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GARD Project No. ASH330

ASHRAE 1254-RP EVALUATING THE ABILITY OF UNITARY EQUIPMENT TO MAINTAIN ADEQUATE SPACE HUMIDITY LEVELS, PHASE II

FINAL REPORT - APPENDICES

Results of Cooperative Research between the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., and GARD Analytics, Inc.

Prepared for

Project Monitoring Subcommittee
ASHRAE Technical Committee TC 8.11
Unitary and Room Air Conditioners and Heat Pumps
(formerly TC 7.6 Unitary Air Conditioners and Heat Pumps)

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APPENDIX A

SECTION 4 HUMIDITY CONTROL OPTIONS FROM PHASE I EVALUATION PLAN

(Note: Table 4-5 showed wrong performance data and has been replaced)

ASHRAE RP-1121 Final Report: Evaluation Plan

Evaluating the Ability of Unitary Equipment to Maintain Adequate Space Humidity Levels: Phase 1

Submitted to

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4 HUMIDITY CONTROL OPTIONS

This plan includes a selection of different humidity control options for evaluation. The list of options is based on a broad examination of alternative equipment and control options in engineering practice. The options include a combination of equipment hardware alternatives, load management strategies, and system control strategies.

A total of seventeen (17) system options are considered, including the base cases. For purposes of identification, these options are numbered Case 0 through Case 16. Options are divided into the following main groups.

- **Base DX Equipment Designs**.
  - Conventional DX System (Typical HVAC design practice.)
  - Base DX System (Good HVAC design practice when dehumidification performance is important.)
- **Modifications to the Base DX System**. Modifications to the DX system include changes in refrigeration system design, coil airflow rate, system control, and additional system components to enhance dehumidification.
  - DX Design for Improved Dehumidification (Includes modifications to evaporator coil, compressor, and airflow.)
  - Base DX System with Lower Airflow
  - DX System with Air-to-Air Heat Exchanger (AAHX)
  - DX System with Subcooling Reheat Coil
  - DX System with Fan Control to Drain Coil
  - DX System with Airflow Control Using Bypass Damper
- **Hybrid DX and Desiccant Systems**. Hybrid systems seek to meet sensible cooling loads with a DX system and dehumidification loads with a desiccant system.
  - Hybrid DX and Desiccant System (Condition mixed air stream.)
- **Outdoor Air, or Dual Path, Systems**. While outdoor air is typically mixed with recirculated air prior to conditioning, outdoor ventilation air can also be conditioned directly. Various design alternatives are considered, including heat recovery, dedicated DX system, and dedicated desiccant system.
  - DX System with Enthalpy Recovery
  - DX System with Outdoor Air Preconditioning (Two DX units in series.)

  - DX Dual Path System (Separate DX systems for outdoor and recirculated air.)
  - DX Dual Path with Enthalpy Recovery
  - DX Dual Path with AAHX
  - DX and Desiccant Dual Path System (Desiccant system for outdoor air.)
- **Demand Controlled Ventilation**. Since outdoor air ventilation represents the major dehumidification load, control of ventilation loads based on occupancy needs can improve HVAC system performance.
  - DX System with Demand Controlled Ventilation
  - DX Dual Path System with Demand Controlled Ventilation

The humidity control options selected for consideration have been identified through examination of available systems and control options. The various systems represent a broad set of appropriate approaches to improve humidity control. This section of the evaluation plan describes each option, including physical characteristics and configurations, identifies specific performance characteristics for subsequent analysis, and gives methods and assumptions for the modeling of the humidity control option in an hourly simulation. In general, performance characteristics will be based on representative equipment or operations. The performance will not necessarily be the best possible or market average, but a level of performance available to a well-informed user to address issues of humidity control.

HVAC System Design Assumptions

The design, sizing, and control of an HVAC system can have a significant impact on its performance. Since the objective here is to evaluate and compare a variety of HVAC options, it is critical that the evaluations be performed with consistency. For the purposes of these comparisons, the following key assumptions apply.

1. HVAC equipment capacities are oversized by 10%. That is, under design cooling conditions, the equipment shall be sized to give the following relationships.

$$\min\left(\frac{Q_{tot,HVAC}}{Q_{tot,load}},\frac{Q_{sen,HVAC}}{Q_{sen,load}}\right)=1.10 \tag{4–1}$$

   In this equation, $Q_{tot,HVAC}$ and $Q_{sen,HVAC}$ are the total and sensible capacities of the HVAC equipment, and $Q_{tot,HVAC}$ and $Q_{sen,HVAC}$ are the total and sensible loads on the equipment. Note that, if the sensible heat ratios of the load and equipment are not matched, either the sensible or total capacity will be oversized by a factor greater than 10%.

2. HVAC systems are designed in compliance with ASHRAE Standard 62-1999. Unless otherwise noted, it is assumed that the outdoor airflow rate is constant and continuous during occupied hours of the building.

3. Unless otherwise stated, HVAC system fans operate continuously during occupied hours with a constant airflow rate.

4. The supply and return air distribution systems are designed to give an external static pressure of 0.7 inWG at the HVAC equipment for the design airflow rate for each humidity control option.

Fan energy use is very significant in most commercial buildings. Many dehumidification improvements involve changes to system airflow or the addition of components in the air path. Proper evaluation of the effects of these changes includes consideration of the impact on fan energy. For example, the addition of a subcooling reheat coil or air-to-air heat exchanger will increase the pressure drop of the HVAC system, resulting in greater fan energy use.

Fan power can be related to airflow, pressure differential, and efficiencies with the following relationship.

$$W(kW) = \frac{V(cfm) \cdot H_{fan}(inWG)}{8520 \eta_{fan} \eta_{motor}} \tag{4–2}$$

where

W = fan motor power, kW
V = fan airflow rate, cfm
H_{fan} = pressure rise through the fan, inWG
η_{fan} = fan efficiency
η_{motor} = fan motor efficiency

The pressure rise across the fan is equal to the sum of the pressure drop though the HVAC equipment components and the pressure drop through the attached duct system, also know as the external static pressure: $H_{fan} = H_{eq} + H_{esp}$. While the pressure drop through the duct system is a design parameter for the mechanical design engineer, the pressure drop through the equipment depends on the particular HVAC system.

For some humidity control options, it will be necessary to evaluate the impact of changes in airflow rate or component face velocity on fan energy use. It is assumed that the pressure drops in the system, both within the HVAC equipment and the duct system, follow a standard power relationship. Changes in pressure drop through the system can be related to changes in velocity, or airflow, by the following equation.

$$\frac{H_2}{H_1} = \left(\frac{V_2}{V_1}\right)^n \tag{4–3}$$

The exponent, *n*, depends on the pressure loss characteristics of the equipment and air distribution system. Its value will be determined using performance data for typical manufacturers’ data.

Base Case DX Systems

Case 0) Conventional DX System

Description

One of the main objectives of this work is to evaluate methods for *improved* dehumidification over some base conventional system. This base system is considered to be a conventional, high-efficiency, packaged DX rooftop unit, shown schematically in Figure 4-1. It has two single-stage scroll compressors, each with a dedicated refrigeration circuit. The evaporators each have three tube rows and are configured in a face-split configuration.

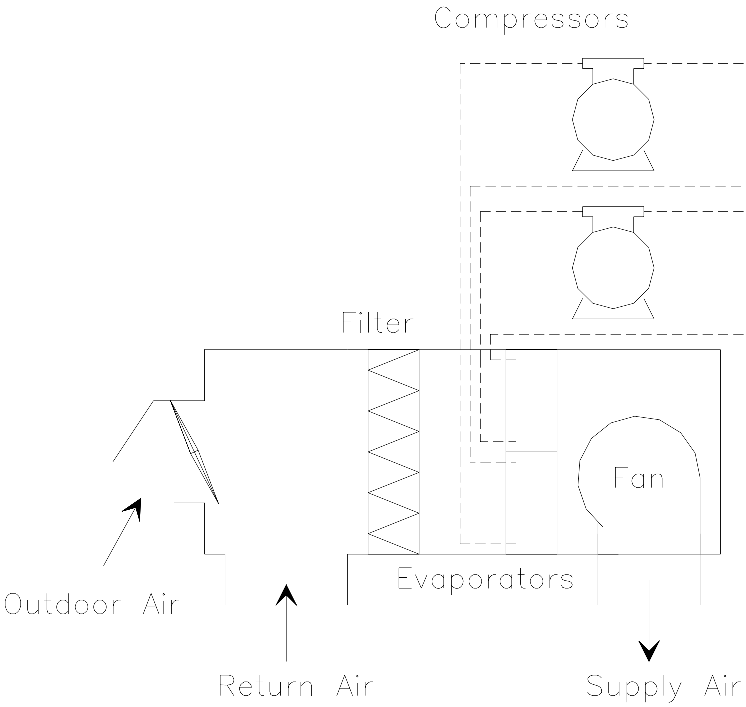
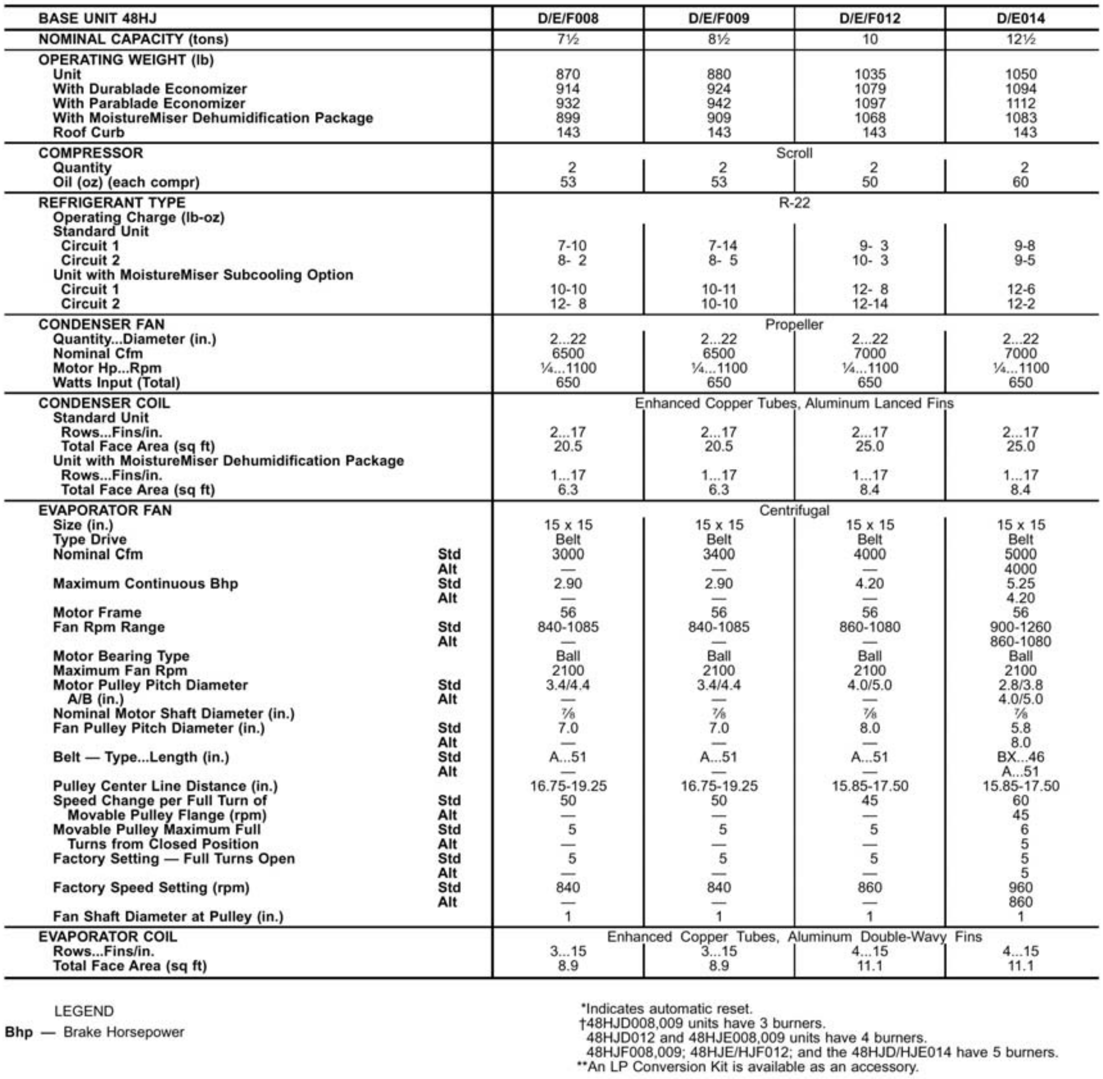


Figure 4-1 Schematic diagram of DX RTU

Rather than identify the performance of a generic, unspecified rooftop unit, it was desired to select a specific rooftop unit with readily available performance characteristics as the base case. It was further desired that this unit be in the size range of 6 - 15 tons cooling capacity, representing the largest market segment. The Carrier Model 48HJ line of packaged rooftop units with gas heating was selected as representative. Table 4–1 give the general characteristics of four of these units. The Model 48HJ008, with a nominal capacity of 7½ tons and an ARI rated airflow rate of 400 cfm/ton was selected as the typical conventional design. (As will be described in the next two cases, the Model 48HJ009 with 350 cfm/ton will be selected as the dehumidification base case and the 48HJ012 with 300 cfm/ton will be selected as a system with improved DX design for dehumidification.)

Table 4–1: Characteristics of Carrier Model 48HJ Rooftop Units



BASE UNIT 48HJ		D/E/F008	D/E/F009	D/E/F012	D/E014
NOMINAL CAPACITY (tons)		7½	8½	10	12½
OPERATING WEIGHT (lb)					
Unit		870	880	1035	1050
With Durablade Economizer		914	924	1079	1094
With Parablade Economizer		932	942	1097	1112
With MoistureMiser Dehumidification Package		899	909	1068	1083
Roof Curb		143	143	143	143
COMPRESSOR		Scroll			
Quantity		2	2	2	2
Oil (oz) (each compr)		53	53	50	60
REFRIGERANT TYPE		R-22			
Operating Charge (lb-oz)					
Standard Unit					
Circuit 1		7-10	7-14	9- 3	9-8
Circuit 2		8- 2	8- 5	10- 3	9-5
Unit with MoistureMiser Subcooling Option					
Circuit 1		10-10	10-11	12- 8	12-6
Circuit 2		12- 8	10-10	12-14	12-2
CONDENSER FAN		Propeller			
Quantity...Diameter (in.)		2...22	2...22	2...22	2...22
Nominal Cfm		6500	6500	7000	7000
Motor Hp...Rpm		¼...1100	¼...1100	¼...1100	¼...1100
Watts Input (Total)		650	650	650	650
CONDENSER COIL		Enhanced Copper Tubes, Aluminum Lanced Fins			
Standard Unit					
Rows...Fins/in.		2...17	2...17	2...17	2...17
Total Face Area (sq ft)		20.5	20.5	25.0	25.0
Unit with MoistureMiser Dehumidification Package					
Rows...Fins/in.		1...17	1...17	1...17	1...17
Total Face Area (sq ft)		6.3	6.3	8.4	8.4
EVAPORATOR FAN		Centrifugal			
Size (in.)		15 x 15	15 x 15	15 x 15	15 x 15
Type Drive		Belt	Belt	Belt	Belt
Nominal Cfm	Std	3000	3400	4000	5000
	Alt	—	—	—	4000
Maximum Continuous Bhp	Std	2.90	2.90	4.20	5.25
	Alt	—	—	—	4.20
Motor Frame		56	56	56	56
Fan Rpm Range	Std	840-1085	840-1085	860-1080	900-1260
	Alt	—	—	—	860-1080
Motor Bearing Type		Ball	Ball	Ball	Ball
Maximum Fan Rpm		2100	2100	2100	2100
Motor Pulley Pitch Diameter	Std	3.4/4.4	3.4/4.4	4.0/5.0	2.8/3.8
A/B (in.)	Alt	—	—	—	4.0/5.0
Nominal Motor Shaft Diameter (in.)		⅞	⅞	⅞	⅞
Fan Pulley Pitch Diameter (in.)	Std	7.0	7.0	8.0	5.8
	Alt	—	—	—	8.0
Belt — Type...Length (in.)	Std	A...51	A...51	A...51	BX...46
	Alt	—	—	—	A...51
Pulley Center Line Distance (in.)		16.75-19.25	16.75-19.25	15.85-17.50	15.85-17.50
Speed Change per Full Turn of	Std	50	50	45	60
Movable Pulley Flange (rpm)	Alt	—	—	—	45
Movable Pulley Maximum Full	Std	5	5	5	6
Turns from Closed Position	Alt	—	—	—	5
Factory Setting — Full Turns Open	Std	5	5	5	5
	Alt	—	—	—	5
Factory Speed Setting (rpm)	Std	840	840	860	960
	Alt	—	—	—	860
Fan Shaft Diameter at Pulley (in.)		1	1	1	1
EVAPORATOR COIL		Enhanced Copper Tubes, Aluminum Double-Wavy Fins			
Rows...Fins/in.		3...15	3...15	4...15	4...15
Total Face Area (sq ft)		8.9	8.9	11.1	11.1

LEGEND

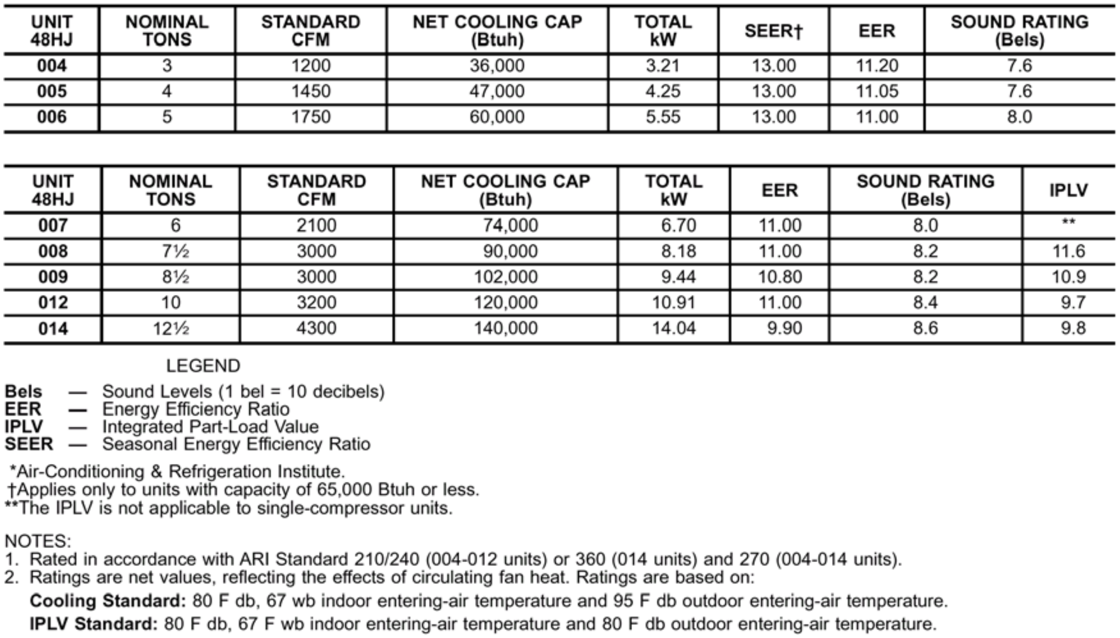
Bhp — Brake Horsepower

*Indicates automatic reset.
†48HJD008,009 units have 3 burners.
48HJD012 and 48HJE008,009 units have 4 burners.
48HJF008,009; 48HJE/HJF012; and the 48HJD/HJE014 have 5 burners.
**An LP Conversion Kit is available as an accessory.

Performance Characteristics

The ARI rating information for the line of rooftop units is given in Table 4–2. The published cooling performance of the 7½-ton Model 48HJ008 DX system is given in Table 4–3.

Table 4–2: ARI Rating Data for Typical Unit (from Carrier)



UNIT 48HJ	NOMINAL TONS	STANDARD CFM	NET COOLING CAP (Btuh)	TOTAL kW	SEER†	EER	SOUND RATING (Bels)
004	3	1200	36,000	3.21	13.00	11.20	7.6
005	4	1450	47,000	4.25	13.00	11.05	7.6
006	5	1750	60,000	5.55	13.00	11.00	8.0

UNIT 48HJ	NOMINAL TONS	STANDARD CFM	NET COOLING CAP (Btuh)	TOTAL kW	EER	SOUND RATING (Bels)	IPLV
007	6	2100	74,000	6.70	11.00	8.0	**
008	7½	3000	90,000	8.18	11.00	8.2	11.6
009	8½	3000	102,000	9.44	10.80	8.2	10.9
012	10	3200	120,000	10.91	11.00	8.4	9.7
014	12½	4300	140,000	14.04	9.90	8.6	9.8

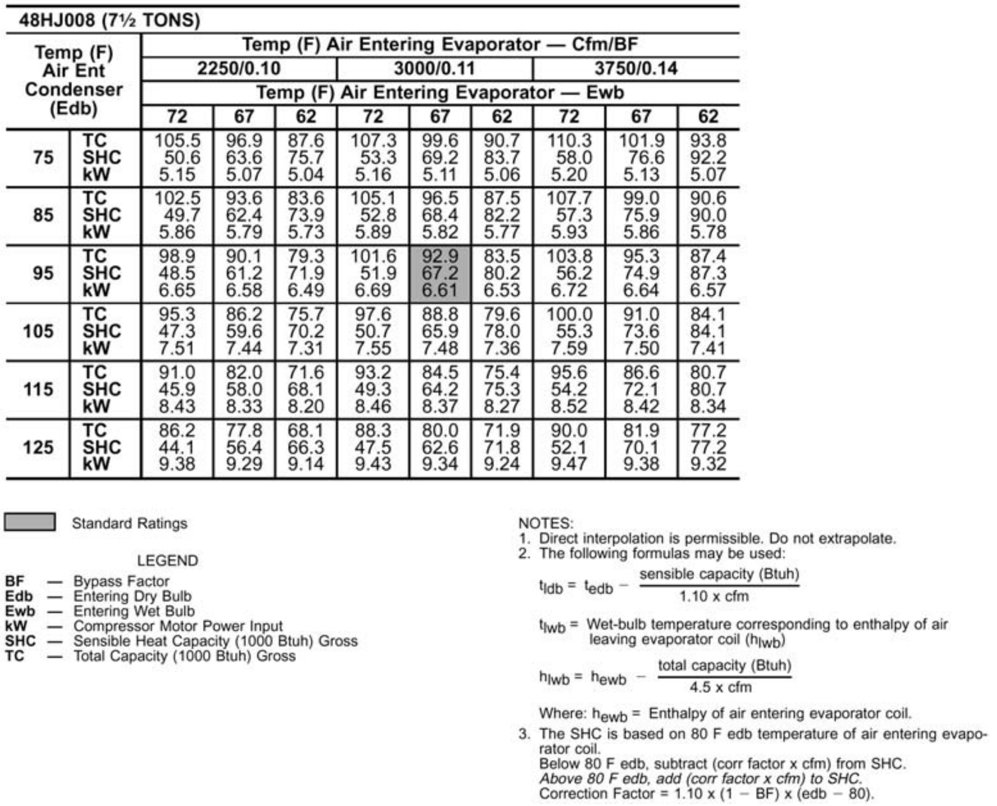
LEGEND

Bels — Sound Levels (1 bel = 10 decibels)
EER — Energy Efficiency Ratio
IPLV — Integrated Part-Load Value
SEER — Seasonal Energy Efficiency Ratio

*Air-Conditioning & Refrigeration Institute.
†Applies only to units with capacity of 65,000 Btuh or less.
**The IPLV is not applicable to single-compressor units.

NOTES:
1. Rated in accordance with ARI Standard 210/240 (004-012 units) or 360 (014 units) and 270 (004-014 units).
2. Ratings are net values, reflecting the effects of circulating fan heat. Ratings are based on:
   Cooling Standard: 80 F db, 67 wb indoor entering-air temperature and 95 F db outdoor entering-air temperature.
   IPLV Standard: 80 F db, 67 F wb indoor entering-air temperature and 80 F db outdoor entering-air temperature.

Table 4–3: Cooling Performance of Conventional DX System (from Carrier)



48HJ008 (7½ TONS)

Temp (F) Air Ent Condenser (Edb)		Temp (F) Air Entering Evaporator — Cfm/BF								
		2250/0.10			3000/0.11			3750/0.14		
		Temp (F) Air Entering Evaporator — Ewb								
		72	67	62	72	67	62	72	67	62
75	**TC**	105.5	96.9	87.6	107.3	99.6	90.7	110.3	101.9	93.8
	SHC	50.6	63.6	75.7	53.3	69.2	83.7	58.0	76.6	92.2
	kW	5.15	5.07	5.04	5.16	5.11	5.06	5.20	5.13	5.07
85	**TC**	102.5	93.6	83.6	105.1	96.5	87.5	107.7	99.0	90.6
	SHC	49.7	62.4	73.9	52.8	68.4	82.2	57.3	75.9	90.0
	kW	5.86	5.79	5.73	5.89	5.82	5.77	5.93	5.86	5.78
95	**TC**	98.9	90.1	79.3	101.6	92.9	83.5	103.8	95.3	87.4
	SHC	48.5	61.2	71.9	51.9	67.2	80.2	56.2	74.9	87.3
	kW	6.65	6.58	6.49	6.69	6.61	6.53	6.72	6.64	6.57
105	**TC**	95.3	86.2	75.7	97.6	88.8	79.6	100.0	91.0	84.1
	SHC	47.3	59.6	70.2	50.7	65.9	78.0	55.3	73.6	84.1
	kW	7.51	7.44	7.31	7.55	7.48	7.36	7.59	7.50	7.41
115	**TC**	91.0	82.0	71.6	93.2	84.5	75.4	95.6	86.6	80.7
	SHC	45.9	58.0	68.1	49.3	64.2	75.3	54.2	72.1	80.7
	kW	8.43	8.33	8.20	8.46	8.37	8.27	8.52	8.42	8.34
125	**TC**	86.2	77.8	68.1	88.3	80.0	71.9	90.0	81.9	77.2
	SHC	44.1	56.4	66.3	47.5	62.6	71.8	52.1	70.1	77.2
	kW	9.38	9.29	9.14	9.43	9.34	9.24	9.47	9.38	9.32

▨ Standard Ratings

LEGEND

BF — Bypass Factor
Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Compressor Motor Power Input
SHC — Sensible Heat Capacity (1000 Btuh) Gross
TC — Total Capacity (1000 Btuh) Gross

NOTES:
1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \text{ x cfm}}$$

t_{lwb} = Wet-bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

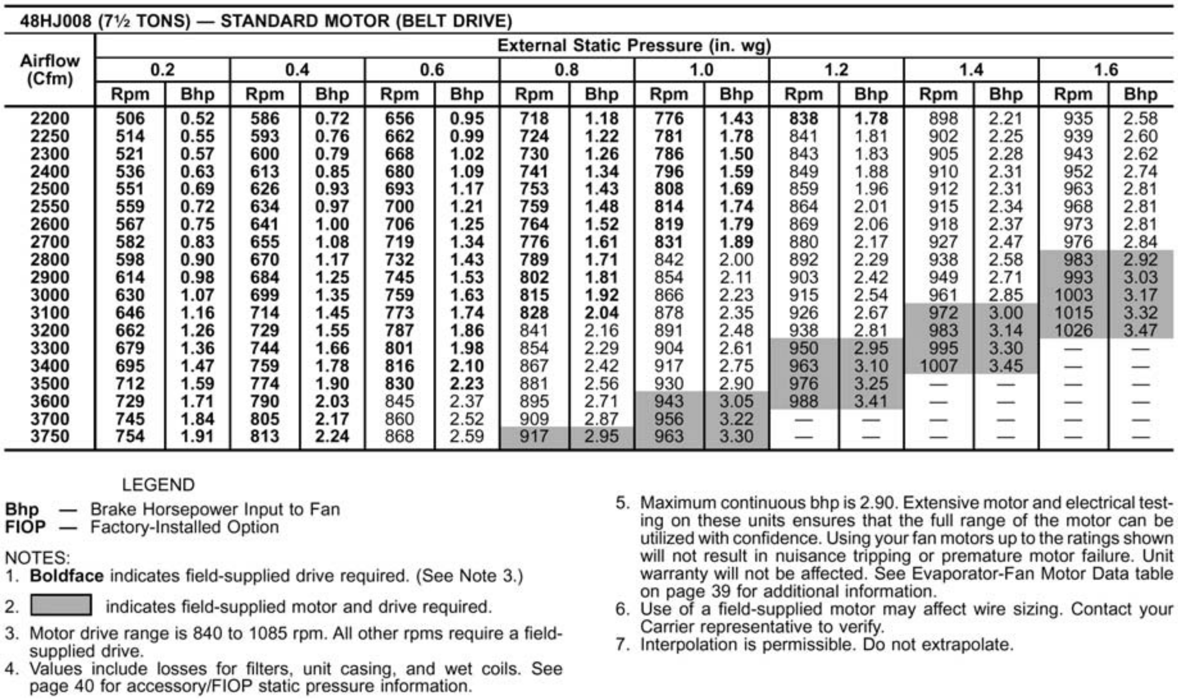
$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \text{ x cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil.

3. The SHC is based on 80 F edb temperature of air entering evaporator coil.
   Below 80 F edb, subtract (corr factor x cfm) from SHC.
   Above 80 F edb, add (corr factor x cfm) to SHC.
   Correction Factor = 1.10 x (1 − BF) x (edb − 80).

The fan power depends on the airflow rate and duct system external static pressure. Performance data for the conventional DX system is given in Table 4–4.

Table 4–4: Fan Performance of Conventional DX System (from Carrier)



48HJ008 (7½ TONS) — STANDARD MOTOR (BELT DRIVE)

Airflow (Cfm)	**External Static Pressure (in. wg)**															
	0.2		**0.4**		**0.6**		**0.8**		**1.0**		**1.2**		**1.4**		**1.6**	
	Rpm	**Bhp**	**Rpm**	**Bhp**	**Rpm**	**Bhp**	**Rpm**	**Bhp**	**Rpm**	**Bhp**	**Rpm**	**Bhp**	**Rpm**	**Bhp**	**Rpm**	**Bhp**
2200	**506**	**0.52**	**586**	**0.72**	**656**	**0.95**	**718**	**1.18**	**776**	**1.43**	**838**	**1.78**	898	2.21	935	2.58
2250	**514**	**0.55**	**593**	**0.76**	**662**	**0.99**	**724**	**1.22**	**781**	**1.78**	841	1.81	902	2.25	939	2.60
2300	**521**	**0.57**	**600**	**0.79**	**668**	**1.02**	**730**	**1.26**	**786**	**1.50**	843	1.83	905	2.28	943	2.62
2400	**536**	**0.63**	**613**	**0.85**	**680**	**1.09**	**741**	**1.34**	**796**	**1.59**	849	1.88	910	2.31	952	2.74
2500	**551**	**0.69**	**626**	**0.93**	**693**	**1.17**	**753**	**1.43**	**808**	**1.69**	859	1.96	912	2.31	963	2.81
2550	**559**	**0.72**	**634**	**0.97**	**700**	**1.21**	**759**	**1.48**	**814**	**1.74**	864	2.01	915	2.34	968	2.81
2600	**567**	**0.75**	**641**	**1.00**	**706**	**1.25**	**764**	**1.52**	**819**	**1.79**	869	2.06	918	2.37	973	2.81
2700	**582**	**0.83**	**655**	**1.08**	**719**	**1.34**	**776**	**1.61**	**831**	**1.89**	880	2.17	927	2.47	976	2.84
2800	**598**	**0.90**	**670**	**1.17**	**732**	**1.43**	**789**	**1.71**	842	2.00	892	2.29	938	2.58	983	2.92
2900	**614**	**0.98**	**684**	**1.25**	**745**	**1.53**	**802**	**1.81**	854	2.11	903	2.42	949	2.71	993	3.03
3000	**630**	**1.07**	**699**	**1.35**	**759**	**1.63**	**815**	**1.92**	866	2.23	915	2.54	961	2.85	1003	3.17
3100	**646**	**1.16**	**714**	**1.45**	**773**	**1.74**	**828**	**2.04**	878	2.35	926	2.67	972	3.00	1015	3.32
3200	**662**	**1.26**	**729**	**1.55**	**787**	**1.86**	841	2.16	891	2.48	938	2.81	983	3.14	1026	3.47
3300	**679**	**1.36**	**744**	**1.66**	**801**	**1.98**	854	2.29	904	2.61	950	2.95	995	3.30	—	—
3400	**695**	**1.47**	**759**	**1.78**	**816**	**2.10**	867	2.42	917	2.75	963	3.10	1007	3.45	—	—
3500	**712**	**1.59**	**774**	**1.90**	**830**	**2.23**	881	2.56	930	2.90	976	3.25	—	—	—	—
3600	**729**	**1.71**	**790**	**2.03**	845	2.37	895	2.71	943	3.05	988	3.41	—	—	—	—
3700	**745**	**1.84**	**805**	**2.17**	860	2.52	909	2.87	956	3.22	—	—	—	—	—	—
3750	**754**	**1.91**	**813**	**2.24**	868	2.59	917	2.95	963	3.30	—	—	—	—	—	—

LEGEND

Bhp — Brake Horsepower Input to Fan
FIOP — Factory-Installed Option

NOTES:

1. **Boldface** indicates field-supplied drive required. (See Note 3.)
2. ▨ indicates field-supplied motor and drive required.
3. Motor drive range is 840 to 1085 rpm. All other rpms require a field-supplied drive.
4. Values include losses for filters, unit casing, and wet coils. See page 40 for accessory/FIOP static pressure information.
5. Maximum continuous bhp is 2.90. Extensive motor and electrical testing on these units ensures that the full range of the motor can be utilized with confidence. Using your fan motors up to the ratings shown will not result in nuisance tripping or premature motor failure. Unit warranty will not be affected. See Evaporator-Fan Motor Data table on page 39 for additional information.
6. Use of a field-supplied motor may affect wire sizing. Contact your Carrier representative to verify.
7. Interpolation is permissible. Do not extrapolate.

As noted above, it is assumed that the duct system has been designed to give an external static pressure of 0.7 inWG. At the standard airflow rate of 3000 cfm and 0.70 inWG external static pressure, the fan shaft power of this conventional unit is 1.77 hp. With a fan motor efficiency of 80%, the indoor fan motor power is 1.65 kW. On a normalized basis, the fan motor power is 0.55 W/cfm, which is representative of typical packaged DX equipment.

As will be shown in the next section, the Base Case DX system has the same fan system performance as this conventional system design. Other humidity control options will involve variations on this fan system performance. It is convenient to now note that the data of Table 4–4 can be used to identify the parameters of the fan model given in Equations 4–2 and 4–3. Specifically, nonlinear regression techniques can be used to solve for the fan efficiency of Equations 4–2, the exponent *n* of Equation 4–3, and the pressure drop through the HVAC equipment at the design airflow rate of 3000 cfm. The regression results for the conventional and base case DX units are:

$\eta_{fan} =$ 0.24
$n =$ 2.4
$H_{eq} =$ 0.535 inWG at 3000 cfm

Modeling Methods and Assumptions

Modeling can be performed using a regression to manufacturer's performance data (DOE 1982, ASHRAE 1993). The regression must respect the limits of the manufacturer's data. Extrapolation beyond the data range is not allowed. In fact, it is possible for operation outside the domain of published data. Furthermore, several of the subsequent cases for analysis involve modifications of the base system that will likely involve operation outside this domain. It is therefore recommended that a detailed model of the base DX system be developed in a stand-alone vapor compression system analysis program, such as HPDM (Rice and Fischer, 1983) or HPSIM (Domanski and Didion, 1983). The detailed model should be calibrated to the manufacturer's data of Table 4–3 to confirm representative performance. The detailed model should then be used to generate a more comprehensive performance map over a wider range of independent variable values.

The regression models developed here should be normalized to the rated conditions of the DX unit. By normalizing the performance, the results of the model can be readily scaled to meet any design load. Ultimately, this single model can then be used in a simulation of any of the building applications discussed in Section 3.

It must be recognized that the performance data from Table 4–3 represents steady-state performance. The analysis of the base case must account for cycling effects on both steady state and latent capacity. The methods of DOE2.1 and the ASHRAE HVAC2 Toolkit account for cyclic losses through a part-load correction function, but this method does not properly account for latent effects. The model used for this analysis should follow the work by Henderson and Rengarajan (1996), which also accounts for re-evaporation of condensate when the DX unit cycles off.

The DX system should be controlled to maintain the zone temperature at 75°F.

Case 1) Base DX System

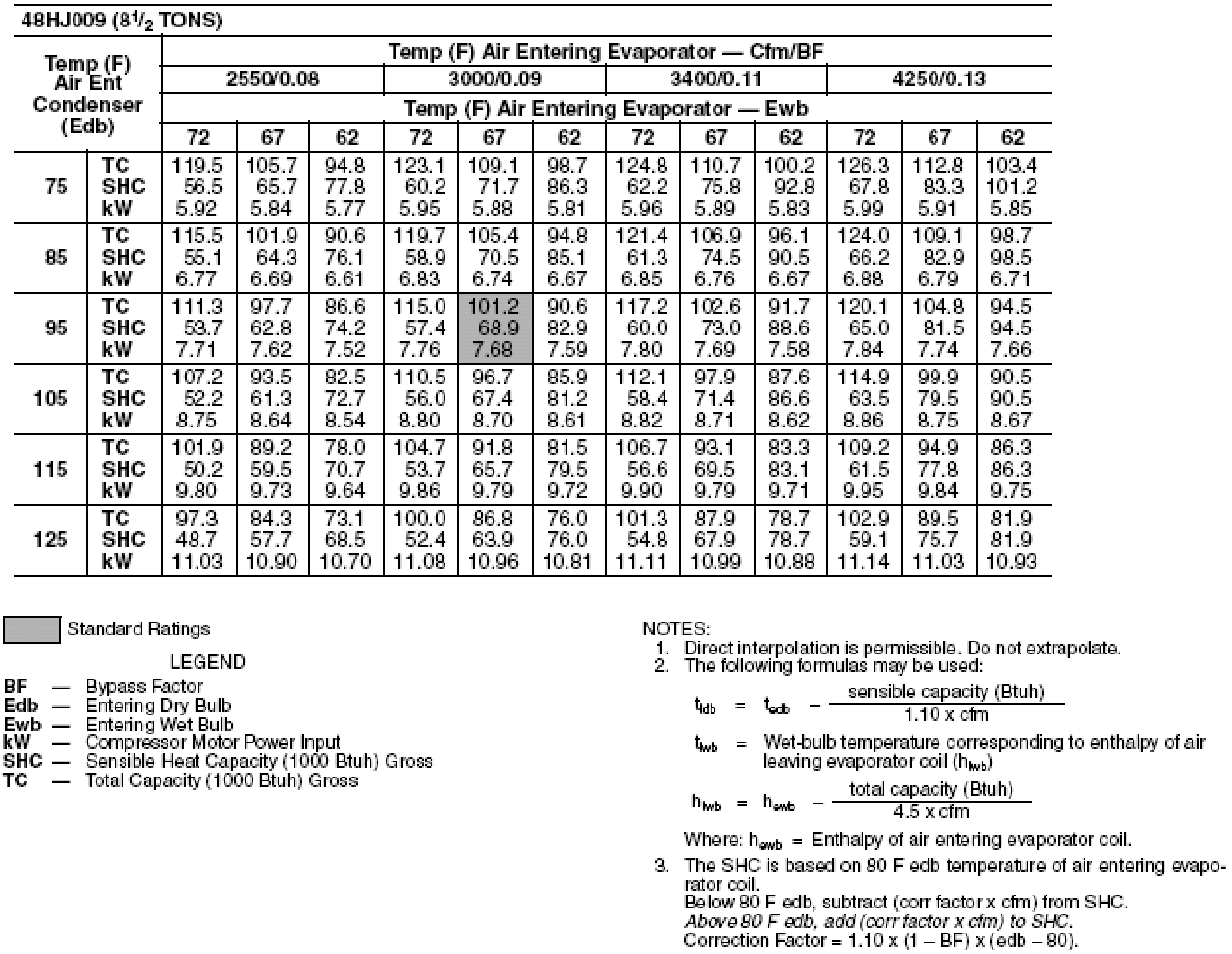
Description

The base DX system of Case 0) is designed for a standard airflow of 400 cfm/ton. While this design may be representative of typical practice, it is not representative of good HVAC design for applications in which humidity control is a high priority. A more enlightened design would use a packaged system for which the design airflow is 350 cfm/ton and the compressor is slightly oversized for the evaporator, ensuring low evaporator temperatures. Coincidentally, the Model 48HJ009 (8½ tons) of Table 4–1 is representative of such a system. Compared to the 7½ ton size, the 8½ ton unit uses the same evaporator and condenser, and the same rated airflow, giving about 350 cfm/ton. This system represents good performance for selection in commercial building applications in humid climates. It will serve as the base case for comparison with all subsequent humidity control options.

Performance Characteristics

The performance of the base DX system is given in Table 4–5. The design airflow rate is 3000 cfm, corresponding to about 350 cfm/ton.

Table 4–5: Performance of Base DX System (from Carrier)



48HJ009 ($8^1/_2$ TONS)

Temp (F) Air Ent Condenser (Edb)		Temp (F) Air Entering Evaporator — Cfm/BF											
		2550/0.08			3000/0.09			3400/0.11			4250/0.13		
		Temp (F) Air Entering Evaporator — Ewb											
		72	67	62	72	67	62	72	67	62	72	67	62
75	TC	119.5	105.7	94.8	123.1	109.1	98.7	124.8	110.7	100.2	126.3	112.8	103.4
	SHC	56.5	65.7	77.8	60.2	71.7	86.3	62.2	75.8	92.8	67.8	83.3	101.2
	kW	5.92	5.84	5.77	5.95	5.88	5.81	5.96	5.89	5.83	5.99	5.91	5.85
85	TC	115.5	101.9	90.6	119.7	105.4	94.8	121.4	106.9	96.1	124.0	109.1	98.7
	SHC	55.1	64.3	76.1	58.9	70.5	85.1	61.3	74.5	90.5	66.2	82.9	98.5
	kW	6.77	6.69	6.61	6.83	6.74	6.67	6.85	6.76	6.67	6.88	6.79	6.71
95	TC	111.3	97.7	86.6	115.0	101.2	90.6	117.2	102.6	91.7	120.1	104.8	94.5
	SHC	53.7	62.8	74.2	57.4	68.9	82.9	60.0	73.0	88.6	65.0	81.5	94.5
	kW	7.71	7.62	7.52	7.76	7.68	7.59	7.80	7.69	7.58	7.84	7.74	7.66
105	TC	107.2	93.5	82.5	110.5	96.7	85.9	112.1	97.9	87.6	114.9	99.9	90.5
	SHC	52.2	61.3	72.7	56.0	67.4	81.2	58.4	71.4	86.6	63.5	79.5	90.5
	kW	8.75	8.64	8.54	8.80	8.70	8.61	8.82	8.71	8.62	8.86	8.75	8.67
115	TC	101.9	89.2	78.0	104.7	91.8	81.5	106.7	93.1	83.3	109.2	94.9	86.3
	SHC	50.2	59.5	70.7	53.7	65.7	79.5	56.6	69.5	83.1	61.5	77.8	86.3
	kW	9.80	9.73	9.64	9.86	9.79	9.72	9.90	9.79	9.71	9.95	9.84	9.75
125	TC	97.3	84.3	73.1	100.0	86.8	76.0	101.3	87.9	78.7	102.9	89.5	81.9
	SHC	48.7	57.7	68.5	52.4	63.9	76.0	54.8	67.9	78.7	59.1	75.7	81.9
	kW	11.03	10.90	10.70	11.08	10.96	10.81	11.11	10.99	10.88	11.14	11.03	10.93

▨ Standard Ratings

LEGEND

BF	—	Bypass Factor
Edb	—	Entering Dry Bulb
Ewb	—	Entering Wet Bulb
kW	—	Compressor Motor Power Input
SHC	—	Sensible Heat Capacity (1000 Btuh) Gross
TC	—	Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \text{ x cfm}}$$

t_{lwb} = Wet-bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \text{ x cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil.

3. The SHC is based on 80 F edb temperature of air entering evaporator coil.
Below 80 F edb, subtract (corr factor x cfm) from SHC.
Above 80 F edb, add (corr factor x cfm) to SHC.
Correction Factor = 1.10 x (1 – BF) x (edb – 80).

Since this system has the same evaporator and airflow rate as that of Case 0), the fan energy consumption will again be 0.55 W/cfm.

Modeling Methods and Assumptions

The modeling methods and assumptions of Case 0) are also used for this analysis.

Modifications to Base DX System

Case 2) DX Design for Improved Dehumidification

Description

This case considers modification of the base DX system (Case 1) to further improve dehumidification performance. As noted above, reduced airflow and larger compressor (relative to evaporator size) can improve dehumidification performance. Another approach involves increasing the number of cooling coil rows, increasing contact time between the moist air and coil surface. The option considered here is a combination of some of these effects.

The 10-ton Model 48HJ012 unit described in Table 4–1 offers a further improvement over the 7½ ton and 8½ ton models. Specifically, the coil is four rows deep rather than three rows and the ARI rated airflow is 320 cfm/ton. This case considers the 10-ton model operating at a design airflow rate of 300 cfm/ton.

Performance Characteristics

The performance of the DX system for this case is given in Table 4–6. Note that all of these first three cases operate with the same airflow (3000 cfm) per specified unit. Note also that, at 300 cfm/ton used for this case, the coil SHR at ARI rating conditions is 0.66, compared to values of 0.72 and 0.68 for Cases 0) and 1), respectively.

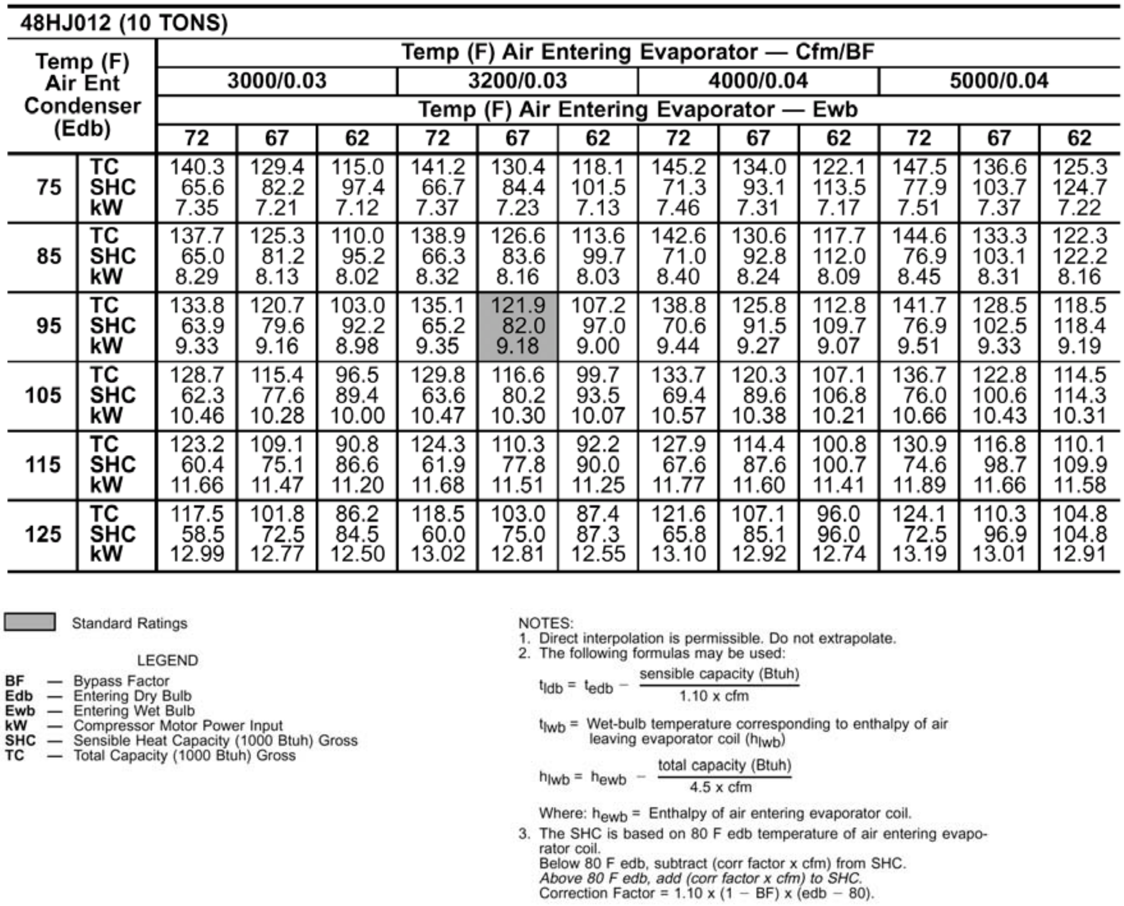
Fan energy use for this case will be different than the previous cases. While the airflow through each unit may be the same and the duct systems may be identical, the pressure drop inside the unit will be different. The cooling coil has an additional row, which will increase pressure drop, but the internal velocities are lower, reducing losses. The previous two cases had evaporator coils with a face area of 8.9 ft^2, giving a face velocity of 337 fpm, while the current case has a face area of 11.1 ft^2 and a face velocity of 270 fpm. For consistency with the previous cases, which used a fan power of 0.55 W/cfm, the fan power for this case is calculated based on the engineering principles discussed previously.

Since the velocity in the duct system will not change, the correction only applies to the pressure differential within the unit. It is assumed that the duct system accounts for 0.7 inWG pressure drop and that the pressure drop within the base DX unit is 0.535 inWG. Using Equation 4–3, the pressure drop within the unit can be corrected to 0.314 inWG as the velocity is reduced from 337 fpm to 270 fpm. From manufacturer's literature, it can be found that an additional row of coil adds approximately 0.08 inWG at 300 fpm, giving a pressure drop through the equipment of 0.376 inWG at 270 fpm and 3000 cfm.. The total pressure differential across the fan though this system, using an airflow of 3000 cfm, can be estimated as 1.076 inWG, which gives a power of 0.479 W/cfm.

Modeling Methods and Assumptions

As with the base case, a regression model can be used for the hourly simulation of the DX system. Part-load performance should be modeled as described previously.

Table 4–6: Performance of Improved DX Design (from Carrier)



48HJ012 (10 TONS)

Temp (F) Air Ent Condenser (Edb)		Temp (F) Air Entering Evaporator — Cfm/BF											
		3000/0.03			3200/0.03			4000/0.04			5000/0.04		
		Temp (F) Air Entering Evaporator — Ewb											
		72	67	62	72	67	62	72	67	62	72	67	62
75	TC	140.3	129.4	115.0	141.2	130.4	118.1	145.2	134.0	122.1	147.5	136.6	125.3
	SHC	65.6	82.2	97.4	66.7	84.4	101.5	71.3	93.1	113.5	77.9	103.7	124.7
	kW	7.35	7.21	7.12	7.37	7.23	7.13	7.46	7.31	7.17	7.51	7.37	7.22
85	TC	137.7	125.3	110.0	138.9	126.6	113.6	142.6	130.6	117.7	144.6	133.3	122.3
	SHC	65.0	81.2	95.2	66.3	83.6	99.7	71.0	92.8	112.0	76.9	103.1	122.2
	kW	8.29	8.13	8.02	8.32	8.16	8.03	8.40	8.24	8.09	8.45	8.31	8.16
95	TC	133.8	120.7	103.0	135.1	121.9	107.2	138.8	125.8	112.8	141.7	128.5	118.5
	SHC	63.9	79.6	92.2	65.2	82.0	97.0	70.6	91.5	109.7	76.9	102.5	118.4
	kW	9.33	9.16	8.98	9.35	9.18	9.00	9.44	9.27	9.07	9.51	9.33	9.19
105	TC	128.7	115.4	96.5	129.8	116.6	99.7	133.7	120.3	107.1	136.7	122.8	114.5
	SHC	62.3	77.6	89.4	63.6	80.2	93.5	69.4	89.6	106.8	76.0	100.6	114.3
	kW	10.46	10.28	10.00	10.47	10.30	10.07	10.57	10.38	10.21	10.66	10.43	10.31
115	TC	123.2	109.1	90.8	124.3	110.3	92.2	127.9	114.4	100.8	130.9	116.8	110.1
	SHC	60.4	75.1	86.6	61.9	77.8	90.0	67.6	87.6	100.7	74.6	98.7	109.9
	kW	11.66	11.47	11.20	11.68	11.51	11.25	11.77	11.60	11.41	11.89	11.66	11.58
125	TC	117.5	101.8	86.2	118.5	103.0	87.4	121.6	107.1	96.0	124.1	110.3	104.8
	SHC	58.5	72.5	84.5	60.0	75.0	87.3	65.8	85.1	96.0	72.5	96.9	104.8
	kW	12.99	12.77	12.50	13.02	12.81	12.55	13.10	12.92	12.74	13.19	13.01	12.91

▨ Standard Ratings

LEGEND

BF — Bypass Factor
Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Compressor Motor Power Input
SHC — Sensible Heat Capacity (1000 Btuh) Gross
TC — Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \times \text{cfm}}$$

t_{lwb} = Wet-bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \times \text{cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil.

3. The SHC is based on 80 F edb temperature of air entering evaporator coil.
   Below 80 F edb, subtract (corr factor x cfm) from SHC.
   Above 80 F edb, add (corr factor x cfm) to SHC.
   Correction Factor = 1.10 x (1 − BF) x (edb − 80).

Case 3) Base DX System with Lower Airflow

Description

The base DX system of Case 1) operates at a design airflow of 350 cfm/ton. While the previous case considered a design with 300 cfm/ton and a four-row cooling coil, this case examines the base DX system of Case 1) operating at 300 cfm/ton. The results of the analysis should also give an indication of the level of variability among DX system designs operating a the same airflow rate.

Performance Characteristics

The DX system performance of Table 4–5 should be used with an airflow of 300 cfm/ton. The fan energy consumption will decrease with the lower airflow rate. As discussed above, it is assumed that the duct system has been specifically designed for 0.7 inWG and that there is a pressure drop of 0.535 inWG within the unit when the airflow rate is 350 cfm/ton. When the airflow is reduced to 300 cfm/ton, the internal pressure drop will decrease to about 0.370 inWG. With the reduction in total head across the fan, the fan energy will drop from 0.55 W/cfm of the base case to 0.476 W/cfm for this case.

Modeling Methods and Assumptions

The DX system should be modeled using the same techniques as Case 1, including part-load performance.

Case 4) DX System with AAHX

Description

An air-to-air heat exchanger (AAHX) can be used to improve the dehumidification performance of a DX system through a clever combination of reheating and precooling. These systems were introduced as *runaround coils* in the 1940s using water as an indirect heat transfer medium. Today, the most common systems employ heat pipes or compact air-to-air devices. The basic system and its performance is described in Figure 4-2. Alternative configurations are shown in Figure 4-3. The dashed line on the chart is the process line for a conventional coil without the heat exchangers. The dashed process line has a much higher SHR than that of the AAHX system. Part of this improvement is due to the reheating, but part is also due to the lower leaving air temperature that comes with precooling the air stream.

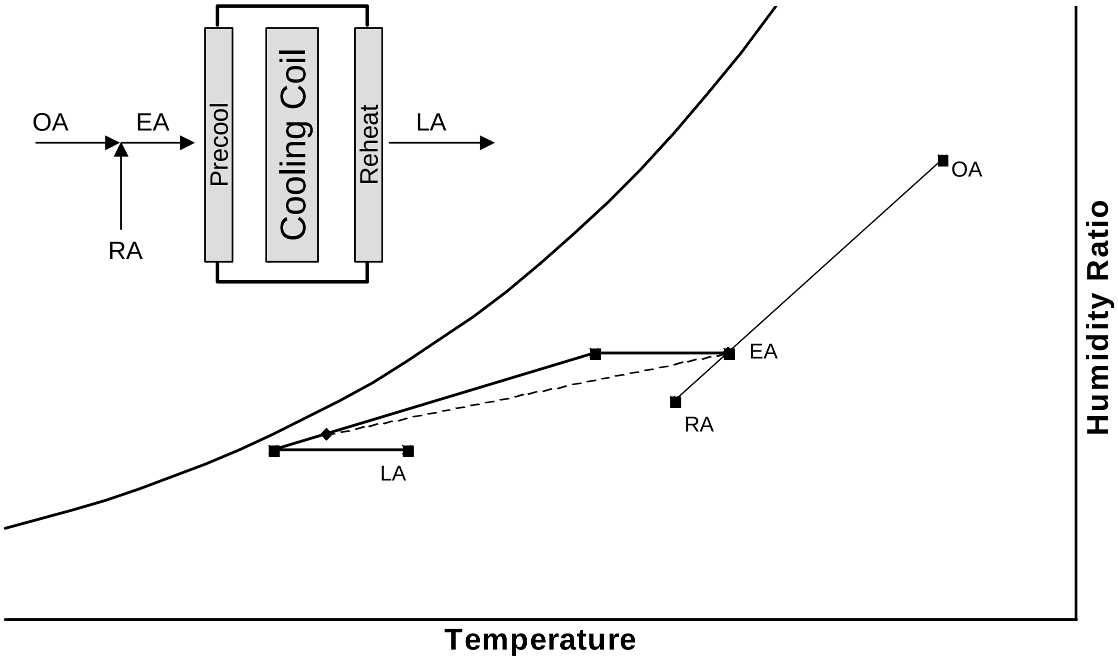


Figure 4-2 Use of air-to-air heat exchanger (AAHX) with cooling coil.

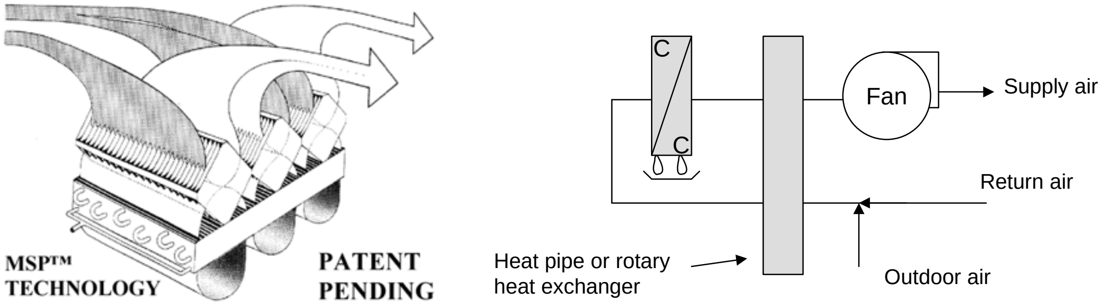


Figure 4-3 Alternative AAHX system configurations (MSP from Lossnay)

Performance Characteristics

The performance of a DX system with an AAHX involves a combination of the effects of the heat exchanger performance and the change in the DX system performance at lower entering air dry-bulb and wet-bulb temperatures. The dehumidification base DX system performance is given in Table 4–5. The AAHX performance depends on the particular design of the device, but is generally described by an overall heat exchanger effectiveness for sensible heat transfer.

$$\varepsilon_S = \frac{T_1 - T_2}{T_1 - T_3} \qquad (4–4)$$

where

T_1 = temperature of air stream entering precool portion
T_2 = temperature of air stream leaving precool portion
T_3 = temperature of air stream entering reheat portion

In general, the effectiveness is a function of airflow but is independent of the system temperatures. Note that the AAHX defined here does not transfer any moisture between the two airstreams.

While the sensible effectiveness of an AAHX can be quite high, approaching 0.90, the effectiveness of AAHXs used for dehumidification are usually rather low due to space and pressure drop considerations. A design effectiveness of 0.40 should be used for the analysis, representing typical performance of a two-row heat pipe. At a design face velocity for the base DX system of 337 fpm, the pressure drop through each row of heat pipe coil should be 0.07 inWG, giving a total additional pressure drop of 0.28 inWG. The fan power can then be calculated to be 0.675 W/cfm.

Modeling Methods and Assumptions

The DX system should be modeled using the same techniques as Case 1, including part-load performance. However, it is critical that the regression model be developed for an appropriate range of entering evaporator conditions.

The AAHX should be modeled using standard effectiveness-NTU method available in standard heat transfer or HVAC design textbooks. The model is also presented in the ASHRAE HVAC2 Toolkit (ASHRAE 1993). With constant airflows, the effectiveness will be constant. Note that the analysis requires an iterative approach, since the temperature of air entering the reheat portion of the AAHX is the discharge air temperature from the cooling coil, which is affected by the air temperature leaving the precool portion of the AAHX.

Case 5) DX System with Subcooling Reheat Coil

Description

Reheat is an effective method of increasing the latent fraction of system capacity. One alternative is to modify the vapor compression cycle to selectively draw reheat energy from the condenser and, at the same time, improve DX system performance. A subcooling reheat coil provides such a solution. A schematic diagram of a particular subcooling coil arrangement is shown in Figure 4-4.

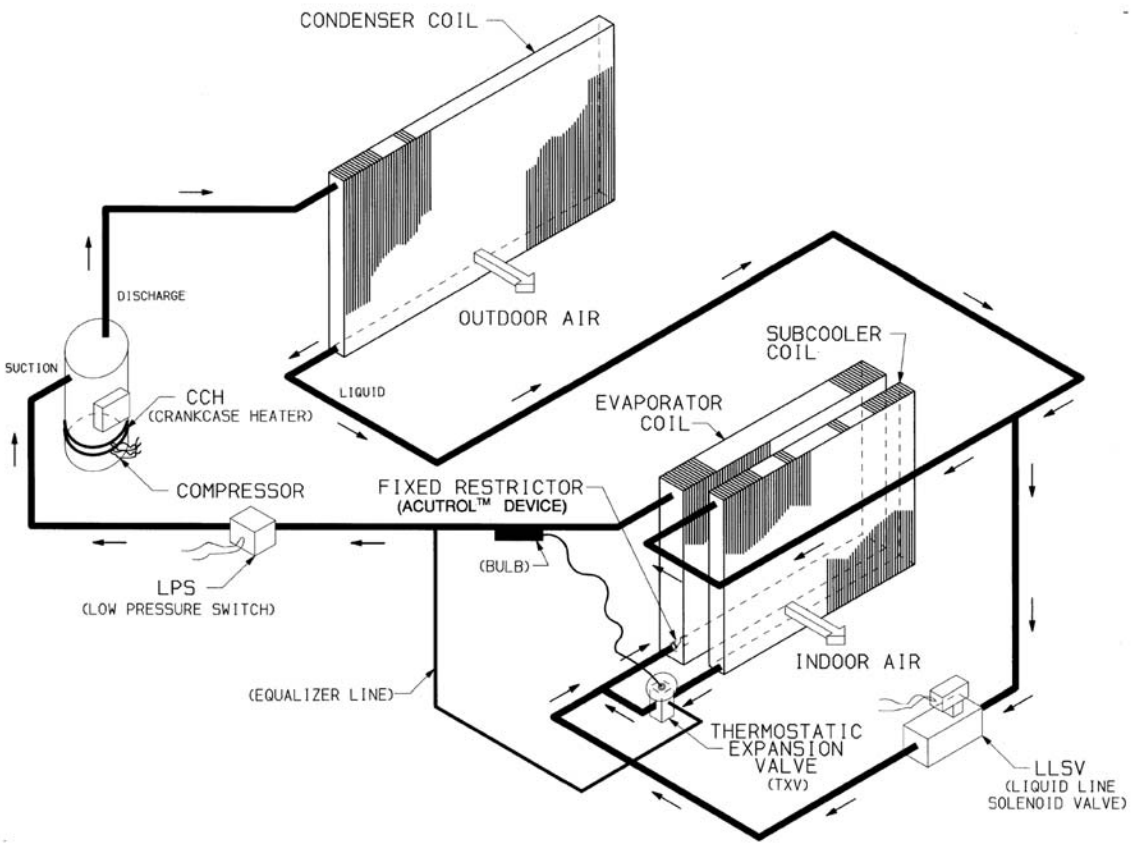


Figure 4-4 DX system with MoistureMiser (from Carrier)

This system, the MoistureMiser manufactured by Carrier, uses a controllable subcooling coil. The system is available as an option to standard Carrier rooftop units 48HJ and 50HJ. When additional dehumidification is required, as indicated by a space humidistat, refrigerant leaving the condenser is directed to an additional coil downstream of the evaporator. There, the refrigerant is further subcooled and the air is heated. The additional subcooling increases the capacity of the DX system. If additional dehumidification is not required the subcooling coil is deactivated.

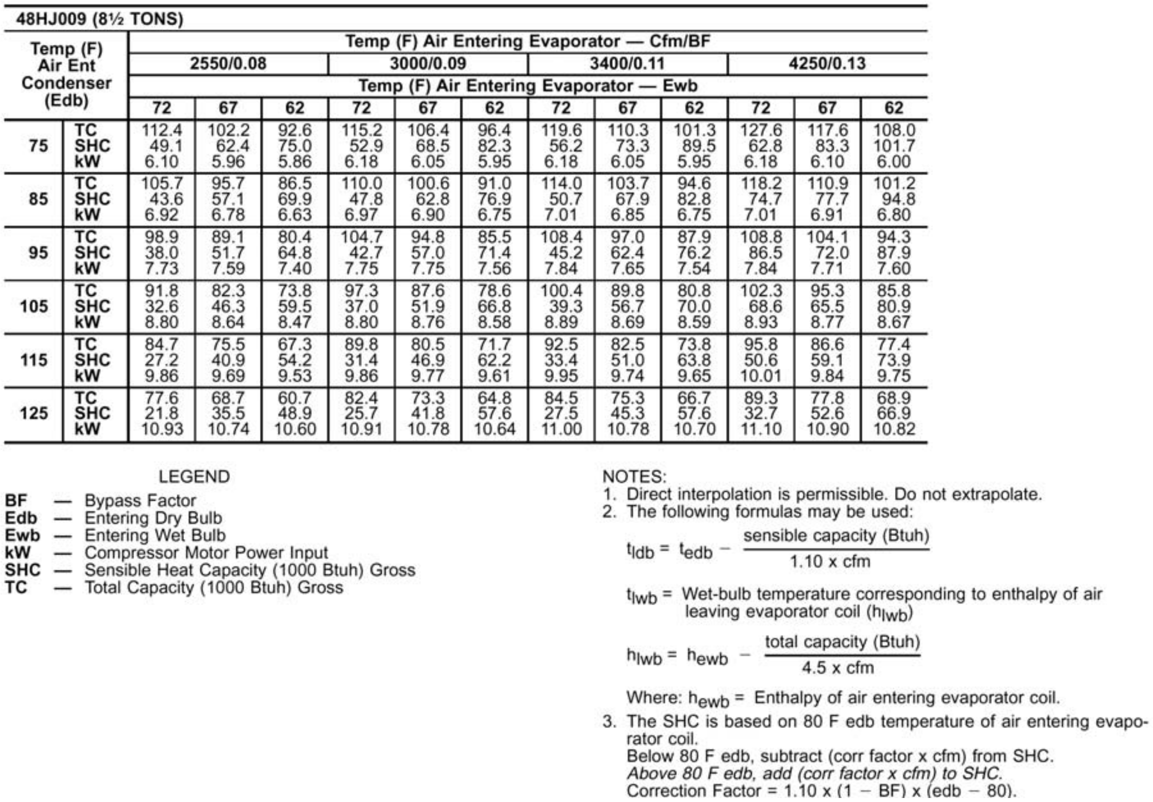
Performance Characteristics

The performance of the DX system with subcooling reheat coil is given in Table 4–7 as obtained from the manufacturer. Fan energy use will increase due to the additional pressure drop through the subcooling coil. Manufacturer's data states that, at 350 cfm/ton design airflow, the subcooler coil adds 0.12 inWG pressure drop. Using the base case fan energy and the fan energy estimation methods discussed previously, the new fan energy can be calculated to be 0.603 W/cfm.

Modeling Methods and Assumptions

The performance of the system should be modeled using a regression to the manufacturer's data.

Table 4–7: Performance of DX System with Subcooling Reheat Coil



48HJ009 (8½ TONS)

Temp (F) Air Ent Condenser (Edb)		Temp (F) Air Entering Evaporator — Cfm/BF											
		2550/0.08			3000/0.09			3400/0.11			4250/0.13		
		Temp (F) Air Entering Evaporator — Ewb											
		72	67	62	72	67	62	72	67	62	72	67	62
75	TC	112.4	102.2	92.6	115.2	106.4	96.4	119.6	110.3	101.3	127.6	117.6	108.0
	SHC	49.1	62.4	75.0	52.9	68.5	82.3	56.2	73.3	89.5	62.8	83.3	101.7
	kW	6.10	5.96	5.86	6.18	6.05	5.95	6.18	6.05	5.95	6.18	6.10	6.00
85	TC	105.7	95.7	86.5	110.0	100.6	91.0	114.0	103.7	94.6	118.2	110.9	101.2
	SHC	43.6	57.1	69.9	47.8	62.8	76.9	50.7	67.9	82.8	74.7	77.7	94.8
	kW	6.92	6.78	6.63	6.97	6.90	6.75	7.01	6.85	6.75	7.01	6.91	6.80
95	TC	98.9	89.1	80.4	104.7	94.8	85.5	108.4	97.0	87.9	108.8	104.1	94.3
	SHC	38.0	51.7	64.8	42.7	57.0	71.4	45.2	62.4	76.2	86.5	72.0	87.9
	kW	7.73	7.59	7.40	7.75	7.75	7.56	7.84	7.65	7.54	7.84	7.71	7.60
105	TC	91.8	82.3	73.8	97.3	87.6	78.6	100.4	89.8	80.8	102.3	95.3	85.8
	SHC	32.6	46.3	59.5	37.0	51.9	66.8	39.3	56.7	70.0	68.6	65.5	80.9
	kW	8.80	8.64	8.47	8.80	8.76	8.58	8.89	8.69	8.59	8.93	8.77	8.67
115	TC	84.7	75.5	67.3	89.8	80.5	71.7	92.5	82.5	73.8	95.8	86.6	77.4
	SHC	27.2	40.9	54.2	31.4	46.9	62.2	33.4	51.0	63.8	50.6	59.1	73.9
	kW	9.86	9.69	9.53	9.86	9.77	9.61	9.95	9.74	9.65	10.01	9.84	9.75
125	TC	77.6	68.7	60.7	82.4	73.3	64.8	84.5	75.3	66.7	89.3	77.8	68.9
	SHC	21.8	35.5	48.9	25.7	41.8	57.6	27.5	45.3	57.6	32.7	52.6	66.9
	kW	10.93	10.74	10.60	10.91	10.78	10.64	11.00	10.78	10.70	11.10	10.90	10.82

LEGEND

BF — Bypass Factor
Edb — Entering Dry Bulb
Ewb — Entering Wet Bulb
kW — Compressor Motor Power Input
SHC — Sensible Heat Capacity (1000 Btuh) Gross
TC — Total Capacity (1000 Btuh) Gross

NOTES:

1. Direct interpolation is permissible. Do not extrapolate.
2. The following formulas may be used:

$$t_{ldb} = t_{edb} - \frac{\text{sensible capacity (Btuh)}}{1.10 \text{ x cfm}}$$

t_{lwb} = Wet-bulb temperature corresponding to enthalpy of air leaving evaporator coil (h_{lwb})

$$h_{lwb} = h_{ewb} - \frac{\text{total capacity (Btuh)}}{4.5 \text{ x cfm}}$$

Where: h_{ewb} = Enthalpy of air entering evaporator coil.

3. The SHC is based on 80 F edb temperature of air entering evaporator coil.
Below 80 F edb, subtract (corr factor x cfm) from SHC.
Above 80 F edb, add (corr factor x cfm) to SHC.
Correction Factor = 1.10 x (1 − BF) x (edb − 80).

