

# Portal To Profitability

Variable Refrigerant Volume  
HVAC Systems

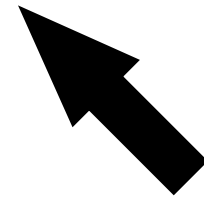
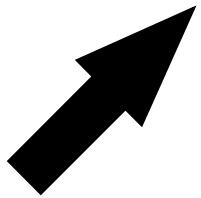
Exploiting Each Kilowatt

Jim Dale

28 June 2010



V R F / V



**Variable Refrigerant**

**Flow**

**Volume**

# History

- VRV was developed in response to the 1970's oil crisis and the resulting strict energy efficiency laws in Japan
- **VRV/V Concept**
  - 1- System Simplicity
  - 2- Low Energy consumption
  - 3- Individual Operation
  - 4- Design Flexibility
  - 5- Easy Installation
  - 6- Advanced Control
  - 7- User Comfort
  - 8- Versatile
- Introduced in Japan 1982
- Introduced in Europe 1987
- Introduced in North America 2001

# Available VRF/V Suppliers Worldwide

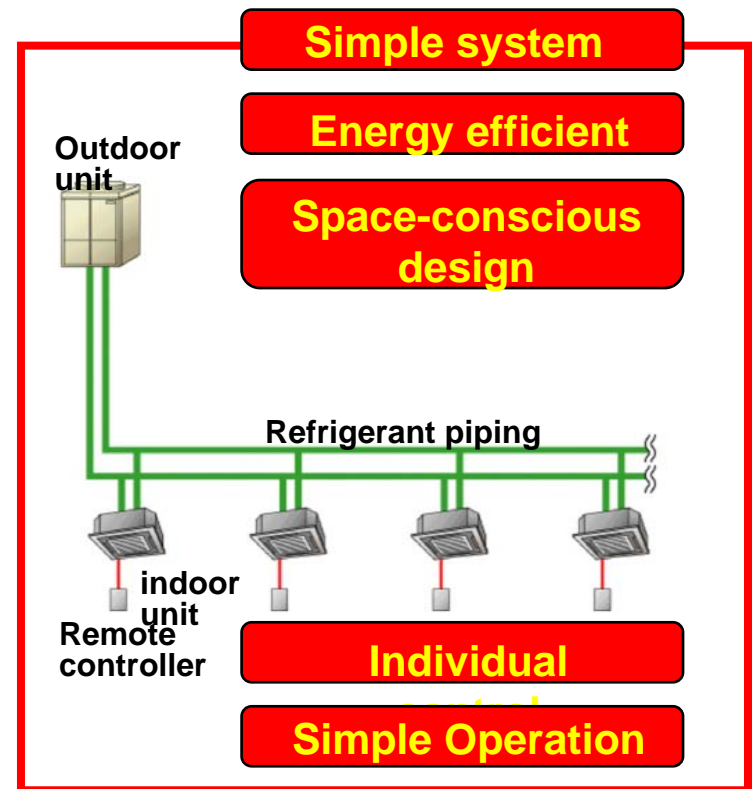
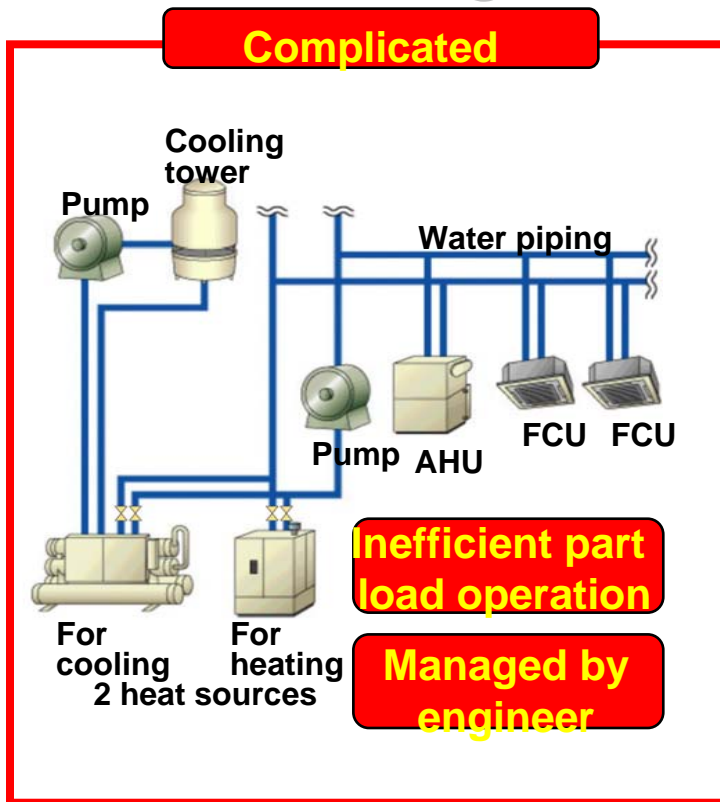
## Existing Suppliers

- Daikin, VRV and VRV-S, VRV-W
- Mitsubishi Electric , City Multi
- Hitachi ,Set free
- Sanyo , Eco Multi
- Fujitsu , Airstage
- Panasonic
- Toshiba MM-S Modular Multi
- LG , Multi V

