EE 1:
IMPROVE ENERGY MODELING FOR BUILDING DESIGN

ANSI/ASHRAE/IESNA Standard 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue :
ASHRAE 90.1 allows designers to follow a prescriptive path or to use energy modeling to demonstrate compliance. Energy modeling, however, is prone to manipulation because it lets enhanced efficiency in one energy system be traded off against poor efficiency in another system.

Recommendation
Require projects using energy modeling to demonstrate design energy use that is 14% lower than the prescriptive path.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Amend Section 4.2.1.3 as follows:

4.2.1.3 Alterations of Existing Buildings. *Alterations* of *existing buildings* shall comply with the provisions of Sections 5, 6, 7, 8, 9, and 10 or Section 11 provided, however, that nothing in this standard shall require compliance with any provision of this standard if such compliance will result in the increase of energy consumption of the building.

2. Amend Section 11.1.4 as follows:

11.1.4 Compliance. Compliance with Section 11 will be achieved if

a. all requirements of Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 are met;

b. the *design energy cost*, as calculated in Section 11.3, does not exceed 90% of the *energy cost budget*, as calculated by the simulation program described in Section 11.2, for New Buildings, or does not exceed 95% of the *energy cost budget*, as calculated by the simulation program described in Section 11.2, for *alterations* of *existing buildings* or *additions* to *existing buildings*; and

c. the energy *efficiency* level of components specified in the building design meet or exceed the *efficiency* levels used to calculate the *design energy cost.*

Supporting Information

Issue- Expanded
The currently allowable tradeoffs permit, for instance, that the energy efficiency gained by lower lighting density in MEP rooms can be traded off against a lower efficiency for the façade, even though the life expectancy of the two systems is greatly different. This type of allowable tradeoff creates a problem, since the short-life energy efficiency measures may not be continued after their useful life ends, while the inefficiency of long-lived systems will remain in place for a very long time. Also, while very hard to quantify, there is no doubt that a certain amount of gaming is possible under the performance path, leading to buildings whose actual performance falls short of the estimates generated during design. The purpose of this proposal is to level the playing field on both counts, and to ensure that buildings permitted using the performance path perform during their lives as well as buildings permitted under the prescriptive path.

Environmental & Health Benefits

Environmental and health benefits, in terms of calculated savings, at level of building/installation (and sometimes at citywide level) will accrue due to lower energy use.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.3% to 2.9%, depending on building type. It was thus categorized as incurring a medium to higher capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in three to ten years depending on the building type.

Precedents
There are no known precedents for this proposal

LEED
LEED prerequisites for Minimum Energy Performance under the Energy & Atmosphere sections of LEED NC, LEED CS, LEED CI and LEED for Schools require that the scope of work complies with *ANSI/ASHRAE/IESNA standard 90.1-2007*. In addition, a greater number of LEED points or "Optimize Energy Performance" accrue as the project's energy cost budget decreases below that of the base case building. This proposed code requires compliance with measures exceeding *ASHRAE 90.1-2007,* and will require performance consistent with two points in this category.

Implementation and Market Availability
There are no known implementation difficulties for this proposal.

Notes
The committee notes that if the percentage savings were calculated under Appendix G instead of Chapter 11, the buildings would have a more uniform baseline. The difference in baselines is most important for residential-type buildings (housing, hotels, and dormitories). Under Appendix G all residential-type buildings would have as a baseline PTACs. Under Chapter 11, a residential building using PTACs would have PTACs as a baseline, if using water loop heat pumps would have water loop heat pumps as a baseline, and if using an absorption chiller would have an absorption chiller as a baseline. If each of these buildings demonstrated 14% reduction in energy cost against its own baseline, the building with PTACs would probably have a significantly higher energy cost than the one with the absorption chiller. Such difficulties stem from the fact that Chapter 11 was not devised to be used as a baseline in order to demonstrate percentage energy savings; it is Appendix G that was created for this purpose. Yet Chapter 11, rather than Appendix G, forms the basis for the Energy Code.

However, Appendix G requires that the entire energy use of the building be included in the calculation, while Chapter 11 refers only to regulated loads (i.e., excluding computers, printers, copiers, elevators, escalators, kitchen, dishwashing, drying, process and others). Also, for Core & Shell, Chapter 11 refers only to the uses under the control of the developer (i.e., excluding the tenant loads such as lighting and computers). Thus, a 10% reduction under Chapter 11 is easier to attain than a 10% reduction under Appendix G, if the baseline is the same – as is usually the case for office buildings.

The committee will consider the ramifications of substituting the requirements for Appendix G to the ones for Chapter 11. One possibility may be to address the most significant problem in Chapter 11 by requiring, for residential-type buildings, that the baseline be made PTACs regardless of the system type used in the design.

EE 2:
Improve Analysis of Heating & Cooling Needs During Design

Department of Buildings Forms; New York City Mechanical Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Equipment used to heat and cool buildings is often over-sized, resulting in operating inefficiency. To size the equipment appropriately, it is important to accurately calculate the peak heating and cooling load demands of buildings.

Recommendation:
As part of the plans submitted to the Department of Buildings for approval, require detailed calculations of peak heating and cooling loads.

Proposed Legislation, Rule or Study

Changes to Department of Buildings Forms

To apply to all applications including heating and cooling equipment.

For heating equipment, add to DOB Form PW1C: Schedule C, Section 4 Boiler Specifications a check box certifying that the boiler capacity is consistent with peak load calculations included in plans per section 106.6 of the Mechanical Code.[1]

For cooling equipment, add to DOB Form PW4: Equipment Use Application/Permit, Section 5 "Equipment Specifications" a check box certifying that the equipment capacities in BTU per hour are consistent with peak loads presented in the building plans per Section 106.8 of the Mechanical Code.

Amendments to the New York City Mechanical Code

1. Amend section 106.6 as follows:

106.6 Heating systems. Construction documents for heating systems shall include the temperature to be maintained in every room [and the output capacity in BTU per hour (0.2931 W) of the central heating source.], the peak heating demand in BTU per hour in every room, the peak heating demand in BTU per hour in every zone, and the output capacity in BTU per hour of the central heating source. The peak load calculations shall be in accordance with the procedures described in the ASHRAE Fundamentals Handbook, and shall include the following:

1. Thermal transmission load, including thermal bridging of frames and mullions, exposed slab edges, parapets, balconies, concrete columns, steel members, and any other significant thermal connection between the conditioned space and the outdoor and underground environment;

2. Ventilation load, accounting for all specified mechanical ventilation but assuming that windows are closed;

3. Infiltration load, accounting for leakage around all doors, windows, and other envelope penetrations, but recognizing specified air barriers;

4. Internal heat gains when predictable, accountable and manageable; and

5. Solar gains, based on glazing characteristics.

Rooms that are identical with respect to these characteristics may be calculated and reported as aggregates within

zones.

2. Amend section 106.8 as follows:

106.8 Air conditioning and ventilating systems. Construction documents for air conditioning and ventilating systems shall contain plans that include the following data and information:

1. The peak cooling load in BTU per hour in every room, the peak cooling demand in BTU per hour in every zone, and the peak cooling load in BTU per hour on the entire building. The peak load calculations shall be in accordance with the procedures described in the ASHRAE Fundamentals Handbook, and shall include the following:

(a) Thermal transmission load, including thermal bridging of frames and mullions, exposed slab edges, parapets, balconies, concrete columns, steel members, and any other significant thermal connection between the conditioned space and the outdoor and underground environment;

(b) Ventilation load, accounting for all specified mechanical ventilation but assuming that windows are closed;

(c) Infiltration load, accounting for leakage around all doors, windows, and other envelope penetrations, but recognizing specified air barriers;

(d) Internal heat gains when predictable, accountable and manageable; and

(e) Solar gains, based on glazing characteristics.

Rooms that are identical with respect to these characteristics may be calculated and reported as aggregates within zones.

[1] 2. The location and sizes of all ducts; the location of all fire and smoke dampers, motors, fans, and filters; the type, air capacity, and size of all equipment; and where not shown on accompanying structural plans, the operating weight and manner of support of equipment.

[2] 3. The locations of smoke detecting devices.

[3] 4. The location and size of the fresh air intake, the design population, and the required ventilation for each room or space.

[4] 5. The amount of air to be exhausted or supplied from each outlet for each room or space.

[5] 6. In the case of ventilating or exhaust systems for ranges, fryers, ovens, and other similar types of restaurant or bakery equipment, for which a hood is required, the plans shall also show the type of extinguishing system, the location of heat detection devices, nozzles, piping, gas controls, manual and automatic control valves, method of joining ducts, method and location of discharging exhaust from building, the location of break-glass controls, and the quantity in cfm designed for each hood.

Supporting Information

Issue - Expanded

This proposal will enforce good practice in the design of mechanical systems in buildings. In order to specify the correct equipment for a building, the detailed heating and cooling loads must be thoroughly understood. Many engineers currently guess or use rules of thumb or rely on manufacturers who sell the equipment to provide the sizing requirements. Without calculations on the drawings, important communication between the architect, the engineer, and the owner may not take place. Further, authorities having jurisdiction cannot easily review anticipated loads or readily discern whether a building will meet energy efficiency standards without the information called out in this proposal. One effect of this proposal will be to make the oversizing of systems less common. In the absence of careful load calculations, the designer is tempted to specify a generously sized boiler and AC system to ensure that there are no future complaints about failure to meet load on cold or hot days. But the result, especially for small and midsized equipment, is overly rapid cycling, which results in low efficiency and waste. (This is less of a problem with large equipment for which the output can be modulated to match the load.)

Environmental & Health Benefits

Environmental and health benefits will accrue as a result of reduced fuel and electricity consumption, but the savings will vary widely since the measure reduces bad practice, rather than changing any readily calculated metric.

This proposal was found to have a low, positive impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a positive, indirect health impact.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.02% to 0.04%, depending on building type. It was thus categorized as incurring a low capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years for some building types.

Precedents

This proposal includes a return to the standards of the 1968 code, which required in Article 17, §[C26-116.3] 27-182: "(a) Air Conditioning and Ventilation Systems.- Plans for air conditioning and ventilating systems shall contain at least the following data and information: (1) The location and sizes of all ducts the location of all fire dampers, motors, fans, and filters the type, air capacity, and size of all equipment; and . . . (e) Heating Systems.- Plans for heating systems shall contain at least the following data and information: (1) the temperature to be maintained in every room, and (2) the amount of heat in Btu per hour to be provided in every room, and the output capacity in Btu per hour of the central heat sources" (§[C26-116.3] 27-182 Plans required, Article 17: Applications for Equipment Work Permits of Title 27, Chapter 1: Construction and Maintenance.[2] It is not clear how well those code requirements were honored. This proposal contains an additional reporting requirement.

Although this measure will result in greater energy efficiency, it is a better fit to sections of the Mechanical Code than to the New York City Energy Code, since it involves system design and sizing.

LEED

There are no LEED credits directly affiliated with this proposal

However, due to improved energy performance resulting from these measures, this proposal may assist in compliance with LEED prerequisites for Energy & Atmosphere under most of the rating systems. These prerequisites require that the scope of work for Minimum Energy Performance is in accordance with ANSI/ASHRAE/IESNA standard 90.1-2004, or the local energy code, whichever is more stringent. LEED 2009 will reference ANSI/ASHRAE/IESNA standard 90.1-2007.

These recommendations will also facilitate achieving LEED Energy and Atmosphere credits:

- LEED NC- EA cr.1 Optimize Energy Performance;
- LEED CI-EA cr. 1.3 Optimize Energy Performance, HVAC;
- LEED EB-EA cr.1 Optimize Energy Performance;
- LEED ND-GCT cr.2 Energy Efficiency in Buildings;
- LEED for Schools EA cr.1 Optimize Energy Performance;
- LEED for Homes EA cr.1 Optimize Energy Performance;
- Credits under LEED pilot programs.

These credits require exceeding the minimum standards established by the Energy and Atmosphere prerequisites.

The process of including this information in a project's construction documents will expedite the LEED certification process, which requires submittal templates with detailed tables and calculations.

Implementation and Market Availability

There are no known implementation issues for this proposal. The practice was called for in the previous version of the Building Code.

Endnotes:

[1] The City of New York, NY., Forms: Permits, http://www.nyc.gov/html/dob/html/forms/forms_permits.shtml#pw1 (last visited Jan.

28, 2010); and INTERNATIONAL BUILDING CODE § BC 106.14 (2008).

[2] CITY OF NEW YORK, NY., BUILDING CODE Tit. 27, ch. (2008), available at http://www.nyc.gov/html/dob/downloads/bldgs_code/bc27s1.pdf.

EE 3:
Assess Co-generation Feasibility in Large Buildings

ANSI/ASHRAE/IESNA Standard 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code

Summary

Issue:
Properly designed co-generation systems are roughly twice as efficient as electricity from the grid because these systems utilize waste heat from electric generation. Owners are often unaware of the potential for co-generation in their buildings.

Recommendation:
Require new developments of 350,000 square feet or more to analyze the potential for co-generation.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA Standard 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code

1. Add a new Section 1.1.1.5.1.2(4) as follows:

   1.1.1.5.1.2 Energy Analysis
   4. For new building projects or substantial improvements larger than 350,000 gross sq. ft., including one or more new buildings on a lot, a feasibility analysis, as defined by the department, for combined heat and power shall be provided. At a minimum, such analysis shall include an identification of operational or technical barriers, conceptual engineering, and a preliminary economic analysis, including a simple payback calculation, as per a Level 1 Feasibility Analysis as defined by the United States Environmental Protection Agency.

Amendments to the New York City Building Code

2. Amend Section 202 to include the following definitions:
   CO-GENERATION SYSTEM: See COMBINED HEAT AND POWER SYSTEM

   COMBINED HEAT AND POWER SYSTEM: A system, including but not limited to turbines, micro-turbines, reciprocating engines, and fuel cells, that generates both electrical power and heat that can be productively utilized for the heating or cooling of space, domestic water, or processes.

Supporting Information

Issue – Expanded
Cogeneration offers substantial fuel savings when utilized in larger buildings to produce both electric power and heat. But because it is a somewhat unfamiliar technology, which is sometimes thought of as “only for the real pros”, cogeneration is not even considered during design development for many buildings that could profit from its use. This proposal would require buildings large enough to be reasonable candidates for cogeneration to conduct a simple feasibility study to determine whether the option would be worth examining further.

A level 1 feasibility analysis identifies potential operational or technical barriers, such as power purchase contracts that prevent installation of on-site power generation or local utility and regulatory policies that hamper distributed generation. This exercise also includes an economic analysis of the projected budget and payback. The budget estimate includes the cost of construction, CHP system tie-in, and operations and maintenance. The payback calculation takes into account: (1) the amount of heat and power produced by the CHP system, and the estimated amount of each to be used on the site, (2) the avoided costs of utility-purchased heat and power, (3) the amount and cost of fuel associated with running the CHP system, and (4) the budgetary cost to install and maintain the system.[1]

Environmental & Health Benefits

Co-generation offers considerable environmental benefits when compared with purchased electricity and on-site-generated heat. By capturing and utilizing heat that would otherwise be wasted from the production of electricity, co-generation systems require less fuel than equivalent separate heat and power systems to produce the same amount of energy.[2]

Because less fuel is combusted, greenhouse gas emissions, such as carbon dioxide (CO2), as well as criteria air pollutants like nitrogen oxides (NOx) and sulfur dioxide (SO2), are reduced.[3] With electricity created on site, co-generation also means a reduction of the strain on New York City's Electricity grid.[4]

This proposal was found to have a positive indirect environmental impact.

This proposal was found to have a positive indirect health impact.

Cost / Savings

This proposal, which requires only a simple study, is not expected to have any significant impact on capital costs. Nor will the study itself generate any savings.

Precedents

The Revised Code of Washington state includes a section on the investigation and development for cogeneration projects in new and existing state facilities, which includes performing a feasibility study on the project's cost-effectiveness and energy efficiency.[5]

LEED

There are no LEED credits affiliated with the completion of a feasibility analysis.

Should the analysis result in actual co-generation systems being implemented, LEED for Neighborhood Development GCT cr.12 On-Site Energy Generation addresses this type of system. Additionally, there would be applicable LEED credits for meeting energy performance standards under the Energy & Atmosphere sections of the various rating systems, and improved air quality resulting from a reduction in CO2 emissions, which would assist in complying with Indoor Environmental Quality credits.

Implementation and Market Availability

There are no known implementation issues for this proposal.

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[1] U.S. EPA, Combined Heat and Power Partnership: Stage 2: Level 1 Feasibility Analysis, http://www.epa.gov/CHP/project-development/stage2.html (last visited Jan. 28, 2010).

[2] U.S. EPA, Combined Heat and Power Partnership: Basic Information, http://www.epa.gov/CHP/basic/index.html (last visited Jan. 28, 2010).

[3] Ibid.

[4] Ibid.

[5] WASH. REV. CODE § 39.35C.070 (1996), *available at* http://apps.leg.wa.gov/RCW/default.aspx?cite=39.35C.070.

EE 4:
IMPROVE ENERGY & WATER EFFICIENCY UPON SALE OF RESIDENCES

New York City Administrative Code and New York City Building Code
Proposal developed by the Homes Committee

Summary

Issue:
Housing stock accounts for over 37% of the total energy consumed in NYC. Year after year, these properties are renovated before or after they are sold. But typically, these renovations do not include cost-effective energy or water efficiency improvements.

Recommendation:
Require one- to two-family houses and apartments to implement simple energy and water conservation measures at the time of sale and major renovation, unless a property has been sold under financial distress

Proposed Legislation, Rule or Study

Amendments to the Administrative Code of the City of New York:

1. Add a new Chapter 30 to Title 11 as follows:

Chapter 30

CONSERVATION IMPROVEMENTS UPON SALE OR RENOVATION OF RESIDENTIAL PROPERTY

§11-3001 Definitions
§11-3002 Conservation Improvements
§11-3003 Exceptions
§11-3004 Rules

§11-3001 Definitions. a. For the purposes of this chapter only, the following terms shall have the following meaning:
(1) "Certificate of compliance" shall mean a certificate by a certification agent attesting that a covered property is in compliance with the standards prescribed in this chapter. Such certificate of compliance may be recorded against a covered property.
(2) "Certification agent" shall mean a person who has received a certification by the Department of Buildings demonstrating expertise in energy efficiency and the capability to assess compliance with this chapter.
(3) "Covered property" shall mean a building, or an individual dwelling unit within a building, classified in occupancy group R in accordance with Chapter 3 of the *New York City Building Code* that is less than fifty thousand square feet. A building shall not be a covered building if more than fifty percent of the uses, measured in square feet of floor area, in such building are other than in occupancy group R.
(4) "Insufficient roof cavity" shall mean vertical clear height, measured from the top of the bottom chord of the truss or ceiling joist to the underside of the roof structural members or rafters at the roof ridge or high point, that is less than 12 inches.
b. The terms "consideration", "deed", "grantee", "grantor", "instrument", "net consideration", "transaction", and "transfer" shall have the meaning set forth in section 11-2101 of this code.

§11-3002 Conservation Improvements. a. Prior to the delivery of a deed for a covered property from grantor to grantee, the grantor of such covered property shall submit to the grantee a certificate of compliance demonstrating compliance with the standards prescribed in subdivisions (b) and (c).
b. An entire building shall comply with the following standards:
(1) Any showerhead that consumes more than 2.5 gallons per minute and any toilet that consumes more than 1.6 gallons of water per flush shall be replaced with a showerhead / toilet that is compliant with the water consumption requirements of section 604.4 of the New York City Plumbing Code. Any sink or lavatory faucet that does not comply with the water consumption requirements of section 604.4 of the New York City Plumbing code shall either be fitted with an aerator to bring such faucet into compliance or be replaced with a compliant faucet.

(2) Any roof that is uninsulated or whose existing insulation has a thermal resistance value of R-11 or less, shall be insulated to a minimum thermal resistance value of R-38; provided that any building with insufficient roof cavity shall install insulation with the highest thermal resistance value that can fit within such space. Prior to the installation of any such insulation, any roof subject to this subsection shall be inspected for leaks and any leaks shall be repaired.
(3) Any leaks in furnace ducts at all joints in the ducting system and at the plenum shall be sealed with pressure sensitive tape or mastic. Furnace ducts shall be insulated to a minimum thermal resistance value of R-3 except where ducts are inside heated space, between floors, inside interior walls or partitions, are asbestos coated, or otherwise inaccessible without alteration.
(4) Any domestic storage water heater shall be insulated with an external insulation blanket rated at a minimum thermal resistance value of R-12. This requirement shall not apply where there is less than two inches clearance from all walls and other permanent fixtures and where the thermal resistance of the water heater insulation jacket is R-12 or greater. Water heaters shall include a pressure-temperature (PT) safety release valve.
(5) Any uninsulated hot water pipes in pumped, recirculating domestic water heating systems shall be insulated to a minimum thermal resistance value of R-3. This requirement shall not apply to any hot water pipes between floors, inside interior walls, or deemed otherwise inaccessible by the certification agent.
(6) Any exposed, uninsulated hot or cold water pipe within twenty-four inches of a water heater shall be insulated to a minimum thermal resistance value of R-3.
(7) Weatherstripping shall be applied to all exterior doors and caulking shall be applied to any visible cracks in window assemblies and other shell penetrations.
(8) Any fireplace chimney shall include a damper or door to block airflow.
(9) Any building shall install programmable thermostats in compliance with sections 403.1 of the Energy Conservation Construction Code of New York State or energy controls in compliance with either Section 6.3 or Section 6.4.3 of INSA/ASHRAE/IESNA 90.1 (2007), as applicable.
c. An individual dwelling unit shall comply with the following standards:
(1) Paragraph (1) of subdivision (b) of this section.
(2) If heat or hot water is supplied to the individual dwelling unit through a dedicated heating system or hot water heater, and the owner of such unit has the right to access and modify such system or hot water heater, such system or heater and its piping shall comply with any applicable provisions of paragraphs (3), (4), (5) and (6) of subdivision (b) of this section, and shall include thermostatic controls, either through thermostatic controls for the heat supply to the entire unit or on each radiator.
d. In lieu of delivering a certificate of completion as provided in subdivision (a) hereof, prior to the delivery of the deed, the grantor may assign and the grantee may assume any and all of the grantor's obligations under this section pursuant to a contract executed by the grantor and grantee. Such contract shall:

(1) provide that the grantee shall complete any and all of grantor's assigned obligations within a period no later than eighteen months following the conveyance of the deed; provided, however, that the grantee may apply to the commissioner of the department of buildings for an extension of such completion date, which the commissioner may grant in his or her discretion;

(2) require grantor to deposit in escrow funds equal to the maximum required expenditure for the covered property as set forth in subdivision (a) of section 11-2122 of this chapter. The escrow agent shall distribute such funds to grantee, upon grantee's written request, to perform or cause the performance of grantor's obligations under this section that have been assumed by grantee. Any funds remaining in the escrow upon the completion of such work shall be returned to grantor. In the event grantee fails to complete the obligations assumed pursuant to the contract within the period provided in paragraph (1) of this subdivision, then escrow agent shall pay any funds in the escrow to the department to be deposited in a special fund established by the department to further green technologies, energy efficiency and conservation in building construction and operation. Upon the forfeiture of such funds, grantee shall have no further liability under this section. In no event shall grantor have any further liability under this section after depositing in escrow funds in the amount of the maximum required expenditure.

e. At least once every two years, the Commissioner of Buildings, in conjunction with the Mayor's Office of Long-Term Planning & Sustainability, shall review and, if necessary, recommend to the Mayor and the City Council new requirements or standards.

