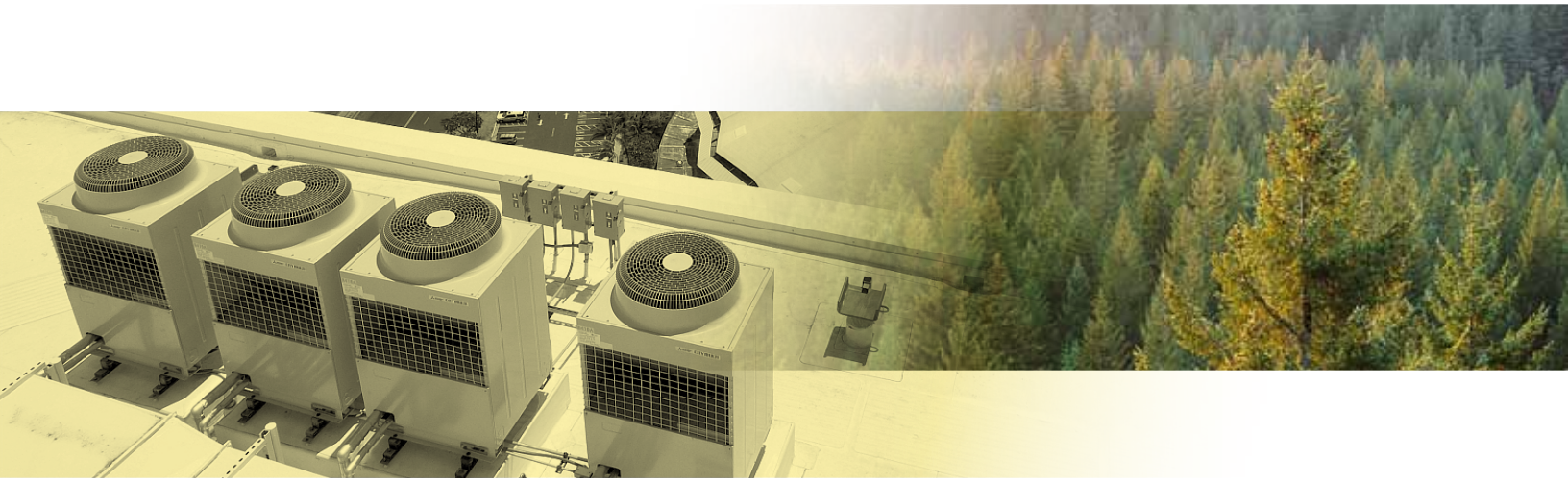
# VRF Zoning Systems: An Innovative Technology for Sustainable Building Design



White Paper

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A state-of-the-art HVAC technology, Variable Refrigerant Flow (VRF) zoning systems are poised for dramatic growth in all areas of commercial construction because they provide precise zoned control that can contribute toward the achievement of LEED® certifications. This paper describes the major benefits of VRF systems and how to garner LEED points by applying these systems.

But first, a quick review of this cutting-edge technology. VRF zoning is a method of providing precise comfort control to buildings with multiple floors and areas by moving refrigerant to the zone to be heated or cooled. The systems, which can simultaneously cool some zones while heating others, have many benefits, including the following:

**Eley Guild Hardy Architects, Biloxi, Miss. LEED Certified**

**Energy efficiency.** Because the Inverter compressor varies its motor rotation speed and capacity (the indoor units vary their capacity, too), the system precisely meets each zone's load. Power consumption is reduced because the system operates only at the levels needed to maintain a constant, comfortable indoor environment. Certain indoor units have sensors that compare air and floor temperatures and adjust the output as needed to optimize comfort.

**Design and installation flexibility.** The compact compressors and components of a VRF zoning system can be installed in smaller indoor and outdoor spaces requiring less piping and duct space. They generally include two refrigerant pipes with a non-polar, two-wire control connection equating to faster installations with fewer installers.

**Lighter weight.** VRF systems are 31 percent lighter than chilled-water systems, so they are easier to handle and cost less to transport. Moreover, the load can be distributed across an existing structure or avoided by mounting on the ground.

**Lower life-cycle costs.** The total installed cost of a VRF system is less than or equal to the total installed cost of most conventional systems. Also, maintenance is greatly reduced and requires no special trades to perform the simple functions of changing/cleaning filters and cleaning outdoor condensing units.

**Quiet operation.** Inverter technology is inherently quiet because it ramps up and down to meet the needs of the space served. In addition, the compressor is encased in sound-dampening insulation to further reduce noise, and the indoor unit is designed for quiet performance.

**Discreet indoor units.** The wide variety of indoor wall-mounted, ceiling-concealed and ducted styles provides more design options than other systems.

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## VRF SYSTEMS HELP ACHIEVE LEED CERTIFICATION

For LEED certification, VRF systems can contribute a great number of points in the Energy & Atmosphere (EA) and Indoor Environmental Quality (IEQ) categories for the following LEED ratings: New Construction and Major Renovations; Core and Shell Development; Existing Buildings; Schools (new and renovation); and Retail (new and renovation). As of Jan. 1, 2012, healthcare facilities have been moved from the New Construction rating into the new LEED for Healthcare program. For all LEED rating certifications, buildings can gain points for the following categories:

### ENERGY & ATMOSPHERE (EA)

**Prerequisite: Fundamental Commissioning of the Building Energy Systems**
A VRF system meets this prerequisite because it has an integrated control system providing for testing, control and reporting.