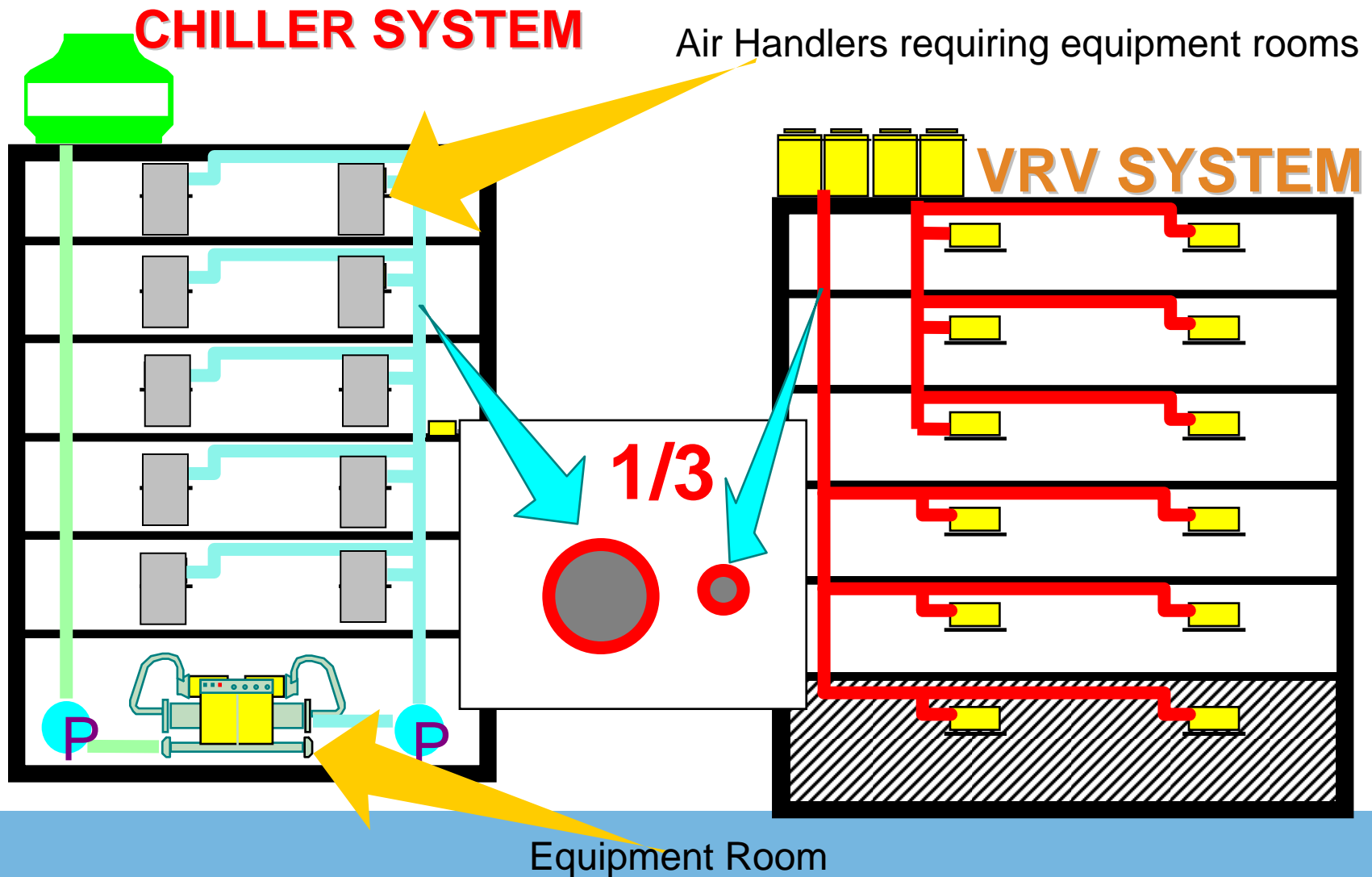
Some manufacturers do not have the VR technology, but have a multi zone system with an un-loader compressor: Samsung DVM, Midea, Haier

Let's think of the VRV system as a hot / chilled water system that employs refrigerant instead of water

# Central System



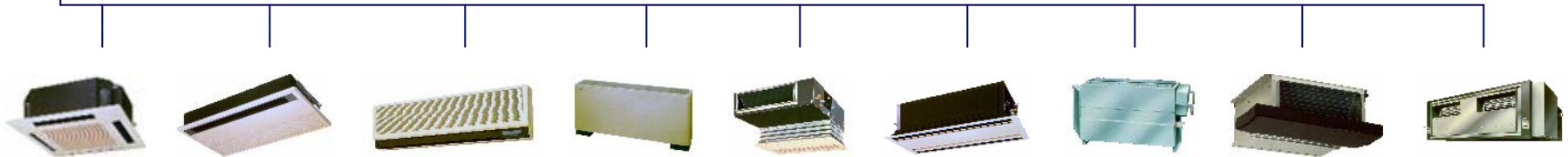
# Efficient use of space



# System Design



- Factory set suction temperature.
- PID (Proportional, Integral & Derivative) - control in every indoor unit
- Complete variable capacity modulation.