§11-3003. Exceptions.
a. The maximum required expenditure to bring a covered property into compliance with this chapter shall be:
(1) 0.75 percent of the consideration for the transfer of a covered property that is a building (or portion of a building) classified in occupancy groups R-3 or of the consideration for the transfer of a covered property that is an individual dwelling unit classified in occupancy groups R-1 or R-2; and
(2) Fifty cents per square foot for any covered property that is a building classified in occupancy groups R-1 or R-2.
b. This chapter shall not apply to the delivery of a deed:
(1) pursuant to inheritance, involuntary transfer of title resulting from default on an obligation secured by real property, change of title pursuant to marriage or divorce, condemnation, or any other involuntary change of title effected by operation of law;
(2) pursuant to a transaction described in section 11-2106 of this code, other than a transaction described in paragraph (2) of subdivision (b) of such section;
(3) that is for a covered property where the net consideration of the conveyance of such covered property is less than the net consideration paid by the grantor for an economic interest in the covered property;
(4) that is the grant, assignment or surrender of a leasehold interest in a covered property; or

(5) that is for a covered property scheduled for demolition within one year of the delivery of the deed, provided the grantor or grantee has obtained a demolition permit from the Department of Buildings, and such real property is demolished within one year of delivery of the deed.

c. The Commissioner may exempt any covered property from the provisions of this chapter upon a determination of undue hardship.

§ 11-3004. Rules. The Commissioner shall promulgate any rules necessary or appropriate to implement this chapter.

Amendments to the Energy Conservation Construction Code of New York State, as incorporated in Chapter 13 of the New York City Building Code:

1. Add a new Section 401.4 as follows:

401.4 Alterations. Upon any alteration of any individual dwelling unit in a residential building of less than fifty thousand (50,000) square feet costing fifty thousand dollars ($50,000) or more, the owner of such dwelling unit shall undertake conservation improvements in accordance with chapter 30 of title 11 of the Administrative Code of the City of New York.

Amendments to ANSI/ASHREA/IENSA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Add a new Section 4.1.1.6 as follows:

4.1.1.6 Alterations Upon any alteration of any individual dwelling unit in any existing building of less than fifty thousand (50,000) square feet, classified in occupancy group R and costing fifty thousand dollars ($50,000) or more, the owner of such dwelling unit shall undertake conservation improvements in accordance with chapter 30 of title 11 of the administrative code of the City of New York.

Supporting Information

Issue – Expanded

Green building policy in New York City has focused primarily on large, high-rise buildings because, although few in number, they are responsible for half of building energy use. While this approach is logical, New York City will be unable to reduce its greenhouse gas emissions by 30% by 2030, as required by city law, if all buildings are not part of the solution.

NYC's housing stock accounts for over 37% of the total energy consumed. One challenge to improving the energy (and water) efficiency of housing is that ownership is dispersed and owners have limited access to capital.

Other U.S. cities are improving the efficiency of their housing stock by requiring the most basic and most cost-effective energy and water efficiency improvements when small residential buildings and apartments are sold or undergo expensive renovations. The sale of a property is a logical time to undertake efficiency measures because buyers and sellers typically make improvements to a home either right before or after the sale and it is a time when they have financing. Other municipal energy/water improvement ordinances wisely include provisions exempting properties sold under financial duress and limit the cost of any required improvements to a small percentage of the sale price. It should be noted that this proposal limits the cost of conservation improvements for 1-2 family homes to a maximum of 0.75% of the sale price; in comparison, real estate brokers charge sellers 6% of the sale price for their services.

Environmental & Health Benefits

The wise and efficient use of energy and water is essential to the health, safety and welfare of the people of the City of New York. In 2007, 2.5% of 1-3 family homes in NYC were sold, meaning this proposal has the potential to improve the efficiency of a large number of homes over time.[1]

This proposal was found to have a high, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 3.

This proposal was found to have no significant positive health impact.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in

which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase costs at the time of sale by up to 0.75%. It was thus categorized as incurring a higher cost increment.

Precedents

Several U.S. cities have implemented similar standards to this proposal. San Francisco, for example, has required energy conservation upgrades at the time of sale and major renovation since 1982 through the Residential Energy Conservation Ordinance (RECO).[2] RECO mandates limited energy and water efficiency measures at the time of sale for one- and two-family dwellings, apartment buildings, and residential hotels.[3] The ordinance also requires upgrades at major renovations, which is defined as renovations in excess of $20,000 for one- and two-family dwellings, $6,000 per unit for apartment buildings, and $1,300 per unit for residential hotels.[4] Upgrades are also required at meter conversions and condo conversions.[5]

Similarly, on November 25, 2008, the Santa Rosa (California) City Council accepted its Green Building Advisory Committee's recommendations, including Recommendation D.[6] Recommendation D creates "energy efficiency requirements for existing residential and non-residential buildings, to be triggered by a transfer of title or major renovation."[7]

Other Jurisdictions:
1. Berkeley requires homeowners to implement certain energy conservation measures before ownership changes. Homeowners are not required to spend more than .75% of the final sale price for a structure with two units or less, or fifty cents per square foot in a structure containing three units or more.[8]
2. Burlington, VT, Ann Arbor, MI, and the State of Wisconsin have residential energy conservation ordinances for rental properties.[9]
3. The State of California recently amended its Water Code to add a new Section 379, stating that it's the intent of the legislature for lower jurisdictions implementing the code to enact ordinances requiring the retrofit of outdated fixtures at the time of sale of properties.[10]
4. Boulder, CO is considering implementing a Residential Energy Conservation Ordinance.[11]

LEED

LEED does not specifically refer to energy improvements at time of building sale. However, the implementation of this proposal would facilitate achieving credits in numerous areas of the LEED for Homes rating system.

These LEED for Homes credits include but are not limited to: WE cr. 3 Indoor Water Use (requires slightly more efficient fixtures than included herein); EA cr. 1 Optimize Energy Performance (requires compliance with Energy Star); EA cr. 3 Air Infiltration (addresses the air leakage rate of the building envelope); EA cr. 5 Heating & Cooling Distribution System (addresses duct leakage); EA cr. 6 Space Heating & Cooling Equipment (addresses piping designed as part of a heat pump system); EA cr. 7 Water Heating (requires more pipe insulation than included herein).

Many of these credits are mutually exclusive. Project teams must refer to LEED reference manuals to determine compliance.

Any project classified under occupancy group R which is seeking certification via the LEED for Existing Buildings rating system, will more easily achieve Energy & Atmosphere credits by adhering to the measures outlined in this proposal.

Implementation and Market Availability

Any building materials needed to implement this proposal are readily available.

Care should be taken when insulating ceiling cavities to protect lighting housing intended for non-insulated ceilings.

ENDNOTES:

[1] CITY OF NY DEP'T OF FIN., ANNUAL REPORT ON THE NYC PROPERTY TAX FISCAL YEAR 2008 (2008), http://nyc.gov/html/dof/html/pdf/08pdf/nyc_property_tax_fy08.pdf. (As of 2008, there were 1,049,031 one, two and three family residential units in New York City (p. 1) and 26,234 were sold in 2007 (p. 34). Sales %: 26,234/1,049,031 = 2.5%).
[2] CITY OF SAN FRANCISCO DEP'T OF BLDG. INSPECTION, WHAT YOU SHOULD KNOW ABOUT THE RESIDENTIAL ENERGY CONSERVATION ORDINANCE (2006), http://www.sfgov.org/site/uploadedfiles/dbi/Key_Information/ResidEnergyConsOrd1006.pdf.
[3] Ibid. at 2-3.
[4] Ibid.
[5] Ibid.
[6] CITY OF SANTA ROSA CITY COUNCIL, AGENDA ITEM #11.1: GREEN BUILDING ADVISORY COMMITTEE REPORT (Nov. 25, 2008), http://ci.santa-rosa.ca.us/doclib/agendas_packets_minutes/Documents/20081125_CC_Item11.1.pdf.
[7] Ibid. at 7-9.
[8] BERKELEY, CA., MUN. CODE ch. 19.16 (1991), available at

http://www.codepublishing.com/ca/berkeley/html/Berkeley19/Berkeley1916/Berkeley1916.html.
[9] HOWARD GELLER, NEVADA ENERGY EFFICIENCY STRATEGY, 37.
[10] CAL. WATER CODE § 379 ("It is the intent of the Legislature that public entities exercise authority pursuant to this chapter to enact ordinances that require the retrofitting of outdated, high water use plumbing fixtures, and the disclosure thereof, in connection with the transfer of real estate.").
[11] RACHEL REISS & JOSH RADOFF, CITY OF BOULDER OFF. OF ENVTL. AFF., CONSIDERATION OF A RESIDENTIAL ENERGY CONSERVATION ORDINANCE FOR BOULDER, CO., (2007), available at http://www.recaonline.com/docs/arc/arc2008/PointofSale_BoulderCO.pdf.

EE 5:
IMPROVE EFFICIENCY OF BOILERS & HEATING DISTRIBUTION SYSTEMS

ANSI/ASHRAE/IESNA 90.1 (2007) and Energy Conservation Construction Code of New York State, as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
The energy code permits the use of inefficient boilers and heat-distribution systems.

Recommendation:
Establish higher efficiency standards for heating systems. Also, prohibit the installation of new one-pipe steam systems and other inefficient systems.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007)

1. Amend Section 6.3.2(d) as follows:

d. Heating (if any) shall be provided by (i) a unitary packaged or split-system heat pump that meets the applicable efficiency requirements shown in Table 6.8.1B (heat pumps) or Table 6.8.1D (packaged terminal and room air conditioners and heat pumps), (ii) a fuel fired furnace (x) with a capacity less than 225,000 Btu/hour that meets the applicable efficiency requirements shown in Table 6.8.1E (furnaces, duct furnaces, and unit heaters); or, (y) with a capacity of 225,000 Btu/hour or more and meeting the greater of the applicable efficiency requirements shown in Table 6.8.1E (furnaces, duct furnaces, and unit heaters) or 81%; in either case using the test procedures specified in Table 6.8.1E; or (iii) [an electric resistance heater, or] a baseboard system connected to a boiler (x) with a capacity less than 300,000 Btu/hour that meets the applicable efficiency requirements shown in Table 6.8.1F (boilers); or, (y) for such units with capacity of 300,000 Btu/hour or more, meeting the greater of the applicable efficiency requirements showing in Table 6.8.1F (boilers) or 81%; in either case using the test procedures specified in Table 6.8.1F. Atmospheric boilers shall not be permitted. The capacity of any auxiliary electric resistance space heater(s) shall be limited to a maximum of 5% of the peak heating load of the building.

2. Add a new Section 6.3.2(p) as follows:

p. One-pipe steam distribution is prohibited. No steam terminal units shall be permitted with capacity less than 500,000 Btu/hour. All hydronic distribution shall utilize radiation sized to permit a heating design point water supply temperature not to exceed 190°F.

Exception: Steam radiators may be replaced by equivalent units of similar or greater capacity and thermal mass if fewer than 10% of the radiators in the building are being replaced in one calendar year.

3. Amend Section 6.4.1.1 as follows:

6.4.1.1 Minimum Equipment Efficiencies – Listed Equipment-Standard Rating and Operating Conditions. Equipment shown in Tables 6.8.1A through [6.8.1G] 6.8.1D and 6.8.1G shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure except that furnaces with capacity of less than 225,000 Btu/hour shall have a minimum performance at the specified rating conditions in Table 6.8.1E when tested in accordance with the specified test procedure. Furnaces with capacity of 225,000 Btu/hour or greater shall have a minimum performance at the greater of the specified rating conditions in Table 6.8.1E or 81% when tested in accordance with the specified test procedure. Boilers with capacity less than 300,000 Btu/hour shall have a minimum performance at the specified rating conditions in Table 6.8.1F when tested in accordance with the specified test procedure. Boilers with capacity of 300,000 Btu/hour or greater shall have a minimum performance at the greater of the specified rating conditions in Table 6.8.1F or 81% when tested in accordance with the specified test procedure. The capacity of any auxiliary electric resistance space heat shall be restricted to 5% of the peak heating load of the building. Where multiple rating conditions or performance requirements….(remainder of 6.4.1.1 is unchanged.)

4. Add Section 6.4.4.3:

6.4.4.3 Heating Distribution Efficiency

6.4.4.3.1 Hydronic Distribution. For hydronic distribution, the heating design point water supply temperature shall not exceed 190°F, and associated radiation shall be sized to permit operation at such temperature.

6.4.4.3.2 One-Pipe Steam. One-pipe steam distribution shall be prohibited in all construction required to conform with this standard.

6.4.4.3.3 Minimum Size of Steam Terminal Units. No steam terminal unit shall be permitted with capacity less than 500,000 Btu/h.

> Exception: Steam radiators may be replaced by equivalent units of similar or greater capacity and thermal mass if fewer than 10% of the radiators in the building are being replaced in one calendar year.

Amendments to the Energy Conservation Construction Code of New York State, as incorporated in Chapter 13 of the New York City Building Code:

1. Delete Section 403.7 and replace as follows:

403.7 Mechanical Equipment Efficiency. [The building thermal envelope shall be permitted to meet the requirements of Table 402.1.(2) where the building mechanical system conforms with the requirements of Table 403.7.] (Delete Table 403.7). Equipment, including furnaces having a capacity of less than 225,000 Btu/hour and boilers having a capacity of less than 300,000 Btu/hour, shall meet the minimum efficiency requirements of Tables 803.2.2(1), 803.2.2(2), 803.2.2(3), 803.2.2(4), and 803.2.2(5) when tested and rated in accordance with the applicable test procedure. Furnaces having a capacity of 225,000 Btu/hour or more shall meet the minimum efficiency standards of Table 803.2.2(4) or 81%, whichever is greater, when tested and rated in accordance with the applicable test procedure. Boilers having a capacity of 300,000 Btu/hour or more shall meet the minimum efficiency standards of Table 803.2.2(5) or 81%, whichever is greater, when tested and rated in accordance with the applicable test procedure. The efficiency shall be verified through data furnished by the manufacturer or through certification under an approved certification program. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements.

403.8 One-pipe steam distribution. One-pipe steam distribution is prohibited in all construction subject to this chapter.

403.9 Steam terminal units. No steam terminal units shall be permitted with a capacity less than 500,000 Btu/hour.

> Exception: Steam radiators may be replaced by equivalent units of similar or greater capacity and thermal mass if fewer than 10% of the radiators in the building are being replaced in one calendar year.

403.10 Auxiliary electric resistance space heat. The capacity of any auxiliary electric resistance space heat shall be limited to a maximum of 5% of the peak heating load of the building.

403.11 Atmospheric boilers. Atmospheric boilers are prohibited in all construction subject to the requirements of this code.

Supporting Information

Issues – Expanded

Boilers and heating distribution systems are available with a wide variety of efficiencies, including some inexpensive but totally outdated technologies. This proposal will raise the floor on boiler efficiency, removing some of the least efficient options (such as atmospheric gas boilers) from consideration and raising minimum efficiencies slightly on larger boilers and furnaces. For smaller boilers and furnaces, federal standards preempt New York City from establishing more rigorous local standards.

One-pipe steam distribution systems are notoriously wasteful of both energy and water,[1] and this measure will prohibit their use in new construction and whenever a renovation is sufficiently extensive to trigger this portion of the code. Electric resistance heat has two or three times the carbon footprint of good gas-fired heating, and it too would be prohibited except as a minor trim capability or for peak loads in heat pump systems (PTHPs).

Hydronic (water) distribution of heat is widely accepted as the most efficient system when fired by gas, oil, or ground-source heat pumps. For oil or gas fired systems, condensing boilers have substantially higher efficiencies, in the 92 to 97% range rather than in the high 80% range, when operating in condensing mode. However, they can only operate in

this mode if return water from the distribution system has been cooled to 140°F and the efficiency increases as the return water temperature is lowered. Although it is not reasonable to expect a heating system to operate in condensing mode at design point (peak) conditions, the larger the radiating surfaces in the heated space, the lower the system water temperature can be, and the more often the boilers can operate in this efficient mode. By requiring that radiation be sized for a design point temperature of 190°F, this proposal moves in the direction of promoting the effective use of condensing technology.

It should be noted that the Committee was not unanimous on what design point temperature was optimal. Some members thought 190°F would be sufficient, others wanted 150 or 160°F (mirroring practice in much of Europe), and the value 190°F is certainly the highest value that would be acceptable. An alternative would be to call for a gradual decline in the temperature, coinciding with the code review cycle.

Environmental & Health Benefits
All of these improvements will lower fuel use and attendant emissions of CO_2 and Clean Air Act pollutants. Energy-related carbon dioxide emissions, resulting from the combustion of petroleum, coal, and natural gas, represented 82% of total U.S. anthropogenic greenhouse gas emissions in 2006."[2] Pollutants produced by combustion of standard fossil fuels in boilers that are known to have harmful effects on humans and the environment include carbon monoxide, nitrogen oxide, sulfur oxides, volatile organic compounds, and particulate matter. By controlling NOx levels, along with the other pollutants, the levels of acid rain and ozone can be reduced.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.5% to 5.6%, depending on building type. It was thus categorized as incurring a higher capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in three to ten years depending on the building type.

Precedents
This proposal is a straightforward tightening of existing efficiency standards. The proposal does not address boilers and furnaces under 300,000 Btu/hour, which are regulated by AFUE and for which NYS and NYC are therefore preempted.

LEED
Current LEED prerequisites for Minimum Energy Performance under the Energy & Atmosphere sections of almost all of the rating systems require that the scope of work complies with ANSI/ASHRAE/IESNA standard 90.1-2004. This proposed code requires compliance with measures exceeding ASHRAE 90.1-2007. Since LEED 2009 prerequisites for Minimum Energy Performance also reference ASHRAE 90.1-2007, the measures outlined in this proposal will be correlated with the next generation of LEED.

However, LEED qualifies that a more stringent local code requirement becomes the LEED prerequisite requirement as well. Therefore, this proposal will change the baseline criteria that registered projects must meet for LEED certification.

Code revisions under this proposal do not apply to the LEED for Homes or the LEED for Existing Buildings rating systems, which reference Energy Star criteria. For existing buildings, LEED EB provides an alternate calculation method.

Implementation & Market Availability
There are no known implementation issues for this proposal. All the technologies are readily available.

Notes
The committee considered explicit limits on oversizing boilers, but found that various code sections already prohibit it, so the current tendency to oversize is primarily an enforcement problem.

ENDNOTES:

[1] R.W.Leigh and E.Guerra presentation at the Multifamily Building Conference, Tales from the AMP Database (2006) (For copy of presentation please email R.W. Leigh at rwl@urbangreencouncil.org).

[2] Energy Information Administration, Energy and the Environment Explained: Greenhouse Gases, http://www.eia.doe.gov/bookshelf/brochures/greenhouse/Chapter1.htm (last visited Mar. 25, 2009).

EE 6:
INCREASE EFFICIENCY OF LARGE COOLING SYSTEMS

ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Air conditioning is responsible for approximately 17% of electricity use in New York office buildings. Buildings often install inefficient air conditioning systems, resulting in excessive electric demand and usage.

Recommendation:
Steer buildings toward more efficient air conditioning by prohibiting outdated, inefficient cooling equipment and limiting the use of other equipment associated with inefficient systems.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Add footnote "d" to Table 6.8.1A in Section 6.8.1 as follows:

   d. Air Conditioners, water and evaporatively cooled, >= 240,000 Btu/h shall not contain more than four refrigeration compressors.

2. Amend Table 6.8.1C in Section 6.8.1 as follows:

   Under "Water cooled, electrically operated, positive displacement (reciprocating)" under the column entitled "Minimum Efficiency", delete "4.20 COP 5.05 IPLV" and insert "Not Allowed".

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[a]	Test Procedure[b]
Water cooled, electrically operated, positive displacement (reciprocating)	All capacities	-	[4.20 COP 5.05 IPLV] Not Allowed	[ARI 550/590] "NA", blank or "-"

Supporting Information

Issue Expanded
Air conditioning is the second largest electricity end use in New York office buildings next to lighting,[1] and is responsible for approximately 5% of total office building energy use (taking into account use of both electricity and fuel) in New York City.[2] Further, the maximum electricity demand for air conditioning occurs during peak summer hours, increasing the risk of brownouts and leading to the use of the city's oldest, dirtiest power plants. Removing obstacles to the utilization of high efficiency equipment, and encouraging its use, is one of the most straightforward paths to lower stress on the electrical system and reduce related carbon emissions.

A clear example of poor practice is the use of outdated refrigeration compressor technology, particularly reciprocating compressors, for small package water chillers. Reciprocating refrigeration compressors have been superseded for all practical purposes by scroll and screw compressor technology at comparable cost and greater energy efficiency in all sizes, and there is no reason to allow continued use of this technology. The amendments to Table 6.8.1C exclude reciprocating chillers, and will result in a no-cost increase in chiller efficiencies, although one that is hard to quantify given the wide spectrum of choices still available.

The most efficient type of cooling system for commercial buildings is a large central chilled water plant (utilizing large centrifugal chillers) that creates cold water that is circulated throughout the building for use by air handling units and fan coil units (devices that consist of a fan and a chilled water coil). The most common alternatives to this approach are

lower efficiency systems that consist of multiple smaller chillers or multiple package direct expansion (DX) units, often with a separate installation on each floor and commonly cooled by water from a central cooling tower. Both of these alternative approaches utilize multiple compressors (that are not high efficiency centrifugal types), and as such are less energy efficient than single large chillers. The difference in energy efficiency between these two approaches can be significant: as much as 0.20 kw/ton (equivalent to a 25% difference in energy efficiency).