Case 6) DX System with Fan Control to Drain Coil

Description

All other DX system analysis has been performed assuming continuous fan operation with a part-load latent performance degradation due to re-evaporation during the off-cycle of the DX compressor (Henderson and Rengarajan, 1996). The effect of re-evaporation can be minimized by briefly turning the fan off (15-30 seconds) when the compressor cycles off. With the fan off, much of the condensate entrained on the coil can drain from the fin surface. After this short drain time, the fan is engaged again to provide ventilation and air distribution.

Performance Characteristics

The use of fan control to allow coil drainage can significantly reduce re-evaporation. With this option, the part-load performance more closely matches the steady state performance described in manufacturer’s literature.

Modeling Methods and Assumptions

The effect of fan control to drain the cooling coil can be modeled by ignoring the effect of re-evaporation as described by Henderson and Renjaragan (1996).

Case 7) Airflow Control with Bypass Damper

Description

The dehumidification performance of a DX system at part load can be enhanced by control of the airflow. One of the disadvantages of simple reducing the airflow of a DX system with constant fan speed is that dehumidification does not always drive system operation. In addition, it is sometimes required to maintain a higher supply airflow rate than desired for cooling coil performance.

This case analyzes the scenario for which the total supply airflow must be maintained at 350 cfm/ton (base DX system), but the airflow over the coil can be controlled using a two position damper as shown in Figure 4-5. Regardless of damper position, the airflow through the fan is 350 cfm/ton. When the damper is open, only 300 cfm/ton is delivered across the coil, with the remainder bypassing the coil through the damper. The approach of this improvement is to reduce airflow across the coil when the indoor humidity is above a desired setpoint.

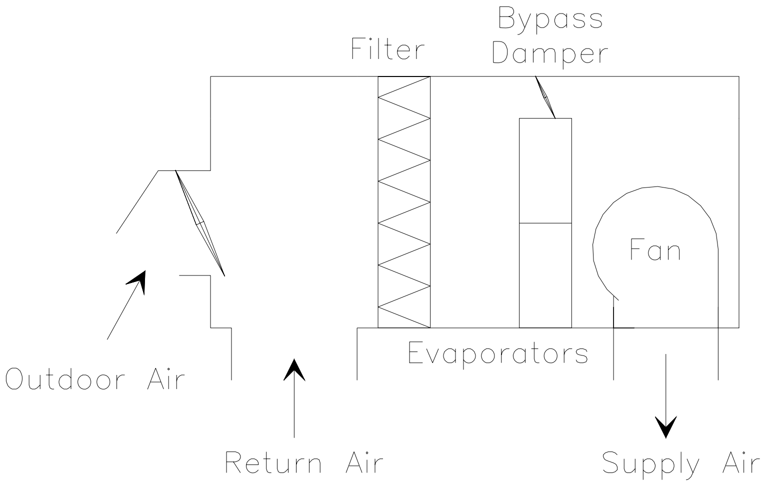


Figure 4-5 DX System with Two-Position Bypass Damper

Performance Characteristics

The performance characteristics are the same as discussed previously for the base DX system and the base system with lower airflow. Fan energy consumption is constant at 0.55 W/cfm.

Modeling Methods and Assumptions

Modeling methods are the same as discussed previously for DX systems. The bypass damper is opened whenever the dew-point of the indoor air is above a setpoint of 55°F.

Hybrid DX and Desiccant Systems

Case 8) Hybrid DX/Desiccant System

Description

Dehumidification loads in most buildings are accompanied by some sensible cooling requirements. One approach is to combine the dehumidification capabilities of a desiccant system with the cooling capabilities of a DX system. While the two technologies can be applied in independent packages in the same building, it is possible to integrate desiccant dehumidification and mechanical cooling into a single package and process stream. Such systems are known as integrated or hybrid systems. The one potential advantage of integrating a DX and desiccant system is that the DX system can be designed to meet only sensible loads. A DX system specifically designed for sensible cooling could operate at a higher coil temperature, improving DX system efficiency.

Figure 4-6 shows a schematic diagram of a hybrid system. It consists of a rotary desiccant dehumidifier, with a rotary heat exchanger for heat recovery, coupled to a standard DX system. The heat exchanger helps performance by reducing the load on the DX coil.

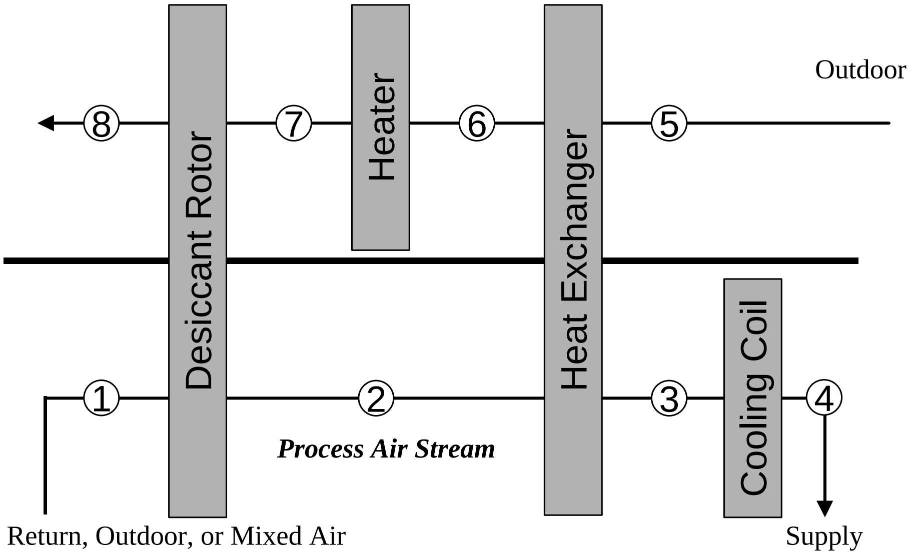


Figure 4-6 Hybrid integrated desiccant and DX system

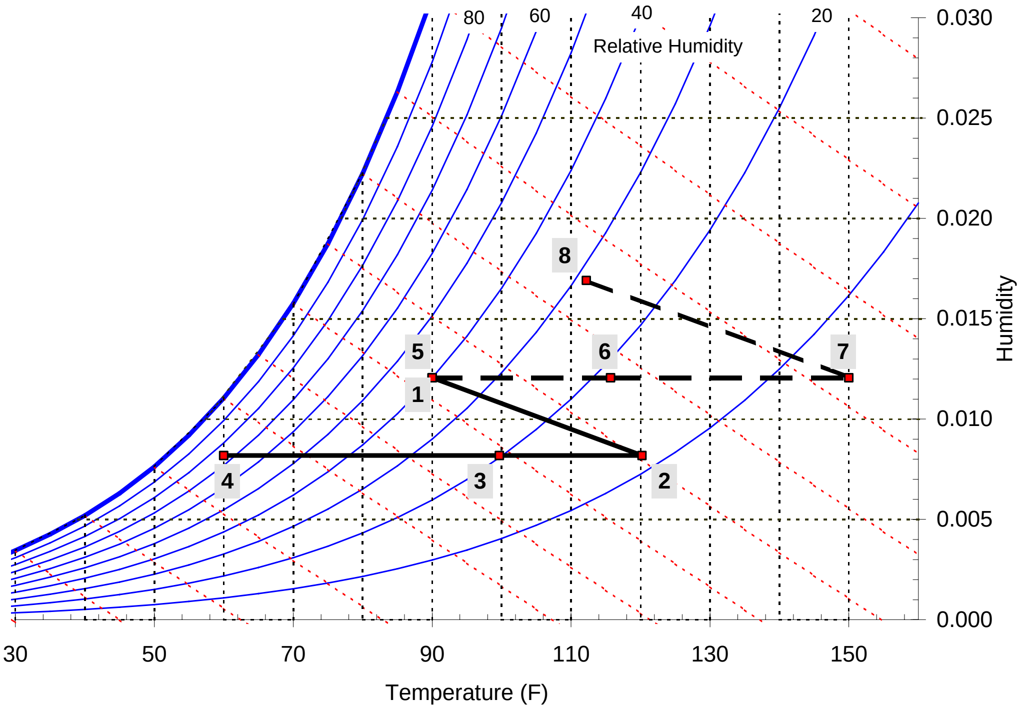


Figure 4-7 Psychrometric processes of hybrid desiccant and DX system

Performance Characteristics

Conceptually, the desiccant system provides dehumidification while the DX system provides only sensible cooling. With appropriate controls, dehumidification and cooling loads can be treated independently. The system could exactly meet any possible load sensible heat ratio.

The performance of a hybrid system is a combination of the performance of a DX system, a rotary heat exchanger, and a rotary desiccant dehumidifier. Figure 4-7 shows the processes of the various components on a psychrometric chart. (The chart is drawn for 100% outdoor air.) The performances of the DX system and heat exchanger have been discussed previously. The desiccant rotor dehumidifies the air, but also adds significant heat.

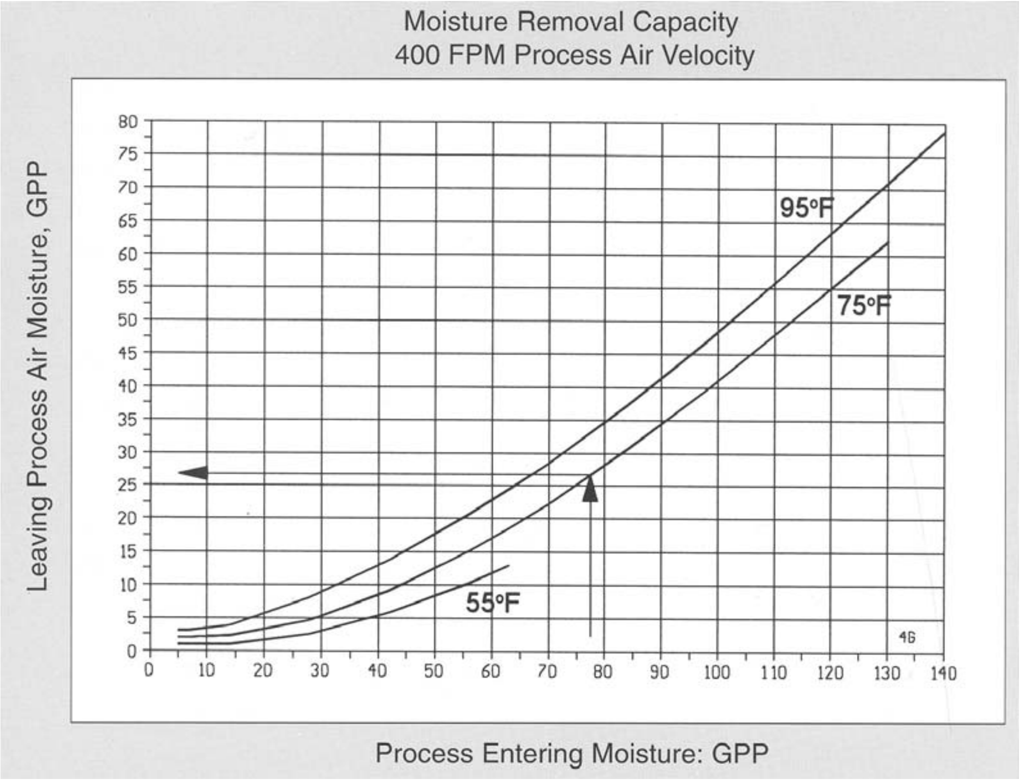
The performance of a desiccant dehumidifier is shown in Figure 4-8. The data includes the effects of entering conditions of the process air stream. Other operating variables affecting performance, in addition to physical design variables, are the regeneration air temperature and humidity, process and regeneration airflow rates, and wheel rotation speed. However, for a particular unitary application, most systems operate at fixed process airflow, regeneration temperature, and wheel speed.

Modeling Methods and Assumptions

The analysis should be based on regression to the manufacturer's performance data for both the desiccant rotor and the rotary heat exchanger. Since the airflow through the system is constant, the heat exchanger effectiveness will be constant. The regeneration temperature should be assumed to be constant, but the regeneration humidity will change with outdoor conditions. The desiccant system should be sized to meet design latent loads in the building.

Since the DX system will have little dehumidification demands, the conventional DX system of Case 0) should be used with design airflow of 400 cfm/ton. The DX system should be sized to meet all sensible cooling requirements and to overcome any heat added to the system by the desiccant system.

The desiccant system should be controlled by a dew-point humidistat located in the zone with a setpoint of 55°F. The DX system should be controlled by a standard room thermostat set to 75°F. While the effect of desiccant system cycling can be significant, there are no readily available simple models to properly account for the effects. Steady state performance should be assumed.



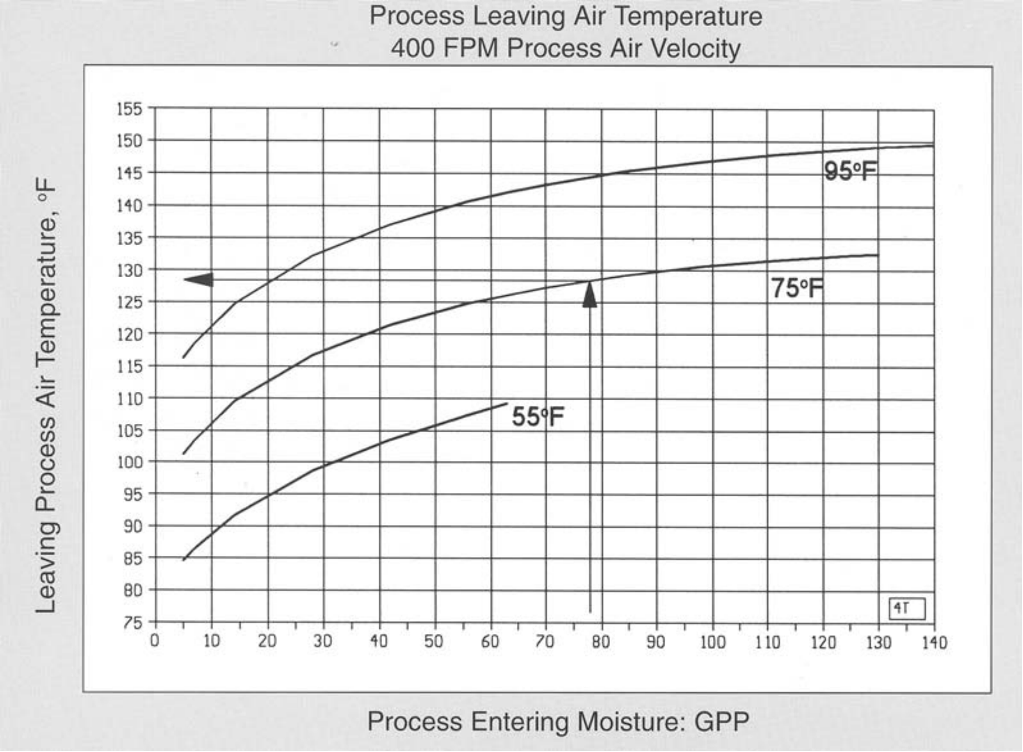


Figure 4-8 Desiccant Dehumidifier Performance Data (from Air Technology Systems)

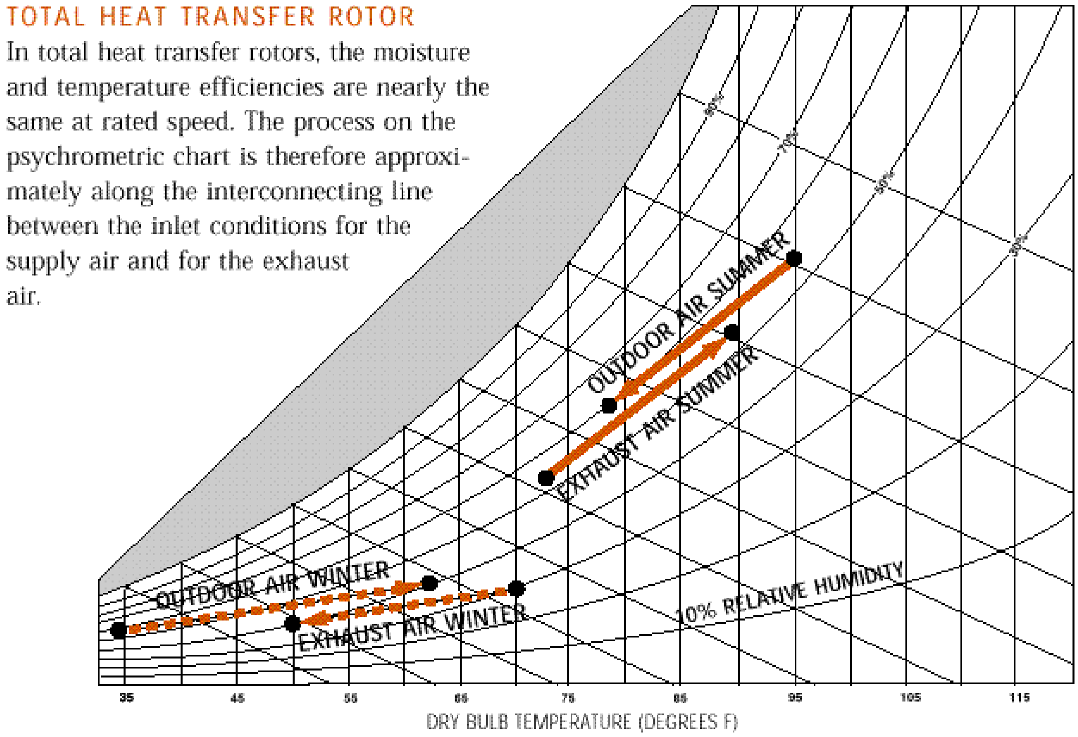
Outdoor Air and Dual Path Systems

Case 9) DX System with Enthalpy Recovery

Description

Enthalpy, or total energy, exchangers reduce the dehumidification load associated with ventilation air by transferring moisture from the humid outdoor ventilation air to the relatively drier exhaust air from the building. The moisture transport is analogous to heat transfer; while heat moves from hot to cold, water vapor moves from high vapor pressure to low vapor pressure. The generic behavior of an enthalpy exchanger is given in Figure 4-9.

Moisture transport typically occurs through either direct transfer through a membrane that separates the two air streams or indirect transfer to a matrix that rotates between the two air streams. Figure 4-10 shows a schematic representation of an enthalpy exchanger integrated with a DX rooftop unit.



TOTAL HEAT TRANSFER ROTOR

In total heat transfer rotors, the moisture and temperature efficiencies are nearly the same at rated speed. The process on the psychrometric chart is therefore approximately along the interconnecting line between the inlet conditions for the supply air and for the exhaust air.

Figure 4-9 Representative performance of enthalpy exchanger (from Des Champs)

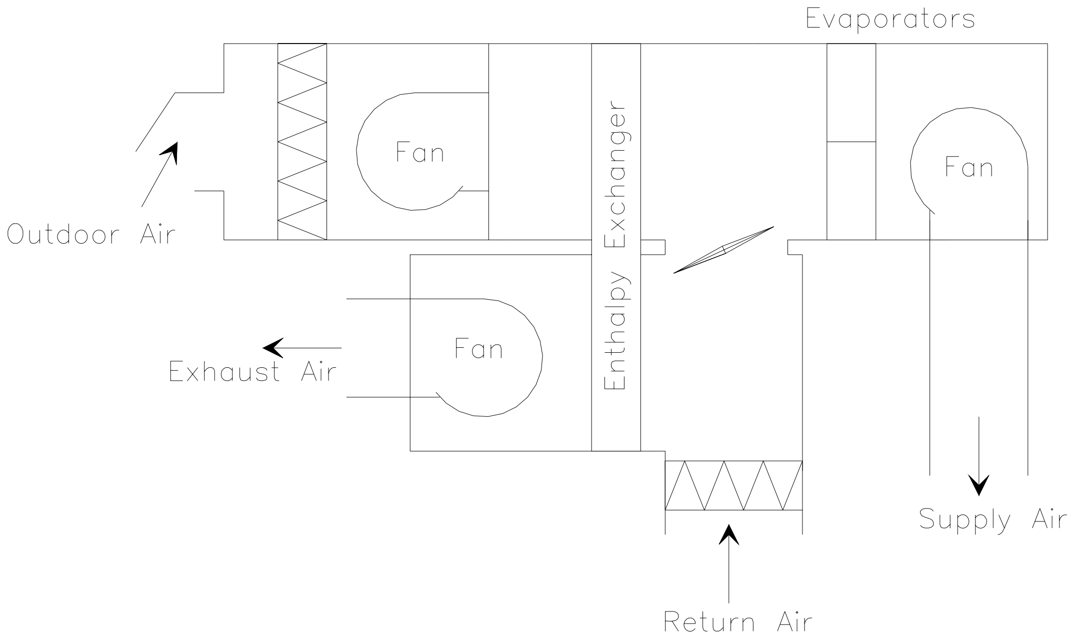


Figure 4-10 Schematic Diagram of Enthalpy Recovery in DX System

One of the limitations of enthalpy recovery in packaged equipment is that some portion of the outdoor airflow is used to offset exfiltration through the building envelope and mechanical exhaust (e.g. restrooms). The exchanger also imposes a pressure drop that increases fan energy use.

Performance Characteristics

An enthalpy exchanger is most commonly modeled using an enthalpy exchange effectiveness, or total effectiveness, combined with a sensible exchange effectiveness.

$$\varepsilon_T = \frac{\dot{m}_1 (h_{1,ent} - h_{1,lvg})}{\dot{m}_{\min} (h_{1,ent} - h_{2,ent})} = \frac{\dot{m}_2 (h_{2,lvg} - h_{2,ent})}{\dot{m}_{\min} (h_{1,ent} - h_{2,ent})} \qquad (4–5)$$

where

m_i = mass flow rate of stream i
m_{min} = minimum of m_1 and m_2
$h_{i,ent}$ = enthalpy of stream i entering exchanger
$h_{i,lvg}$ = enthalpy of stream i leaving exchanger

Analogous expressions are also used to separate the sensible and latent components of the energy exchange using effectivenesses for temperature and humidity ratio. The temperature effectiveness can be calculated from the effectivenesses of enthalpy and humidity ratio using standard psychrometric relationships.

The enthalpy efficiency is often reported by manufacturers as a function of airflow rate. Figure 4-11 give performance data for a Des Champs Type RSX rotary exchanger, made of a synthetic material impregnated with a molecular sieve. The figure shows separate effectiveness relationships for temperature (sensible), humidity ratio (latent), and enthalpy (total). For simplicity, it is often assumed that the leaving air states lie on the locus of points joining the two entering air states on a psychrometric chart. In fact, the humidity, or latent effectiveness will always be slightly less than the enthalpy effectiveness. It is noted that the efficiency data presented in the figure are based on balanced airflows with return air at 75/66.5°F dry-bulb/wet-bulb and outdoor air at 95/78°F dry-bulb/wet-bulb.

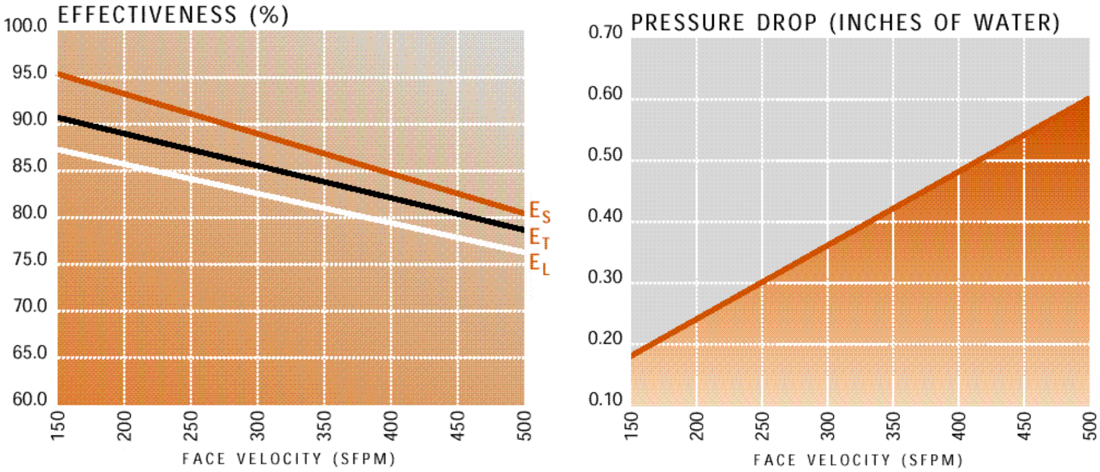


Figure 4-11 Performance of enthalpy recovery equipment (from Des Champs)

Modeling Methods and Assumptions

The modeling of enthalpy exchanger should be performed using an effectiveness approach. It should be assumed that these effectivenesses are independent of entering air conditions. Given that the DX system will have fixed airflow, the effectivenesses will be constant. For the data of Figure 4-11 and assuming a face velocity of 400 fpm, the analysis should use an enthalpy effectiveness of 0.82 and a humidity ratio effectiveness of 0.79 for a balanced flow exchanger. With exfiltration and local building exhaust, it should be assumed that the exhaust airflow through the exchanger is 80% of the outdoor airflow. For an exchanger with a flow ratio of 0.80, the effectiveness will increase by about six percentage points, giving an enthalpy effectiveness of 0.88 and a humidity ratio effectiveness of 0.85.

There will be additional fan energy to move air through the enthalpy exchanger. It should be assumed that two additional fans will be require, one each for outdoor and exhaust airflow. The fans are only required to overcome the pressure drop of the exchanger and filters. Given the data of Figure 4-11, assuming that the filter pressure drop will be the same as without the exchanger, and assuming reasonable values of fan and motor efficiencies, the additional power for each fan motor is 0.15 W/cfm.

Case 10) DX System with Outdoor Air Preconditioning

Description

Conventional DX unitary equipment introduces ventilation air into the unit and mixes it with return air upstream of the DX coil. One approach to reducing the load on the main cooling and dehumidifying coil is to precondition the outdoor air with a separate DX system. The system considered here preconditions the outdoor air before it mixes with return air and passes over the main DX coil.

The system can be particularly helpful in retrofit applications where it is necessary to increase outdoor airflow for improved air quality. In such retrofit applications, the existing cooling coil may be unable to meet the increased cooling and dehumidification demands of the increased ventilation. An outdoor air preconditioning system could be designed to bolt onto the ventilation air intake of the existing system. In new installations, the preconditioning system could be used to reduce the size of the main unit.

Two different system designs might be considered for the outdoor air preconditioning system. One approach involves the use of a conventional DX packaged air conditioner for preconditioning in which condenser heat is rejected to ambient air. Figure 4-12 shows an alternative arrangement to be evaluated here. In this case, the preconditioning system rejects heat to the exhaust air from the building, giving higher efficiency due to cooler air entering the condenser. The other advantage of the configuration of Figure 4-12 is that the preconditioning system can be a heat pump, offering preheating of outdoor air in winter to reduce heating requirements. The heat pump arrangement is particularly appealing when electric resistance heating is applied to the main unit.

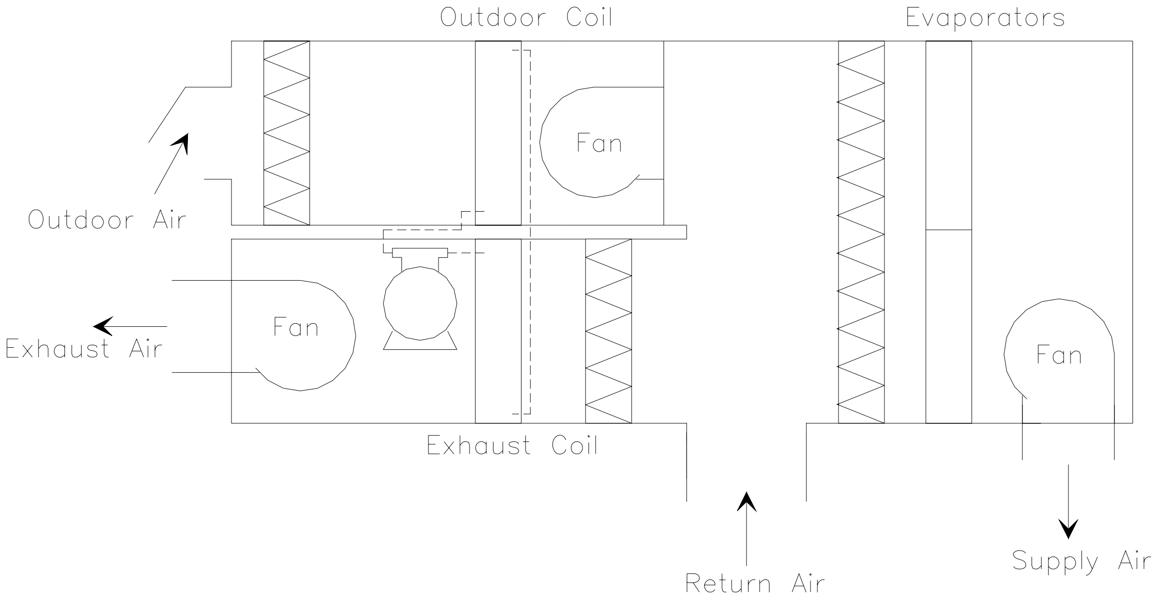


Figure 4-12 Schematic of DX System With Outdoor Air Preconditioning

The system of Figure 4-12 uses three fans and three sets of filters, which is an arrangement that is well suited for retrofit applications. In some applications, particular in new systems, it may be possible to eliminate the supply fan of the outdoor air unit. It may also be possible to filter the return air before it splits to the exhaust stream, eliminating the need for filters upstream of both the exhaust and main unit coils. However, for this analysis is should be assumed that all components are required to ensure adequate airflow and coil protection.

Performance Characteristics

Since the DX system with outdoor air preconditioning of Figure 4-12 is simply a combination of two packaged DX systems, the performance of the system might appear to be well known. While the main DX system will be a conventional base case DX system, the outdoor air preconditioning system will have unique characteristics. Note that, in cooling mode, the system always sees the same air temperature entering the condenser, while the air conditions entering the evaporator vary dramatically with changing outdoor air conditions.

While several custom equipment manufacturers have offered outdoor air preconditioning systems, comprehensive performance data have not generally been available. However, Carrier Corporation introduced the 62AQ Energy$Recycler in 2000 as an accessory for their packaged rooftop units and a relatively broad set of performance data has been published. Table 4–8 gives the performance of the unit designed to precondition outdoor air at a nominal airflow of 1000 cfm. The actual size of the preconditioning system will be set by the required outdoor airflow rate. Performance data should be scaled accordingly.

The main DX system is expected to be a standard unit, that is, the Base Case DX system of Case 1). However, depending on the size of the preconditioning system, the capacity of the main DX system could be reduced. Under cooling design conditions, the combined capacities of the two systems should satisfy the overall cooling and dehumidification needs of the building.

Fan energy consumption of the DX system with outdoor air preconditioning can be significantly greater than other systems. Manufacturer’s data suggests that each of the outdoor and exhaust fans consume approximately 0.3 W/cfm.

Table 4–8: Performance of Outdoor Air Preconditioner (from Carrier)

Exhaust Air Entering Condenser			SUPPLY AIR ENTERING EVAPORATOR CFM/BF																							
			600/0.3								800/0.32								1000/0.34							
			Supply Air — EDB (F)/EWB (F)																							
CFM	**F**		**67/62**	**80/67**	**125/72**	**75/74**	**95/75**	**80/78**	**89/80**	**89/82**	**67/62**	**80/67**	**125/72**	**75/74**	**95/75**	**80/78**	**89/80**	**89/82**	**67/62**	**80/67**	**125/72**	**75/74**	**95/75**	**80/78**	**89/80**	**89/82**
600	75	**TC**	16.4	17.7	22.8	19.9	19.9	21.0	21.6	22.3	17.0	18.4	24.8	20.5	20.6	21.7	22.3	23.0	17.5	18.8	26.1	20.9	20.9	22.2	22.8	23.5
		SHC	8.51	12.2	22.8	5.88	15.0	6.13	9.46	8.36	9.21	13.9	24.8	5.98	17.5	6.39	10.6	9.25	9.88	15.5	26.1	6.10	19.6	6.64	11.7	10.1
		CMP	1.48	1.54	1.79	1.63	1.64	1.68	1.71	1.74	1.51	1.57	1.89	1.65	1.67	1.71	1.74	1.77	1.53	1.59	1.96	1.67	1.69	1.73	1.77	1.80
		LDB	54.0	60.9	86.2	65.9	70.8	70.4	73.9	75.7	56.4	63.6	93.4	68.0	73.9	72.5	76.4	78.0	57.9	65.4	98.3	69.3	76.1	73.8	77.8	79.4
		LWB	52.4	57.4	59.5	64.9	65.6	69.1	71.1	73.3	54.7	59.7	62.1	67.2	67.9	71.3	73.3	75.4	56.1	61.1	63.8	68.5	69.3	72.6	74.6	76.7
	80	**TC**	16.0	17.3	22.4	19.3	19.4	20.6	21.1	21.7	16.6	17.9	24.3	20.0	20.1	21.2	21.8	22.4	17.1	18.3	25.6	20.4	20.5	21.6	22.3	22.9
		SHC	8.35	12.1	22.4	5.69	14.9	5.99	9.32	8.23	9.05	13.7	24.3	5.83	17.3	6.25	10.5	9.11	9.71	15.3	25.6	5.96	19.3	6.50	11.6	9.96
		CMP	1.57	1.63	1.89	1.70	1.72	1.76	1.80	1.83	1.59	1.66	1.99	1.74	1.76	1.80	1.83	1.86	1.61	1.68	2.06	1.76	1.78	1.82	1.86	1.89
		LDB	54.2	61.1	86.8	66.2	71.0	70.6	74.2	75.9	56.6	63.8	94.0	68.2	74.1	72.7	76.5	78.1	58.1	65.6	98.9	69.4	76.3	73.9	77.9	79.5
		LWB	52.7	57.6	59.7	65.2	65.9	69.4	71.3	73.5	54.9	59.9	62.3	67.3	68.1	71.5	73.4	75.6	56.2	61.2	63.9	68.6	69.4	72.8	74.7	76.8
800	75	**TC**	—	—	—	—	—	—	—	—	17.6	19.0	25.7	21.3	21.4	22.7	23.3	24.0	18.1	19.4	27.2	21.8	21.9	23.2	23.8	24.6
		SHC	—	—	—	—	—	—	—	—	9.43	14.2	25.7	6.23	17.8	6.64	10.9	9.51	10.1	15.7	27.2	6.36	20.0	6.90	12.0	10.4
		CMP	—	—	—	—	—	—	—	—	1.39	1.44	1.69	1.51	1.52	1.56	1.58	1.61	1.41	1.45	1.75	1.52	1.54	1.57	1.60	1.63
		LDB	—	—	—	—	—	—	—	—	56.2	63.3	92.2	67.8	73.5	72.2	76.0	77.6	57.7	65.2	97.2	69.1	75.6	73.5	77.6	79.1
		LWB	—	—	—	—	—	—	—	—	54.5	59.4	61.6	66.8	67.6	71.0	72.9	75.1	55.9	60.9	63.4	68.2	69.0	72.3	74.3	76.4
	80	**TC**	—	—	—	—	—	—	—	—	17.2	18.5	25.3	20.8	21.0	22.2	22.8	23.5	17.6	18.9	26.7	21.3	21.4	22.6	23.3	24.0
		SHC	—	—	—	—	—	—	—	—	9.27	14.0	25.3	6.08	17.6	6.50	10.7	9.38	9.93	15.6	26.7	6.22	19.8	6.76	11.8	10.2
		CMP	—	—	—	—	—	—	—	—	1.47	1.51	1.78	1.59	1.61	1.64	1.67	1.69	1.48	1.53	1.84	1.60	1.62	1.65	1.69	1.71
		LDB	—	—	—	—	—	—	—	—	56.3	63.6	92.8	67.9	73.7	72.4	76.2	77.8	57.9	65.4	97.7	69.2	75.8	73.7	77.7	79.2
		LWB	—	—	—	—	—	—	—	—	54.6	59.6	61.8	67.0	67.7	71.2	73.1	75.2	56.0	61.0	63.5	68.4	69.2	72.5	74.4	76.5
1000	75	**TC**	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18.3	19.9	27.8	22.4	22.5	23.8	24.5	25.3
		SHC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10.2	15.9	27.8	6.52	20.3	7.07	12.1	10.5
		CMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.33	1.37	1.62	1.44	1.46	1.48	1.51	1.53
		LDB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	57.6	65.0	96.7	68.9	75.4	73.4	77.4	79.2
		LWB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	55.8	60.7	63.2	68.1	68.8	72.2	74.1	78.9
	80	**TC**	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17.9	19.4	27.3	21.9	22.0	23.3	24.0	24.6
		SHC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10.0	15.7	27.3	6.38	20.1	6.93	12.0	10.4
		CMP	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.40	1.45	1.71	1.52	1.53	1.56	1.59	1.60
		LDB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	57.8	65.2	97.2	69.1	75.6	73.5	77.5	79.1
		LWB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	55.9	60.9	63.3	68.2	69.0	72.3	74.3	76.4

LEGEND

BF — Bypass Factor
CMP — Compressor Power (kW)
EDB — Entering Dry Bulb (F)
EWB — Entering Wet Bulb (F)
LDB — Leaving Dry Bulb (F)
LWB — Leaving Wet Bulb (F)
SHC — Sensible Heat Capacity (1000 Btuh) Gross
TC — Capacity (1000 Btuh) Gross

Modeling Methods and Assumptions

The outdoor air and return air systems should be modeled as two independent systems. The individual DX systems of each system should be modeled using the same methods discussed previously for other DX systems.

With exfiltration and local building exhaust, it should be assumed that the exhaust airflow through the exchanger is 80% of the outdoor airflow.

The control strategy employed for the two DX units can have an effect on part-load performance. For this analysis, it should be assumed that the outdoor air preconditioning unit is used for the second stage of space cooling, but should be engaged whenever indoor humidity is above desired levels. The outdoor air preconditioning unit should be disengaged whenever the discharge air temperature from the unit is colder than 45°F.

Case 11) Base DX Dual Path System

Description

Conventional DX unitary equipment introduces ventilation air into the unit and mixes it with return air upstream of the cooling coil. A dual path system relies on separate conditioning of the ventilation air stream before mixing with the return air. The dual path processes are shown in Figure 4-13. A schematic representation of a dual path system is shown in Figure 4-14. The figure shows a true dual path arrangement with separate coils for return and outdoor air streams. However, the improvements in dehumidification are largely based on the improved dehumidification performance of a system that conditions 100% outdoor air.

These systems are also known as 100% outdoor air units or make-up air units. However, the cooling and dehumidification loads of a commercial building almost always require a combination of outdoor and return air conditioning. For this reason, a building system that provides separate conditioning of outdoor air will be referred to as a dual path system.

Dehumidification improvements of dual path systems are largely based on the low SHR available by conditioning air at the high humidities associated with outdoor air. That is, the process line in Figure 4-13 for the outdoor air coil is much steeper than that of the return air coil. This performance feature is an inherent characteristic of mechanical cooling systems.

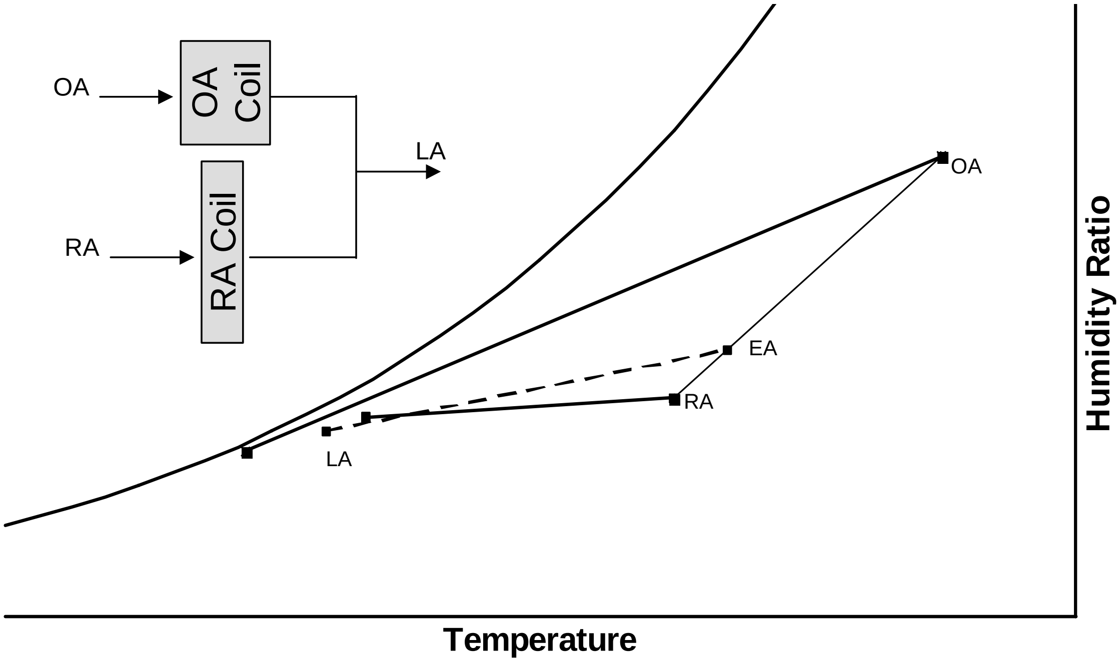


Figure 4-13 Dual Path System Processes

Dual path systems can be applied in two main configurations.

- **Independent Systems.** One approach is to treat the outdoor and return air systems as independent of each other. The outdoor air system can have separate fan and ductwork to deliver conditioned outdoor air to the zone.
- **Common Supply System**. The outdoor and return air systems could share a common supply fan and ductwork. The discharge air from the two systems can be mixed immediately upstream of the supply fan. Airflow through the two systems can be controlled with dampers, or an injection fan can be used to help control outdoor airflow.

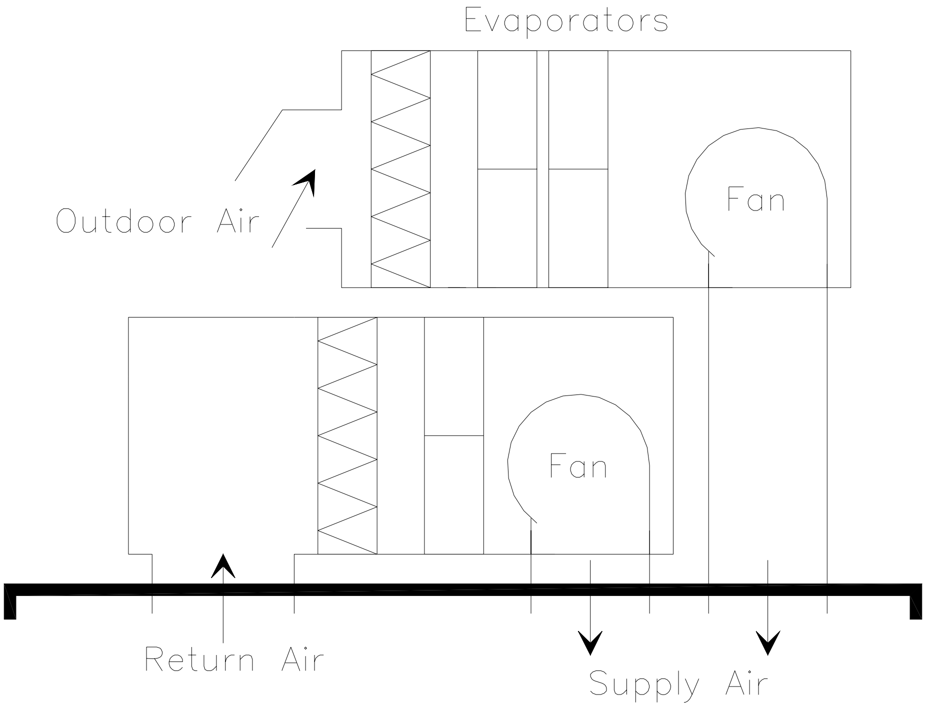


Figure 4-14 Schematic of Dual Path System

For the purposes of this analysis, the performance of these two main configurations will be considered identical. In actual applications, the independent systems may have higher initial costs, but may be easier to control.

A well-designed dual path system will also exhibit improved efficiency, especially for multi-stage systems. Since the outdoor air DX system has the same air conditions entering the evaporator and condenser, the required compressor lift is lower and efficiency can be higher. However, the control of the outdoor air DX unit is particularly challenging. While the return air system typically sees nearly constant entering air conditions and airflow rate, the outdoor air system sees wide variations in outdoor temperature and humidity. More advanced systems can also modulate outdoor airflow rate to match indoor air quality needs, further complicating the capacity control challenge.

Performance Characteristics

Since a dual path system is simply a combination of two packaged DX systems, the performance of the system might appear to be well known. However, the effectiveness of a dual path system depends on the particular design and control of the outdoor and return air systems.

The return air system will have little dehumidification demand, since the ventilation latent load will be met by the outdoor air system. Therefore, the return air system should be designed using the DX system of Case 0) at 400 cfm/ton.

A well-designed outdoor air system will not have the same performance characteristics as the base DX system of Table 4–5. Under design conditions, the outdoor air unit will be forced to condition air from a wet-bulb temperature of 77-80°F to a discharge air temperature of 55°F. The large enthalpy difference would normally lead to a deeper coil design. In addition, the enthalpy difference gives a design airflow of about 150 cfm/ton.

In the absence of detailed performance data for an air-cooled DX system specifically designed for 100% outdoor air applications, the analysis should be performed using the system shown in Figure 4-15. The system has four equal stages of capacity. Stages 1 and 2 have the same performance as the dehumidification base DX system of Case 1). Stages 3 and 4 also share these same performance characteristics. Effectively, two base case DX systems are combined in series. Since the total system has an airflow of about 150 cfm/ton, the airflow for each individual system is 300 cfm/ton. The performance data of Table 4–5 can then be used with 300 cfm/ton airflow to describe each unit. Note that the entering air conditions for stages 1 and 2 are the leaving air conditions from stages 3 and 4.

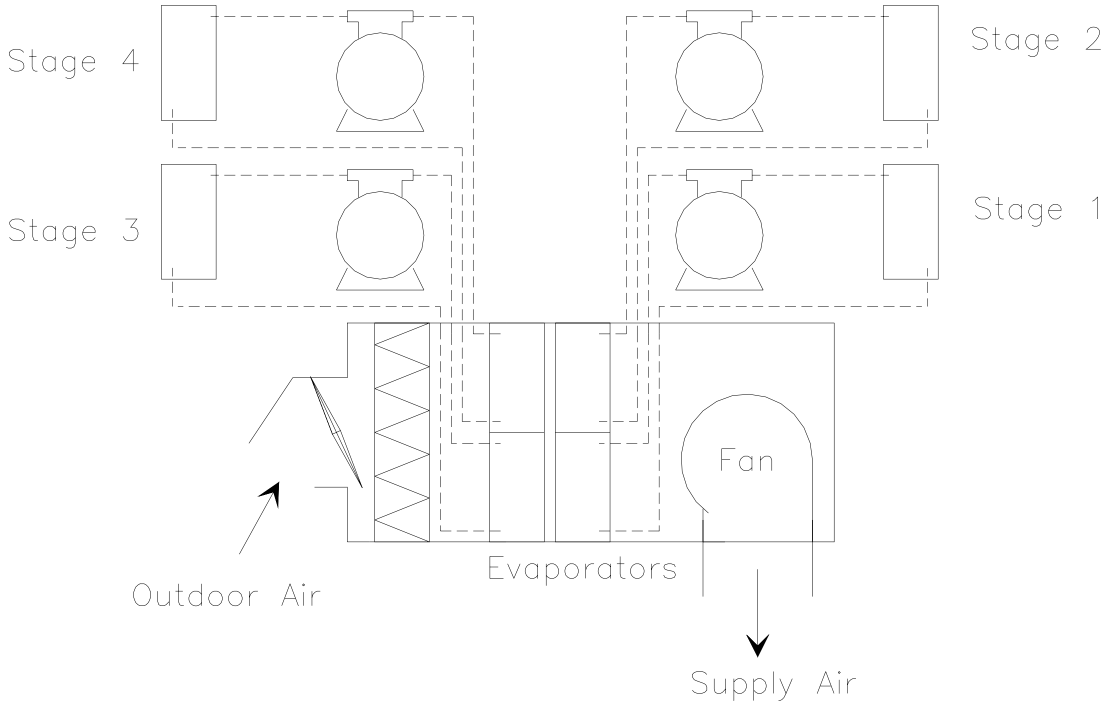


Figure 4-15 Design of Outdoor Air System for Analysis

The fan power for each path of the dual path system should be calculated separately. The return path system has the same performance as the conventional base DX system with 400 cfm/ton and 0.55 W/cfm. The outdoor air system, though has no return duct system or mixing chamber, but adds a second coil. Assuming that the total duct system has a pressure drop of 0.7 inWG with 25% of the loss in the return duct, the supply duct system has a loss of 0.525 inWG. The airflow through the outdoor unit is slightly less than the dehumidification DX base case, which gives a lower pressure drop within the unit than the base case. Noting that the velocity will be 14% lower (300 cfm/ton vs. 350 cfm/ton), the internal pressure drop will be reduced from 0.535 inWG to 0.370 inWG. Assuming that the additional three-row coil adds 0.18 inWG, the total pressure drop through the equipment and duct system at a design airflow of 300 cfm/ton is 1.075 inWG, giving a fan power of 0.479 W/cfm.

Modeling Methods and Assumptions

The outdoor air and return air systems should be modeled as two independent systems. The individual DX systems of each system should be modeled using the same methods discussed previously for other DX systems.

A unique feature of the simulation of the dual path system is the modeling of system control and staging. For this analysis, it should be assumed that the outdoor air unit is used for the first stage of space cooling, provided that the discharge air temperature of the unit is not so low to compromise equipment reliability. When the outdoor air unit is operating, capacity should be controlled to ensure that the discharge air temperature from the unit is no colder than of 45°F. The outdoor air system should be sized to deliver discharge air at a temperature of 55°F under design cooling conditions. The return air system should be sized to meet the remaining load.

Case 12) DX Dual Path System with Enthalpy Recovery

Description

The dual path system of the previous case can be combined with enthalpy recovery equipment to precondition the outdoor air before the DX cooling system. Figure 4-16 shows a schematic depiction of the system. Note that the enthalpy exchanger will dramatically reduce the load on the DX cooling coil, eliminating the need for four stages of capacity used in the dual path system without recovery.

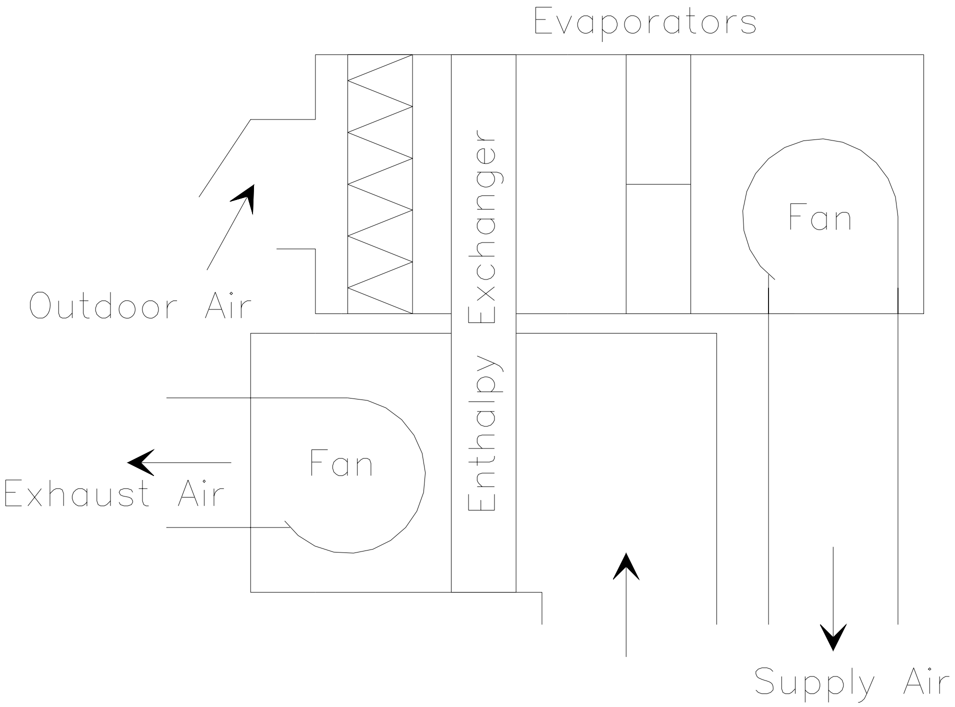


Figure 4-16 Dual Path System with Enthalpy Recovery

Performance Characteristics

The performance of the dual path system with enthalpy recovery is simply a combination of the performance of the two subsystems. The performance of these two system are described previously. The dual path system is discussed in Case 11) and the enthalpy recovery device is discussed in Case 9). The one main difference is that only two stages of DX cooling capacity are required for the outdoor air path in this system. This system should have the same performance as the base dehumidification DX system of Table 4–5.

The fan power calculations are also slightly different due to the physical configuration. It should be assumed that the exhaust fan consumes 0.15 W/cfm. The enthalpy recovery wheel adds 0.5 inWG of pressure drop, but the removal of three rows of coil reduces the pressure drop by 0.18 inWG. The result of these competing influences increases the supply fan power of the outdoor air conditioning unit from 0.479 W/cfm to 0.622 W/cfm.

Modeling Methods and Assumptions

Thermal performance models are the same as discussed previously.

Case 13) DX Dual Path System with AAHX

Description

The dual path system of Case 11) can be combined with AAHX equipment to precondition the outdoor air before the DX cooling system. Figure 4-17 shows a schematic depiction of the system.

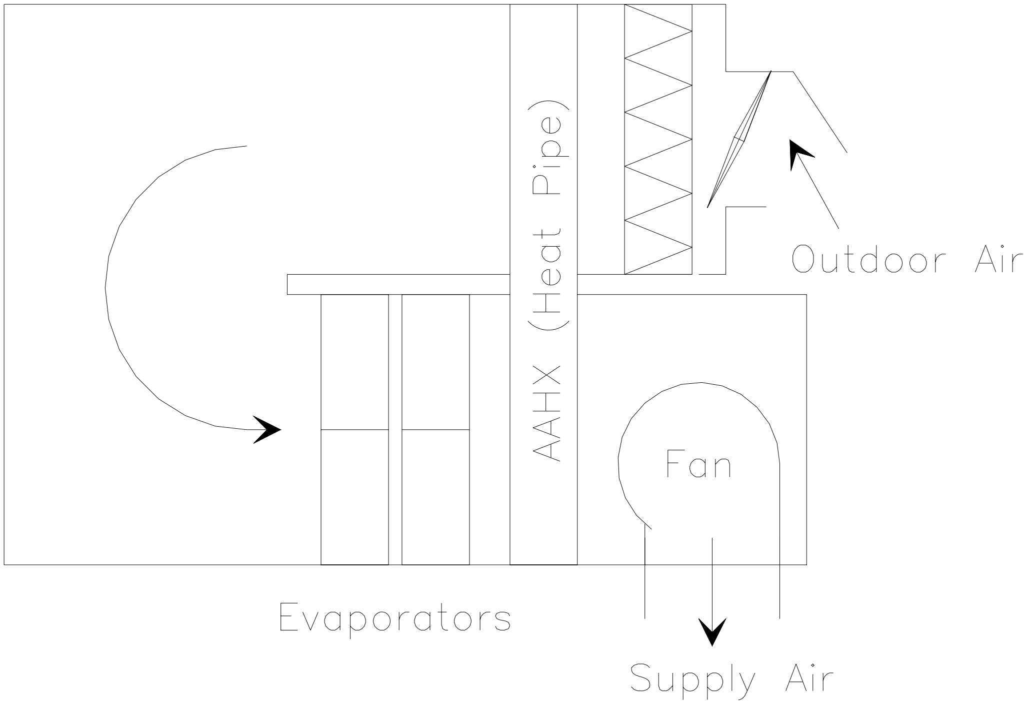


Figure 4-17 Dual path system with AAHX

Performance Characteristics

The performance of the dual path system with an AAHX is simply a combination of the performance of the two subsystems. The performance of each system is described previously. The dual path system is discussed in Case 11) and the AAHX device is discussed in Case 4).

The presence of the AAHX increases the fan energy use. As noted in Case 4), the AAHX increases the pressure drop through the equipment by 0.28 inWG, which increases the fan energy to 0.604 W/cfm.

Modeling Methods and Assumptions

Thermal performance models are the same as discussed previously in Case 11) and Case 4).

Case 14) Hybrid DX and Desiccant Dual Path System

Description

The hybrid desiccant dual path system is a variation of the dual path and hybrid systems discussed in Case 11) and Case 8), except that the hybrid DX/desiccant system is used to condition outdoor air and a separate DX system is used to condition the return air. A schematic diagram is shown in Figure 4-18. Conceptually, the hybrid DX/desiccant system will meet all dehumidification requirements of the building and introduce conditioned outdoor air to the zone at room temperature.

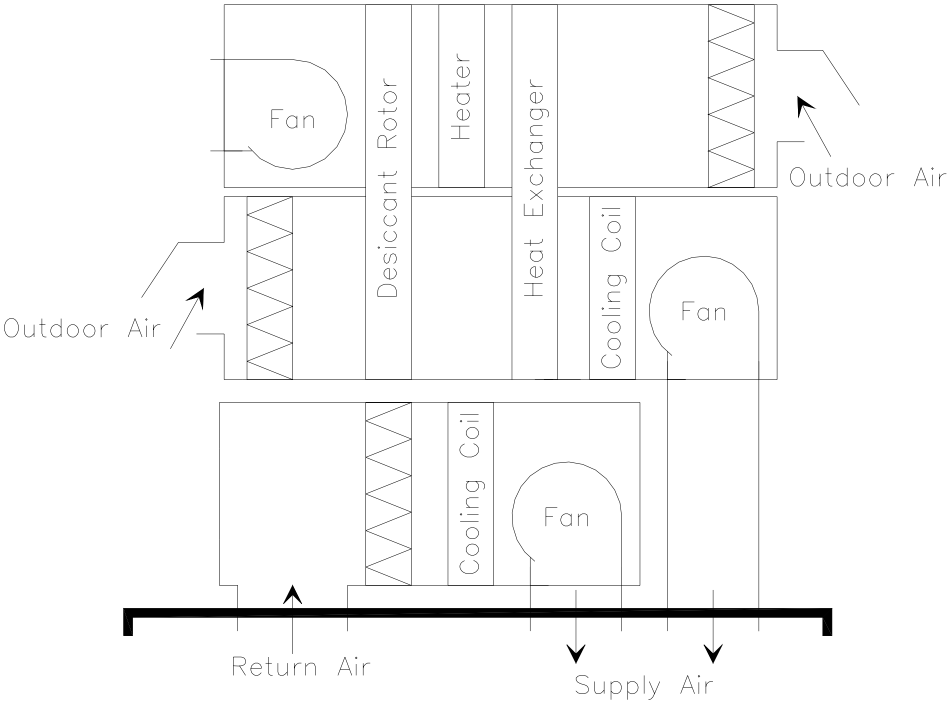


Figure 4-18 Hybrid DX/desiccant dual path system

Performance Characteristics

The performance of the system is a combination of the performance of the individual subsystems previously discussed.

Modeling Methods and Assumptions

The basic models previously discussed should be used for the analysis. The desiccant system should be controlled by a dew-point humidistat located in the zone with a setpoint of 55°F. The DX system in the outdoor air path should be controlled to maintain discharge air temperature at 75°F.

Demand Controlled Ventilation Systems

Case 15) DX System with Demand Controlled Ventilation

Description

In most commercial buildings, dehumidification loads are dictated by ventilation requirements. Since ventilation is dictated by indoor air quality concerns, it is possible to modulate ventilation airflow in response to air quality demands. For commercial buildings in which occupant-generated contaminants dictate ventilation requirement, ASHRAE Standard 62-1999 allows modulation of ventilation air to maintain the concentration of CO_2 at 1000 ppm in the occupied zone. Of the building applications for this study, all buildings except the retail store are considered to have ventilation requirements dictated by occupant-generated contaminants. This humidity control option involves control of ventilation airflow rate to maintain 1000 ppm CO_2. As a limiting case, the control should also be applied to the retail building.

Performance Characteristics

The performance of this humidity control option is dictated by the performance of the DX system, previously discussed, operating with the particular combination of mixed air conditions and load requirements.

Modeling Methods and Assumptions

Given a typical CO_2 generation rate of 0.3 L/min per person, outdoor CO_2 concentration of 350 ppm, and a zone air exchange effectiveness of 85%, demand controlled ventilation to maintain 1000 ppm CO_2 can be modeled assuming an outdoor airflow rate of 19 cfm/person. That is, the outdoor airflow rate should be scheduled with occupancy. To ensure adequate building pressurization, the outdoor airflow rate should not drop below 0.05 cfm/ft^2 of building floor area.

Case 16) Dual Path System with Demand Controlled Ventilation

Description

In most commercial buildings, dehumidification loads are dictated by ventilation requirements. Since ventilation is dictated by indoor air quality concerns, it is possible to modulate ventilation airflow in response to air quality demands. For commercial buildings in which occupant-generated contaminants dictate ventilation requirement, ASHRAE Standard 62-1999 allows modulation of ventilation air to maintain the concentration of CO_2 at 1000 ppm in the occupied zone. Of the building applications for this study, all buildings except the retail store are considered to have ventilation requirements dictated by occupant-generated contaminants. This humidity control option involves control of ventilation airflow rate to maintain 1000 ppm CO_2. As a limiting case, the control should also be applied to the retail building.

Performance Characteristics

The performance of this humidity control option is dictated by the performance of the dual path system, previously discussed, operating with the particular combination of outdoor air conditions and airflow requirements.

Modeling Methods and Assumptions

Given a typical CO_2 generation rate of 0.3 L/min per person, outdoor CO_2 concentration of 350 ppm, and a zone air exchange effectiveness of 85%, demand controlled ventilation to maintain 1000 ppm CO_2 can be modeled assuming an outdoor airflow rate of 19 cfm/person. That is, the outdoor airflow rate should be scheduled with occupancy. To ensure adequate building pressurization, the outdoor airflow rate should not drop below 0.05 cfm/ft^2 of building floor area.

