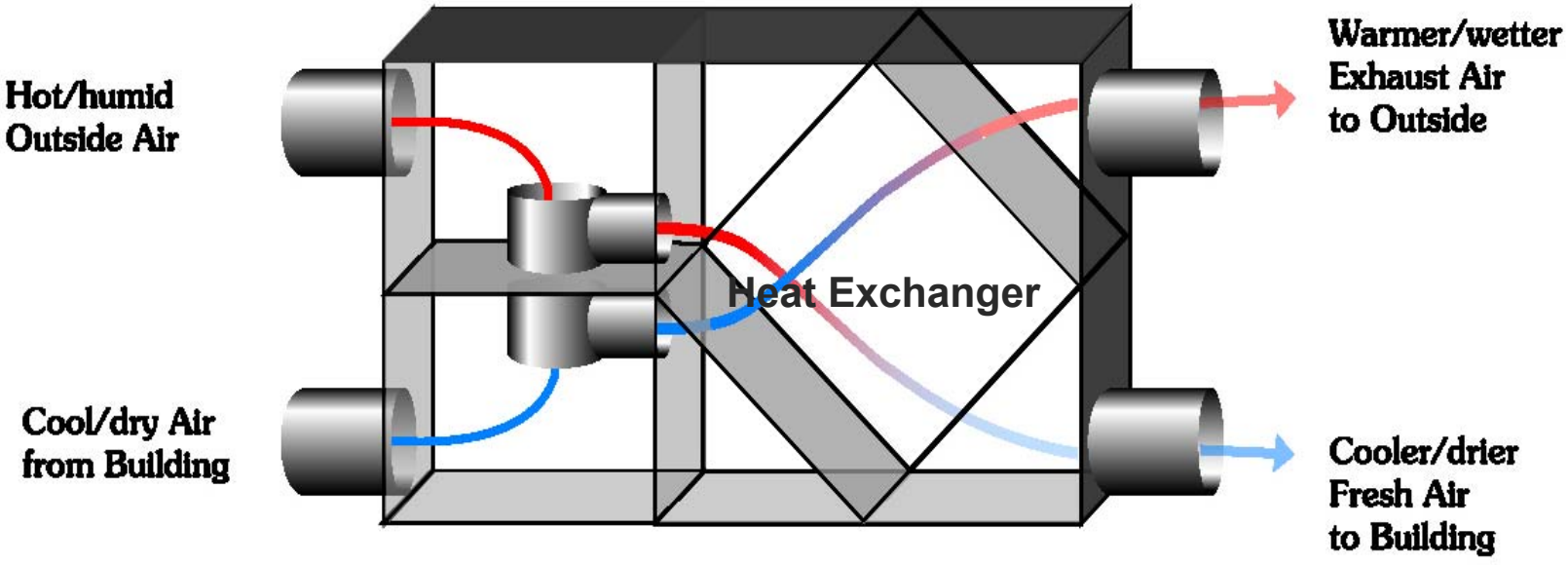
Dais-Analytic High Latent Fixed Plate Energy Recovery Ventilator

Dais-Analytic Corp

What is Energy Recovery Ventilation?

- Preconditioning of fresh outside air by using exhaust (return air) from a building
- Air to air energy exchange
- Typical types of ERV:
  - Enthalpy wheels
  - Heat pipes
  - Fixed plate heat exchangers

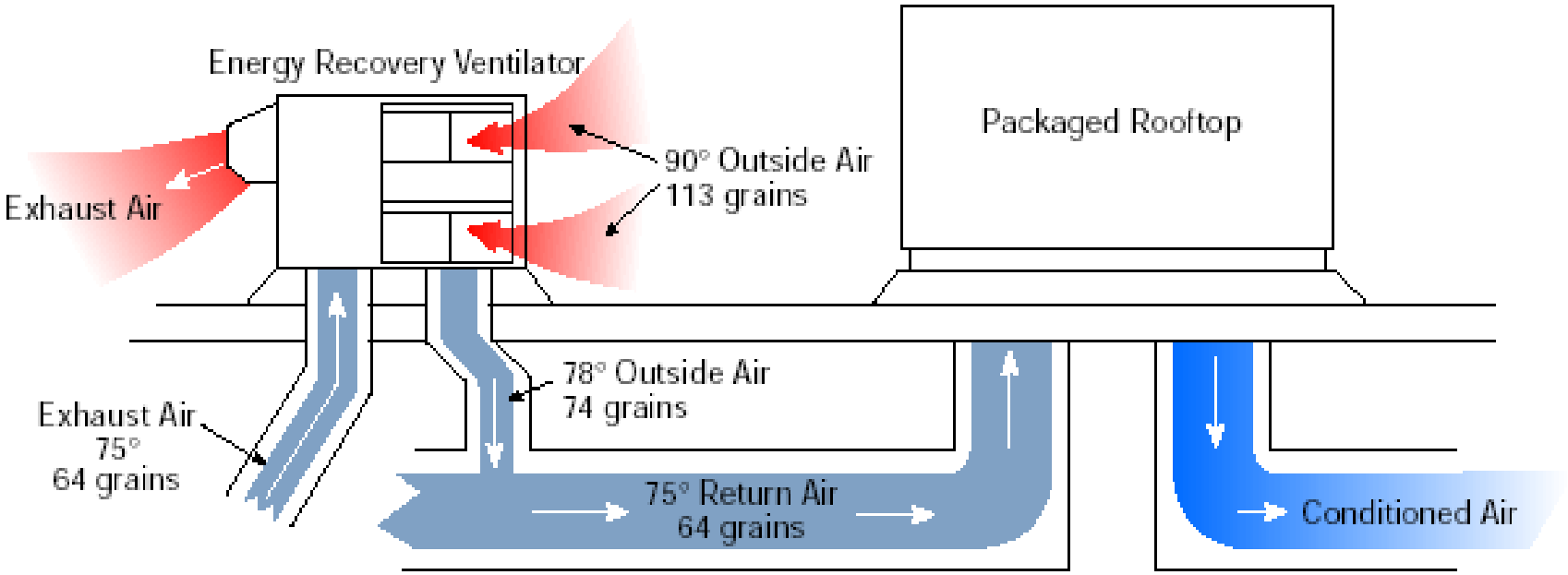
Heat Exchanger: Used to Precondition Outside Air