This proposal eliminates the option of a large number of small compressors. It does not require the use of larger, more efficient, and probably more expensive central chilled water systems, although the expense is justified as discussed below. But by requiring the use of larger units, it does put the choice between local DX units and a central chiller on a more level playing field, where the market and good practice can be expected to lead to the use of better systems.

Environmental & Health Benefits
Reduced energy use will result in increased energy efficiency and reduced greenhouse gas emissions.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These draft cost and savings estimates are presented in the February 1st version of Appendix D. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.7%. It was thus categorized as incurring a higher capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in more than ten year.

Bovis' costing on this measure was augmented by expert opinion from a committee member.[3]

Under "Option 1" (as reported in Appendix A), there is no increased cost and no savings. This is how the proposal is reported here and in summary tables.

Under "Option 2", where it is assumed the engineer chooses a high efficiency central chilled water system, Bovis' estimate of the increased expenditure was sufficient to merit three dots, and that is what appears in the proposal's entry in the Executive Summary. Subsequently, the task force revised this estimate downward, and now believe the additional cost will be as presented in Appendix A, amounting to a 0.4% increment in the cost of the large commercial building. This would merit two dots, but will not be reported as such, since the proposal does not require the improvement. Still, were the improvement made, savings, based solely on electrical energy and omitting demand charges savings, would pay for this increase in cost in less than seven years. These savings are also omitted from the summary tables.

Precedents
This measure is primarily an adjustment of existing efficiency requirements. As discussed in the notes, some aspects of this issue are specific to New York City.

LEED
The higher efficiency requirements are generally consistent with the current requirements of LEED.

Implementation & Market Availability
There are no known implementation issues for this proposal. All the equipment mentioned is available from multiple manufacturers in a mature market.

Notes
The use of direct expansion air conditioning systems is peculiar to New York City and other large urban markets in the United States. A common air conditioning solution for high-rise office buildings is a local air conditioning system within the building core on each occupied floor. These systems are typically either chilled water type (supplied with chilled water from a central chilled water plant located within the building) or direct expansion refrigeration type (supplied with condenser cooling water from a roof-mounted cooling tower).

The choice between these systems has an impact on how cooling usage can be metered and paid for, and a desire for the tenant to pay for their cooling directly has provided an incentive toward less efficient systems. It is simple to meter the tenant usage of refrigeration energy of floor-by-floor direct expansion air conditioning systems, even if they are energy inefficient, since only electricity need be metered. Metering energy usage from a central chilled water plant, on the other hand, entails measuring the amount of chilled water that is consumed by the local floor air-handling unit. This requires a more expensive metering device than that required to measure electricity consumption, although it is readily available from the market. For this "cooling energy metering" to work, the owner would need to establish a cost for chilled water consumption, which for some period of time will be an unfamiliar leasing parameter to the tenant market.

The NYC Fire Code, section 27-4194 requires an operating engineer to operate all refrigeration systems where there is a compressor horsepower greater than 50 Hp or where the sum of all compressors in the machines larger than 15 Hp exceed a total of 100 Hp. In an effort to avoid this requirement, some buildings opt to install smaller, direct expansion air conditioning systems with multiple compressors. With modern compressor technology, this configuration does not necessarily result in extremely poor energy efficiency, but it precludes the high efficiency of central chilled water plants based on modern centrifugal chillers. Though some perceive this section of the Fire Code as a de-facto disincentive for energy efficiency, in reality it is typical for the operating staff of large buildings to be comprised of licensed engineers and licenses can be obtained without difficulty.

ENDNOTES:

[1] New York State Energy Research and Development Authority, Energy Efficiency and Renewable Energy Efficiency and Renewable Energy Resource Development Potential in New York State, Vol. 3: Energy Efficiency Technical Report 3-42, Table 3.3.1 (2003). The breakdown is as follows: indoor lighting (41%), cooling (18%), office equipment (10%), ventilation (10%), space heating (6%) and other uses (15%).

[2] City of New York, NY., PlaNYC, A Greater, Greener New York 107 (2007), http://www.nyc.gov/html/planyc2030/downloads/pdf/full_report.pdf.

[3] Scott Frank, PE, of Jaros, Baum, & Bolles.

EE 7:
INCREASE LIGHTING EFFICIENCY IN APARTMENT BUILDINGS

Administrative Code (Housing Maintenance Code)
Proposal developed by the Lighting & Daylighting Committee

Summary

Issue:
The current lighting requirements in the Housing Maintenance Code for hallways, stairs, and common laundry facilities reference an old terminology for lighting: the use of incandescent lights. They also imply that the lights in hallways, stairs, and common laundry facilities should always be fully on.

Recommendation:
Update the language in the code to match other city codes, particularly the energy code. Specify a minimum efficacy for light bulbs, and expressly allow bi-level lighting for hallways and stairs, and occupancy sensors for laundries.

Proposed Legislation, Rule or Study

Amendments to the Administrative Code of the City of New York:

1. Amend Section 27-2038 as follows:

§ 27-2038 Electric lighting fixtures in certain public parts of dwellings; fixtures and lights required.

a. In every multiple dwelling and tenant-occupied two-family dwelling, the owner shall provide electric lighting fixtures for every public hall, stair, fire stair and fire tower on every floor, in accordance with the following requirements:

[(1) If an incandescent lighting fixture is provided, it shall be capable of providing illumination of at least ten watts per twenty-five square feet of floor area or fraction thereof. Each lighting fixture shall be provided with one or more lights of a total of not less than sixty watts. Where, under this requirement, the number of watts per fixture would exceed one hundred, one or more additional fixtures shall be provided and shall be located as may be prescribed by the department, except where the distance from the fixture to the farthest intersecting wall does not exceed twenty feet.

(2) If a fluorescent lighting fixture is provided, it shall be capable of providing illumination of at least four watts cool white fluorescent light per twenty-five square feet of floor area or fraction thereof. Each lighting fixture shall be provided with one or more lights of a total of not less than twenty watts. Where, under this requirement, the number of watts per fixture would exceed forty, one or more additional fixtures shall be provided and shall be located as may be prescribed by the department, except where the distance from the fixture to the farthest intersecting wall does not exceed twenty feet.]

(1) Lighting fixtures shall be capable of providing an average illumination level no less than of five foot-candles measured at the floor in hallways, and no less than seven and one half foot-candles measured at the floor in stairs. The lighting fixtures shall be capable of providing minimum illumination levels that are not less than ten percent of the required average levels, measured at floor level no closer than six inches from the wall, and maximum-to-minimum illumination uniformity ratio that does not exceed twenty to one. The minimum luminous efficacy of all light bulbs (lamps) shall be fifty lumens per watt.

[(3)] (2) In every multiple dwelling hereafter erected, in addition to other lighting requirements, a sufficient number of [incandescent or fluorescent] electrical lighting fixtures shall be provided so that the distance between fixtures is not more than thirty feet and so that no wall is more than fifteen feet distant from a fixture.
(3) Automatic, occupant sensor lighting controls shall be permitted provided that the switch controllers are equipped for fail-safe operation ensuring that if the sensor or control fail the lighting levels will be at the levels required when the space is occupied, the illumination times are set for a minimum 15-minute duration, and the occupant sensor is activated by any occupant movement in the area served by the lighting units

[b. The department may approve electric lighting for public halls, stairs, fire stairs and fire towers other than the incandescent and fluorescent lighting required in subdivision a of this section if such other method of electric lighting provides equivalent illumination, and meets the requirements of the electrical code.

c.] b. Notwithstanding any other requirement of this section, the department may require fixtures to be so located, and additional fixtures to be installed, in order to assure that every part of every public hall, stair, fire stair or fire tower is adequately lighted.

2. Amend paragraphs a, b and c of Section 27-2039 as follows:

§ 27-2039 [Lighting] Illumination to be provided [at]day and night; owner's responsibility.

a. [The owner of a multiple dwelling shall turn on all required lights in every public hall and stair at sunset every day and shall keep them on until sunrise the day following.] Any occupied public hall, stair, fire stair or fire tower shall be illuminated by either natural light or electrical lighting to an average illumination level no less than five foot-candles in hallways, and seven and one half foot-candles in stairs, measured at floor level. Minimum illumination levels shall not be less than ten percent of the required average levels, measured at floor level no closer than six inches from the wall, and the maximum-to-minimum illumination uniformity ratio shall not exceed twenty to one.

b. [The owner of a multiple dwelling shall keep all required lights burning continuously (1) in every fire stair and fire tower; (2) in every stair and public hall where there is no window opening on a street, court, yard, space above a setback, or on a shaft; and (3) in every stair and public hall where there is a window which in the opinion of the department does not provide adequate natural light.] Any unoccupied public hall, stair, fire stair or fire tower unoccupied, shall be illuminated by either natural light or electrical lighting to an average illumination level no less than one foot-candle measured at floor level. Minimum illumination levels shall not be less than ten percent of the required average levels, measured at floor level no closer than six inches from the wall, and the maximum-to-minimum illumination uniformity ratio shall not exceed twenty to one.

c. [The owner of a multiple dwelling shall provide electric light at all hours of the day and night in] Any occupied room[s] or space[s] in a multiple dwelling[s] in which laundry equipment is provided for the common use of the occupants [whenever natural light is insufficient in the opinion of the department] shall be illuminated by either natural light or electrical lighting to an average illumination level of at least twenty foot candles measured at a horizontal surface three feet above the floor. Any occupancy sensor lighting switches used in any such room or space shall conform with section 27-2038(a)(3).

Supporting Information

Issue – Expanded
The lights in the hallways, stairs, and laundry rooms of New York City apartment buildings burn all day and night at full brightness regardless of whether anyone is in those spaces or sunlight is streaming in. This is due to outdated requirements in the Housing Maintenance Code, which also specify minimum lighting levels in terms of watts (a measure of energy consumption) rather than foot-candles (a measure of lighting level). These same requirements specify particular lighting technologies rather than provide a performance standard, leaving no room for newer, energy-efficient technologies.

This proposal would treat sunlight as a source of illumination alongside electric lighting, permitting electric lighting to be dimmed during the day thereby saving energy. In keeping with industry standards, it would replace watts as the unit of measurement with foot-candles, replace requirements for particular lighting technologies with a performance standard, and establish minimum energy efficiency standards for lighting. Other provisions would authorize the use of bi-level lighting in hallways and stairs so that sensors can reduce lighting to a lower level when an area is unoccupied (returning to full brightness whenever a person enters the area). Finally, occupancy sensors would be permitted in laundry rooms, automatically turning off lighting when the rooms are unoccupied.

Environmental & Health Benefits
This proposal was found to have a low, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 2.

This proposal was found to have no significant positive health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.03% to 0.09%, depending on building type. It was thus

categorized as incurring a low to medium capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in three to ten years depending on the building type.

Precedents
There are no known precedents for this proposal.

The Illuminating Engineering Society of North America (IESNA), which sets the standards for lighting across the country, recommends illumination levels of 5 foot-candles in hallways and 5-10 foot-candles in stairways. Energy analyses commonly identify lighting in unoccupied hallways, stairs, and laundry room as prime opportunities for energy efficiency upgrades.[1]

LEED
There are no LEED credits directly affiliated with this proposal. However, due to improved energy performance resulting from these measures, this proposal may assist in compliance with LEED prerequisites for Energy & Atmosphere under most of the rating systems. These recommendations may also facilitate achieving LEED Energy and Atmosphere credits, which require exceeding the minimum standards established by the prerequisites:

- LEED NC-EA cr.1 Optimize Energy Performance
- LEED EB-EA cr.1 Optimize Energy Performance
- LEED CI-EA cr.1.1 Optimize Energy Performance, Lighting Power
- LEED ND-GCT cr.2 Energy Efficiency in Buildings
- LEED for Schools EA cr.1 Optimize Energy Performance
- LEED for Homes EA cr.1 Optimize Energy Performance
- Additional credits under LEED pilot programs.

Implementation & Market Availability
There are no known implementation issues for this proposal.

Notes
A more efficient use of lighting equipment and power would lead to reduced occurrences of equipment repairs and replacement, thereby reducing the level of building equipment failure and need for frequent building maintenance

ENDNOTES:

[1] SEATTLE CITY LIGHT, BUILT SMART CITY MANUAL ch. 6 (2006), available at http://www.ci.seattle.wa.us/light/Conserve/Resident/BSbinder/docs/cv5_bs1.pdf. (This developer incentive program of the Seattle utility company, Seattle City Light, notes that energy-efficient fixtures should be used common areas such as hallways, stairs, and laundry rooms. The program also recommends the use of sensors to reduce electric lighting when common areas are unoccupied or have adequate levels of daylight.).

EE 8:
ENCOURAGE INSTALLATION OF ENERGY STAR® APPLIANCES

New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Home appliances, such as refrigerators, freezers, dishwashers and clothes washers, are a significant contributor to building energy consumption. Energy Star® appliances are more efficient, and they are readily available.

Recommendation:
Require owners of buildings and apartments undertaking kitchen and/or laundry facility construction to either purchase Energy Star® appliances or undertake alternate energy-saving measures.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

Amend Chapter 13 to include a new Section 1302 as follows:

SECTION BC 1302

ENERGY EFFICIENT APPLIANCES

1302.1 Definitions. The following words and terms shall, for the purposes of this Chapter and as used elsewhere in this code, have the meanings shown herein.

LARGE HOUSEHOLD APPLIANCE. Any refrigerator, freezer, dishwasher or clothes washer.

ENERGY CONSERVATION OBJECTIVE. The aggregate difference between the maximum energy consumption permitted under federal law for the expected large household appliances and the maximum energy consumption of the expected large household appliances permitted under Energy Star®.

ENERGY STAR®. A designation and/or labeling indicating that a product meets the energy efficiency standards set forth by the United States Environmental Protection Agency and the United States Department of Energy for compliance with the Energy Star® program.

EXPECTED LARGE HOUSEHOLD APPLIANCE. The number and type of large household appliances typically expected to be found in any building classified in occupancy groups R-1, R-2 or R-3, or any dwelling unit within such building, to be determined based on criteria established by the department.

1302.2 Calculation of the Energy Conservation Objective. The department shall calculate the energy conservation objective and update it every two years thereafter, beginning on the second anniversary of the effective date of the local law that added this section. The energy conservation objective shall be specified in terms of the estimated total consumption of energy, which may be specified in units of energy or its equivalent cost.

1302.3 Appliance or other energy savings. Any construction, alteration or addition of a kitchen in a building classified in occupancy groups R-1, R-2 or R-3, or any dwelling unit within such building, that requires a permit from the department shall achieve the energy conservation objective. The energy conservation objective may be satisfied by either:

1. the installation of large household appliances certified as Energy Star® for all large household appliances in the applicable kitchen or kitchens of such building or dwelling unit; or

2. any other method or combination of methods that will achieve the energy conservation objective as demonstrated through energy modeling methodologies adopted by the department that are distinct from the energy modeling methodology required to comply with Section 1301.1.1, provided that such energy modeling

methodology incorporates the applicable testing procedures set forth in title 42, section 6293 of the United States Code.

Exceptions:

1. Any building or dwelling unit that has received a permit subject to this section within a five (5) year period prior to submitting an application for a new permit.

2. If the percentage aggregate difference between the maximum energy consumption permitted under federal law for the expected large household appliances and the large household appliances is less than 20 percent.

3. Any large household appliance shall be excluded from the calculation of the energy conservation objective if:

a. There is no Energy Star® certified large household appliance manufactured that would be of an appropriate size for installation in a building or dwelling unit such that the movement of walls or fixtures would not be necessary to create sufficient space for such large household appliance.

b. Such large household appliance was purchased within 5 years of the permit application.

4. The commissioner may exempt any building or dwelling unit from the provisions of this section upon a determination of undue hardship.

Supporting Information

Issue – Expanded
Appliances consume over 40% of the energy in New York residential buildings.[1] Since 1992, the U.S. Environmental Protection Agency and U.S. Department of Energy have certified appliances as Energy Star® if they are significantly more energy-efficient than required under federal law.

In a building where plug loads represent a large portion of total energy consumption, reductions in appliance energy use could result in significant energy savings. Even in buildings that have a smaller proportion of unregulated loads, installing Energy Star appliances is a simple, low-cost way to achieve reductions in energy use and cost, water use, and carbon emissions.

Under this proposal, in accordance with federal law, buildings would have the option of either installing Energy Star® appliances or undertaking other retrofit measures that would achieve equivalent energy savings.

Environmental & Health Benefits
Installing appliances that have the Energy Star® label or comply with the criteria to achieve Energy Star® will result in reduced energy consumption and cost, reduced carbon emissions, and process water savings (depending on the type of appliance). Not only will energy consumption drop substantially as old, inefficient appliances are eliminated, but the summer peak load will be reduced.

While the actual energy savings will vary by building and appliance type, LEED contemplates reductions in total building energy use of 5% or greater from improved appliance efficiency.[2]

This proposal was found to have a low, positive impact environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 2.

This proposal was found to have no significant positive health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal is not expected to have any significant impact on capital costs. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years depending on the building type.

Precedents
The California Building Code and at least one proposed model code contain provisions analogous to this Task Force recommendation. The California Green Building Standards Code requires buildings to either follow a prescriptive that

specifies Energy Star® equipment, or follow a performance path that does not specify such equipment.[3] Likewise, proposed ASHRAE Standard 189P follows this same model, requiring Energy Star® equipment under a prescriptive path, while also offering a performance path without the requirement.[4]

LEED
Adherence to this provision could help a project achieve LEED points under almost all of the various LEED rating systems. Specifically, Energy Star appliances could help a project achieve the following credits: LEED for Homes EAc9: Appliances, LEED for Schools WEc4: Process Water Use Reduction, LEED for Existing Buildings MRc2.1: Sustainable Purchasing - Durable Goods, LEED for Commercial Interiors EAc1.4: Optimize Energy Performance, Equipment and Appliances. Energy Star appliances are also referred to in LEED systems that are currently in development, like LEED for Healthcare WEc4: Process Water and EAc7: Medical and Process Equipment Efficiency.

Some of these credits specifically require the use of appliances and equipment with the Energy Star label. In the cases where it is not required, a performance target is established that could be met either by products with the Energy Star label or products with equivalent performance efficiency.

Although they are not specifically cited in the Reference Guides, Credit Interpretation Requests have established that under the LEED for New Construction rating system, Energy Star appliances can contribute to a potential Innovation credit (for LEED-NC 2.1) or can contribute to EAc1 using the Exception Calculation Method (LEED-NC 2.2).

Implementation & Market Availability
Energy Star® appliances are readily available on the market.

ENDNOTES:

[1] New York State Energy Research and Development Authority, Energy efficiency and renewable energy resource development potential in New York state, Vol. 5, Appendices 5-12, Table 5.1.2.4 (2003). The breakdown is as follows: refrigeration (20%), electronic equipment (11%), and clothes washing (washer and dryer) (11%). "Electronic equipment" consists of televisions, videocassette recorders, microwaves, stereos, computers, and laser printers.

[2] Under a LEED-NC 2.1 Credit Interpretation Request, projects can receive an Innovation Credit for Energy Star appliances if the projected appliance energy savings is greater than or equal to 5% of the building's total energy use.

[3] CAL. CODE, Tit. 24, pt. 11 § 500 (2008), available at http://www.documents.dgs.ca.gov/bsc/2009/part11_2008_calgreen_code.pdf.

[4] American Society Of Heating, Refrigerating And Air-Conditioning Engineers, Inc., Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, Third Public Review, ch. 7 (2009) available at http://finance.ky.gov/NR/rdonlyres/C350F0AD-FFCF-4EDE-A643-37B81188524A/0/HPBWorkGroup.pdf.

EE 9:
IMPROVE OPERATION OF DRYERS IN APARTMENT BUILDINGS

Administrative Code (Housing Maintenance Code)
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Shared clothes dryers in multifamily residential properties have a large energy impact because they are heavily used. Many dryers sell drying time in large increments (45 minutes to an hour), causing the dryer to run longer than necessary.

Recommendation:
Require dryers to sell time in increments of 15 minutes or less.

Proposed Legislation, Rule or Study

Amendments to the Administrative Code of the City of New York:

1. Add a new Section 27-2051.1 as follows:
   § 27-2051.1 Common Clothing Dryers. Any clothing dryer purchased or rented after July 1, 2010 and intended for common use by the occupants of a multiple dwelling shall allow the purchase of drying time in increments of fifteen minutes or less.

Supporting Information

Issue- Expanded

Nationally, clothes dryers are the second biggest electricity-consuming home appliance after the refrigerator. According to 2001 Department of Energy statistics, they account for 5.8% of the total residential electricity.[1] While some dryers use moisture sensors that determine when the clothes are dry and automatically shut-off, most dryers have an adjustable timer that shuts the machine off after a pre-selected period. Commercial dryers typically sell drying time in large increments, which results in dryers running longer than required. The situation is exacerbated by the tendency to overestimate required time to dry a load. Over-drying results in wasting energy, time, and money as well as often wear-and-tear of fabric and shrinkage.

While both federal standards and ENERGY STAR criteria for residential clothes washers changed on January 1, 2007 to ensure energy savings, there was no parallel change regarding clothes dryers.[2] In fact, there is still no federal regulation related to dryers and, consequently, ENERGY STAR does not have a program or labeling system that applies to dryers.

New York City is different from many other cities in that dryers typically utilize gas rather than electricity, which makes them far more efficient. In this context, the most effective approach to reducing energy consumption of dryers in New York City is to reduce the time dryers run by allowing for small increments of drying time to be sold in multi-family residential properties.

Environmental & Health Benefits

Shorter drying times will give consumers more control over the drying, allowing a more efficient use of the dryers. In addition to conserving energy, time and money, this proposal gives the consumer options on how dry and how fast they can complete the task of doing their laundry. Shorter drying times may have the added benefit of making clothes last longer as a result of not over-drying.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a positive, indirect health impact.

Cost / Savings
This proposal is not expected to have any significant impact on capital costs.

Precedents
There are no known precedents for this proposal.

LEED
The government does not test or assign ENERGY STAR ratings to dryers because most dryers use relatively similar amounts of energy. Therefore, dryers will not comply with credits LEED CI-EA cr.1.4 or LEED for Homes EA9, which use ENERGY STAR ratings as the standard for Equipment & Appliances.

The reduction in power usage may assist in achieving Energy & Atmosphere prerequisites and credits in all of the rating systems, depending upon which options are pursued for LEED compliance.

Under the performance method outlined in LEED NC EA prerequisite 2 Minimize Energy Performance and EA cr. 1 Optimize Energy Performance, process energy is considered to include laundry washing and drying. Process loads shall be identical for both the baseline building performance rating and for the proposed building performance rating. However, project teams may follow the Exceptional Calculation Method (ASHRAE 90.1-2007 G2.5) to document measures that reduce process loads.