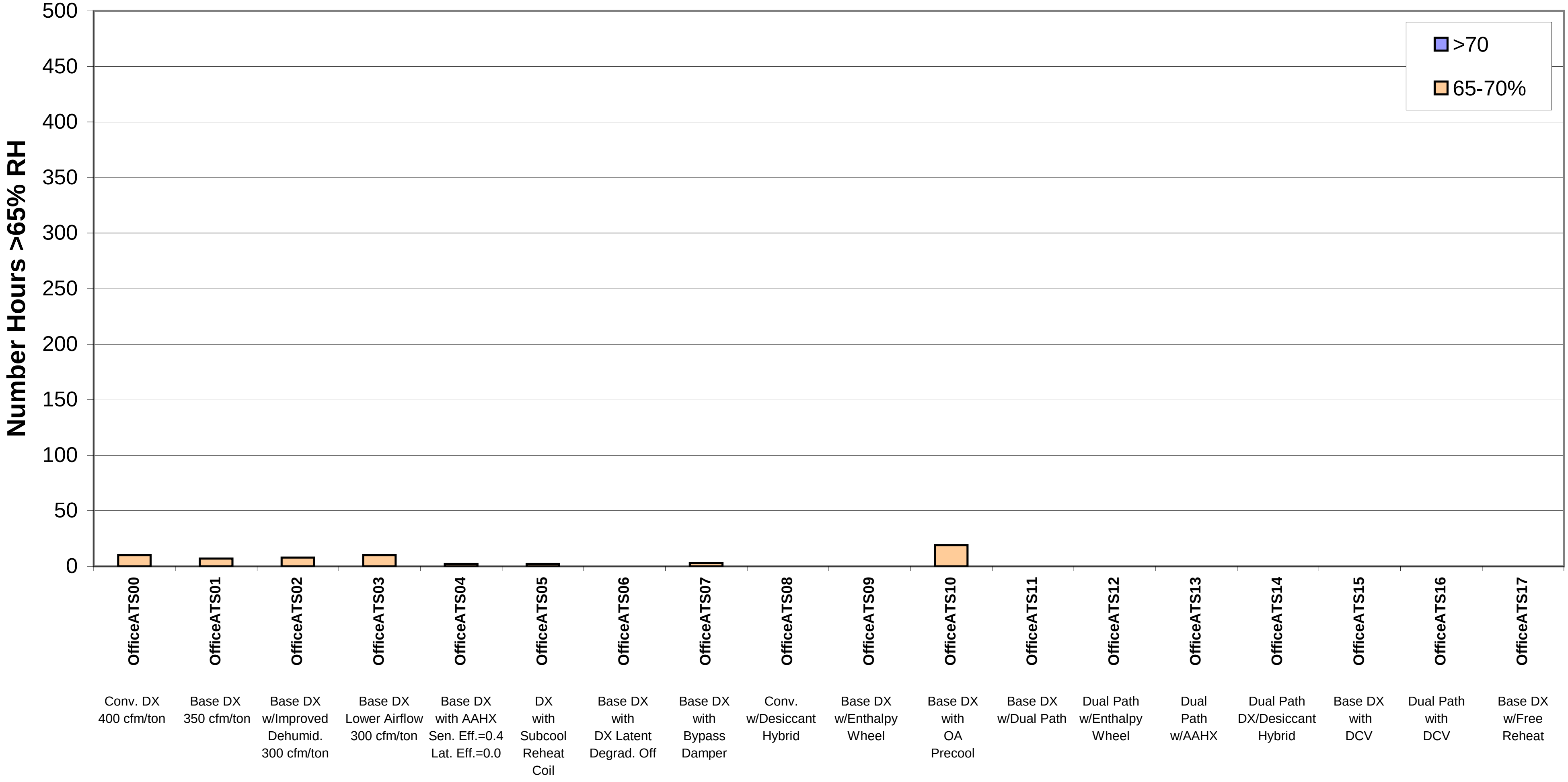
APPENDIX B

DETAILED RESULTS OF SIMULATIONS

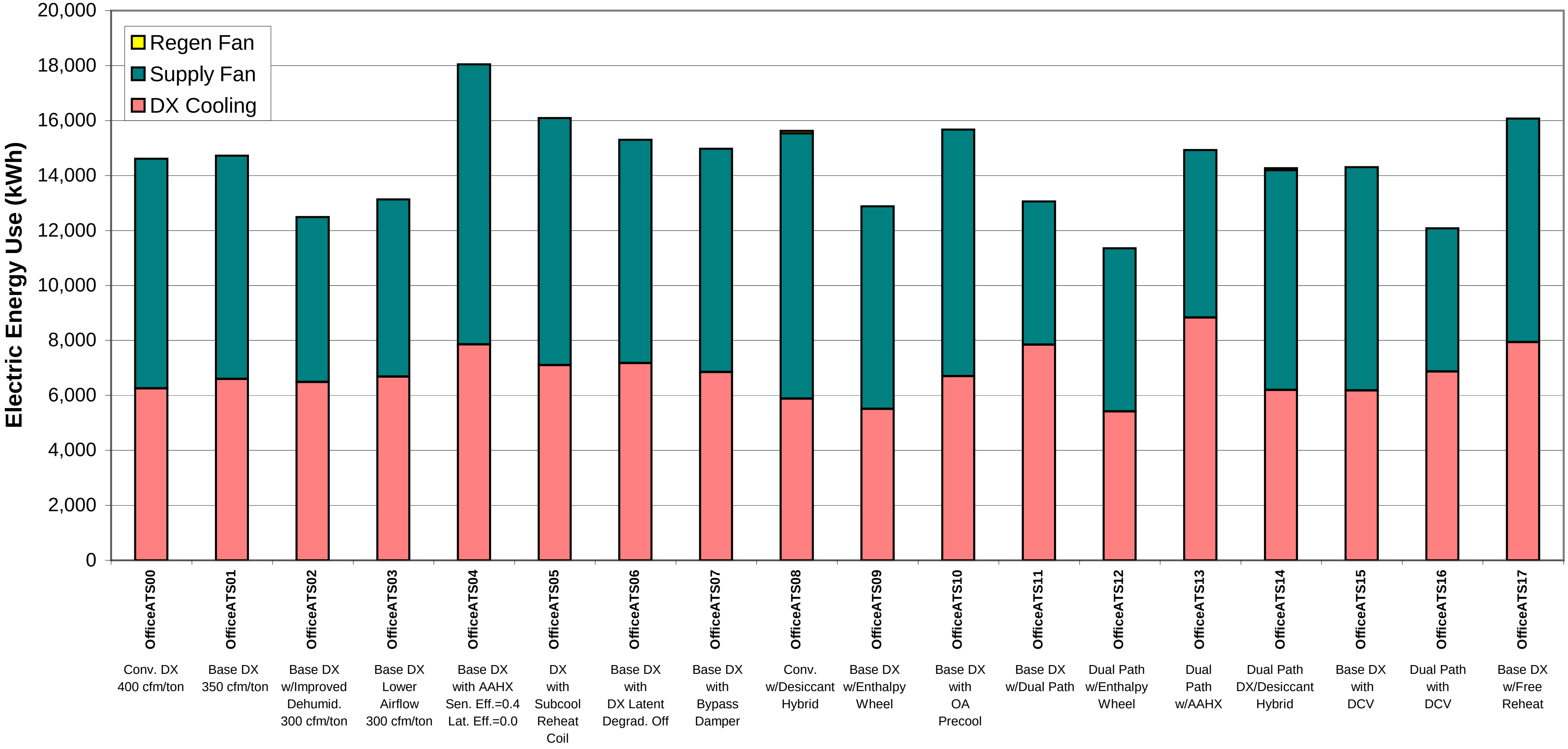
2001 Standard Charts
2001 Standard Tables
2004 Standard Charts
2004 Standard Tables

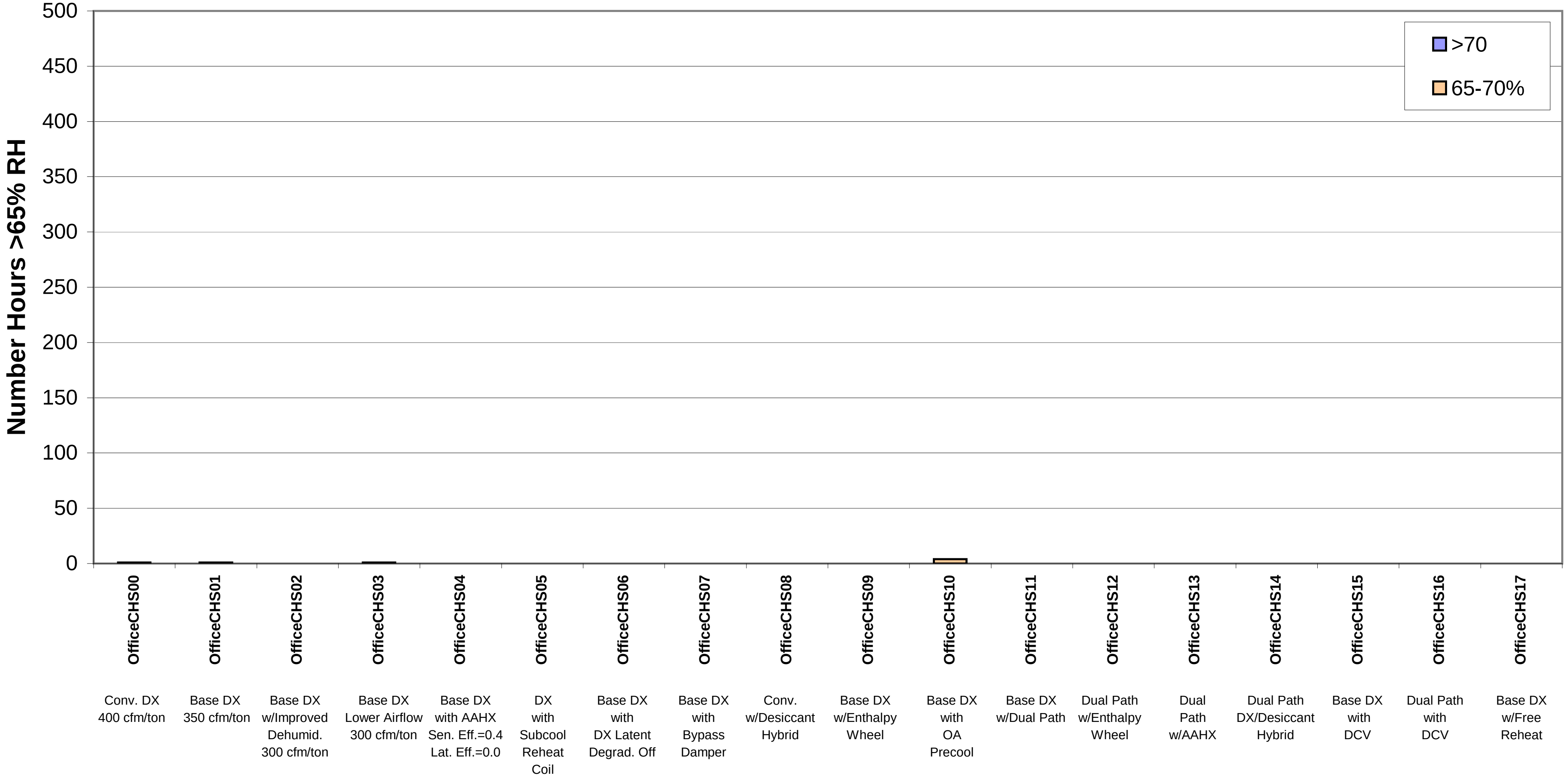
Within each section:
Office
Restaurant
Retail
Theater
School 9-Month
School 12-Month
Motel

2001 Standard Office in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



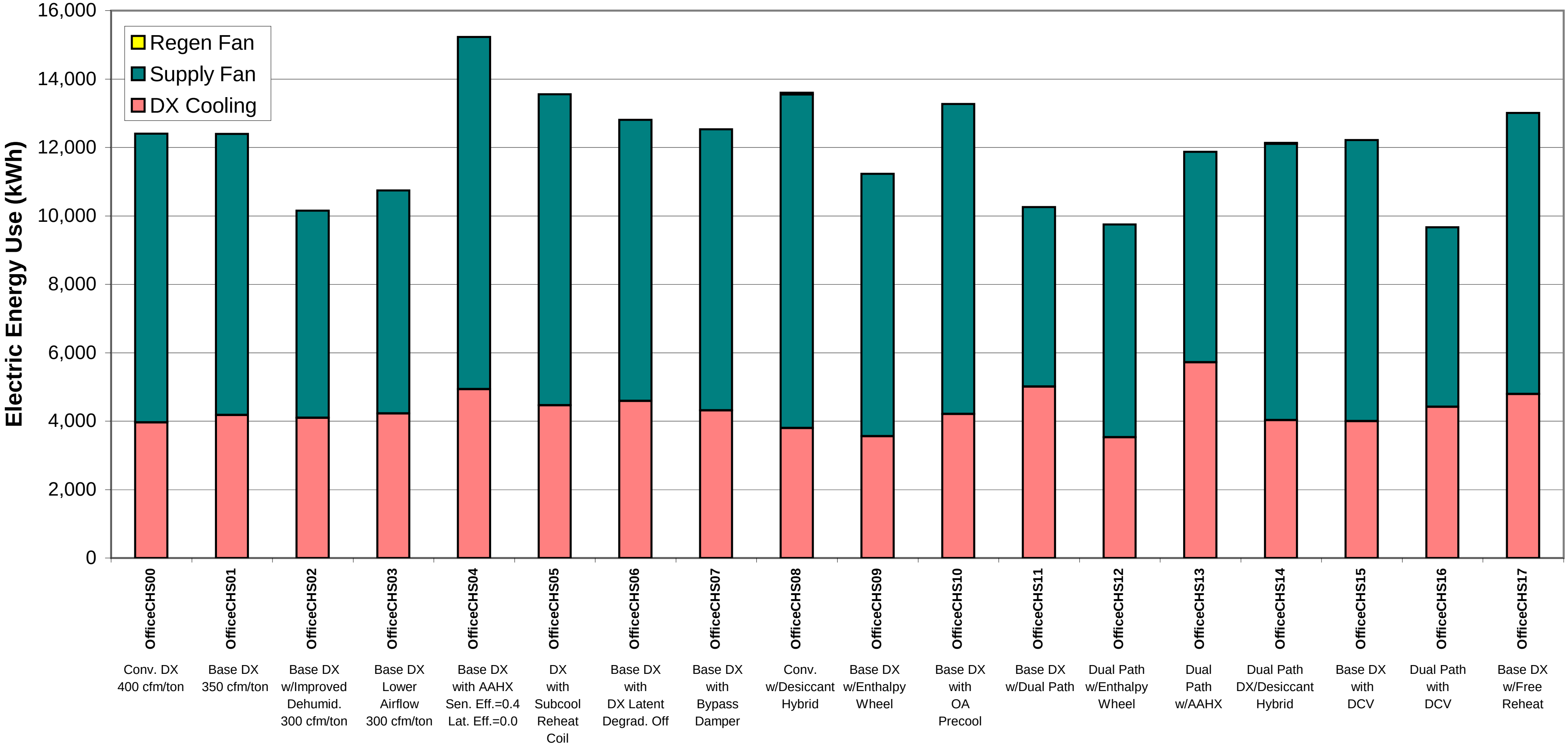
2001 Standard Office in Atlanta GA
Annual HVAC System Electric Energy Use



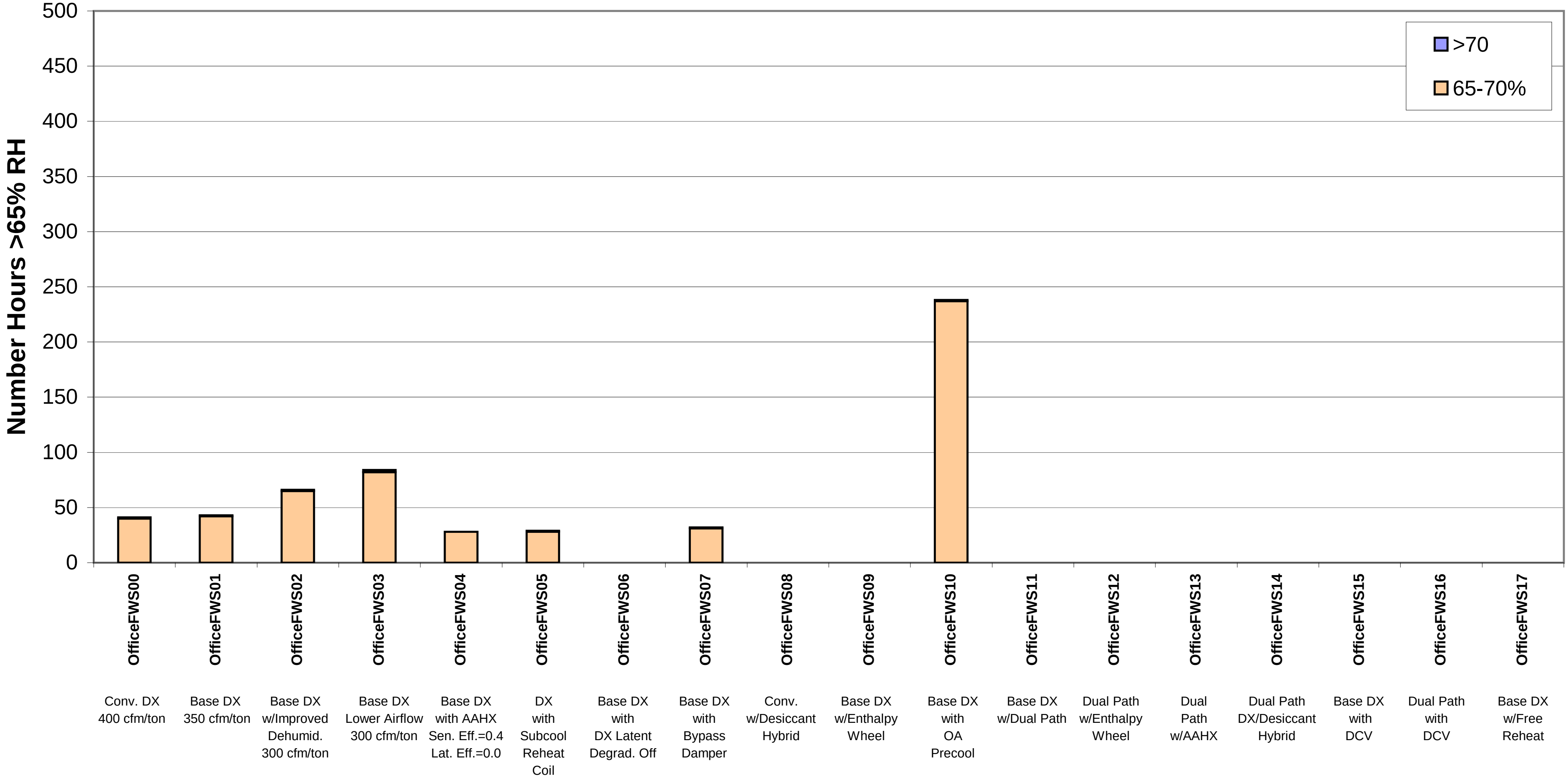


2001 Standard Office in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%

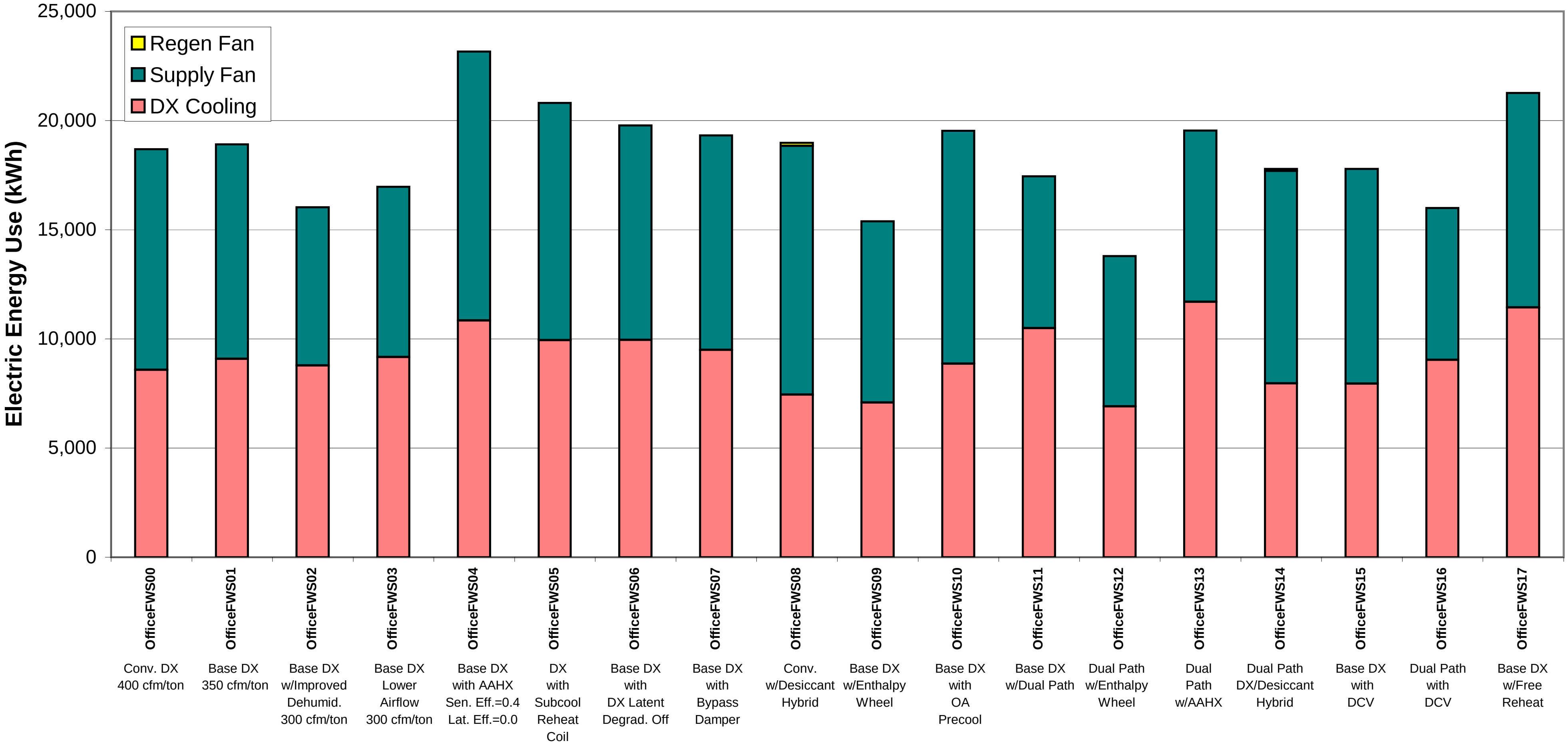
2001 Standard Office in Chicago IL
Annual HVAC System Electric Energy Use



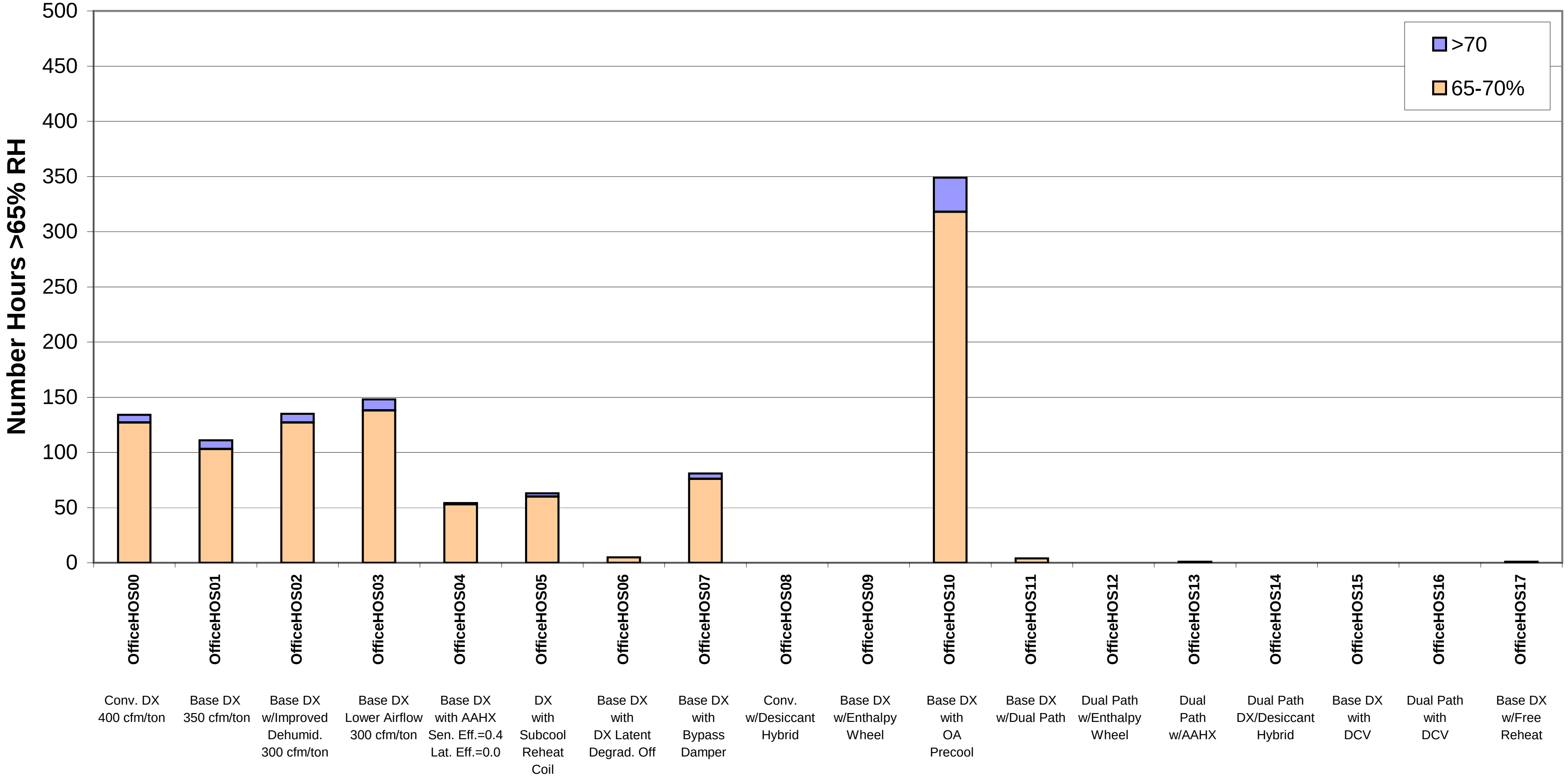
2001 Standard Office in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



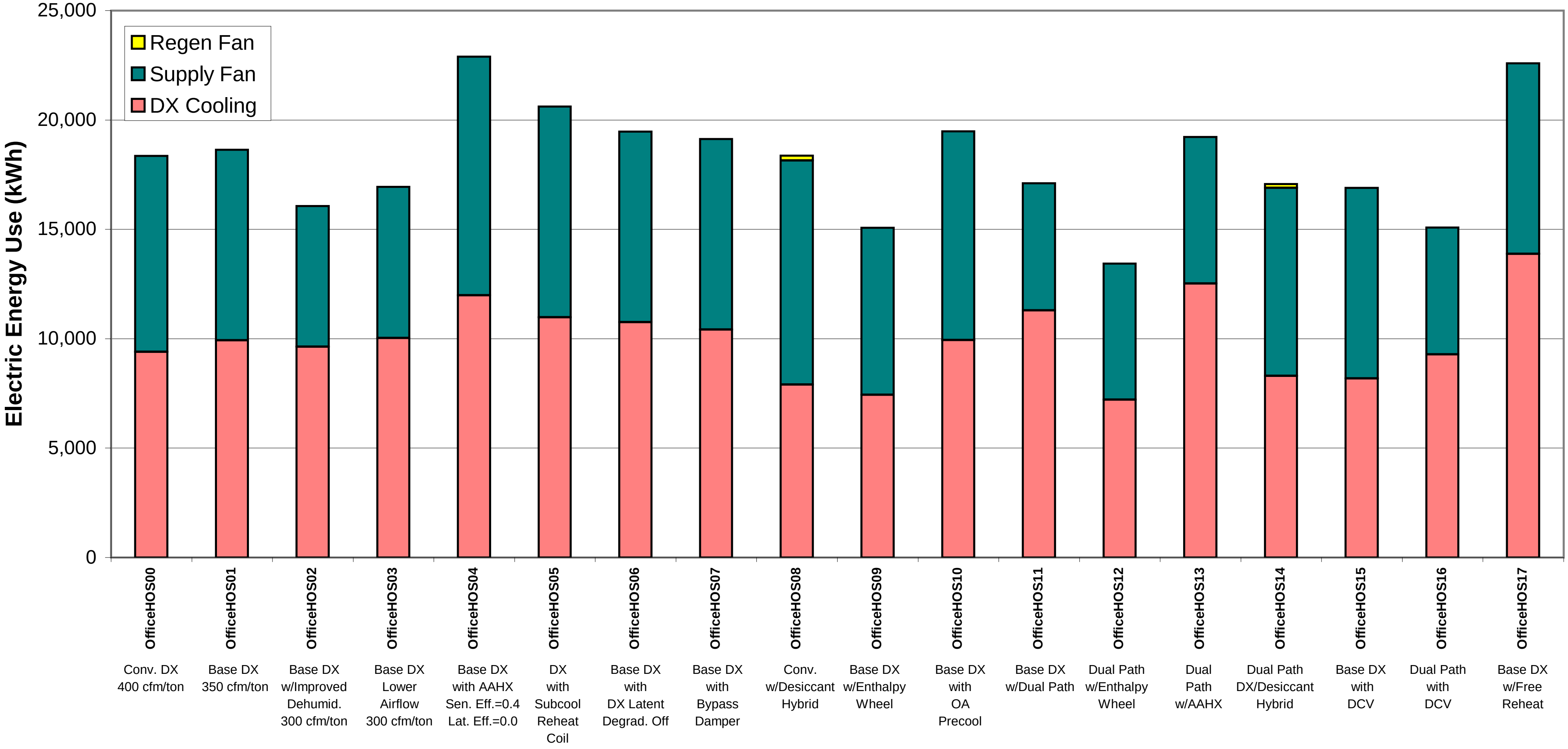
2001 Standard Office in Fort Worth TX
Annual HVAC System Electric Energy Use



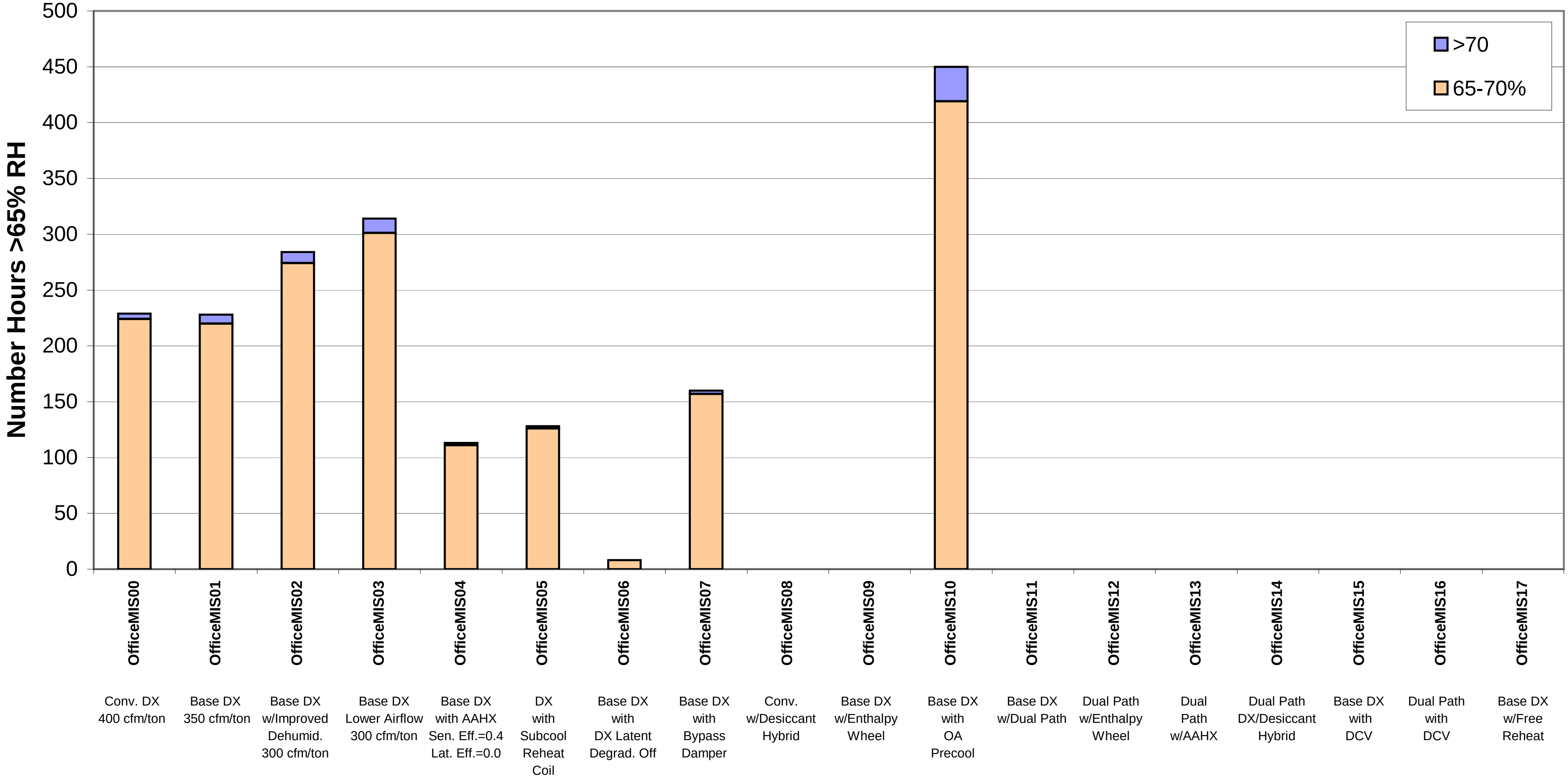
2001 Standard Office in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



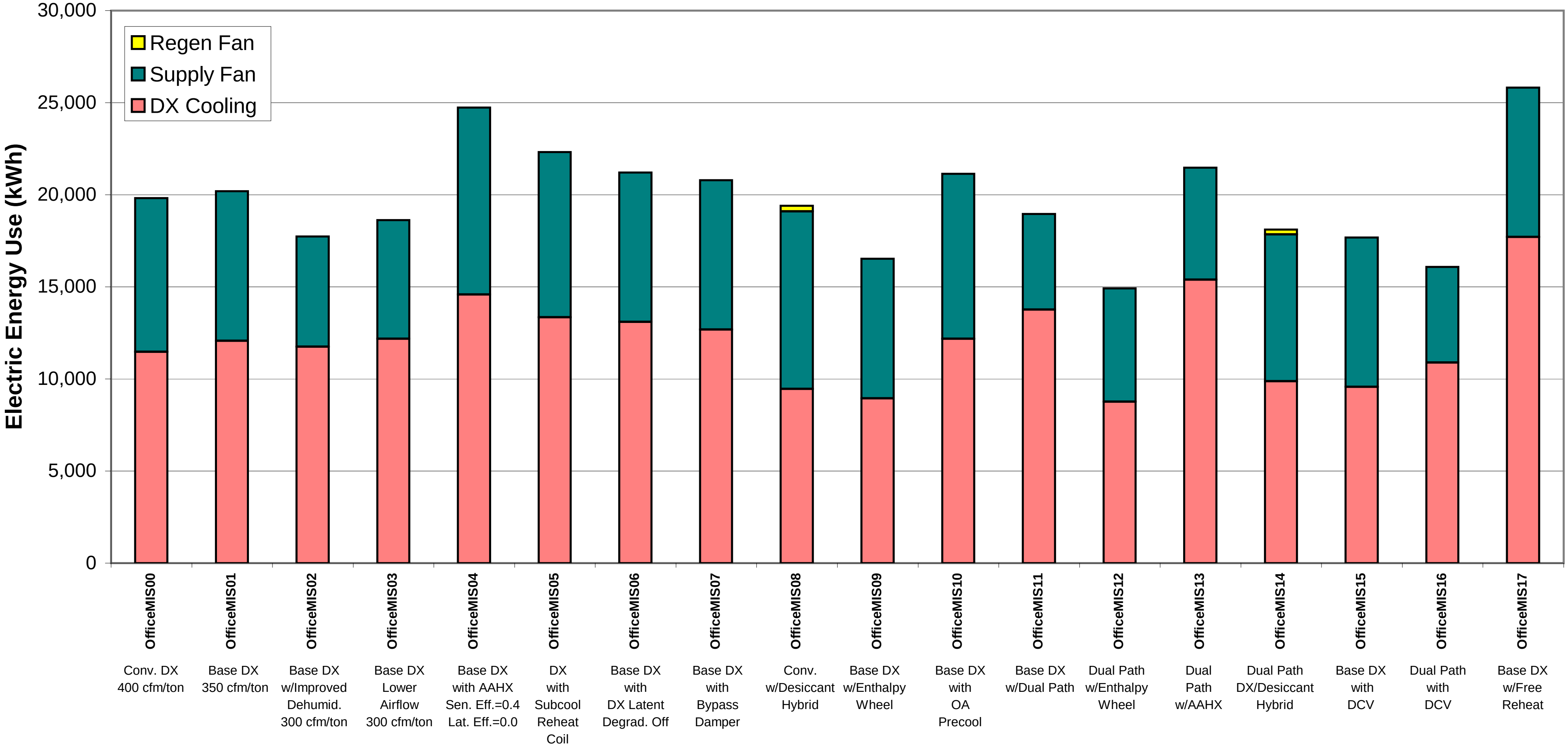
2001 Standard Office in Houston TX
Annual HVAC System Electric Energy Use



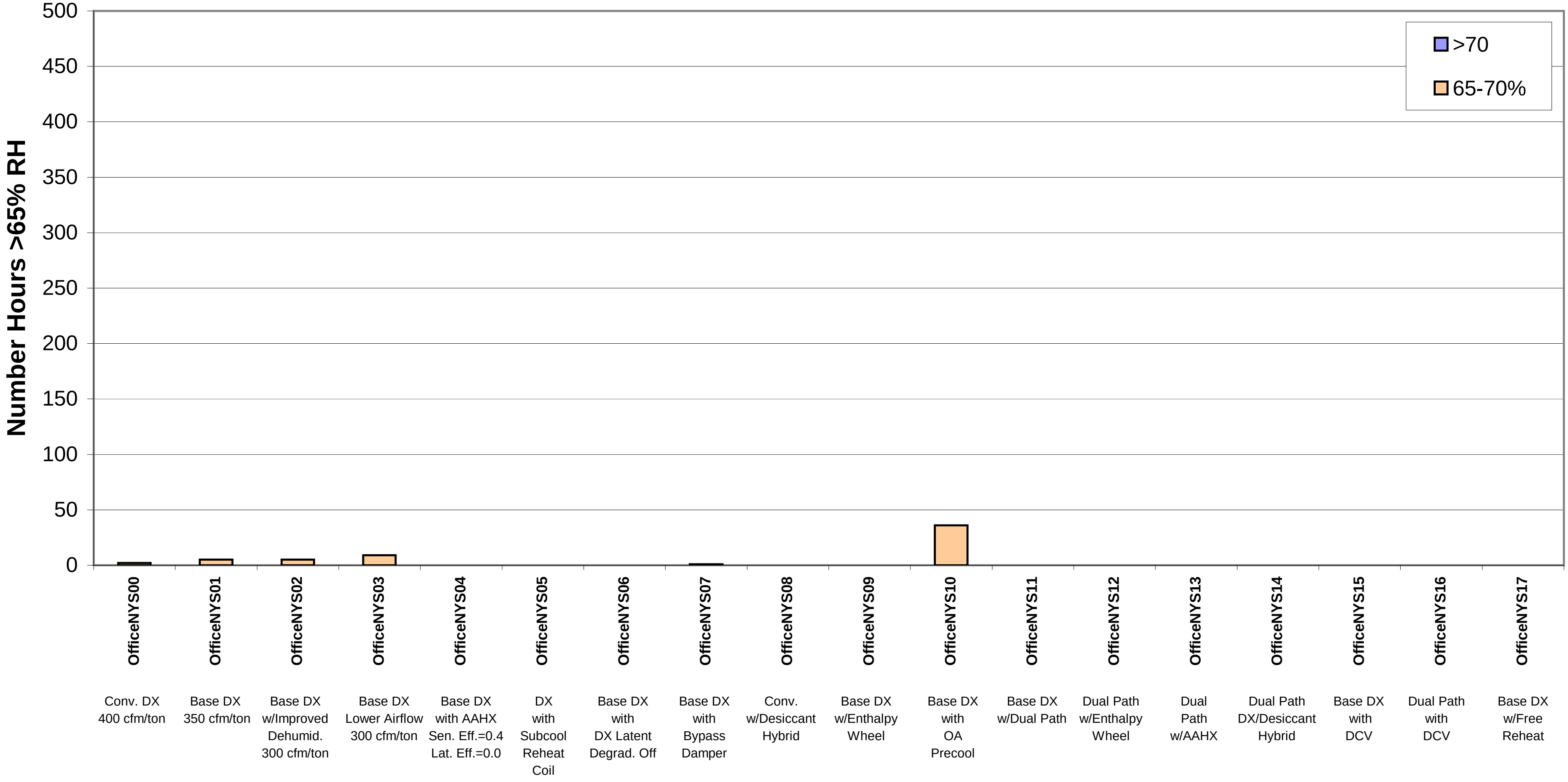
2001 Standard Office in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



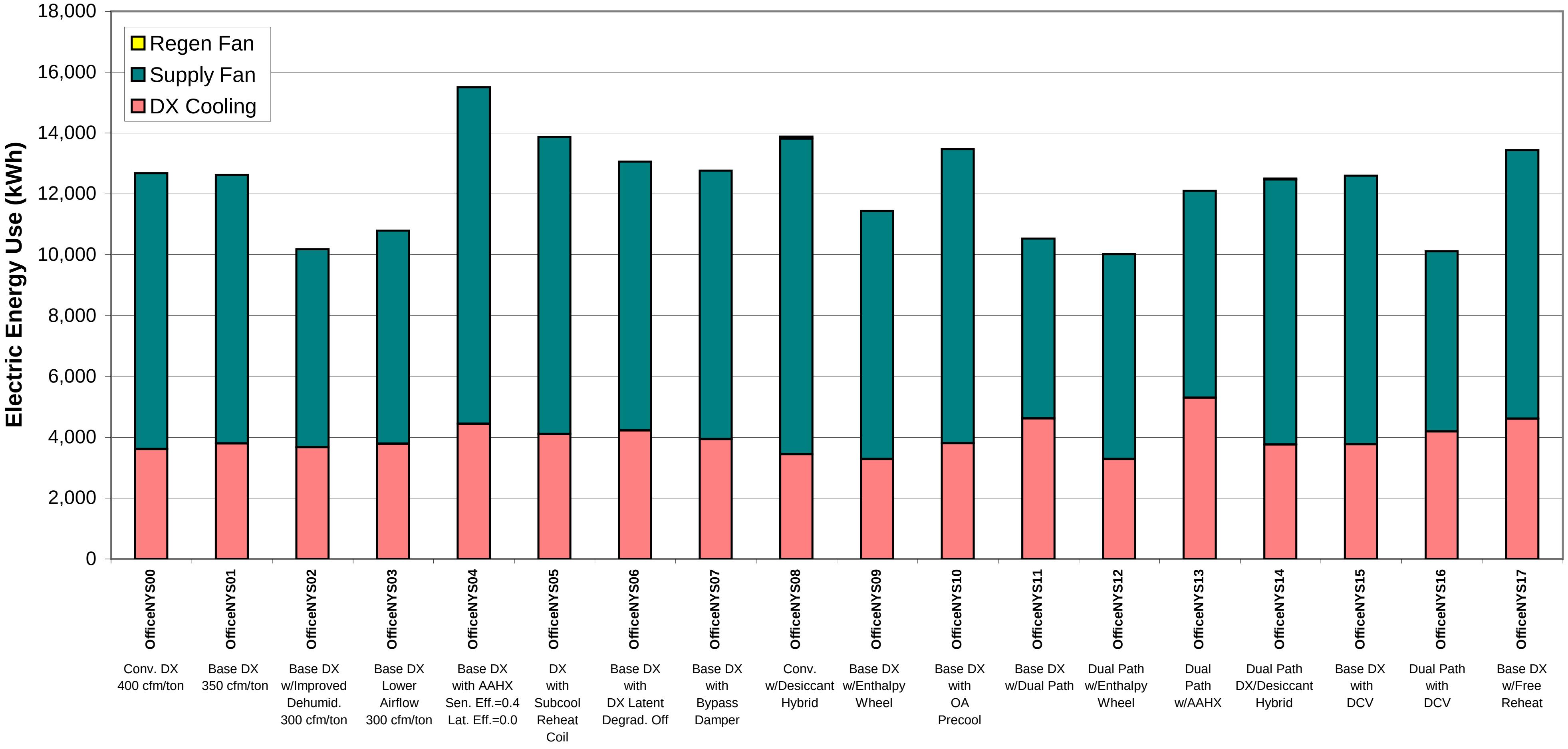
2001 Standard Office in Miami FL
Annual HVAC System Electric Energy Use



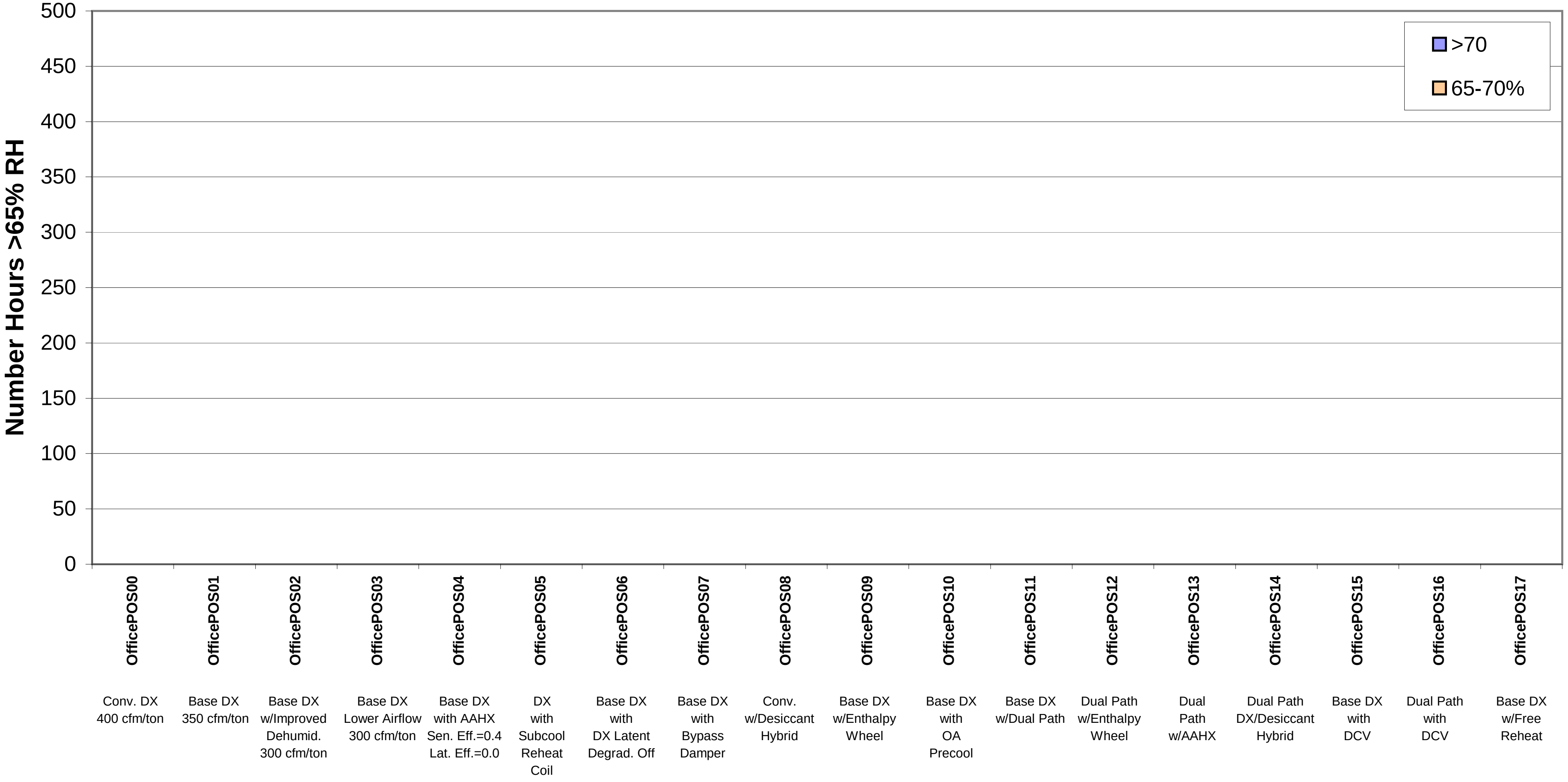
2001 Standard Office in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



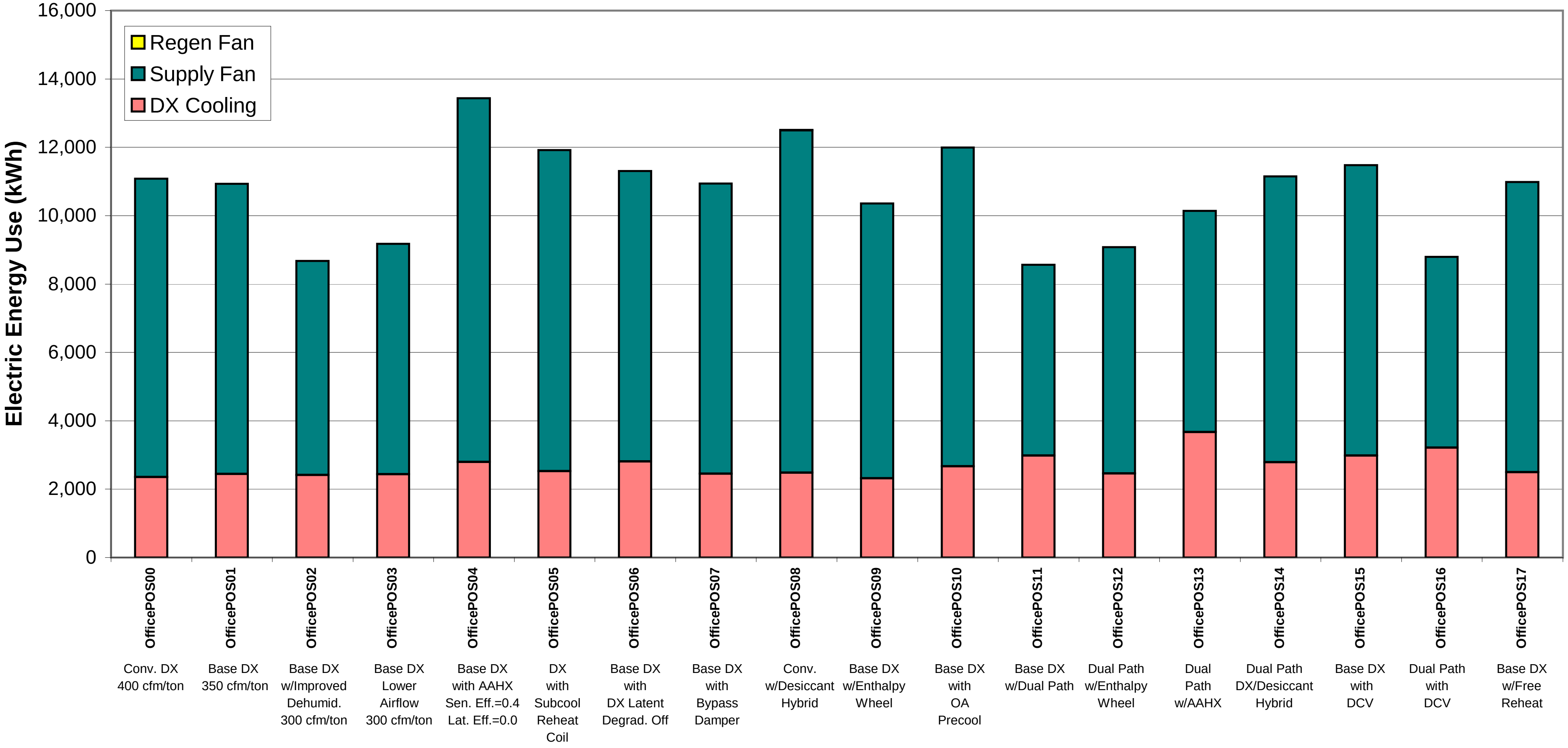
2001 Standard Office in New York NY
Annual HVAC System Electric Energy Use

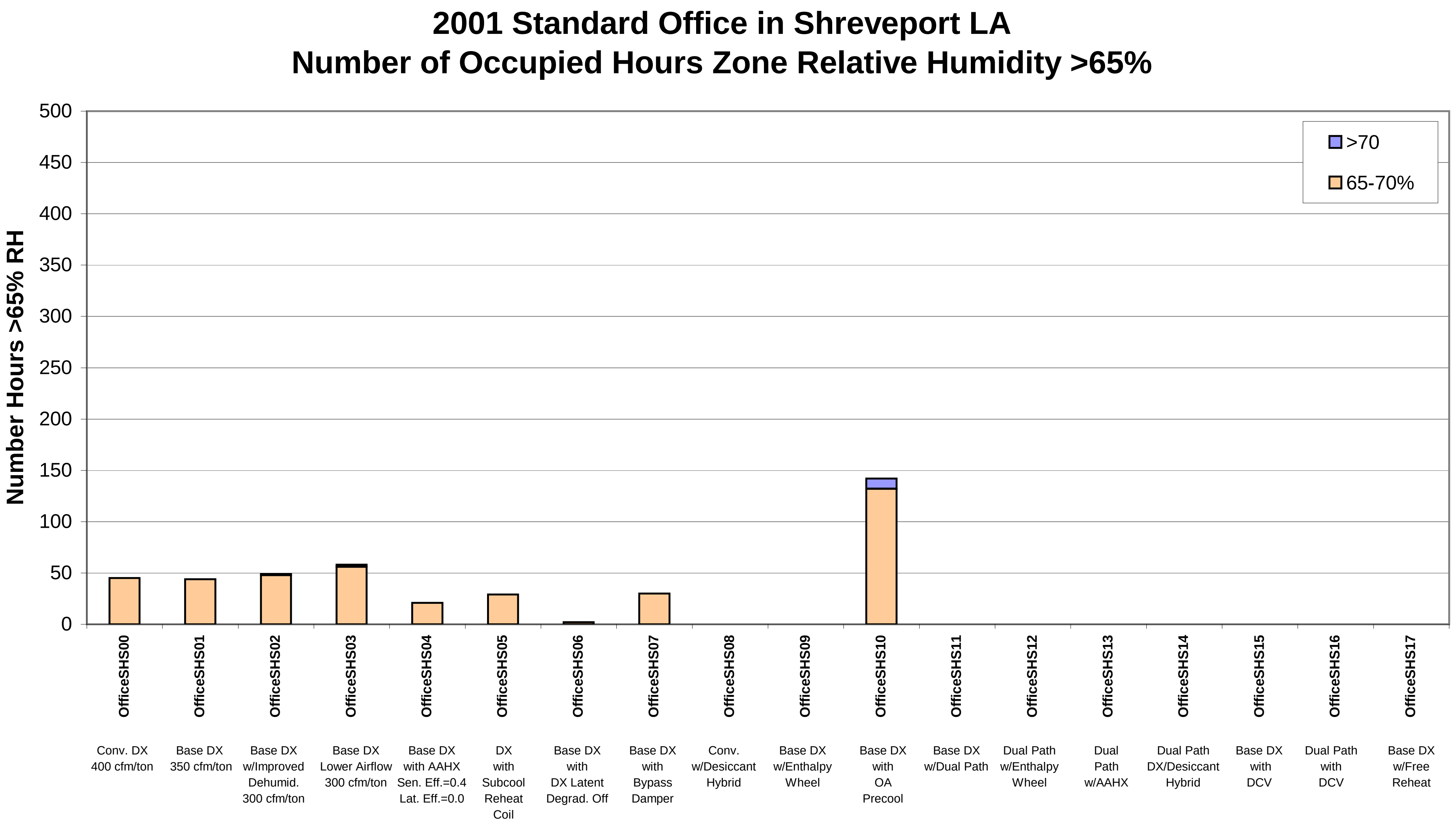


2001 Standard Office in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%

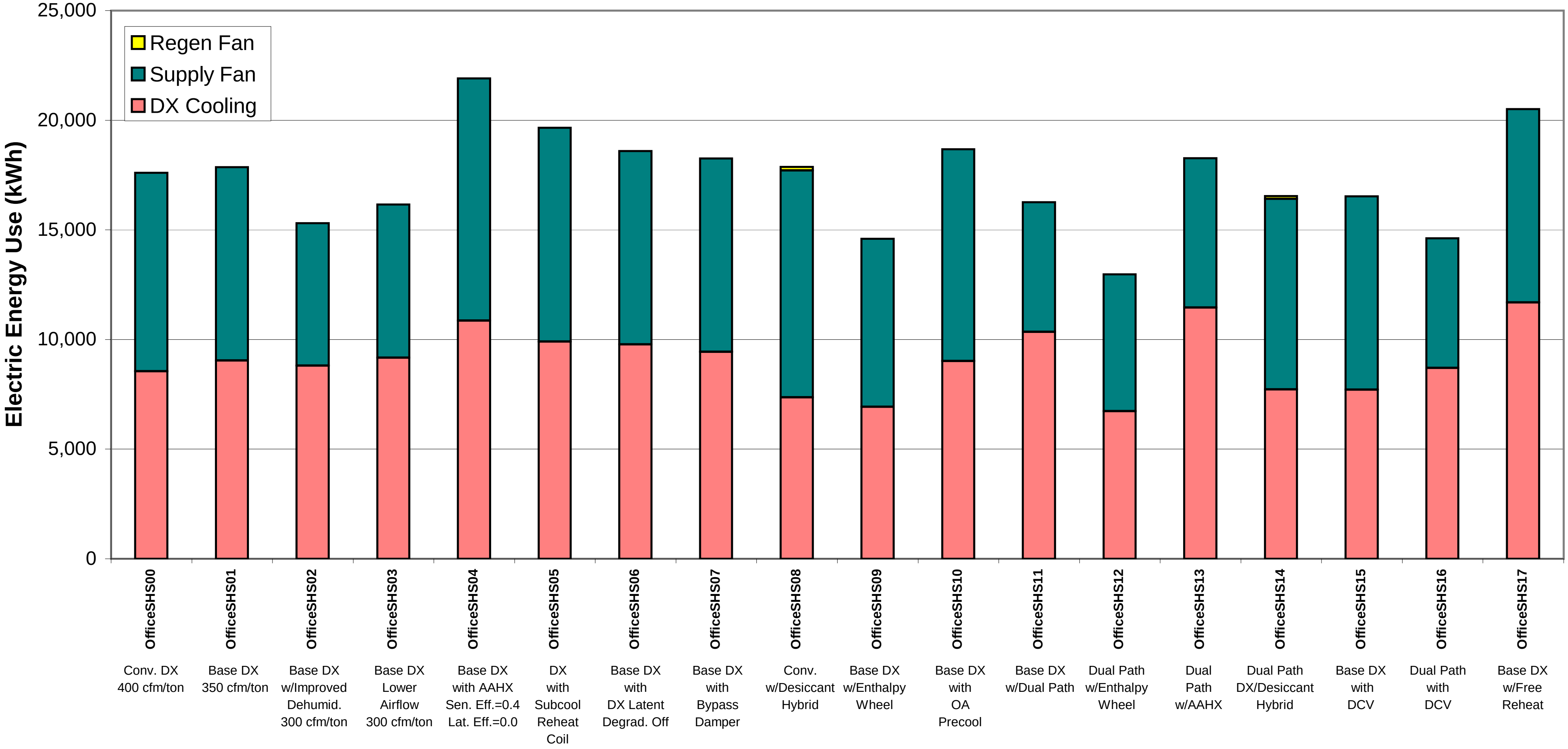


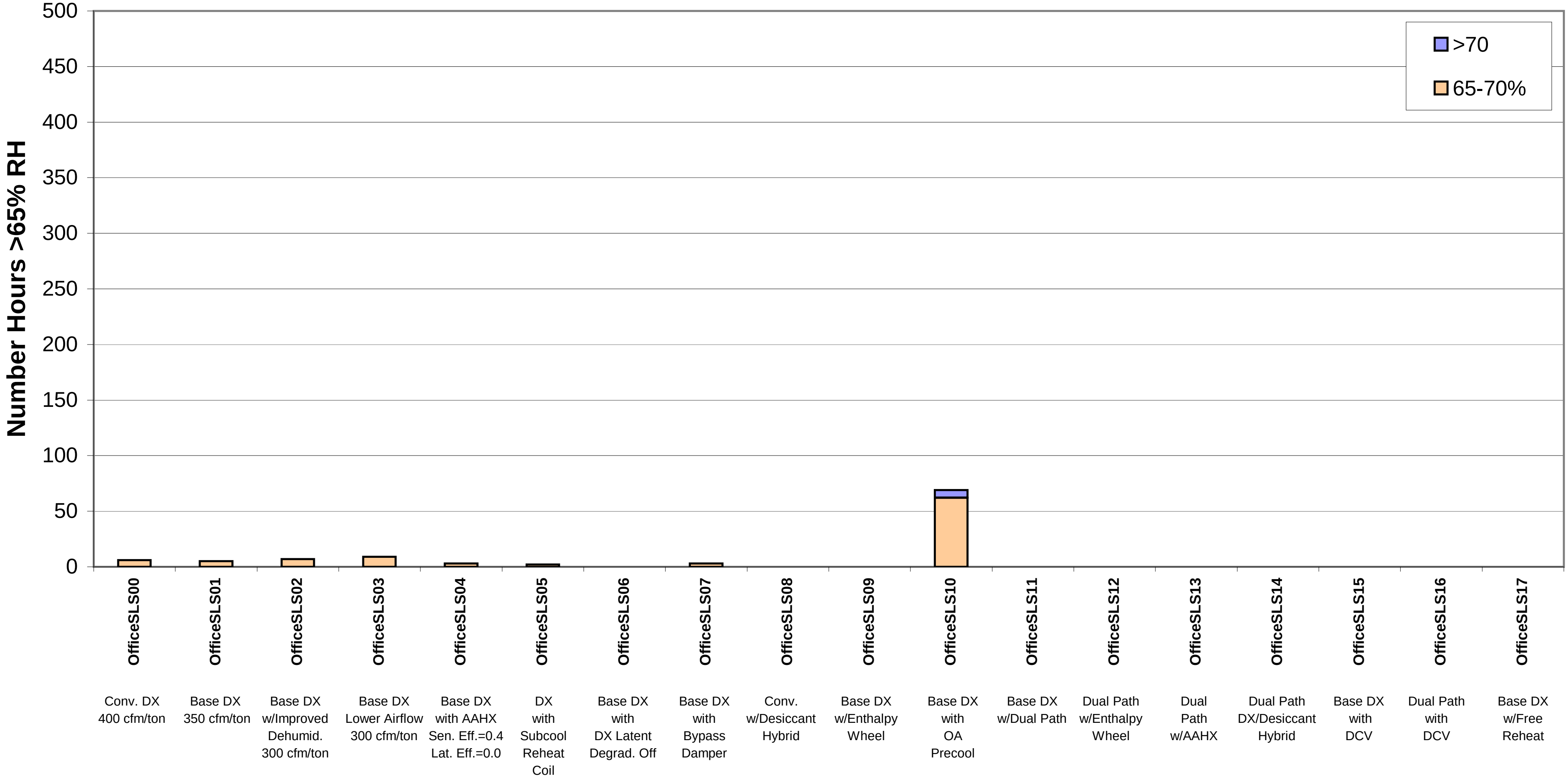
2001 Standard Office in Portland OR
Annual HVAC System Electric Energy Use




2001 Standard Office in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
500
450
400
350
300
250
200
150
100
50
0
>70
65-70%
OfficeSHS00
OfficeSHS01
OfficeSHS02
OfficeSHS03
OfficeSHS04
OfficeSHS05
OfficeSHS06
OfficeSHS07
OfficeSHS08
OfficeSHS09
OfficeSHS10
OfficeSHS11
OfficeSHS12
OfficeSHS13
OfficeSHS14
OfficeSHS15
OfficeSHS16
OfficeSHS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

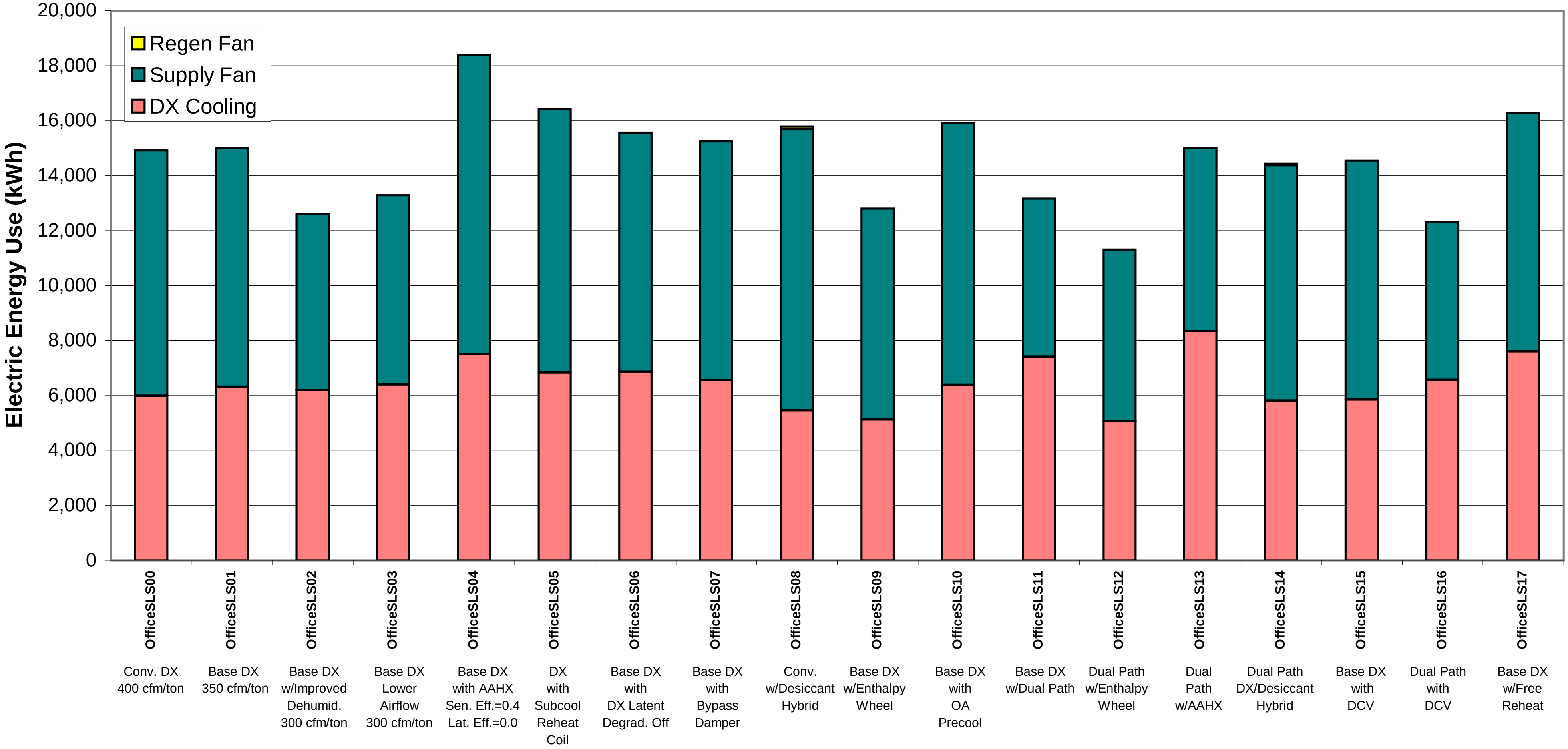
2001 Standard Office in Shreveport LA
Annual HVAC System Electric Energy Use



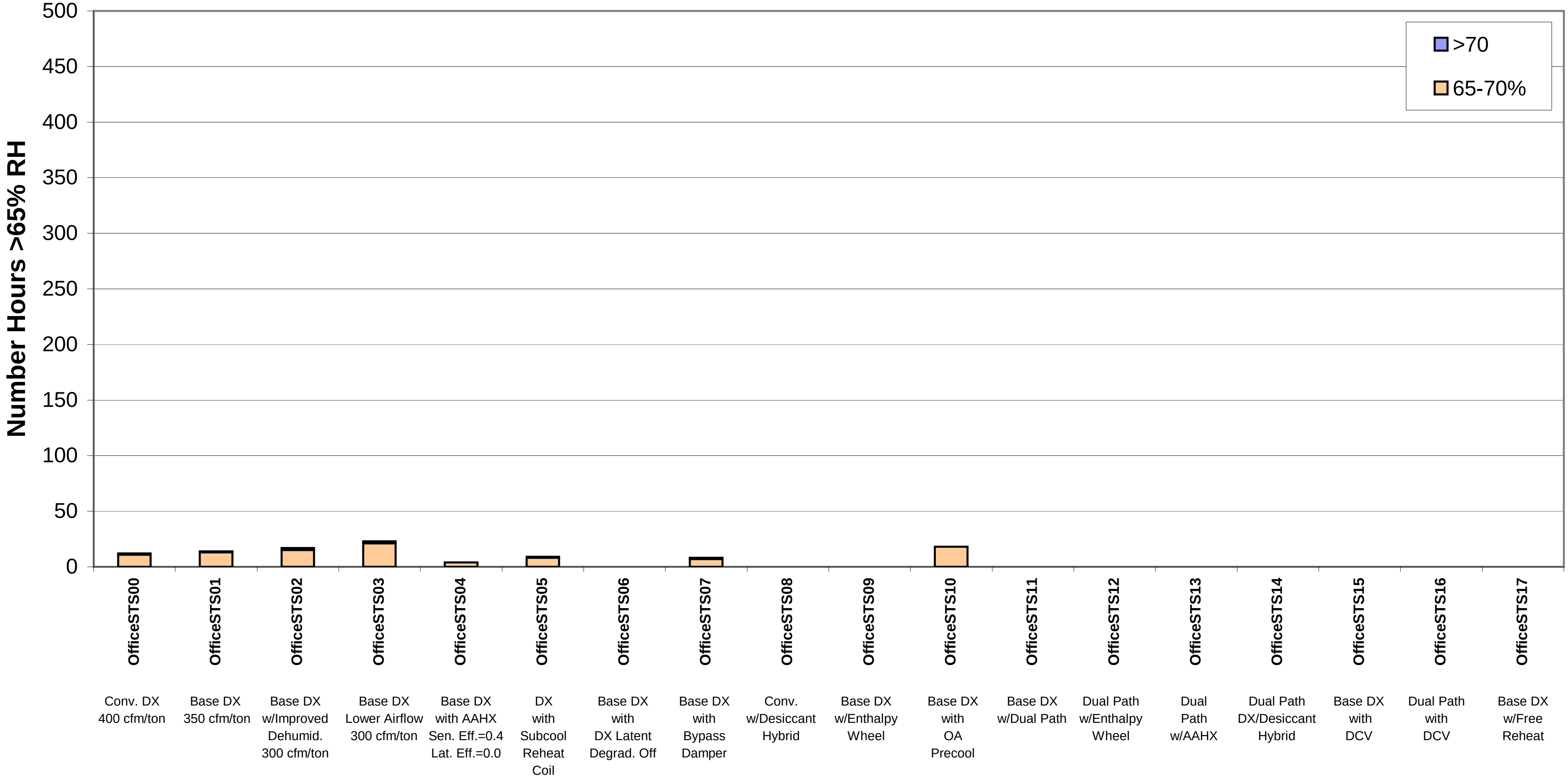


2001 Standard Office in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%

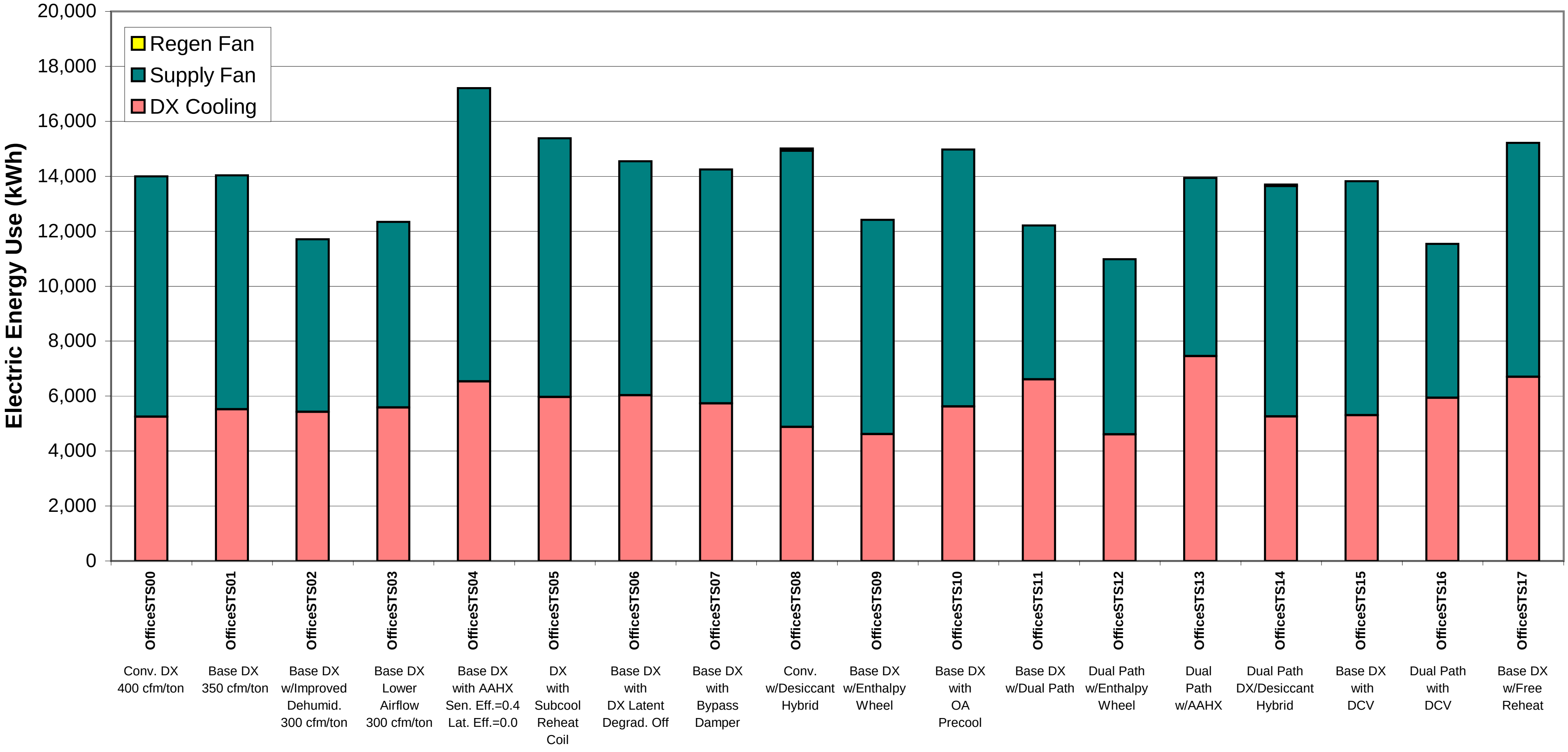
2001 Standard Office in St. Louis MO
Annual HVAC System Electric Energy Use



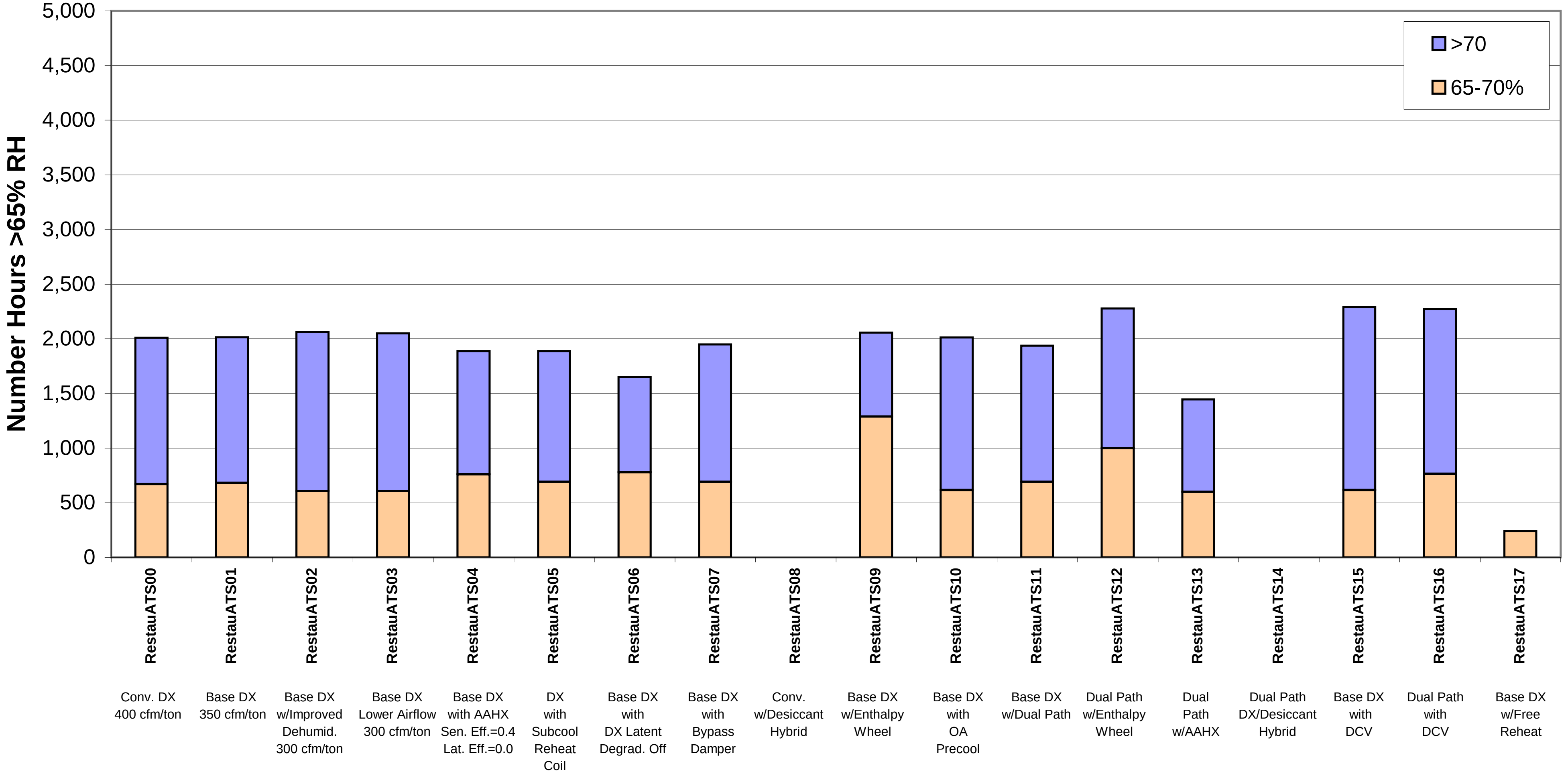
2001 Standard Office in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