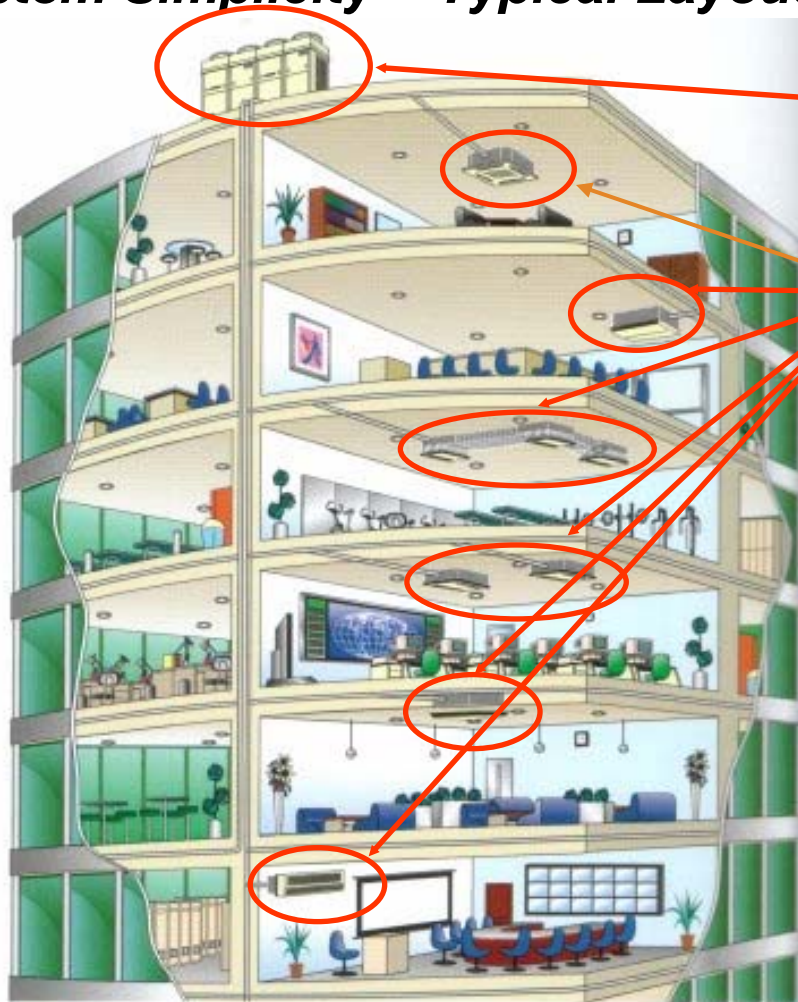
- Multiple Indoor Units
- Individual Control
- Modular Build-up
- Energy Saving @ full and part-load
- Cost Effective
- Low Noise



# VRV Concept

## 1- System Simplicity – Typical Layout

Air cooled shown, also available  
in water cooled



**Outdoor Unit**

**Indoor Unit**

Main features:-

- Energy Saving
- Individual control
- Long refrigerant Piping
- Wide range of units
- Low Noise Level
- Less interior space used