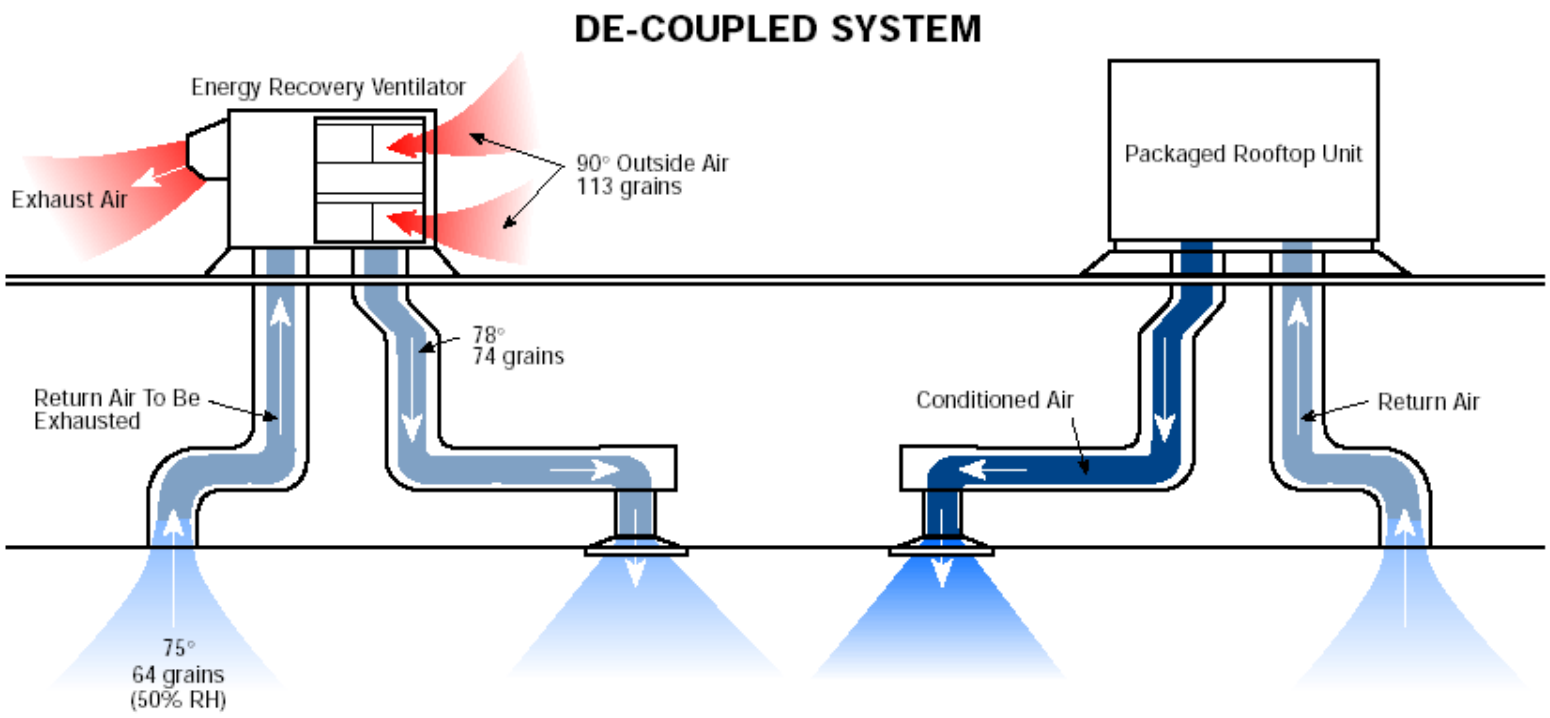
Dais Analytic Membrane Core
The heart of the system.
The membrane energy
recovery core has both
sensible and latent transfer.