**Prerequisite: Minimum Energy Performance**
VRF technology provides the means to exceed ASHRAE Standard 90.1-1999, thus achieving the prerequisite for minimum energy performance.

**Credit: Optimize Energy Performance**
The VRF system's inherent energy efficiency provides the ability to achieve high levels of energy savings above ASHRAE Standard 90.1. Inverter technology, heat recovery and zone controls provide the best opportunities for energy savings.

**Gilbert Hall, Pacific University, Forest Grove, Ore., LEED Gold**

**Credit: Measurement and Verification**
VRF integrated controls and maintenance software provide the ability to monitor and report building-energy usage on an ongoing basis in order to meet this credit.

### INDOOR ENVIRONMENTAL QUALITY (IEQ)

**Prerequisite: Minimum IAQ Performance**
VRF systems can meet this prerequisite (Sections 4 through 7 of ASHRAE Standard 62.1-2004) through indoor units with ventilation connections or integrated dedicated outside air systems.

**Credit: Outdoor Air Delivery Monitoring**
Integrated controls for $CO^2$ monitoring can be incorporated into a VRF system. Likewise, certain indoor units utilize MERV 8 filtration to meet the credit's intent.

**Credit: Controllability of Systems — Thermal Comfort**
VRF's zoning capability allows occupant control with wall-mounted remote controllers.

**Credit: Thermal Comfort — Design**
VRF systems and the building envelope must be designed to meet requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy.

**Credit: Thermal Comfort — Verification**
When properly designed into a building, VRF systems provide temperature and humidity control in accordance with ASHRAE 55-2004 guidelines.

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Other LEED points also can be gained in the following specific ratings:

## HEALTHCARE IEQ

**Credit: Acoustic Environment**

Many VRF indoor units have tested noise levels that fall at or below the given ranges in the 2010 FGI Guidelines' Table 1.2-2 Minimum-Maximum Design Criteria for Noise.

**Credit: Community Contaminant Prevention-Airborne Releases**

VRF systems do not include any gas-fired equipment, so there are no products of combustion to contain.

## SCHOOLS IEQ

**Prerequisite: Minimum Acoustic Environment**

Many VRF system indoor units have tested noise levels that fall at or below 45 dB(A) as specified.

**Credit: Mold Prevention**

When properly designed into a building, VRF systems meet humidity requirements.

VRF systems are sustainable, cost-effective HVAC solutions that offer many benefits, including energy savings, increased comfort, design and installation flexibility, lower maintenance costs and quiet operation. As important, VRF technology offers the ability to capture a significant number of points toward LEED certification. For more information about how VRF systems can contribute to LEED certifications, visit the U.S. Green Building Council's website at www.usgbc.org.

## CASE STUDY: GEORGIA POWER

### VRF Zoning Preserves Historic Building While Meeting Owner's LEED Platinum Goal

VRF zoning systems from Mitsubishi Electric Cooling & Heating, Suwanee, Ga., have been used in many LEED-certified commercial projects — from Certified to Platinum rated — including the restoration of a concrete structure that was transformed into the Coastal Regional Office for Georgia Power. Built in 1920 as an automobile factory and supply store, 28 Abercorn Street is a two-story, 11,400-square-foot building purchased for $2.6 million in November 2009 by Georgia Power, which wanted the structure to be a corporate metaphor for green building practices.

**Georgia Power, Savannah, Ga., LEED Platinum**

"From the beginning of the design process, everyone agreed that our sustainability goal should be LEED 2009 NC Platinum," said James (Jimmy) Swails, PE, LEED AP, principal for the Savannah-based engineering firm Dulohery Weeks, Sustainable Engineering.

To achieve this goal, the design team set out to capture every possible credit for energy optimization. The strategy mandated an ultra-efficient HVAC system because of the high cooling and dehumidification

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**Georgia Power, Savannah, Ga., LEED Platinum**

loads demanded by the coastal climate. The relatively small structure offered minimal space for ductwork, which narrowed the field of acceptable HVAC system choices.

Architect Patrick Shay, AIA, LEED AP, Gunn Meyerhoff Shay, Savannah, agreed to explore Variable Refrigerant Flow (VRF) zoning heat pump systems because he and Swails had successful experiences with VRF systems from Mitsubishi Electric. "We found them to be very efficient, flexible and especially suitable for historic building renovations and tight spaces," Shay said.

In the end, architect and engineer recommended the Mitsubishi Electric technology. "The VRF split-ductless, two-pipe system designed by Mitsubishi Electric enabled us to maintain the beauty and integrity of these generous spaces by providing a wide variety of indoor air handlers connected through minimal piping and wiring to the outdoor condensers," Shay noted. "Through the ingenuity of Inverter technology, we're able to supply the ultimate in precise indoor comfort control, which led to LEED credits and significant energy conservation." The building garnered 84 points; 80 are required for LEED Platinum certification.

"When you have the proper HVAC technology, engineering and equipment, historic preservation and energy conservation are a perfect partnership, like hand-in-glove," Shay concluded.

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**For more information** about Mitsubishi Electric HVAC products, visit www.mitsubishipro.com.

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