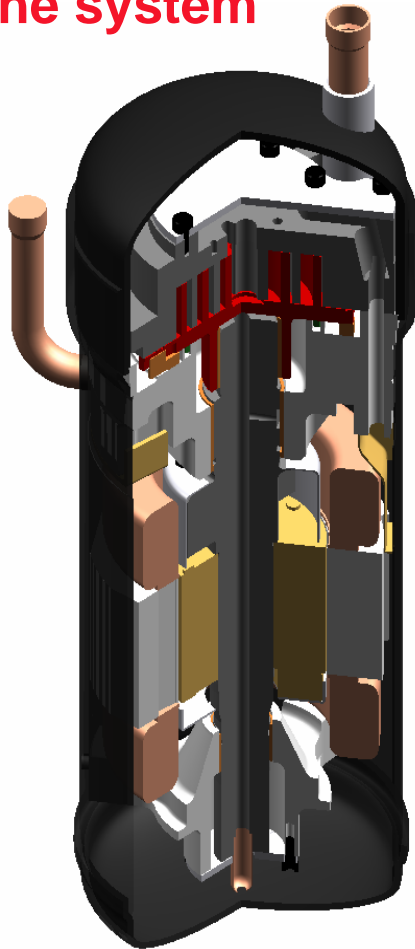




**Available fan coil  
configurations**  
**From .5 ton to 8 ton**

# High Performance Scroll Compressor

## The Heart of the system

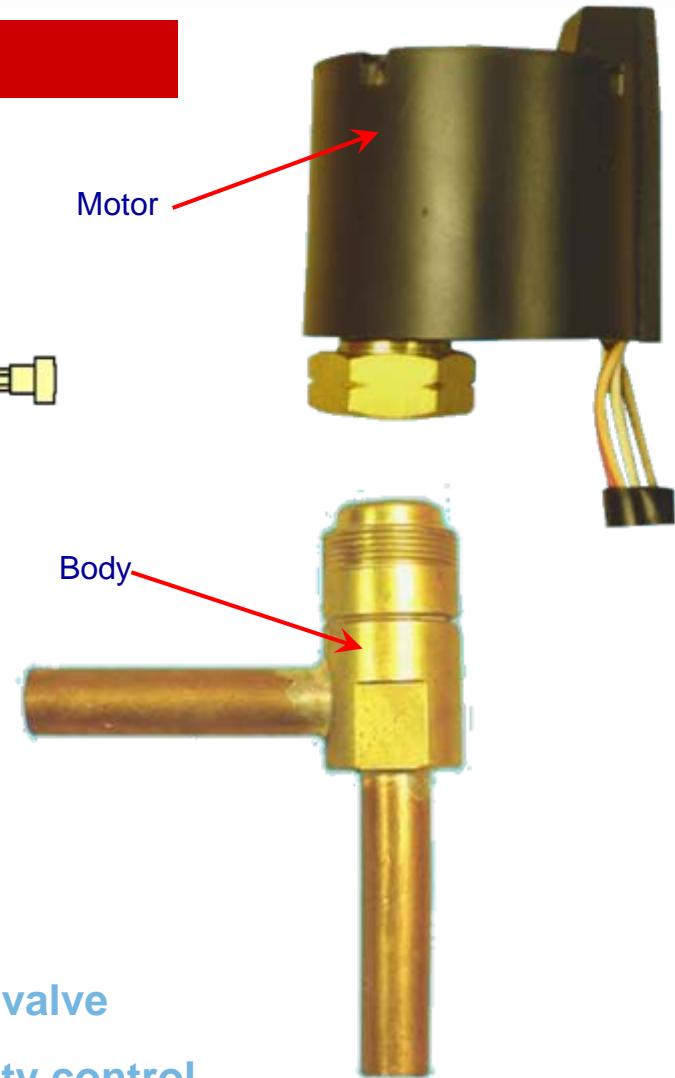
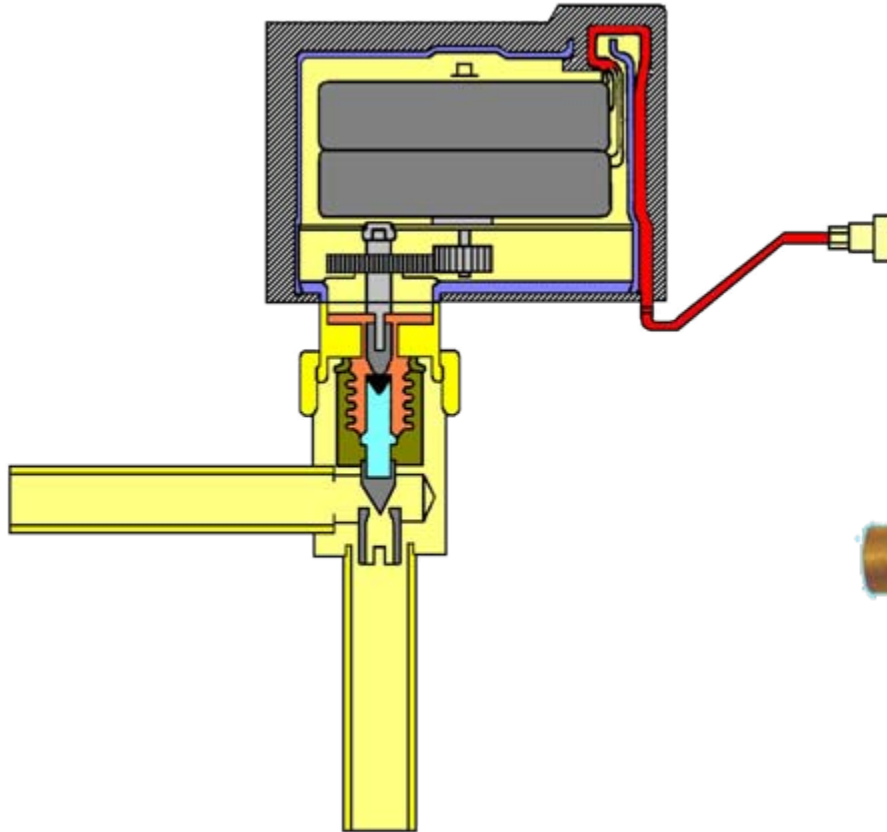


- Reluctance DC Motor
- Inverter driven
- Optimized Scroll (R-410A)
- High Pressure Shell
- Stronger Shell material
- Improved Sealing
- Stable oil temperature
- Improved efficiency
- Improved Reliability