- Pre-Cools air during the summer
- Pre-Heats air during the winter

Typical Installations



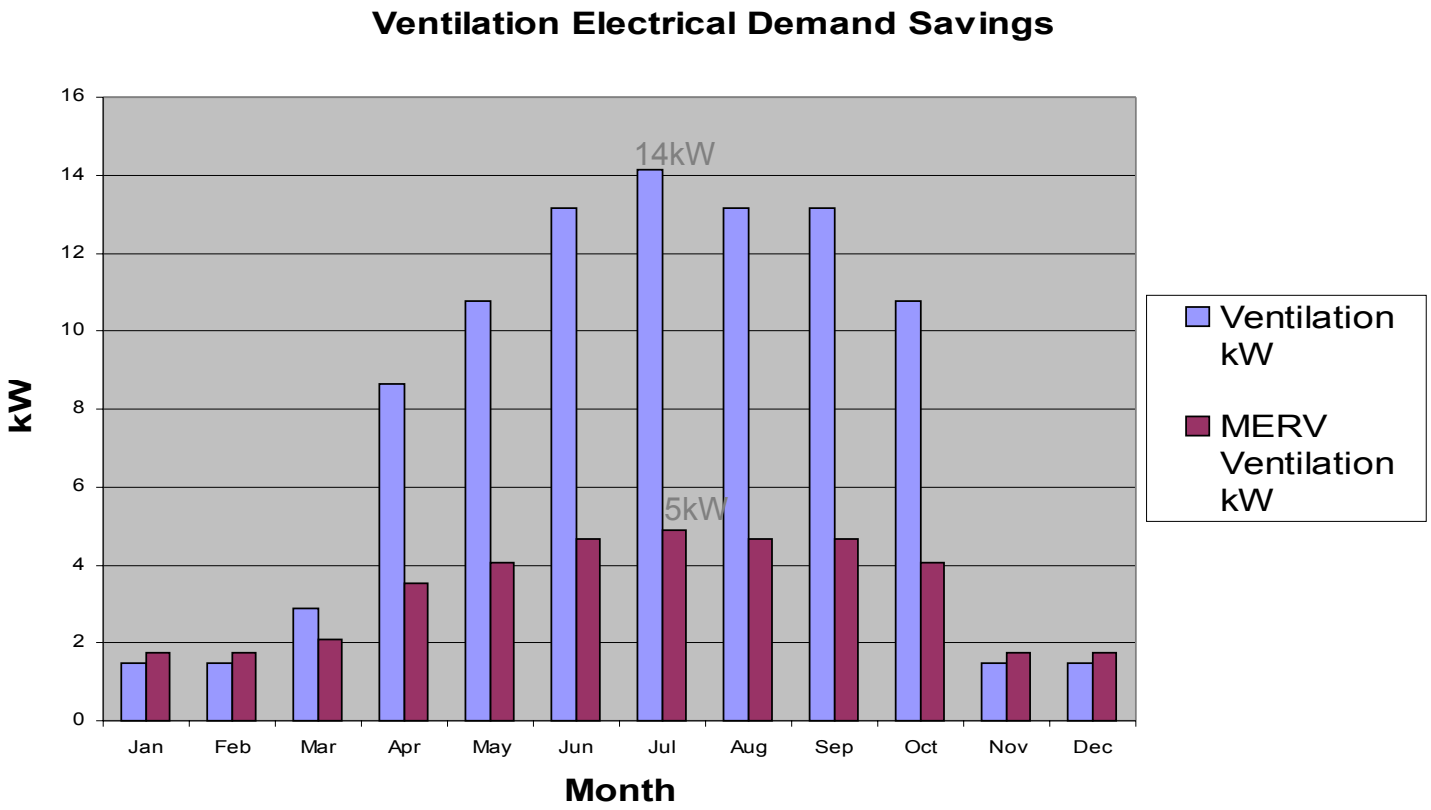
Decoupled from Packaged Rooftop



ERV Benefits

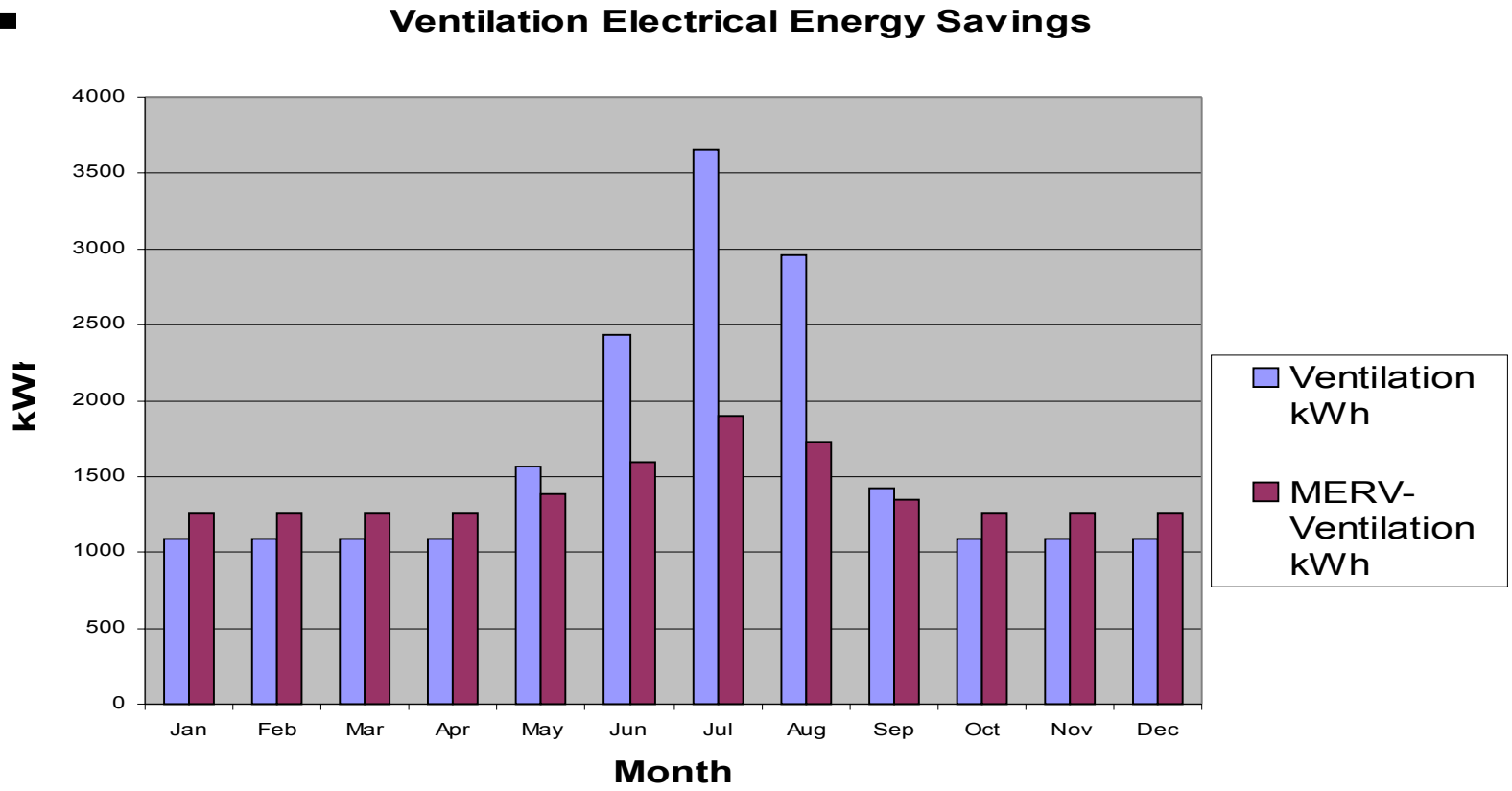
- Reduces building loads
  - 1/3 can be loads due to conditioning OA
  - Saves $
  - Allows for downsizing other HVAC equipment
  - Saves peak KW and KWH
- Controls moisture in buildings (if using ERV that can transfer latent)

