R-3 Heat Recovery Ventilation (R403.6)

Summary: Improve mechanical ventilation provisions to include heat recovery ventilation (HRV) or energy recovery ventilation (ERV) systems in the coldest climate zones. The IECC and IRC already jointly mandate mechanical ventilation in all new residences. Many builders already employ whole-house ventilation systems; recovering heat from the exhaust streams is an effective energy strategy, especially in cold climates. Analysis demonstrates that heat recovery is a cost-effective strategy in the coldest zones.

A comment review for DOE proposal R-3 was added on December 18, 2015.

Stakeholder Feedback: There were eight public comments received for proposal R-3. Comments are summarized below, followed by a DOE review:

- One comment suggesting that DOE establish a specific CFM/watt requirement for ventilation systems.

  Review: While such a change might be worthwhile, it is considered beyond the scope of this proposal.
- One comment noting that the Simulated Alternative Compliance path makes ambiguous statements regarding the inclusion of ventilation in the energy tradeoffs.

  Review: The R405 Scope states that analysis shall include heating, cooling, and water heating energy only, while Table R405.5.2(1) includes provisions for mechanical ventilation. While not directly related to this proposal, correcting the Scope is a good idea and has been added as DOE's proposal R-7.
- One comment questioning the correctness of the Simulated Alternative Compliance path as it appears to allow proposed designs to take advantage of changes to internal heat gains when more (or less) efficient ventilation systems are located within the conditioned space.

  Review: The performance path does seem to allow this and it would seem to be reasonable, since the heat from ventilation fans inside conditioned space do contribute to the net heating and cooling loads in the space.
- Two comments suggesting that the proposal should allow for ERVs in addition to HRVs, to accommodate humidity concerns in coastal and other cool but humid regions.

  Review: ERV systems, though primarily useful in warm-humid climates, may be appropriate in some cold-climate situations. DOE will modify the proposal to allow ERVs as well as HRVs provided the requisite sensible recovery efficiency is achieved. Because the motivation for this proposal is institutionalizing a practice found to be very common (near universal) among builders participating in its Building America program, which sees HRVs used in a large majority of projects but very few ERVs, DOE will not at this time propose provisions for latent capacity or total energy conversion efficiency.
- One comment questioning whether the energy cost savings of this proposal are based on higher residential boiler efficiency standards that took effect in 2013 and the higher residential furnace standards that will take effect in November 2015, and for possible furnace efficiency increases that will take effect by 2021.

  Review: The proposal is based on equipment efficiencies expected to be current as of 2018.
- One comment noting that the commenter will be proposing to make HRVs an option in one of the commenter's 2018 IECC proposals.

  Review: The comment is informational.
- One comment expressing concern that the cost-effectiveness of this option is overstated because analysis assumed Federal minimum equipment efficiencies rather than market average efficiencies.

  Review: Federal minimum equipment efficiencies are allowed and frequently used in construction, and are therefore an appropriate baseline for DOE's analyses, which are focused on the minimum code.

Basing new code proposals on average efficiencies would result in many new home buyers having homes more costly than necessary to operate.

In response to these comments, DOE will submit proposal R-3 as originally posted.

= = = IECC PROPOSAL:

Modify Section R403.6 as follows:

R403.6 Mechanical Ventilation (Mandatory). The building shall be provided with ventilation that meets the requirements of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ~~ventilation system is not operating.~~

~~**R403.6.1 Whole-house mechanical ventilation system fan efficacy.** Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1.~~

~~**Exception:** Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.~~

R403.6.1 Heat recovery ventilation (Prescriptive). The building shall be provided with a heat recovery or energy recovery ventilation system in climate zones 6, 7 and 8. The system shall be balanced with a minimum sensible heat recovery efficiency of 70% at 0 °C (32 °F) and at rated airflow.

R403.6.1.2 Whole-house mechanical ventilation and heat recovery ventilation system fan efficacy. Mechanical and heat recovery ventilation system fans, shall meet the efficacy requirements of Table R403.6.1.

Exception: Where mechanical ventilation and heat recovery fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

Reason: The energy used to condition ventilation air is completely lost through exhaust air in exhaust-based ventilation systems. This provision increases energy efficiency of ventilation systems by recovering a portion of energy lost to the exhaust air stream to condition in-coming ventilation air. It also provides for a balanced ventilation system to avoid induced infiltration/exfiltration and minimize potential downdrafting problems. A large majority of projects constructed since 2010 in the cold/very cold regions under DOE's Building America program have included heat recovery ventilation.[1]

Energy Savings: Most Heat Recovery Ventilation systems (HRVs) have a sensible heat recovery efficiency of 70%-80%.[2] The present analysis conservatively assumes a sensible heat recovery efficiency of 70%. The energy analysis indicates that HRVs yield annual energy cost savings ranging from 9.4% to 11.2% of IECC-regulated end uses (heating, cooling, lighting and water heating), in climate zones 6 through 8.

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.

[1] See Case Studies in the "cold/very cold" regions in the Building America Solution Center at https://basc.pnnl.gov/optimized-climate-solutions/coldvery-cold

[2] See EnergySavers website http://www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11900

Cost impact: The cost of HRV equipment ranges from $500-1100, depending on the manufacturer and capacity. The present analysis assumes a total measure cost of $1,300 for a single-point HRV system based on the NREL Retrofit Database, inclusive of equipment and installation.[3] Russell, Sherman and Rudd found a similar cost of $1,350 including installation.[4] A study conducted by the National Association of Home Builders (NAHB) indicates the life of HRVs to be 20+ years.[5]

Cost-effectiveness: Analysis shows that HRVs are life-cycle cost-effective in climate zones 6 through 8. Life-cycle cost savings range from $868 in zone 6 to $4,464 in zone 8.

[3] See cost of 70% effective HRV at http://www.nrel.gov/ap/retrofits/measures.cfm?gId=10&ctId=236&scId=2522
[4] Russell, Sherman and Rudd. 2007. LBNL 57730 - Review of Residential Ventilation Technologies. HVAC&R Research, Volume 13.
[5] http://www.deckerhomeservices.com/nahb-study.pdf