# Electronic Expansion Valve

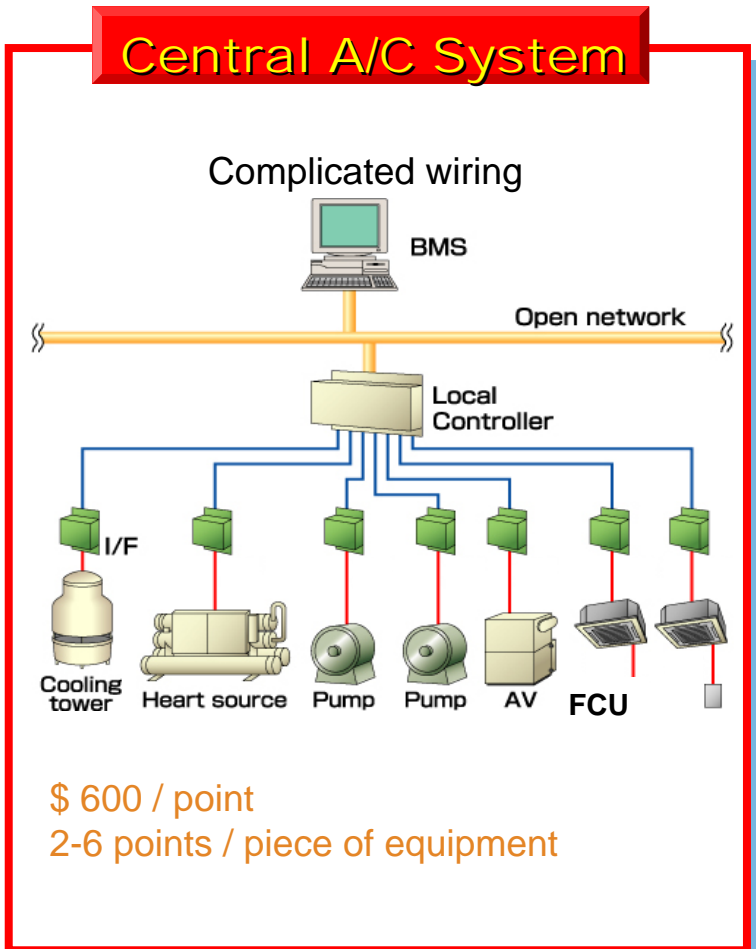
**In Every Indoor Unit**



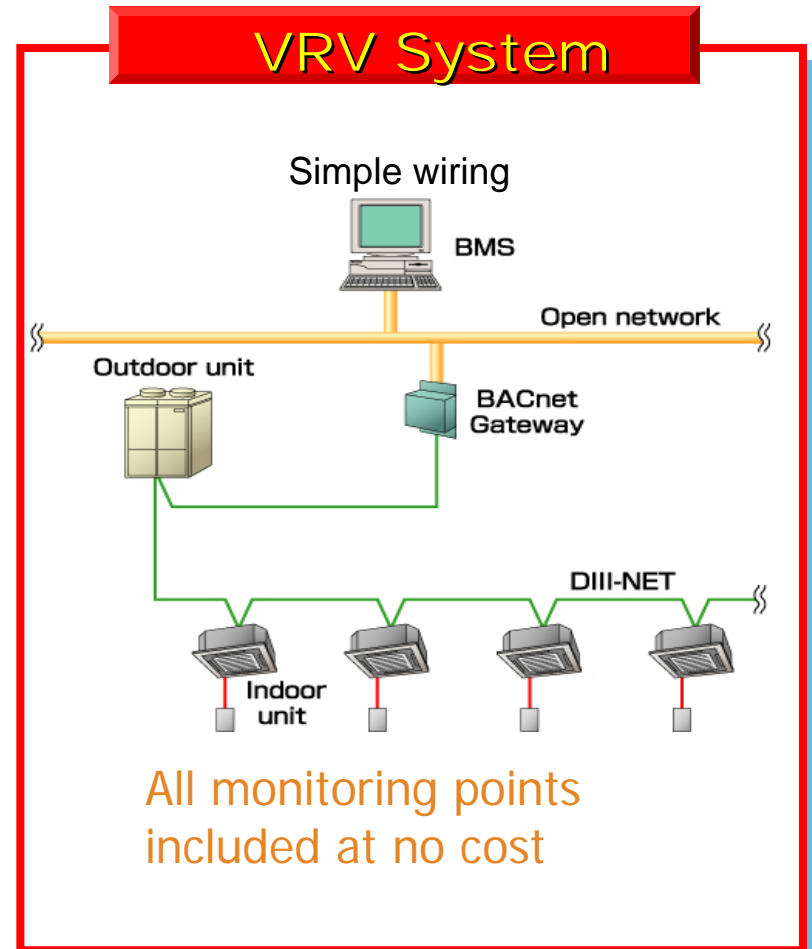
2,000 pulses (Steps) in every valve  
For precise temperature & humidity control

**Unlike the standard systems the VRV systems comes complete with Direct Digital controls factory installed w/o additional costs other than installation of the communication network**

### Central A/C System



### VRV System



# VRV Operation -(electric power research institute)

VRV consumed 40-48% less energy and provided a more comfortable environment compared with conventional Ducted System.