Demand Savings(kW) Projection – Walmart



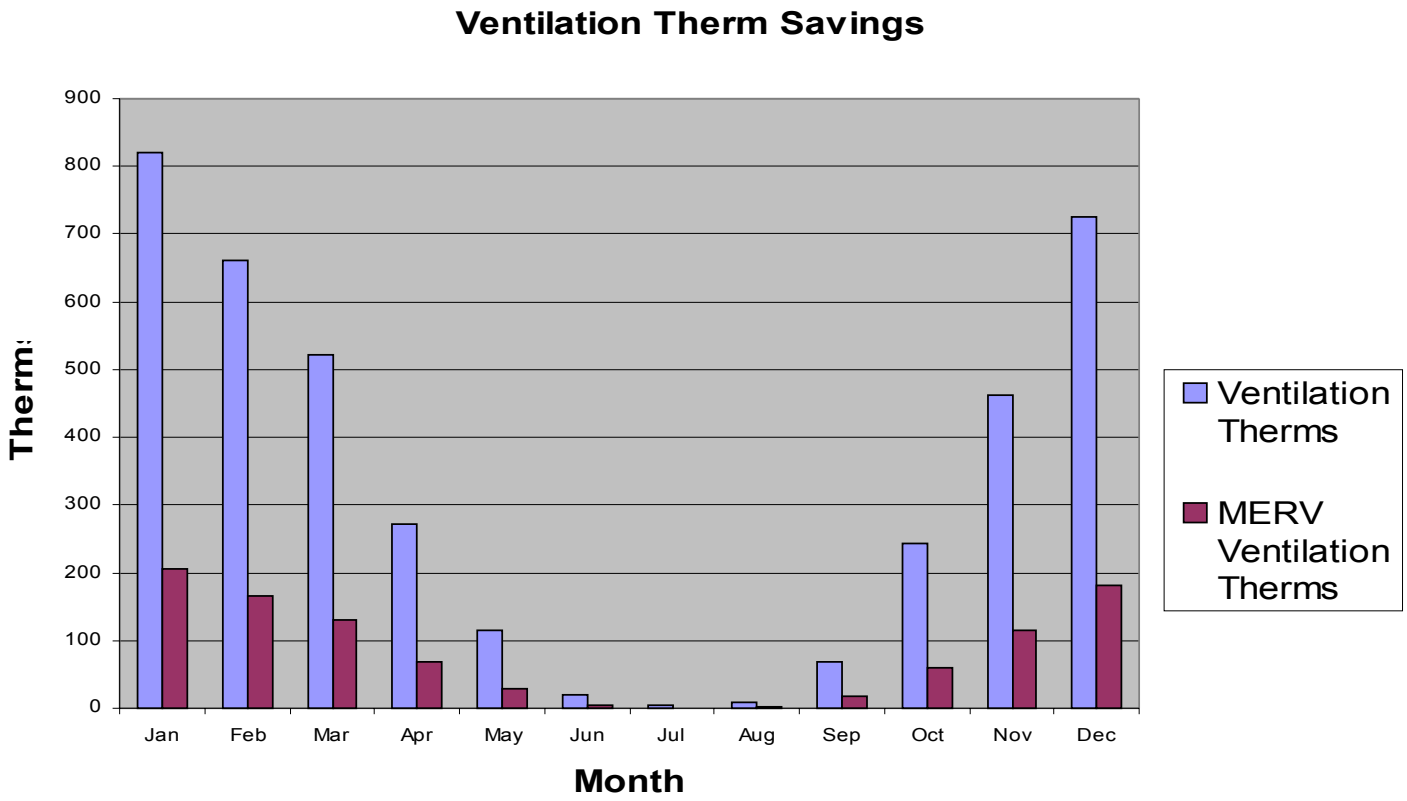
Ventilation Peak Demand = 14kW
MERV Ventilation Peak Demand = 5kW
Peak Demand Savings = 9kW 64%

Energy Savings (kWh) Projection – Wal-Mart



Ventilation Energy = 19,640kWh
MERV Ventilation Energy = 16,781kWh
Total Energy Savings = 2,859kWh 15%

Therm Savings Projection – Wal-Mart

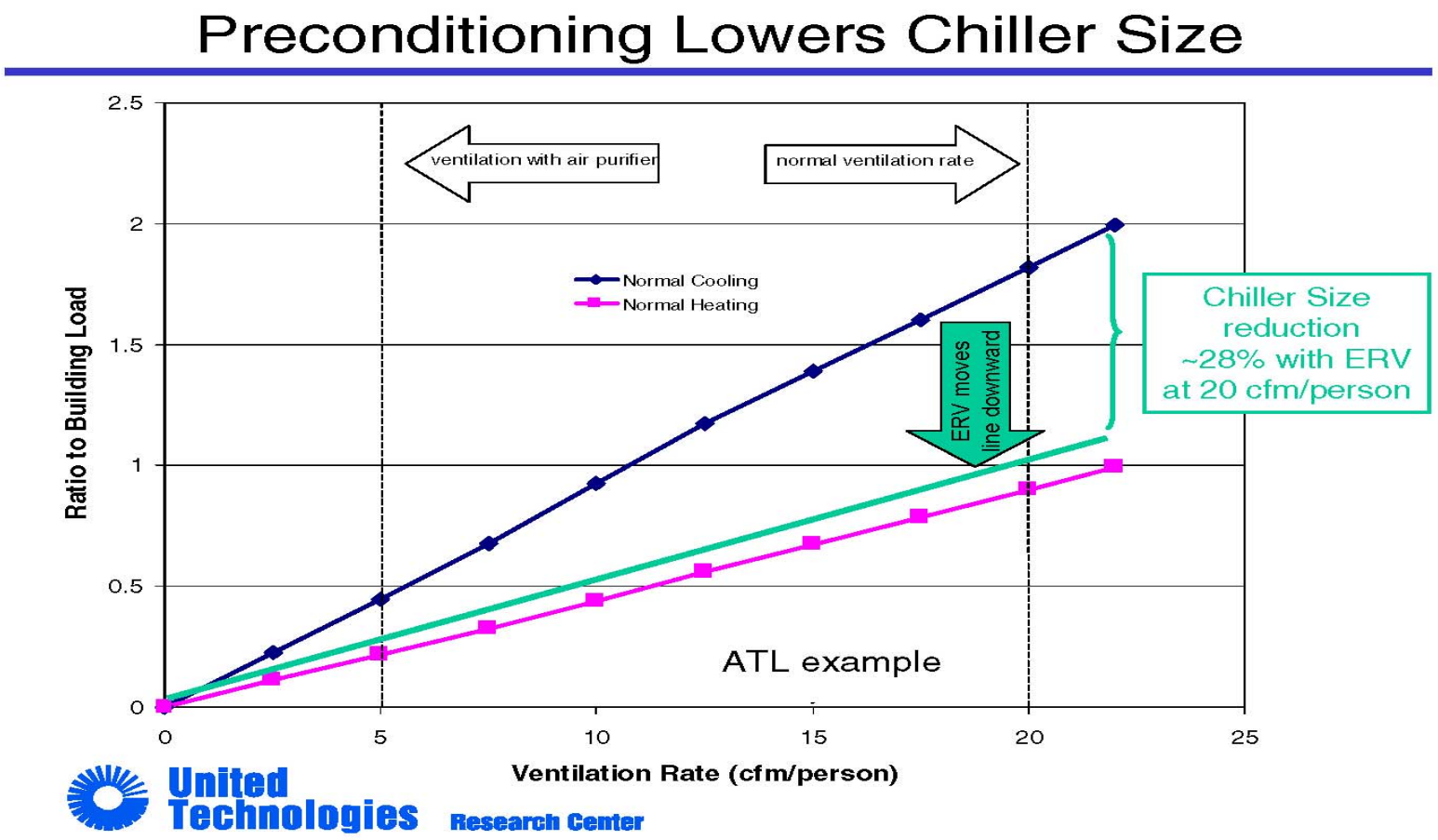


Ventilation Therms = 3922 therms
MERV Ventilation Therms = 980 therms
Total Therm Savings = 2,942 therms 75%

Downsizing HVAC Plant

- Conditioning of outside air can account for up to 1/3 of a building's cooling load
- Load is reduced by using ERV
- Example:
  - AC plant reduced from 40 ton load to 30 tons
  - At $500/ton AC installed cost
  - Owner saves $5,000 towards first cost of AC