Implementation and Market Availability
There are no known implementation or market availability issues for this proposal.

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[1] Energy Information Administration, U.S. Department of Energy, End-use Consumption of Energy 2001, http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html (last visited Jan. 28, 2010).

[2] U.S. EPA, ENERGYSTAR, MARKET IMPACT ANALYSIS OF POTENTIAL CHANGES TO THE ENERGYSTAR CRITERIA FOR CLOTHES WASHERS, (2008), http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/clotheswash/CriteriaAnalysis_2008.pdf.

EE 10:
REDUCE OVERHEATING IN APARTMENTS

Administrative Code of the City of New York
Proposal developed by the Energy & Ventilation Committee.

Summary

Issue:
Many apartment residents have little or no control over individual radiators in their living spaces. This results in overheating in the winter. Residents then open windows and waste energy.

Recommendation:
Over a 10-year period, phase in individual room or apartment temperature controls in residential buildings.

Proposed Legislation, Rule or Study

Amendments to the Administrative Code of the City of New York

1. Add a new paragraph (49) to subdivision (a) of Section 27-2004 as follows:

49. A thermostatic control is a heating control, such as a thermostatic radiator control valve, that conforms with the requirements of ASHRAE 90.1 2007, Section 6.4.3.1 "Zone Thermostatic Controls."

2. Add a new Section 27-2034 as follows:

§ 27-2034 Apartment heat control.

a. In accordance with the implementation schedule listed in Table 27-2034, there shall be a thermostatic control in every dwelling unit of a multiple dwelling that shall control the heat sources within such dwelling unit. More than one thermostatic control per dwelling unit is permitted, provided there is not more than one thermostatic control per heat source.

Table 27-2034

Implementation Schedule: Fraction of radiators, fan-coil units, packaged terminal air conditioner, or other heat sources in each building to be controlled by specified date:

Date:	July 1, 2013	July 1, 2017	July 1, 2020	July 1, 2023	July 1, 2026
Fraction:	20%	40%	60%	80%	100%

b. Notwithstanding the foregoing, thermostatic controls shall not be required:

1. If heating is provided by a hydronic system plumbed such that a thermostatic control in one dwelling unit would control heat supplied to a different dwelling unit; or

2. If the building has a central energy management system or building management system that incorporates temperature sensors in twenty percent or more of the dwelling units in the building and controls heat supply on the basis of zones, as such term is defined in ASHRAE 90.1 2007.

Supporting Information

Issue – Expanded
Lack of control over heating and, to a lesser extent, cooling, leads residents of apartment buildings to open their windows during heating season in order to maintain a comfortable environment. This results in substantial fuel being burned to heat air that is vented to the outdoors, a transparent waste. Because central cooling is rare in older

apartment buildings, this proposal is focused on heating.

The same issue can arise in commercial buildings, but happens less often since they are more likely to have zoned controls already, and even if they do not, are required under the Energy Code to install controls during renovations.

In new construction, Section 6.4.3.1, "Zone Thermostatic Controls" of ASHRAE 90.1 2007 requires control of both heating and cooling in all new construction, both residential and commercial. Under this provision, an entire residential apartment can be considered a "zone", and thus run off a single thermostat, even if two rooms have different exposure. While a single thermostat is not ideal, strengthening this requirement would be complex and would not result in substantial savings, since many residential developments use individual radiator controls to meet this requirement.

This proposal is therefore focused on the heating systems of existing residential buildings, three families and larger. These buildings are not normally appropriate for apartment-wide zone controls, since vertical steam or hot water risers provide heat to radiators independently of which apartment they are in. However, there are a wide variety of thermostatic radiator valves (TRVs) that can be retrofitted to control individual radiators.

The proposal also permits control of the entire building through an energy management system or building management system, if such a system includes zoned controls so that, for example, the heat supply to the south side of a building can be restricted while the north side is heated. This is actually the preferred solution, but requires a more rapid investment schedule. Smaller buildings are normally already controlled by thermostats and so are omitted.

Environmental & Health Benefits
Residents who open windows when their apartments are overheated cause the boiler to burn more fuel, which costs money and adds carbon emissions to the atmosphere. This measure will reduce this practice.

Except in extreme cases, no health problems are directly linked to overheated residences. Ambient temperature is a highly subjective matter and discomfort from too much heat varies greatly between people.

This proposal was found to have a high, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 3.

This proposal was found to have a low positive health impact per building and to impact a small number of buildings. It was thus given a health score of 1.

Cost & Savings
Cost will vary dramatically. It is easy to retrofit a TRV on a 1-pipe steam radiator and could cost as little as $100. For two pipe steam and hydronic systems to which TRVs can be fitted, the valve must be inserted into the circuit, resulting in costs as high as $600 for contract labor.

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These draft cost and savings estimates are presented in the February 1st version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

At $600 per radiator, this proposal was found to incur capital cost by between $1.20 and $2.20/square foot, and was thus categorized as incurring a medium to higher capital cost. Installation of an energy management system would cost substantially less.

This proposal was also estimated to generate financial savings that will pay for the capital costs in three to ten years. NYSERDA research reports space heat savings of 9.5% to 15.5% from the installation of thermostatic radiator valves (TRVs).[1] Similar savings would be expected from thermostats on fan-coil units -- with the added benefit of electricity savings from reduced fan run-time. In Appendix A, calculations based on the assumption of 10% savings show payback periods of less than seven years for the high capital cost associated with two-pipe steam in a high rise residential building.

Precedents
Most municipalities in cold and temperate zones, including New York City, require minimum temperatures that landlords must maintain in apartments, but none require that units have devices that can control temperature.

As stated, ASHRAE 90.1 2007 requires apartment heating and cooling controls in all new construction and all construction requiring a building permit for work on the heating system.

LEED
Implementation of this change could help a project achieve points under LEED for Existing Buildings – Operations and

Maintenance as part of a plan to reduce fuel use.

Implementation & Market Availability
There are numerous proven approaches to providing individual apartment heating controls using widely available devices.

One of the most commonly used devices is a thermostatic control valve (TRV), a temperature-regulated control valve that senses room temperature and allows a fluid to pass or not depending on that temperature. For hot water and two-pipe steam systems, the valve controls the inflow of hot fluid. For one-pipe steam systems, the valve controls the outflow of air from the radiator at the start of each boiler cycle. If the room is warm, air cannot leave the radiator, so only a fraction of the normal amount of steam can get in. (TRVs only work well on one-pipe systems if the boiler is operated at low steam pressures, as it should be in any event). The best TRVs have a temperature sensor that mounts on the wall, at a distance from the radiator, to minimize feedback.

Some hot water distribution systems are plumbed so that the installation of TRVs would stop all circulation in the system, rather than in one radiator, and plumbing sufficient to overcome this would be onerously expensive. This proposal offers an exception for such systems.

Some heating systems provide steam or hot water to a contained, finned coil, equipped with a fan that blows room air through the coil. (These are referred to either as fan-coil units if single purpose or Packaged Terminal Air Conditioners, PTACs, if they include a cooling function.) In this case, the thermostat need control only the fan, a much less expensive alternative.

ENDNOTES:

[1] T. Rieger, Radiator valves prevent apartment overheating, HOME ENERGY MAGAZINE ONLINE, May/June 1996, http://www.homeenergy.org/archive/hem.dis.anl.gov/eehem/96/960509.html.

EE 11:
TURN OFF EQUIPMENT IN EMPTY HOTEL ROOMS

ANSI/ASHRAE/IENSA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Lighting & Daylighting Committee

Summary

Issue:
Currently lights, television sets and excess heating and cooling operations are often running in hotel and motel rooms when no one is there, which uses substantial energy for no purpose.

Recommendation:
Require a master switch, such as a room key electronic control that is commonly used elsewhere in the world, which automatically turns off lighting and television screens, and sets back the temperatures when the room is vacated.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Amend paragraph (c) of Section 9.4.1.4 as follows

    c. Hotel, [and] Motel Guest Room, and Guest Suite Lighting & Power–

    1. hotel and motel guest rooms and guest suites shall have a master control device at the main room entry that controls all permanently installed luminaires [and], switched receptacles and televisions.

    2. room heating or cooling units shall be equipped with controls that automatically setback temperatures when the room is unoccupied. The setback temperature for cooling units shall be no lower than 78°F, and the setback temperature for heating units to be no higher than 65°F.

    3. enclosed bathrooms shall be controlled by a manual-on/automatic-off occupancy control device(s). Control(s) shall turn the lighting off automatically within 30 minutes of all occupants leaving the room. Bathroom night-lighting, if provided, shall not exceed one watt, and shall be manually controlled independently from the general lighting for the bathroom.

Supporting Information

Issue – Expanded
About half the energy used in hotels is used in guest rooms.[1] Studies on lighting energy use in hotel rooms show that there is not a big dip in energy use during the day - hours when rooms are typically unoccupied.[2] In addition, 75% of the energy consumption from lighting in hotel guestroom bathrooms is during cycles of two hours or more, indicating that guests often leave bathroom lights on after they exit the room.[3] Likewise, hotel rooms are typically heated and cooled regardless of whether the room is occupied, and televisions are sometimes left on.

This proposal would require hotel rooms to be equipped with control devices to reduce energy use when the rooms are unoccupied. Bathroom lighting would turn off 30 minutes after occupants have left and televisions would be controlled by master switch at the front of the hotel room. In addition, the temperature of hotel rooms equipped with individual heating or cooling units would be set back when the room is unoccupied.

Environmental & Health Benefits
Studies have found energy savings of 17%-52% when occupancy based lighting controls are used in a variety of commercial rooms.[4] A decrease in energy consumption will improve air quality and reduce greenhouse has emissions.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will

vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.3%. It was thus categorized as incurring a medium capital cost increment.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have no significant positive health impact.

Precedents
Several model codes and standards include guidelines for master switches in hotels. IECC 2006, 505.2.3 recommends that sleeping units in hotels, motels and similar buildings have at least one master switch and control at the main entry to control all permanently wired luminaries and switched receptacles.

Similarly, ANSI/ ASHRAE/ IESNA Standard 90.1-2004 require that hotel and motel guest rooms and suites have a master control device at the main entry that controls all permanently installed luminaries and switched receptacles.[5] The 2007 Addenda expands on this measure to specify that bathrooms in the rooms be required to have an occupancy sensor to automatically turn off bathroom lighting within 60 minutes of non-occupancy.

In addition, Section 503.8.3.3 Control Setback and Shut-Off in Seattle's energy code requires that thermostats or other kind of temperature control switches have a manual or automatic means of reducing energy usage during periods of non-use or reduced need.[6]

LEED
This proposal may assist in compliance with LEED prerequisites for Energy & Atmosphere under most of the rating systems.

These recommendations will also facilitate achieving LEED Energy and Atmosphere credits:
- LEED NC- EA cr.1 Optimize Energy Performance
- LEED EB-EA cr.1 Optimize Energy Performance
- LEED CI-EA cr.1.1 Optimize Energy Performance, Lighting Power
- LEED CI-EA cr.1.3 Optimize Energy Performance, HVAC
- LEED ND-GCT cr.2 Energy Efficiency in Buildings
- LEED for Schools EA cr.1 Optimize Energy Performance
- Additional credits under LEED pilot programs.

These credits require exceeding the minimum standards established by the Energy and Atmosphere prerequisites.

Implementation & Market Availability
There are no known implementation issues for this proposal. Occupancy sensors, computer check-in systems, and card-key wall switches are readily available.

Notes
ASHRAE is considering similar measures for future versions of the 90.1 standard.

ENDNOTES:

[1] Hotelsmag, Digital Controls (April 2001), http://www.hotelsmag.com/article/359714-Digital_Control.php.

[2] ERIK PAGE AND MICHAEL SIMINOVITCH, LIGHTING ENERGY SAVINGS OPPORTUNITIES IN HOTEL GUESTROOMS, LAWRENCE BERKELEY NATIONAL LABORATORY, 6 (October 1999), available at http://www.osti.gov/bridge/servlets/purl/764355-63RfOi/webviewable/764355.pdf.

[3] Ibid

[4] Energy Savings and Demand Reduction, Iss. TB151 THE WATT STOPPER: TECHNICAL BULLETIN, February 1, 2002 http://www.wattstopper.com/getdoc/1328/TB151.demand%20reduction.pdf

[5] Hotel Lighting Controls: Reduce Energy while Guests are Away, WALLSTOPPER (Wallstopper New Product Brochure pub no. 27002) 2008, http://wattstopper.com/getdoc/2211/HS_NewProdBroch_08.pdf

[6] CITY OF SEATTLE ENERGY CODE , ch. 5, § 503.8.3.3 (2006) available at http://www.seattle.gov/DPD/Codes/Energy_Code/Residential/Chapter_5/default.asp

EE 12:
PROVIDE VENTILATION AIR ONLY AS NEEDED IN LARGE SPACES

New York City Mechanical Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
HVAC systems typically provide outdoor air based on maximum occupancy, wasting energy when rooms are partially occupied or empty. Demand control ventilation adjusts the amount of air pumped into rooms as needed.

Recommendation:
Require demand control ventilation for large spaces of variable occupancy.

Proposed Legislation, Rule or Study

Amendments to the New York City Mechanical Code

1. Amend Section 403.3.1 as follows:

403.3.1 System operation. The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3 and the actual number of occupants present. Intermittent exhaust shall be permitted where an individual exhaust duct and fan are provided and the operation of the fan is controlled by occupants of the space being vented.

Exception: In intermittently occupied spaces that do not have processes or operations that generate dusts, fumes, mists, vapors or gasses and are not provided with local exhaust ventilation in accordance with Chapter 5, the rate of outdoor air may be reduced if the ventilation system serving the space is controlled by a demand control ventilation device complying with Section 403.3.5.

2. Add a new Section 403.3.5 as follows:

403.3.5. Demand control ventilation. Demand control ventilation shall be provided as follows:

1. Demand control ventilation shall be required, and shall have demand ventilation sensors and controls complying with this section, in single-zone HVAC systems where:

1.1. Such system has an outdoor air economizer; and

1.2. The demand control ventilation serves a space with an estimated occupancy load greater than or equal to 25 persons per 1000 square feet (less than or equal to 40 square feet per person).

Exceptions:

1. Natatoriums, classrooms, R-2 and R-3 occupancies and healthcare facilities shall not be required to have demand control ventilation.
2. Demand control ventilation shall not be required where space exhaust is greater than the outdoor airflow rate required by Table 403.3.
3. Spaces that have processes or operations that generate dusts, fumes, mists, vapors, or gases and are not provided with local exhaust ventilation in accordance with Chapter 5 shall not be required to provide demand control ventilation.

2. Where demand control ventilation is required by this section, sensor and control devices shall be required as follows:

2.1. CO_2 sensors shall be installed in each room, between one foot and six feet above the floor.

2.2. In each room with CO_2 sensors, demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 parts per million plus the outdoor air CO_2 concentration.

Exception: The outdoor airflow rate is not required to be larger than the outdoor airflow rate required by Table 403.3, regardless of CO2 concentration.

2.3 Outdoor air CO2 concentration shall be determined by one of the following:

i. CO2 concentration shall be assumed to be 400 parts per million without any direct measurement; or

ii. CO2 concentration shall be dynamically measured using a CO2 sensor located within six inches of the outdoor air intake.

2.4 When the system is operating during hours of occupancy, the controls shall maintain system outdoor airflow rates no less than the rate listed in Table 403.3 times the conditioned floor area for spaces with CO2 sensors, plus the rate required by Section 403.3.1 for other spaces served by the system, or the exhaust air rate, whichever is greater;

2.5 CO2 sensors shall be certified by the manufacturer to have an accuracy within 75 parts per million and to require calibration no more frequently than once every 5 years, and shall be factory-calibrated or calibrated at start-up.

3. A special inspection shall be required in accordance with department rules to verify that the demand control ventilation system meets the requirements of this section.

Supporting Information

Issue – Expanded

Demand-controlled ventilation reduces energy use by reducing the amount of air that gets heated or cooled. Instead of ventilating all the air in a given space at its maximum capacity at all times, only the amount of air that is actually needed by the occupants gets drawn into and exhausted from the space. Since fresh air must be heated or cooled a good portion of the year, execution of this proposal will reduce heating and cooling costs for the spaces in question. If the space is occupied on an irregular basis, the savings can be substantial.

Various mechanisms are available for controlling the amount of air. The most straightforward may be a carbon dioxide sensor, since the presence of carbon dioxide indicates that people are present and correctly measures how hard they are breathing – useful, for example, in a gymnasium.

Environmental & Health Benefits

This carries the benefits of lowered emissions from boilers and electric generators.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a positive, indirect health impact.

Cost / Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.
This proposal was estimated to increase first capital costs by 0.04%. It was thus categorized as incurring a low capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in about four years. (Unfortunately, this measure was mis-represented in the Executive Summary as having a payback period greater than ten years.)

Precedents

Demand-controlled ventilation has become more feasible and cost-effective in recent years, and state energy departments such as in Oregon have promoted DCV as a means of cutting energy costs and usage. The conservation division of the Oregon Department of Energy has issued a design guide for Demand-Controlled Ventilation, which can be found here.[1]

ASHRAE 90.1 2007 includes a section (6.4.3.9) requiring DCV in high-occupancy areas. This measure extends the coverage to lower occupancy levels, and is necessary because the mechanical code would pre-empt the ASHRAE requirement.

LEED

LEED does not provide credit for utilizing a demand-controlled-ventilation system, although it does cite the logic of implementing a DCV system in certain large spaces.
LEED does provide credit for installing Carbon Dioxide sensors. Therefore, this proposal will assist projects in complying with LEED under the following subsections (including various pilot programs):

- LEED NC-EQ cr.1, Outdoor Air Delivery Monitoring
- LEED CI-EQ cr.1, Outdoor Air Delivery Monitoring
- LEED for Schools EQ cr.1, Outdoor Air Delivery Monitoring
- LEED EB-EQ cr.1, Outdoor Air Delivery Monitoring

LEED for Homes requires Carbon Monoxide detection devices, and thus does not correlate with the requirements of this proposal.

Implementation and Market Availability

There are no known implementation issues for this proposal. CO_2 based demand control ventilation systems are technically mature and widely available.

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[1] Oregon Dep't of Energy, Demand-Controlled Ventilation, http://www.oregon.gov/ENERGY/CONS/BUS/DCV/DCVintro.shtml (last visited Jan. 28, 2010); and M. STIPE, OREGON DEP'T OF ENERGY, DEMAND-CONTROLLED VENTILATION: A DESIGN GUIDE (2003), http://www.oregon.gov/ENERGY/CONS/BUS/DCV/docs/DCVGuide.pdf.

EE 13:
USE MANUAL ON-AUTO OFF LIGHTING

New York City Building Code
Proposal developed by the Lighting & Daylighting Committee

Summary

Issue:
Occupancy sensors turn on lights when a room is entered, then turn them off after people have departed. This does not maximize energy savings because light is not always needed at entry, if the use is transitory or daylighting is available.

Recommendation:
Require vacancy sensors, which contain a manual On switch, coupled with an occupancy sensor that turns lights off after a period of vacancy.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Add a new definition to Section 3.2 as follows:

Vacancy sensor: An occupant sensor for which the lights must be manually turned on but the sensor automatically turns the lights off soon after an area is vacated that meets the following requirements:
a. Shall not turn on the lighting automatically, except that they shall have a grace period of 15 seconds to 30 seconds to turn on the lighting automatically after the sensor has turned off the lighting; and
b. Shall not have an override switch that converts occupant sensors from manual on to automatic-on functionality.

2. Amend paragraph (a) of Section 9.4.1.2 as follows:

9.4.1.2 Space Control. Each space enclosed by ceiling height partitions shall have at least one control device to independently control the general lighting within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting.

a. A vacancy sensor [An occupant sensor] shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space[, except spaces with multi-scene control,] in

1. classrooms (not including shop classrooms, laboratory classrooms, and preschool [through 12th grade] classrooms),
2. conference/meeting rooms, [and]
3. employee lunch and break rooms, and
4. offices smaller than 200 square feet.

Supporting Information

Issues – Expanded
Occupant sensors have been used for decades, saving tremendous amounts of energy, and are required under the Energy Code. These sensors automatically turn on lights when a person enters a room and then automatically turn the lights off when the room is vacant. Unfortunately, occupant sensors sometimes turn lighting on when it is not needed, such as when a room is already sunlit or when someone is only passing briefly through a room. Once turned on, occupant sensors typically do not turn lights off for 30 minutes.

A variation of occupant sensors, known as a "vacancy sensor," addresses this problem. Whereas occupant sensors turn automatically on and off, a vacancy sensor requires a person to manually turn the lights on and then automatically turns the lights off when the room is vacant.

This proposal would require vacancy sensors in the place of occupancy sensors for several building areas that are typically lit by natural light or that people often enter only briefly. It would also require vacancy sensors in small offices

where no sensors are currently required under the Energy Code.

Environmental & Health Benefits
Vacancy sensors will reduce energy use, leading to reductions in greenhouse gas emissions and improvements to air quality.

This proposal was found to have a low, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 2.

This proposal was found to have no significant positive health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal is not expected to have any significant impact on capital costs. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years depending on the building type.

Precedents
There are no known precedents for this proposal.

LEED
This proposal may facilitate achieving the following LEED Energy and Atmosphere credits:

- LEED NC-EA cr.1 Optimize Energy Performance;
- LEED EB-EA cr.1 Optimize Energy Performance;
- LEED CI-EA cr.1.2 Optimize Energy Performance, Lighting Controls;
- LEED ND-GCT cr.2 Energy Efficiency in Buildings;
- LEED for Schools EA cr.1 Optimize Energy Performance;
- Additional credits under LEED pilot programs.

Implementation & Market Availability
There are no implementation issues with this proposal. Vacancy sensors are widely available from manufacturers of lighting controls.

EE 14:
LIMIT AFTER-HOURS RETAIL LIGHTING

New York City Building Code
Proposal developed by the Lighting & Daylighting Committee

Summary

Issue:
Many retail establishments in New York City light their spaces all night long. This wastes energy, especially because stores often use high-wattage fixtures.

Recommendation:
Require retail lighting, other than lighting used in window displays or for egress, to be turned off when stores are unoccupied.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Add a new paragraph (g) to Section 9.4.1.4 as follows:

9.4.1.4 Additional Control

g. Retail lighting--retail spaces shall be equipped with one or more automatic control device(s) to turn off all general interior lighting or to reduce the lighting levels to the minimum required by law for egress. Such lighting reduction shall occur within 20 minutes of store closing. Lighting levels shall be programmed to return to desired levels 20 minutes prior to store opening or initiated by occupancy.