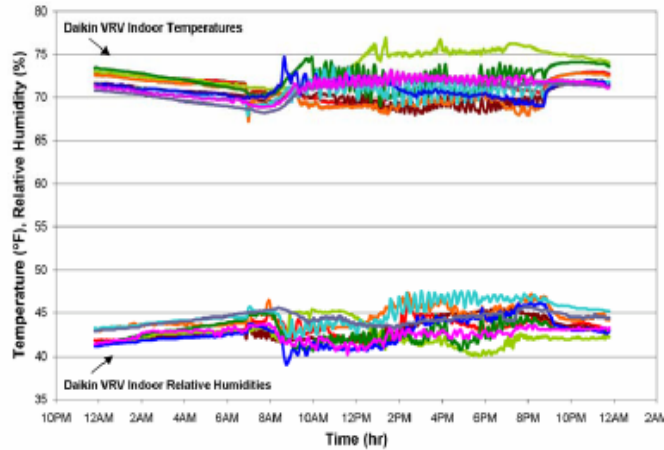


Figure 5-8  
Daikin VRV Daily Indoor Conditions Profile (October 5, 2008)

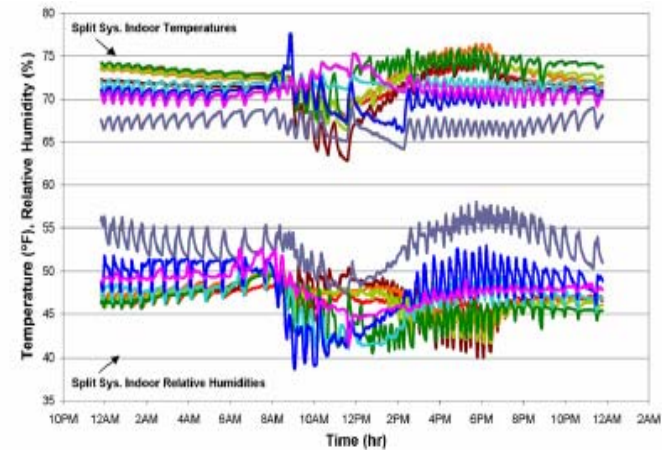


Figure 5-7  
Split System Daily Indoor Conditions Profile (October 11, 2008)

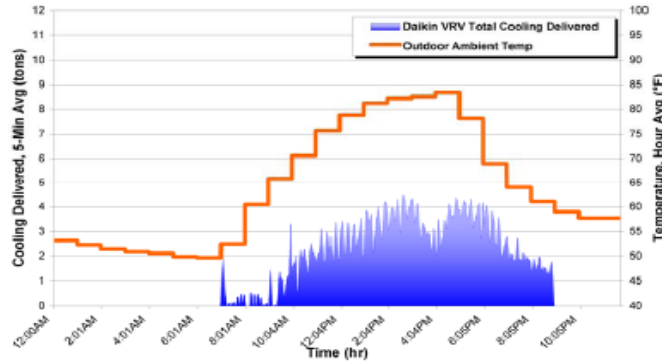


Figure 5-6  
Daikin VRV Daily Cooling Delivered Profile (October 5, 2008)

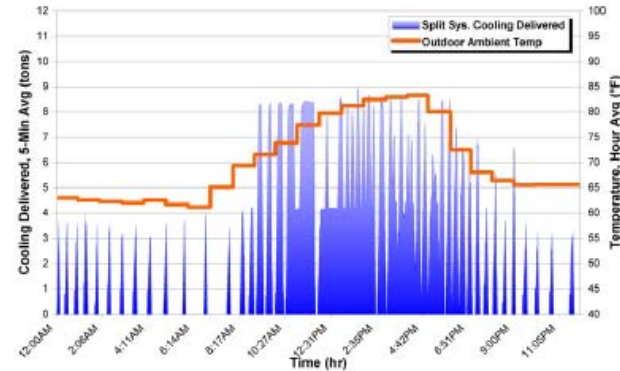
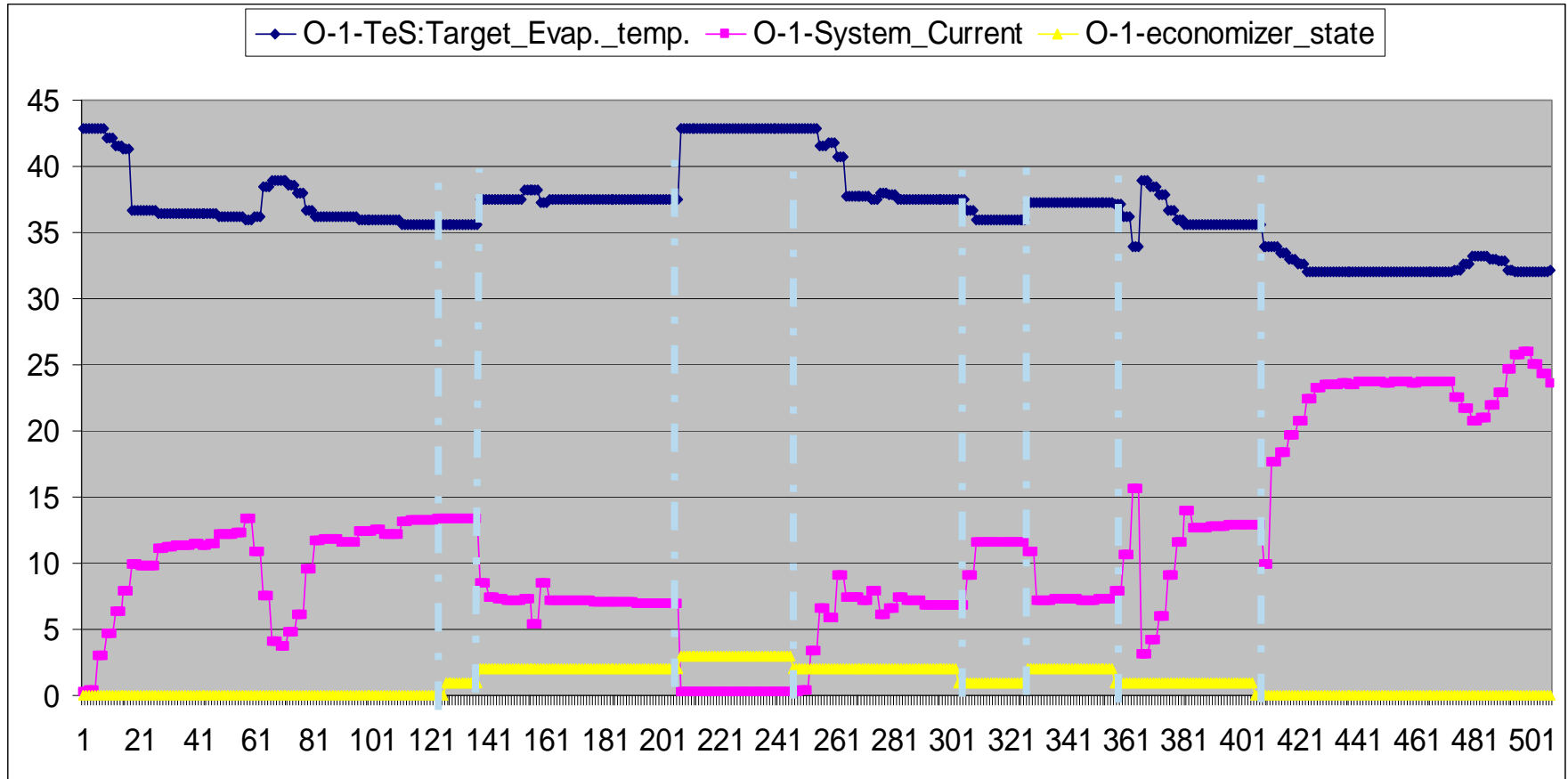


