C-6: Expand use of occupancy sensors (C405.2.1)

Summary: Occupancy sensors have become mainstream technology, and new systems are now available which are effective in open office areas. The proposal extends their use to open office areas. Greater use of occupancy sensors will reduce lighting use compared to traditional timer control systems, especially during custodial hours.

DOE proposal C-6 was revised on December 18, 2015.

Stakeholder Feedback: There were three public comments received for proposal C-6. Comments are summarized below, followed by a DOE review:

- It would be helpful to have language describing the energy and economic impact of proposal C-8 (significantly lower lighting power densities) being published in the 2018 IECC on this proposal. For example, if the LPD’s are reduced by 20%, then the savings from sensors are reduced by 20%, and the payback periods are 20% longer.
  Review: Generally, for individual proposals DOE analyzes measures individually against the current code, as it is unknown what other proposals may be included. When an entire new edition is completed, DOE completes an analysis of the interactive effects of proposals in the new code edition in its entirety.

- One comment suggested that the list of space types be made consistent with the LPD tables.
  Review: While changing the list of space types is worthwhile, it is beyond the scope of this proposal and is more appropriate as a separate proposal. The commenter may wish to pursue this in their own proposal to ICC.

- One comment suggested that the maximum lighting area be based on wattage rather than floor area and one suggested the area be increased to 600 square feet.
  Review: The point that control savings is related more to watts controlled rather than area is well taken; however, the maximum area was selected based on typical occupancy sensor range rather than watts controlled. Further, as LPDs go down, continuing to increase the area controlled independently would reduce the overall savings impact, as the chance a zone would be vacant decreases the larger the coverage area is. The minimum control area was increased from 500 to 600 square feet.

- Two comments suggested wording changes that would help clarify application of the proposal. The wording revisions in one required dimming systems and manual on control.
  Review: DOE has modified the proposal, using some clarifying wording from both comments. DOE wanted to retain an option without dimming systems to allow for lower cost and less complex systems in simpler buildings. DOE also intentionally did not require manual-on controls in large open office areas, as they are not appropriate for areas with multiple occupants, and automatic-on control provides more savings than timed control.

In response to these comments, DOE will revise its proposal to clarify the control requirements language. DOE retained the option to implement this proposal without dimming systems, does not require manual-on in open areas, and increased the maximum control zones to 600 square feet.
IECC PROPOSAL:

Modify Sections C405.2.1 and C405.2.1.1 as follows

C405.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges.
5. Employee lunch and break rooms.
6. Private offices
7. Open plan office areas
8. Restrooms.
11. Locker rooms.
12. Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.
13. Warehouses.

C405.2.1.1 Occupant sensor control function. Occupant sensor controls in spaces other than warehouses or open plan office areas, as specified in Section C405.2.1 shall comply with the following:

1. Automatically turn off lights within 30 minutes of all occupants leaving the space.
2. Be manual on or controlled to automatically turn the lighting on to not more than 50 percent power.

   Exception: Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

3. Shall incorporate a manual control to allow occupants to turn lights off.

C405.2.1.2 Occupant sensor control function in warehouses.

No changes to C405.2.1.2

Add new section C405.2.1.3 as follows:

C405.2.1.3 Occupant sensor control function in open plan office areas. Occupant sensor controls in open plan office spaces less than 250 ft² (23 m²) shall comply with C405.2.1.1. Occupant sensor controls in all other open plan office spaces shall comply with the following:

1. Be configured so that general lighting can be controlled separately in control zones with floor areas no greater than 600 ft² (55 m²) within the open plan office space.
2. Automatically turn off general lighting in all control zones within 20 minutes of all occupants leaving the open plan office space.
3. Be configured so that general lighting power in each control zone is reduced to no more than 20% of full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone. Control functions that switch control zone lights completely off when the zone is vacant meet this requirement.

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4. Any daylighting control that is included with an open area lighting control system shall not activate open plan office space general lighting or control zone general lighting unless occupancy for the same area is also detected.

**Reason:** This proposal adds occupant sensor control to open plan office areas. These areas were not previously included in occupant sensor control requirements because there were not readily available controls to switch off small groups of work stations while maintaining a minimum background illumination in the overall area. Multiple manufacturers now have those controls available, so they can be included in code requirements. There are significant savings, especially during after-hours use and custodial service, as lighting only the workstation areas in actual use rather than the entire open office space saves significant energy. The control function for these areas is written so it can be accomplished either with dimming or switching systems and “manual on” is intentionally excluded from this control function, because that is not easily workable in an open office plan area with multiple occupants. The provision does not apply to areas smaller than 250 square feet, as the control function in Section C405.2.1.1 is more appropriate for smaller areas with multiple workstations. For open office areas between 250 and 600 square feet, the control function in either Sections C405.2.1.1 or C405.2.1.3 can be applied, as the control function of C405.2.1.1 meets the requirements of C405.2.1.3, as switching lights off is “no more than 20%.”

**Energy Savings:** An analysis of energy impact shows that net savings from the expanding occupancy sensors to open office areas as proposed is about $34 annually per 400 square feet of floor area in offices in Climate Zone 8. Other climate zones will have greater total savings, as there will be less increase in heating resulting from the lower internal loads. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at: https://www.energycodes.gov/development/2018IECC.

**Cost Impact:** The cost for additional lighting controls in open office areas is expected to be about $250 per 400 square foot workstation area for simple controls, or $0.95 per square foot for advanced wireless control systems; however, there are significant savings associated with these applications.

**Cost-effectiveness:** PNNL performed a cost-effectiveness analysis using the established DOE methodology. Results of the cost-effectiveness analysis showed that the average savings-to-investment ratio (SIR) is 2.2 to 1.4 in typical offices, depending on the sophistication of the system installed. A proposal is cost-effective when the SIR is greater than 1.0, indicating that the present value of savings is greater than the incremental cost. The complete cost-effectiveness analysis is available at: https://www.energycodes.gov/development/2018IECC.

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