Exceptions:

1. Lighting used for nighttime marketing and not exceeding an interior lighting power allowance of 50 watts per linear foot of the perimeter display window area until midnight, and 25 watts per linear foot of the perimeter display window area after midnight. No more than 20% of the total allowance shall be used by luminaires located more than 15 feet from display windows. All luminaires used for nighttime marketing shall have a luminous efficacy greater than 30 lumens per watt.

2. Light fixtures used in spaces containing automatic teller machines.

3. Zoned lighting controls connected to occupancy sensors or timeclock override switches not exceeding two hours per override that enable cleaning, re-stocking, construction of displays or other activities that occur during off-hours.

4. Zoned lighting controls connected to occupancy sensors for nightlighting or security lighting.

5. Temporary seasonal window displays operating no later than midnight or one hour after store closing, whichever is later.

Supporting Information

Issue - Expanded
Many stores remain illuminated all night long, well after closing time. It is always wasteful to light unoccupied spaces and especially so for retail establishments since their lighting consumption can be equivalent many floors of offices. While retailers feel that lighting stores during off-hours provides a marketing advantage, most merchandise cannot be seen beyond ten or fifteen feet from the perimeter windows.

Limiting lighting to display windows and 15 feet of the store interior will enable retailers to display their goods to consumers, while saving energy. Window display lighting is also sufficient to illuminate the street, promoting pedestrian

street activity and a sense of urban security. In addition, retail security does not require illumination the deep interior of stores. In case of unauthorized entry, lights and alarms can be activated through the use of occupancy sensors, cameras, security sensors, alarms, and other low-energy security devices.

Environmental & Health Benefits
Using less lighting will reduce the demand for electricity and thereby lower carbon emissions and improve air quality.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have no significant positive health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase capital cost by $0.05/square foot. It was thus categorized as not incurring a capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years.

Precedents
Automated controls, and separate circuits for decorative and display lighting are already part of existing codes and standards and this proposal would regulate how those controls function. For at least the last seven years, the NYS Energy Conservation Construction Code of 2002 (referencing ASHRAE/IESNA Standard 90.1-1999) has required that all buildings over 5000 square feet be controlled by an automatic control device to shut off lighting in all spaces (this can be a programmed time switch). In addition, each space with full height partitions requires local control of zones (switches or occupancy sensors) that can be between 2500 square feet and 10,000 square feet. The 5000 square foot limit was been removed in Standard 90.1 – 2007, so all buildings now require automatic shut off regardless of size.

The ASHRAE/IESNA/NBI/DOE Advanced Energy Design Guide for Retail recommends the following, "Put all general, all accent, and all display case lighting on separate circuits and switches (use multiple circuits and switches as required). Use automatic time scheduling time switches to turn on accent and display case lighting no more than 20 minutes prior to normal scheduled hours and to turn off accent and display case lighting no more than 20 minutes after normal scheduled hours".[i]

LEED

This proposal may assist in compliance with LEED prerequisites for Energy & Atmosphere under most of the rating systems.

These recommendations will also facilitate achieving LEED Energy and Atmosphere credits:
- LEED NC-EA cr.1 Optimize Energy Performance
- LEED EB-EA cr.1 Optimize Energy Performance
- Additional credits under LEED pilot programs.

These credits require exceeding the minimum standards established by the Energy and Atmosphere prerequisites.

Implementation & Market Availability
Devices to turn off lighting are readily available. Wireless controls for existing installations are expected to be commonplace within 2-3 years. Utility or NYSERDA incentives for wireless controls would enable existing retail to comply sooner.

EE 15:
REDUCE ARTIFICIAL LIGHTING IN SUNLIT LOBBIES & HALLWAYS

New York City Building Code
Proposal developed by the Lighting & Daylighting Committee

Summary

Issue:
The building code mandates excessive lighting for egress spaces and that they be illuminated by artificial means even when the space is daylit or unoccupied.

Recommendation:
Align NYC egress illumination requirements with national standards and allow natural light to supply the required illumination, while maintaining current NYC standards when spaces are occupied.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Sections 1006.1 and 1006.2 as follows:

   1006.1 Illumination Required. Exits, exit discharges, and public corridors shall be illuminated at all times by either natural light or electrical lighting fixtures. Exit access components shall be illuminated by either natural light or electrical lighting fixtures at all times [during occupancy] that the space served by the exit access component is occupied.

   1006.2 Illumination Level. The means of egress illumination level shall not be less than 2 foot-candles (22 lux) at the floor levels in exits, at exit discharges, and in public corridors[,] when these spaces are occupied, nor less than 1 foot-candle when these spaces are unoccupied, and shall not be less than 1 foot-candle (11 lux) at the floor level in exit access components other than public corridors.

2. Add a new Section 1006.2.1 as follows:

   1006.2.1 Sensors and Controls. Automatic, occupant sensor lighting controls shall be permitted within means of egress, provided that the switch controllers are equipped for fail-safe operation, the illumination times are set for a minimum 15-minute duration, and the occupant sensor is activated by any occupant movement in the area served by the lighting units.

Supporting Information

Issue – Expanded
For obvious safety reasons, the Building Code requires all means of egress to be illuminated. However, the code does not credit daylight as a source of illumination for means of egress. It also requires "exit access components," such as corridors in offices and aisles in supermarkets, to be fully illuminated even when a space is unoccupied. Moreover, New York City requires twice the illumination as the rest of the nation for means of egress, even in an unoccupied building. These code provisions unnecessarily waste energy without increasing safety.

Since the Building Code does not recognize daylight as illumination in means of egress, buildings cannot use daylight-responsive controls to turn off electric lights when those areas are sunlit. It is common to see new, "green" buildings with daylight-responsive lighting controls where all of the lights in a day lit corridor have been turned off except for the emergency lights, which continue to operate at full output in the midst of streaming sunlight.

Under the code, all exit access components must also remain illuminated whenever any part of a building is occupied. This means that emergency lighting in a locked and vacant supermarket on the ground floor of a 40-storey office building is required to remain on at 2:00 AM if someone is working late on the 23rd floor.

It is wasteful and unnecessary for light fixtures to operate at full output next to a sunny window or to light unoccupied

fire stairs more brightly than the rest of the nation lights occupied fire stairs. This proposal would credit natural light as a source of illumination in means of egress. It would also allow lighting in exit access components to be turned off when an area is unoccupied. Finally, the proposal would permit occupant sensing lighting controls to set back the lighting in means of egress to national standard illumination levels when the space is not occupied. Section 1006.2.1, which describe how these controls would operate, is taken directly from the Life Safety Code of the National Fire Protection Association.

Policy makers may be concerned that lighting controls will malfunction during an emergency and leave fire stairs dark. However, this proposal would maintain lighting in exits, exit discharges, and public corridors 24 hours a day, 365 days a year. Since these spaces are used on a daily basis, any failure of the lighting controls would be as noticeable as a burned out light bulb, and much less likely.

Environmental & Health Benefits
This proposal will result in energy savings since lights could be switched off or dimmed when they do not need to be on. It will also reduce peak electricity demand, because peak demand usually occurs in the middle of a sunny summer afternoon, which coincides with peak daylight availability.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have no significant positive health impact.

Cost & Savings
This proposal is for a code allowance, which will have no direct impact on construction costs.

Precedents
Several national and state codes already allow the use of automatic lighting controls in means of egress. The International Building Code (IBC 2006 and 2009), Section 1006.1 Illumination Required, states, "The means of egress, including the exit discharge, shall be illuminated at all times the building space served by the means of egress is occupied." This means that lights can be switched off when the building space served by the means of egress is unoccupied. This same language is found in Massachusetts State Building Code[1], which is the building code for the City of Boston.

The National Fire Protection Association's Life Safety Code (NFPA 101 2009) states that, "Automatic, motion sensor-type lighting switches shall be permitted within means of egress, provided that the switch controllers are equipped for fail-safe operation, the illumination timers are set for a minimum 15-minute duration, and the motion sensor is activated by any occupant movement in the area served by the lighting units"[2]

A 2001 Code Application Notice issued by California's Office of Statewide Health Planning and Development amended previous state egress code regarding illumination. It states that "egress illumination is not needed for portions of the building that are not occupied"[3] This allows the egress illumination in unoccupied areas to be monitored and determined by actual user need.

The Lighting & Day Lighting Committee is not aware of any codes aside from New York City's that prohibit the control of lighting in means of egress.

LEED
Due to improved energy performance resulting from these measures, this proposal may assist in compliance with LEED prerequisites for Energy & Atmosphere under most of the rating systems.

These recommendations will also facilitate achieving LEED Energy and Atmosphere credits:
- LEED NC-EA cr.1 Optimize Energy Performance
- LEED EB-EA cr.1 Optimize Energy Performance
- LEED ND-GCT cr.2 Energy Efficiency in Buildings
- LEED for Schools EA cr.1 Optimize Energy Performance
- and credits under LEED pilot programs. These credits require exceeding the minimum standards established by the Energy and Atmosphere prerequisites.

LEED CI-EA cr.1.1 Optimize Energy Performance, Lighting Power, specifically addresses reducing lighting power throughout the entire tenant space. According to the LEED CI 2.0 Reference Manual, for commercial interior projects the reduction of interior lighting power stands to be the greatest energy conservation method available. Therefore, this proposal will have a significant positive impact on LEED certification.

LEED Indoor Environmental Quality subsections regarding daylight illumination, and LEED CI-EA cr.1.2 Daylight response controls, are only applicable to regularly occupied spaces. Therefore, this proposal will not assist in achieving

these credits.

Implementation & Market Availability
There are no known implementation issues for this proposal.

Photosensors have been used for decades to turn off exterior emergency lighting at points of exit discharge from buildings. The proposal would allow this same technology to be used inside the building. Occupancy sensors have also been in widespread use for decades, and are extremely good at detecting the "major body motion" of a person walking.

ENDNOTES:

[1] MASS. BLD. CODE REGS. 780 § 1006.1 (2008).

[2] NFPA, LIFE SAFETY CODE 101 § 7.8.1.2.2 (2009).

[3] STATE OF CALIFORNIA OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT, CODE APPLICATION NOTICE (2004), http://www.oshpd.ca.gov/FDD/Regulations/CANS/2001/2-1003-2-9.pdf.

EE 16:
INCREASE LIGHTING EFFICIENCY ON CONSTRUCTION SITES

New York City Building Code
Proposal developed by the Construction Practices Committee

Summary

Issue:
The standards for temporary lighting on construction sites are outdated, allowing for inefficient fixtures and wasteful practices.

Recommendation:
Update the efficiency standards for lighting on construction sites, provide separate circuits for life-safety lighting and let natural light illuminate foot bridges, temporary walkways and sidewalk sheds.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Section 3302.1 to include the following defined terms:

CONSTRUCTION LIGHTING, GENERAL. Temporary lighting of construction sites that is not construction safety lighting.

CONSTRUCTION LIGHTING, SAFETY. Lighting of foot bridges, temporary walkways, sidewalk sheds, stairwells and other pathways through a construction site for the purposes of illuminating ingress and egress pathways 24 hours a day.

PHOTOCELL SENSOR. A device that detects light and varies the electricity provided to a lamp or ballast according to ambient illumination. All photocell sensors shall fail on, such that if the sensor stops working then lamps will receive electricity by default.

2. Amend Section 3303.2.3 as follows:

303.2.3 Electrical work. All temporary electrical equipment and wiring shall meet the requirements of the New York City Electrical Code, and shall be maintained in compliance with such requirements. Portions of permanent electrical installations may be used for temporary operations provided the requirements of the New York City Electrical Code are met. Safety construction lighting and general construction lighting shall have a luminous efficacy of 45 lumens per watt or greater. In addition, general construction lighting shall be:

1. Separately circuited from safety construction lighting.
2. Controlled by master switches, which shall also control all non-essential power circuits. The master switches shall be located close to the main access to the construction site and be clearly labeled. The ingress pathway to master switches shall be illuminated by safety construction lighting.
3. Turned off when the construction site is not open.

3. Amend paragraph 2 of Section 3307.2.1 as follows:

All temporary walkways shall be illuminated at all times either by natural or artificial light. The level of illumination shall be the equivalent of that produced by [200 watt, 3400 lumen minimum, standard incandescent lamps] 32 watt 2700 lumen minimum T8 fluorescent lamps enclosed in vandal-proof fixtures and spaced 15 feet (4572 mm) apart and 8 feet (2438 mm) above the floor level. All lamps shall have a luminous efficacy of 45 lumens per watt or greater, be instant-start, and be rated for low temperature use. Artificial lighting units shall be inspected [nightly] daily; and burned out or inoperative units shall be replaced or repaired immediately. Photocell sensors may be used to control artificial lighting according to the amount of natural light available.

4. Amend paragraph 2 of Section 3307.2.2 as follows:

All foot bridges shall be illuminated at all times either by natural or artificial light. The level of illumination shall be the equivalent of that produced by [200 watt, 3400 lumen minimum, standard incandescent lamps] 32 watt 2700 lumen minimum T8 fluorescent lamps enclosed in vandal-proof fixtures and spaced 15 feet (4572 mm) apart and 8 feet (2438 mm) above the floor level. All lamps shall have a luminous efficacy of 45 lumens per watt or greater, be instant-start, and be rated for low temperature use. Artificial lighting units shall be inspected [nightly] daily; and burned out or inoperative units shall be replaced or repaired immediately. Photocell sensors may be used to control artificial lighting according to the amount of natural light available.

5. Amend Subdivision 2 of Section 3307.6.5 as follows:

2. The underside of sidewalk sheds shall be illuminated at all times either by natural or artificial light. The level of illumination shall be the equivalent of that produced by [200 watt, 3400 lumen minimum, standard incandescent lamps] 32 watt 2700 lumen minimum T8 fluorescent lamps enclosed in vandal-proof fixtures and spaced 15 feet (4572 mm) apart and 8 feet (2438 mm) above the floor level. All lighting shall have a luminous efficacy of 45 lumens per watt or greater. Lamps shall be 'instant-start' and rated for low temperature use. Artificial lighting units shall be inspected [nightly] daily; and burned out or inoperative units shall be replaced or repaired immediately. Photocell sensors may be used to control artificial lighting according to the amount of natural light available.

Supporting Information

Issue – Expanded
New York City is filled with construction sites and sidewalk sheds that are illuminated 24/7 with inefficient incandescent light bulbs. Typically, sidewalk shed lights remain on all the time, even when daylight is sufficient. Leaving non-essential lighting on while job sites are closed is wasteful and does not enhance public or worker safety – work on a construction site after 6:00 pm requires a special City permit and thus is not the norm.

These wasteful practices are primarily the result of outdated code provisions. For example, the Building code does not mandate minimum energy efficiency measures for construction lighting and power, as it does for permanent installations. Furthermore, it does not differentiate between lighting requirements for emergency access versus general construction activities.

This proposal would create a minimum efficiency standard for construction lighting and require that non-safety lighting on a construction site be turned off after-hours. The fluorescent lamps specified in this proposal use 65 to 75 percent less energy than incandescent lamps to provide the same amount of light and can last up to 10 times longer.

The proposal would also update outdated illumination standards for temporary walkways, foot bridges, and sidewalk sheds. Among other changes, these updates would allow sidewalk sheds to use photocell sensors to turn off artifical lighting when there is sufficient illumination from daylight.

Implementing this proposal would save energy and money with no impact on safety.

Environmental & Health Benefits
This proposal will save substantial energy, improving air quality and reducing greenhouse gas emissions.

Even if existing lighting standards remain in place, just switching off construction lighting after-hours and using photocell sensors in sidewalk sheds would generate enormous energy savings. Turning off lights 12 hours per day (including weekends) at construction could save 11,680 MWh/year of electricity.[i] Controlling sidewalk shed lighting with photocell sensors could save approximately 7,712 MWh/year of electricity and reduce peak electric demand on weekdays by 1.8 MW.[ii]

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score 2.

This proposal was found to have no significant health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

For some buildings this proposal will result in no increase of capital costs and for others an increase of up to 0.03%. It was thus categorized as incurring no to a low capital cost increment.

Savings to Building Owner:

For a 100,000 SF building with a 10,000 SF floor plate that takes 30 months to construct, turning general construction lighting off after hours would save the building owner approximately $77,000 if the building has incandescent construction lighting and approximately $18,000 if the building uses CFL's for construction lighting. This assumes that 75% of the construction lighting is general construction lighting and work takes place 12 hours a day, 5 days a week. Reducing lamps' operation hours also extends their life, thus saving the building owner approximately $4500 of replacement incandescent bulbs (6 fewer bulb changes at $1.67 per bulb) or approximately $4500 of CFL lamps (2 fewer bulb changes at $5 per bulb). These cost savings do not include potential labor savings in avoided bulb replacement.

For Foot Bridges, Temporary Walkways and Sidewalk Sheds, energy savings will range from 9.7 to 11.1 watts per linear foot of sidewalk and maintenance will be reduced by 80% or more because the higher efficacy lamps also have a longer life and require less maintenance. Maintenance savings are particularly significant for these applications, because burned out lamps are costly to replace and threaten public safety.

Savings to NYC:

The direct energy savings for the measures proposed herein would accrue to the owner, but New York's utility system would also benefit by the corresponding reduction in electricity demand. Switching lights off 12 hours/day during the week and keeping them off throughout the weekend would save 15,000 MWh/year of electricity. This assumes 6 million square feet of building construction illuminated by 100W incandescent bulbs spaced 15′ X 15′ on center. The savings are less, but still significant, if all construction lighting is 23W CFL spaced 15' X 15' on center: 2687 MWh/year.

Controlling sidewalk shed lighting with photocells would save 7,712 Mwh/year of electricity and reduce peak electric demand on weekdays by 1.8 Mw. This assumes 80% of NYC's estimated 25 miles of sidewalk shed have access to daylight and are currently illuminated by 200W incandescent fixtures spaced 15′ on center.

Precedents

The strongest precedent for replacing current code language that specifies illumination in terms of incandescent bulb wattage is the national energy bill George Bush signed into law in 2007. The bill banned manufacturing of 100 watt incandescent bulbs in 2012 and incandescent 40 watt bulbs in 2014.

OSHA's Standards for the Construction Industry(located under Subpart D, Occupational Health and Environmental Controls) are as follows: 3 foot-candles for "general construction areas, concrete placement, excavation and waste areas, access ways, active storage areas, loading platforms, refueling and field maintenance areas" and 5 foot-candles for other "general construction areas."[iii]

LEED

While this proposal is consistent with the goals of LEED to reduce energy waste and reduce light pollution, LEED does not have any prerequisites or credits dealing with energy use during construction or temporary lighting.

Implementation & Market Availability

The technology and equipment promoted by this proposal are readily available: CFLs fit existing fixtures commonly used in construction lighting and fluorescent lamps specifically designed for rough duty are available. Photocell sensors are widely used for other applications.

Unless the industry begins making left handed screw compact fluorescent lamps, electrical contractors will need to replace the lamp sockets on their temporary light stringers to accept conventional right-handed screw lamps. Conventional sockets are readily available.

Notes

Safety of Photocells:

The committee discussed whether there are any safety concerns with using photocell sensors in sidewalk sheds or other applications.

The issues with doing so are the same as for occupancy sensors, which have been used for years around the country in egress paths. The NFPA 101 2006 Life Safety Code, for example, permits the use of lighting controls (specifically motion

sensors). NFPA addresses safety concerns by requiring occupancy sensors in egress paths to "fail on," meaning that if the occupancy sensor is no longer working, the lights will come on as the default position.

The principles for photocell sensors are similar. Photocell sensors will only shut lights off if the sensor detects the level of ambient light programmed by the installer. For example, an installer can set a photocell sensor to keep light on until 60 footcandles are detected, even if an area is only required to have 30 footcandles of illumination. This ensures the electric lights controlled by the photocell can be turned off without dropping the illumination level below the design level and that the area is never darker than intended. Many photocell sensors are already designed to "fail on" so that if a photocell stops working for some reason, lights will come on and stay on until the photocell is repaired or replaced.

Requiring Photocell Sensors for Sidewalk Sheds:

The Committee discussed whether to recommend mandating their use in sidewalk sheds. Since sidewalk sheds are located throughout the city, there may be substantial energy savings from requiring this practice.

In particular, the Committee considered including the following language in Subdivision 2 of Section 3307.6.5:

> Any lamp located within 15 feet of an open edge of a sidewalk shed shall be controlled by a photocell sensor that shall turn off the lamp when daylight provides a minimum illumination level of 20 foot-candles measured at the ground at the middle of the sidewalk shed.

However, the Committee was unable to identify any locations in NYC that had used photocells in this manner. For these reasons, the Committee opted to leave photocells as an option in this section and will encourage owners and contractors to pilot this sensor application.

Mercury in Fluorescent Lamps:

Unlike incandescent lamps, fluorescent lamps contain mercury, which can be released if the lamps are broken in uncontrolled circumstances. However, the quantity of mercury released poses relatively little risk to an adult. In the event of a breakage, fluorescent lamps should be cleaned up with a HEPA vacuum or damp cloth to contain the mercury. Further, the primary source of mercury emissions in the U.S. is from electricity generation so using fluorescent lamps instead of incandescent will reduce overall mercury exposure levels.[iv] At the end of their useful life, fluorescent lamps should be recycled to recapture the mercury.

ENDNOTES:

[i] Assumes 6 million square feet of building construction is illuminated by 100W incandescent bulbs spaced 15′ X 15′ on center.

[ii] Assumes that 80% of New York City's estimated 25 miles of sidewalk shed have access to daylight and are currently illuminated by 200W incandescent fixtures spaced 15′ on center.

[iii] 29 C.F.R. § 1926.56, available at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10630.

[iv] ENERGY STAR®, FREQUENTLY ASKED QUESTIONS: INFORMATION ON COMPACT FLUORESCENT LIGHT BULBS (CFLS) AND MERCURY, 1 (July 2008), http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf.

EE 17:
Use Outdoor Air for Cooling

ANSI/ASHRAE/IESNA Standard 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:

Buildings can be cooled using outside air when temperatures are sufficiently low. ASHRAE 90.1 does not require this energy-efficient practice in New York City's climate zone.