Figure 5-5  
Split System Daily Cooling Delivered Profile (October 11, 2008)

# Multiple stage Mechanical Economizer

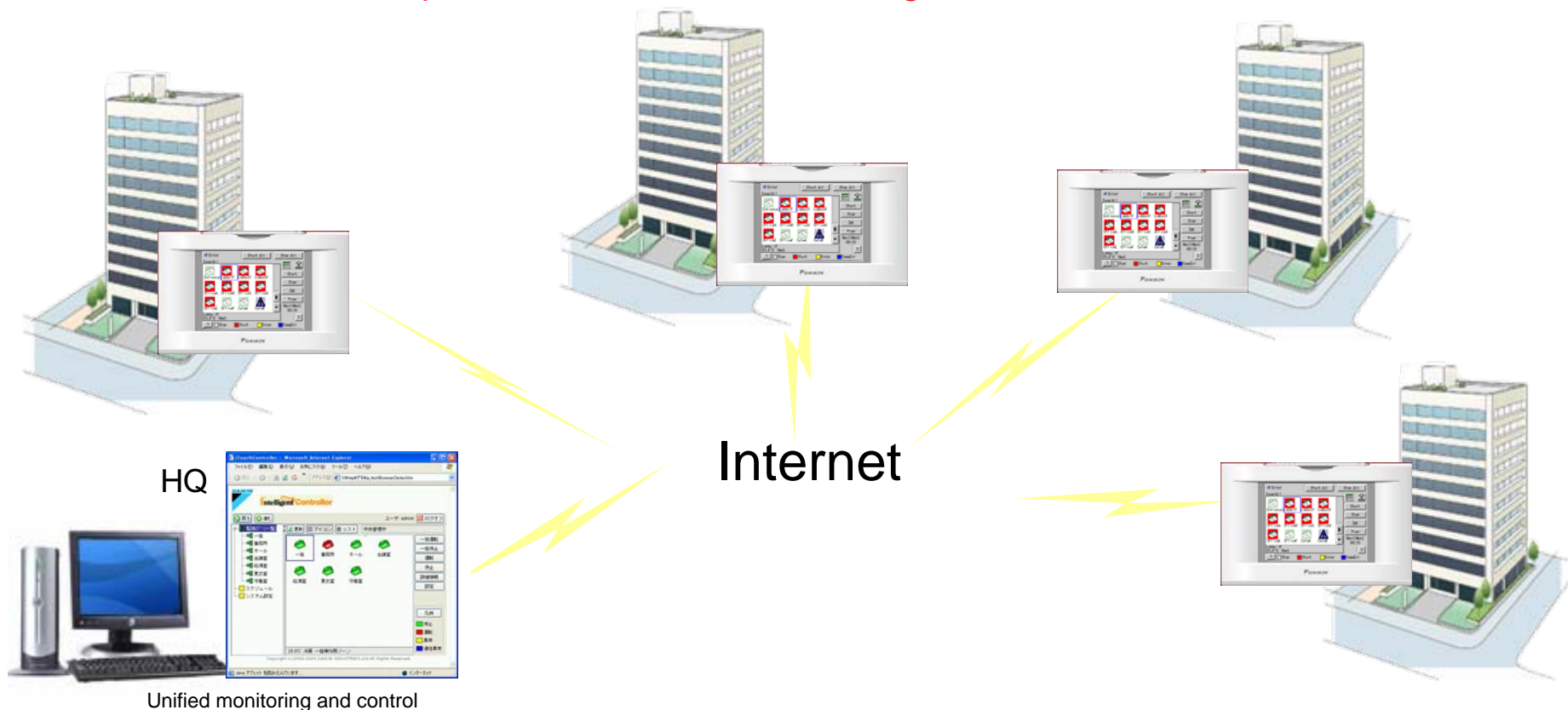
example of 6 ton HR with 4 indoor units totaling 6 tons