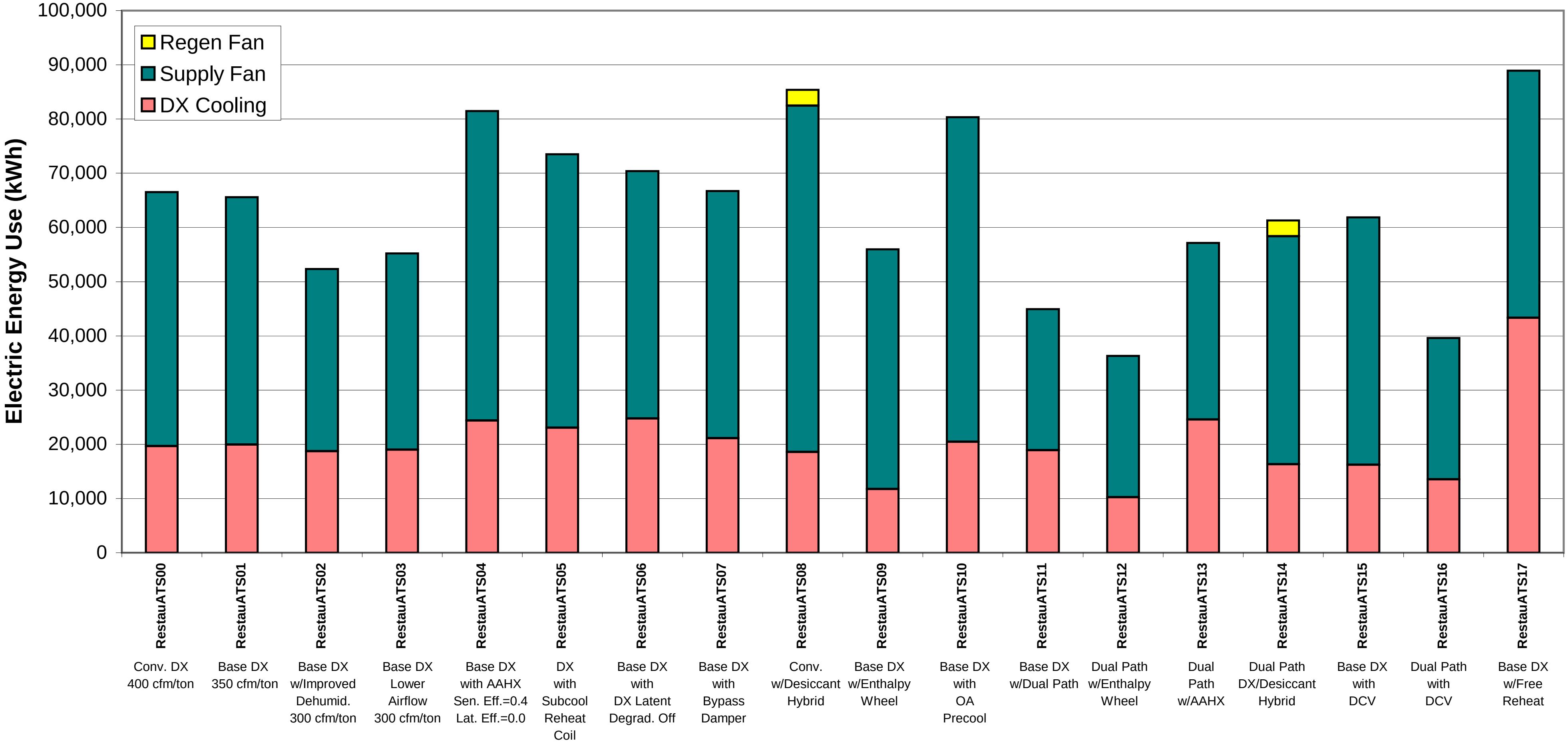
2001 Standard Office in Washington DC
Annual HVAC System Electric Energy Use



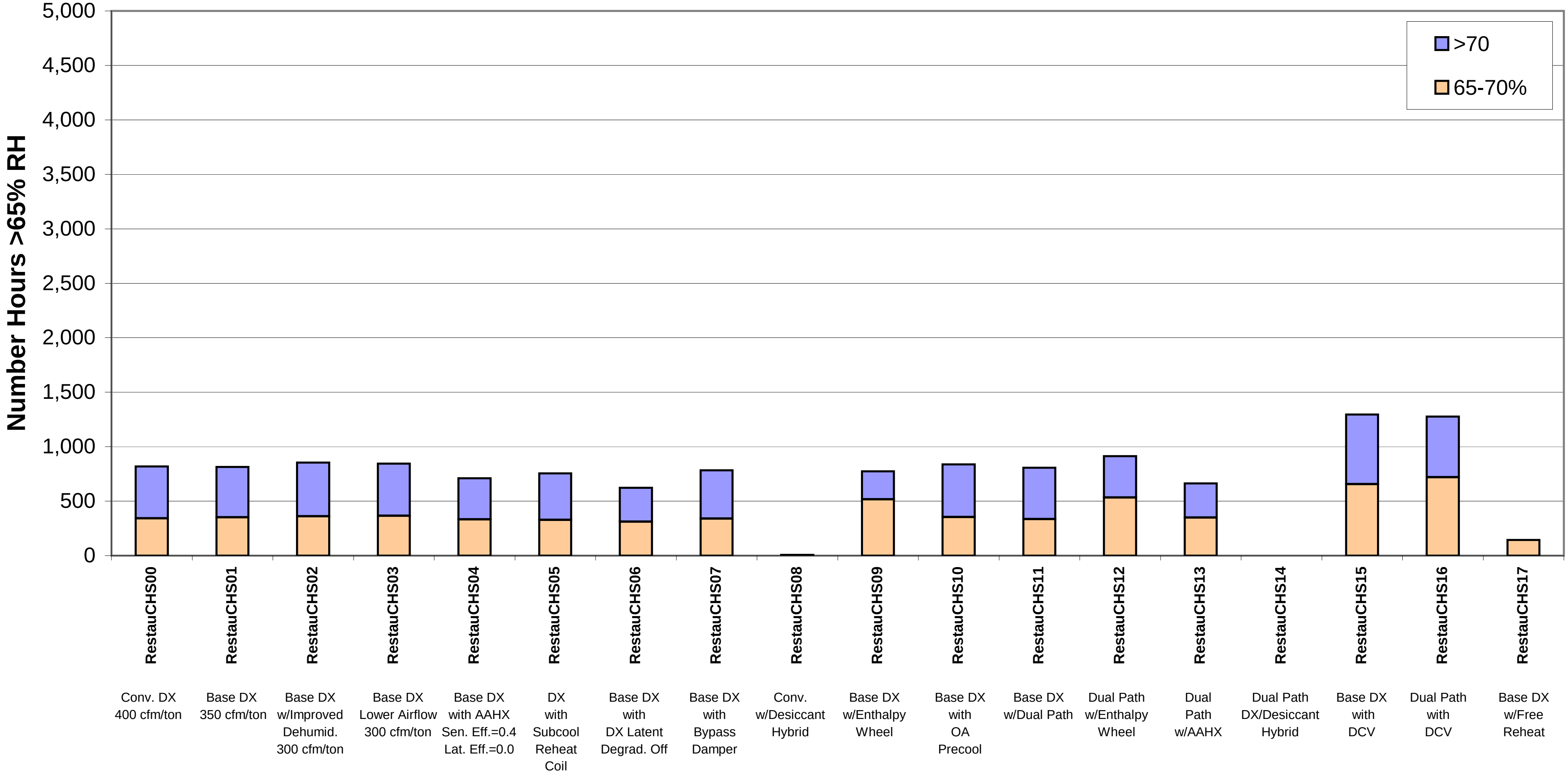
2001 Standard Restaurant in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



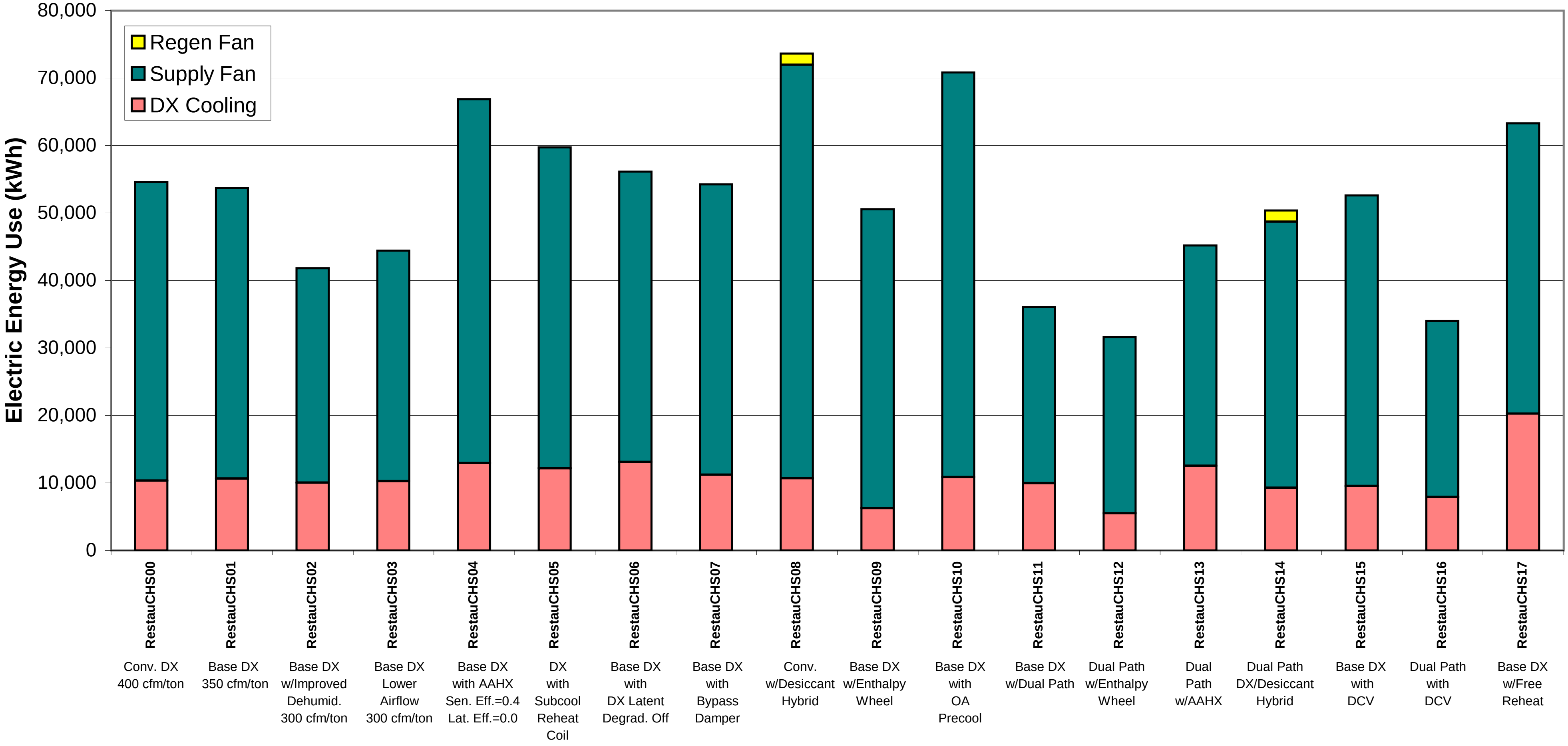
2001 Standard Restaurant in Atlanta GA
Annual HVAC System Electric Energy Use



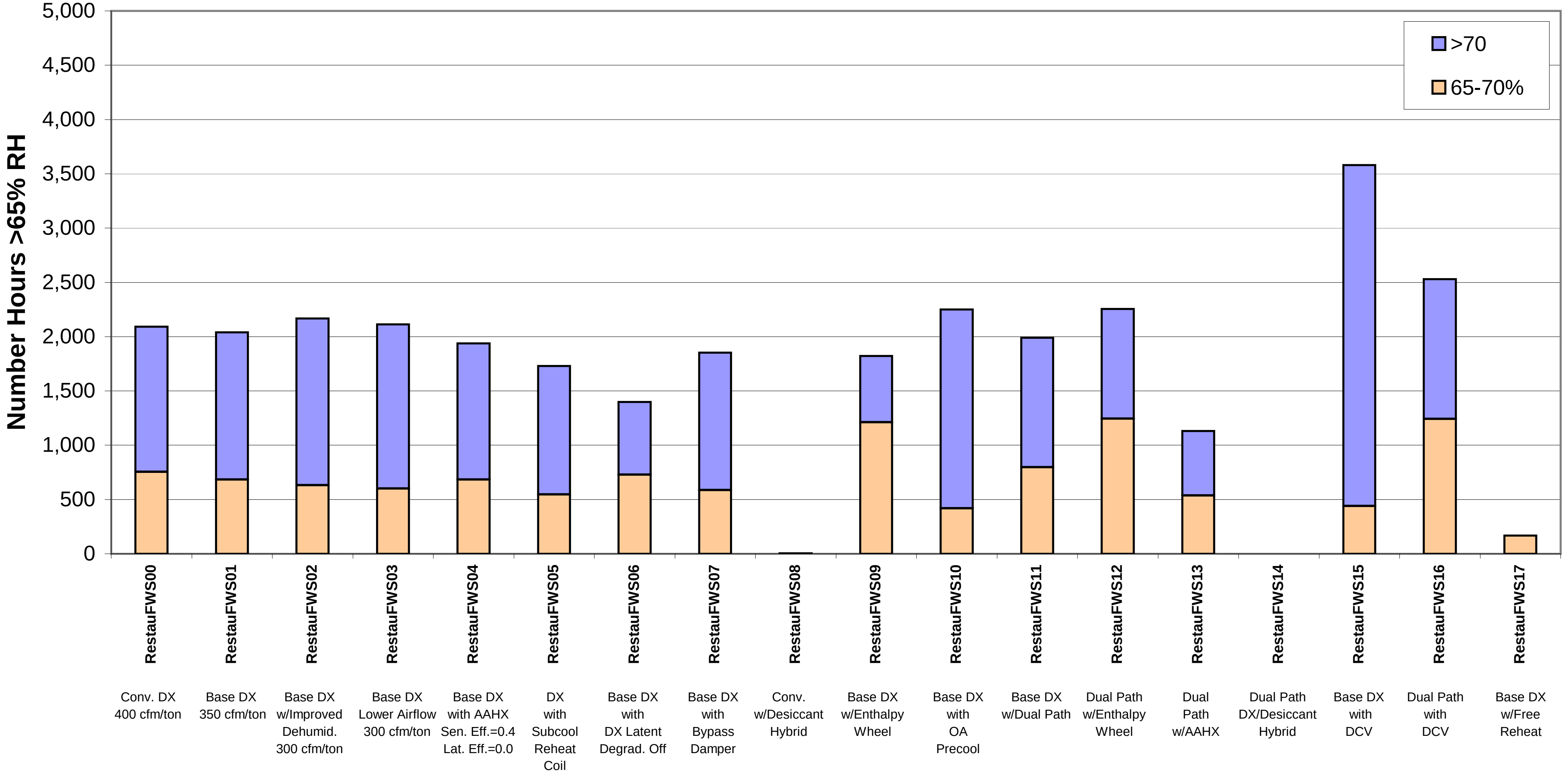
2001 Standard Restaurant in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



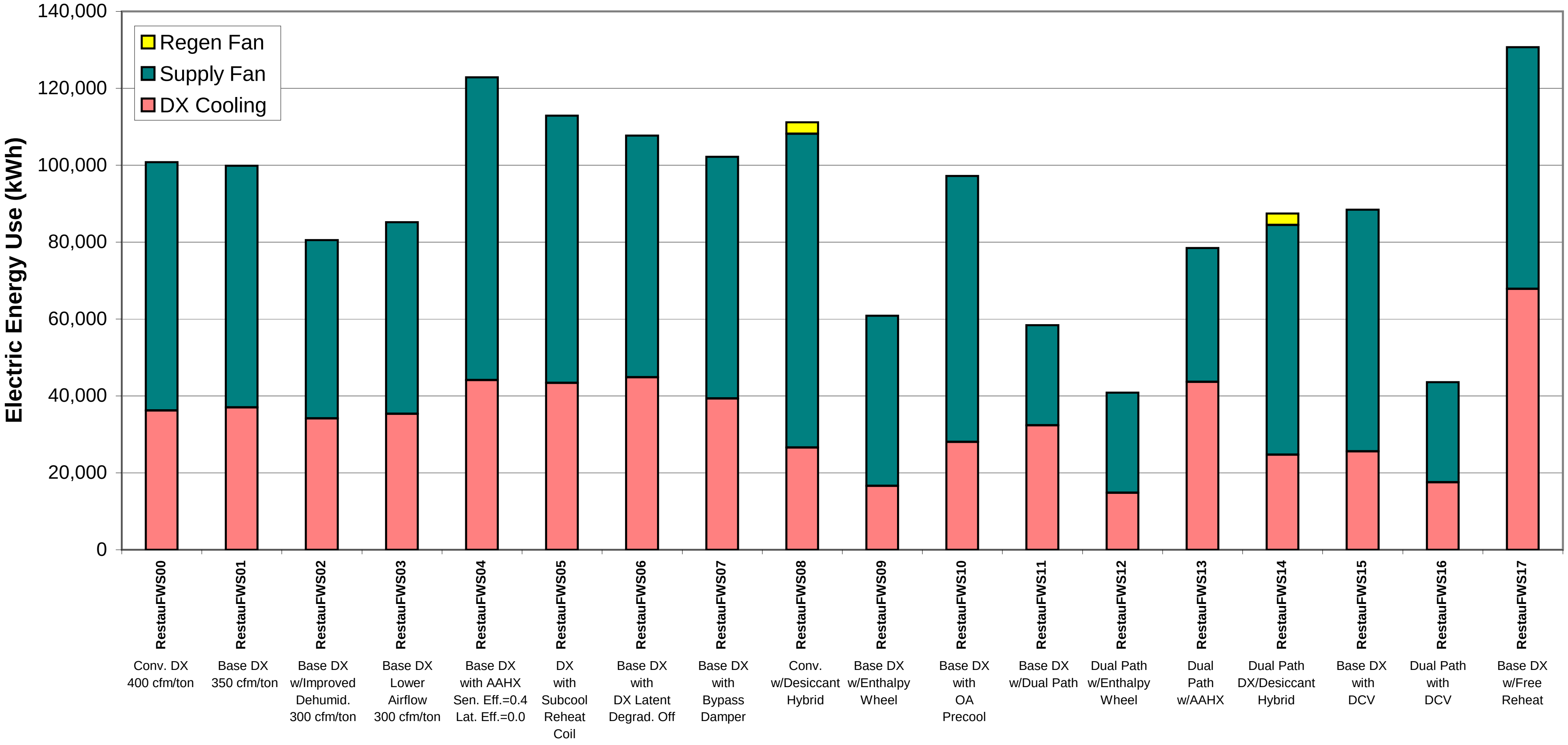
2001 Standard Restaurant in Chicago IL
Annual HVAC System Electric Energy Use



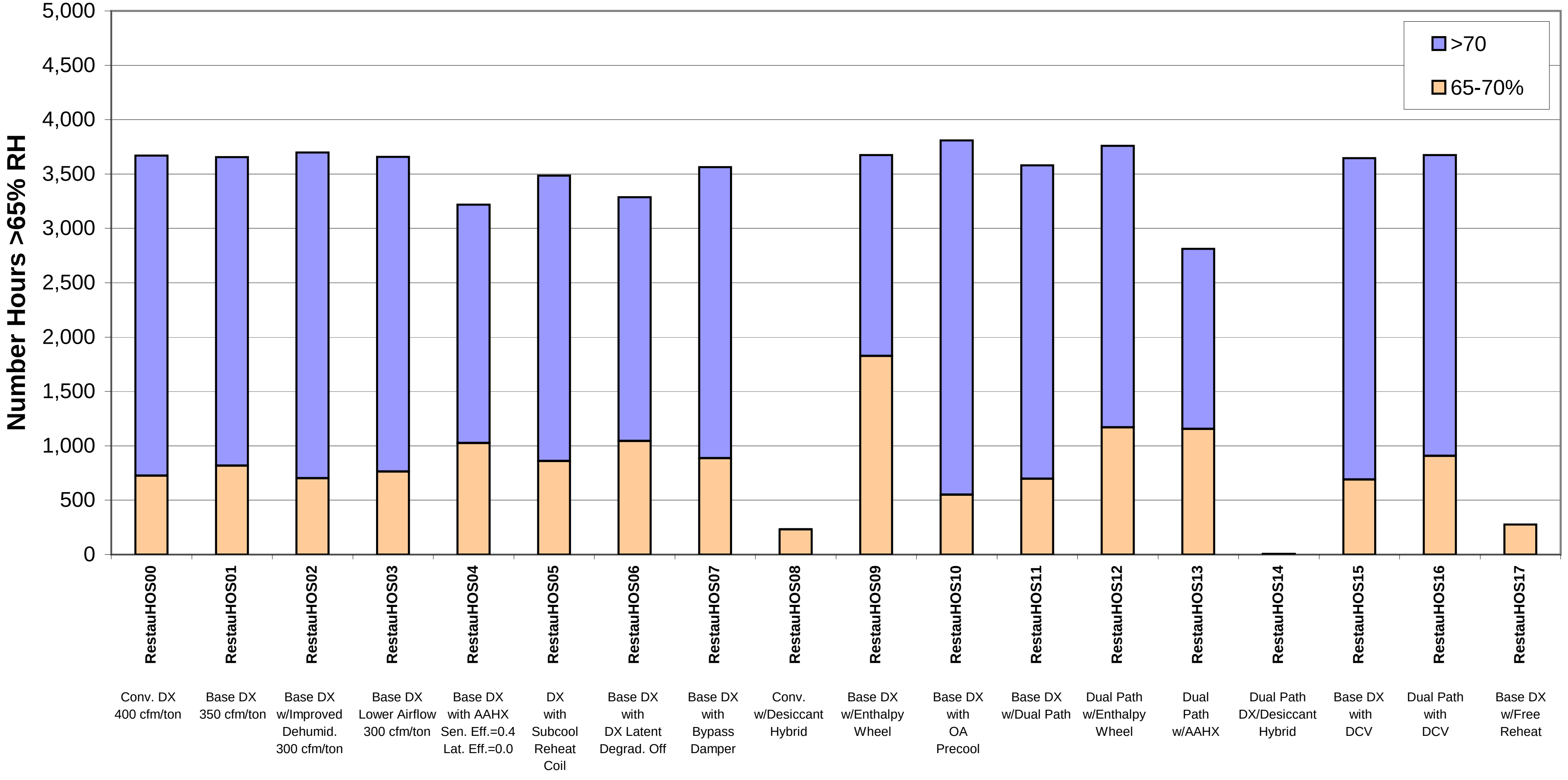
2001 Standard Restaurant in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



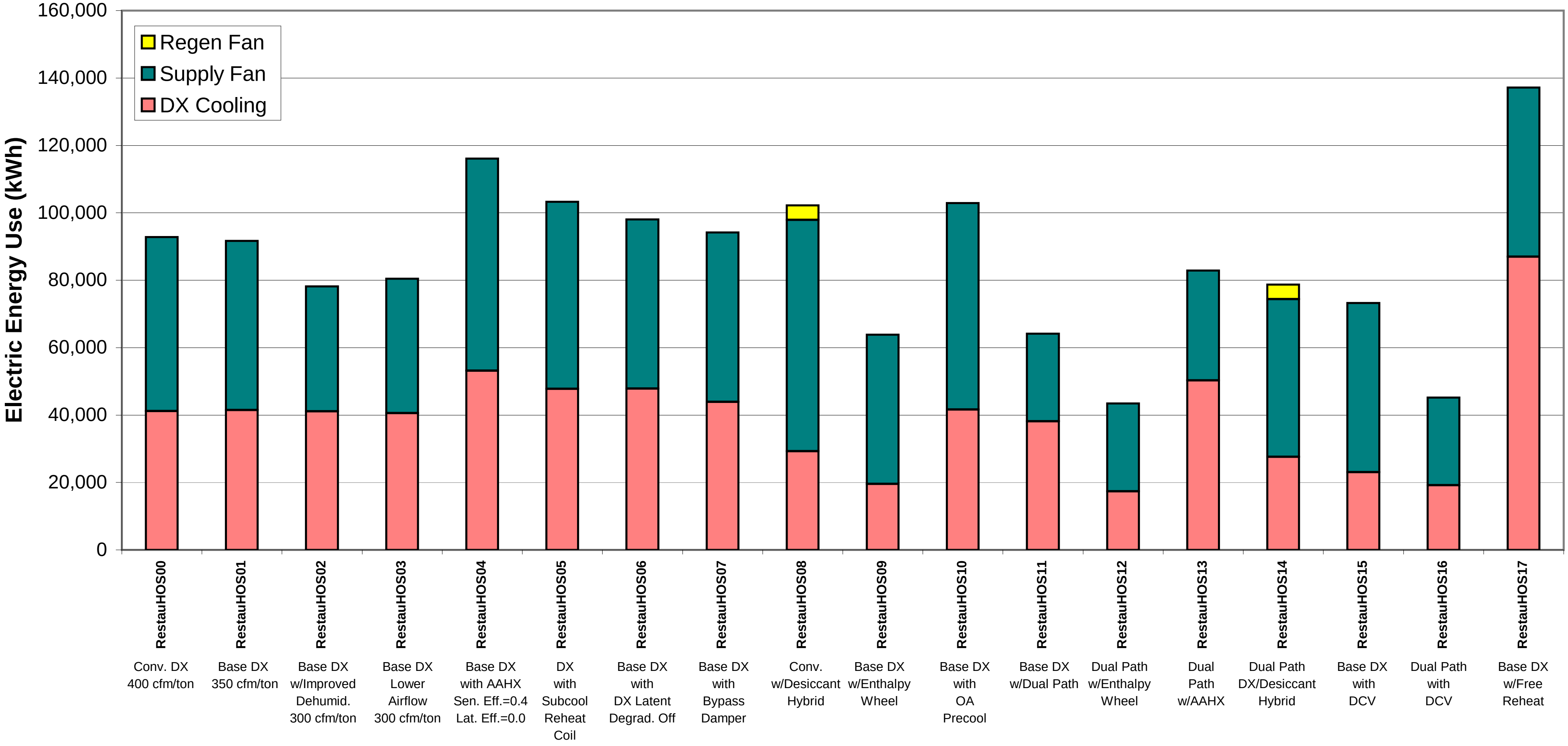
2001 Standard Restaurant in Fort Worth TX
Annual HVAC System Electric Energy Use



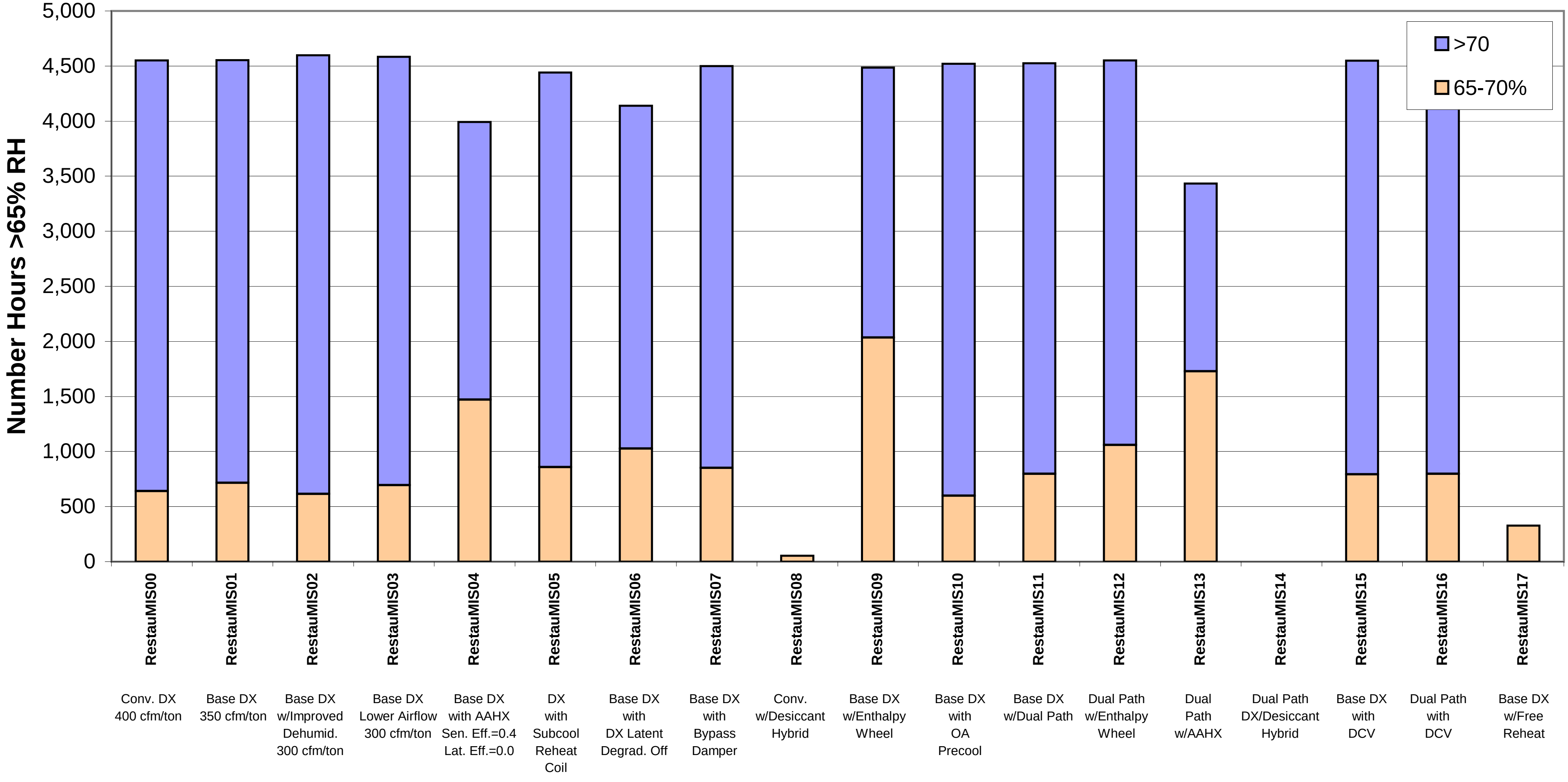
2001 Standard Restaurant in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



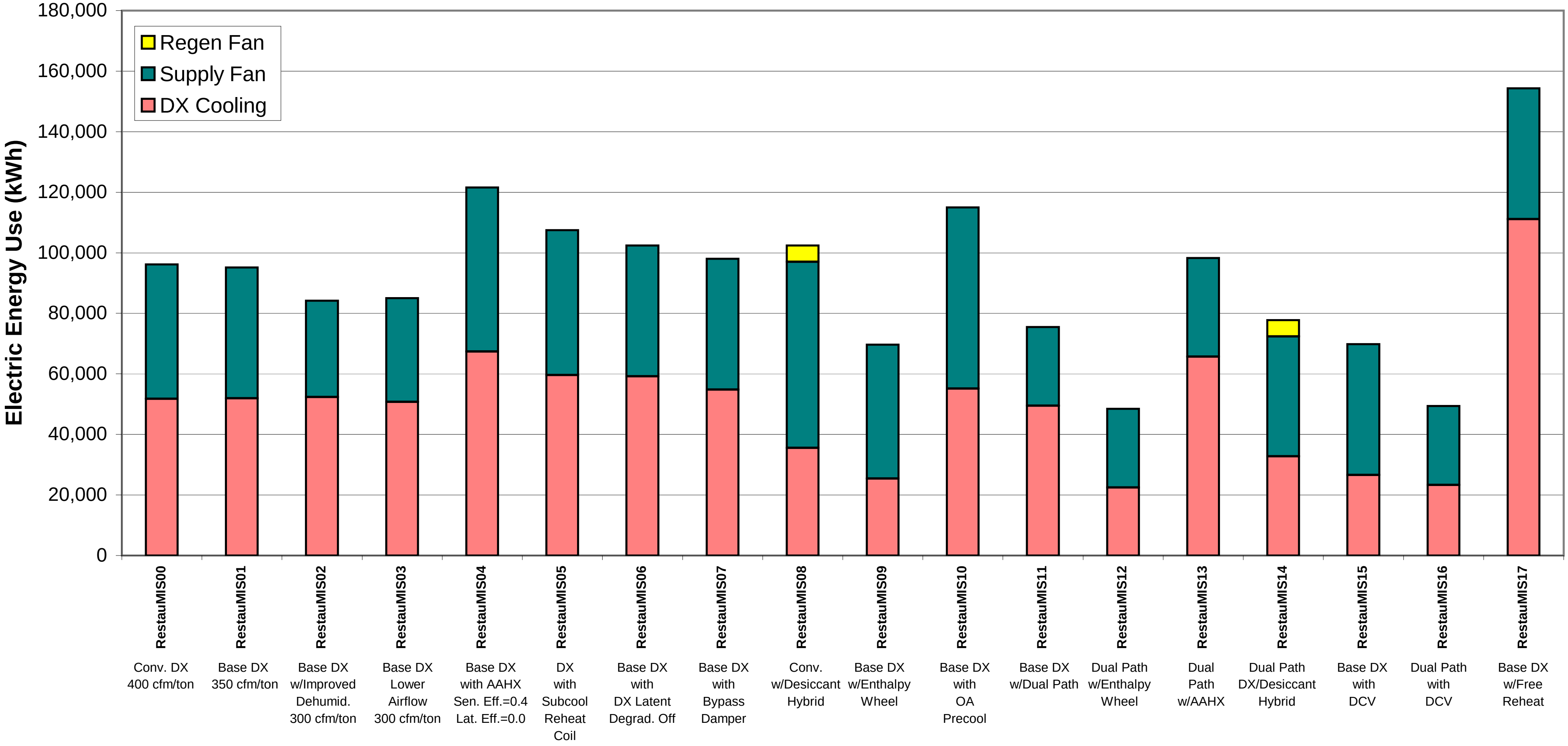
2001 Standard Restaurant in Houston TX
Annual HVAC System Electric Energy Use



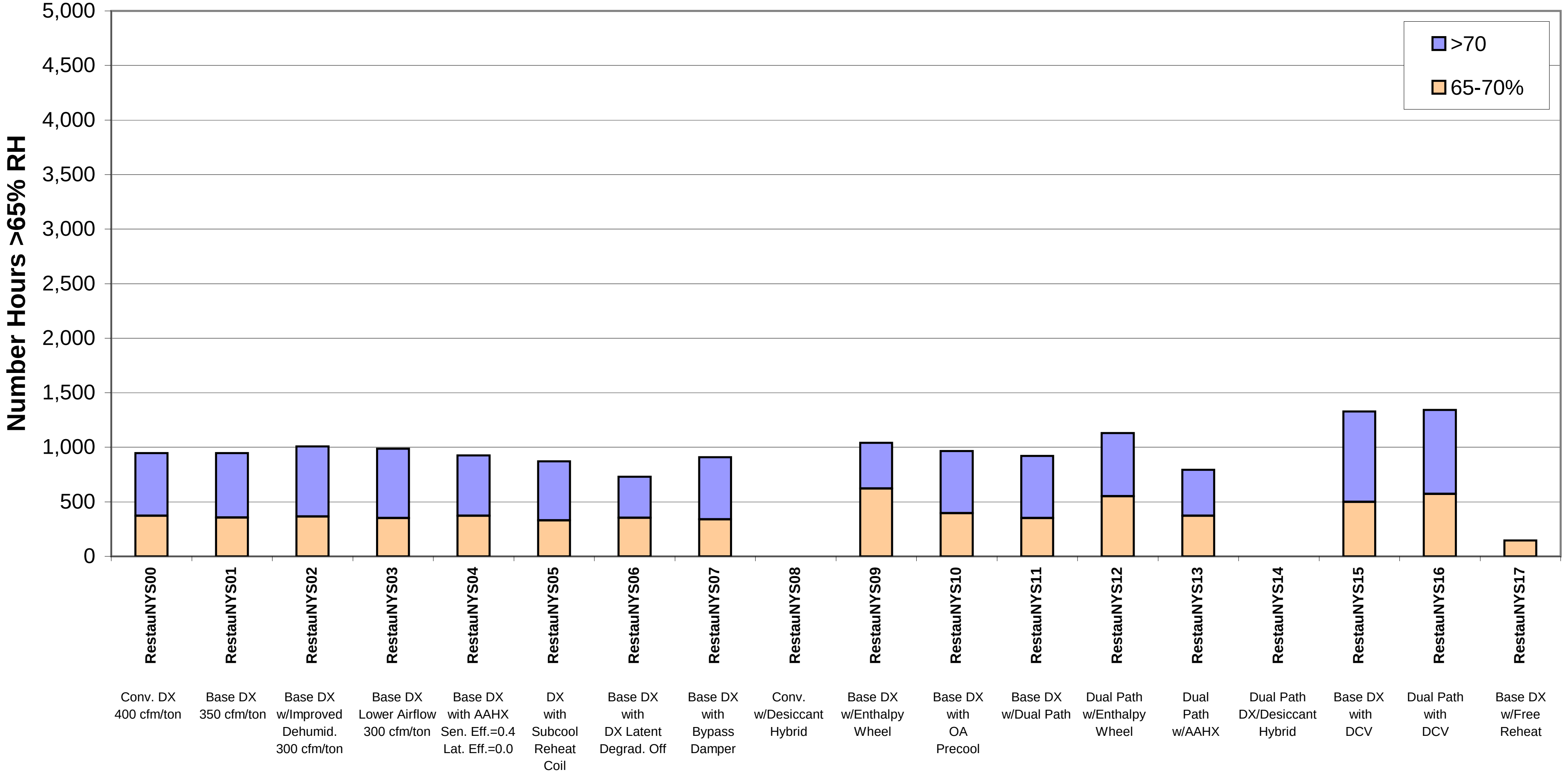
2001 Standard Restaurant in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%

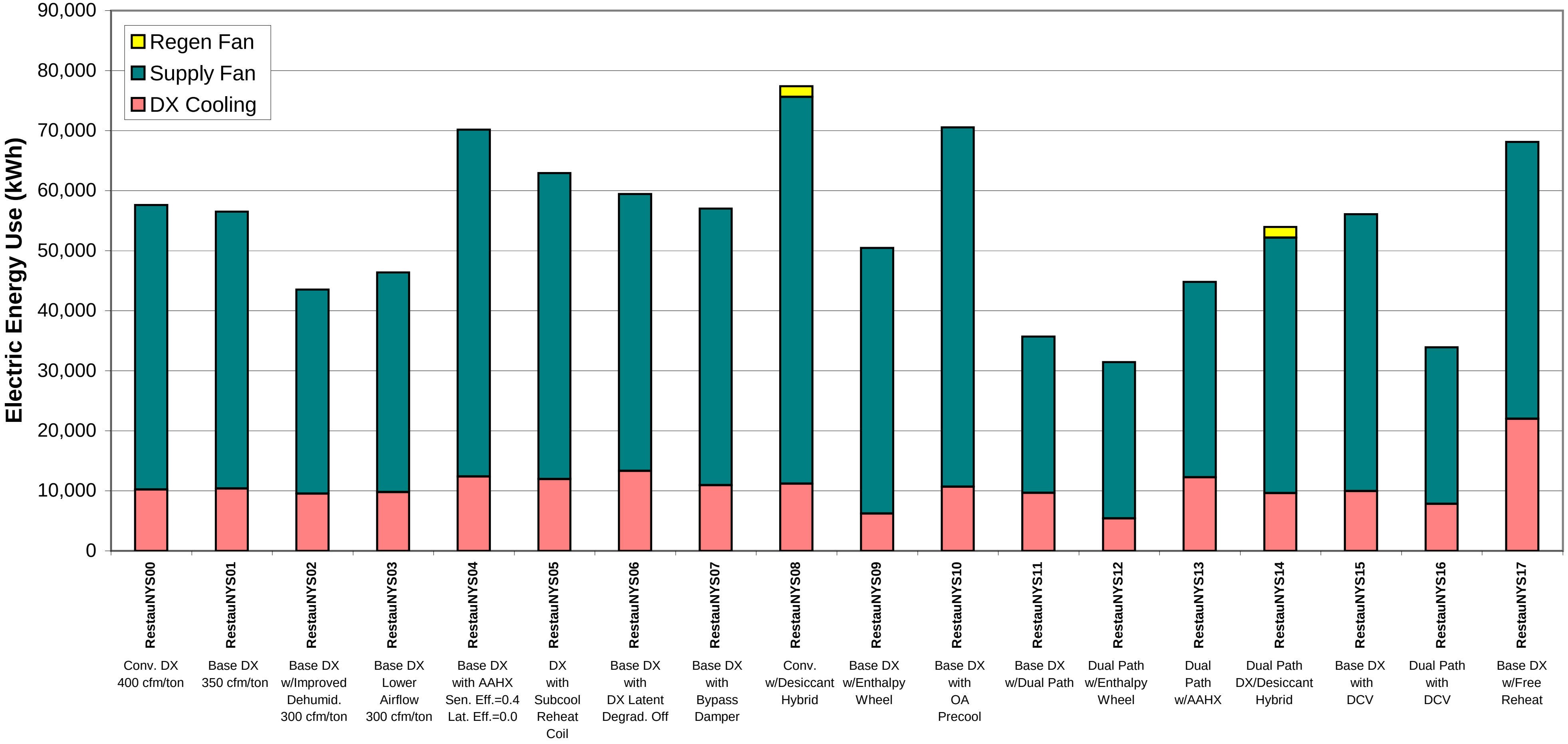


2001 Standard Restaurant in Miami FL
Annual HVAC System Electric Energy Use



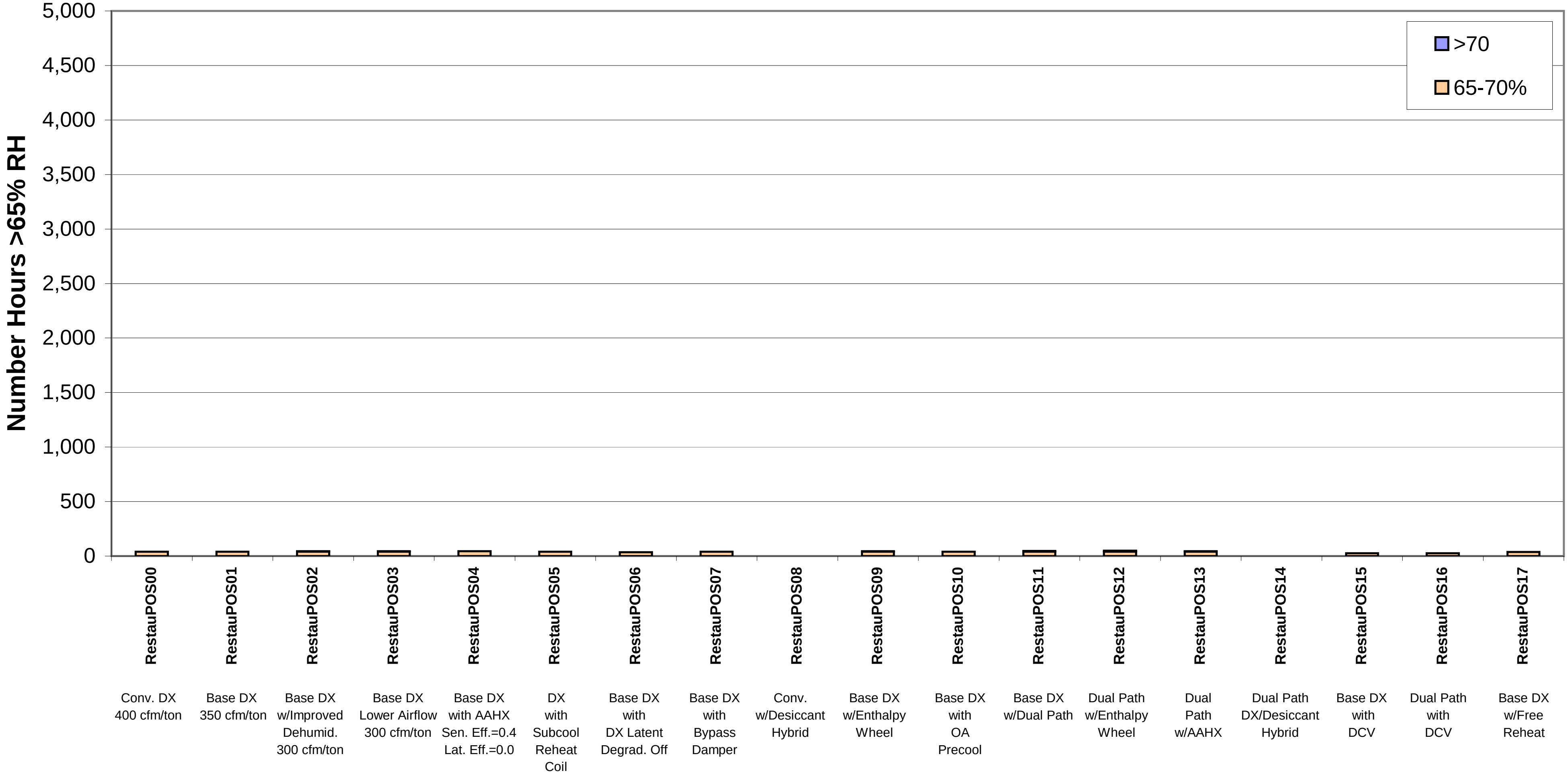
2001 Standard Restaurant in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



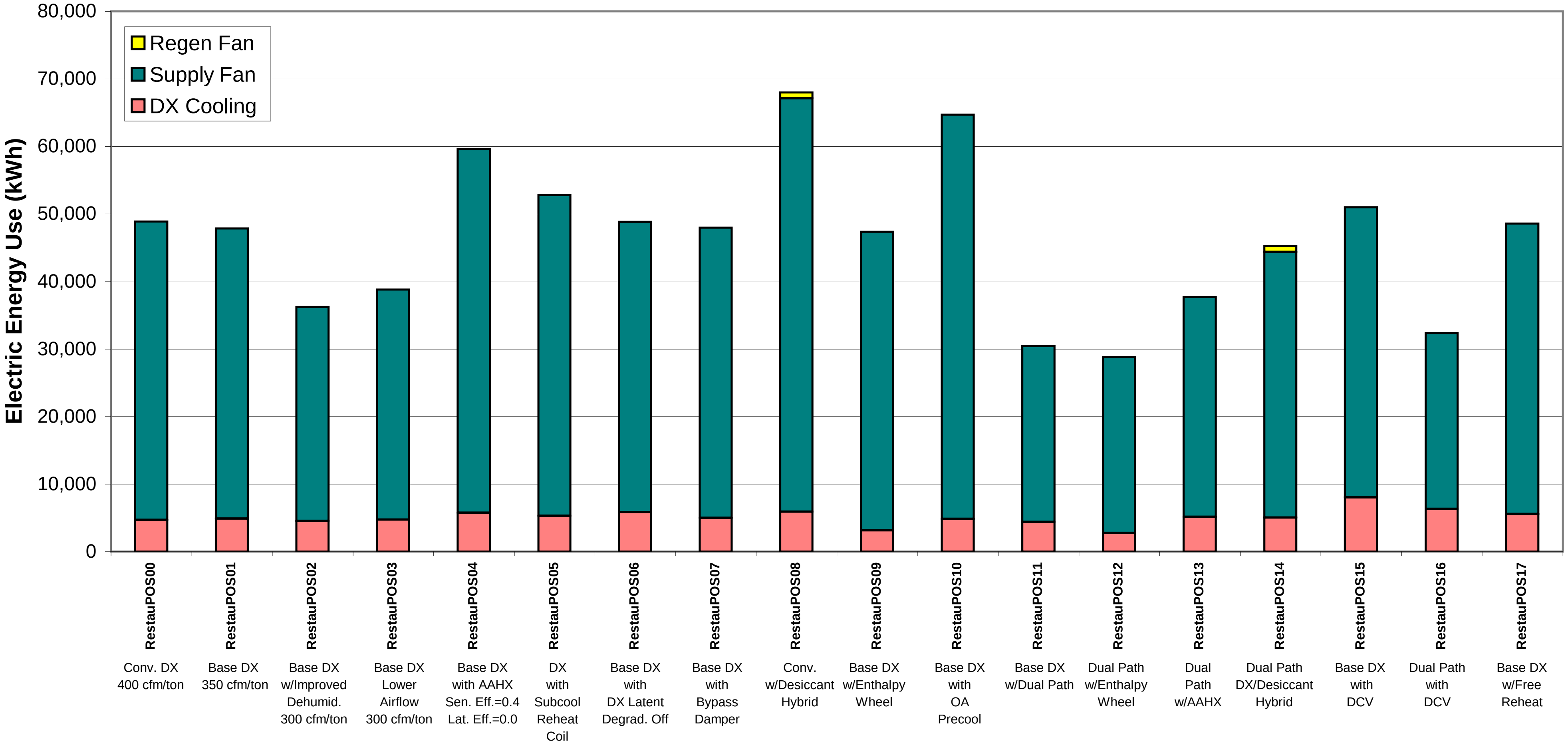


2001 Standard Restaurant in New York NY
Annual HVAC System Electric Energy Use

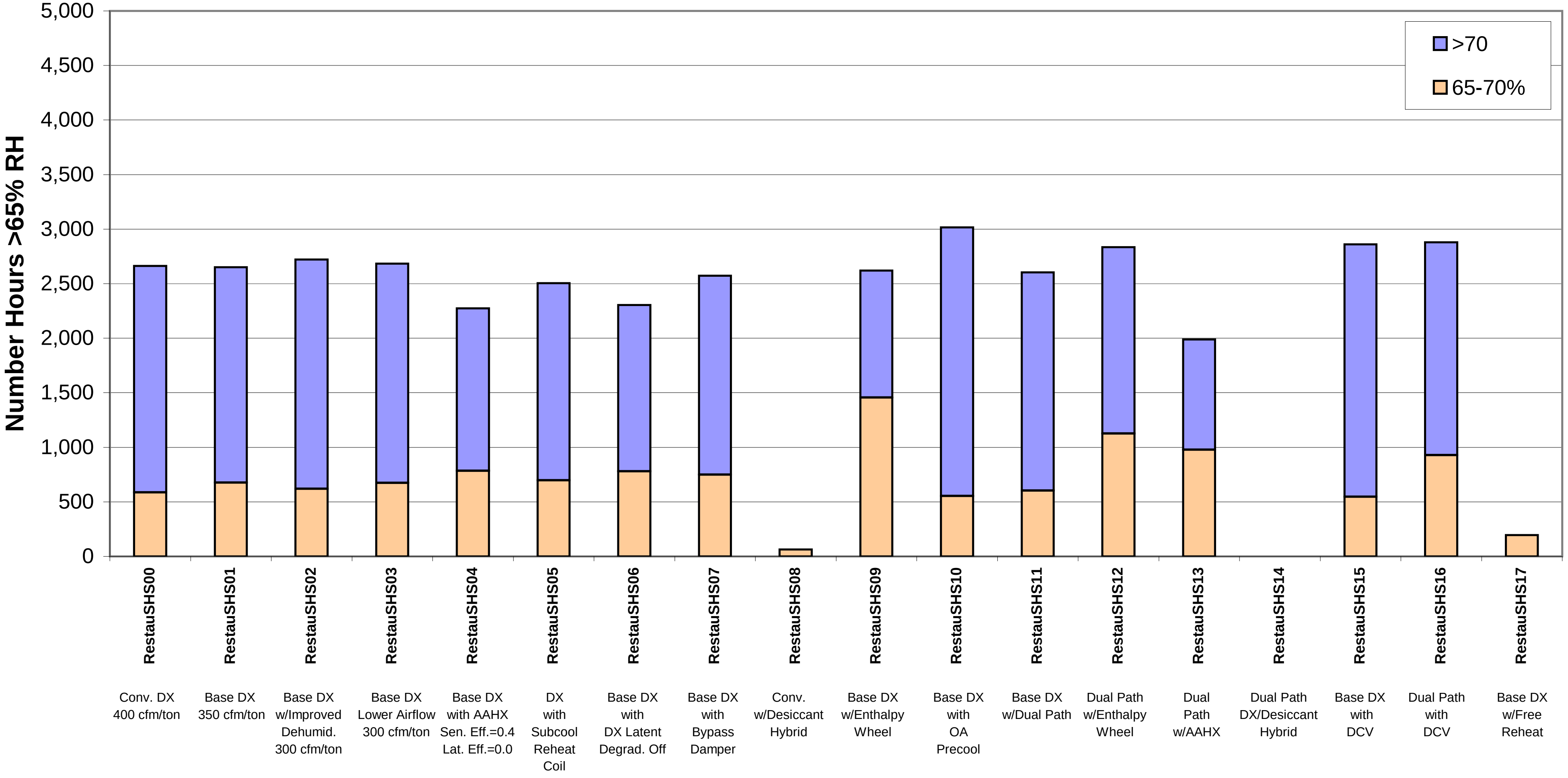
2001 Standard Restaurant in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



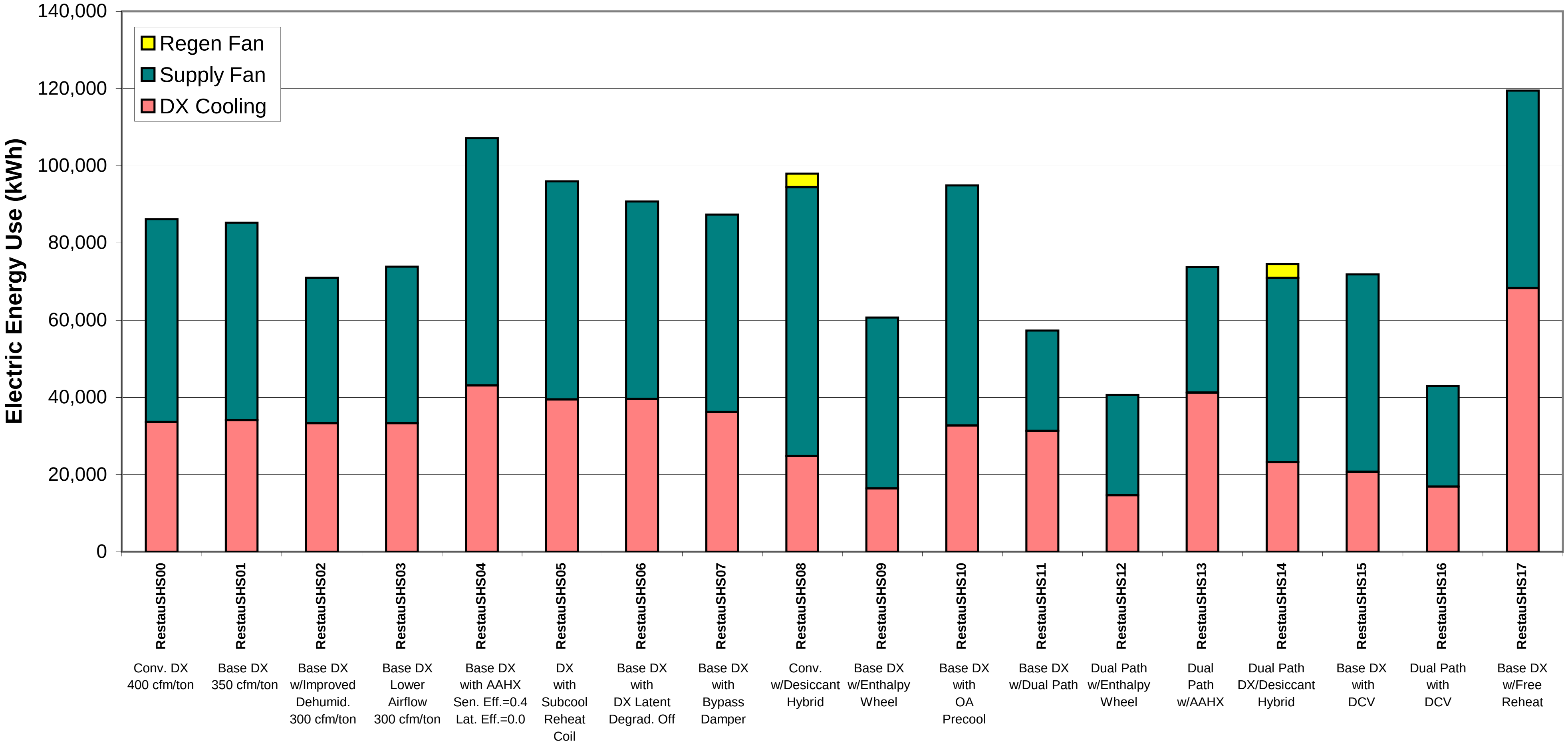
2001 Standard Restaurant in Portland OR
Annual HVAC System Electric Energy Use



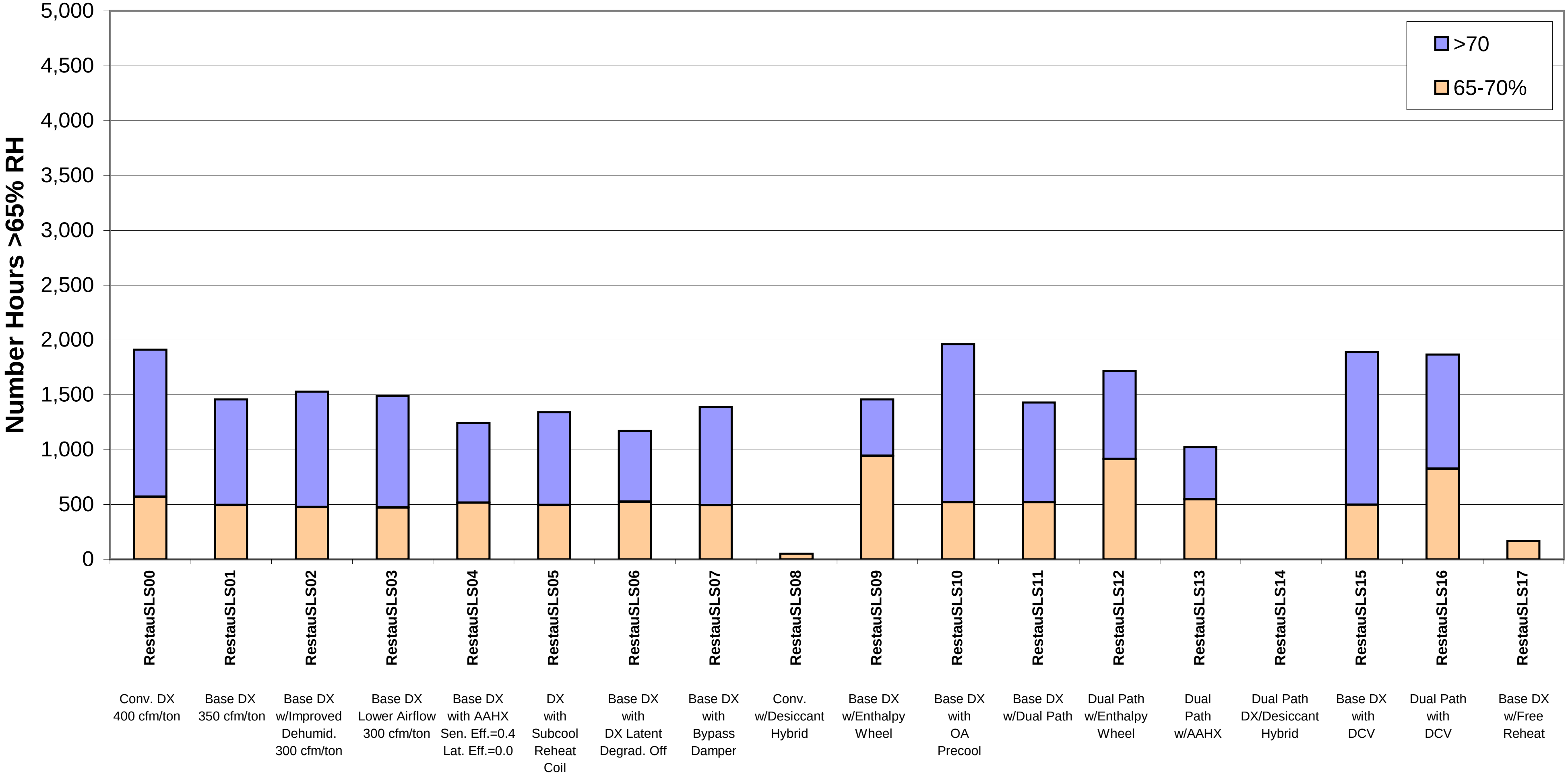
2001 Standard Restaurant in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



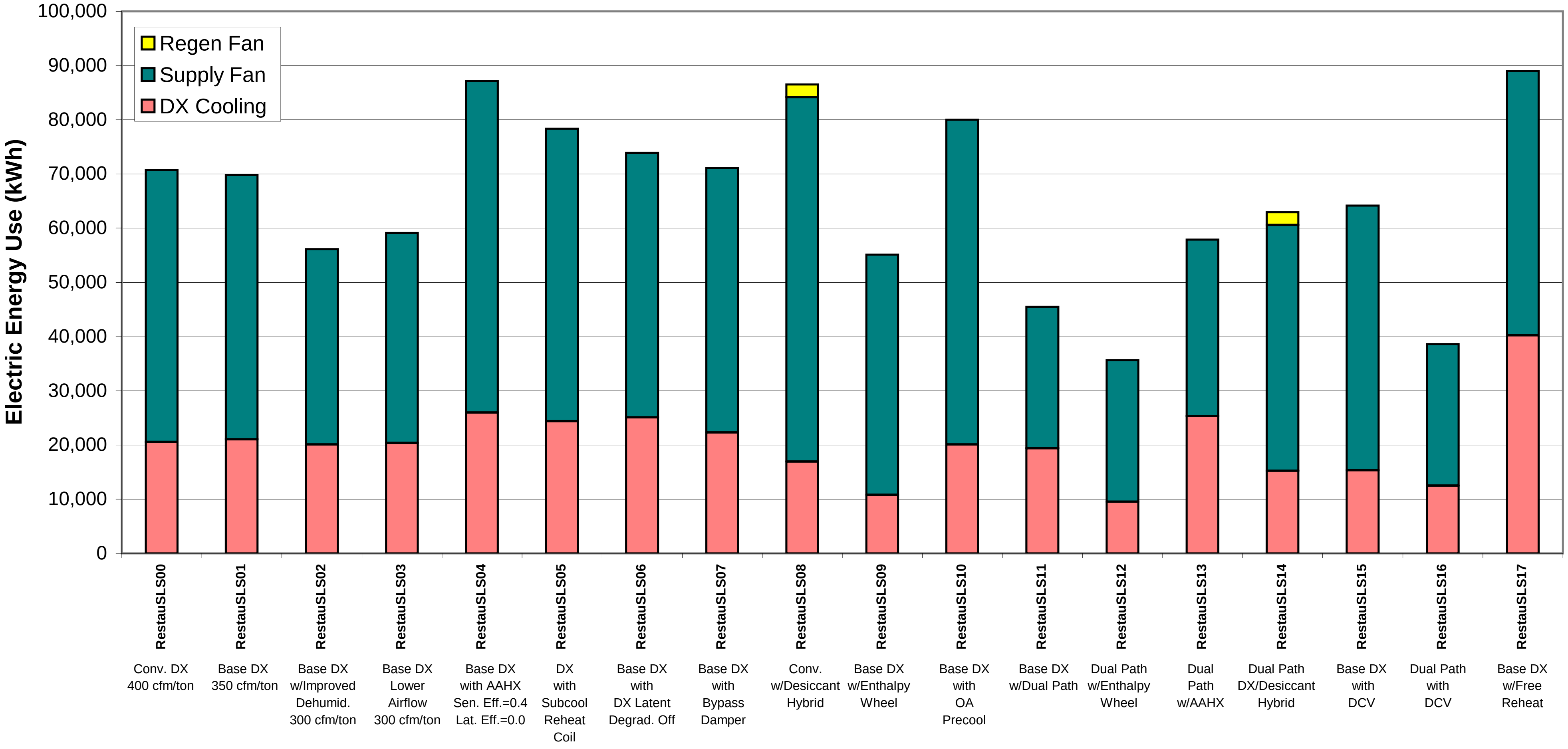
2001 Standard Restaurant in Shreveport LA
Annual HVAC System Electric Energy Use



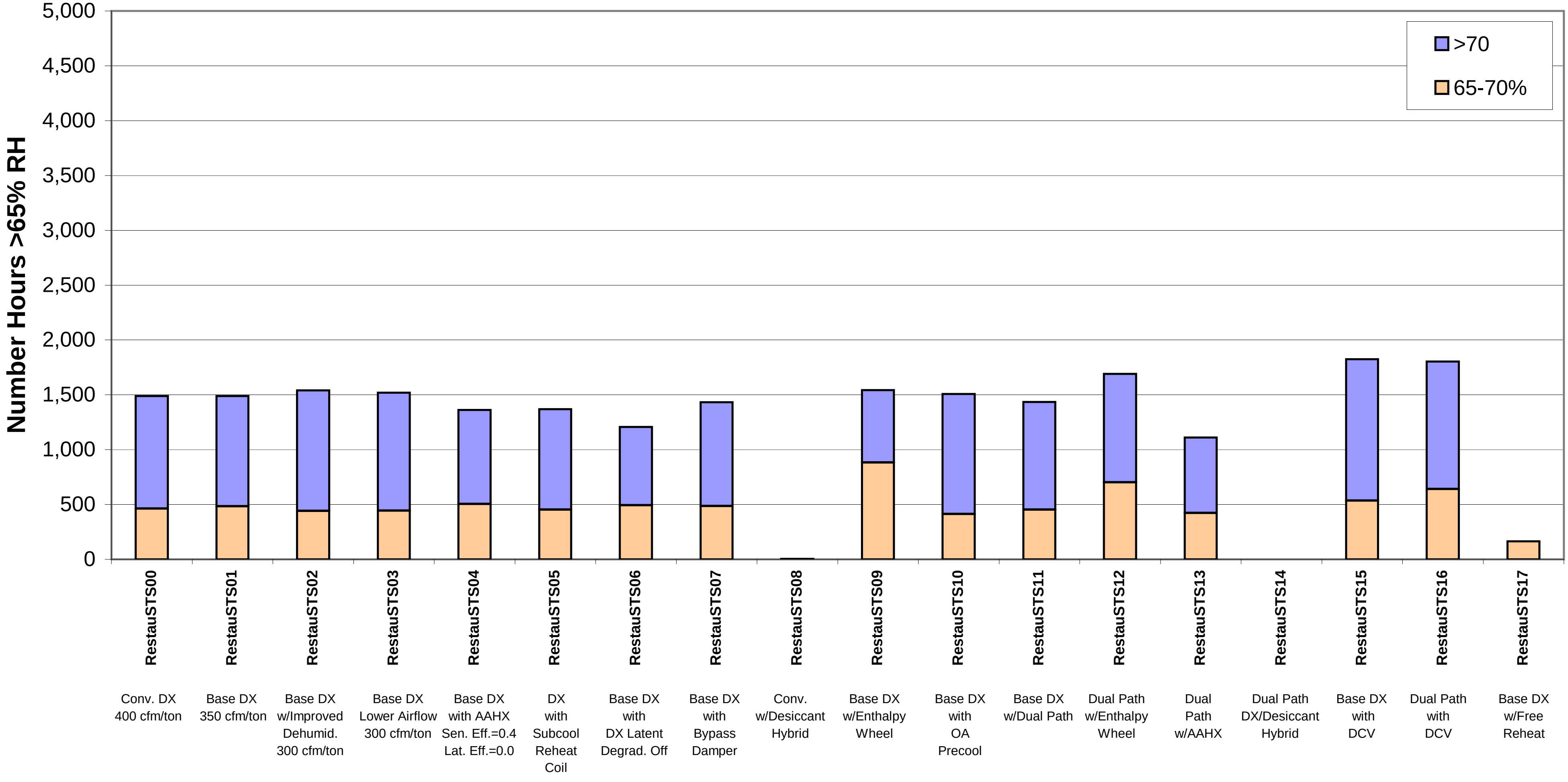
2001 Standard Restaurant in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



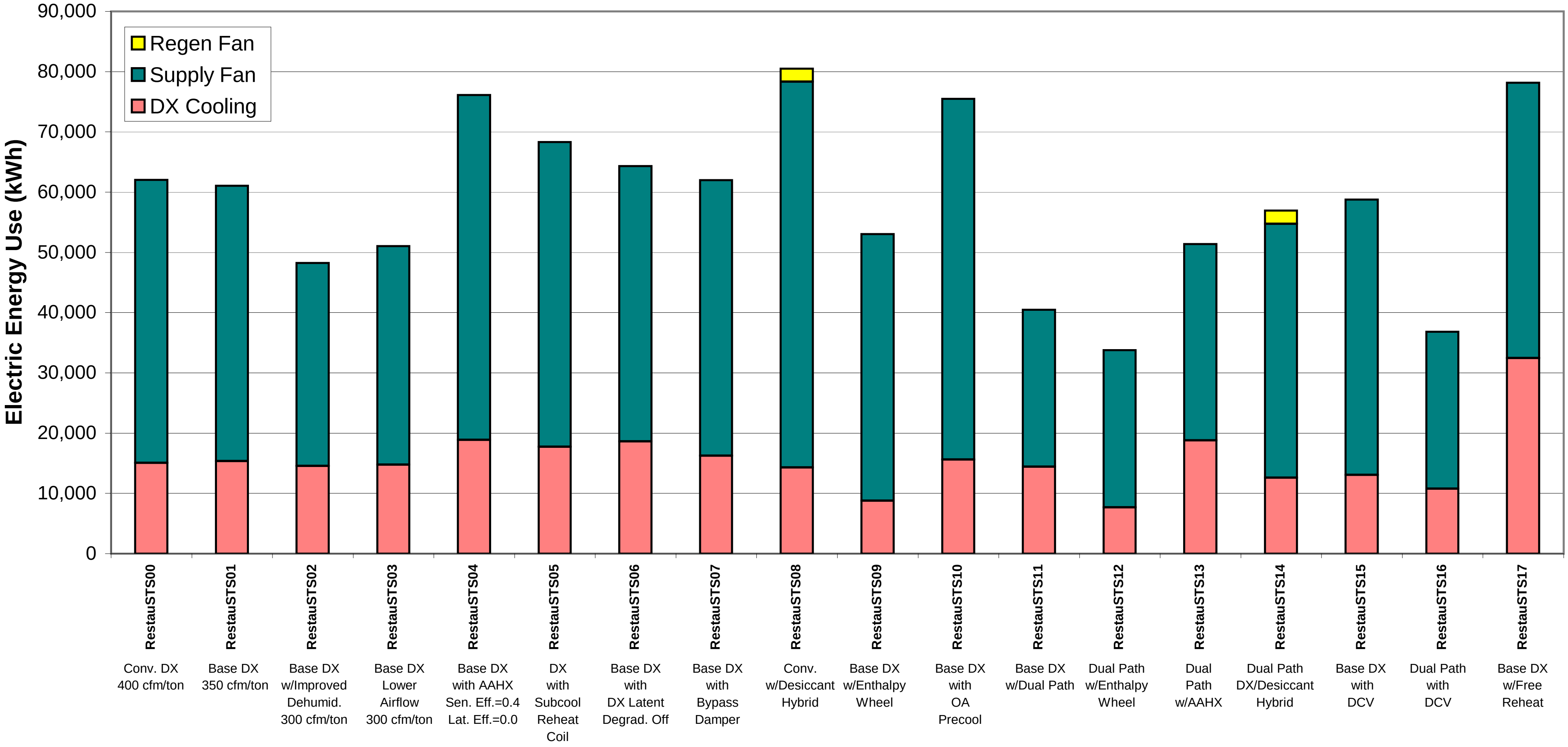
2001 Standard Restaurant in St. Louis MO
Annual HVAC System Electric Energy Use