Recommendation:
Require that new HVAC systems be capable of utilizing outside air for cooling, when temperatures permit.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code:

1. Amend Table 6.5.1 of Section 6.5.1 as follows:

6.5.1 Economizers.

Table 6.5.1 Minimum System Size for Which an Economizer is Required

Climate Zones	Cooling Capacity for Which an Economizer is Required
1a, 1b, 2a, 3a [~~, 4a~~]	No economizer requirement
4a, 2b, 5a, 6a, 7, 8	>= 135,000 Btu/h
3b, 3c, 4b, 4c, 5b, 5c, 6b	>= 65,000 Btu/h

Supporting Information

Issue Expanded
It is often necessary to cool the interior of a building even though the outdoor temperature is at or below a comfortable level. This occurs because of internal loads, such as computers and lights that emit heat into the interior of the structure. A simple air conditioning system will simply continue to operate under these circumstances, using electricity to power in its compressor. An economizer is a collection of vents and controls that allows the system to substitute cool outdoor air for recirculated indoor air that has been cooled in the air conditioner. Since the economizer relies only on fans and permits the compressor to be shut down (or its use greatly reduced), the use of electric energy is lowered substantially.

The economizer consists of some additional equipment, but is relatively minor in the context of a whole system. The payback period for the additional cost is very short, hence the use of economizers in most applications independent of Code requirements. The reason for adding back this requirement to the Energy Code is simply catch the rare situation whereby a designer may not be informed about the use of this technology. For this reason, we have moved the New York City climate zone (4a) from the group that does not require economizers to the group that require economizers on relatively large systems.

Environmental & Health Benefits
Reduced electric energy use will result in reduced emissions of both Clean Air Act pollutants (particulates, nitrous oxides and sulfur oxides) and carbon dioxide, lowering the carbon footprint.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have no significant positive health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.01% to 0.02%, depending on building type. It was thus categorized as incurring no to a low capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years depending on the building type.

Precedents
Economizers have long been required in New York City, under previous versions of ASHRAE 90.1; this measure will merely adjust the regions for which they are required as described above.

LEED
The use of economizers contributes to energy efficiency and to associated LEED points.

Implementation and Market Availability
There are no known implementation issues for this proposal. Economizers are readily available and in widespread use.

EE 18:
USE WASTE HEAT FROM CONED

ANSI/ASHRAE/IES 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Energy is wasted due to the dumping of hot condensate from purchased Con Edison steam. In addition, substantial potable water is wasted cooling the condensate to 150 degrees F. before it is dumped in the sewer.

Recommendation:
Require all new or reconstructed heating systems that use Con Edison's steam to maximize the recovery of heat from steam condensate. Doing so will lead to significant savings of energy and water.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IES 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code

1. Amend Section 6.8 as follows:

6.8 Minimum Equipment Efficiency [Tables]

6.8.1 Minimum Efficiency Requirement Listed Equipment Tables – Standard Rating and Operating Conditions

(Tables 6.8.1A - 6.8.1J are unchanged.)

6.8.3 Minimum Pipe Insulation Thickness Table

(Table 6.8.3 is unchanged.)

6.8.4 Steam

6.8.4.1 General. Buildings utilizing district steam service shall either (i) incorporate the technologies listed below in sections 6.8.4.1.1 and 6.8.4.1.2, or (ii) meet the alternative performance standard described in subsection 6.8.4.1.3.

6.8.4.1.1 Service Hot Water. Buildings utilizing district steam for space heating or cooling shall incorporate heat exchangers utilizing the latent heat in the condensate to heat or preheat service hot water used in the building, in accordance with standards for such equipment established by the department.

6.8.4.1.2 Hot Water Space Heat. Buildings utilizing district steam for space heating and for which the design service hot water load will not lower the temperature of the condensate from all steam utilized to 100°F at winter design point conditions shall incorporate hydronic (hot water) radiation circulating the condensate through a portion of the building sufficient to bring the temperature of the condensate down to 140°F. The condensate shall then supply the service hot water heat exchanger required under subsection 6.8.4.2. 6.8.4.1.1.

6.8.4.1.1.3 Alternate Performance Standard. In lieu of the technologies listed in subsections 6.8.4.1.1 and 6.8.4.1.2, a building may utilize any design that will meet thermal loads within or contiguous to the building and will remove 100 Btus per pound of steam utilized for space heating from the condensate.

Supporting Information

Issue – Expanded
Buildings that use Con Edison district steam for space heat or cooling commonly dump the resulting steam condensate into the sewer. Because of the danger of damage to the sewer system and sanitary requirements, the condensate, which is normally at 212°F, must be cooled to 150°F before it can be released, and this is normally done by adding cold, potable water to temper it. This common practice is wasteful in three different ways: (1) the thermal energy available from the hot condensate is discarded rather than used; (2) potable water is wasted to cool the condensate; and (3) the useful but non-potable condensate is discarded when it could displace potable water for irrigation, sidewalk cleaning, or wet cooling tower use.

This proposal would require buildings to reclaim the useful heat from hot condensate for heating, hot water or other purposes. Using the thermal energy in condensate would also eliminate the waste of potable water, since it would no longer be necessary to cool the condensate for disposal or reuse. WE 7 Reuse Water from ConEd Steam would require the reuse of condensate, addressing the third and final issue noted above.

Environmental & Health Benefits
A 100 unit residential building might use 7,500 million Btu of steam in a year. Complying with the provisions in this proposal will save about 550 million Btu of steam and eliminate the need for over 700,000 gallons of potable water that would have been used to temper the condensate before disposal in the sewer.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.01%. It was thus categorized as incurring a low capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years.

Precedents
There are no known precedents for this proposal. Many other district steam systems return the condensate to the plant; Con Edison does not.

LEED
Current LEED prerequisites for Minimum Energy Performance under the Energy & Atmosphere sections of almost all of the rating systems require that the scope of work complies with ANSI/ASHRAE/IESNA standard 90.1-2004. This proposed code requires compliance with measures exceeding ASHRAE 90.1-2007. Since LEED 2009 prerequisites for Minimum Energy Performance also reference ASHRAE 90.1-2007, the measures outlined in this proposal will be correlated with the next generation of LEED.

However, LEED qualifies that a more stringent local code requirement becomes the LEED prerequisite requirement as well. Therefore, this proposal will change the baseline criteria that registered projects must meet for LEED certification. Code revisions under this proposal do not apply to the LEED for Homes or the LEED for Existing Buildings rating systems, which reference Energy Star criteria. For existing buildings, LEED EB provides an alternate calculation method. LEED does not address water savings accomplished through reclaiming heat from steam condensate. However, the subsequent reuse of condensate water is addressed under LEED Water Efficiency credits.

Implementation & Market Availability
There are no known implementation issues for this proposal. Con Edison recommends condensate heat recovery as a practice, and has useful information at its website.[1]

Notes
This requirement may not eliminate the need for any tempering water, since there are few thermal loads suitable to temper the steam used for absorption chillers once the service hot water loads have been met. It should be practical to make use of condensate from absorption chillers as wet cooling tower make-up water, but because precedents and examples are not available, this is not included as a requirement.
This requirement will only affect new or reconstructed buildings.

ENDNOTES:

[1] Con Edison, Knowledge Center: Operational Tips, http://www.coned.com/steam/kc_cri.asp (last visited Jan. 28, 2010).

EE 19:
INSULATE PIPES EXPOSED DURING CONSTRUCTION

New York City Building Code
Proposal developed by the Energy & Ventilation Committee.

Summary

Issue:
Pipe insulation is a cost-effective measure to improve energy efficiency. While it is required for new construction, most pipes in existing buildings lack this beneficial insulation.

Recommendation:
Require that all pipes exposed during renovations be insulated.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code

1. Add a new Section 1303 as follows:

SECTION BC 1303
INSULATION OF EXISTING PIPING DURING CONSTRUCTION

1303.1 Piping insulation during construction. Except as noted below, any existing pipe for water distribution, heating, or cooling concealed in a wall, floor, ceiling, or chase that is exposed in the course of repair or renovation shall be insulated to the levels specified in ANSI/ASHRAE/IESNA 90.1 (2007), Table 6.8.3. This requirement shall apply to the entire length of pipe between the top and bottom floor plates of the floor on which the pipe is exposed, and to any further length of pipe that can be directly accessed through the openings exposing the pipe, without removal of existing masonry or other permanent building structures.

Exception. Any pipe used for drainage, venting, or fire suppression or that must be exposed in order to function as intended, including pipes that function as part of a heat delivery system.

Supporting Information

Issue – Expanded
Water pipes of all sorts lack insulation in most New York City buildings constructed before the advent of energy codes. In the case of steam and hot water pipes used for heating, this results in a lack of control and overheating, since the heat is emanating from walls or exposed pipes and cannot be turned off with radiator valves.

Domestic hot water (DHW) pipes, similarly uninsulated, often run in proximity to domestic cold water supply pipes, heating the cold water and draining heat from the hot water. The latter is normally replenished by the recirculation system that ensures adequate DHW at taps far from the boiler. Even if the DHW pipes are isolated in a chase, they lose substantial heat to the surrounding walls, which is either uncontrolled heat during heating season or unwanted heat that must be removed by air conditioners during cooling season. Also, insulating hot water pipes can raise water temperature at the tap by 2 to 4ºF," allowing for a lower water temperature setting at the boiler.

Finally, cold water pipes, either for domestic cold water or, far less often, for air conditioning, must be insulated to prevent the accumulation of condensate from natural humidity ("sweating") during warm weather.

Insulating pipes that are embedded in walls is an expensive and disruptive task, and is normally not worth doing on the basis of expected savings if the walls must be opened. However, if the walls are open for other reasons, the cost of insulation is so low that it is currently installed by many responsible contractors and building operators. This proposal seeks to make this practice universal.

Environmental & Health Benefits

Benefits include fuel saved by not wasting heat in heating and DHW systems and associated reduced air pollution. Also, elimination of condensation on cold pipes reduces moisture in walls, inhibiting the growth of molds and other pests.

This was found to have a low, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.2% to 1.4%, depending on building type. It was thus categorized as incurring a medium to higher capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years.

Precedents

There are no known precedents for this proposal. However, insulation guidelines are addressed in ANSI/ASHRAE/IESNA Standard 90.1. ASHRAE has also issued Advanced Energy Guidelines for Small Office Buildings.[1]

See also International Plumbing Code (IPC) and International Building Code (IBC); IBC section 719, Thermal and Sound-Insulating Materials, has several sections that deal with insulating materials.

LEED

For an existing building filing under the LEED EB rating system, there are no LEED credits directly affiliated with this proposal. LEED EB references Energy Star® criteria. However, if the building type is not addressed by ENERGY STAR®, the team may provide calculations showing equivalent EPA ENERGY STAR® rating for the building calculated using the alternate calculation method described in the LEED for Existing Buildings Reference Guide over the performance period. Using this method, the proposed code revision may positively impact compliance with LEED.

The LEED for Homes rating system references Energy Star® criteria and does not provide an alternate calculation method. However, this proposal will assist in achieving LEED for Homes EA cr. 5, which requires insulation around distribution pipes in unconditioned spaces as part of a non-ducted HVAC system. Additionally, LEED for Homes EA cr. 7.2 requires that all domestic hot water piping shall be insulated.

If an existing building is seeking LEED certification under any another rating system, the ASHRAE 90.1 20007 standard will be directly applicable for LEED 2009. In this case, the proposal will directly assist in meeting Energy & Atmosphere prerequisites, and EA credits for Optimizing Energy Performance.

Implementation & Market Availability

There are no known implementation issues for this proposal. Insulation materials are readily available.

ENDNOTES:

[1] American Society Of Heating, Refrigerating And Air Conditioning Engineers, Advanced Energy Design Guide For Small Office Buildings (2004), http://www.energycodes.gov/rc/AEDG_SmallOfficeBuildings.pdf.

EE 20:
CLARIFY STANDARDS FOR EQUIPMENT VENTING

New York City Fuel Gas Code
Proposal developed by the Energy & Ventilation Committee.

Summary

Issue:
Venting boilers to the sidewalls of buildings encourages the use of efficient appliances by reducing costs. However, sidewall venting is often rejected by building inspectors for reasons that are not clearly delineated by any agency guidelines. This creates an uncertainty that discourages contractors from installing efficient equipment.

Recommendation:
Establish physical criteria that clarify when sidewall venting is allowable and ensure these criteria are consistent with national practices.

Proposed Legislation, Rule or Study

Amendments to New York City Fuel Gas Code:

1. Amend subdivision 2 of section 503.8 as follows:

> 2. Where permitted, through-the-wall vents for Category II and IV appliances and non-categorized condensing appliances shall not terminate over public walkways or over an area where condensate or vapor could create a nuisance or hazard, as delineated by physical criteria established by the department, or could be detrimental to the operation of regulators, relief valves or other equipment. Where local experience indicates that condensate is a problem with Category I and III appliances, this provision shall also apply.

Supporting Information

Issues – Expanded
Condensing boilers and other condensing gas-fired equipment are substantially more efficient than traditional, non-condensing designs. They have the added advantage that the exhaust is cooled to temperatures where it is not dangerous to the touch. Further, because condensing equipment is intrinsically clean burning, the exhaust is not noxious. Accordingly, there has been a dramatic increase in the availability of equipment designed to exhaust directly through a wall of the building, rather than using a stack reaching up to the roof.

One nuisance that can result from this sidewall venting is that the exhaust is saturated with water vapor, which can condense and drip. So, for example, if care is not taken, a drip in winter could lead to a trickle of water and then a layer of ice on a sidewalk. Clearly, care and discretion should be brought to bear on any installation. However, these concerns have led to a situation where the use of these efficient devices is fraught with risk for the installer or owner.

Sidewall venting is legal in New York City but is subject to constraints under the New York City Fuel Gas Code. As written, the Code gives great discretion to the building inspector to determine whether a particular installation is acceptable or not, and installers report many instances where inspectors have prohibited an installation for unclear reasons, or have even refused to approve an installation after it was installed in apparent accord with Code requirements. This has led to a situation where installers are reluctant to install this efficient equipment because of potential problems later. This proposal will clarify the conditions under which this equipment can be installed, lessening the uncertainty and encouraging its use.

Environmental & Health Benefits
Increased utilization of condensing equipment will result in decreased fuel use and lowered emissions of both greenhouse gases and Clean Air Act pollutants.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
This proposal is to clarify code requirements, and will therefore have no direct impact on construction costs.

Precedents
Several national codes have implemented installation and safety guidelines for sidewall ventilation of HVAC equipment in response to the growing number of HVAC products that have been designed for sidewall venting. NFPA 54 Section 12.9 and NFGC Section 12.9 provide standards for through-the-wall ventilation.[i]

LEED
This will make achievement of LEED Energy and Atmosphere points easier.

Implementation & Market Availability
There are no implementation issues for this proposal.

ENDNOTES:

[i] HVAC Web Connection, Venting Today: A Complex Subject, http://www.hvacwebconnection.com/hvacarticles/ventingtoday1.htm (last visited Jan. 28, 2010).

EE 21:
MODERNIZE BOILER REGULATIONS

Study
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
NYC's boiler regulations were written in 1973, and are based on now outmoded technology.

Recommendation:
A dedicated task force -- including boiler experts, DEP Air Engineering Staff, and members of the Green Codes Task Force -- should review existing boiler regulations and propose revisions.

Proposed Legislation, Rule or Study

Study on Local law 49/71 and DEP Rules Regarding Fuel Oil Burning Equipment.

By Jan. 1, 2011, the Department of Environmental Protection shall convene a dedicated task force, including boiler experts from city government, NYPA and the private sector, DEP Air Engineering Staff, and members of the Green Codes Task Force, to update the city's regulatory language for boiler regulations and improved combustion efficiency, along with supporting materials. The updated regulations shall be completed by Jan. 1, 2012, with rulemaking completed by June 1, 2012.

Some preliminary ideas follow:

1. Eliminate the need for separate DEP Air Resources approval of equipment. The buildings department as of July 2008 has eliminated the MEA requirement for burners. The only requirement should be that the burner is listed with a NRTL (Nationally Recognized Testing Laboratory, e.g. UL, ETL, CSA, etc.)

2 Provide standard minimum performance criteria. Suggested standards: Minimum 81% boiler/ burner efficiency with zero trace smoke, less than 100 ppm CO and 8% or less O2. This regulation should apply to both oil and gas burners.

3. Ban the installation of new oil burners that do not provide 100% of required combustion air. This ban should become effective within two years after passage of new DEP regulations. There should be no exceptions.

4. Eliminate inconsistencies in the DEP regulations (e.g. B8(b) allows #2 smoke for burner acceptance but smoke alarm regulations state a maximum of #1 smoke).

5. Firing rate controls: There should be phased-in regulations of burner firing rate capability and firing rate controls for all burners, both gas and oil. Suggested standards: Burners 450,000 Btuh can be on-off firing. Burners above 450,000 and under 2,000,000 low-high-low with a minimum 1.5 to 1 turndown ratio. 2,000,000 to 2,800,000 low-high-low with a minimum 2 to 1 turndown ratio. Above 2,800,000 the turndown ratio should be at least 3 to 1 using either step modulation or full modulation.

6. Draft regulations: Current DEP regulations are extremely specific regarding minimum draft for a C of O performance test. They say little or nothing regarding draft control itself. Proposed revisions should include requirements for adequate draft controls based upon chimney height or set draft standards. For example, all combustion equipment must provide adequate draft control to maintain draft between -0.02" w.c and -0.10" w.c with outside air between 0 and 94 degrees Fahrenheit.

7. Reevaluate the need for the chimney receptor regulations in view of proposed combustion performance improvement regulations.

8. Eliminate the prohibition against the use of parallel firing rate lead-lag controls.

9. Reevaluate the threshold for the triennial boiler inspection. Possibly it would be advantageous to lower the size threshold to 1.5 or 2MM Btu/hr to include additional boilers and or boilers firing #2 oil or natural gas.

Supporting Information

Issue- Expanded
The current New York City Department of Environmental Protection (DEP) fuel oil combustion code was written in 1973 and has not been updated since. It was designed with regard to horizontal rotary burners and other types of burners that were not designed to supply the air required for proper combustion by themselves. Rather, these devices relied upon chimney draft for the air necessary to achieve complete combustion. Such burners can no longer be installed in NYC. All oil burners currently installed do provide 100% of the air required for combustion and consequently this code is obsolete for the vast majority of installations. The current code also does not apply to burners smaller than 20 gph and is unevenly enforced. A larger set of other accumulated shortcomings is enumerated above in the formal proposal.

Amending the existing regulation to bring the combustion code up to date to address current technology, and expanding the application of the code to smaller boilers could achieve very significant energy savings.

Environmental & Health Benefits
Implementation of a revised set of regulations will result in reduced soot emissions (2.5 micron) as well as energy savings from higher boiler/burner combustion efficiency. It will also result in lower citywide emissions of greenhouse gasses and of Clean Air Act pollutants due to better combustion efficiency.

This proposal was found to have a positive, indirect environmental impact.

This proposal was found to have a positive indirect health impact.

Cost & Savings
This proposal is for a task force, which will have no direct impact on costs.

Precedents
Enabling law covered in section 204 of Title 4 of NYS labor law governing boilers And NYC local law 62/91.

LEED
This proposal will have no direct impact on LEED credits

Implementation & Market Availability
The resultant changes will only include off the shelf technologies that have not necessarily been previously encouraged in NYC.

Notes
Potential energy savings from all boilers in NYC of 8 to 15% per annum depending upon an existing building's combustion efficiency, combustion control options and heating plant application (heating only or heating/DHW combined.)

EE 22
REDUCE LIGHTING POWER REQUIREMENTS FOR OFFICES

Administrative Code of the City of New York (New York City Amendments to National Electrical Code)
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
An outmoded provision of the Electrical Code mandates that spaces have capacity to deliver three times the power for lighting as is allowed under the Energy Code. This increases cooling load requirements, necessitating oversized, expensive HVAC systems.

Recommendation
Reduce the required lighting power capacity to better align with the Energy Code.

Proposed Legislation, Rule or Study

Amendments to Section 220.12 of Section 27-3025 of the Administrative Code of the City of New York (New York City Amendments to the National Electrical Code):

1. Amend Table 220.12 as follows:

Table 220.12 General Lighting Loads by Occupancy

Type of Occupancy	Unit Load	
	Volt-Ampere per Square Meter	Volt- Ampere per Square Foot
Armories and auditoriums	11	1
Banks	(39[b]) – **14.4** [b]	(3.5b [b])- **1.3** [b]
Barber shops and beauty parlors	33	3
Churches	11	1
Clubs	22	2
Court rooms	22	2
Dwelling units [(a)]	33	3
Garages – commercial (storage)	6	0.5
Hospitals	22	2

Hotels and motels, including apartment houses without provision for cooking by tenants [a]	22	2
Industrial commercial (loft) buildings	22	2
Lodge rooms	17	1.5
Office buildings	(39[b]) – **14.4** [b]	(3.5b [b])- **1.3** [b]

(a) Refer to 220.14(J) in NYC Electrical Code

(b) Refer to 220.14(K) in NYC Electrical Code

Supporting Information

Issue - Expanded
The electrical code prescribes an excessively high wattage per square foot (i.e. power density) – one that is roughly three times the wattage the energy code even *allows* -- to be used in calculating the power requirements for the lighting in commercial and banking space. This overestimation has several negative impacts. Since the electrical load within a space is one of the inputs used in sizing cooling equipment, this provision leads to oversized cooling systems. Oversized cooling systems are expensive to purchase and install, wasting money that could have been used to make the building more efficient; also, often these systems are less efficient when they run on part loads, wasting energy over the long haul. Finally, this minimal code requirement helps create an impression that high power densities are in fact required, causing prudent commercial tenants to think they should ask for even more. Thus, commercial tenants in NYC will commonly ask for 6 to 8 watts per square foot (for lighting and receptacle power) when they will actually use no more than 2.5.

These electrical requirements date from historic conditions that no longer pertain. In the 1980s-1990s commercial office tenants experienced significant hardship in obtaining adequate power from landlords during the introduction of PC's and laser printers to the workplace. Since that time, PC's have become more efficient, particularly due to the increasing use of efficient, flat screen, LCD monitors and through the wide-spread use of laptop computers. In addition, the quality and efficacy of lighting systems have improved dramatically over the past thirty years, with the result that the lighting power density allowed by the 2004 version of ASHRAE is roughly half that allowed in the 1980 version. With the introduction of LED lighting and continual improvements in fluorescent technology, it is clear that power requirements for lighting systems will continue to decrease.

The electrical code has not kept pace with these trends, still prescribing a very a high electrical power density to be used in calculating lighting loads. Thus, it is proposed that the minimum lighting power density prescribed in the electrical code be based on the maximum lighting power density being mandated by the energy code, with a reasonable safety and capacity factor to ensure the safe operation of these systems. ASHRAE 90.1 2007 prescribes a maximum power density of 1w/gsf or approximately 1.1 VA/gsf for lighting in office buildings. The proposed electrical power density of 1.3 VA/gsf for office lighting provides a minimum safety factor and capacity margin of 20%.