Downsizing Cooling Equipment Using Dais ERV



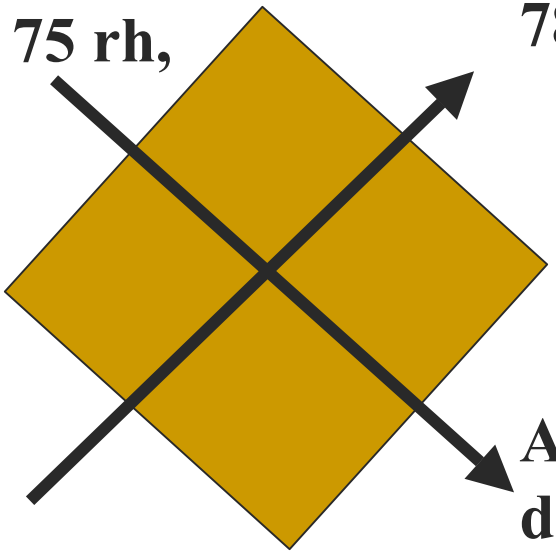
* Presented by United Technologies/Carrier to the US Environmental Protection Agency January 2002

Typical School Downsizing Savings

- Elementary school
- Originally designed at 345 tons
- Using ERV with 65% total effectiveness
  - Reduced load by 85 tons
  - Payback 2.2 years

Moisture Control at Part Load

Outside Air @ 82 db, 75 rh, 105 grains



78 db, 62%, 94 grains

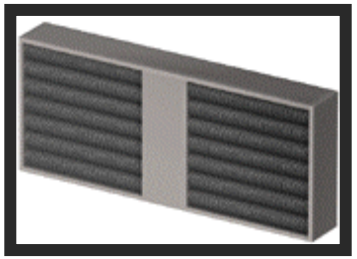
Air to Building @ 78 db, 67%, 92 grains

Return Air @ 77 db, 47%, 65 grains

ERV Technology Comparisons

Types of ERV

Enthalpy wheels: good moisture transfer, higher cost, maintenance



Heat pipes: metal pipes carrying refrigerant, no moisture transfer, sensible only

Fixed plate exchangers: sensible only until now, low cost and maintenance

So, what's different?

- FIXED PLATE Energy Recovery Ventilator
  - High Latent
  - High Sensible
- No rotating parts or excess energy required
- Better peak energy reduction
- Fixed plate has inherently low or no leakage between airstreams
- Energy transfer is in the vapor state - No condensation or drain pans required

Hi Latent Fixed Plate Installation

Heat <u>and</u> moisture exchange in a fixed plate

In the vapor state; no moisture collection in unit

Advantage Over Enthalpy Wheels

- No rotating parts
- Better part load performance
- Less energy and demand usage
- Nothing to “break”
- Failsafe for downsizing HVAC plant – the air flows through the same paths always
- No/low leakage between airstreams

Effectiveness Ratings of ERV Technologies

(Component Testing at ARI Standard 1060 Conditions, June 2002)

Effectiveness	Enthalpy Wheel	Heat Pipes	Other Fixed Plate	**Dais ERV**
Sensible (Summer Conditions)	75%	45%	75%	**75%**
Latent (Summer Conditions)	70%	0%	25%	**75%**
Sensible (Winter Conditions)	75%	50%	78%	**77%**
Latent (Winter Conditions)	70%	0%	28%	**75%**

The membrane ERV has the effectiveness of an enthalpy wheel with no moving parts!

Monitoring of Various ERV Technologies - Field Installation

Florida Power
A Progress Energy Company

ERV Monitoring - Sunray Elementary School

New Port Richey, FL 450 CFM ERV

Based on Normalized Outside Air Enthalpy(40.58 Btu/lb)

	Max Temp Reduction Across Unit	Max Enthalpy Reduction Across Unit	Tons Saved	Peak Kw Saved
Wheel Type ERV	6.46	6.11	1.38	0.16
Fixed Plate ERV	6.53	5.09	1.00	0.57
Membrane ERV	8.10	7.37	1.42	0.99

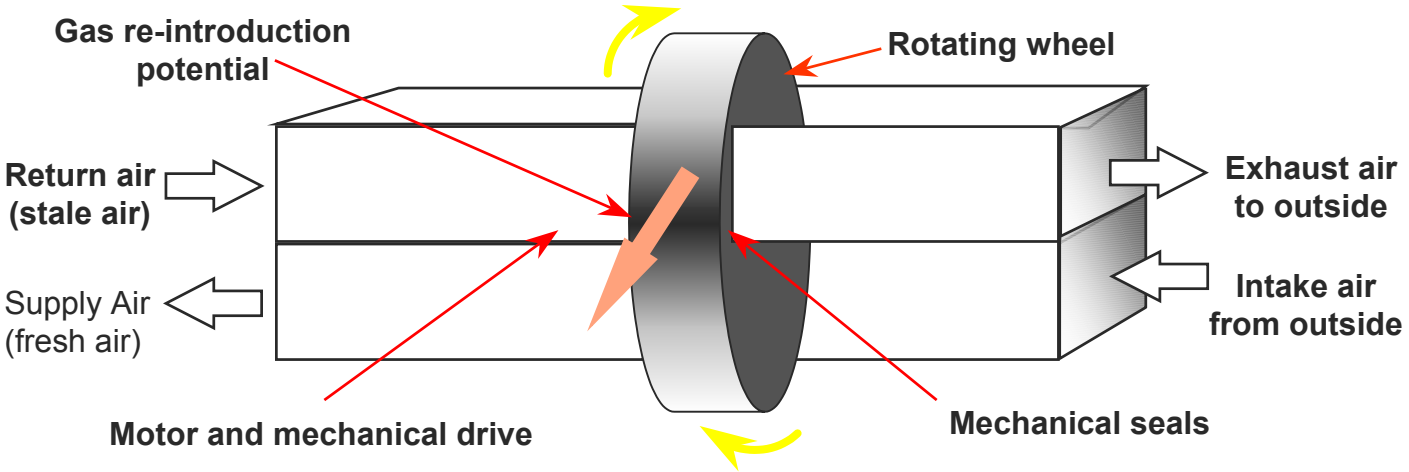
OA enthalpy equivalent to approximately 85 deg F and 60% rh

