# Developing Exhaust Air Energy Recovery Credits for the Florida Energy Code

Bereket Nigusse and Muthusamy Swami, Florida Solar Energy Center, July 17, 2014

## BACKGROUND:

Energy recovery ventilation (ERV) systems help recover wasted energy by using a building's exhaust air to precondition incoming outdoor air and thereby lower energy costs.

Commonly used code compliance software do not have computer models for energy recovery devices. Thus, exhaust air energy recovery credit assessment is usually done by post-processing. The energy savings from energy recovery installation is estimated by applying the percent of energy reduction to the proposed design building HVAC annual energy use. The HVAC annual energy percent reductions that result from ERV installation currently used in Florida are 6% and 4% for Climate Zone 1 and Climate Zone 2, respectively. The ERV system installation credits for commercial code compliance were developed for the 2010 Florida Energy Code. These HVAC annual energy reduction credits are applied uniformly to all building application types and sizes.

## RATIONALE & NEED FOR PROPOSED WORK:

The 2014 Florida Energy Code requirement has changed, and the applicable percent savings credits for energy recovery installation have not been up to date with changes in the latest code. ASHRAE 90.1-2004 and 90.1-2007 require that an exhaust air energy recovery device be used if a fan system meets the following three criterions:

- the design supply air capacity is 5,000 cfm or larger
- the design minimum outdoor air supply is 70% or more of the design supply air
- energy recovery system with at least 50% recovery effectiveness

ASHRAE 90.1-2010 and the 2014 Florida Building Code, Energy Conservation greatly expanded the scope of requirements for energy recovery by establishing a range of values for systems, in some cases lowering the thresholds for design supply air capacity with lower ratios of outdoor air varying by climate zone. The expanded energy recovery device requirements in ASHRAE 90.1-2010 and the 2014 Florida Energy Code depend on the design supply airflow, climate zone, and outdoor air fraction at design supply airflow rate, as shown in Table 1. Also, the standard sets limits on the pressure drop allowed through energy recovery devices.

**Table 1. Energy Recovery Requirements**

| Sources: Table C403.2.6, 2014 Florida Energy Code; Table 6.5.6.1, ASHRAE 90.1-2010 | | | | | | |
|---|---|---|---|---|---|---|
| Climate Zone | % of Outdoor Air Full Design Air Flow Rate | | | | | |
| | 30-40% | 40-50% | 50-60% | 60-70% | 70-80% | ≥80% |
| | Design Supply Fan Airflow Rate (CFM) | | | | | |
| 1, 2 | ≥5,500 | ≥4,500 | ≥3,500 | ≥2,000 | ≥1,000 | ≥0 |

The HVAC annual energy percent reduction resulting from ERV currently in use by Florida Energy Code was developed for the 2010 Florida Building Code. Moreover, the same percent reductions are applied uniformly regardless of building application. Therefore, the existing HVAC energy reduction credits due to ERV installation need to be revised for the latest Florida Energy Code. A percent reduction by building type also needs to be established.

ASHRAE 90.1-2013 even expanded the exhaust air energy recovery for percent of outdoor air ventilation flow rate threshold as low as 10%. This is not included in the 2014 Florida Building Code, Energy Conservation; however, continuous expansion of the ERV requirements to cover a wider range of buildings signifies the importance of installing exhaust air energy recovery devices.

**SCOPE OF WORK**:

**Task 1: Identify Climate Zones and Cities**

It is anticipated that this study will be conducted in Miami, FL, which is Climate Zone 1A, and two or three representative major Florida cities in Climate Zone 2A. The two or three cities in Climate Zone 2A will be selected from four major Florida cities: Tampa, Orlando, Gainesville, and Tallahassee. A set of selected Department of Energy (DOE) reference prototype commercial buildings will be simulated in these four cities to establish the annual cooling and heating energy use by building type. Then the annual energy use and geographic location will be used to limit the number of cities. Cities that show less than 1% total annual energy use differences for a set of selected DOE reference buildings will be represented by one city. This task limits the number of city locations for Climate Zone 2A to a maximum of three. It is envisioned that the total sites that will be investigated for this project, including Miami, will be three or four.

**Task 2: Identify Prototype Building Types**

In this task, different commercial building types will be identified for this computer-simulation-based investigation. It is anticipated that up to eight building application types will be identified for this project. Building application types identified for this investigation include:

- Medium size Office
- Large Office
- Standalone Retail
- Primary School
- Secondary School
- Hospital
- Medium size Hotel
- Large Hotel

The Large Office, Standalone Retail, and Primary School DOE reference building types meet the energy recovery requirements (Thornton et al., 2013) defined in the 2014 Florida Energy Code, Section C403.2.6 Energy Recovery Ventilation Systems. The other building types need to be investigated for whether they meet the 2014 Florida Building Code, Energy Conservation minimum requirements to be considered for this study.

**Task 3: Computer Simulations**

The HVAC system for each reference prototype building will be identified and reviewed. HVAC systems (without ERV) and proposed HVAC systems (with ERV) for each of the candidate-identified building types and climate zones will be created based on the DOE reference buildings. The DOE reference prototype buildings are in EnergyPlus version V8.0. These input definition files (IDF) need to be transitioned to the latest official release version.

Then the annual cooling and heating energy savings potential is estimated from the annual cooling and heating use that is determined by simulating the prototype building with and without ERV for each of the building types identified. Simulation results will be analyzed for effectiveness of ERV operation for each test case, and the state variables output results will be investigated to explain if there are any anomalies in the operation and expected results.

The annual cooling and heating energy differences between HVAC systems with and without ERV for each of the prototype building test case combinations establishes the annual energy savings resulting from the ERV device integration to the HVAC system.

**Task 4: Update ERV Credits**
Develop a schema for estimating the ERV credits calculation based on the system type, number of systems and building type. Based on the results obtained from the investigation of the eight buildings types, recommendations will be made for other building types that are not covered in the simulation study.

**Task 5: Write Final Report**
Write a final report containing the analysis, building type, HVAC system description, assumptions, estimated annual energy savings, schema for ERV systems credits calculation, and recommendations.

**BUDGET & SCHEDULE:**

Estimated Budget $35,200 and 4.5 Person-Months

**OUTCOMES & BENEFIT**:

The two expected outcomes are: 1) expand the energy recovery applicability to wider commercial building types; 2) provide data of percent energy reduction for ERV installation credit calculation compatible with the 2104 Florida Building Code, Energy Conservation. Energy recovery ventilation device installation credits encourage promotion of the state's energy efficient technology expansion. It is anticipated that the report provides data that could be used to update the Florida Building Commission ERV device installation credits calculation. FSEC will deliver a final report describing the findings of the investigation and analysis of the annual energy savings potential due to integration of an exhaust air energy recovery device into the HVAC system based on building type and climate zones in the state of Florida.

**REFERENCES**:

Florida Building Code – Energy Conservation. (2010).

Florida Building Code – Energy Conservation, 5th edition. (2014).

Thornton, B.A., S.A. Loper, V. Mendon, M.A. Halverson, E.E. Richman, M.I. Rosenberg, M. Myer, and D.B. Elliott. (2013). *National Cost-effectiveness of ASHRAE Standard 90.1-2010 Compared to SHRAE Standard 90.1-2007*. Report: PNNL- 22972.