Environmental & Health Benefits
The ability to down-size the cooling system will certainly result in lower capital costs, and may produce demand and/or energy savings, depending upon the equipment installed. Depending on individual practice, demand for copper in wiring may also be reduced.

This proposal was determined to have a low environmental impact per building and to impact a low number of buildings. It was thus given an environmental score of 1.

This proposal was determined to have no direct or indirect health impact.

Cost & Savings
This proposal will not cause any increase in capital costs, since it will permit downsizing of equipment. It may result in cost decreases, but on a project-by-project basis, which cannot be projected at a useful level of confidence.

Precedents
There are no known precedents for this proposal.

LEED
There are no LEED credits affiliated with this proposal.

Implementation and Market Availability
There are no known implementation issues for this proposal.

EE 23:
REDUCE CO2 EMISSIONS DUE TO CONCRETE

New York City Building Code and Administrative Code
Proposal developed by the Materials & VOCs Committee

Summary

Issue:
Manufacturing cement, a significant component of concrete, requires large amounts of energy that produce significant quantities of CO2. Cement can easily be replaced in concrete with less energy-intensive materials.

Recommendation:
Limit the amount of cement permitted in concrete, substituting other cementitious materials, such as readily available industrial by-products.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Section 1905.2 as follows:

1905.2 Selection of concrete proportions. Concrete proportions shall be determined in accordance with the provisions of Sections 1905.2.1 through [1905.2.3.] 1905.2.4.

2. Add a new Section 1905.2.4 as follows:

1905.2.4 Maximum cement content. All concrete mixes requiring a compressive strength of 14,000 psi or less shall contain a maximum of 400 lbs. of Portland cement per cubic yard of concrete.

Amendments to the Administrative Code of the City of New York:

1. Add a new Section 6-308.1 as follows:

§ 6-308.1 Maximum cement content.

a. No concrete mixes requiring a compressive strength of 14,000 psi or less purchased by any agency shall contain more than four hundred pounds of Portland cement per cubic yard of concrete.

b. The director shall conduct an inter-agency study on the availability and cost of pre-cast concrete units purchased by agencies that could meet the requirements of Portland cement content as set forth in subdivision (a). No later than July 1, 2011, the director shall promulgate rules seeking to minimize the content of Portland cement in pre-cast concrete units purchased by agencies, while considering commercial availability, suitability of use and comparative cost.

c. The department of transportation shall promulgate rules no later than July 1, 2011 that incorporate the standards for Portland cement content as set forth in subdivision (a) in all specifications for sidewalk construction.

Supporting Information

Issue – Expanded
Cement manufacturing is responsible for 3.4-5% of global carbon emissions and is the largest source of U.S. emissions after fossil fuel consumption.[1] [2] [3] The primary source of carbon emissions from cement production is the use of coal and petroleum to fuel kilns. The production one ton of Portland cement results in the emission of approximately one ton of CO_2.

All concrete can be made with reduced amounts of Portland cement by using supplementary cementitious materials. The materials are typically fly ash, ground granulated blast-furnace slag (GGBFS) and silica fume, all of which are by-products of industrial processes that are typically placed in landfills. Since they are waste products, the use of supplementary cementitious materials directly offsets the CO_2 that would otherwise be released in cement production.

Fly ash can replace up to 50% of Portland cement in concrete mixtures, and the use of 25% fly ash is already common. GGBFS commonly replaces up to 40% of cement, and has replaced up to 80%.[4] Silica fume can replace 5% to 7% of cement. In addition to reducing CO_2 emissions, fly ash and blast furnace slag increase the workability of concrete, which aids finishing operations, and reduce water demand. Supplementary cementitious materials also reduce the permeability of concrete, making them a necessary ingredient in concrete that has reinforcing steel or is subjected to chlorides, such parking structures, bridge decks, road pavements and marine structures.

Environmental & Health Benefits
As previously discussed, replacing Portland cement with fly ash reduces greenhouse gas emissions. Each cubic yard of concrete produced in New York City is estimated to include 650 lbs of cement, as required under the old building code. By capping cement content at 400 lbs by 2010, this proposal will reduce concrete usage by a minimum of 250 lbs per cubic yard of cement used. With NYC using over 2 million cubic yards of concrete annually, this proposal will result in an annual reduction of 250,000 tons of CO2.

According to New York City's 2009 Inventory of Greenhouse Gas Emissions, the city's CO2 emissions were 53.3 million metric tons in 2008. Therefore, this proposal will reduce NYC's CO2 emissions by 0.5% in 2010. By way of comparison, converting the city's taxi and black car fleet to hybrids is estimated to reduce the city's CO2 emissions by 0.43%.

This proposal was found to have a high, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 3.

This proposal was found to have no significant positive health impact.

Cost & Savings
This proposal is not expected to have any significant impact on capital costs.

Precedents
Although no known precedents exist for limiting the amount of Portland cement used in concrete mixtures, several municipalities allow for the substitution of supplementary cementitious materials for Portland cement.. For example, California has adopted the use of cementitious alternatives into the state's green building standards, including the use of fly ash, slag cement up to 70% replacement levels, and silica fume up to 7% replacement levels.[5]

The Port Authority of NY & NJ has substituted large quantities of supplementary cementitious materials for Portland cement in concrete mix proportions used at its facilities for various applications. These mix proportions produced concrete with high compressive strength and excellent durability. Some examples of these concrete mix proportions are given below:

Portland Cement (Lbs.)	Supplementary Cementitious Materials (Lbs.)	Compressive Strength (PSI)
80	320	5000
340	230	6500
350	300	8000
300	496	12000
300	580	14000

In winter weather, cold temperatures, to increase strength gain an admixture, strength accelerator can be added to the concrete mix.

LEED
LEED credits are available for the use of alternative cementitious materials that are derived from industrial by-products.

These credits include: LEED NC- MR cr.4.1 & 4.2 Recycled Content; LEED CI-MR cr. 4.1 & 4.2 Recycled content; LEED EB-MR cr.2 Optimize use of Alternative Materials; LEED for Schools MR cr.4.1 & 4.2 Recycled Content; LEED for Homes MR cr. 2 Environmentally Preferable Products; and credits under the various pilot programs.

Implementation & Market Availability
There are no known implementation issues for this proposal. Alternative cementitious materials are readily available. There are enormous qualities of fly ash available and presently ample quantities of GGBFS

It may be necessary to bring some concrete suppliers and engineers up to date with the current concrete technology in the use of supplementary cementitious materials. The Concrete Industry Board of NYC is capable and willing to perform this function.

ENDNOTES:

[1] U.S. ENERGY INFORMATION ADMINISTRATION, EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2007 (2008), ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057308.pdf.

[2] Ernst Worrell, et al., Carbon Dioxide Emissions from the Global Cement Industry, 26 ANN. REV. OF ENERGY & ENVT., 306 (2001).

[3] L.J. HANLE, ET AL., U.S. EPA AND ICF CONSULTING, CO2 EMISSIONS PROFILE OF THE U.S. CEMENT INDUSTRY (2004), http://www.epa.gov/ttnchie1/conference/ei13/ghg/hanle.pdf.

[4] Concrete Thinking for a Sustainable World, Benefits: Recycled Content, http://www.concretethinker.com/solutions/Recycled-Content.aspx (last visited Apr. 6, 2009).

[5] CAL. CODE, Tit. 24 § pt. 11 § 804, 36 (2008), available at http://www.documents.dgs.ca.gov.

EE 24
REDUCE CO2 EMISSIONS FROM SPECIALIZED CONCRETE

New York City Building Code
Proposal developed by the Materials & VOCs Committee

Summary

Issue:
The NYC Building Codes currently limits the amount of recycled material that can be used in concrete exposed to de-icing chemicals.

Recommendation:
Increase the maximum percentage of recycled material that be used in concrete.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Table 1904.2.3 as follows:

TABLE 1904.2.3
REQUIREMENTS FOR CONCRETE EXPOSED TO DE-ICING CHEMICALS

CEMENTITIOUS MATERIALS	MAXIMUM PERCENT OF TOTAL CEMENTITIOUS MATERIALS BY WEIGHT[a,b]
Fly ash or other pozzolans conforming to ASTM C 618	[25] 30
Slag conforming to ASTM C 989	50
Silica fume conforming to ASTM C 1240	10
Total of fly ash or other pozzolans, slag and silica fume	50[c]
Total of fly ash or other pozzolans and silica fume	35[c]

Supporting Information

Issue – Expanded
Cement manufacturing is responsible for 3.4%-5% of global carbon emissions and is the largest source of U.S. emissions after fossil fuel consumption.[1] The primary source of carbon emissions from cement production is the use of coal and petroleum to fuel kilns. The production of one ton of Portland cement results in the emission of approximately one ton of CO_2.

All concrete, including simple flat work and concrete with high compressive strengths, can be made with reduced amounts of Portland cement by using supplementary cementitious materials. These materials are typically fly ash, ground granulated blast-furnace slag (GGBFS) and silica fume, all of which are by-products of industrial processes that are typically placed in landfills. Since they are waste products, the use of supplementary cementitious materials directly offsets the CO_2 that would otherwise be released in cement production.

Fly ash can replace up to 50% of Portland cement in concrete mixtures, and the use of 25% fly ash is already common. GGBFS commonly replaces up to 40% of cement, and has replaced up to 80%.[2] Silica fume can replace 5% to 7% of cement. In addition to reducing CO_2 emissions, fly ash and blast furnace slag increases the workability of concrete, which aids finishing operations, and reduces water demand. Supplementary cementitious materials also reduce the permeability of concrete, making them a necessary ingredient in concrete that has reinforcing steel or is subjected to

chlorides, such parking structures, bridge decks, road pavements and marine structures.

Environmental & Health Benefits
As previously discussed, replacing Portland cement with fly ash reduces greenhouse gas emissions.

NYC uses over 50,000 cubic yards of concrete exposed to chloride based de-icer per year. This proposal would lead to an average reduction of 25 lbs of cement per yard, reducing CO_2 emissions in NYC by over 50 tons per year.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have no significant positive health impact.

Cost & Savings
This proposal is not expected to have any significant impact on capital costs.

Precedents
Many other municipalities across the country allow for the substitution of supplementary cementitious materials for Portland cement. However, the levels proposed here would become the highest known allowed.

The Port Authority of NY &NJ has been replacing 30% of Portland cement with fly ash in concrete mix proportions used on its bridge decks, parking structures and marine facilities. These structures have been subjected to chloride ions for about ten years and the Port Authority reports that the concrete produced is of high strength and durable.

LEED
LEED credits are available for the use of supplementary cementitious materials that are derived from industrial by-products.

These credits include: LEED NC- MR cr.4.1 & 4.2 Recycled Content; LEED CI-MR cr. 4.1 & 4.2 Recycled content; LEED EB-MR cr.2 Optimize use of Alternative Materials; LEED for Schools MR cr.4.1 & 4.2 Recycled Content; LEED for Homes MR cr. 2 Environmentally Preferable Products; and credits under the various pilot programs.

Implementation & Market Availability
There are no known implementation issues for this proposal. Alternative cementitious materials are readily available. There are enormous qualities of fly ash available and presently ample quantities of GGBFS.

It may be necessary to bring some concrete suppliers and engineers up to date with the current concrete technology in the use of supplementary cementitious materials. The Concrete Industry Board of NYC is capable and willing to perform this task.

ENDNOTES:

[1] U.S. ENERGY INFORMATION ADMINISTRATION, EMISSIONS OF GREENHOUSE GASES IN THE UNITED STATES 2007 (2009), *available at* ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057308.pdf; Ernst Worrell, et al*., Carbon Dioxide Emissions from the Global Cement Industry*, 26 ANNUAL REV. OF ENERGY AND THE ENVIRON. (2001), *available at* http://arjournals.annualreviews.org/doi/abs/10.1146%2Fannurev.energy.26.1.303; and L.J. HANLE, ET AL., US EPA AND ICF CONSULTING, CO2 EMISSIONS PROFILE OF THE U.S. CEMENT INDUSTRY (2004), http://www.epa.gov/ttnchie1/conference/ei13/ghg/hanle.pdf.

[2] Concrete Thinking for a Sustainable World, Benefits: "Recycled Content", Apr. 6, 2009, http://www.concretethinker.com/solutions/Recycled-Content.aspx (last visited Jan. 25, 2010).

EE 25:
ENSURE NEW ENERGY SYSTEMS FUNCTION PROPERLY

Amendments to the New York City Building Code and ANSI/ASHRAE/IESNA90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Commissioning is a quality assurance process that is not typically done on building systems. Although often omitted, commissioning helps identify and correct deficiencies in design or installation, resulting in higher energy efficiency and building performance.

Recommendation:
Require commissioning in all new construction, substantial renovations, and additions of greater than 50,000 square feet. Also, require building acceptance testing ("commissioning light") for projects between 5,000 square feet and 50,000 square feet.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code

1. Add a new Section 1302 as follows:

SECTION BC 1302

COMMISSIONING OF NEW BUILDINGS

1302.1 Definitions.

The following words and terms shall, for purposes of this chapter, applicable appendices and as used elsewhere in this code, have the following meanings:

BUILDING ACCEPTANCE REPORT. A document setting forth the results of any building acceptance testing process in the most current format made available by the department.

BUILDING ACCEPTANCE TESTING. For new mid-sized buildings, mid-sized additions, and alterations, performance of the procedures required by Section 28-1302.6.

COMMISSIONING. For new large buildings and large additions, performance of the procedures required by Section 28-1302.3 below.

COMMISSIONING AGENT. A person or agency approved by the department to perform commissioning.

COMMISSIONING PLAN. A document outlining the organization, schedule, allocation of resources, and documentation requirements of the building commissioning process, in the format established by the department.

COMMISSIONING REPORT. A document setting forth the results of any commissioning process in the format established by the department.

FINAL COMMISSIONING REPORT. A commissioning report in the format established by the department and containing documentation and verification of the commissioning of all applicable building systems required to be commissioned under Section 28-1302.4 in the format established by the department.

LARGE ADDITION. Any addition of greater than 50,000 square feet of gross floor area.

LARGE BUILDING. Any structure located on a lot on which the total existing and proposed gross floor area is equal to or greater than 50,000 square feet.

MID-SIZED ADDITION. Any addition equal to or greater than 5,000 square feet, and less than 50,000 square feet, of gross floor area.

MID-SIZED BUILDING. Any structure located on a lot on which the total existing and proposed gross floor area is equal to or greater than 5,000 square feet and less than 50,000 square feet.

POST-OCCUPANCY REPORTS. A commissioning report in the format established by the department and containing (i) documentation and verification of the post-occupancy commissioning activities for all applicable building systems required to be commissioned under Section 28-1302.4, and (ii) submission of all post-occupancy reports and building systems operations manuals.

PRELIMINARY COMMISSIONING REPORT. A commissioning report in the format established by the department and containing documentation and verification of the commissioning of all applicable building systems (i) required to be commissioned under Section 28-1302.4, and (ii) capable of being fully commissioned, other than required post-occupancy reports, at the time of year when a temporary or permanent certificate of occupancy is sought.

1302.2 General. Commissioning is required as part of construction of large buildings and large additions. Building acceptance testing is required as part of (i) construction of mid-sized buildings and mid-sized additions, and (ii) alterations of greater than 5,000 gross square feet.

1302.3 Commissioning. Commissioning shall be performed in accordance with this section using generally accepted engineering standards as determined by the department.

Commissioning shall be incorporated into the pre-design, design, construction, and first year occupancy of the building .

(a) Activities prior to issuance of building permit. Prior to issuance of a building permit, the designated commissioning agent shall submit to the department a commissioning plan providing for commissioning of all applicable building systems required under Section 1302.4.

(b) Activities prior to building occupancy. Prior to issuance of a temporary or permanent certificate of occupancy, the commissioning agent shall submit a preliminary commissioning report, which shall include certifications by such commissioning agent that:

1. All systems required to be commissioned under Section 1302.4 , other than those specified systems that cannot be fully commissioned at the time of occupancy due to seasonal operation, have been commissioned other than any required post-occupancy reports.

2. All operating personnel training requirements identified in the commissioning plan and pertaining to those systems fully commissioned under Section 1302.4(b)(1) have been completed.

3. A system manual has been prepared that includes operations and maintenance documentation and complete warranty information and provides operating personnel all information needed to optimally operate the commissioned systems.

(c) Post-occupancy activities. Within one year of issuance of a permanent certificate of occupancy for the building project, the commissioning agent shall submit a final commissioning report to the department, which shall include:

1. A certification by the commissioning agent that all systems required to be commissioned under Section 1302.4 below have been commissioned.

2. All required post-occupancy reports.

3. A certification by the commissioning agent that a system manual has been prepared that includes operations and maintenance documentation and complete warranty information and provides operating personnel all information needed to optimally operate the commissioned systems.

1302.4 Systems. The following systems, if included in any large building or large addition, shall be commissioned:

(a) Heating, ventilating, air conditioning, indoor air quality and refrigeration systems (mechanical and/or passive) and associated controls;

(b) Building envelope systems, components and assemblies;

(c) Building envelope pressurization, if air-tightness is specified in the commissioning plan;

(d) All lighting and shading controls;

(e) Irrigation;

(f) Plumbing;

(g) Domestic and process water pumping and mixing systems;

(h) Service water heating systems; and

(i) Renewable energy systems.

1302.5 Documentation. Owner shall retain the system manual and final commissioning report, which manual and report shall be provided to local, state and federal agencies or their representatives upon request.

1302.6 Building Acceptance Testing. Building acceptance testing shall be performed in accordance with this section using generally accepted engineering standards as established by the department.

(a) Activities prior to issuance of building permit. Prior to issuance of a building permit, the designated commissioning agent shall certify to the department that he or she has reviewed construction documents to verify relevant sensor locations, devices and control sequences are properly documented for all applicable building systems required under Section 1302.7.

(b) Activities prior to building occupancy. Prior to issuance of a temporary or permanent certificate of occupancy, the commissioning agent shall submit a building acceptance report to the department, which shall include a certification by such commissioning agent that a system manual has been prepared that includes operations and maintenance documentation and complete warranty information and provides operating personnel all information needed to optimally operate the commissioned systems.

28-1302.7 Systems. The following systems, if included in any mid-sized building, mid-sized addition, or alteration of greater than 5,000 square feet, shall have building acceptance testing:

(a) Mechanical Systems: Heating, ventilating, air conditioning, indoor air quality, and refrigeration systems (mechanical and/or passive) and associated controls;

(b) Lighting Systems;

(c) Automatic daylighting controls;

(d) Manual daylighting controls;

(e) Occupancy sensing devices;

(f) Automatic shut-off controls; and

(g) Renewable energy systems.

13.2.2.5 Documentation. Owner shall retain the system manual and building acceptance report, which manual and report shall be provided to local, state and federal agencies or their representatives upon request.

Amendment to ANSI/ASHRAE/IESNA 90.1 (2007), as incorporated in Chapter 13 of the New York City Building Code

1. Delete Section 6.7.2.4

[6.7.2.4 System Commissioning. HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 square feet conditioned area, except warehouses and semiheated spaces, detailed instructions for commissioning HVAC systems (see Informative Appendix E) shall be provided by the designer in plans and specifications.]

Supporting Information

Issue – Expanded
No building functions exactly as its designers intended. In part this is due to usage patterns the designers could not or did not anticipate. Often, buildings use more energy and water than necessary because of large or small errors during installation of the countless components that make up a modern building.
Building commissioning is a process for testing building systems to ensure they function according to engineering design objectives or specifications. The commissioning process has been applied to ocean-going ships for centuries, as designers, ship-builders and crews saw the risk-management value in verifying that all systems were working according to design intent before leaving shore. Applied to buildings, the process ensures that owners get what they pay for when constructing or retrofitting buildings, provides risk-management and "insurance" for policymakers and program managers enabling their initiatives to actually meet targets, and detects and corrects problems that would eventually surface as far more costly maintenance or safety issues.

No two commissioning reports are alike because each building has its own particular systems and construction mistakes; but every commissioning report will find a litany of correctable problems that have a major impact on energy and water consumption. A commissioning report might find: control sensors are disconnected, nonfunctional or installed in the wrong place; temperature and other set points are incorrect; valves are open when they should be closed; or a ventilating fan that is installed facing the wrong direction – this list of potential issues is virtually endless.

A recent report on new building commissioning indicates that it is likely the single-most cost-effective strategy for reducing energy, costs, and greenhouse gas emissions in buildings today.1 Beyond significant energy and other savings, building commissioning also provides occupants with improved indoor environmental conditions.

Environmental & Health Benefits
Building commissioning saves a substantial amount of energy and water, reducing air pollution and greenhouse gas emissions.
Until recently, commissioning services were driven more by other reliability and safety issues, rather than energy or water savings. In the past, the primary goal of commissioning was often occupant safety in laboratory and industrial buildings, and improved occupant comfort in educational and office buildings. Valuation of these benefits can be more challenging than estimating energy cost savings, but interviews among nearly 100 commissioning team members across 21 projects in the Pacific Northwest estimated non-energy commissioning benefits of $0.17 per square foot, a level nearly as high as energy cost savings.2

This proposal is found to have a have low, positive environmental impact and to impact a large number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates**.**
This proposal was estimated to increase capital cost by between $0.10 and $0.20/square foot. It was thus categorized as incurring a low to medium capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years for some building types.

Precedents
California has adopted Green Building Standards Code to supplement the California Building Standards Code. Sections on Commissioning require the inclusion of commissioning be in the design and construction processes of the building project and the completion of a commissioning plan.3

LEED
The measures outlined in this proposal will assist in meeting the following LEED prerequisite and credit requirements:

- LEED NC-EA prerequisite 1, Fundamental Commissioning
- LEED NC-EA cr. 3,Enhanced Commissioning
- LEED CI-EA prerequisite 1, Fundamental Commissioning

- LEED CI-EA cr. 2, Enhanced Commissioning
- LEED for Schools EA prerequisite 1, Fundamental Commissioning
- LEED for Schools EA cr.3, Enhanced Commissioning
- LEED EB- EA prerequisite 1 Existing Building Commissioning
- LEED EB-EA credit 3.1, 3.2, & 3.3 Building Operations and Maintenance

The components of LEED commissioning outlined in this proposal for larger projects exceed LEED criteria. Therefore, adherence to these measures will have a strongly positive impact on LEED certification.
For adherence with LEED E&A prerequisites and credits, a Commissioning Authority (CxA) must be assigned to oversee the commissioning process. The CxA will be ultimately responsible to verify the performance of systems for the purposes of LEED certification.