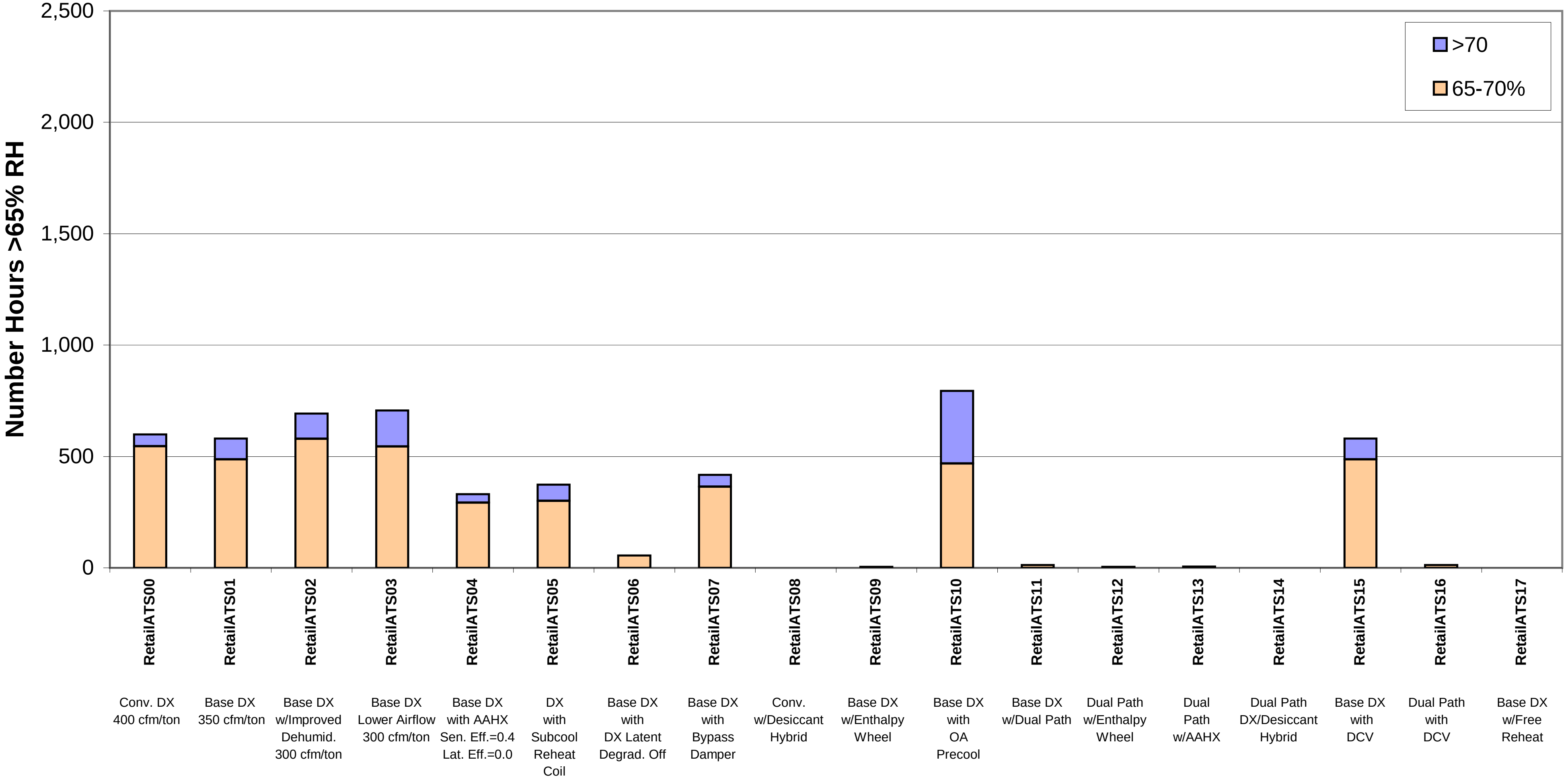
2001 Standard Restaurant in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



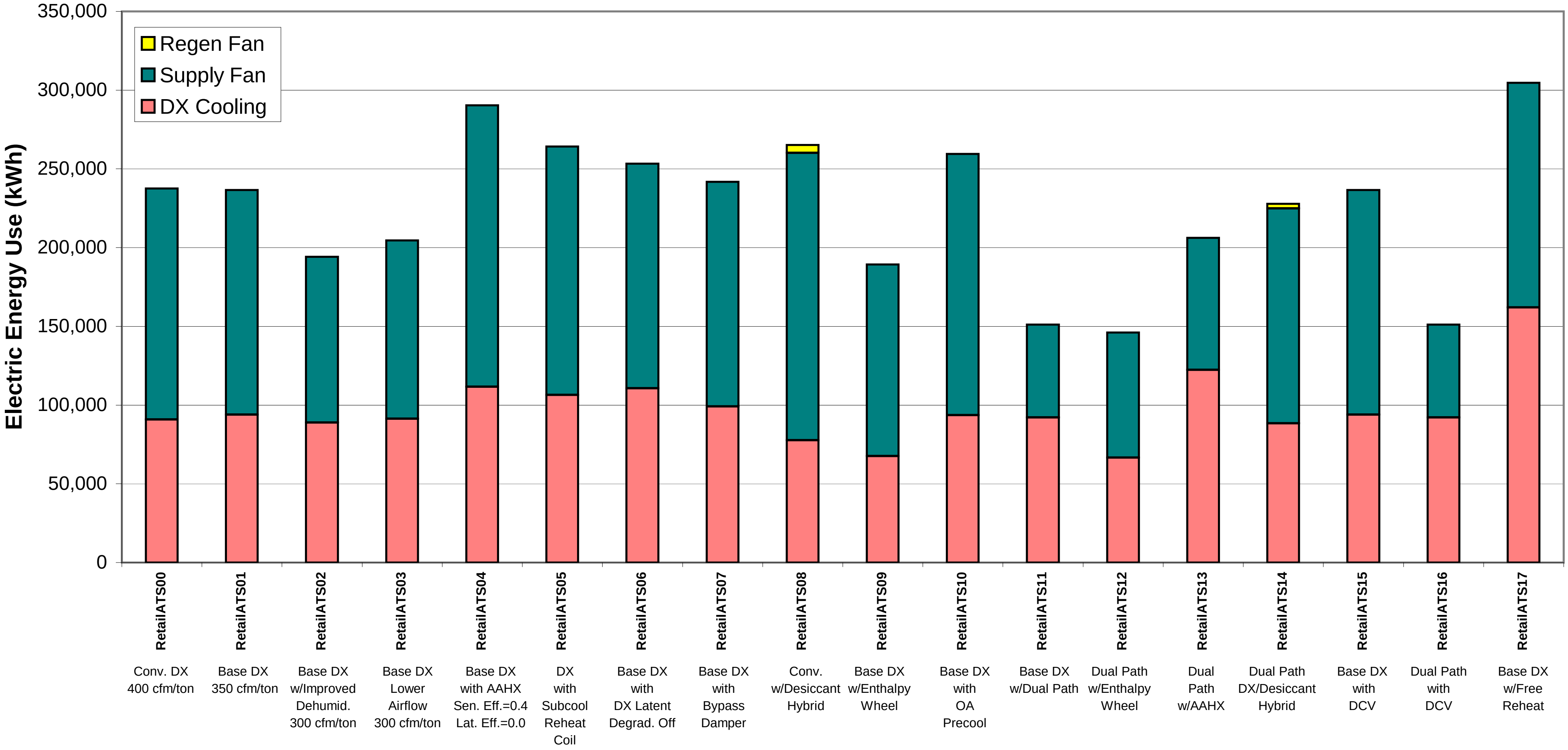
2001 Standard Restaurant in Washington DC
Annual HVAC System Electric Energy Use



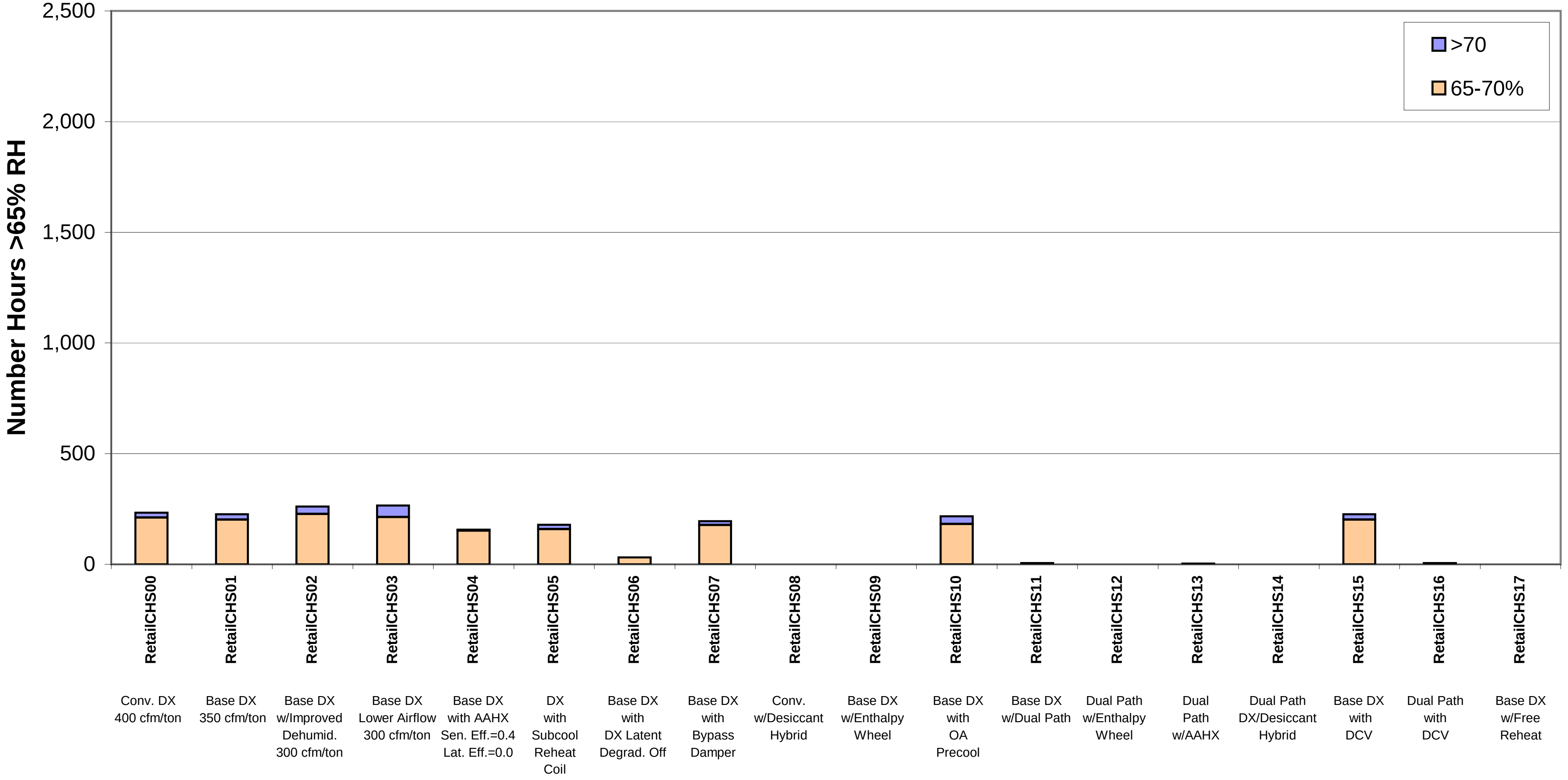
2001 Standard Retail in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



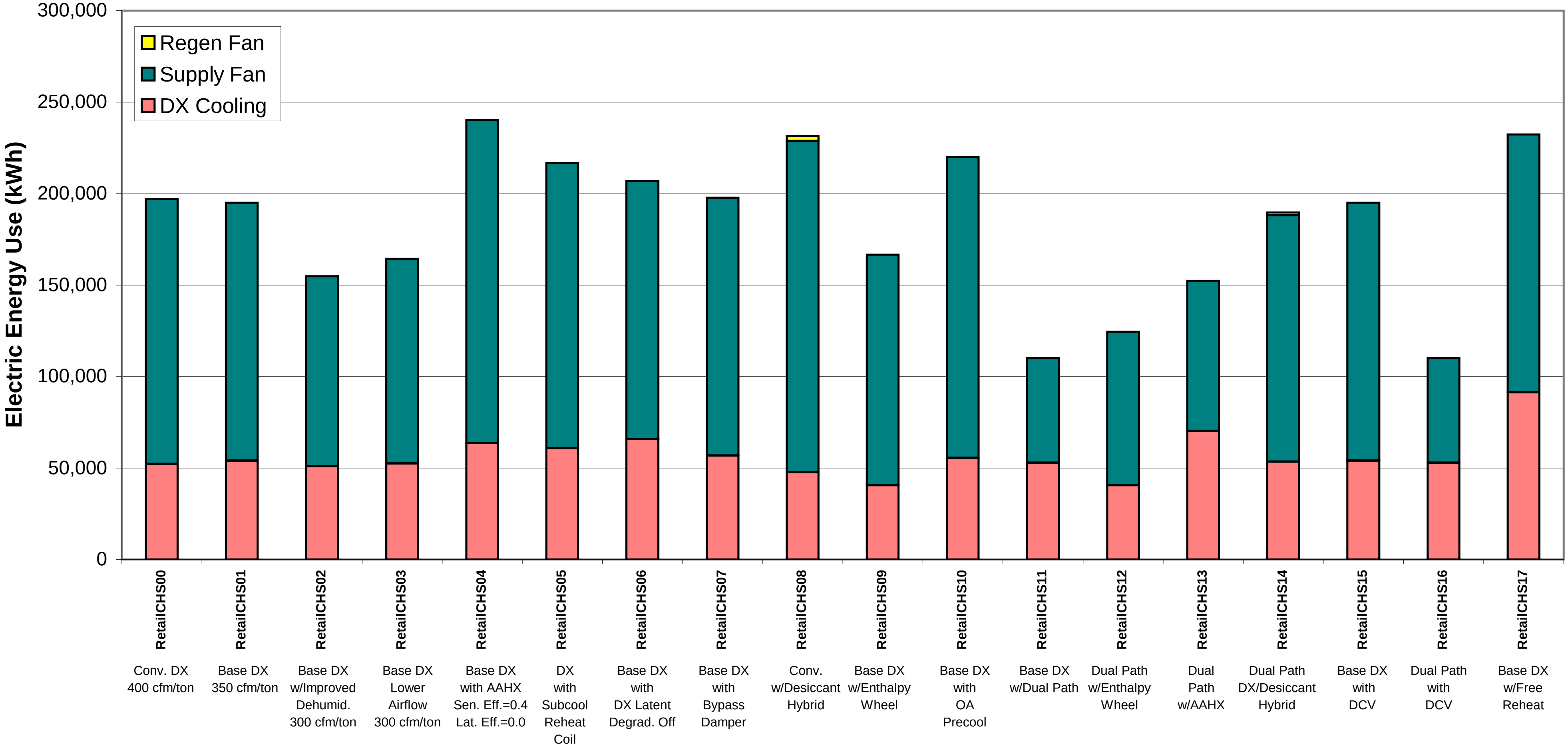
2001 Standard Retail in Atlanta GA
Annual HVAC System Electric Energy Use



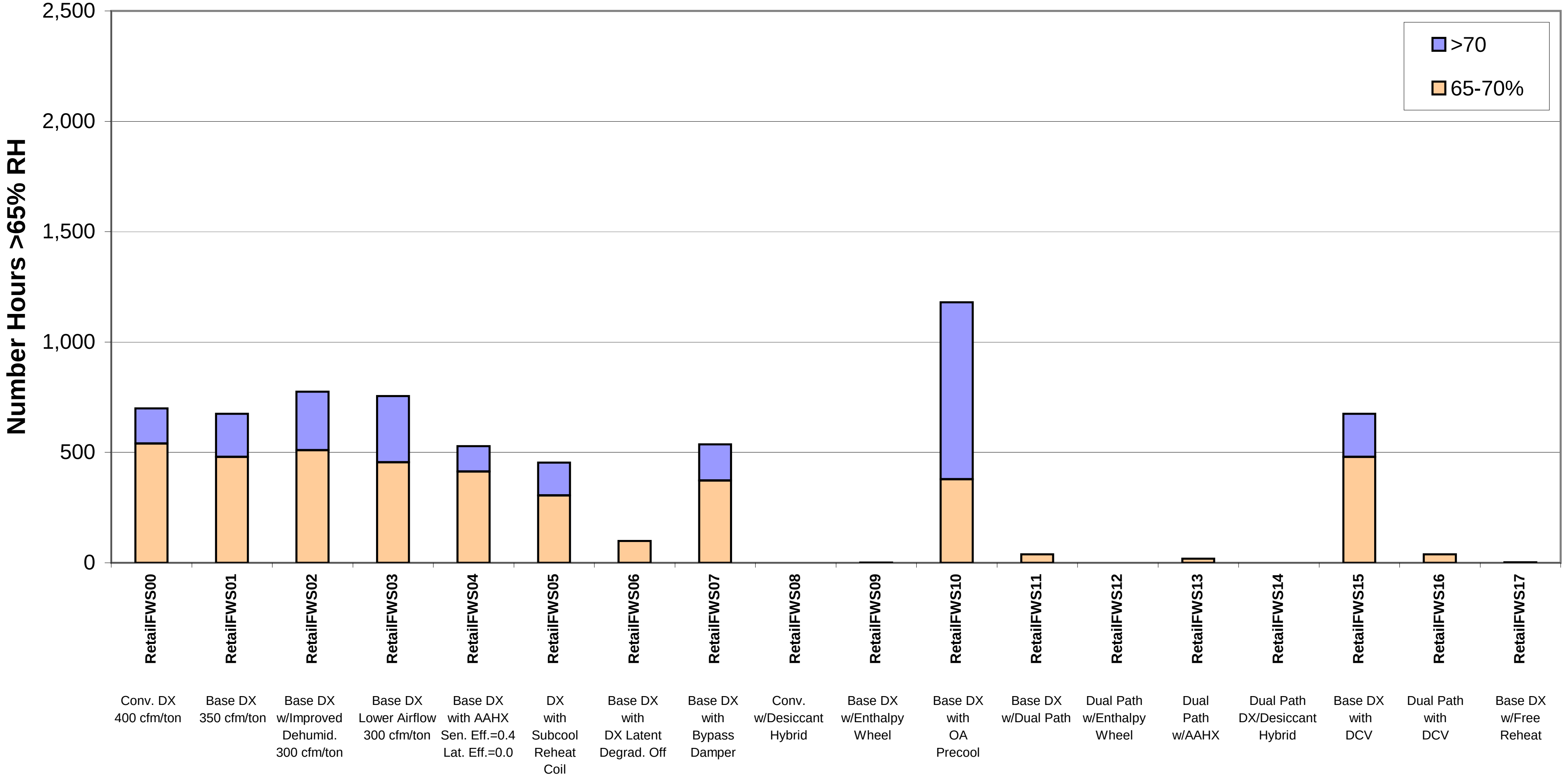
2001 Standard Retail in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



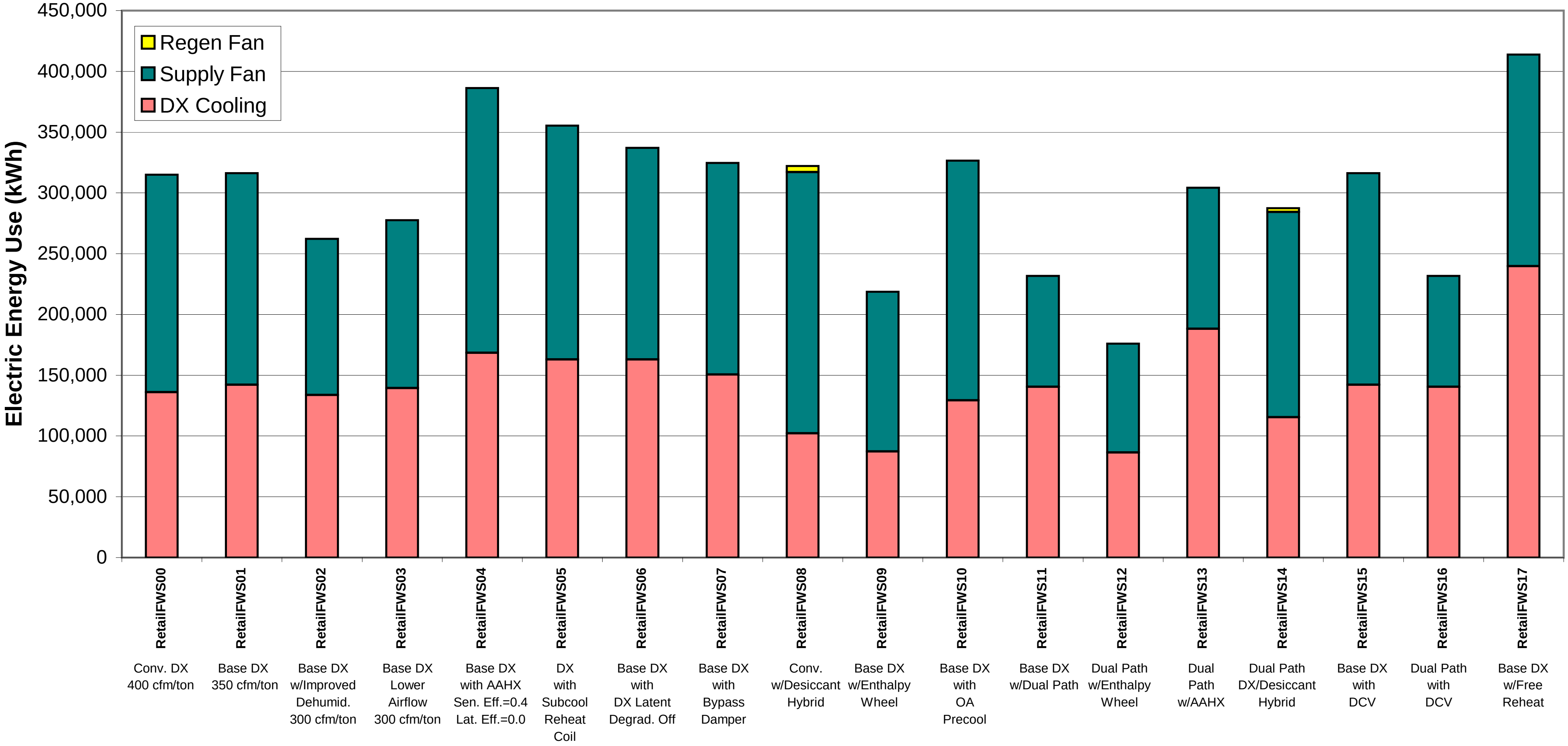
2001 Standard Retail in Chicago IL
Annual HVAC System Electric Energy Use



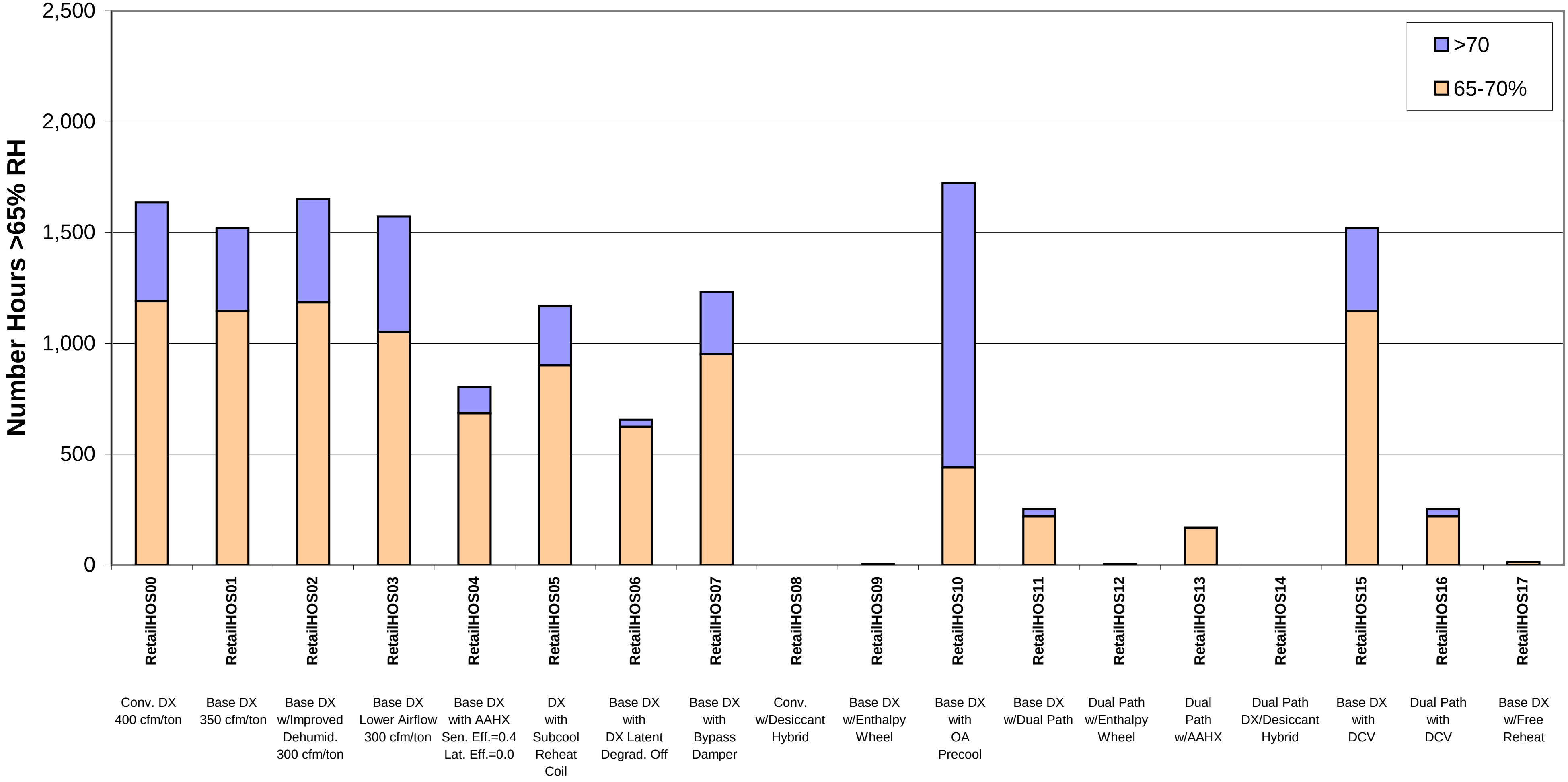
2001 Standard Retail in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



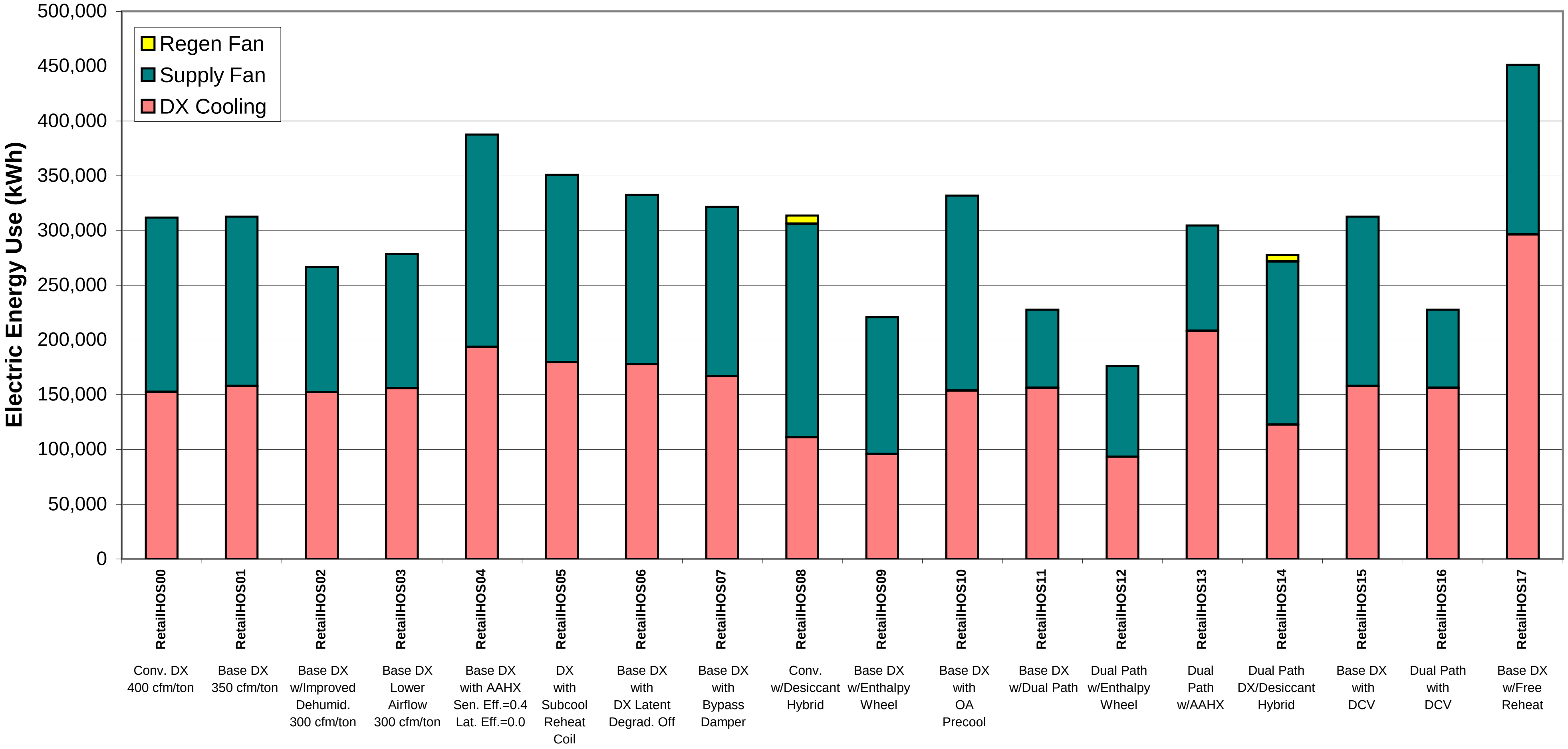
2001 Standard Retail in Fort Worth TX
Annual HVAC System Electric Energy Use

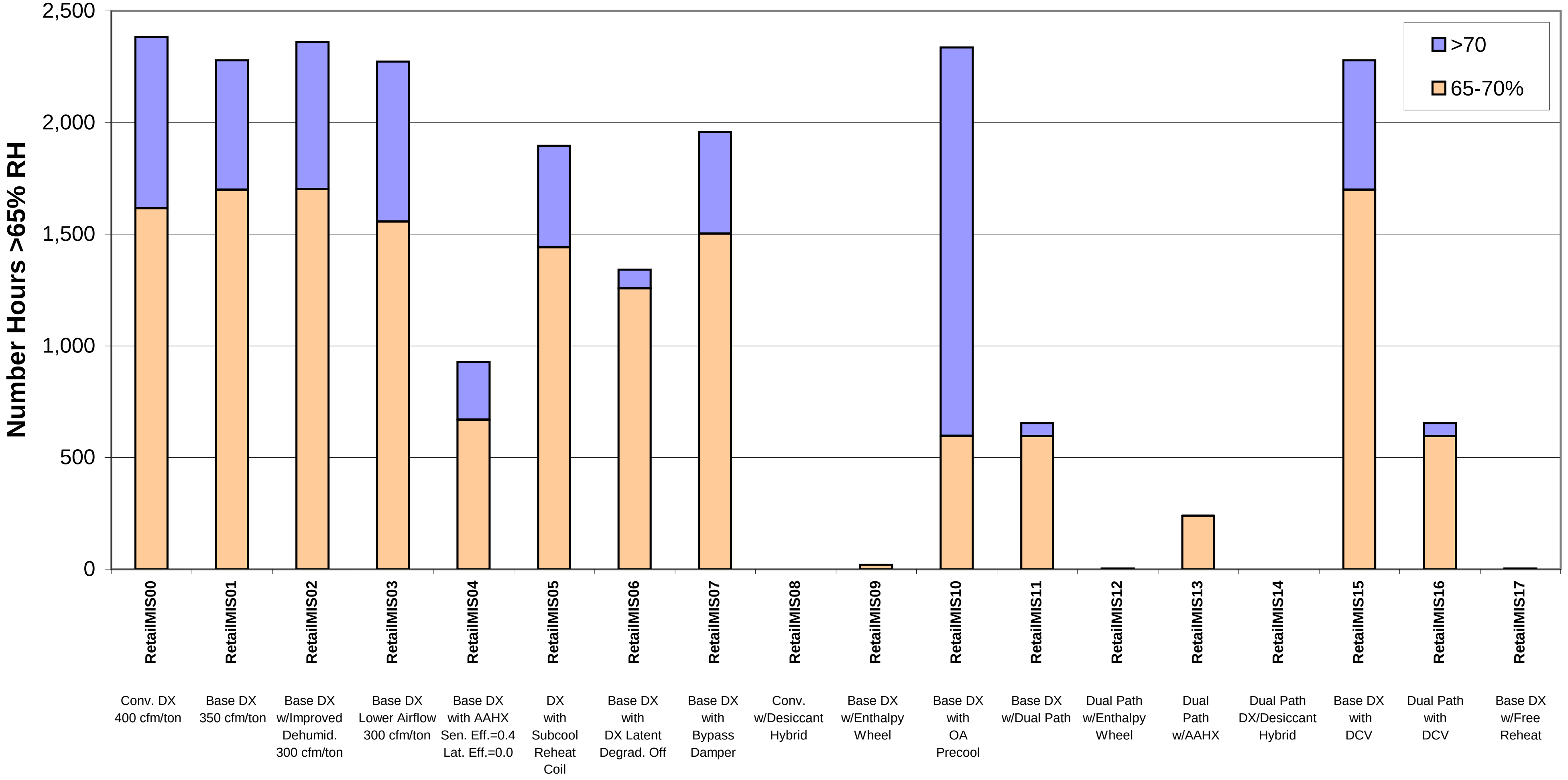


2001 Standard Retail in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



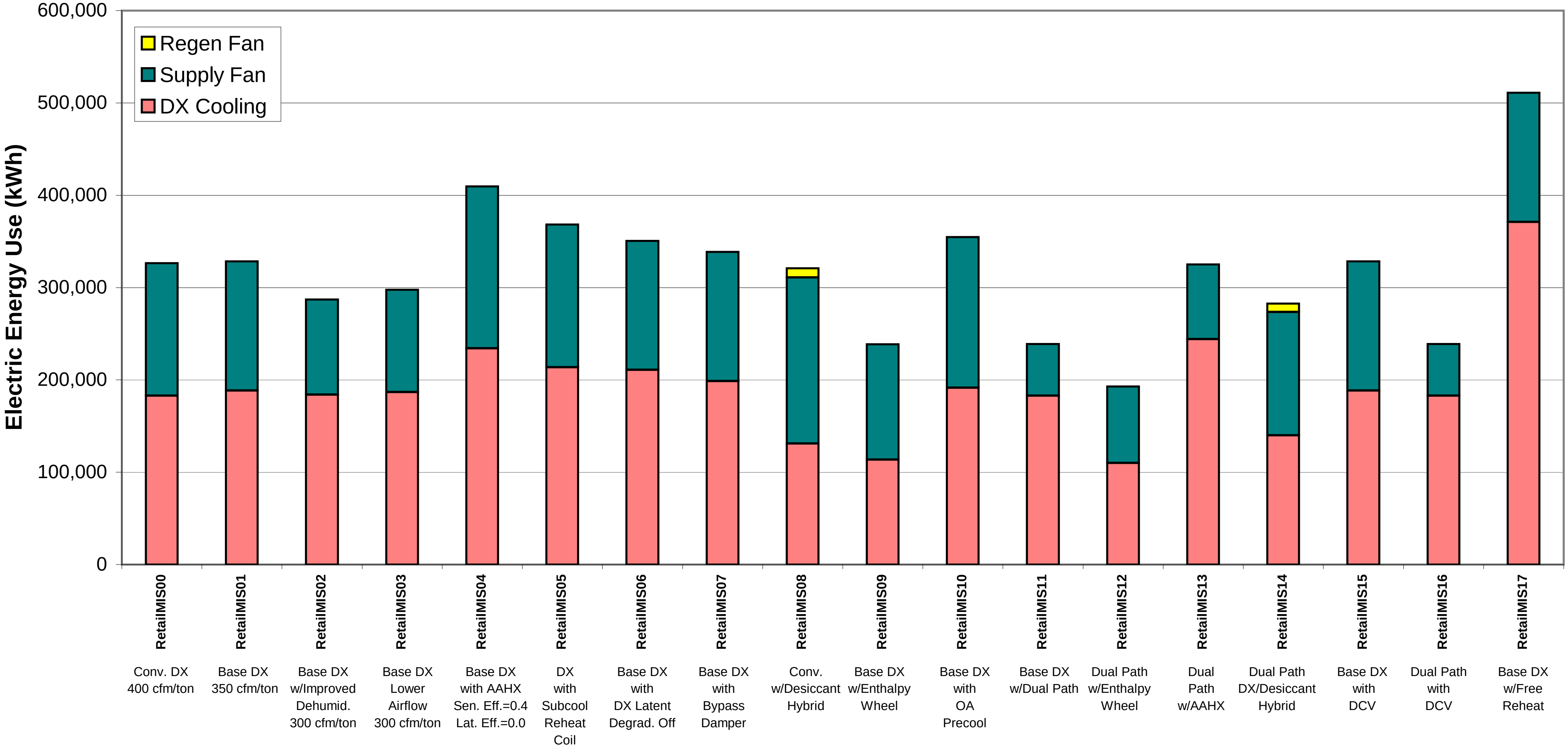
2001 Standard Retail in Houston TX
Annual HVAC System Electric Energy Use



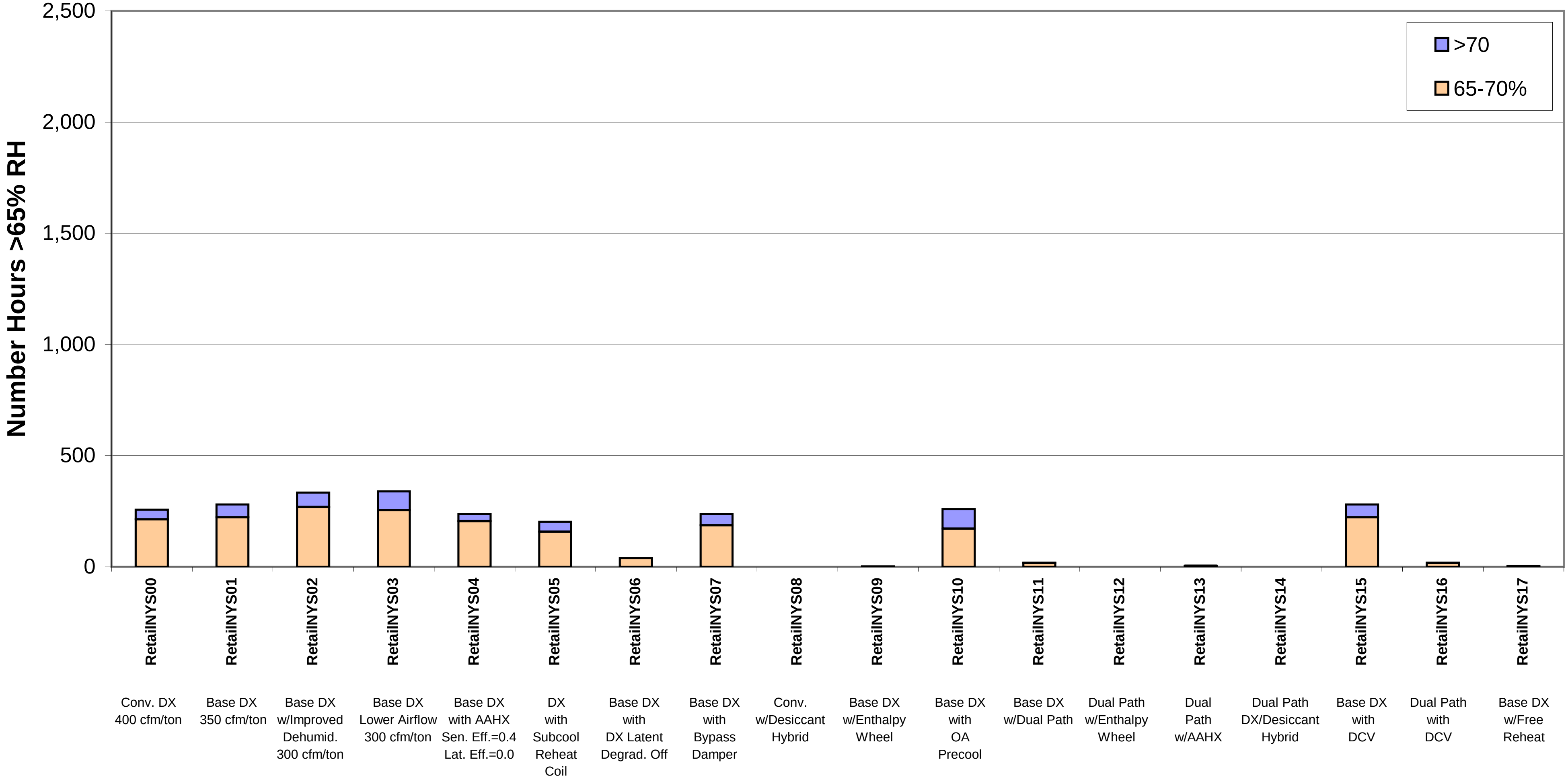


2001 Standard Retail in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%

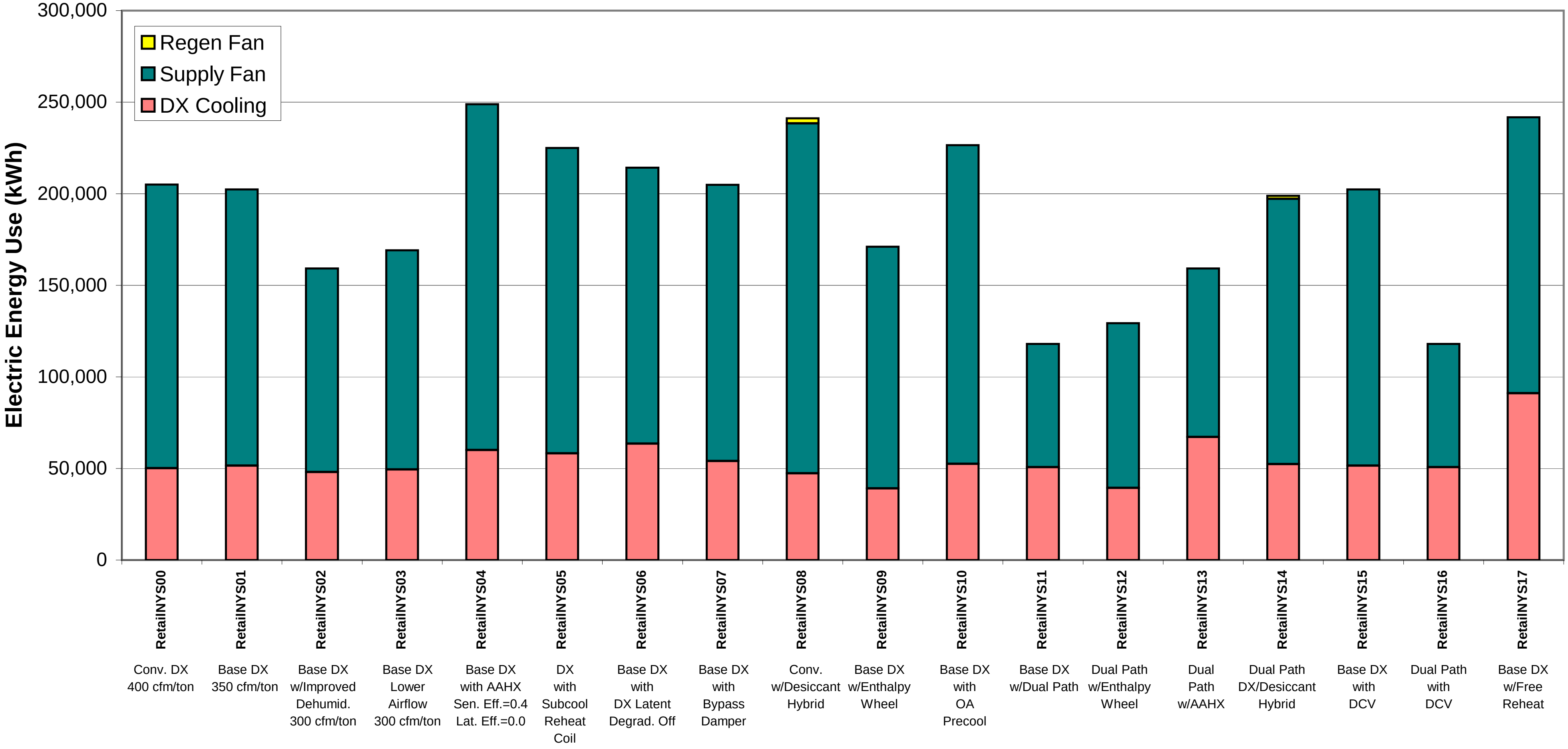
2001 Standard Retail in Miami FL
Annual HVAC System Electric Energy Use



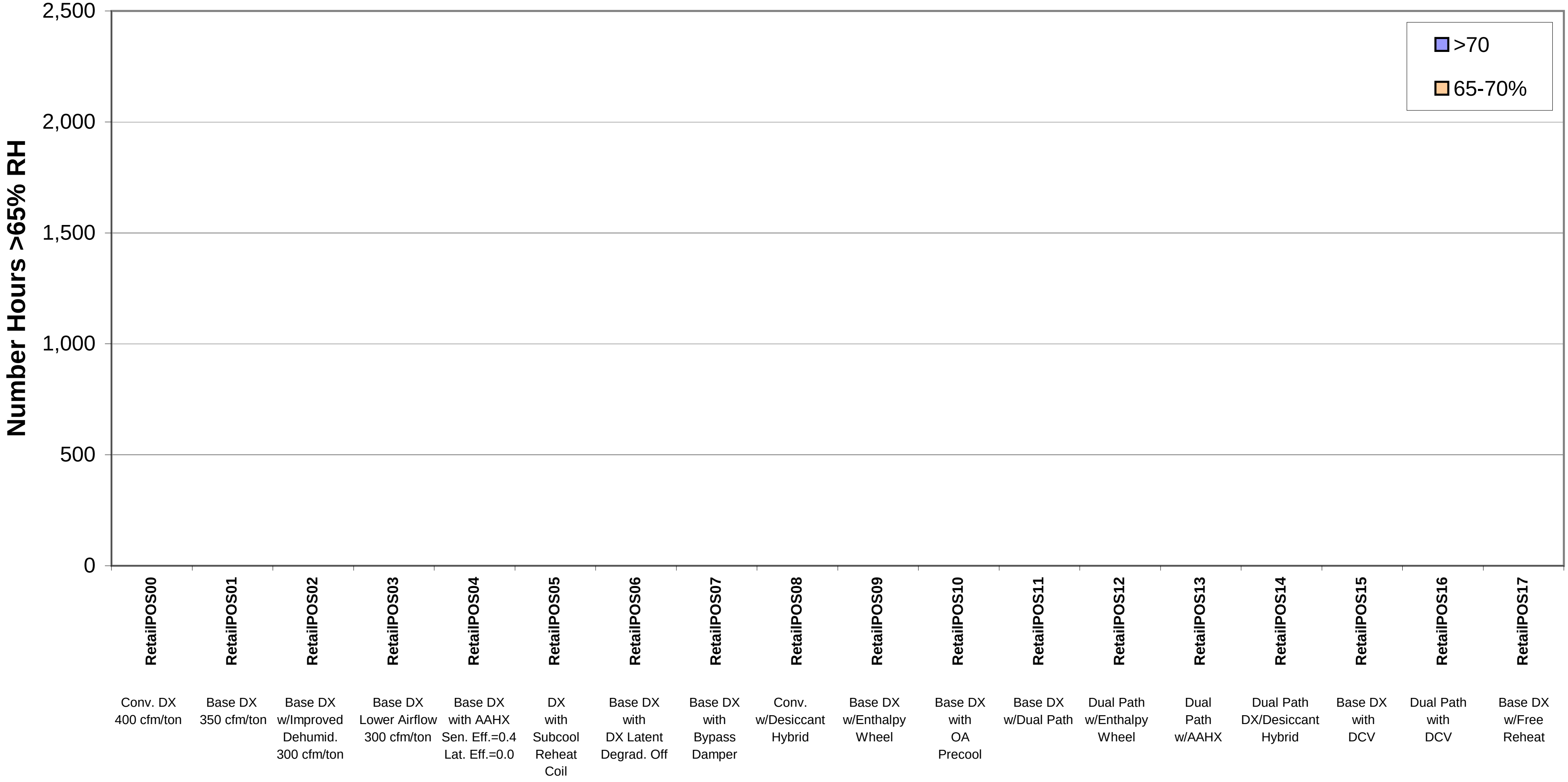
2001 Standard Retail in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



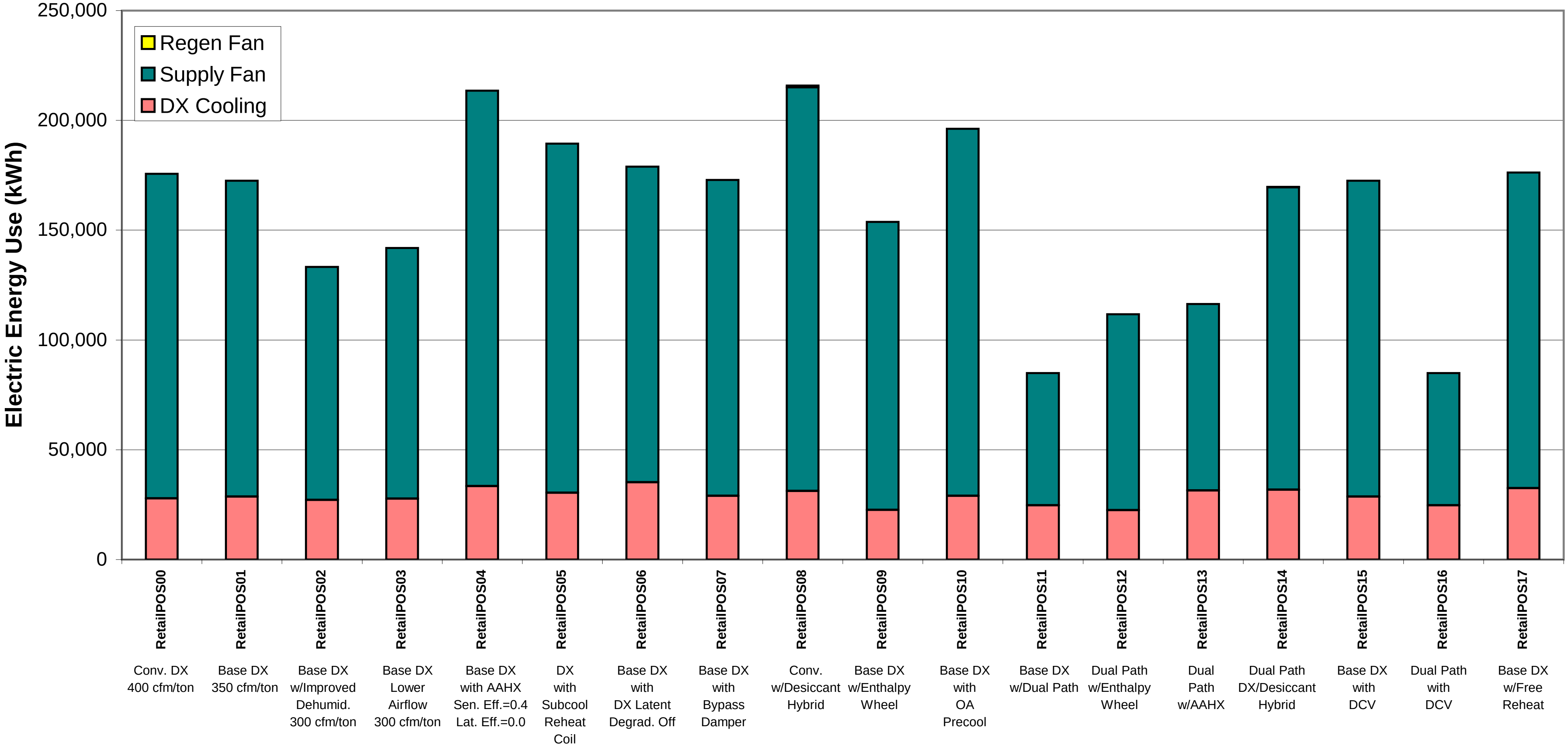
2001 Standard Retail in New York NY
Annual HVAC System Electric Energy Use



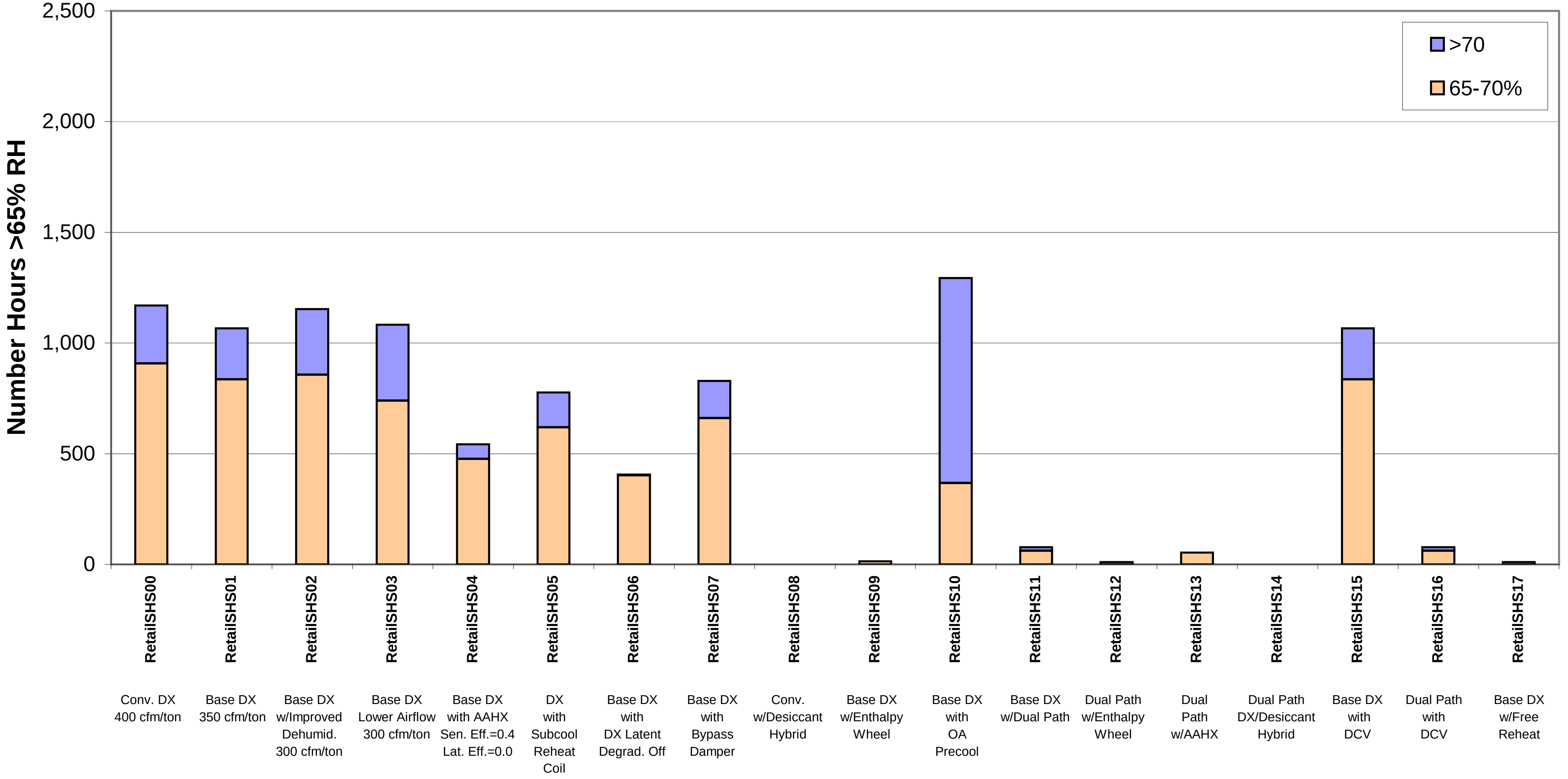
2001 Standard Retail in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



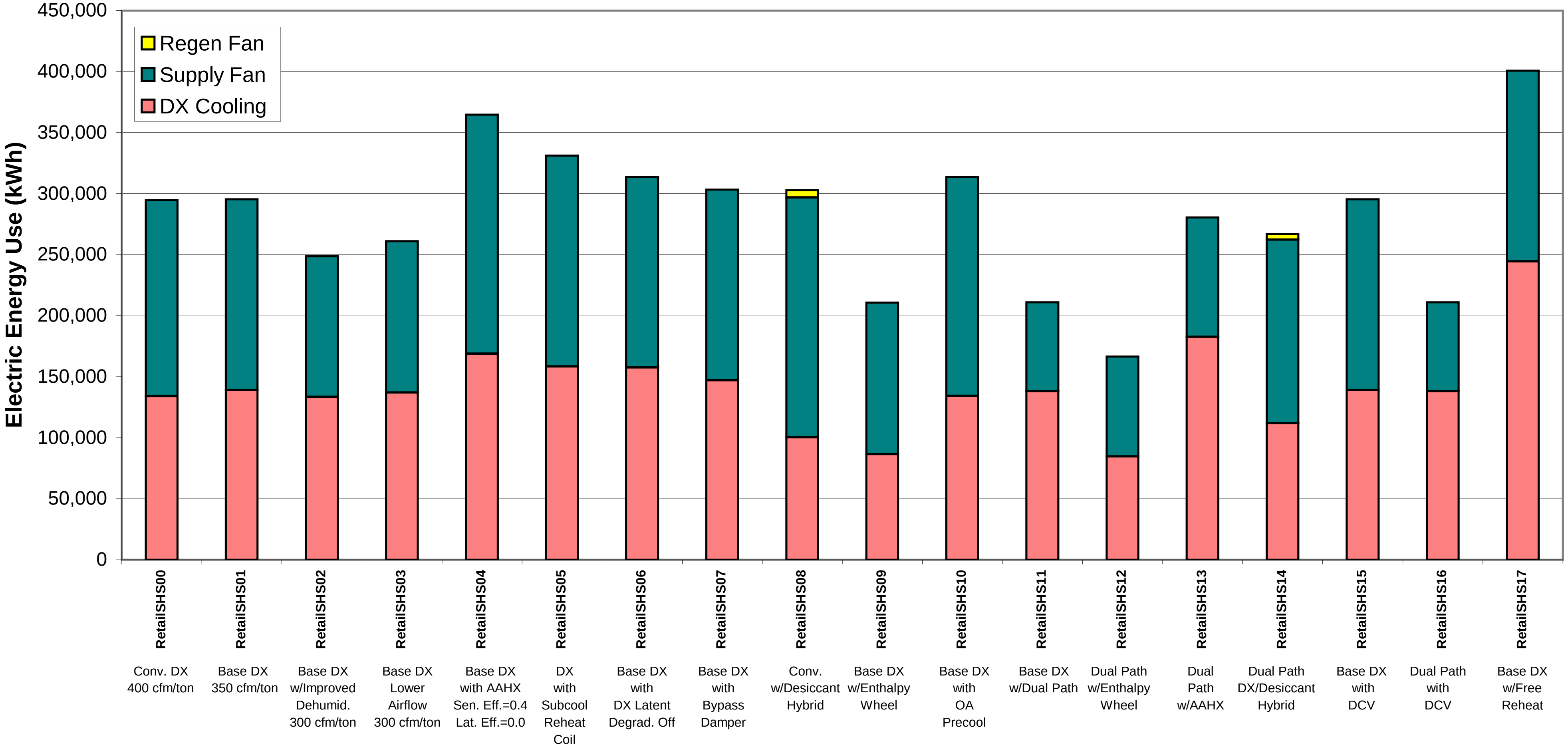
2001 Standard Retail in Portland OR
Annual HVAC System Electric Energy Use



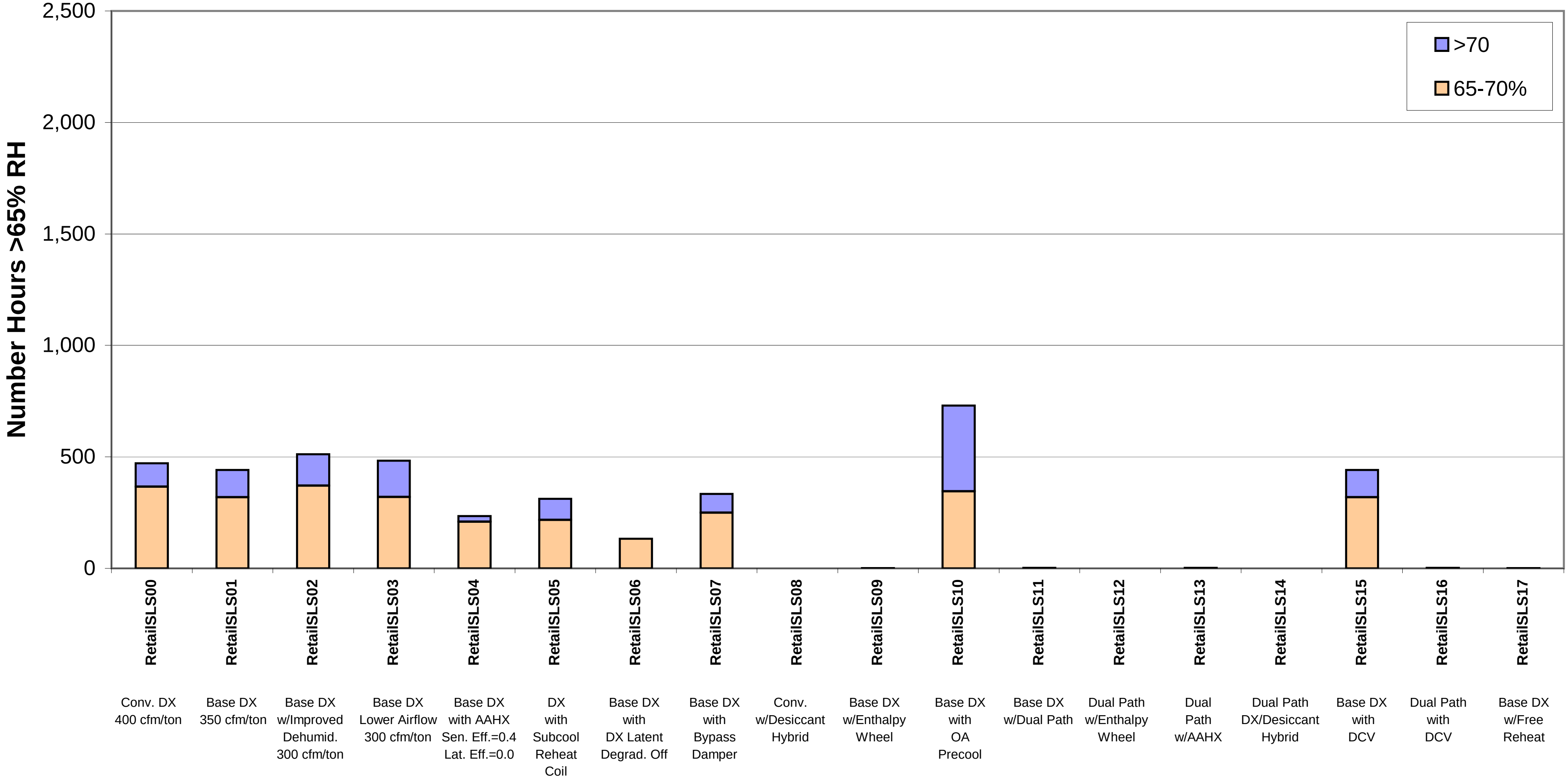
2001 Standard Retail in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



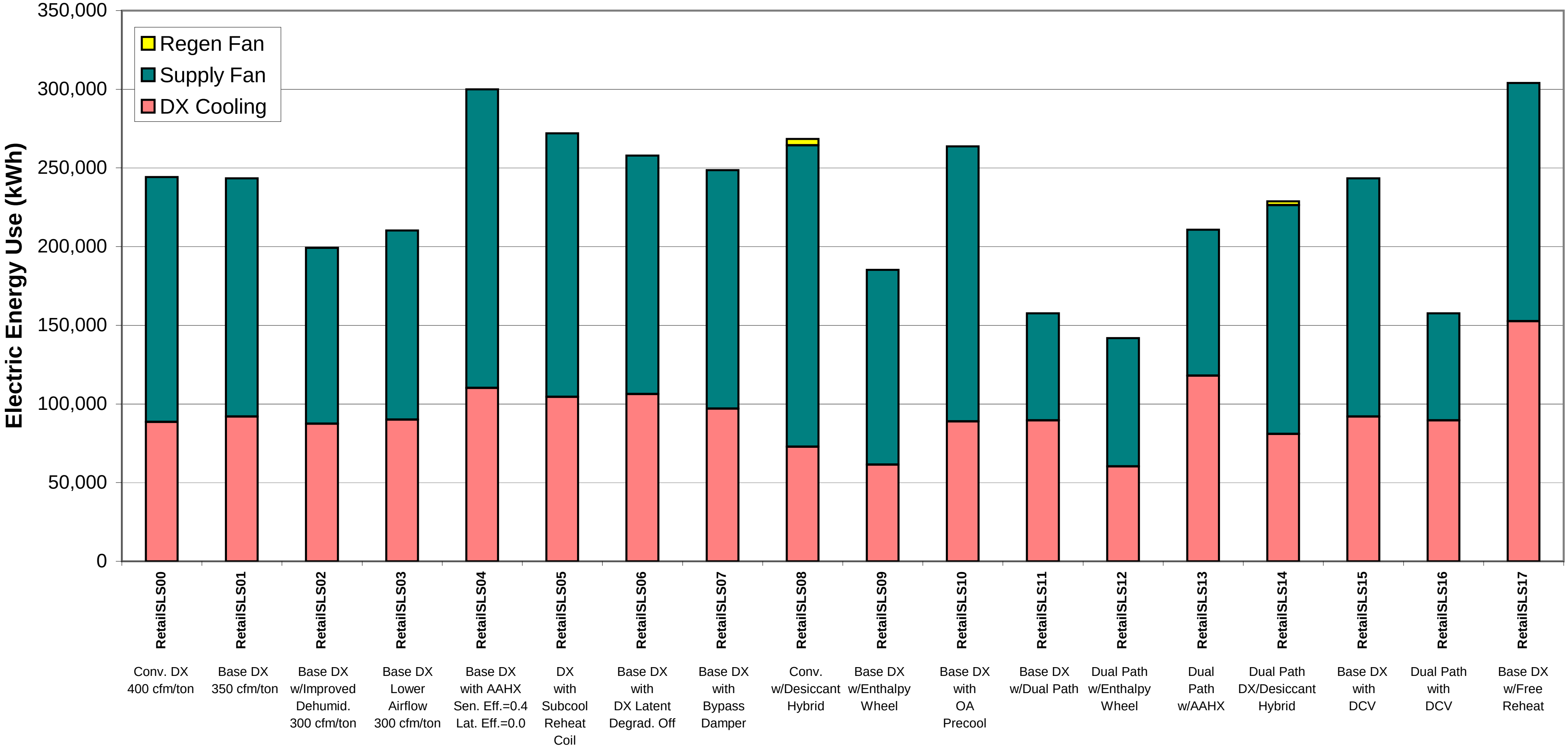
2001 Standard Retail in Shreveport LA
Annual HVAC System Electric Energy Use



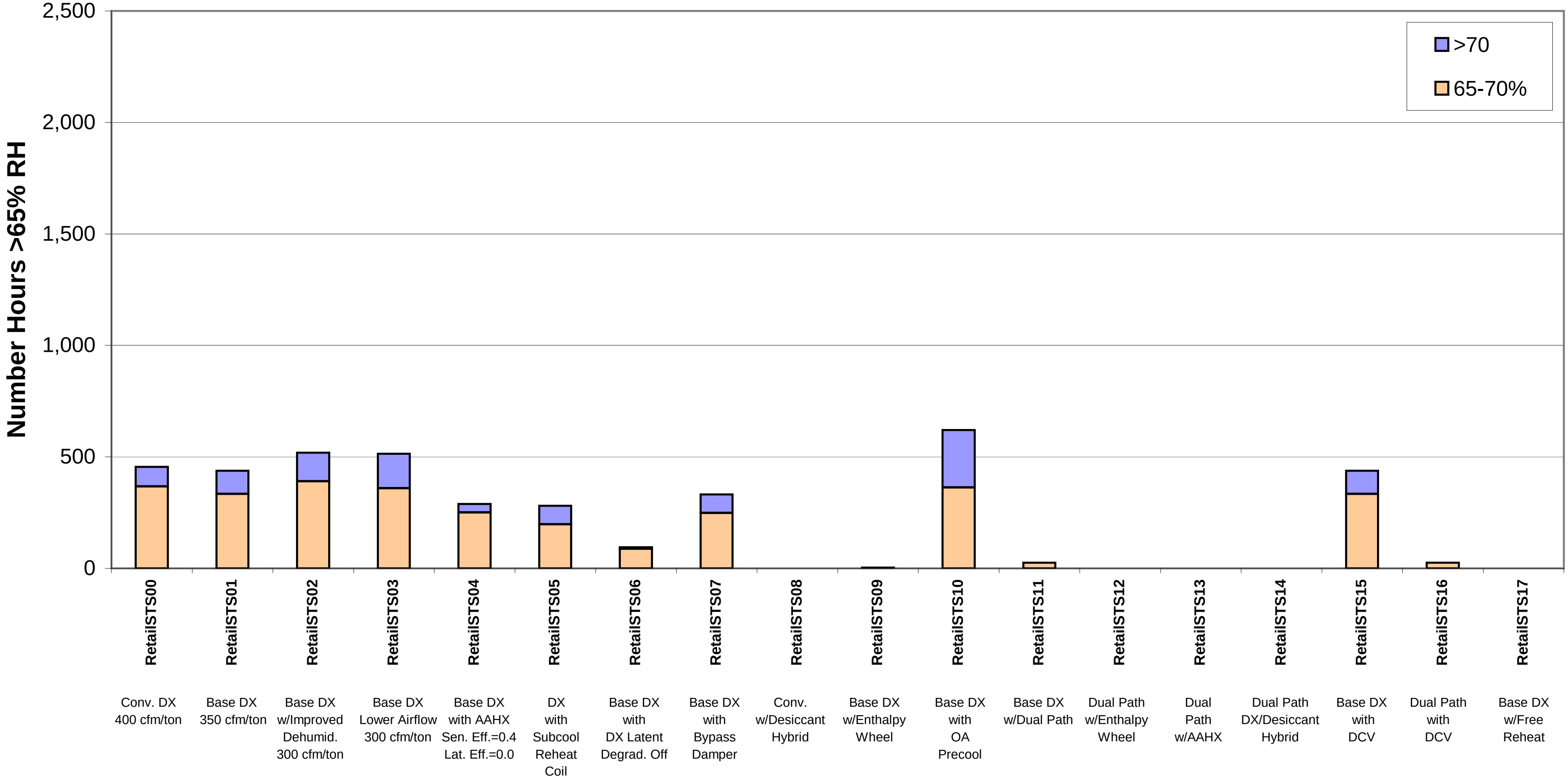
2001 Standard Retail in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