Monitoring of Various ERV Technologies - Field Installation

Florida Power
A Progress Energy Company

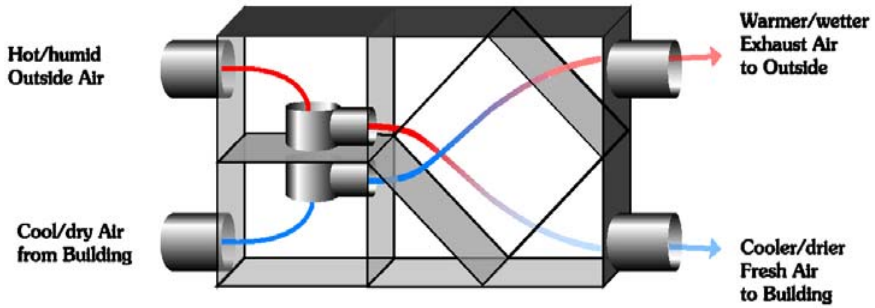
	KW/Ton Cooling Measured
Wheel Type ERV	0.88
“Sensible” Fixed plate ERV	0.45
Dais-Analytic Fixed Plate ERV	0.32

Downsizing Risk Using Wheels



“No Risk” Downsizing

- No rotating parts required for heat exchange – no failure mode
- Air will always proceed in the same path



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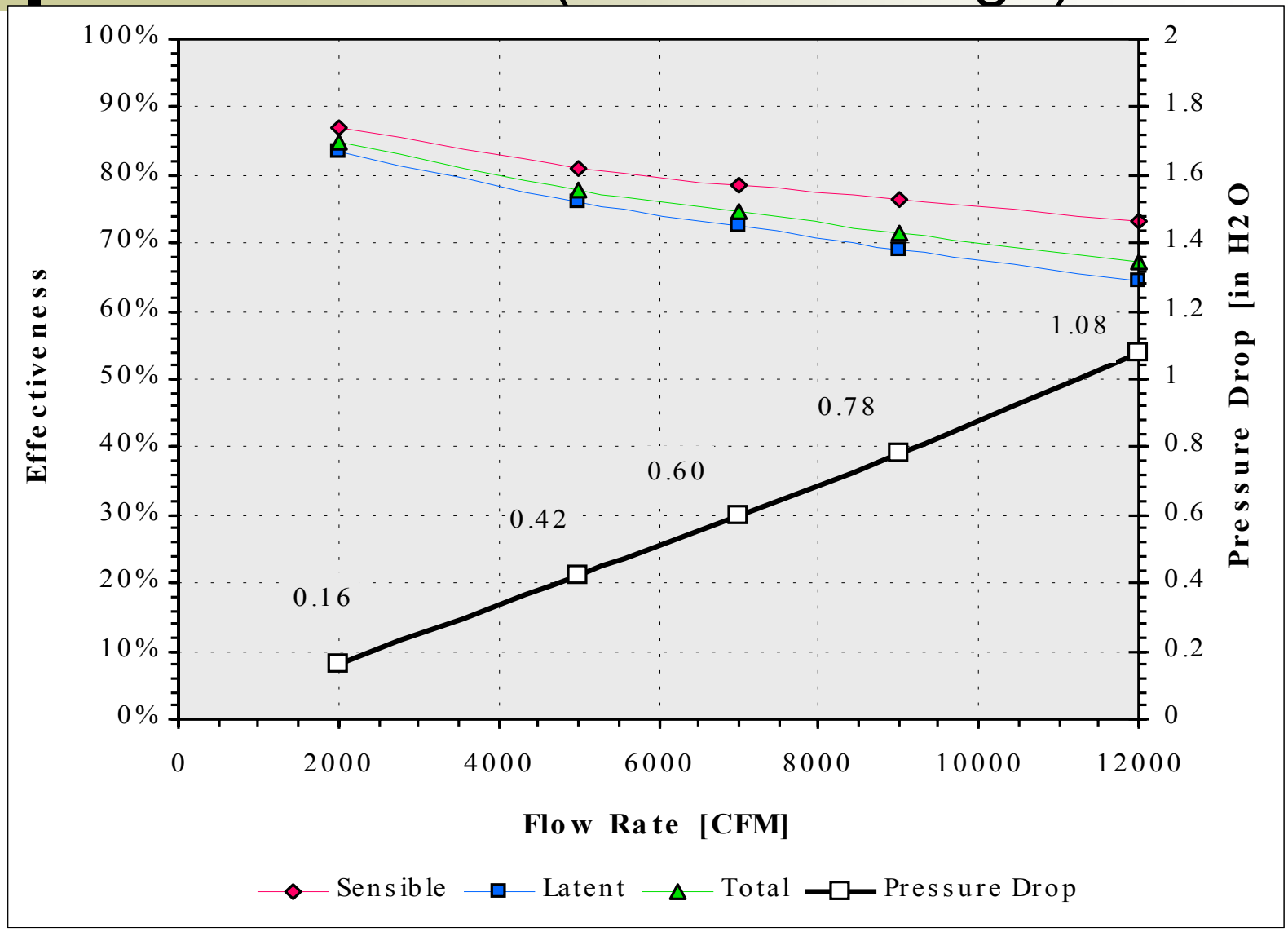
Performance of Dais Analytic

Laboratory

- Air Conditioning and Refrigeration Institute (ARI) lab
- National Renewable Energy Lab (NREL) – part of DOE
- In House

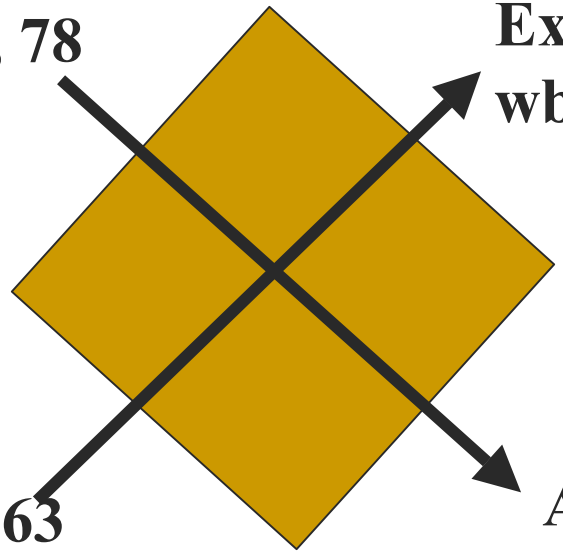
Field Trials

Performance Ratings at ARI conditions 9000 cfm rated (ZERO Leakage)



Performance at ARI Conditions

(psych chart)