## Centralized Monitoring and Control via Web Browser

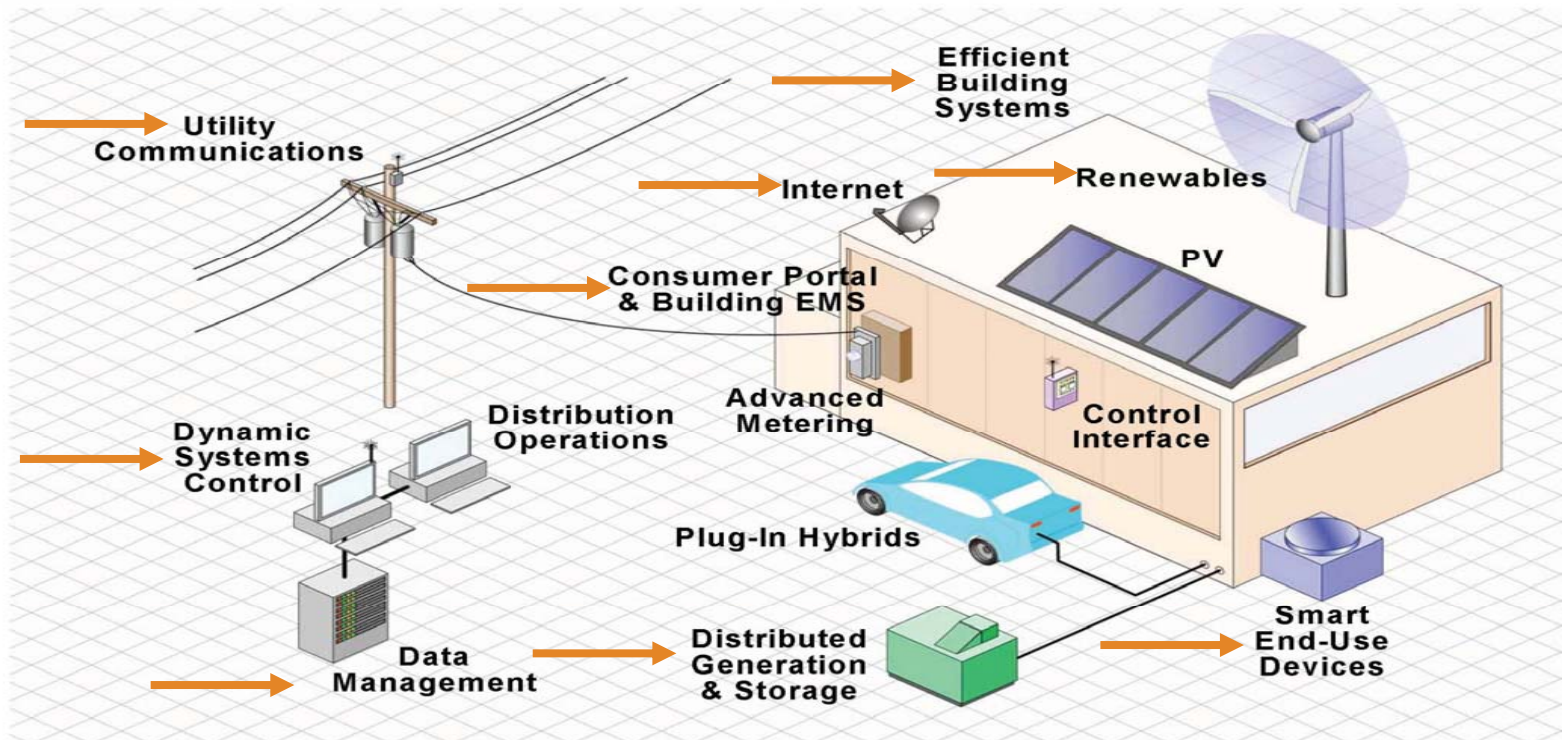
- Remote monitoring of more than one building
- Allows each tenant or department to access and manage, via internet, their environment





# Creating an Intelligent Grid: *Consumer Opportunities*

How VRV systems can contribute to  
The success of the “Smart Grid”



**Energy efficiency and demand response is a driver that will greatly accelerate the creation of a smart grid**