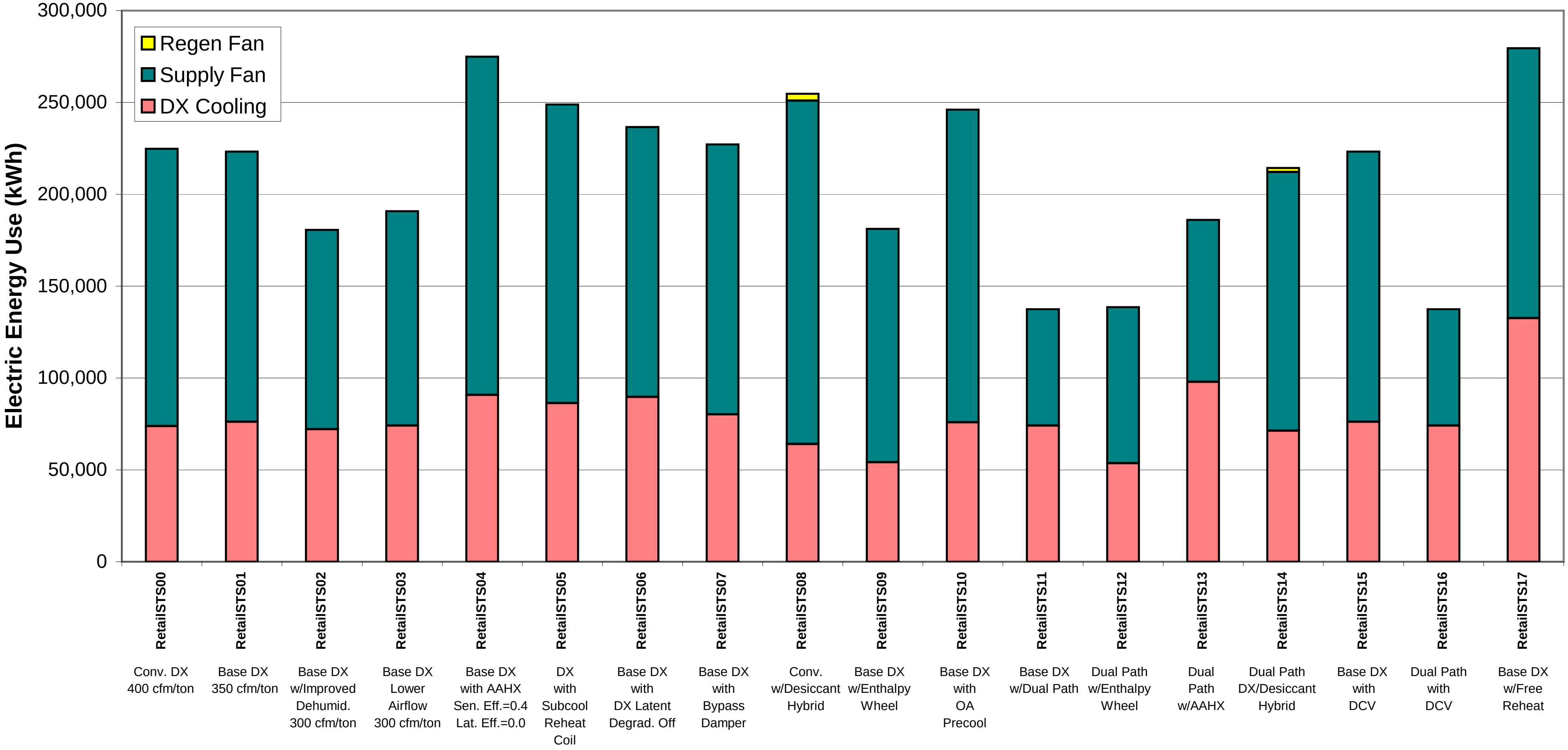
2001 Standard Retail in St. Louis MO
Annual HVAC System Electric Energy Use



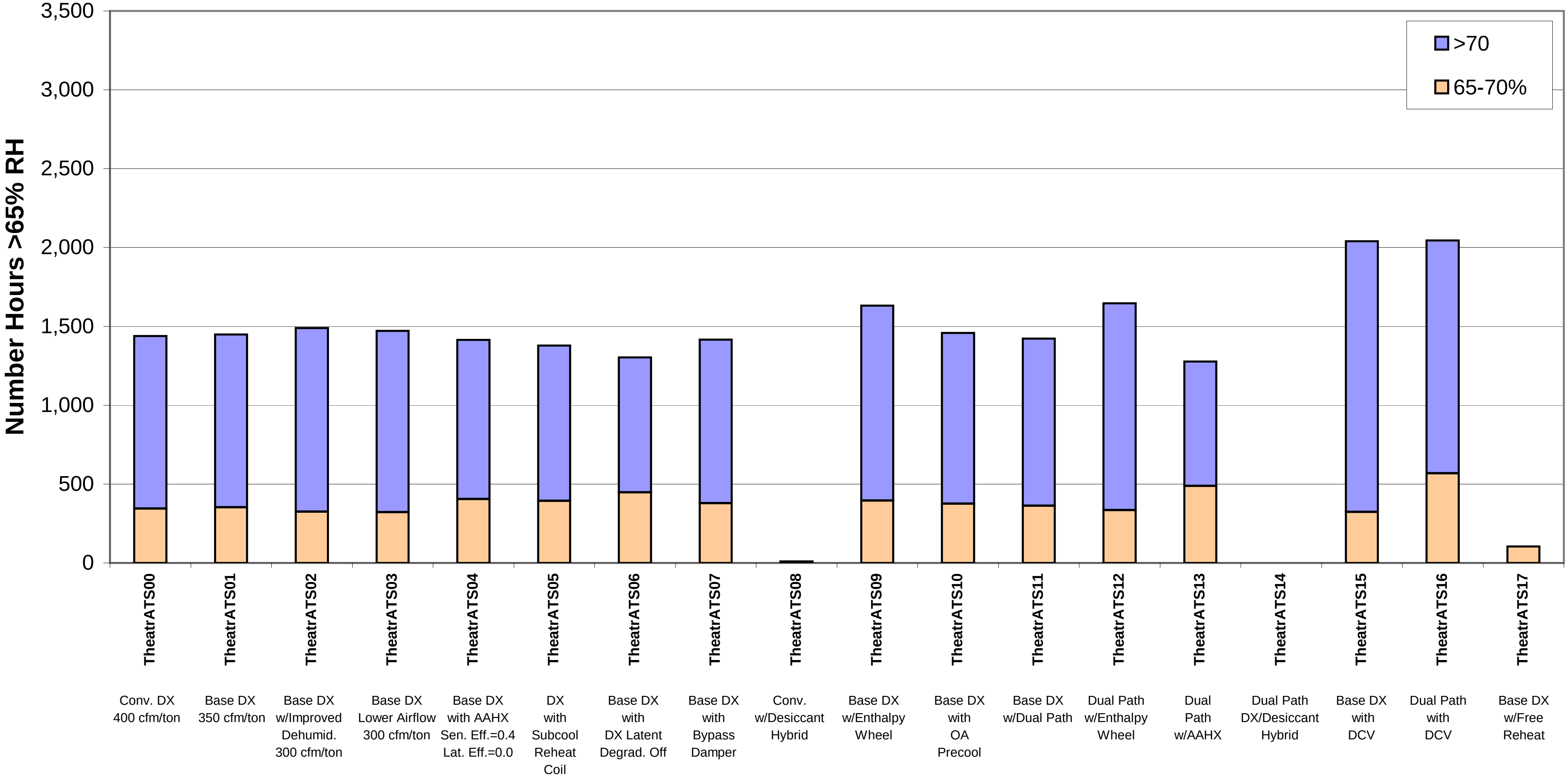
2001 Standard Retail in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



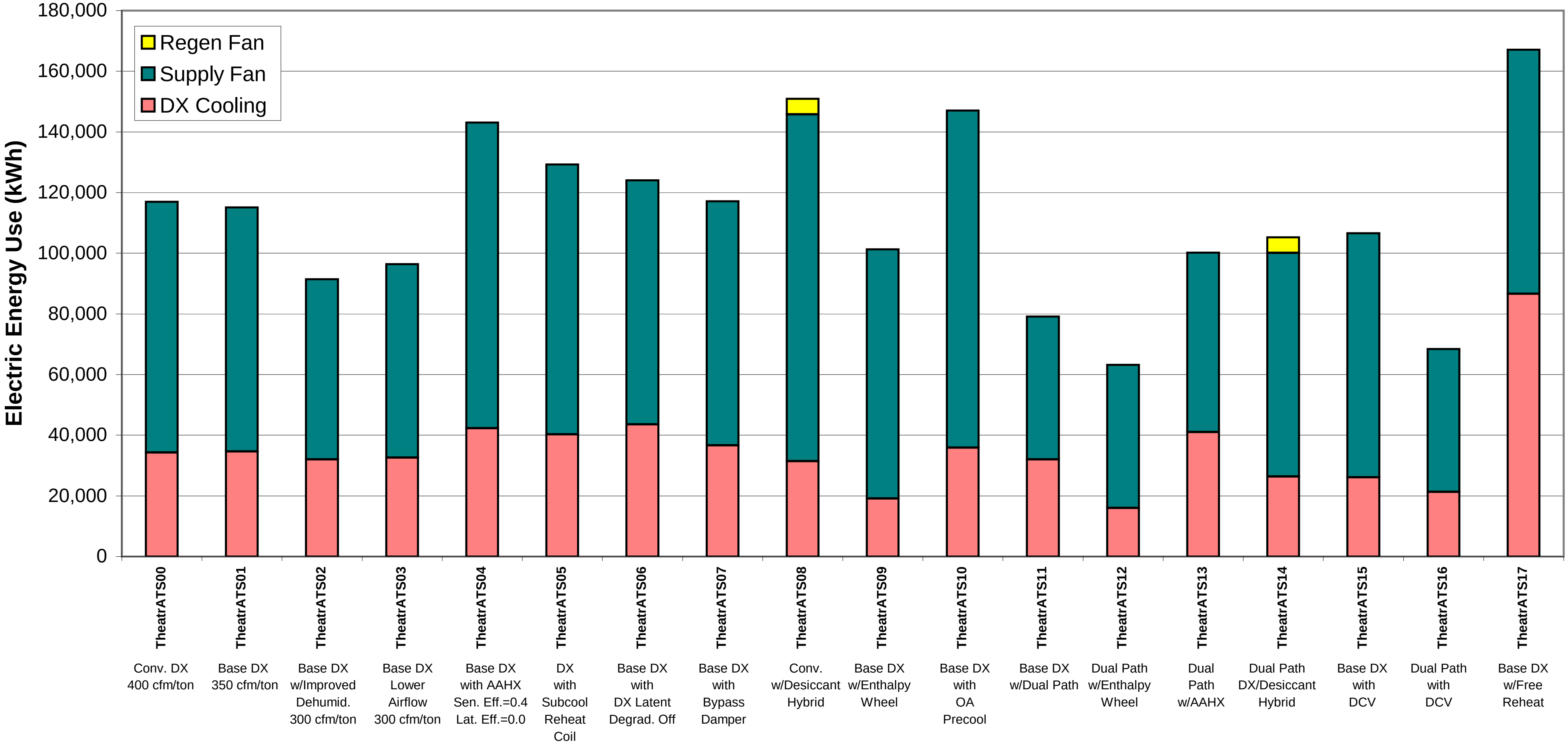
2001 Standard Retail in Washington DC
Annual HVAC System Electric Energy Use



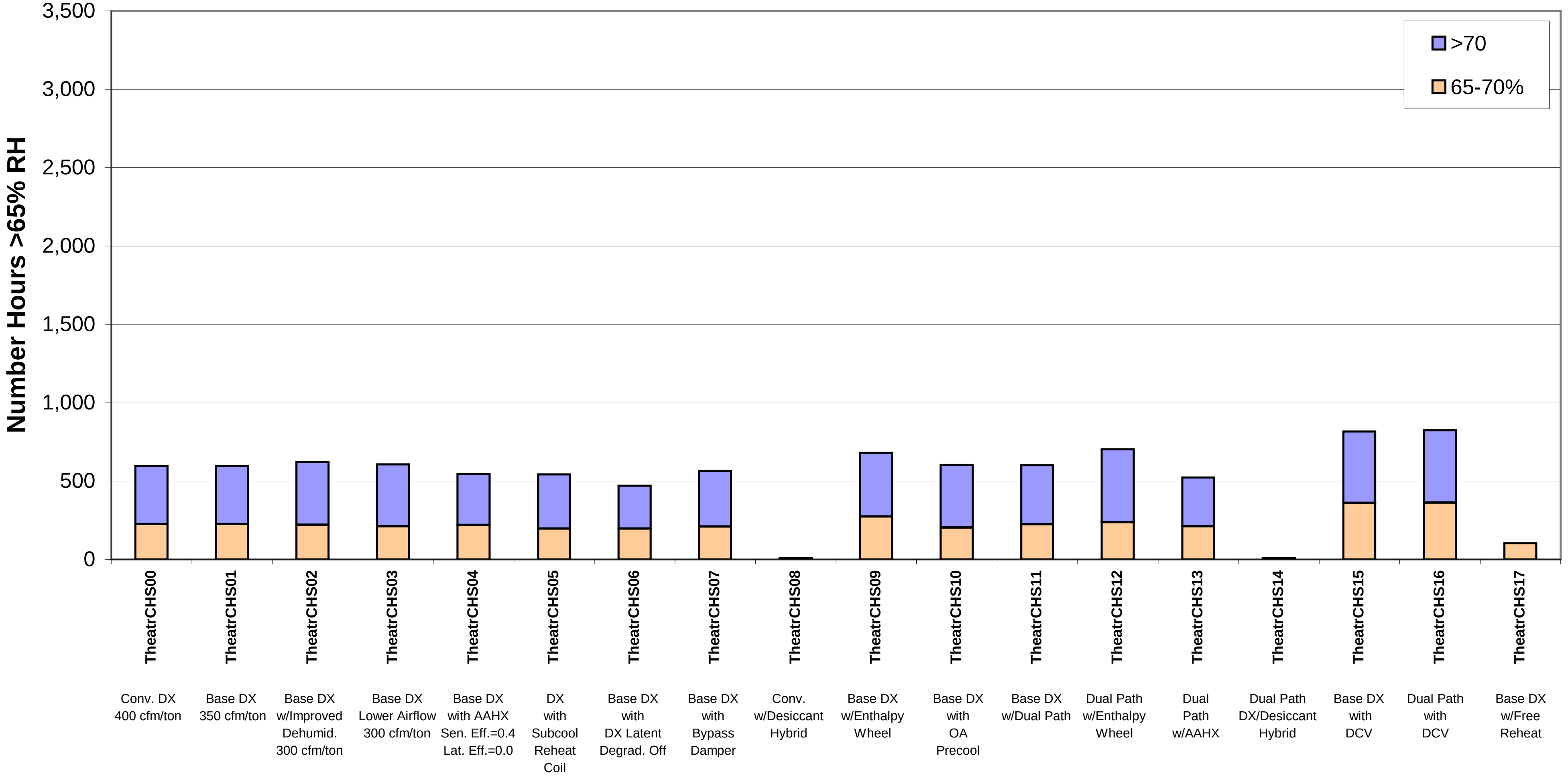
2001 Standard Theater in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



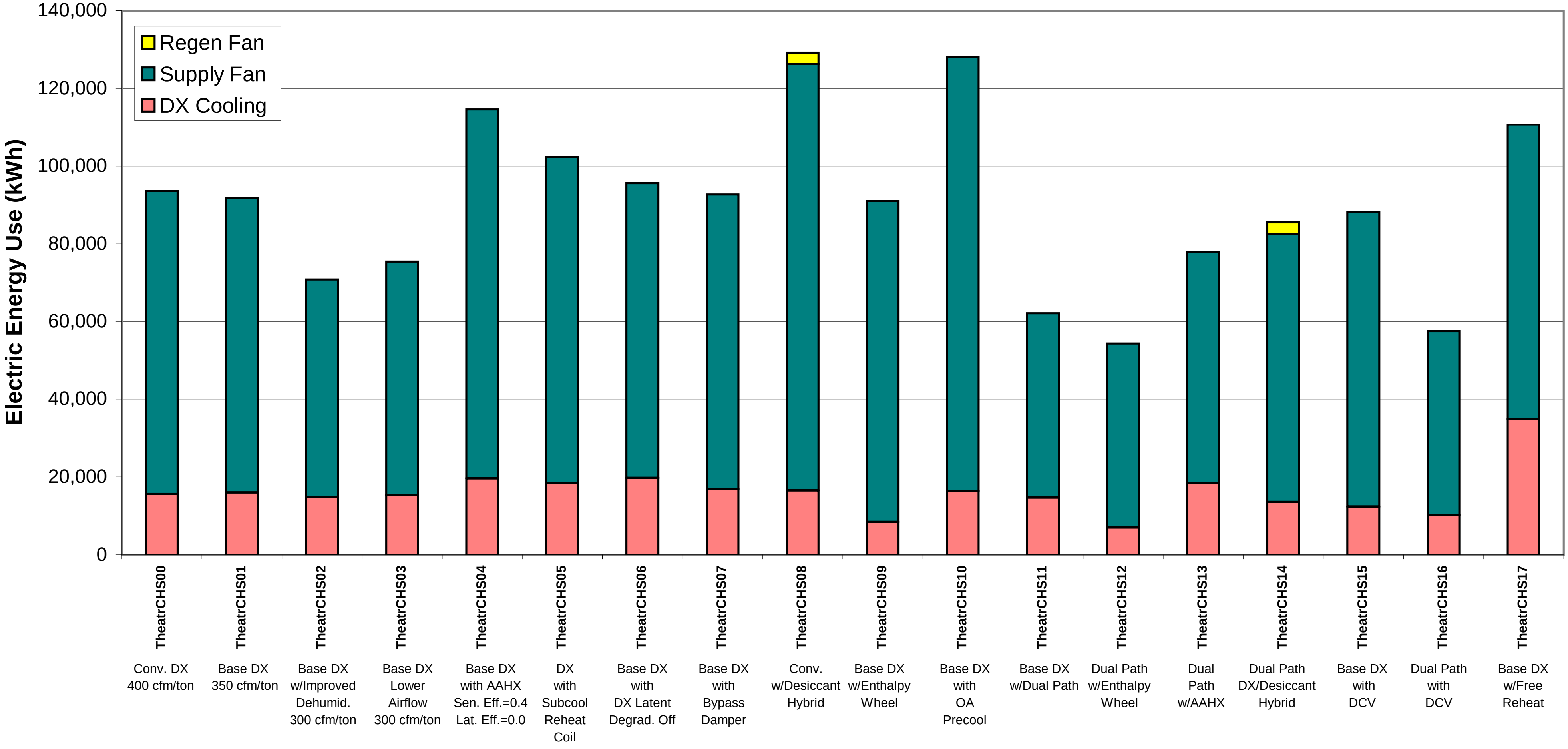
2001 Standard Theater in Atlanta GA
Annual HVAC System Electric Energy Use

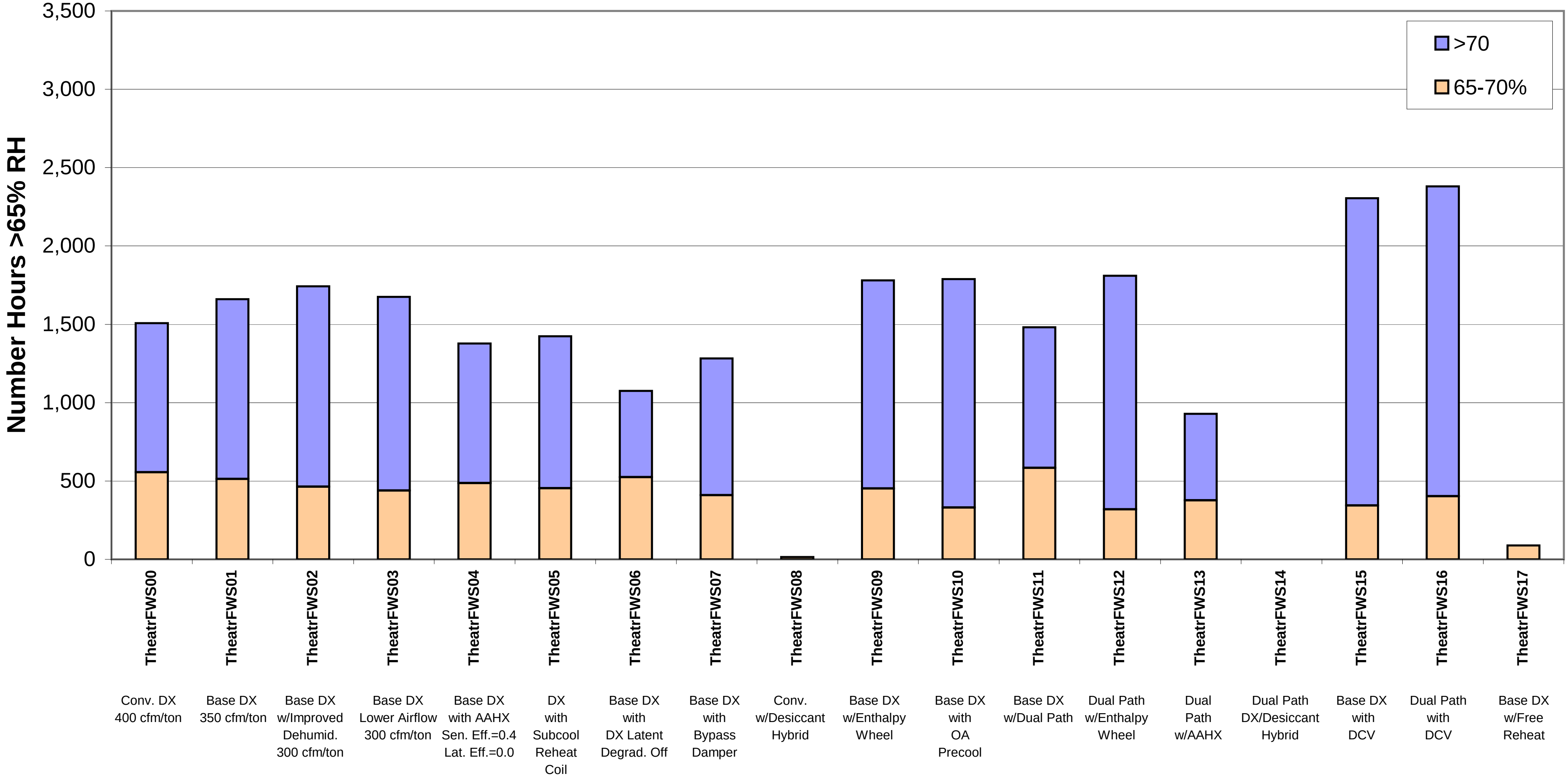


2001 Standard Theater in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



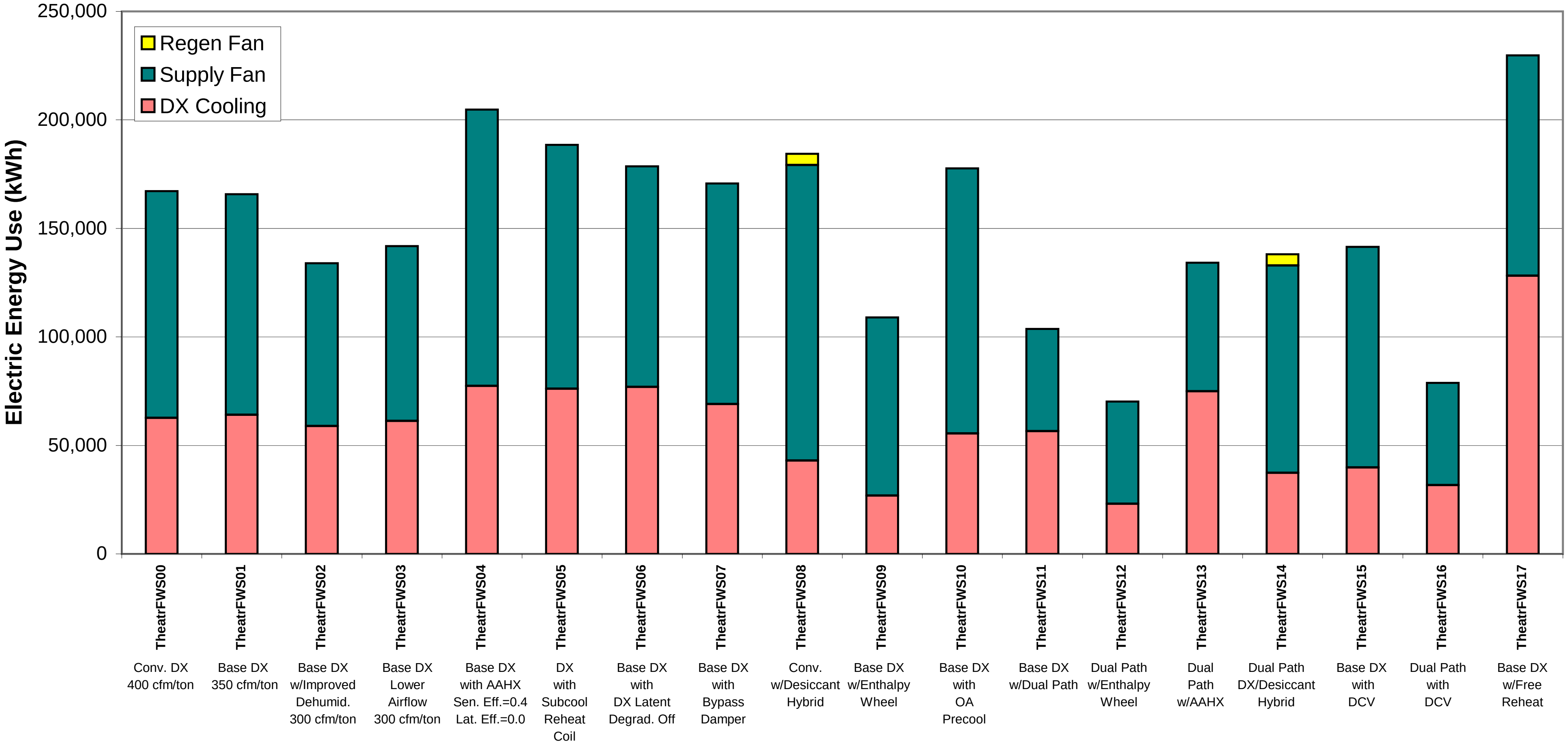
2001 Standard Theater in Chicago IL
Annual HVAC System Electric Energy Use

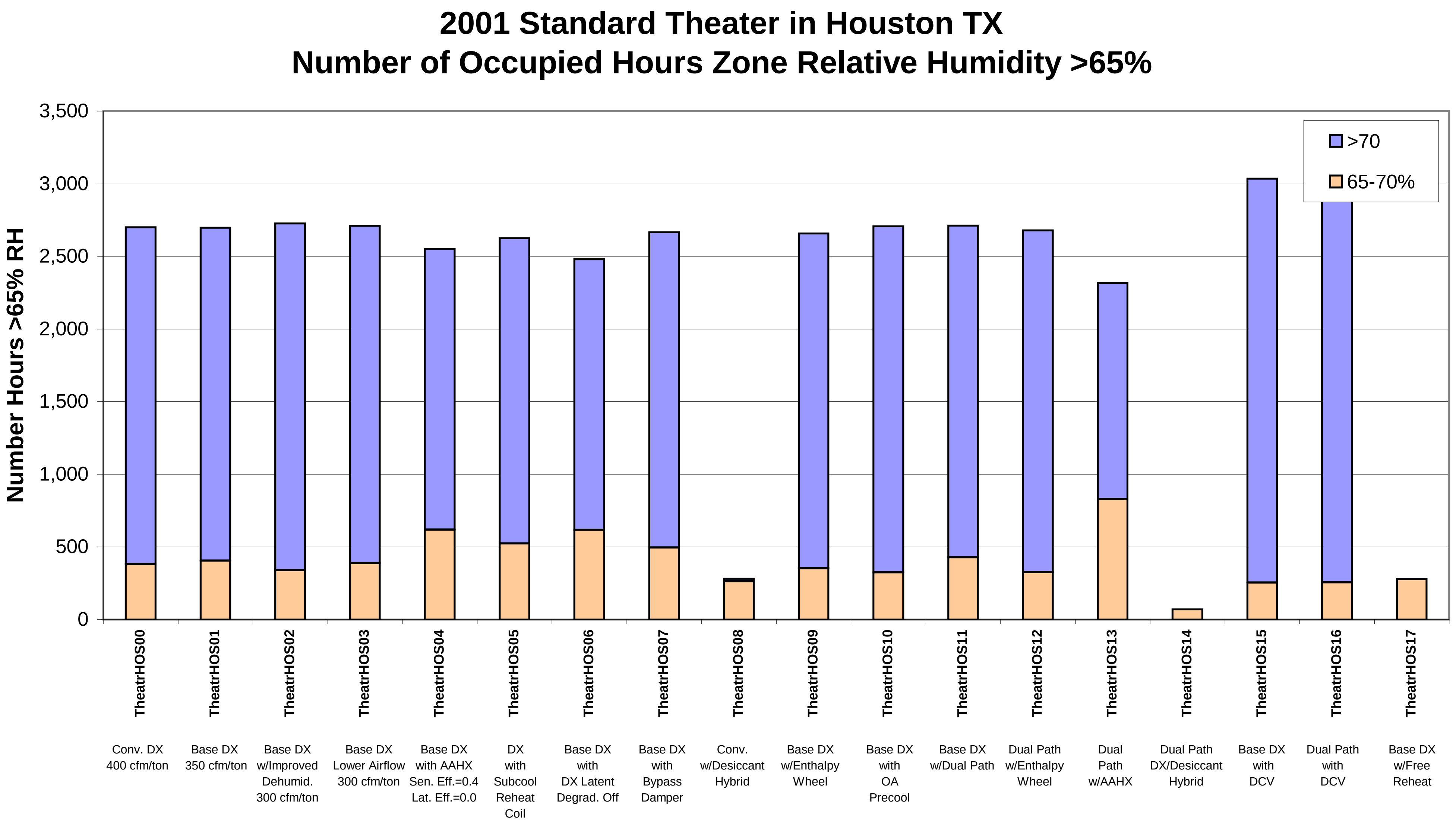




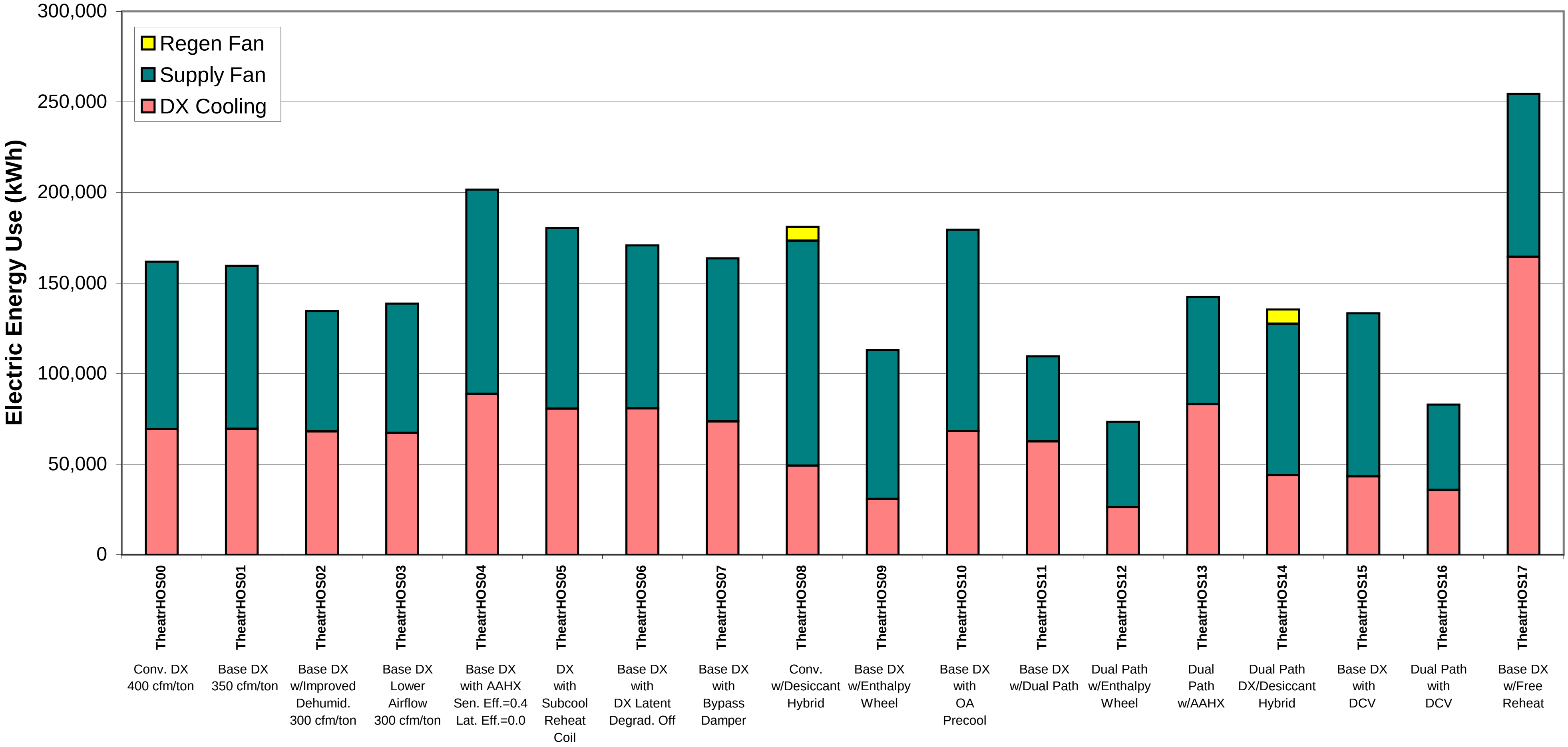
2001 Standard Theater in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%

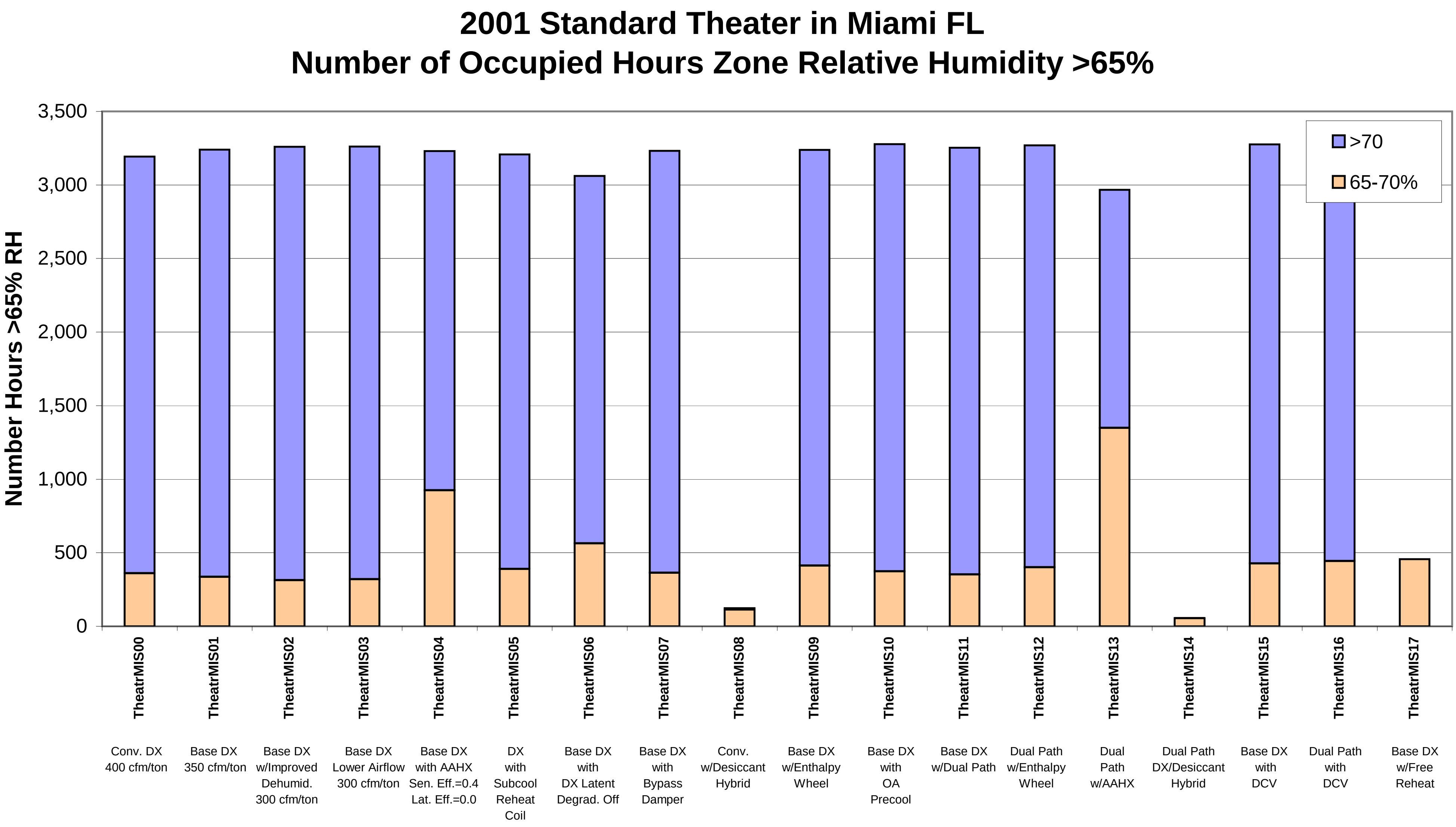
2001 Standard Theater in Fort Worth TX
Annual HVAC System Electric Energy Use




2001 Standard Theater in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,500
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
TheatrHOS00
TheatrHOS01
TheatrHOS02
TheatrHOS03
TheatrHOS04
TheatrHOS05
TheatrHOS06
TheatrHOS07
TheatrHOS08
TheatrHOS09
TheatrHOS10
TheatrHOS11
TheatrHOS12
TheatrHOS13
TheatrHOS14
TheatrHOS15
TheatrHOS16
TheatrHOS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

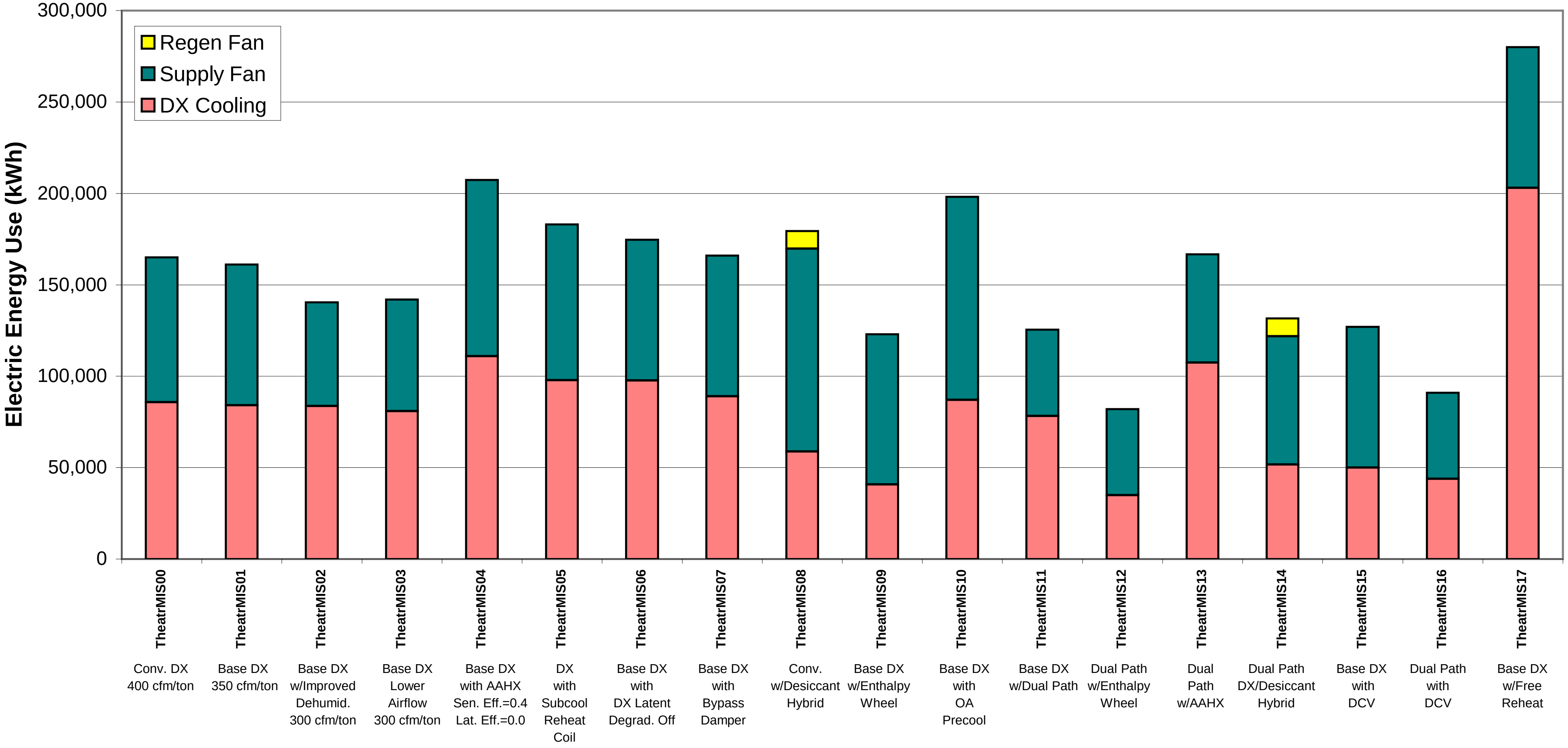
2001 Standard Theater in Houston TX
Annual HVAC System Electric Energy Use



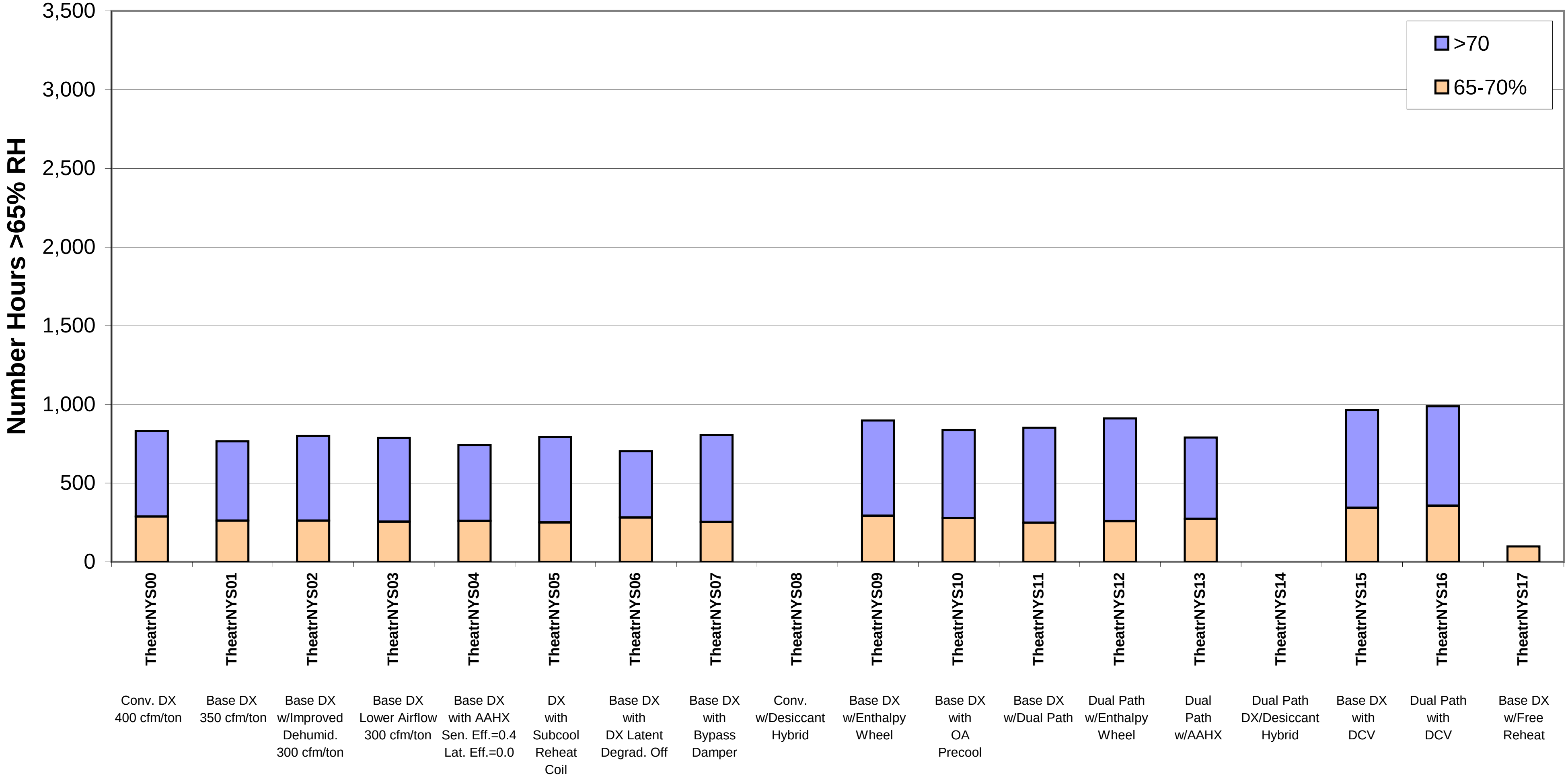


2001 Standard Theater in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%

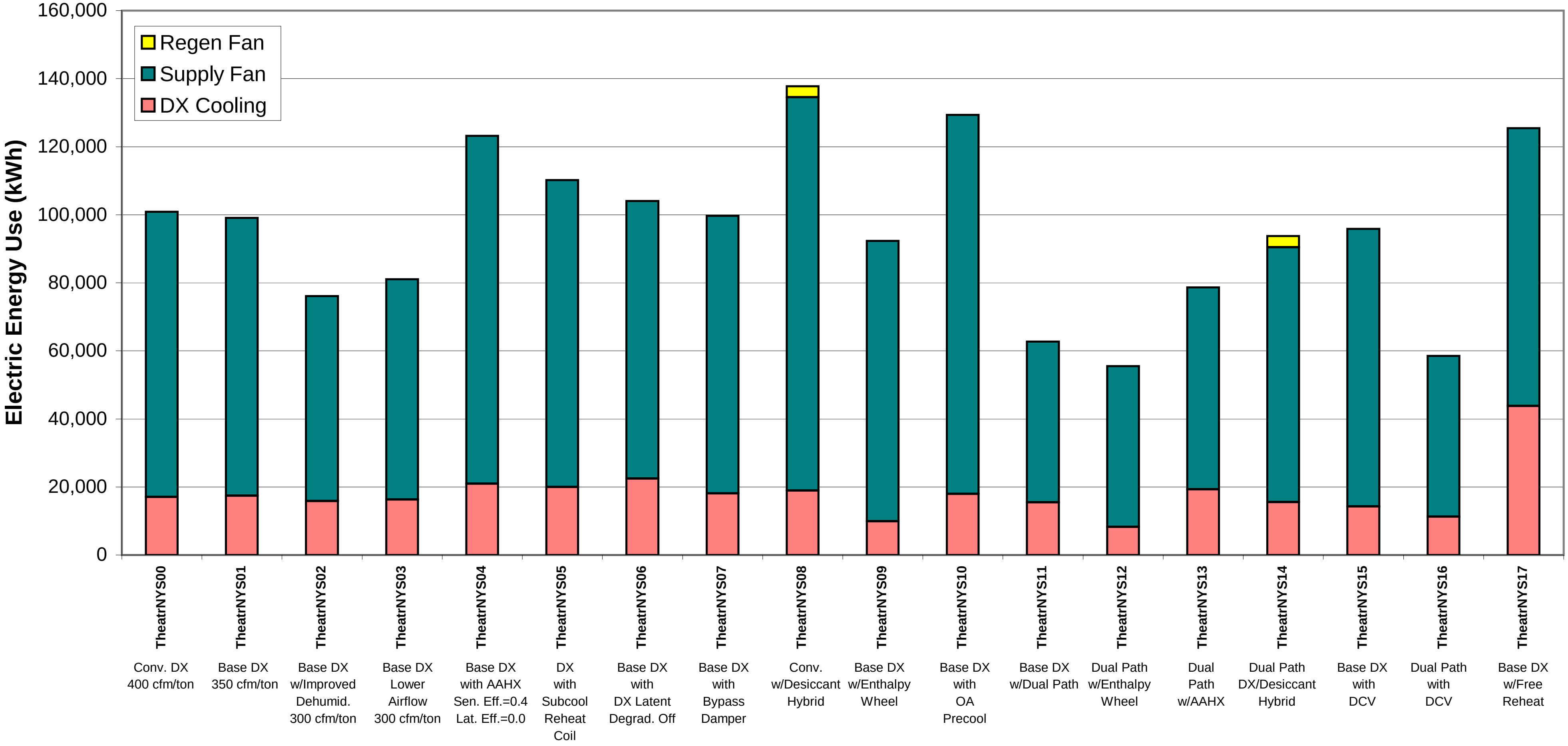
2001 Standard Theater in Miami FL
Annual HVAC System Electric Energy Use



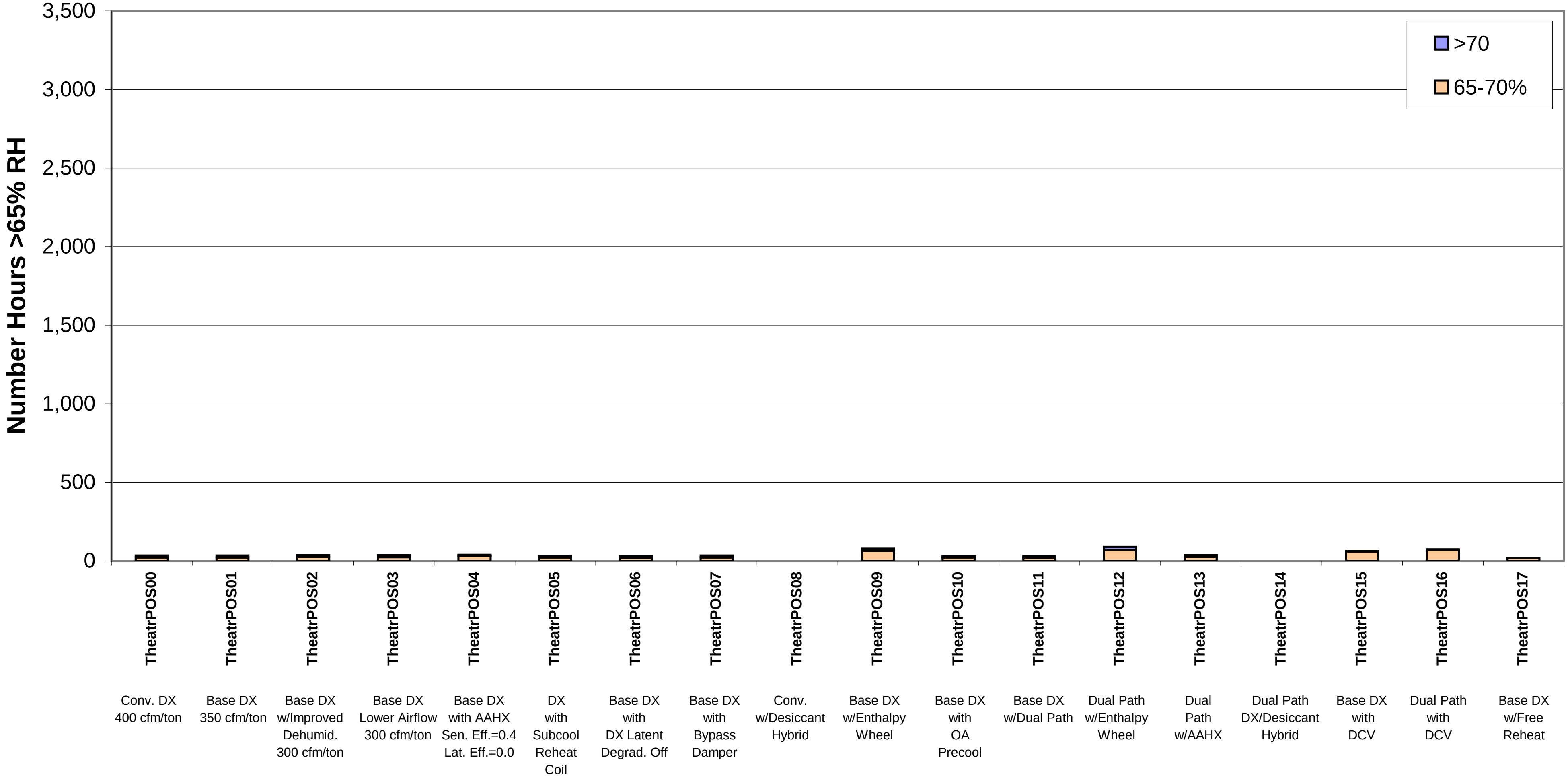
2001 Standard Theater in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



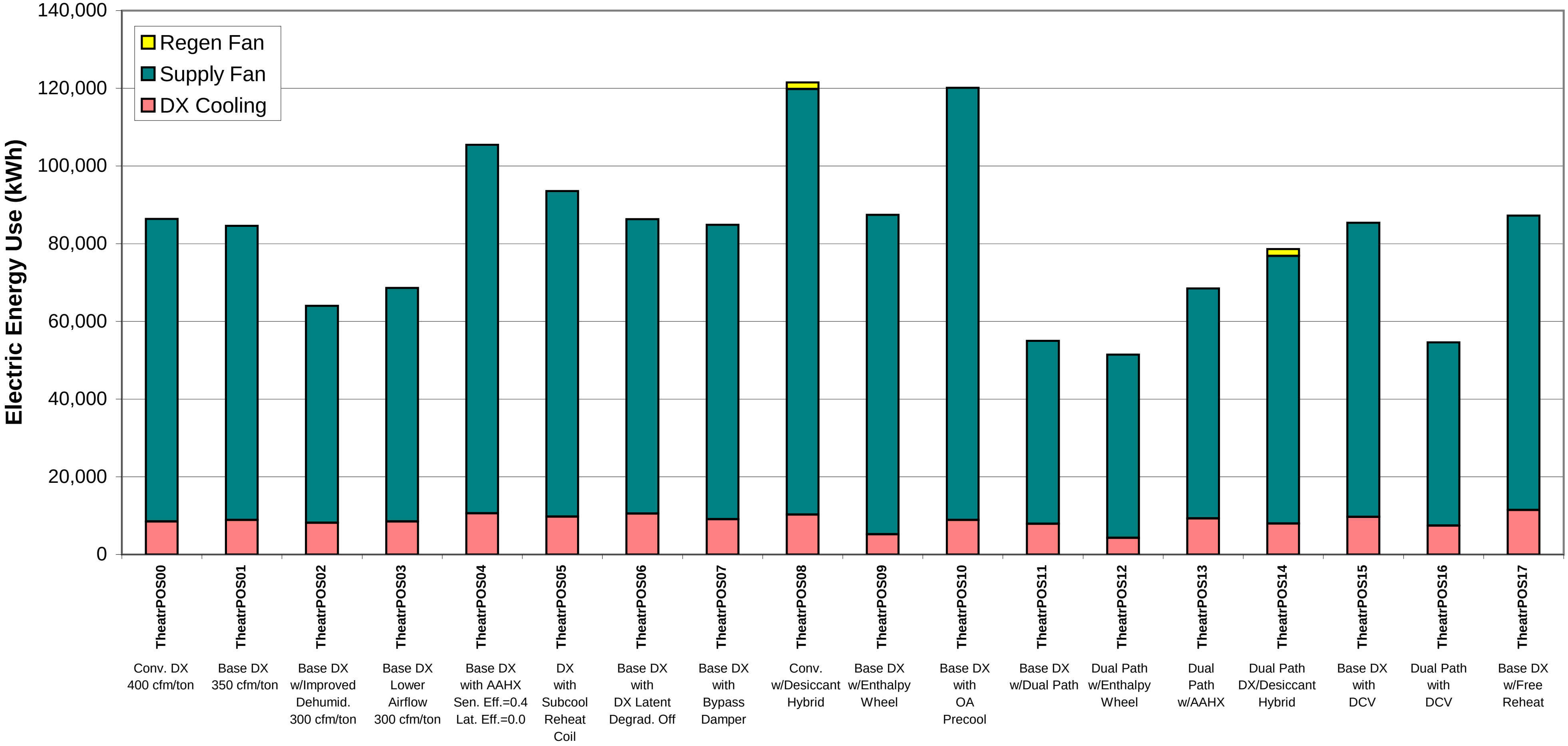
2001 Standard Theater in New York NY
Annual HVAC System Electric Energy Use



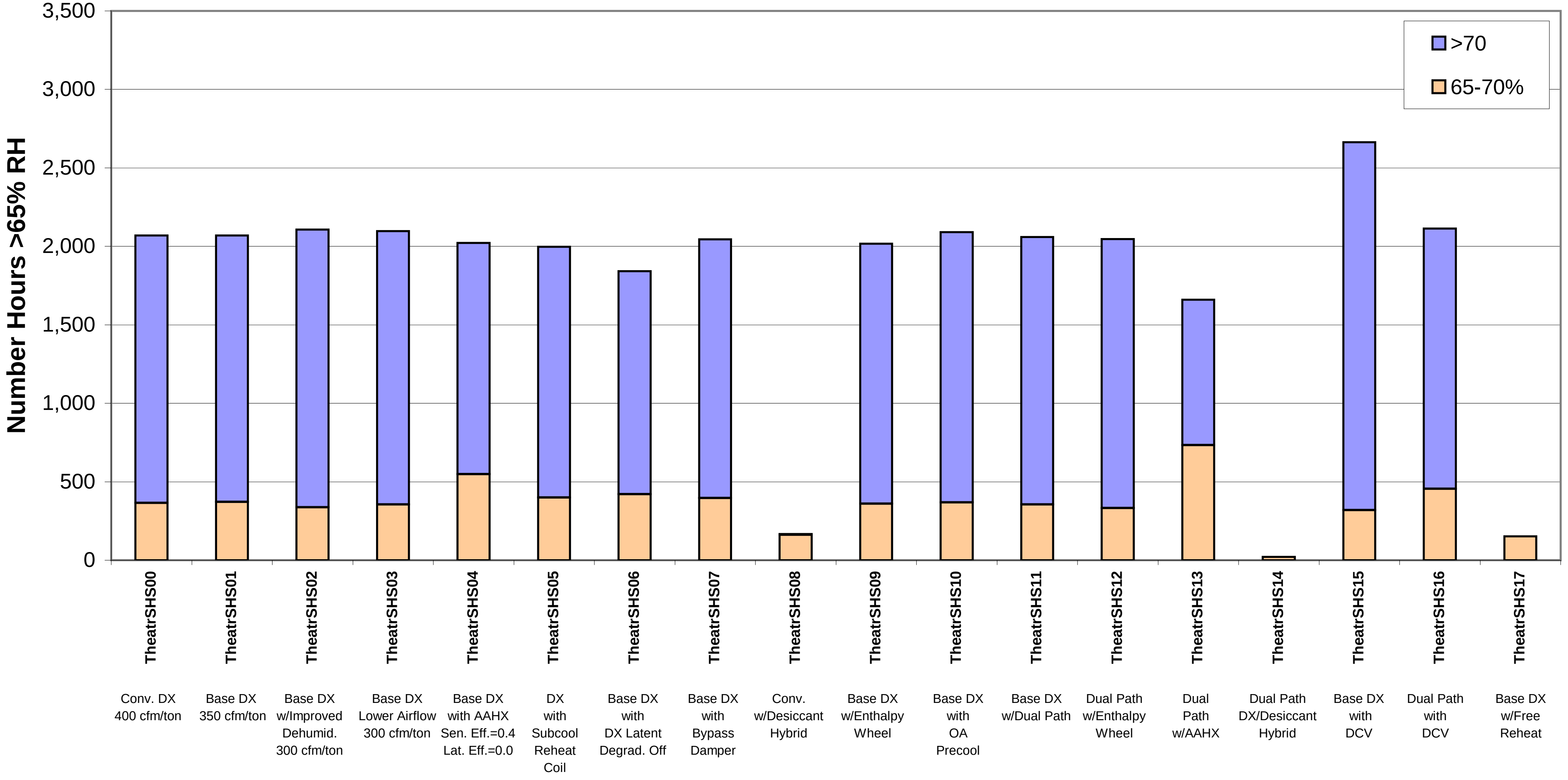
2001 Standard Theater in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



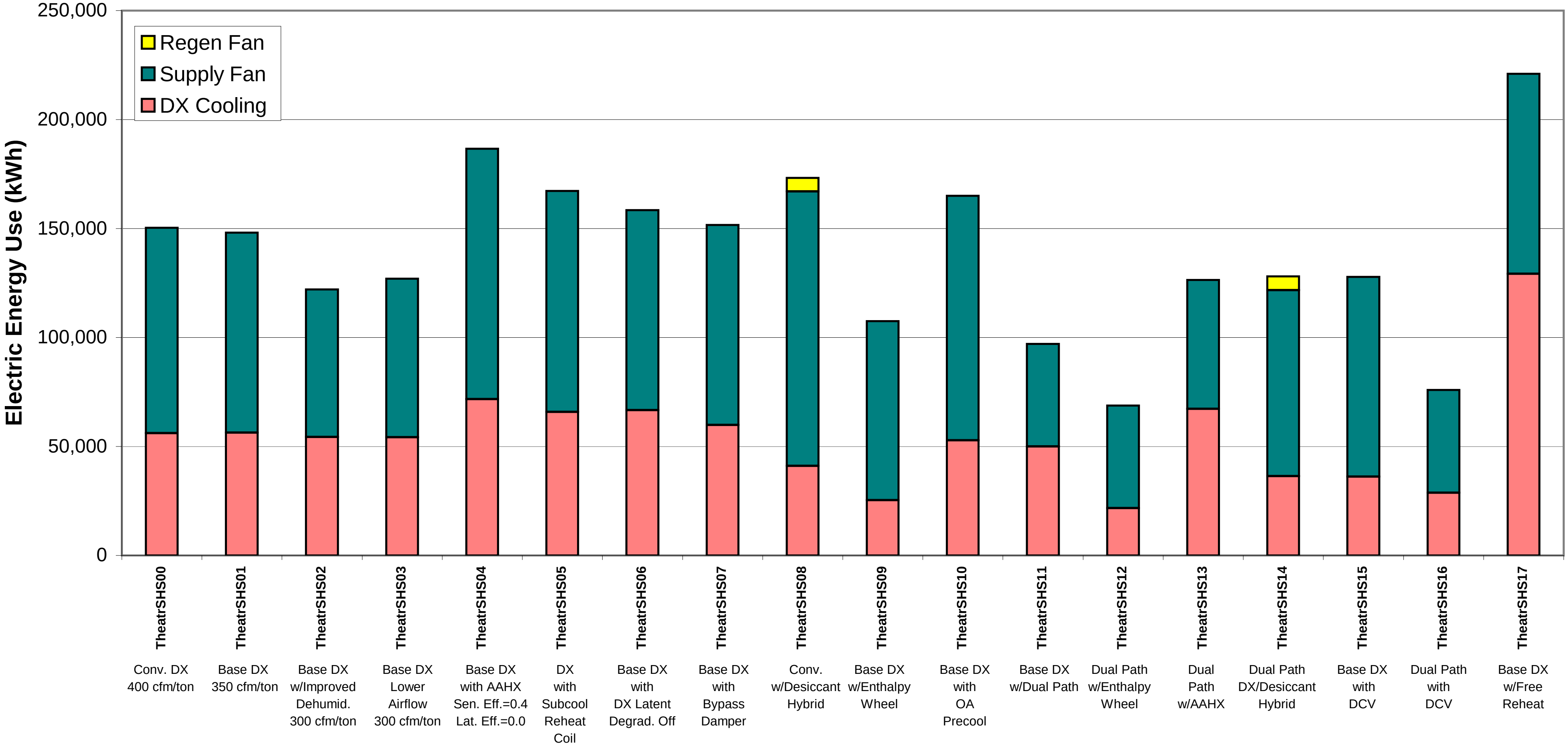
2001 Standard Theater in Portland OR
Annual HVAC System Electric Energy Use



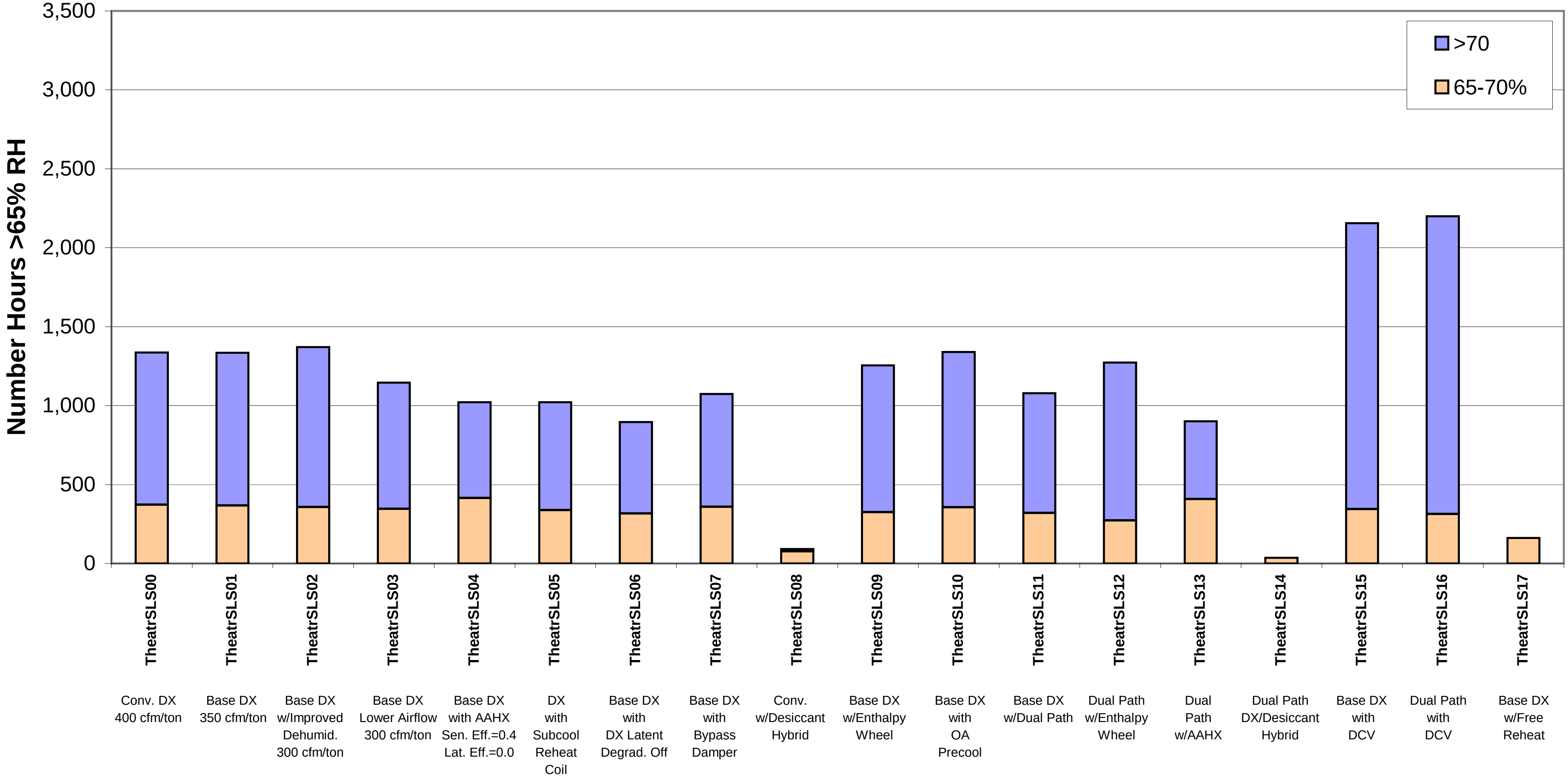
2001 Standard Theater in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



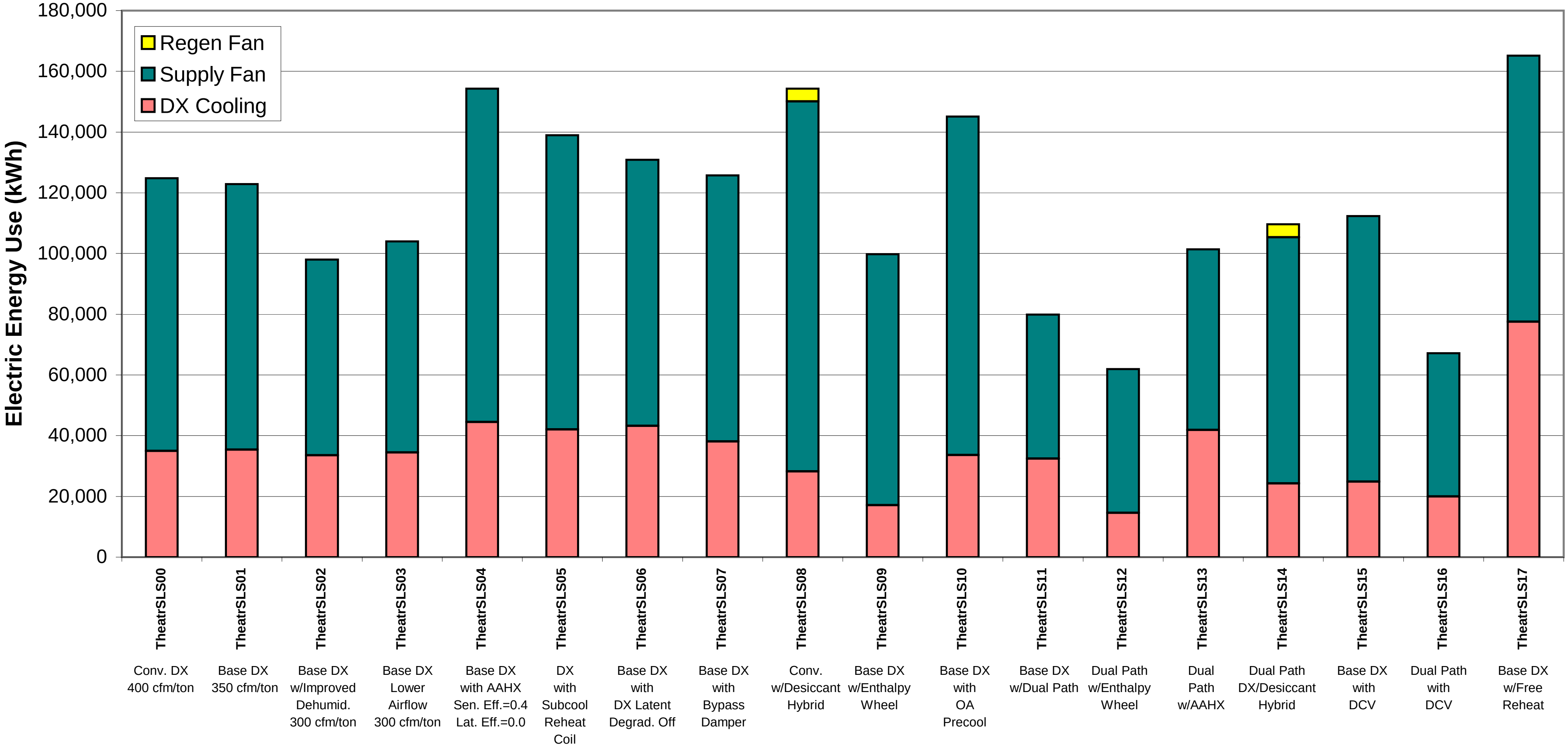
2001 Standard Theater in Shreveport LA
Annual HVAC System Electric Energy Use