Outside Air @ 95 db, 78 wb, 118 grains

Exhaust Air 90 db, 67 wb, 83 grains

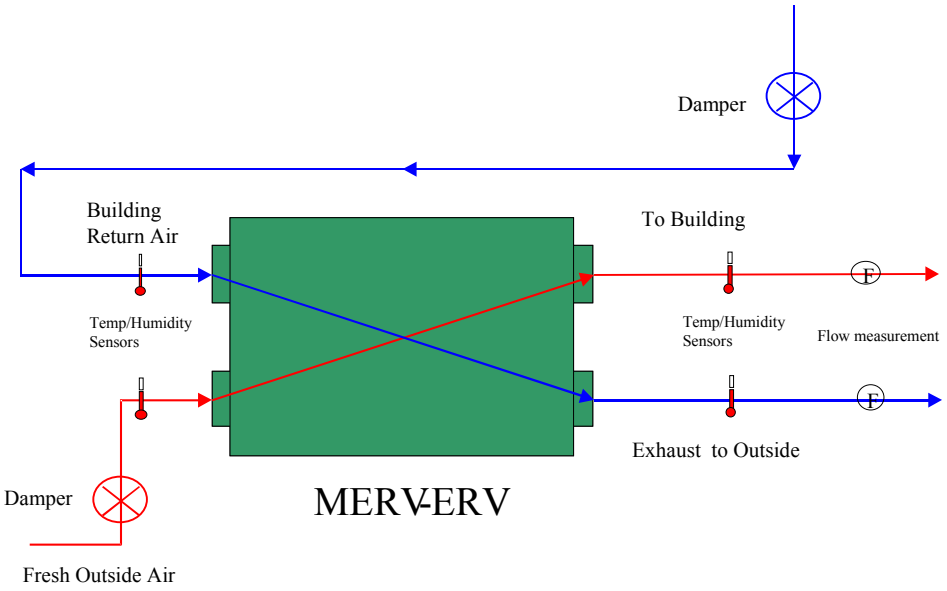
Return Air @ 75 db, 63 wb, 67 grains

Air to Building @ 80 db, 74 wb, 102 grains

Field Installations

- Retail store: Wal-Mart - Mason City, Iowa (Alliant utility)
- Office Building – Omaha, Nebraska (OPPD utility)
- Office Building – Daytona, Florida (FPL utility)
- Office Building – San Jose, Costa Rica
- Elementary School – Pasco County, Florida (FPC utility)
- Manufacturing Facility – Madison, Wisconsin
- Brie's Restaurant – New Port Richey, Florida
- Aspasia Salon – New Port Richey, Florida
- Residence – Largo, Florida
- Subway Restaurant – Brandon, Florida (pending) (TECO utility)
- Retail store: Walgreens – St. Petersburg, Florida (pending)

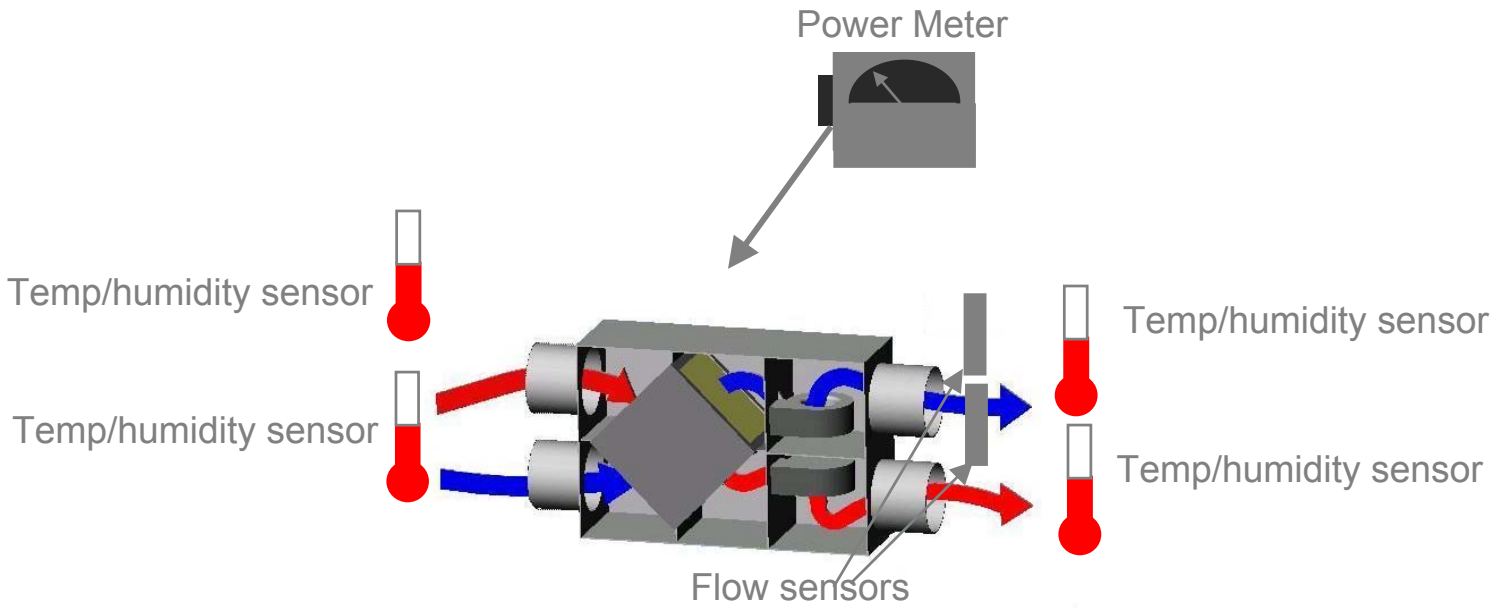
Monitoring



- Based on ARI 1060 Standard
- Measure: Heat transfer across core
- Measure: Total electric usage of unit

Monitoring

- **To validate the savings this system will be monitored using temperature, humidity, and power metering equipment.**



Monitoring Challenges in the Field

- Non steady-state conditions
  - Outside air stream temperature/humidity fluctuations
  - Indoor air control conditions fluctuations
- Condensate may form on sensors
- Sensor location may not be ideal
- Air flow measurement using commercial sensors
- Building and data access

FP&L Installation

- Daytona Office, Florida
- Rooftop mounted
- Reduced 7.65 tons in 2500 OA cfm
- Used 1.98 KW of power for blowers
- Cooling capacity provided by unit
  1.98 KW/7.65 tons = .26 kw/Ton
  (no compressor)

•SHOWS EXCEPTIONAL MOISTURE AND HEAT TRANSFER
•- ESPECIALLY AT MILD OUTSIDE AIR TEMPERATURE CONDITIONS

•THE DOWNSTREAM DRAIN PANS ON THE AIR HANDLING UNITS ARE DRY

FPL Installation – at "Mild Temp" (Stop Mold Problems BEFORE they start) Part Load Performance

Outside Air System

Systems Control

	1st Floor	2nd Floor
Current Flow	1087.02 cfm	1313.72 cfm
CO2 Level	648.66 ppm	659.66 ppm
Max CO2 Setpoint	1100.00 ppm	1100.00 ppm