The process of documenting building performance for the code revisions under this proposal will assist in the accumulation of data for the LEED Construction Submittal Template, which is required to verify prerequisite and credit compliance.

LEED has no equivalent for acceptance testing.

Implementation and Market Availability
There are no known implementation issues for this proposal. Commissioning agents are readily available.

Notes
The language in this proposal largely follows a similar provision in ASHRAE 189.1. Further detail that the Department of Buildings may wish to consider during rulemaking include:

- Specification of submissions to the Department.
- The design review stages should be adjusted to conform to architectural terminology, such as 100% DD documents and 80% CDs.
- These steps “verify the installation and performance..." but do not explicitly discuss start-up. The CxA commissioning agent should be present at equipment start-up and at least witness and collect documentation.
- Envelope commissioning should be mentioned. The specifications should require wall mock-ups that are either inspected by the project architect or the commissioning authority. Wall inspection/photographs at all phases of construction should also be required.
- Consider making a building pressurization, infrared scan mandatory prior to occupancy (although this is season-dependent).
- Consider making a digital recording of training part of the commissioning agent's scope. This should include the actual camera/sound recording and the editing of the sessions on a DVD for the convenient future use of the operations and maintenance staff.
- The commissioning agent should meet with each contractor before providing training and discuss noise control and staying on-topic for the training session.
- A systems manual should be assembled by the commissioning agent and should include complete one-line diagrams of air-side and water-side systems and integrated operating sequences of chillers, cooling towers, circulation pumps, AHUs, VAV boxes, etc., prepared by the design engineer.

ENDNOTES:

[1] E. MILLS, BUILDING COMMISSIONING: A GOLDEN OPPORTUNITY FOR REDUCING ENERGY COSTS AND GREENHOUSE GAS EMISSIONS, LAWRENCE BERKELEY NATIONAL LABORATORY (2009), http://cx.lbl.gov/documents/2009-assessment/LBNL-Cx-Cost-Benefit-Pres.pdf.

[2] SBW CONSULTING AND SKUMATZ ECONOMIC RESEARCH ASSOCIATES, NORTHWEST ENERGY EFFICIENCY ALLIANCE, COST-BENEFIT ANALYSIS FOR THE COMMISSIONING IN PUBLIC BUILDINGS PROJECT (2003).

[3] CAL. CODE, Tit. 24 § pt. 11 (2008), *available at* http://www.documents.dgs.ca.gov.

EE 26:
ENSURE LIGHTING SYSTEMS FUNCTION PROPERLY

New York City Building Code
Proposal developed by the Lighting & Daylighting Committee

Summary

Issue:
Increasingly, lighting systems rely on sophisticated sensors and controls to reduce energy consumption. These systems must be tested and adjusted after installation to ensure that they function properly; unfortunately, this is not common practice.

Recommendation:
Require functional testing of lighting sensors and controls to ensure that the systems perform as designed.

Proposed Legislation, Rule or Study

Amendments to ANSI/ASHRAE/IENSA 90.1 (2007), as incorporated in Section 13 of the New York City Building Code:

1. Add a new Section 9.4.6 as follows:

9.4.6.1 Functional testing requirements.

a. Occupant sensors, time switches, or photosensors shall be subject to the functionality testing to verify that:

1. The location, orientation, masking, sensitivity and time-out adjustments for occupant sensors turns lighting off within 30 minutes of all occupants leaving a space and calibrated to minimize false offs,

2. Time switches are programmed to turn lighting off when spaces are unoccupied or control zones are unused, and

3. Photosensor controls are properly located, oriented, shielded and calibrated to reduce electric light levels in accordance with the amount of usable daylight in the space.

Exception: If functional testing of lighting is already required under a mandated building commissioning process.

b. The functional testing described in paragraph (a) shall be documented and certified as required by the department. Construction documents shall indicate the required calibration settings, control intent narrative, and commissioning criteria necessary to comply with the mandatory requirements of this code, and shall identify the responsible party for conducting and certifying the functional testing. Prior to sign-off, the owner shall provide documentation certifying that the installed lighting system meets or exceeds the intended design performance and verifying conformance with paragraph (a) of Section 9.4.6.1. Such documentation shall include the following:

1. Control intent narrative for each type and application of lighting controls, and verification that the installed equipment meets the design intent, including time switch schedules, calibration settings, daylighting set-points, time delays, and fade rates.

2. Verification that the commissioned controls meet the minimum criteria of the energy code.

3. Written certification signed by the functional tester and/or the owner that the functional testing was successfully completed.

Supporting Information

Issue – Expanded
A critical aspect of energy efficient lighting is ensuring that lighting is not used when it is not needed. This is accomplished via sensors and controls, which turn off or dim lights when there is sufficient daylight or when there are no occupants. These systems can achieve dramatic reductions in energy consumption, but they must be properly installed and calibrated in order to work as intended. If this is not done, lights can remain on when light is not needed or lights can turn off when light is needed. The first of these problems wastes energy directly, and the latter can cause widespread irritation and discontent with the systems, often resulting in systems being disconnected or removed – again resulting in wasted energy.

If the lighting sensor and controls have undergone a quality control process called "functional testing" when it is limited to a single system, or "commissioning" when it is more broadly defined, these problems can be avoided. Functional testing has two main parts. The first is the documentation of how the sensors and controls are meant to function - called the "design intent." The second is the process of testing the components to make sure they work as they were intended, and adjusting them if they are not working properly. This relatively straight forward process is necessary to ensure proper performance.

Section 1513.7 Commissioning Requirements in Seattle's energy code carries supporting data in a Client Assistant Memo[1] that describes the commissioning process in greater detail, in particular the holistic approach to designing and implementing mechanical and lighting systems. It notes that commissioned systems operate more efficiently and have less operational and equipment failures than those that were not commissioned. The resulting efficiency of a building's lighting system would reduce maintenance costs from repairs or equipment replacement thereby reducing the accumulation of building material waste as well as providing a more comfortable lighting environment with fewer distractions.

Environmental & Health Benefits
Improving lighting efficiency will reduce citywide energy consumption, resulting in less greenhouse gas emissions and improving air quality.

This proposal was found to have a high, positive environmental impact per building and to impact a large number of buildings. It was thus given an environmental score of 3.

This proposal was found to have no significant positive health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.0% to 0.02%, depending on building type. It was thus categorized as incurring no to a low capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years depending on the building type.

Precedents
In Seattle, WA, the city's energy code includes a commissioning requirement for lighting systems in non-residential buildings that have automatic and timing sensors - such as daylight or occupancy sensors and automatic shut-off controls - to be tested for quality assurance as per the drawings and specifications of the design. The commissioning requirement also includes commissioning for drawing notes. The city requires that a report of the test procedures and results be prepared and filed with the owner[2] (2).

LEED
LEED requires Fundamental Commissioning of the Building Energy Systems as an Energy & Atmosphere Prerequisite 1 under

- LEED for New Construction
- LEED for Commercial Interiors

- LEED for Existing Buildings
- LEED for Schools rating systems

A project may also achieve LEED credits for Enhanced Commissioning under

- LEED NC-EA cr.3
- LEED CI-EA cr.2
- LEED for Schools EA cr.3

Lighting & Daylighting controls are only one component of LEED commissioning. Additionally, while this proposal addresses only functional testing of specific lighting controls, the LEED commissioning process has a broader scope. However, this proposal will make a contribution towards achieving LEED certification.

For adherence with LEED E&A prerequisites and credits, a Commissioning Authority (CxA) must be assigned to oversee the commissioning process. The CxA will be ultimately responsible to verify the performance of systems for the purposes of LEED certification.

The process of documenting lighting functional testing performance will assist in the accumulation of data for the LEED Construction Submittal Template, which is required to verify prerequisite and credit compliance.

Implementation & Market Availability
In the near term, this proposal could be implemented through owner self-certification that lighting controls have been properly tested and commissioned. Professionals who are qualified to supervise testing in the near term include electrical engineers, lighting designers, interior designs, architects, facilities managers, manufacturer's technicians, or other agents of the owner. It would not be effective or appropriate for the installing contractor to certify the functional testing.

The successful implementation of this proposal in the long term, however, requires the establishment of an educational or certification program so that only individuals with a minimum level of expertise in lighting controls perform functional testing. In New York City, few commissioning agents or licensed professionals currently have expertise in lighting controls.

ENDNOTES:

[1] CITY OF SEATTLE DEPARTMENT ON PLANNING AND DEVELOPMENT, COMMISSIONING FOR NON-RESIDENTIAL MECHANICAL AND LIGHTING SYSTEMS, SEATTLE PERMITS, CAM 419 (2006), available at http://www.seattle.gov/dpd/publications/cam/cam419.pdf.

[2] CITY OF SEATTLE ENERGY CODE Ch. 15 § 1513.7 (2006), available at http://www.seattle.gov/DPD/Codes/Energy_Code/Nonresidential/Chapter_15/default.asp.

EE 27:
REDUCE LEAKAGE FROM AIR DUCTS

New York City Mechanical Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issues:
Energy is wasted when air ducts leak and vents are improperly adjusted.
Recommendation:
Test and seal all ventilation ducts, and adjust vents in new construction or renovations.

Proposed Legislation, Rule or Study

Amendments to the New York City Mechanical Code:

1. Delete Section 403.3.4 and add a new Section 403.3.4 as follows:

403.3.4 Testing, adjusting and balancing. Ventilation systems shall be tested and balanced in accordance with procedures in one of the following standards:

1. AABC *National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems*, or

2. NEBB *Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems*, or

3. SMACNA *HVAC Systems – Testing, Adjusting and Balancing.*

2. Amend Section 603.9 as follows:

603.9 Joints, seams and connections. All longitudinal and transverse joints, seams and connections in metallic and nonmetallic ducts shall be constructed as specified in SMACNA *HVAC Duct Construction Standards—Metal and Flexible* and SMACNA *Fibrous Glass Duct Construction Standards* or NAIMA *Fibrous Glass Duct Construction Standard*s. All longitudinal and transverse joints, seams and connections shall be sealed in accordance with the *Energy Conservation Construction Code of New York State*. Ducts concealed in shaft enclosures extending three or more floors shall be leak-tested in accordance with SMACNA *HVAC Air Duct Leakage Test Manual*, and the rate of air leakage (CL) shall be less than or equal to the established criteria set forth in the manual.

3. Amend Chapter 15 to include the following standards:

AABC *National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems*

NEBB *Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems*

SMACNA *HVAC Systems – Testing, Adjusting and Balancing.*

Supporting Information

Issue – Expanded

Just like dripping water faucets, even small duct leaks factored over time can add up to substantial cost and wasted energy. Likewise, unbalanced ventilation systems can make conditions uncomfortable for occupants. Recognized national industry standards can ensure that mechanical systems are constructed and operate in accord with their design.

It is particularly important to test vertical duct risers prior to closing in building shaft walls. Unlike ductwork in dropped ceilings that can be readily inspected and repaired, the only opportunity to fix leaks in most vertical duct risers will be during construction. Once concealed behind walls, vertical ducts may leak for the life of the building without ever

being detected. Even if the leaks in vertical risers are caught, the cost to remove and reinstall the shaft enclosure means the leaks will probably not be repaired. Testing ducts extending three or more floors during construction and prior to shaft wall construction would facilitate inexpensive repair and provide the quality assurance that ducts in the shafts are properly sealed

Ventilation systems can also suffer from poor balancing. Some systems over-ventilate certain rooms, making them drafty, noisy, and overheated or overcooled, while under-ventilating others, making them stagnant and under-heated or under-cooled. Poorly balanced systems are inherently wasteful. The Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) has established standards for the testing and balancing of ventilation system. Using this standard provides quality assurance that the balancing process was performed in a reliable and repeatable method.

Environmental & Health Benefits

This proposal will improve indoor air quality by ensuring that the air quantities calculated by the design engineer to provide health and comfort and shown on the contract documents are actually realized in the field. The building code requires minimum ventilation (outdoor air) rates to offset the oxygen intake and carbon dioxide (CO2) discharge that occurs through the breathing process. When these rates are not achieved due to improper balancing or duct leakage CO2 concentrations can buildup in occupied areas leading to poor indoor air quality. Pollutants generated in the indoor environment cannot be adequately diluted or flushed out if the space doesn't receive proper airflow.

This proposal was found to have a high, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 2.

This proposal was found to have a positive, indirect health impact.

Cost / Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.0% to 0.07%, depending on building type. It was thus categorized as incurring no to a medium capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years depending on the building type.

Precedents

Precedents for this proposal include California's Energy Efficiency Standards for Residential and Nonresidential Buildings. Established in 1978, these codes were a response to a legislative mandate to reduce California's energy consumption.[1]

LEED

The LEED commissioning process is intended to verify that the project's energy-related systems are installed, calibrated, and perform as intended. Projects that have been tested according to the measures outlined in this proposal will more easily comply with the following LEED prerequisites and credits:

- LEED NC-EA prerequisite 1, Fundamental Commissioning
- LEED NC-EA cr. 3,Enhanced Commissioning
- LEED CI-EA prerequisite 1, Fundamental Commissioning
- LEED CI-EA cr. 2, Enhanced Commissioning
- LEED for Schools EA prerequisite 1, Fundamental Commissioning
- LEED for Schools EA cr.3, Enhanced Commissioning
- LEED EB- EA prerequisite 1 Existing Building Commissioning
- LEED EB-EA credit 3.1, 3.2, & 3.3 Building Operations and Maintenance

For adherence with LEED E&A prerequisites and credits, a Commissioning Authority (CxA) must be assigned to oversee the commissioning process. The CxA will be ultimately responsible to verify the performance of systems for the purposes of LEED certification.

Since indoor air quality may be improved by ensuring that air flows according to the building engineer's design, this

proposal may also facilitate achieving the following credits:
- LEED NC-EQ cr. 3.1 & 3.2 Construction IAQ Management Plan;
- LEED CI-EQ cr. 3.1 & 3.2 Construction IAQ Management Plan;
- LEED EB-EQ cr. 3 Construction IAQ Management Plan;
- LEED for Schools EQ cr. 3.1 & 3.2 Construction IAQ Management Plan;
- LEED for Homes EQ cr. 8 Contaminant Control.

To earn credits under the LEED 2009 rating systems, during construction projects must meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association[2] (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007,
ANSI/SMACNA 008-2008 (Chapter 3). Since the measures outlined in this proposal do not make reference to this specific standard, project teams must research to verify LEED compliance for projects

Implementation and Market Availability
There are no known implementation issues for this proposal. Testing, Adjusting and Balancing contractors are readily available.

ENDNOTES:

[1] CAL. CODE, Tit. 24 § pt. 6 (2008), *available at* http://www.documents.dgs.ca.gov.

[2] SHEET METAL AND AIR CONDITIONING NATIONAL CONTRACTORS ASSOCIATION, IAQ GUIDELINES FOR OCCUPIED BUILDINGS UNDER CONSTRUCTION, ch. 3 (2d ed. 2007).

EE28:
EXPAND BOILER EFFICIENCY TESTING & TUNING

Administrative Code of the City of New York
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
The Department of Environmental Protection tests boiler combustion efficiency only in very large boilers, and only every three years. Annual testing would detect malfunctions, permit tuning, and result in more efficient boiler operation.

Recommendation:
Require annual testing of boilers that generate more than 2 million BTU per hour or are located in buildings larger than 50,000 square feet. Also require boiler cleaning, tuning and repairs as necessary. The issue addressed by this proposal is already under consideration by the City.

Proposed Legislation, Rule or Study

Amendments to the Administrative Code of the City of New York:

1. Add new a subchapter 10 to title 24 as follows:

Subchapter 10
Annual Combustion Efficiency Test Requirements

§ 24-190 Definitions. When used in this subchapter 10, the following terms shall have the following meaning:

(a) Efficiency test shall mean a combustion efficiency test carried out by means of a portable flue gas analyzer capable of detecting oxygen and carbon monoxide concentrations and stack gas temperature.
(b) Fuel burning equipment shall include all boiler/burner combinations of fuel oil fired burning equipment and gas fired installations.

§ 24-191 Permanent criteria and standards. No later than July 1, 2010, the commissioner shall establish criteria and or standards for:

(a) Combustion efficiency testers. Such criteria shall at a minimum consider professional heating contractor experience, emissions/equipment testing experience, boiler safety inspection experience or a combination of the foregoing.

(b) Portable combustion analyzers that directly measure and display flue gas oxygen, carbon monoxide, nitrogen oxide, stack temperature, draft, differential pressure, combustion air temperature, and calculate carbon dioxide. The analyzer shall have a means for calculating efficiency for the specific fuel used.

(c) Test protocol, which shall include criteria that is included in present fuel burning criteria, including location of test ports, specific boiler operational parameters, steady state and firing rates.

§ 24 -192 Interim criteria and standards. Prior to establishing permanent criteria and standards, the department may establish an interim list of acceptable combustion efficiency testers, portable combustion analyzers, and test protocol. These interim criteria and or standards may be utilized to conduct the testing as required by section 24-193 until superseded by permanent criteria and standards.

§ 24-193 Annual test requirement.
(a) Effective January 1, 2011 for all boilers in buildings greater than 50,000 square feet, the building owner shall conduct an annual combustion efficiency test utilizing the portable combustion analyzer and submit the results to the department.

(b) Effective January 1, 2011 for any boiler requiring renewal of the department's triennial certification (for boilers greater than 2.8 million btu/hr), the department shall conduct the combustion efficiency test utilizing the portable combustion analyzer technology.

(c) Effective January 1, 2012 for all boilers greater than 2 million btu/hr in buildings smaller than 50,000 square feet, the building owner shall conduct the annual combustion efficiency test utilizing the portable combustion analyzer and submit the results to the department.

§ 24-194 Electronic Submission of Test Results. Effective January 1, 2011, the results of the annual testing required under section 24-193 shall be electronically submitted to both the department and the department of buildings. The department shall establish the template and format that the building owner shall complete and submit. The template shall include a calculation of the annual savings in energy costs if the boiler were functioning at the acceptable passing score, and a calculation of the annual savings in energy costs if the boiler were replaced with a new, high-efficiency boiler.

§ 24-195 Acceptable Passing Score.
(a) Effective January 1, 2011, the acceptable passing score for the SSE (Steady State Efficiency) shall be: for atmospheric gas fired boilers 79%, for all other gas fired boilers 81%; for all oil fired boilers 83%.

(b) If a boiler burner combination is below the passing score, the building owner shall have the boiler and burner repaired, retuned and retested, with the results submitted within sixty days. The building owner shall also complete a 'work order summary' to be submitted to the department indicating the work completed prior to the second testing.

(c) By January 1, 2014, the department shall evaluate the state of boiler and burner technology and combustion efficiency test results received between January 1, 2011 and January 1, 2013 and:

(1) determine the passing score threshold for combustion efficiency tests commencing thereafter; and
(2) analyze whether any other efficiency criteria or requirements should be established.

§ 24-196 Filing Fees.

Effective January 1, 2011, the department shall establish filing fees sufficient to cover the costs of administering and enforcing the boiler testing program and the electronic filing syste**m.**

Supporting Information

Issue – Expanded
Recent developments in portable technology for testing boiler efficiency now make it feasible to test boilers the way that automobiles have been tested for many years. The current testing program of the Department of Environmental Protection utilizes older technology, limiting testing to the very largest boilers in the city – those over 3.5 million Btu/ yr – and it only does so every three years. This proposal enables the use of the newer technology and then expands the city's boiler efficiency testing to cover more boilers -- those larger than 2 million Btu/ yr or boilers in buildings larger than 50,000 square feet -- and to test those annually. Combined, these boilers cover buildings larger than roughly 30,000 sq. ft. so this proposal will impact well over half of the energy used for space and hot water heating in the city.

Most of these boilers are not tuned and cleaned frequently to keep them operating close to peak efficiency. This proposal requires the boilers to be tested annually. If any boiler cannot achieve a sufficiently high Steady State Efficiency (SSE) score, it must be cleaned and tuned, and then retested, with the scores for both tests being submitted to DEP. Note that the SSE is a measure of how well a boiler is operating, and is not a measure of the underlying efficiency of the boiler model. Therefore it is expected that, with very few exceptions, all boilers can be cleaned, tuned, and repaired sufficiently to enable them to achieve a passing score. It should be understood that boilers that do not achieve passing scores after having been tuned, will not be required to perform further work that year, nor will they need to be replaced.

As part of the process, each building owner will be informed of the dollar savings that would accrue if the boilers were operating at the passing score, and if the boiler were replaced with a high-efficiency model. It is anticipated that such transparency will help building owners make better decisions and investments in their boilers. In addition, the information obtained about boiler efficiencies across the city will enable DEP to fine-tune its requirements after several years.

It is estimated that an average efficiency improvement of between 3% and 5% will be obtained through the regular tuning of boilers, which translates into decreased energy consumption of 4% to 5%. This will save considerable energy and money.

Environmental & Health Benefits
There should be sizable reductions in soot, also known as PM 2.5 (or particulate matter 2.5), which is a pollutant that causes serious damage to the human respiratory tract because of its tendency to lodge deep in the lungs. PM 2.5 is contained in the smoky emissions resulting from the incomplete combustion within poorly tuned boilers.

The citywide impact on CO2 emissions can be estimated as follows:

Buildings are responsible for 78% of the city's CO2 emissions. Of that, heat and hot water are responsible for 59% of the carbon emissions. The large to medium size boilers targeted generate roughly 55% of the city's heat and hot water. If we assume, on average, that the regular retuning of boilers (in excess of that which is currently occurring) will reduce consumption by 4-5% on average, that only 15% of boilers are currently being tuned, and that the city will achieve a 90% compliance, the CO2 savings across the city would be:

.78 x .59 x .55 x (.04 to .05) x .85 x .90 = .77% to .97% of the city's carbon emissions or 485,100 to 604,800 tons of carbon per year. This reduction would occur within a year of beginning to implement the program, and it is equivalent to removing 133,230 to 589,895 cars from the road.

This proposal was found to have a low positive environmental impact per building and to impact a large number of buildings. It was thus given and environmental score of 2.

This proposal was found to have a positive indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to cost $0.00 to $0.01/square foot annually. It was thus categorized as incurring no cost increment. This proposal was also estimated to generate financial savings that will exceed the costs.

Precedents
1. The European Union has a similar testing requirement (EN5037) for gas-fired boilers that have been in place since early 2007.

2. There is also a British standard for these appliances.

3. For many years, automobile owners have been required to perform an annual emissions test, which is the equivalent of the efficiency test now being proposed for boilers.

LEED
This proposal has no direct LEED implications.

Implementation & Market Availability
There are a significant number of national manufacturers marketing the necessary equipment.