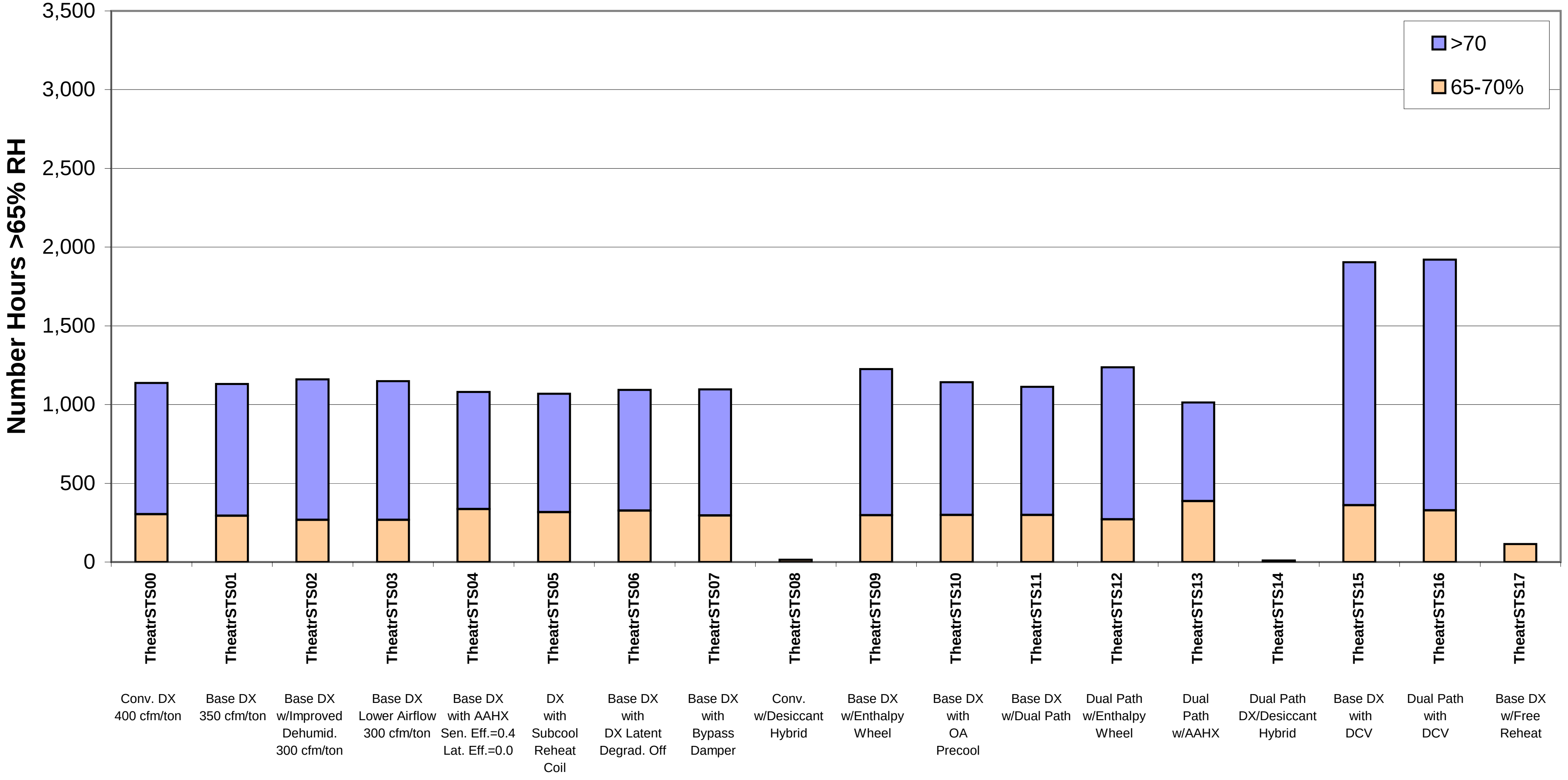
2001 Standard Theater in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



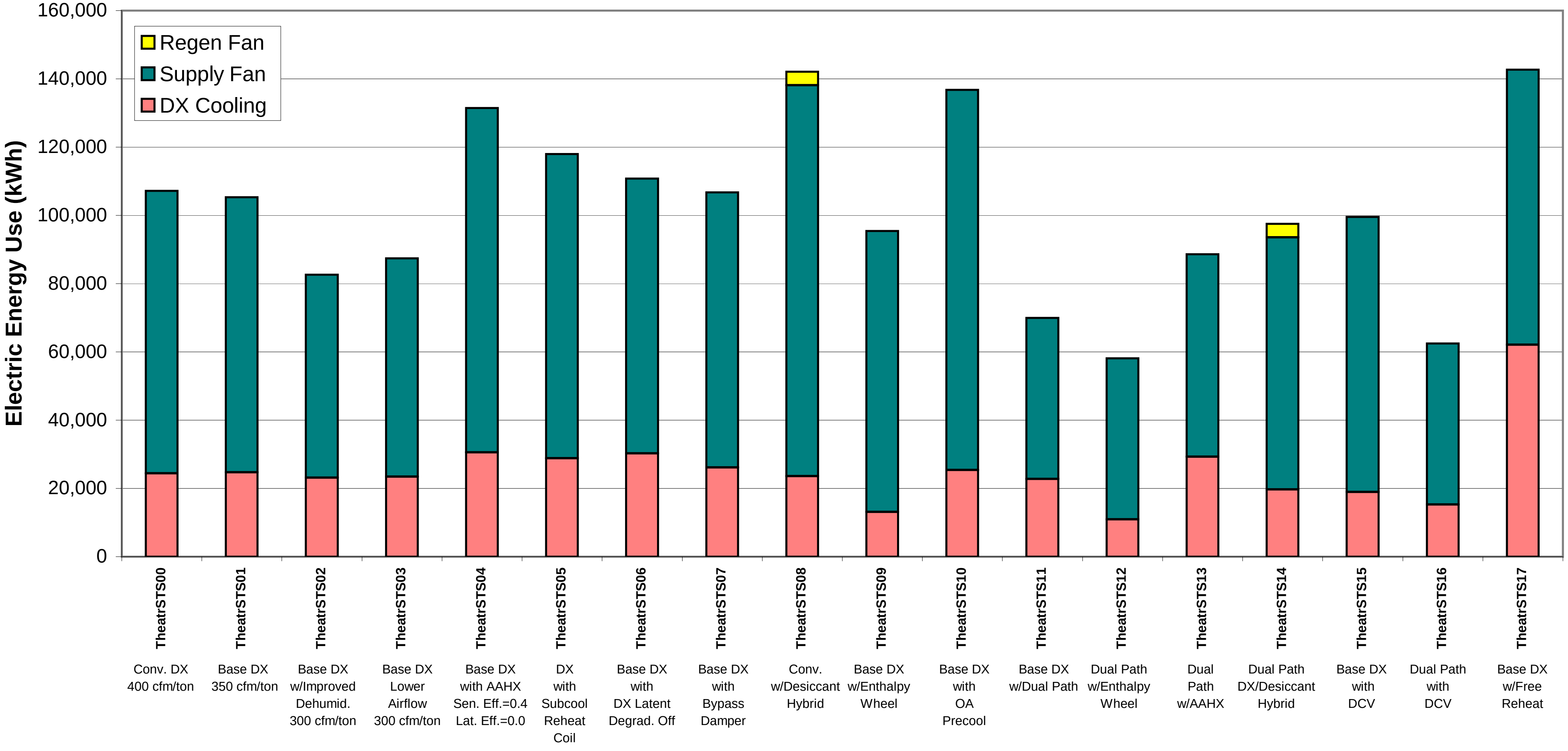
2001 Standard Theater in St. Louis MO
Annual HVAC System Electric Energy Use

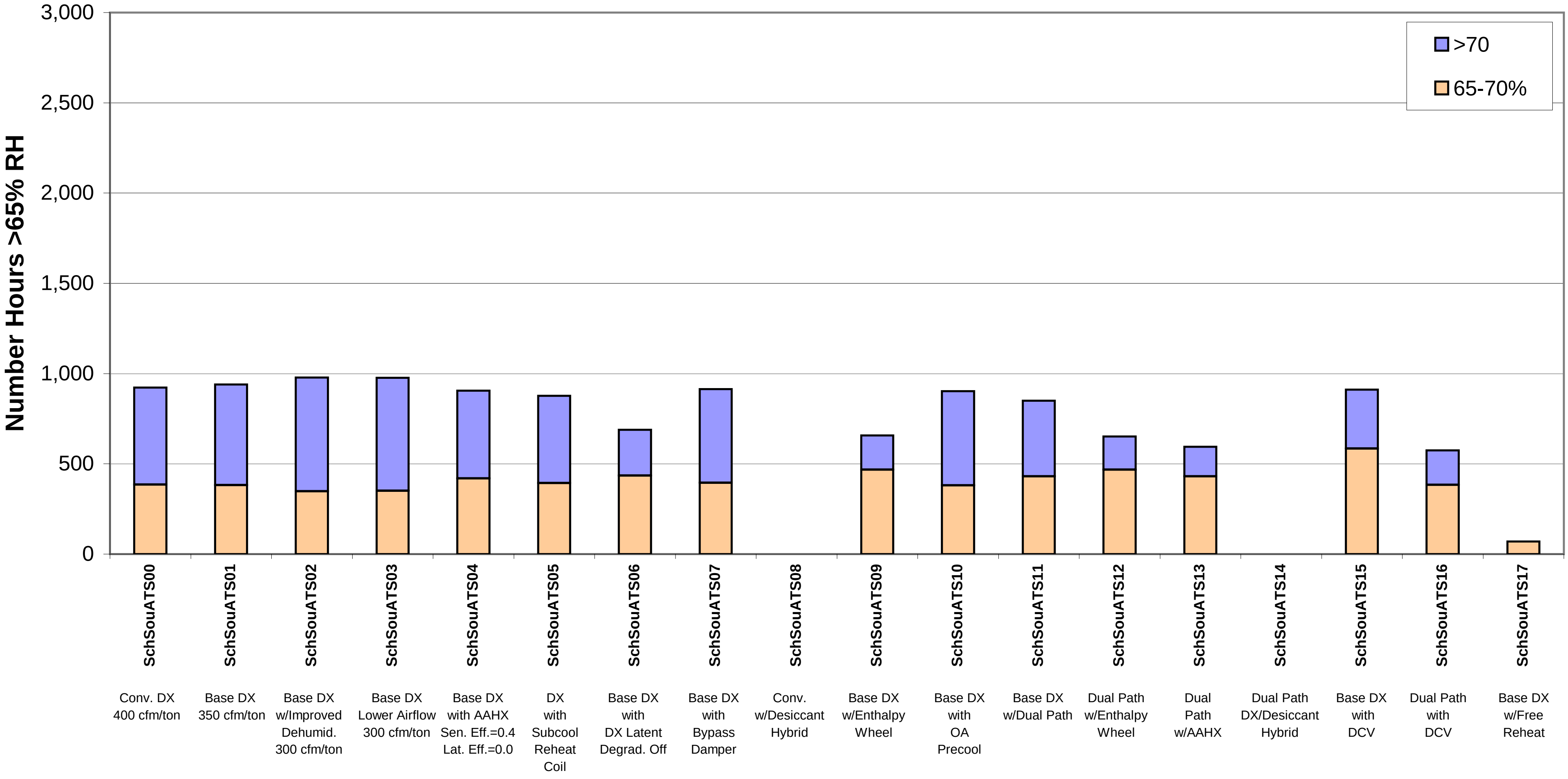


2001 Standard Theater in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



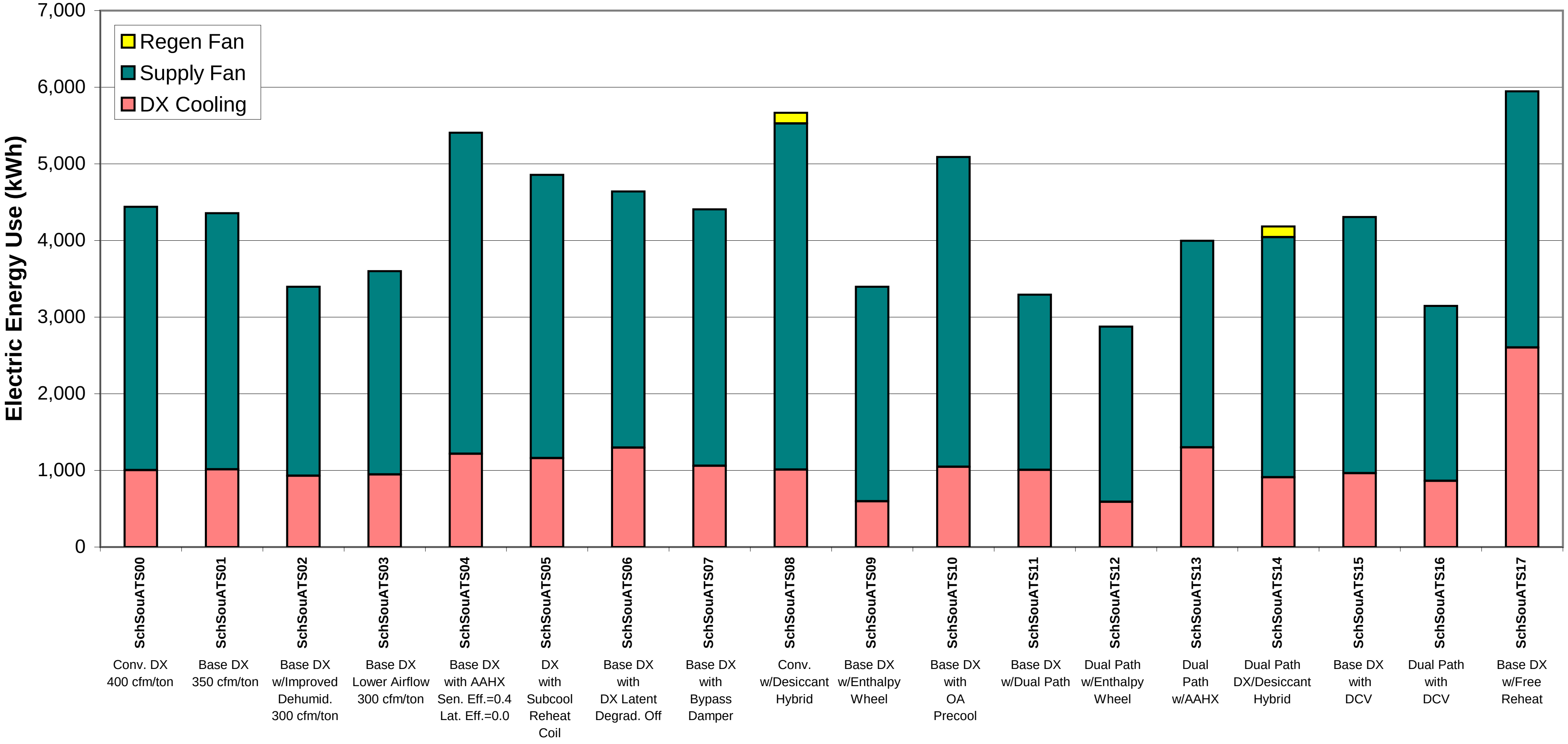
2001 Standard Theater in Washington DC
Annual HVAC System Electric Energy Use



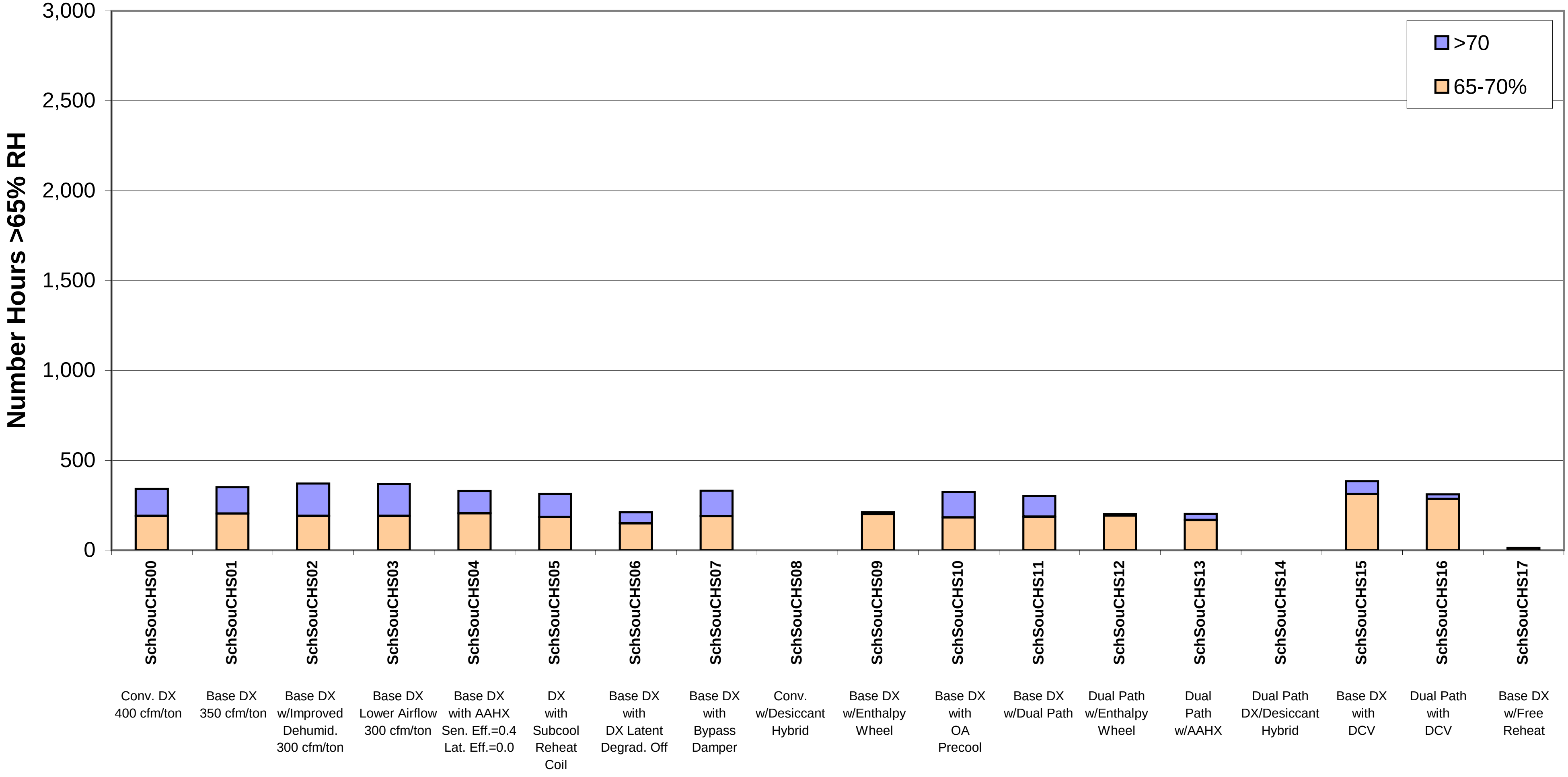


2001 Standard School-9 Month-South in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%

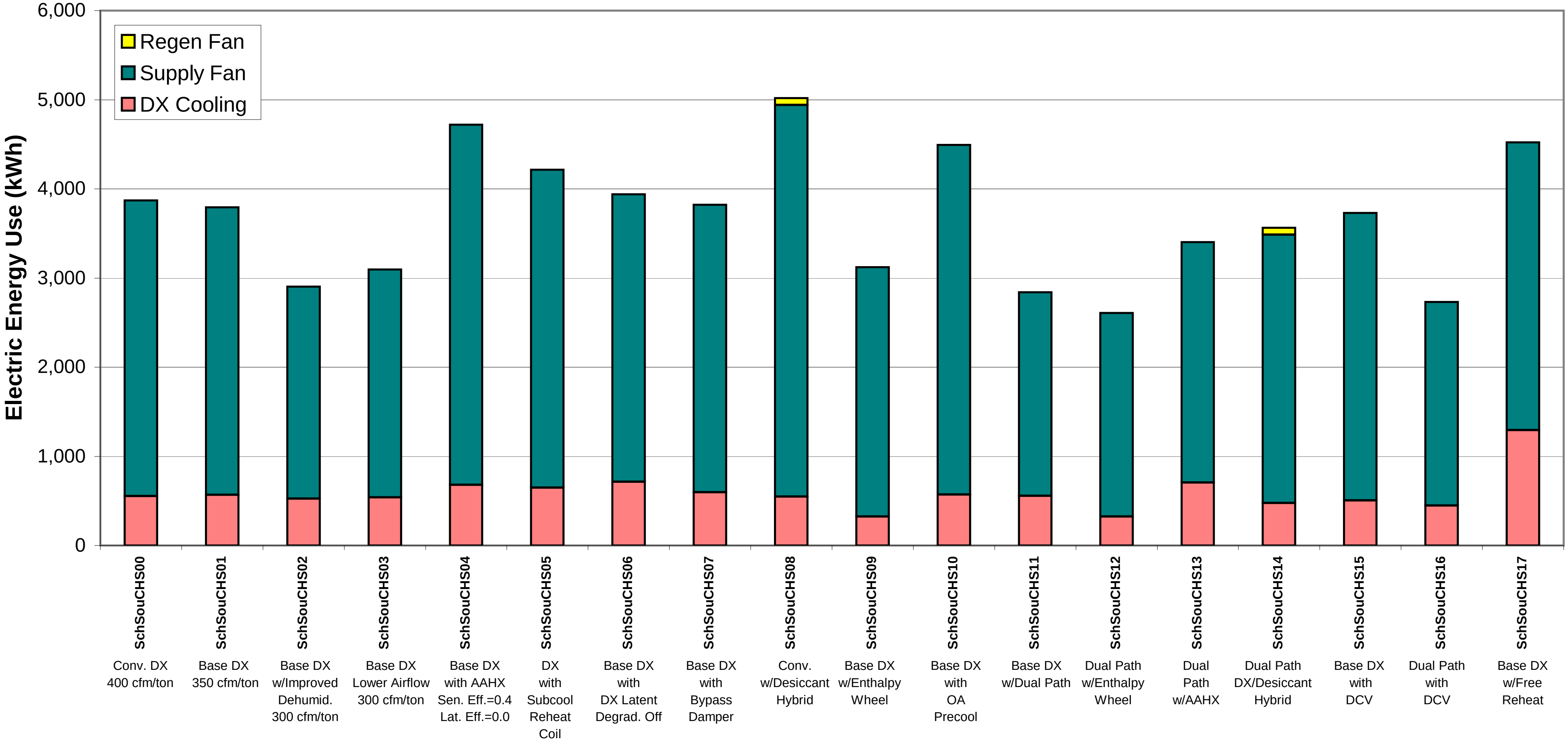
2001 Standard School-9 Month-South in Atlanta GA
Annual HVAC System Electric Energy Use



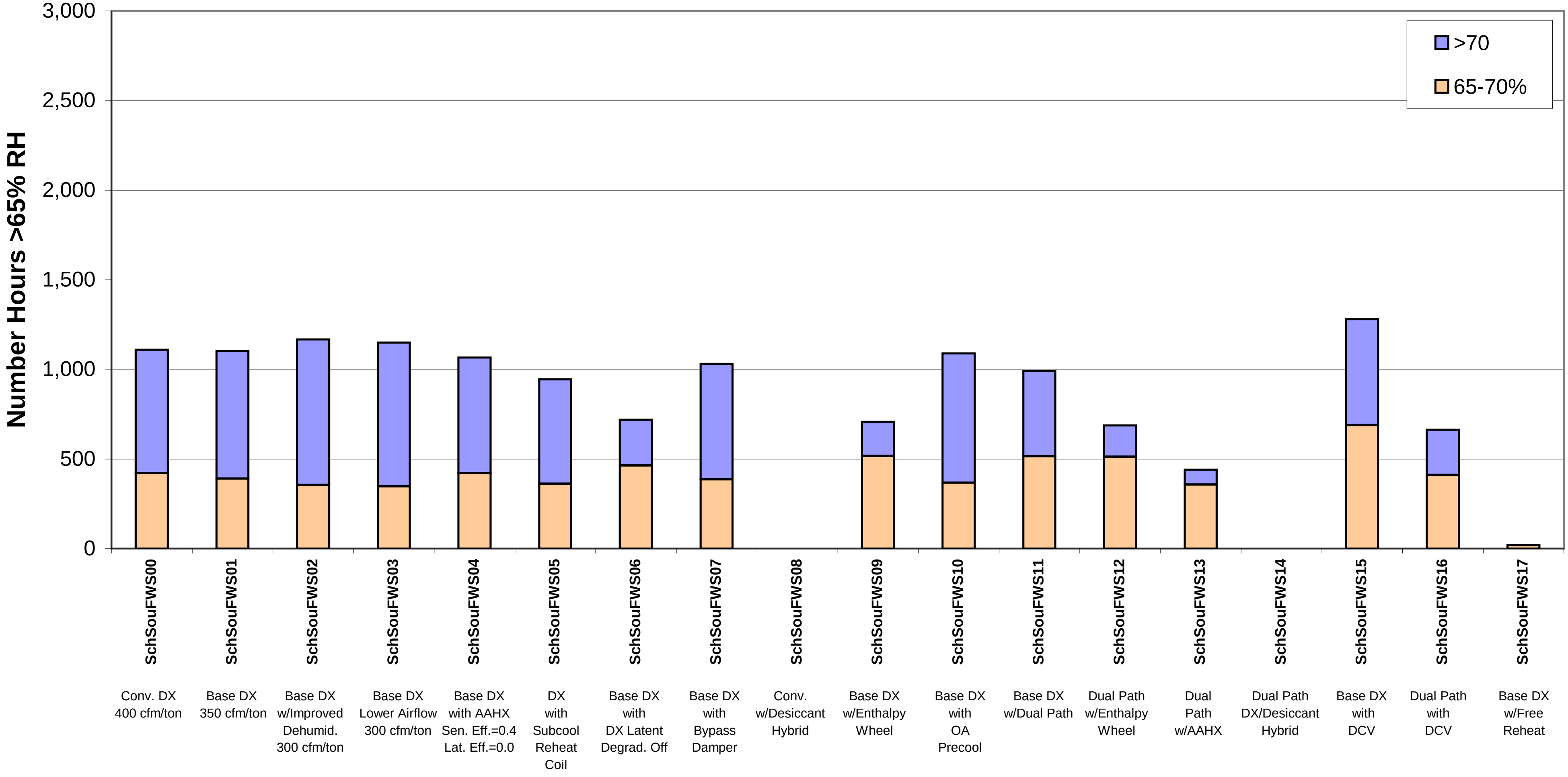
2001 Standard School-9 Month-South in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



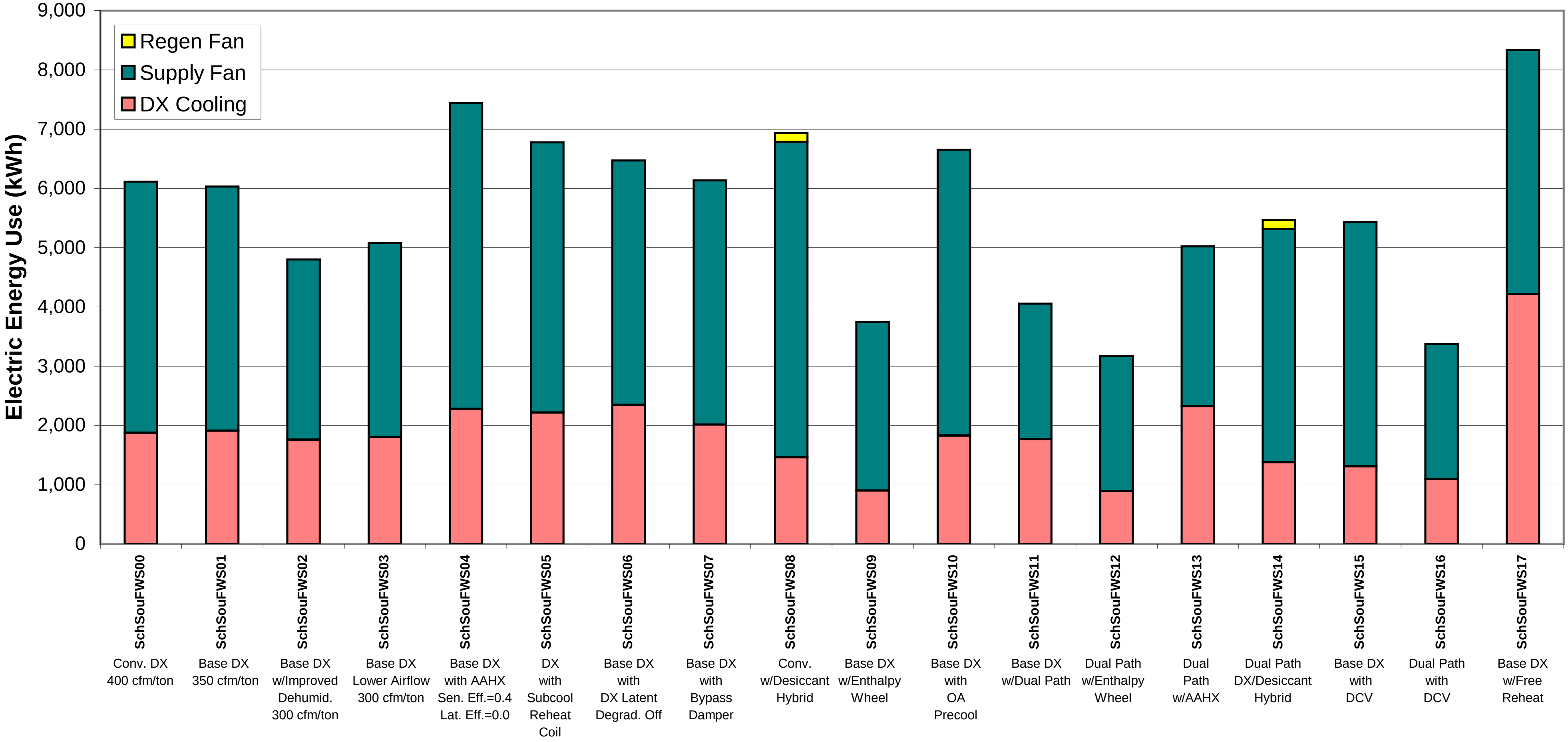
2001 Standard School-9 Month-South in Chicago IL
Annual HVAC System Electric Energy Use

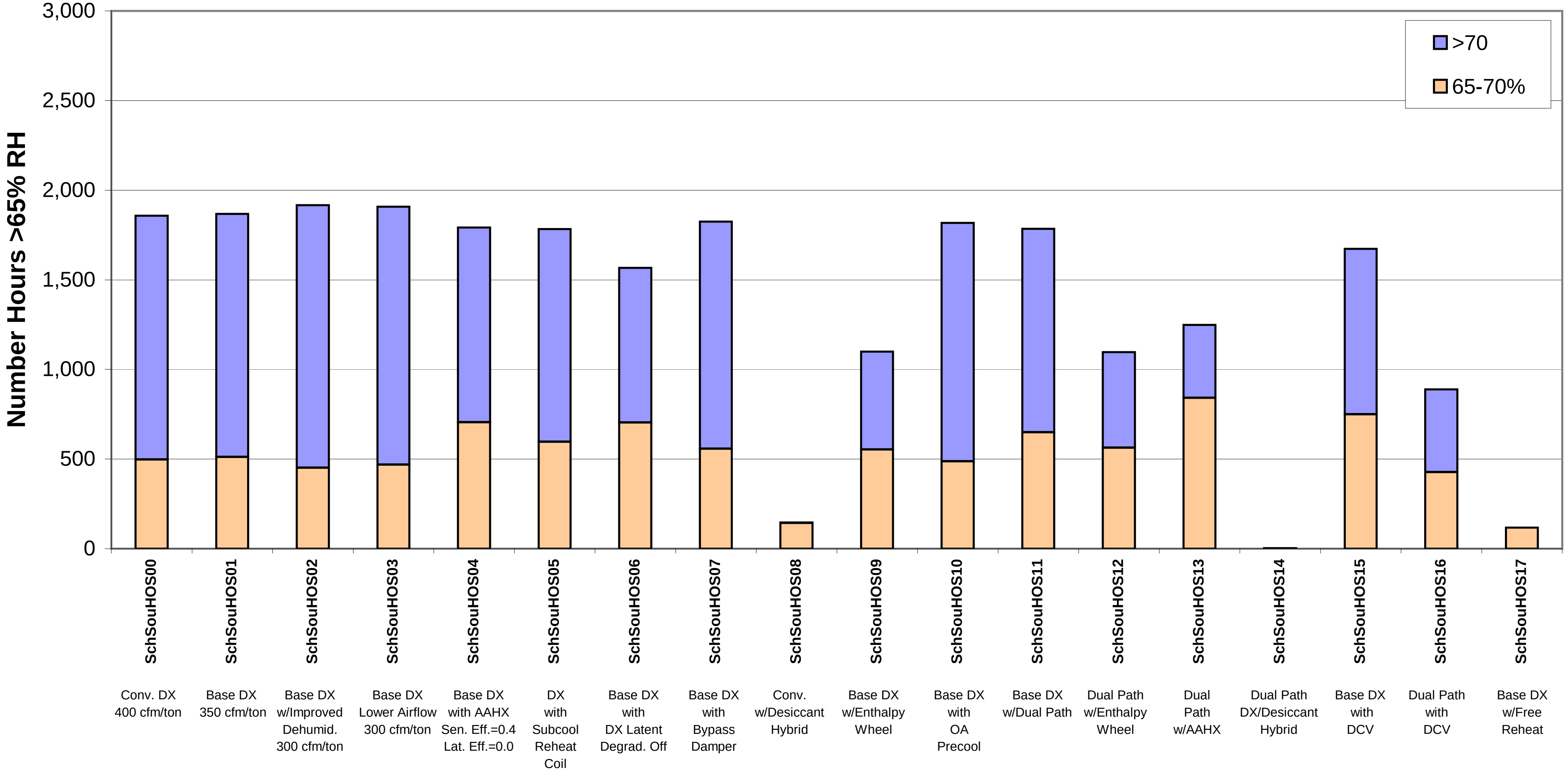


2001 Standard School-9 Month-South in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



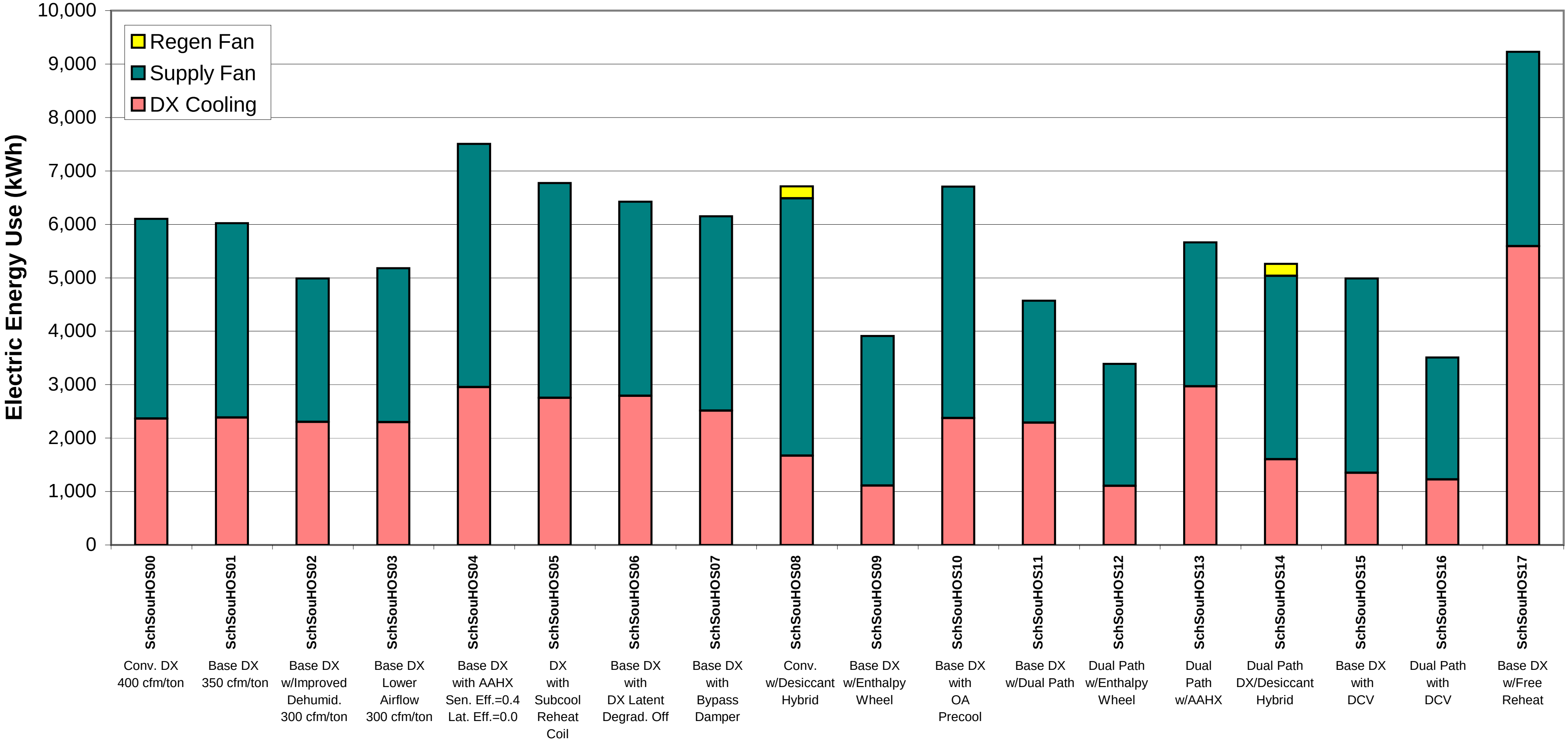
2001 Standard School-9 Month-South in Fort Worth TX
Annual HVAC System Electric Energy Use

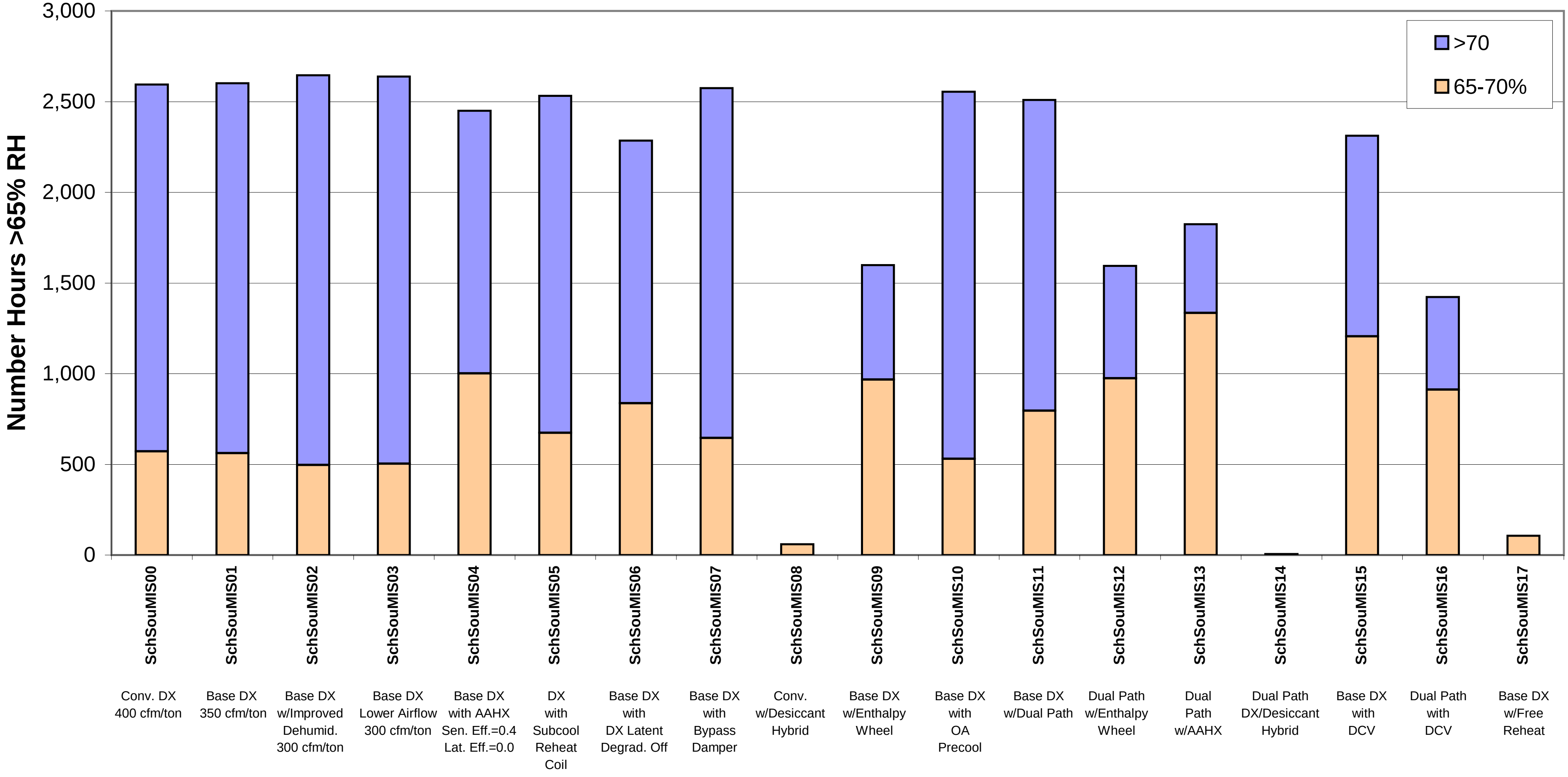




2001 Standard School-9 Month-South in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%

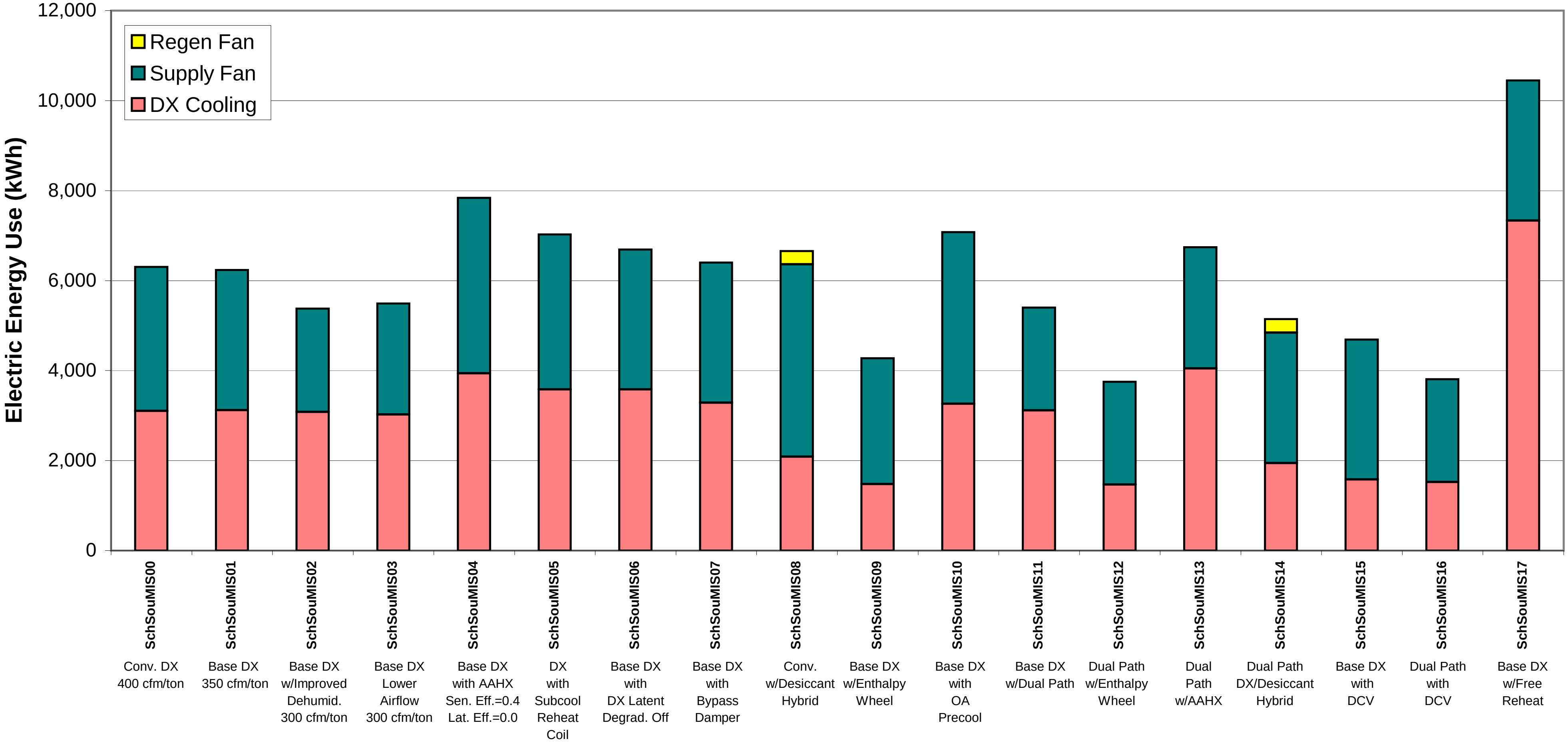
2001 Standard School-9 Month-South in Houston TX
Annual HVAC System Electric Energy Use



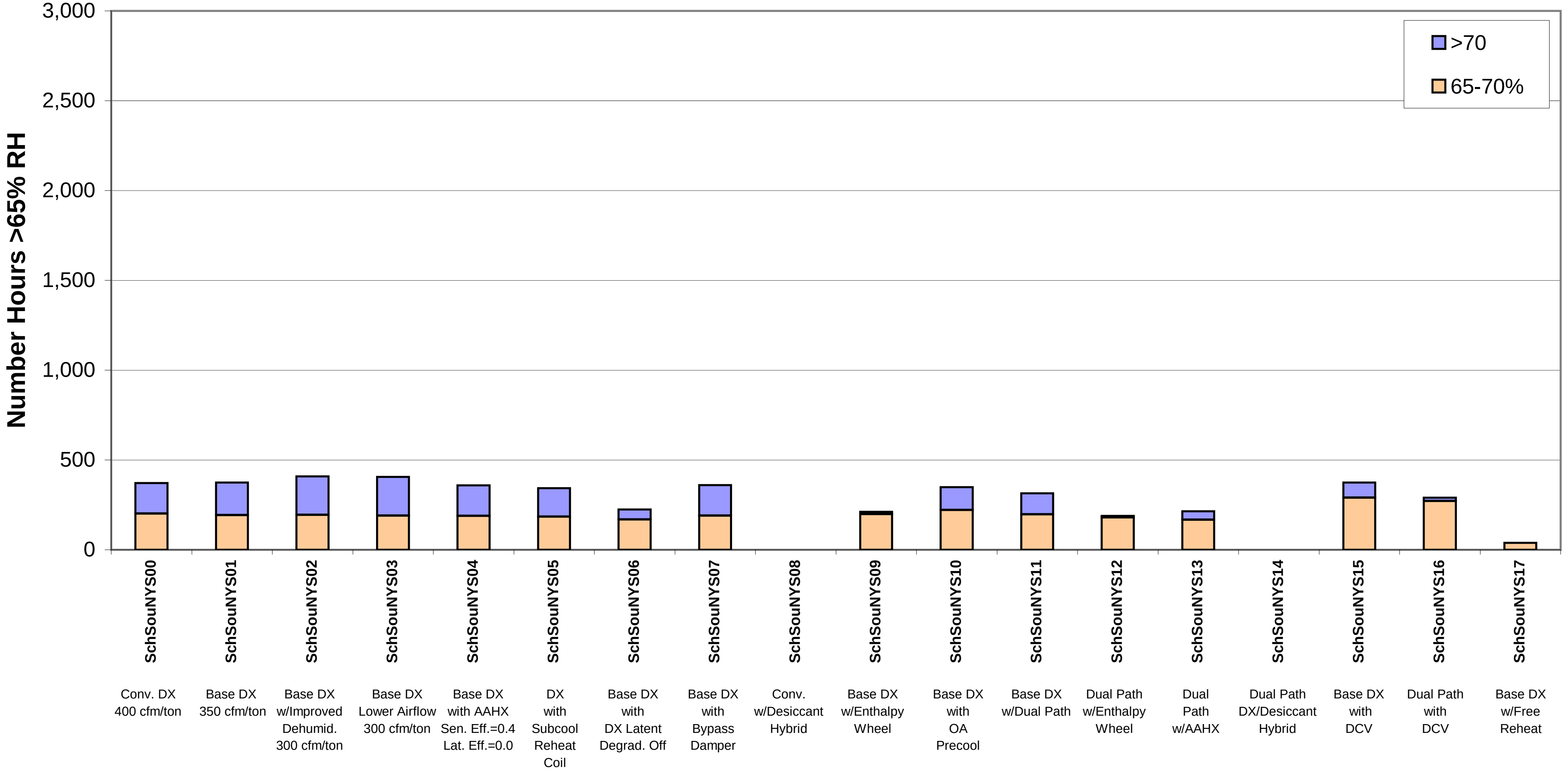


2001 Standard School-9 Month-South in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%

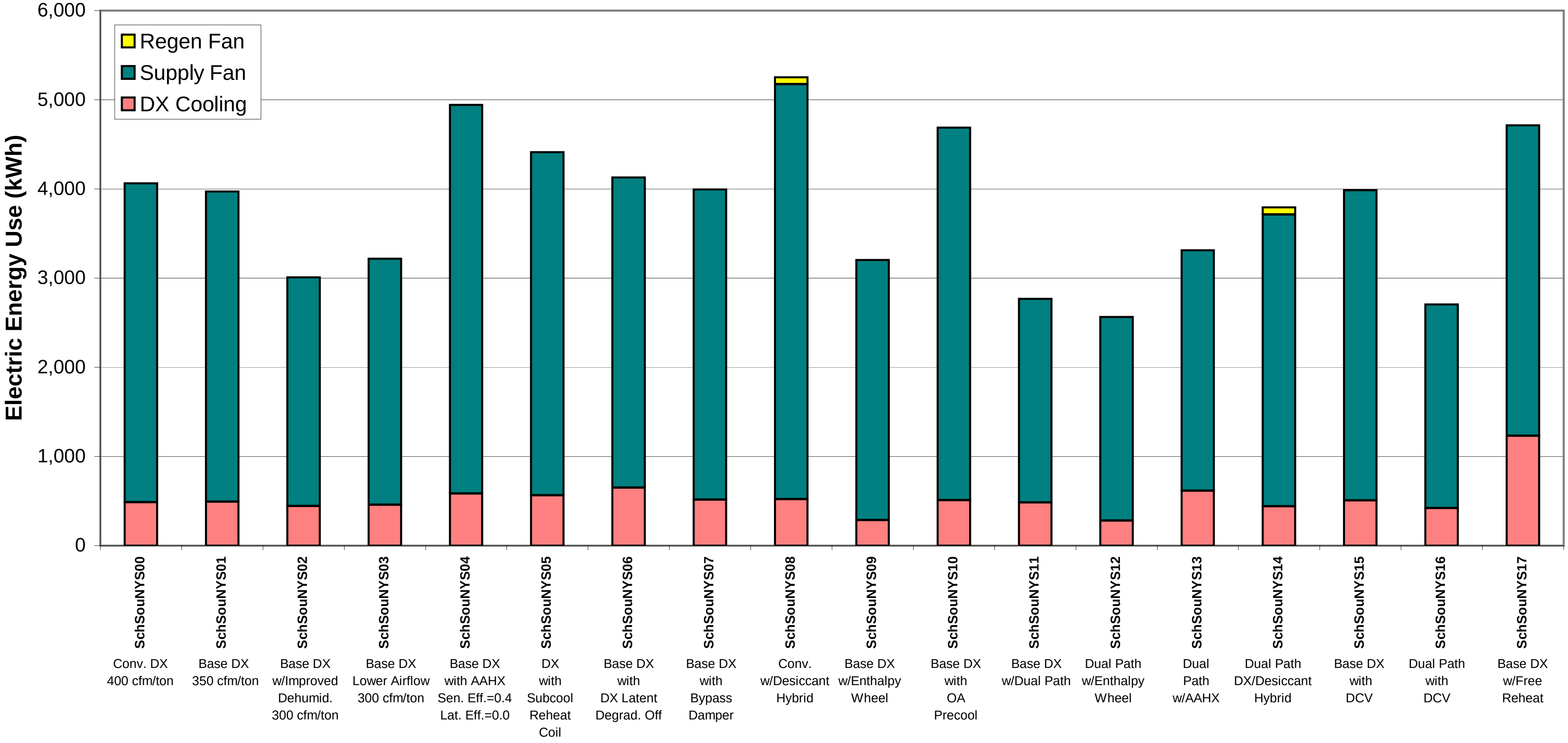
2001 Standard School-9 Month-South in Miami FL
Annual HVAC System Electric Energy Use



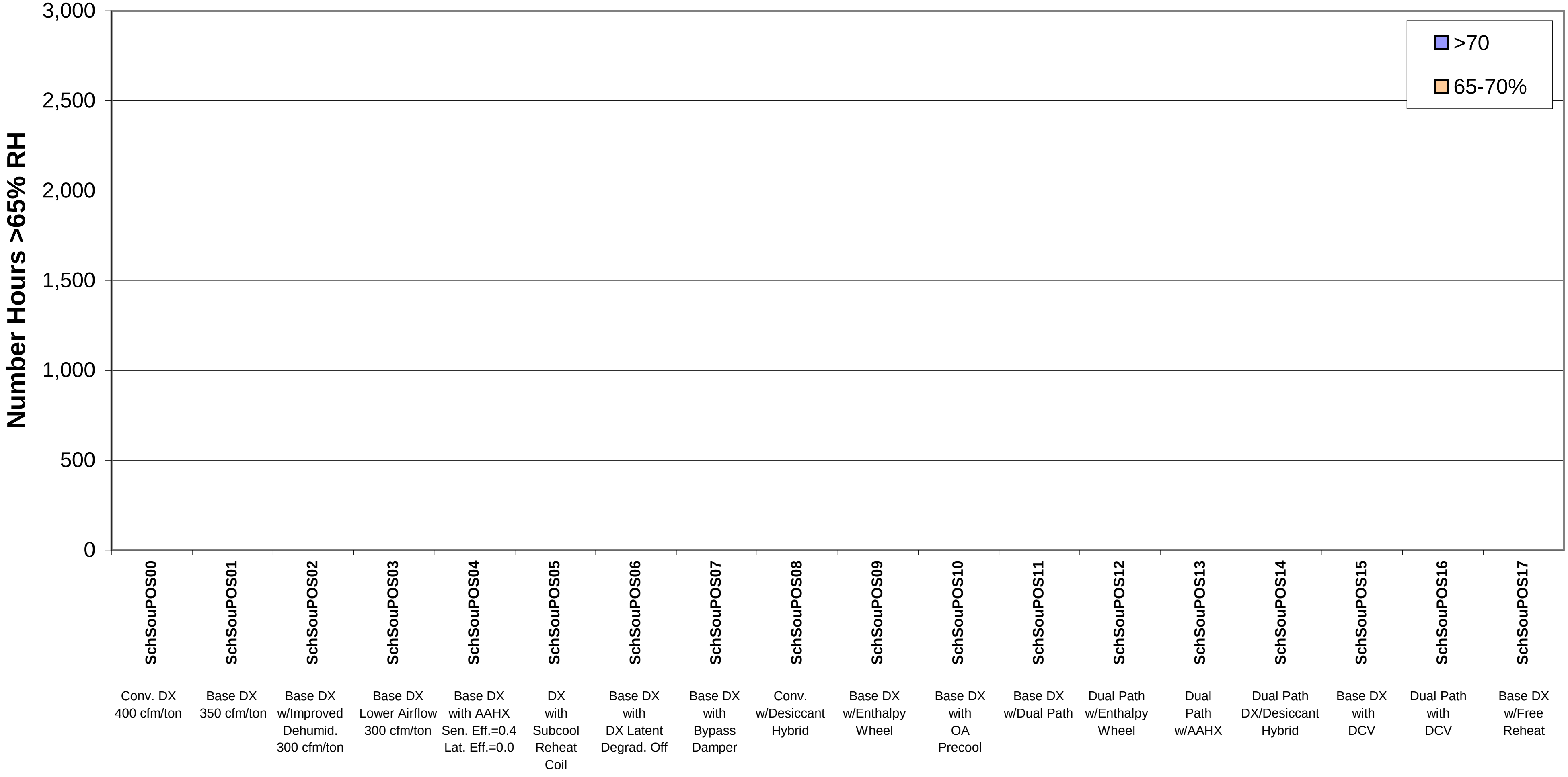
2001 Standard School-9 Month-South in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



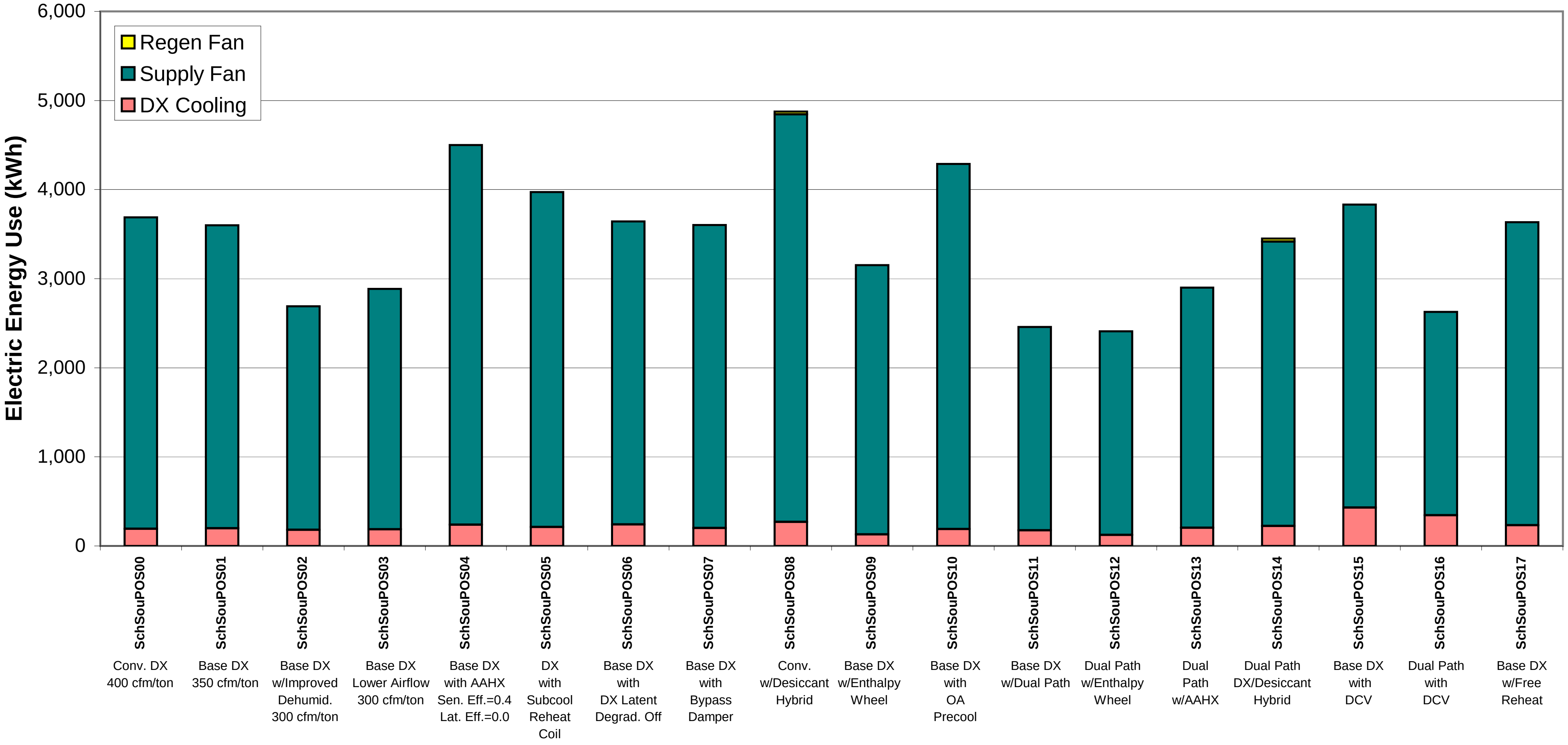
2001 Standard School-9 Month-South in New York NY
Annual HVAC System Electric Energy Use

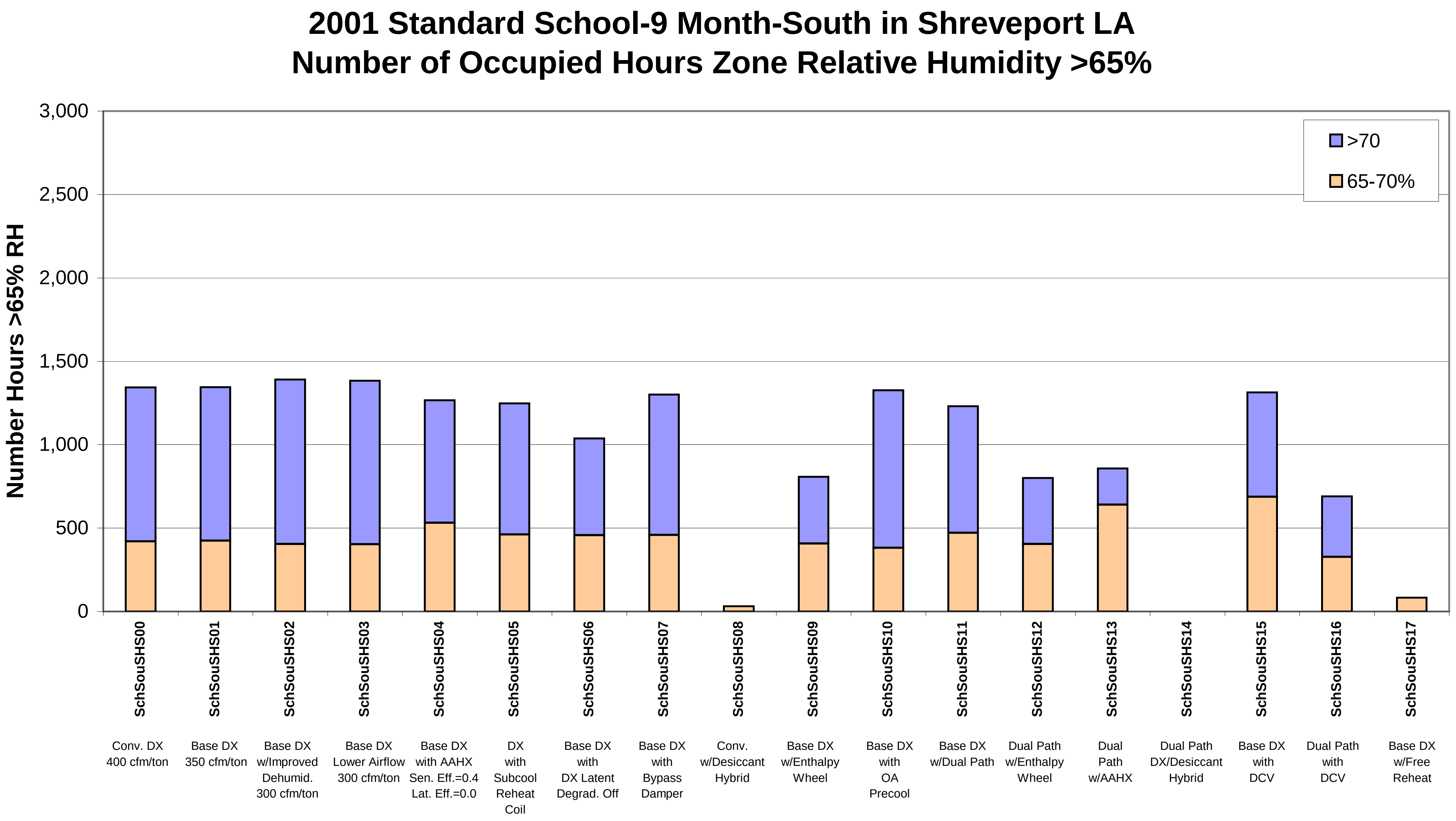


2001 Standard School-9 Month-South in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%

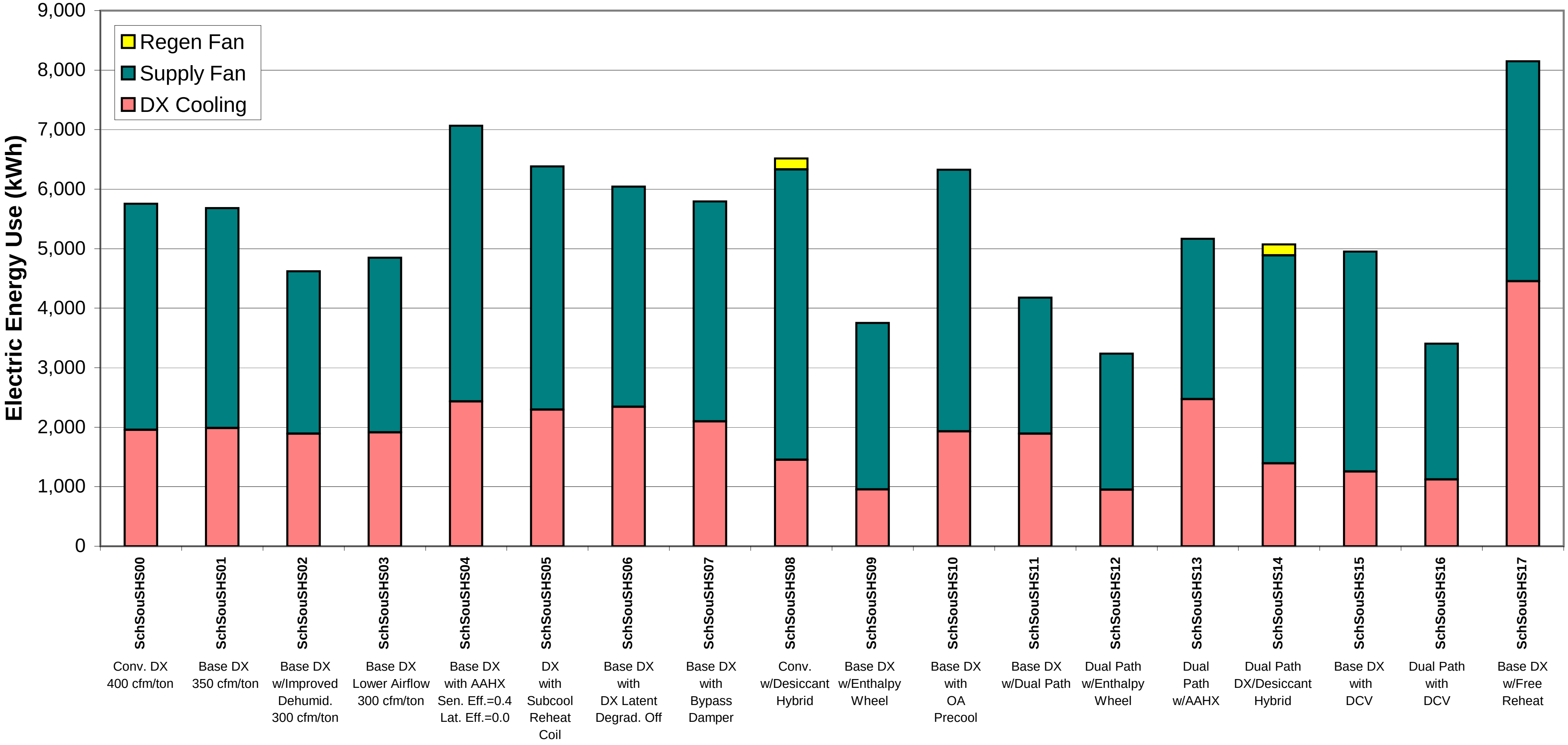


2001 Standard School-9 Month-South in Portland OR
Annual HVAC System Electric Energy Use

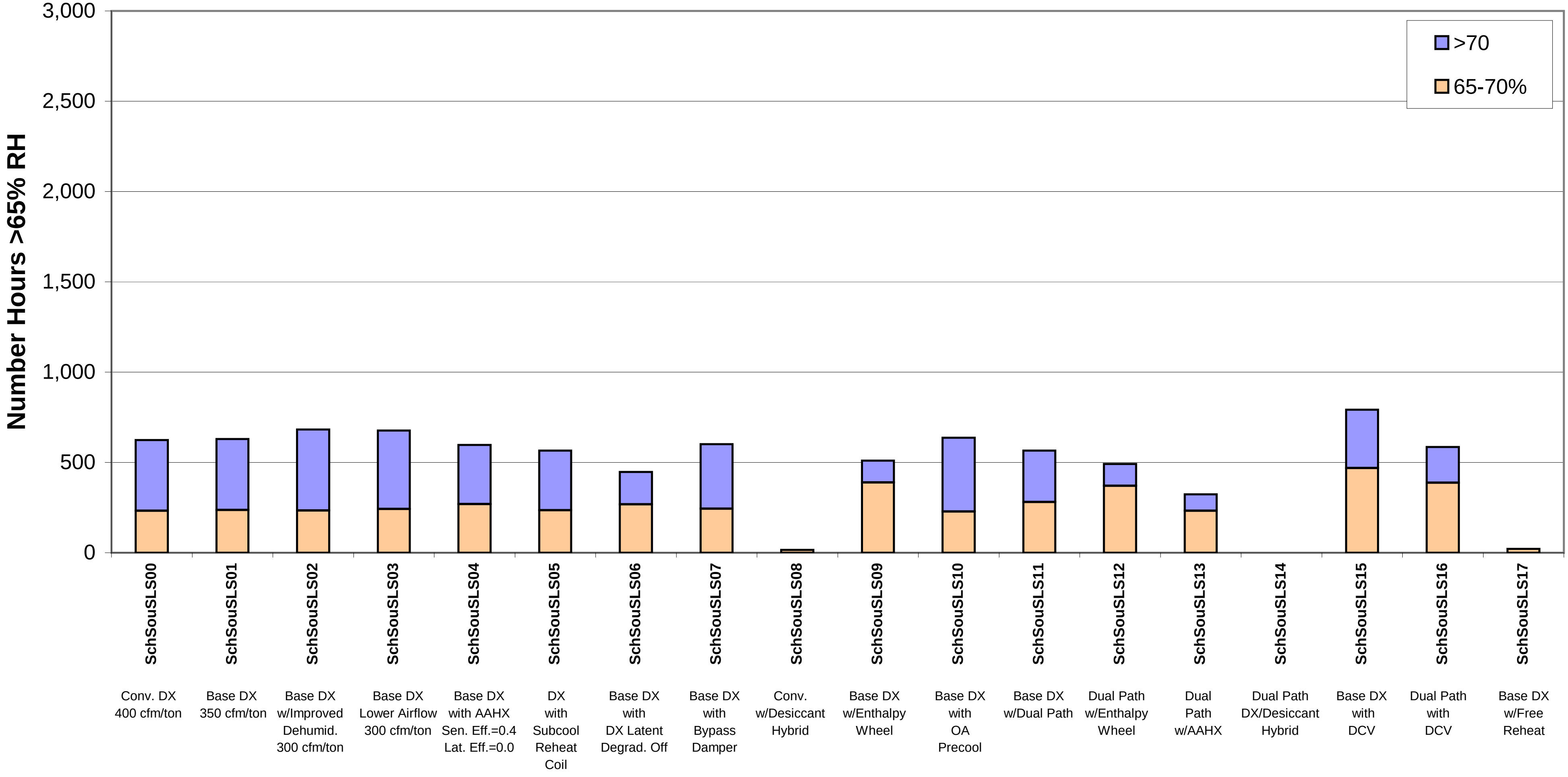



2001 Standard School-9 Month-South in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchSouSHS00
SchSouSHS01
SchSouSHS02
SchSouSHS03
SchSouSHS04
SchSouSHS05
SchSouSHS06
SchSouSHS07
SchSouSHS08
SchSouSHS09
SchSouSHS10
SchSouSHS11
SchSouSHS12
SchSouSHS13
SchSouSHS14
SchSouSHS15
SchSouSHS16
SchSouSHS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