1st Floor Standard | 1st Floor ERV Unit | 2nd Floor Standard | 2nd Floor ERV Unit

1st Floor RR Fan
1st Floor Inline Fan

2nd Floor RR Fan
2nd Floor Inline Fan
2nd Floor Plenum Fan

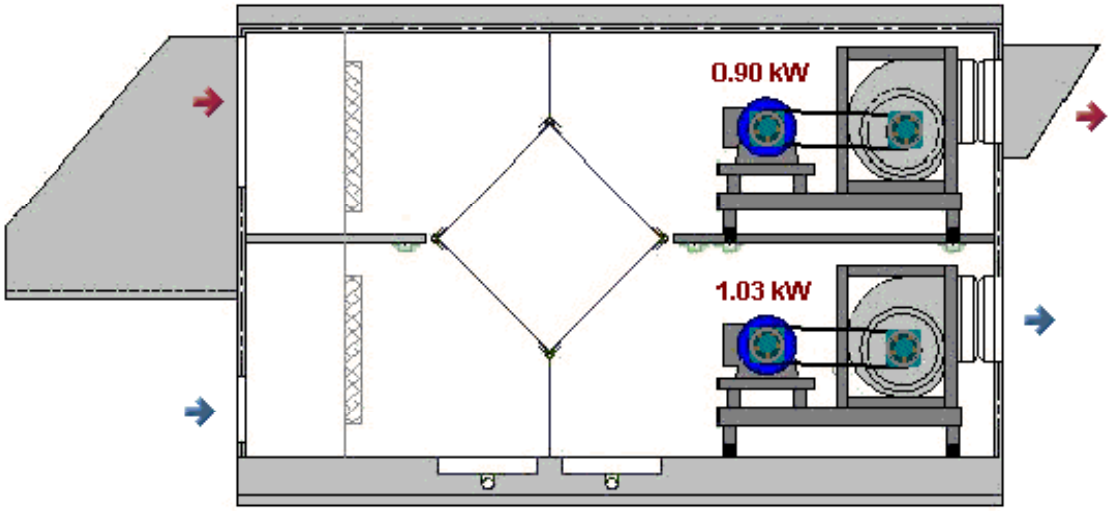
Fan / Damper Control

Energy Recovery Ventilation System Performance Data

Recovered Tons from Exhaust Air:	3.86 tons
Moisture Removed from Supply Air:	32.63 lb/hr
Fan Energy Used:	1.93 kW
Measured Outside Supply Air Flow Rate:	10427.97 lb/hr
Calculated Exhaust Air Flow Rate:	9468.10 lb/hr
Energy Efficiency Ratio:	23.94 EER
Outside Air Temp (Weather Station):	82.00 °F
Decrease of OA Supply Dry Bulb Temp:	4.00 F
Decrease of OA Supply Absolute Humidity:	20.89 %
Recovered Tons (% of Building Load):	16.17 %

Outside Air
82.00 °F
63.82 %RH
72.51 WB
36.12 BTU/lb.
0.35 psia
104.87 gr.
13.98 cf/lb.

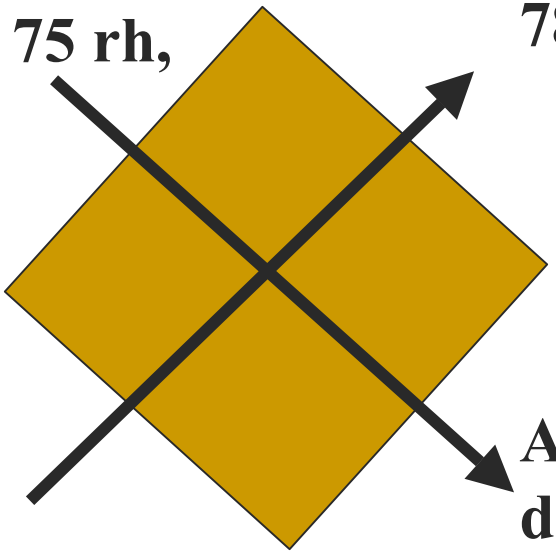
Exhaust Air
77.10 °F
46.71 %RH
63.31 WB
28.64 BTU/lb.
0.22 psia
64.79 gr.
13.73 cf/lb.



Relief Air
78.30 °F
64.82 %RH
69.54 WB
33.53 BTU/lb.
0.31 psia
94.29 gr.
13.86 cf/lb.

Supply Air
78.00 °F
57.71 %RH
67.30 WB
31.68 BTU/lb.
0.27 psia
82.97 gr.
13.81 cf/lb.

Part Load Performance (psych chart)



Outside Air @ 82 db, 75 rh, 105 grains

78 db, 62%, 94 grains

Air to Building @ 78 db, 67%, 92 grains

Return Air @ 77 db, 47%, 65 grains

Wal-Mart Field Installation

- Install 2 MERV units (3400 cfm) at retail customer in Mason City, IA.
- 24 hour facility
- Customer does NOT currently incorporate ventilation energy recovery – provides new opportunity for savings
- Monitor to assure savings

WAL-MART CORPORATION, IOWA

Large retail

2 ERV units

3400 CFM total

Data Points at Various Outside Air Conditions

		Fresh Air IN	Fresh Air IN	Fresh Air OUT	Fresh Air OUT	Exh. Air IN	Exh. Air IN	Exh. Air OUT	Exh. Air OUT	Fresh Air
Date	Time	Temp	RH	Temp	RH	Temp	RH	Temp	RH	Flow
		[deg. F]	[%]	[deg. F]	[%]	[deg. F]	[%]	[deg. F]	[%]	[cfm]
12/5/2002	7:45	6.77	61.63	43.5	14.8	65.1	10.54	18.33	56.55	1848
12/4/2002	9:50	25.03	71.6	53.26	23.44	67.18	16.26	34.27	55.83	1788
12/9/2002	12:50	40.28	32.2	60.7	14.44	68.64	14.1	46.79	31.19	1705
12/14/2002	15:35	54.27	38.97	67.43	23.47	70.6	24.58	59.07	36.06	1599
8/29/2002	14:50	83	46.5	78.1	49.02	72.1	48.9	82.6	39.24	1719
8/26/2002	15:30	85.2	50.05	78.9	53.42	72.4	52.12	84.3	41.44	1713

Maintenance

- Filters recommended for inlet airstreams
- Vacuum face of core twice per year to remove particulate
- Cores slide in and out for maintenance or inspection

Offices

Schools


PARENTS TO KIDS PROGRAM
J LY 9 AND 16
10 - 11 AM - 5 - 6 PM
YEAR BOOKS ARE IN
SUNRAY
ELEMENTARY SCHOOL

Wal-Mart

Subway

Walgreens