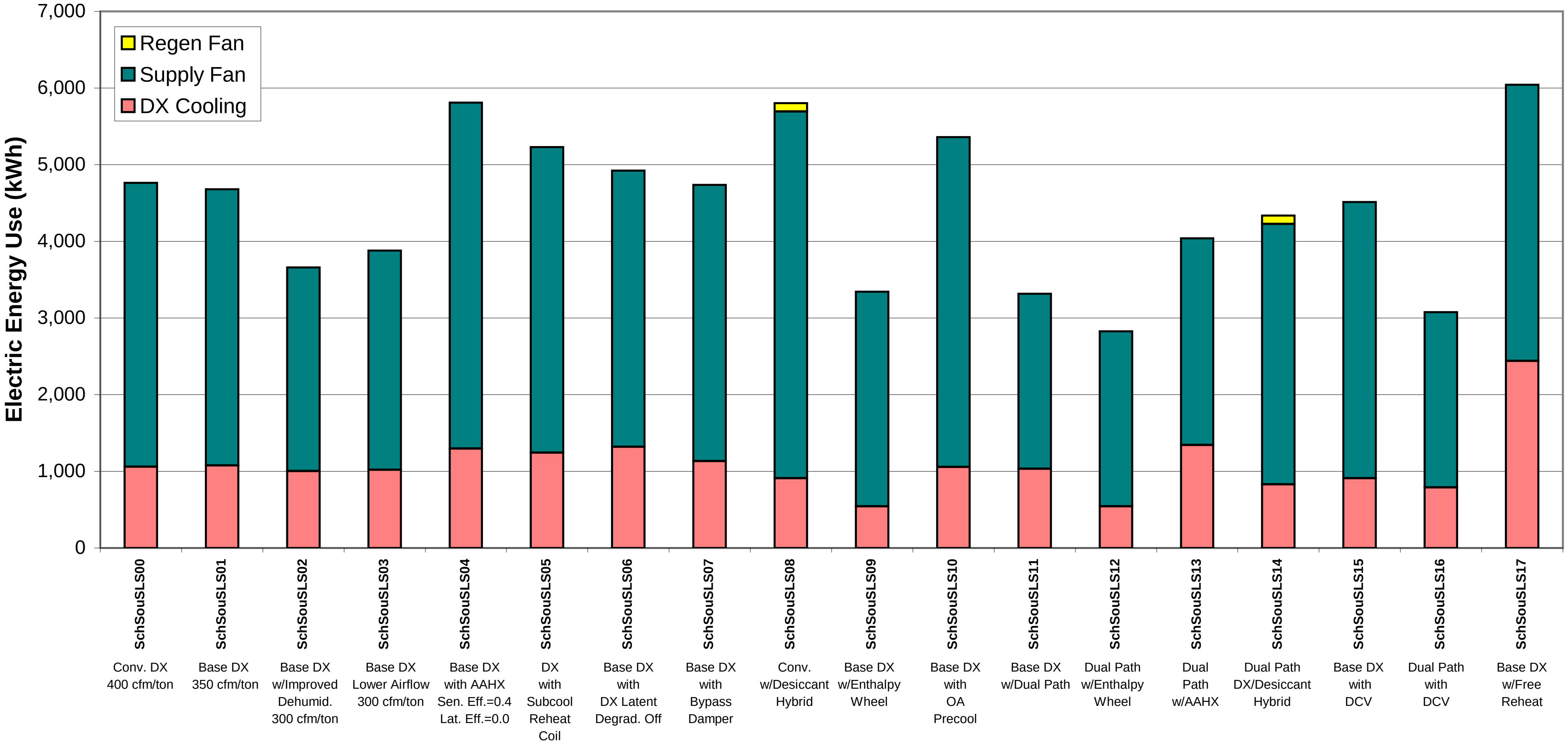
2001 Standard School-9 Month-South in Shreveport LA
Annual HVAC System Electric Energy Use

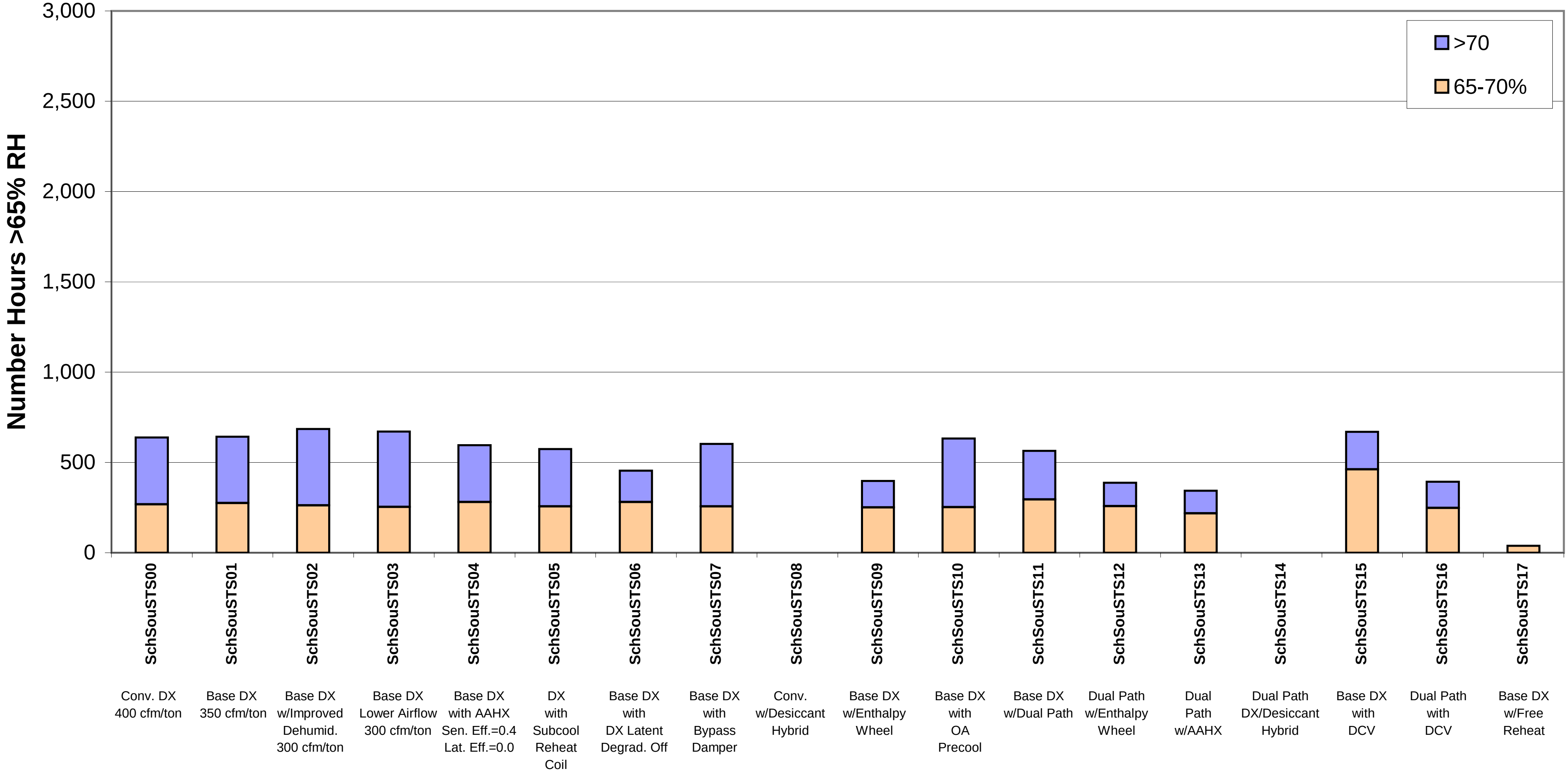


2001 Standard School-9 Month-South in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%

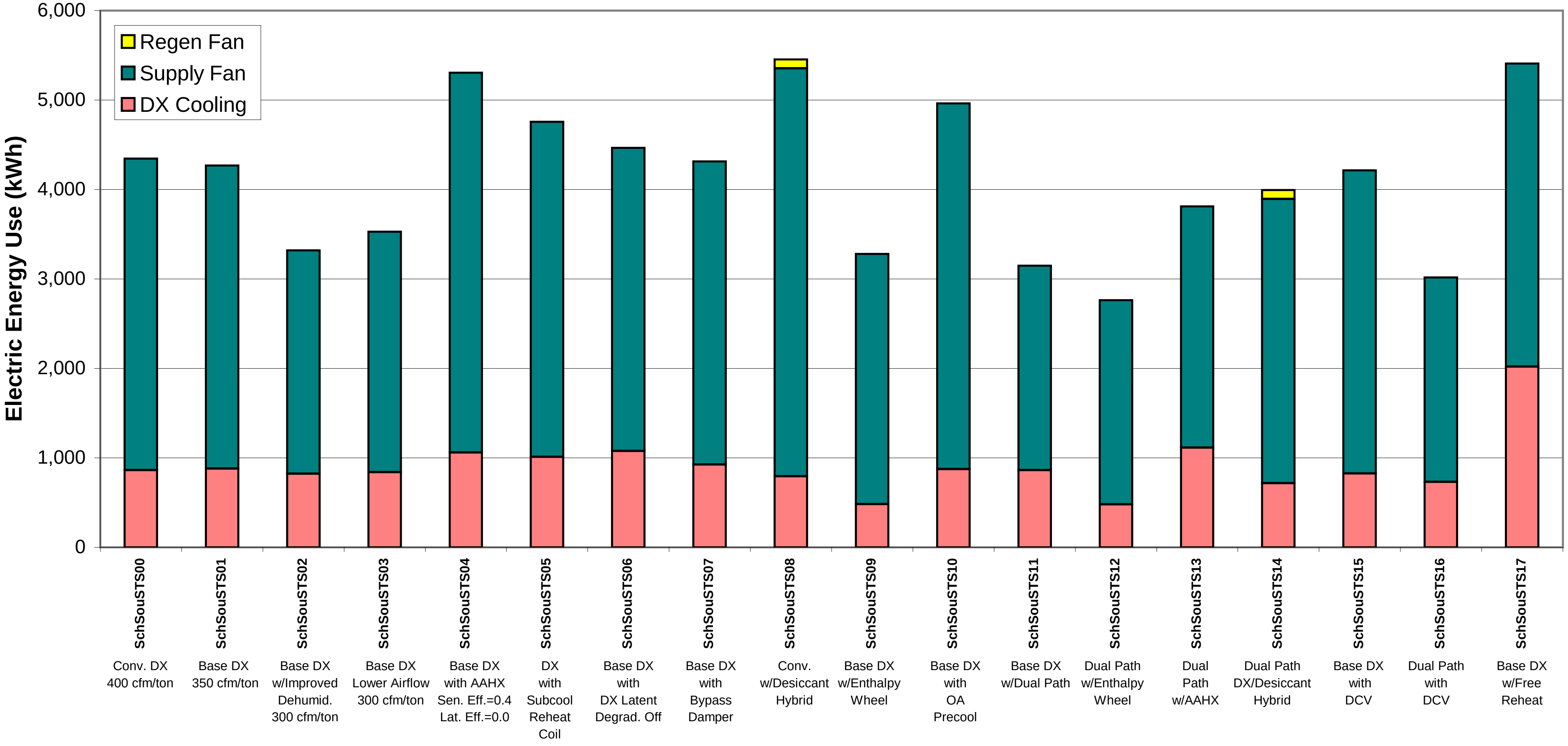


2001 Standard School-9 Month-South in St. Louis MO
Annual HVAC System Electric Energy Use

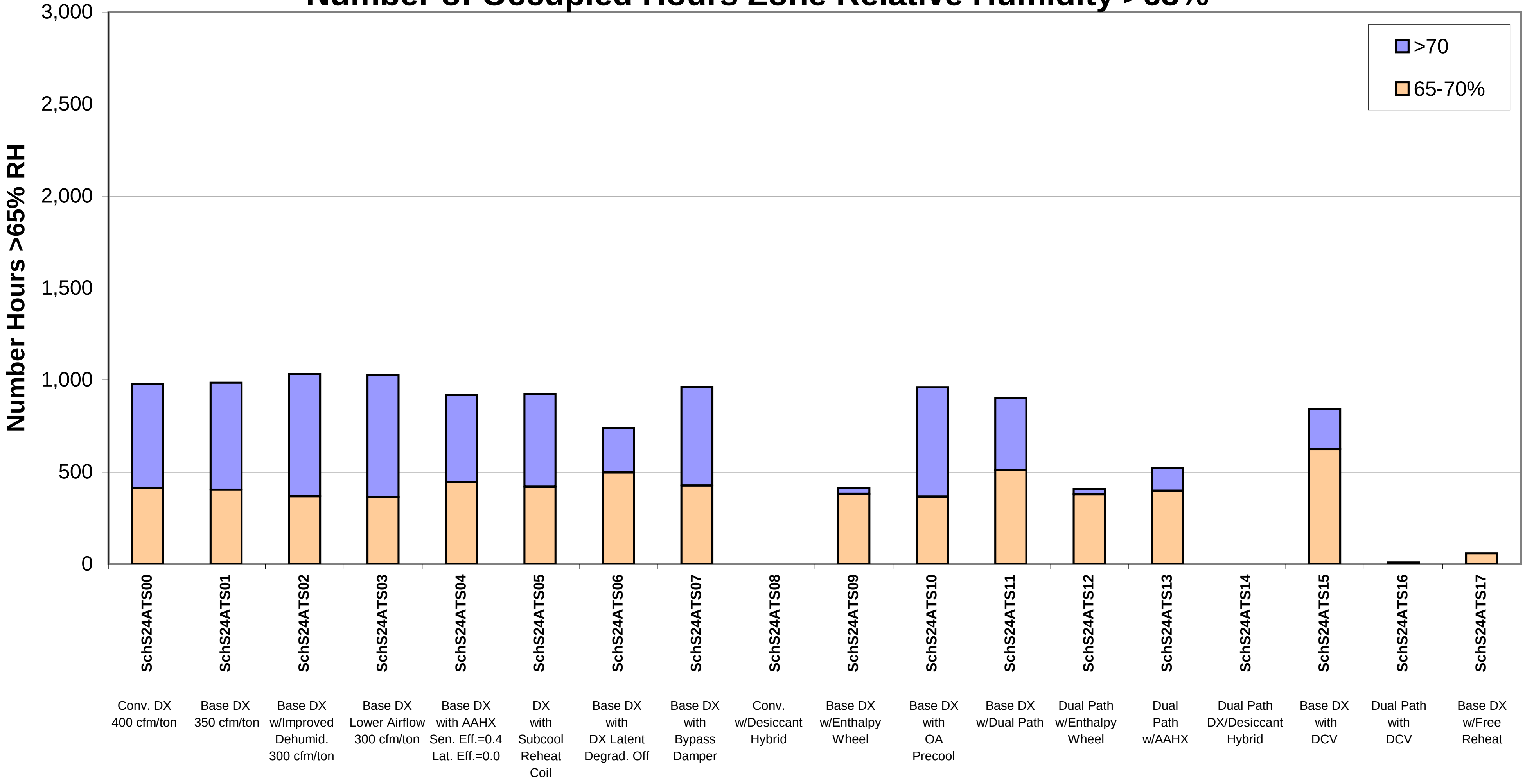



2001 Standard School-9 Month-South in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%

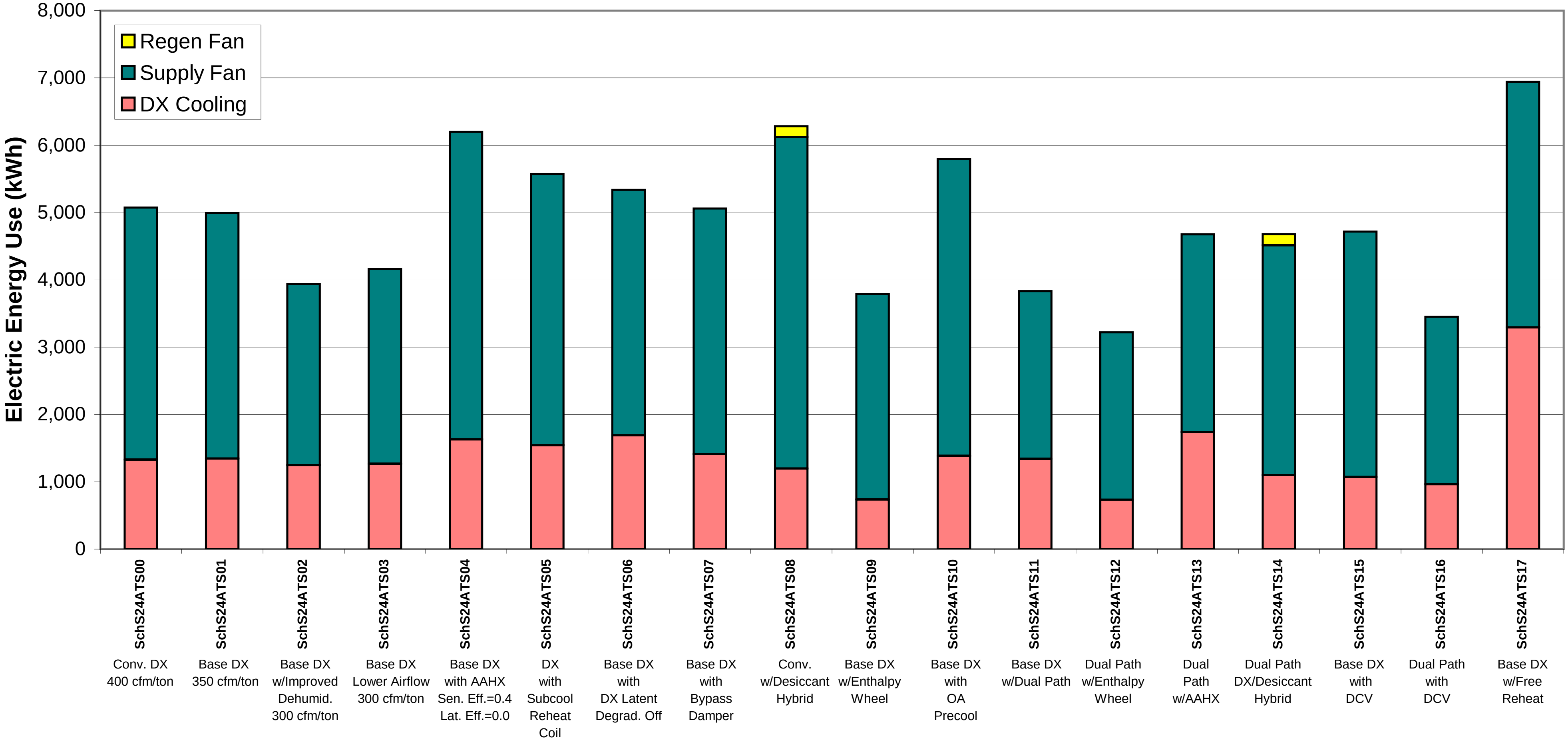
2001 Standard School-9 Month-South in Washington DC
Annual HVAC System Electric Energy Use



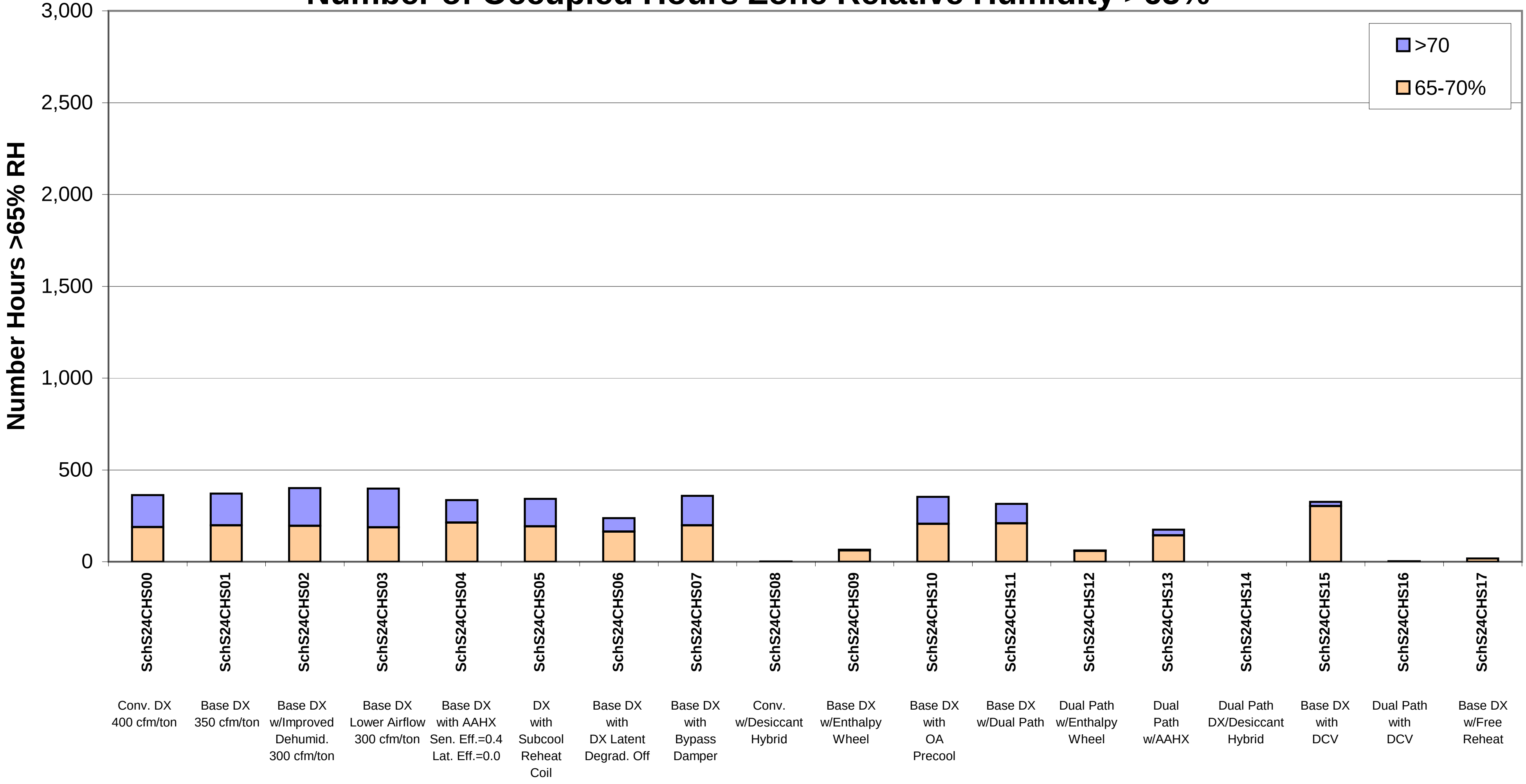
2001 Standard School-12 Month-South in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



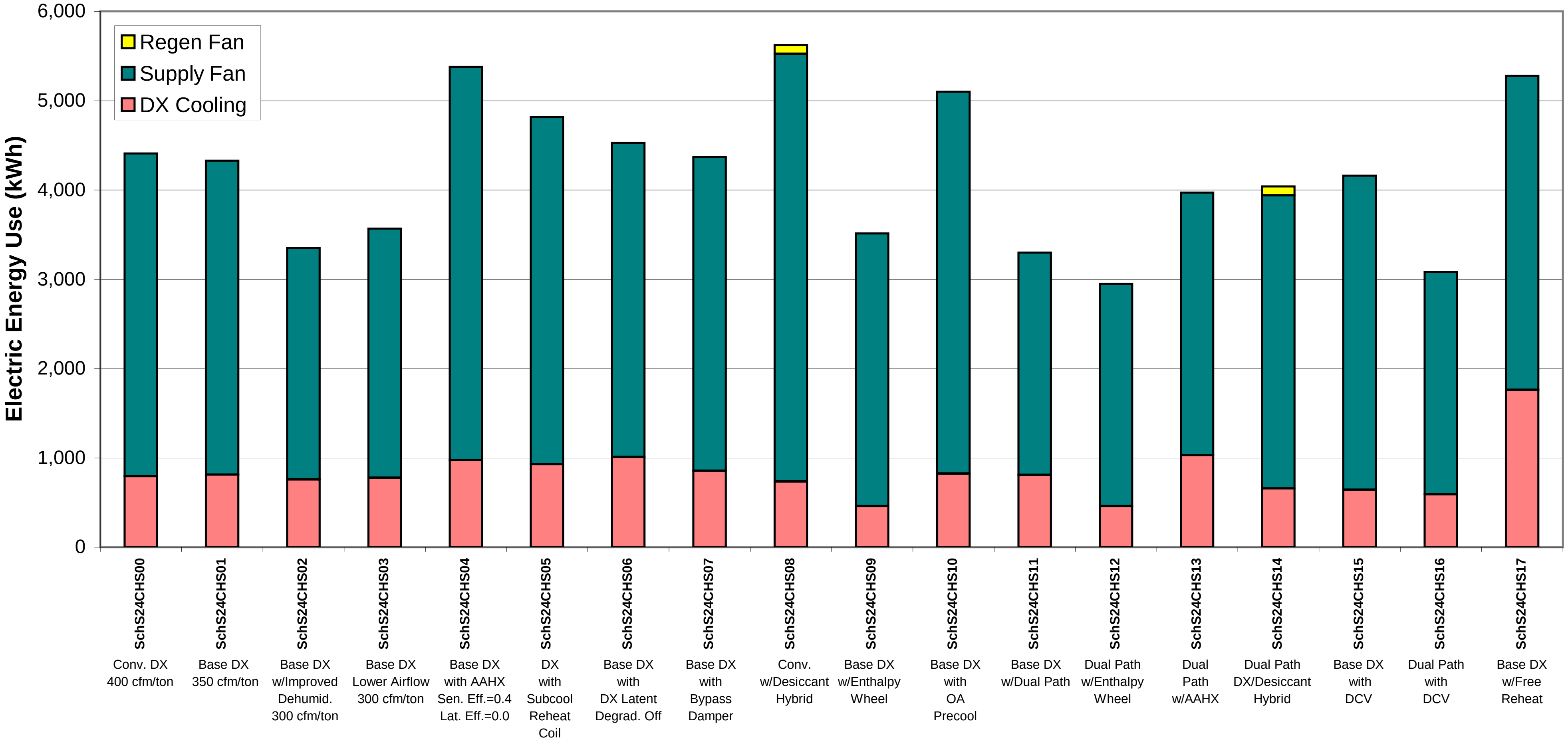
2001 Standard School-12 Month-South in Atlanta GA
Annual HVAC System Electric Energy Use



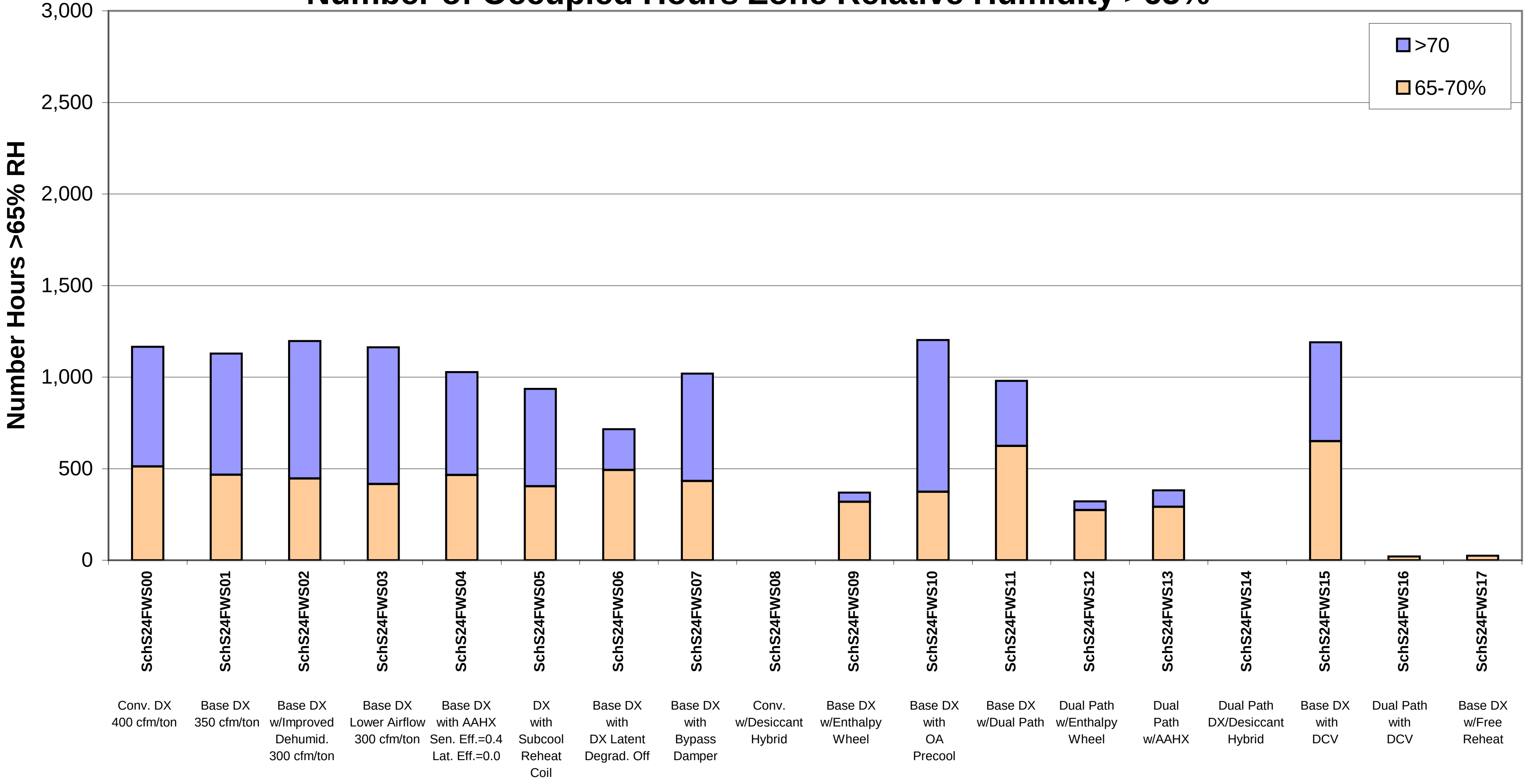
2001 Standard School-12 Month-South in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



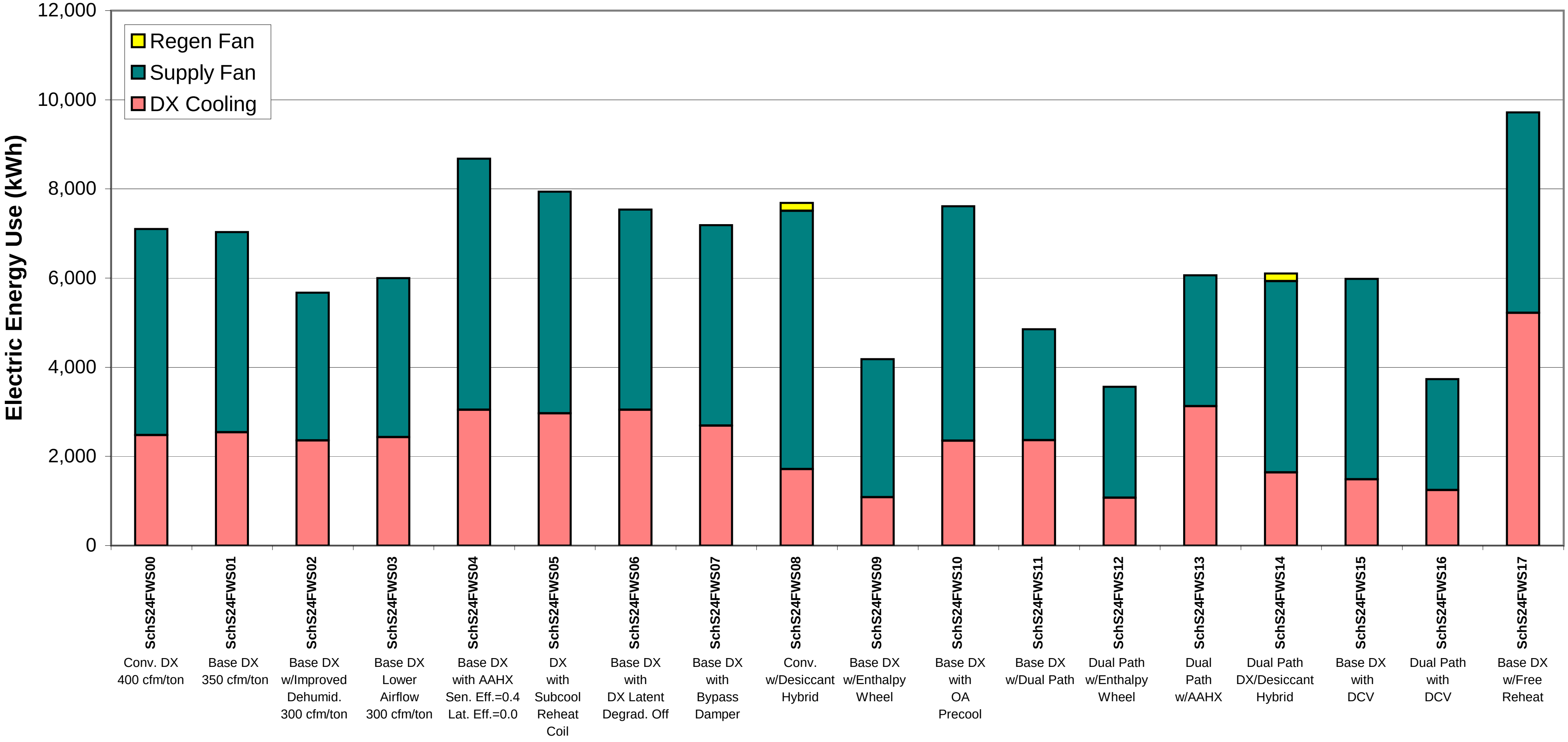
2001 Standard School-12 Month-South in Chicago IL
Annual HVAC System Electric Energy Use



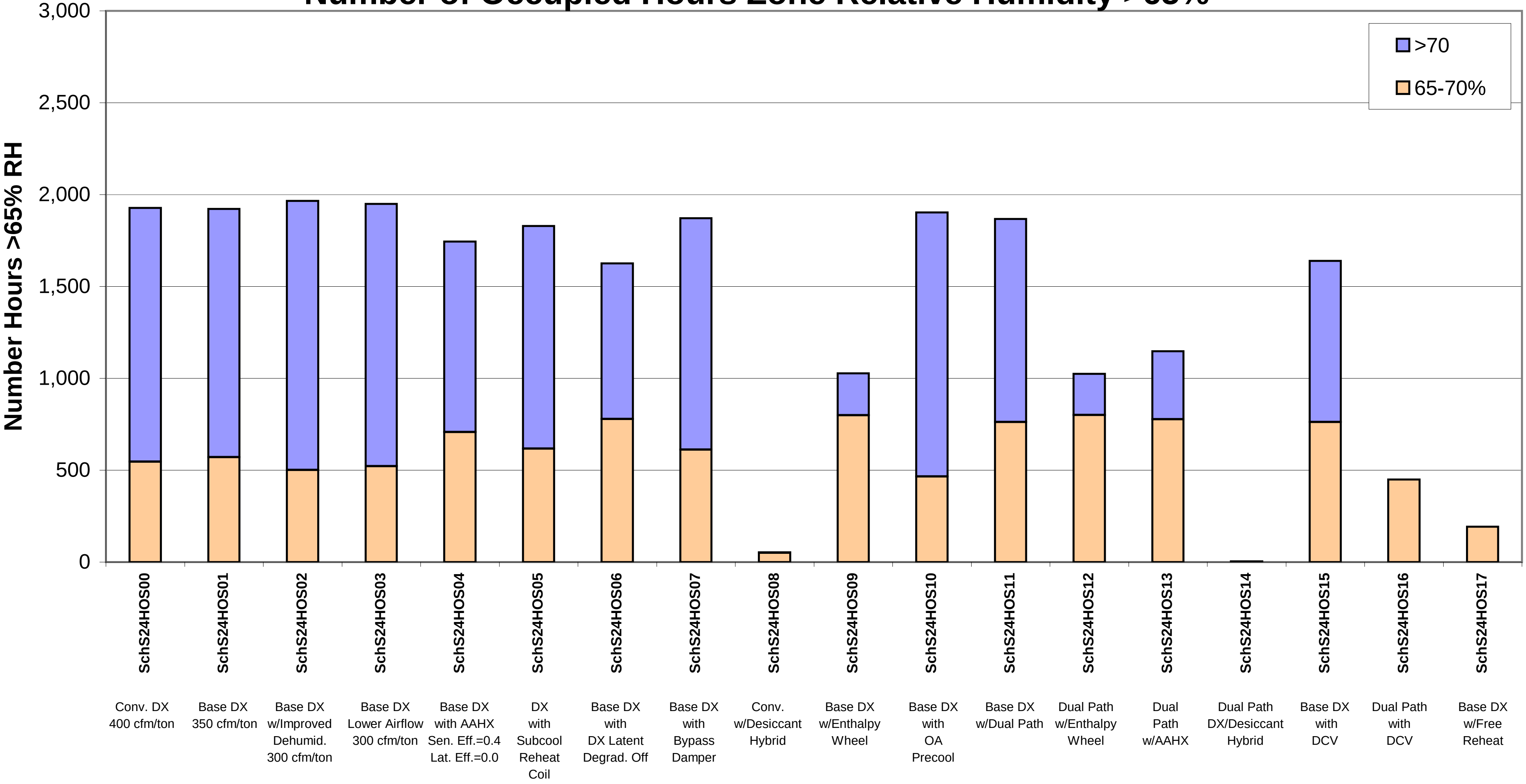
2001 Standard School-12 Month-South in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



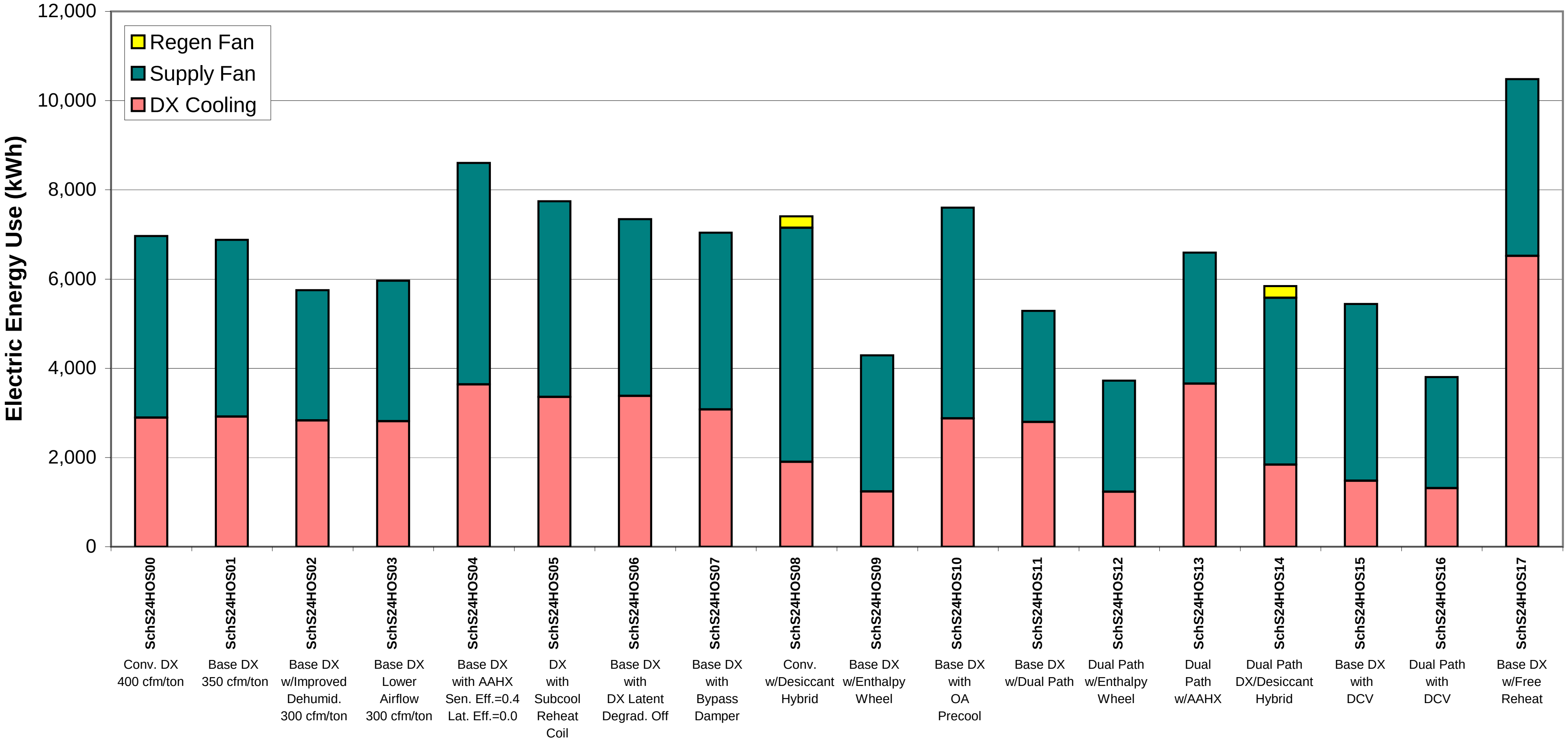
2001 Standard School-12 Month-South in Fort Worth TX
Annual HVAC System Electric Energy Use



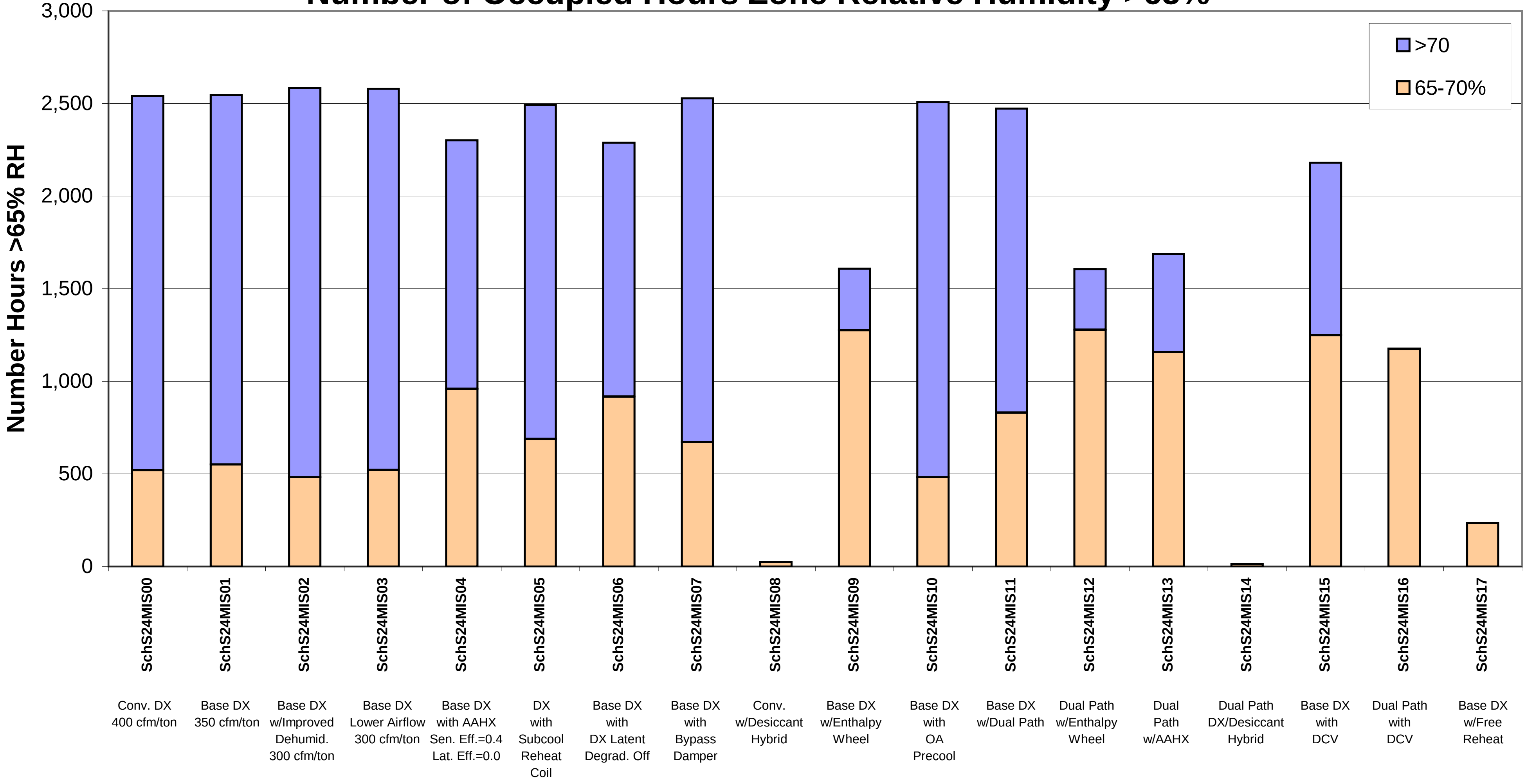
2001 Standard School-12 Month-South in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



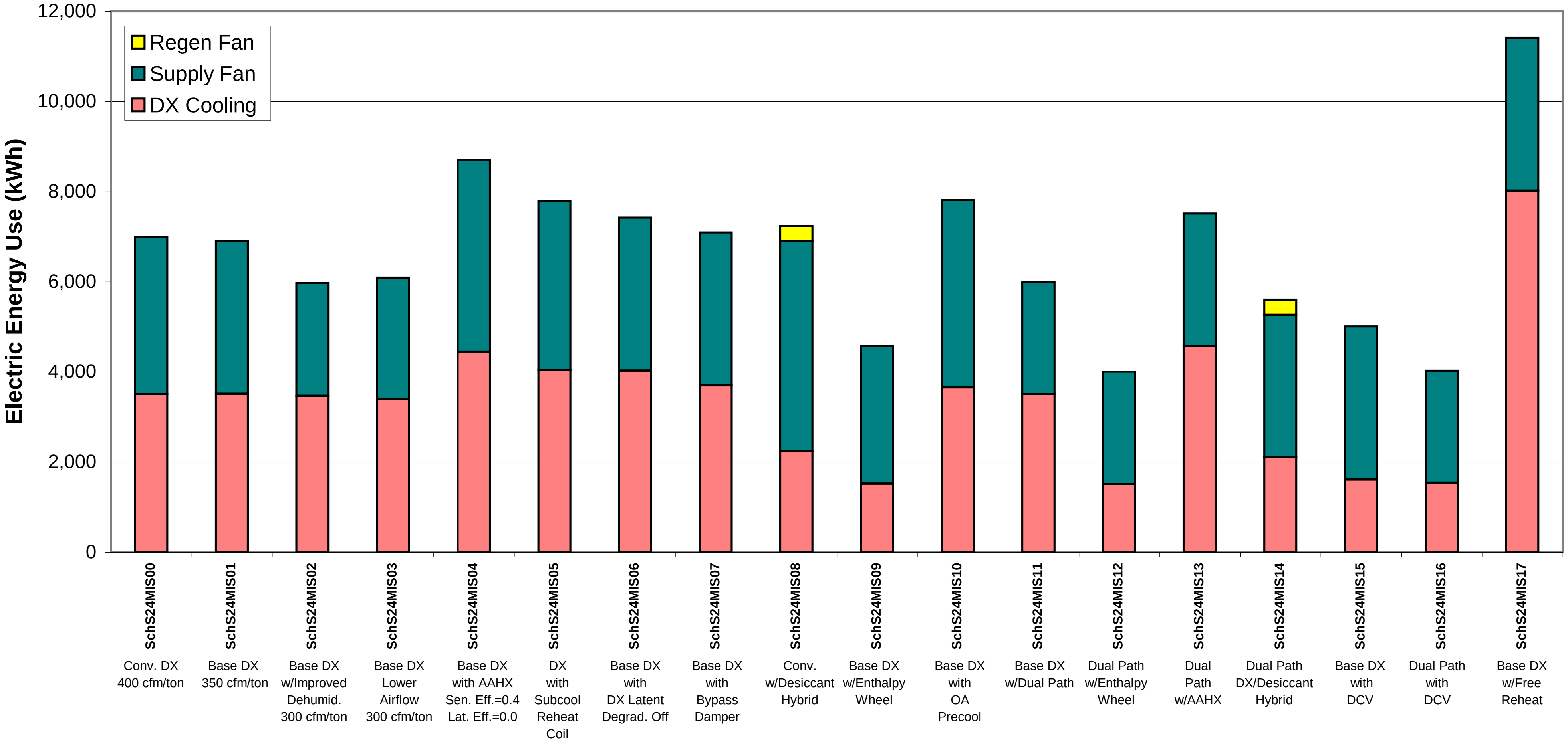
2001 Standard School-12 Month-South in Houston TX
Annual HVAC System Electric Energy Use

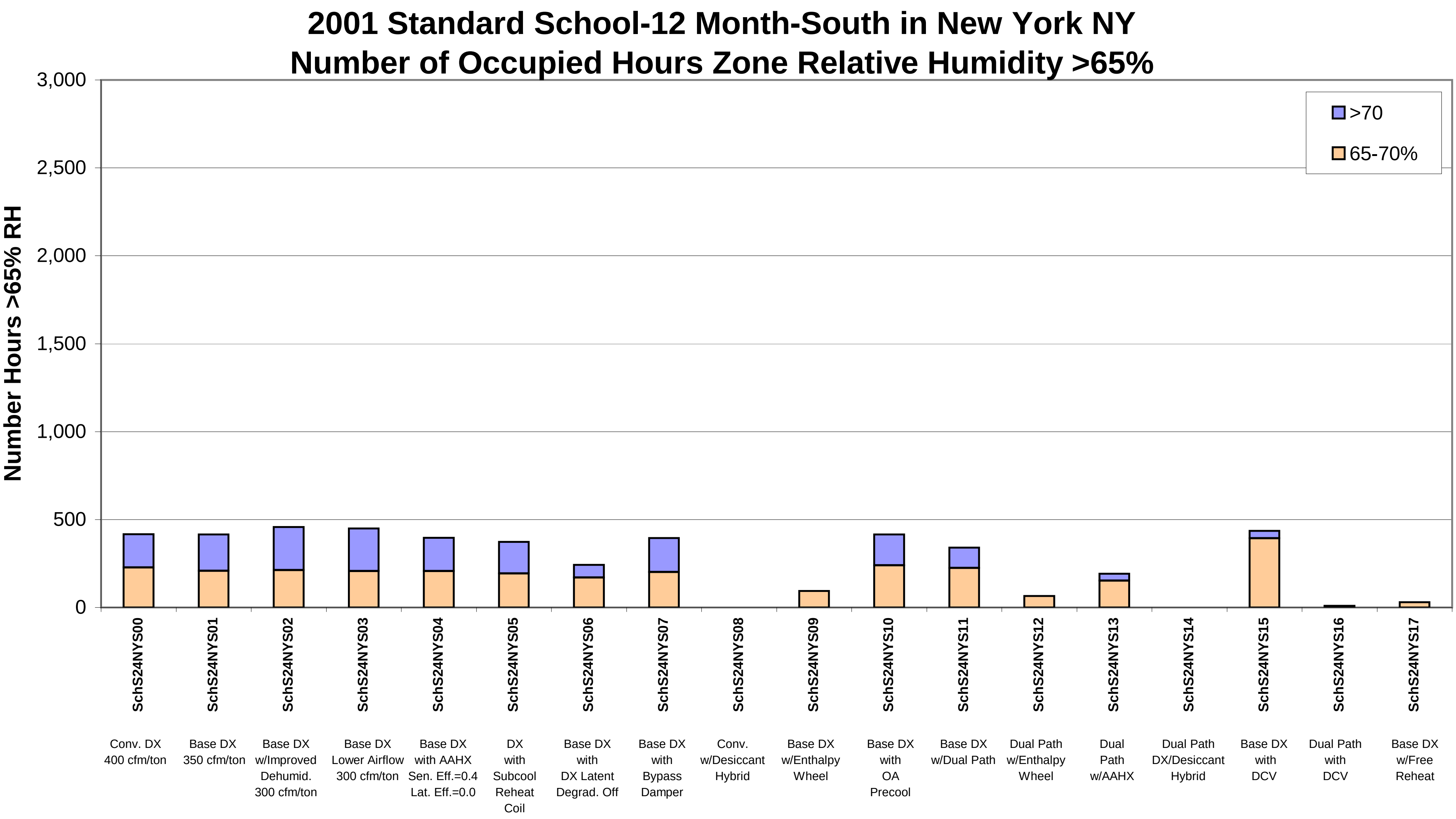


2001 Standard School-12 Month-South in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%

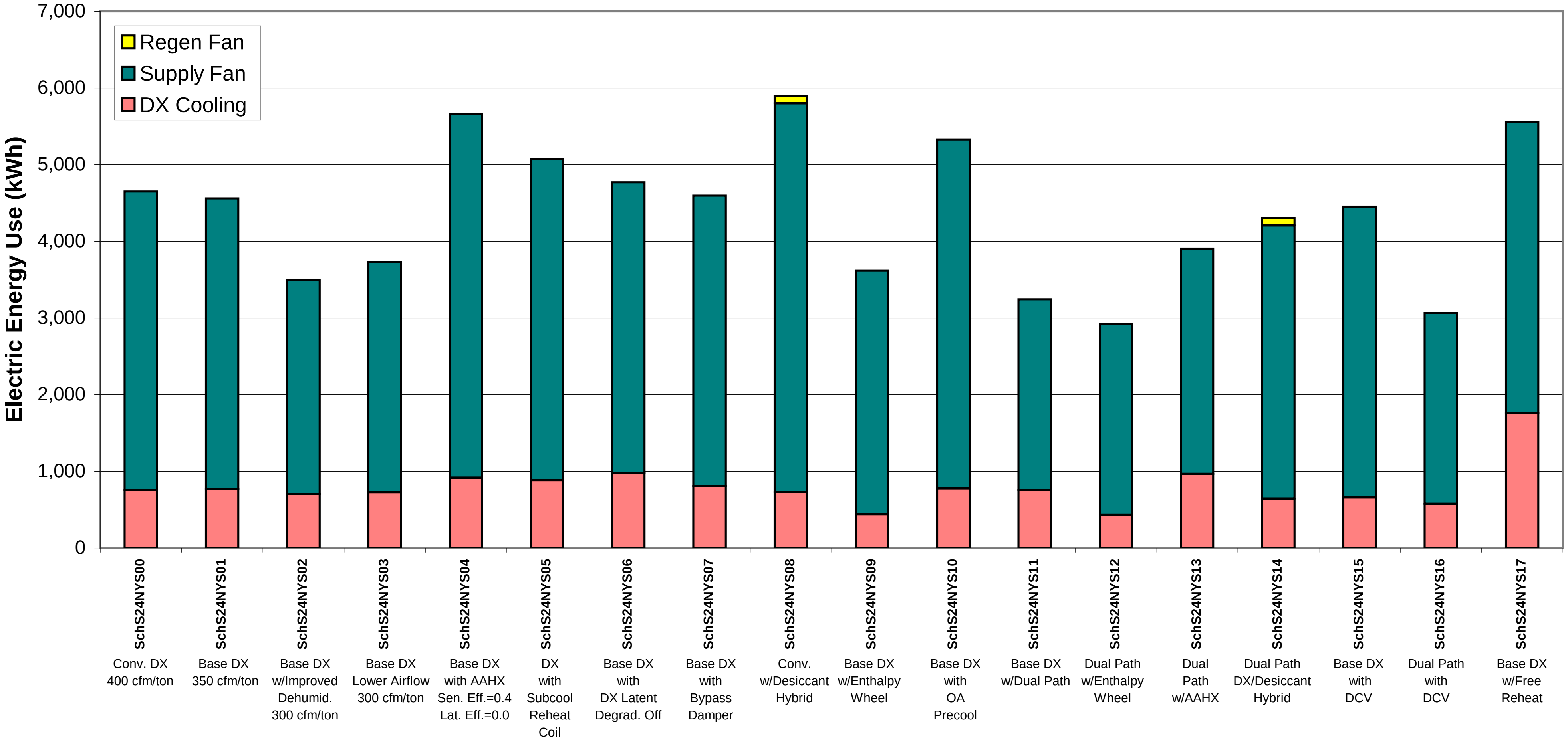


2001 Standard School-12 Month-South in Miami FL
Annual HVAC System Electric Energy Use

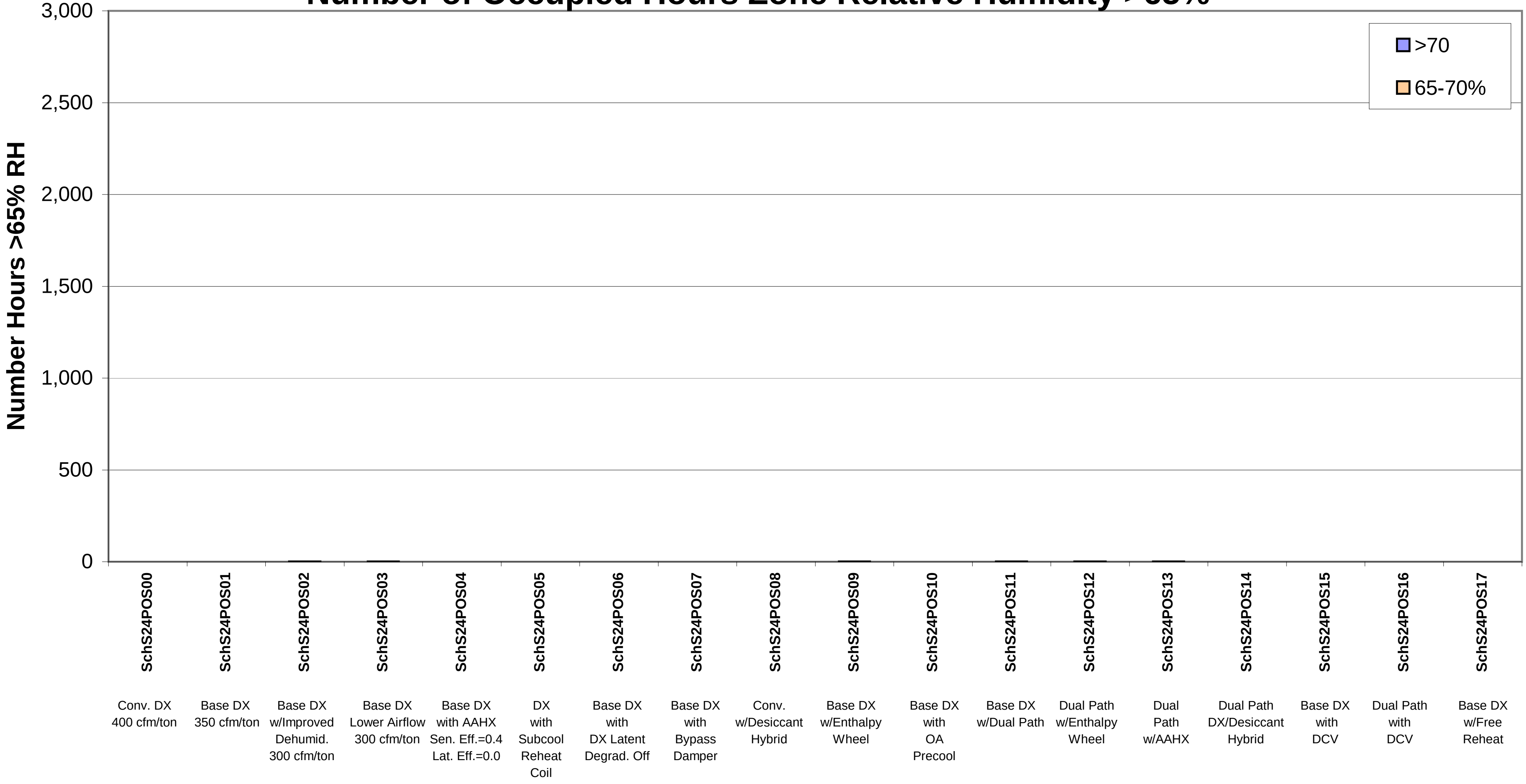



2001 Standard School-12 Month-South in New York NY
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24NYS00
SchS24NYS01
SchS24NYS02
SchS24NYS03
SchS24NYS04
SchS24NYS05
SchS24NYS06
SchS24NYS07
SchS24NYS08
SchS24NYS09
SchS24NYS10
SchS24NYS11
SchS24NYS12
SchS24NYS13
SchS24NYS14
SchS24NYS15
SchS24NYS16
SchS24NYS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

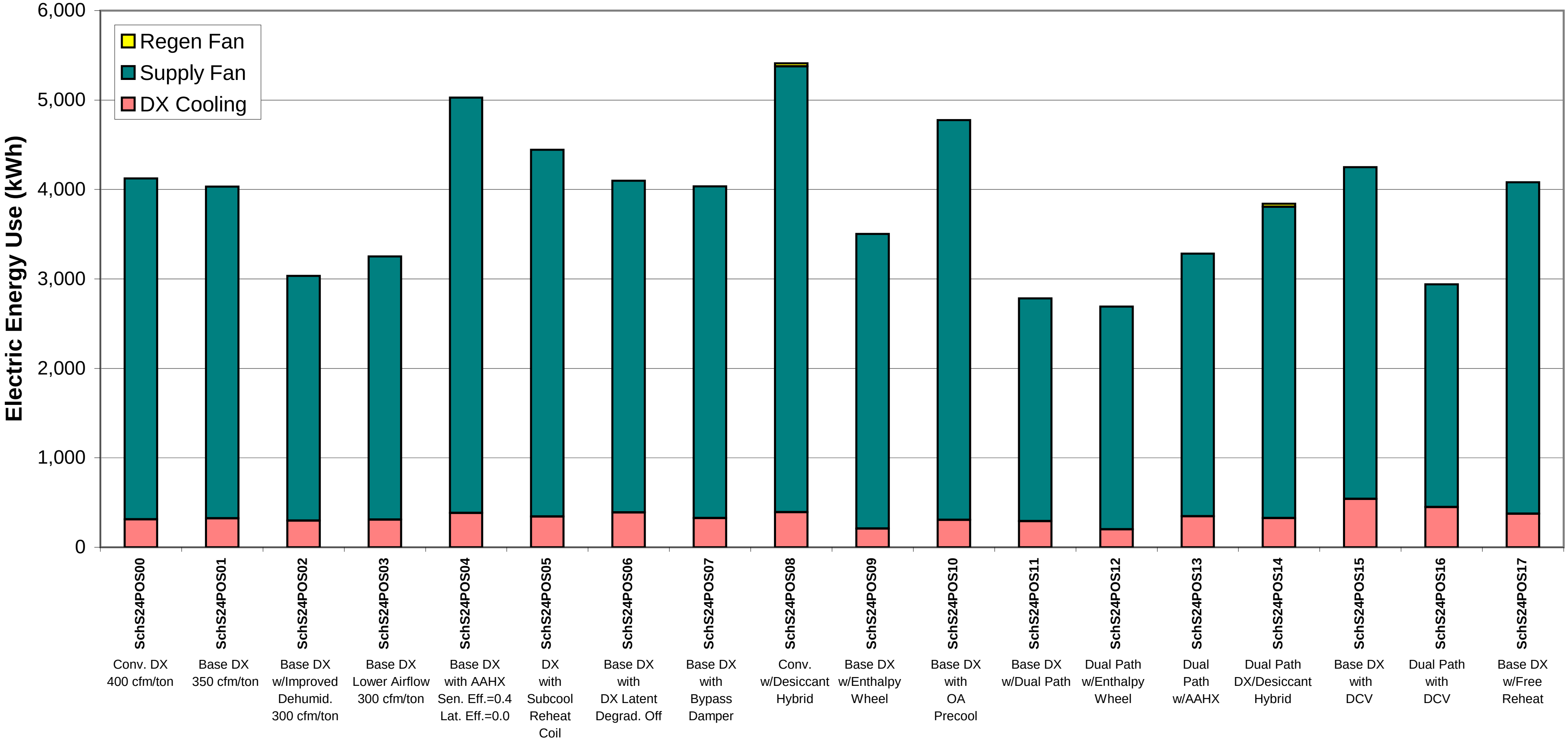
2001 Standard School-12 Month-South in New York NY
Annual HVAC System Electric Energy Use



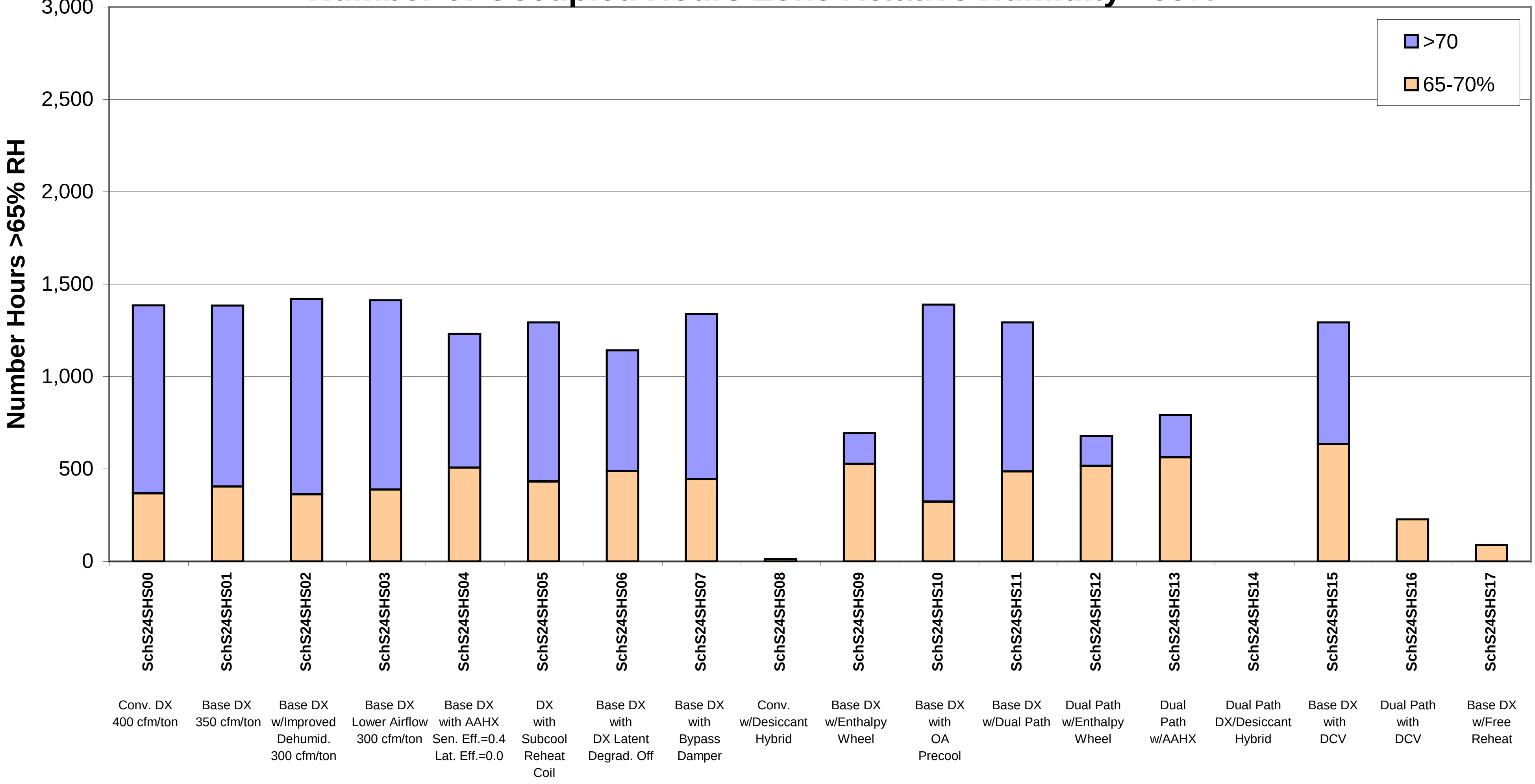
2001 Standard School-12 Month-South in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



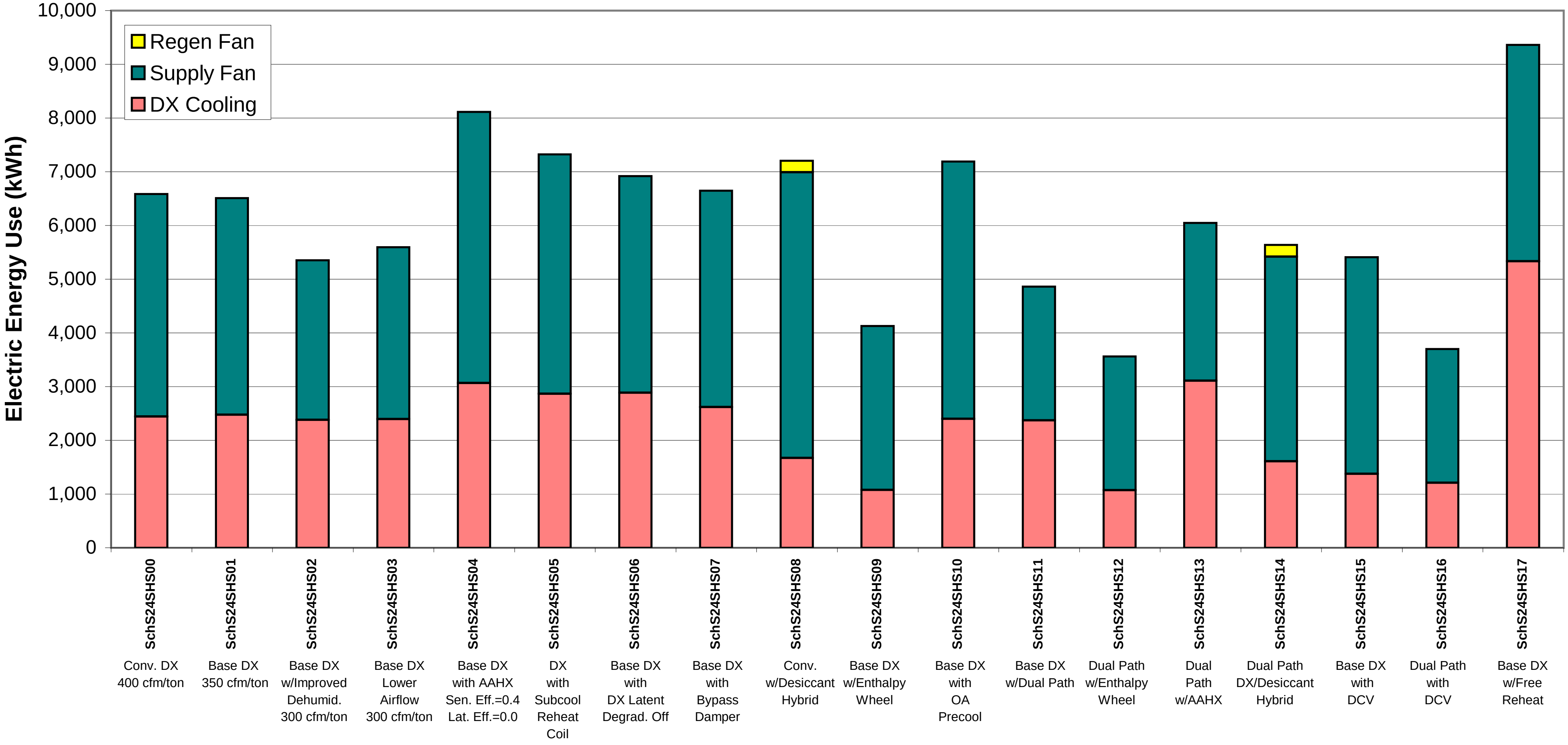
2001 Standard School-12 Month-South in Portland OR
Annual HVAC System Electric Energy Use

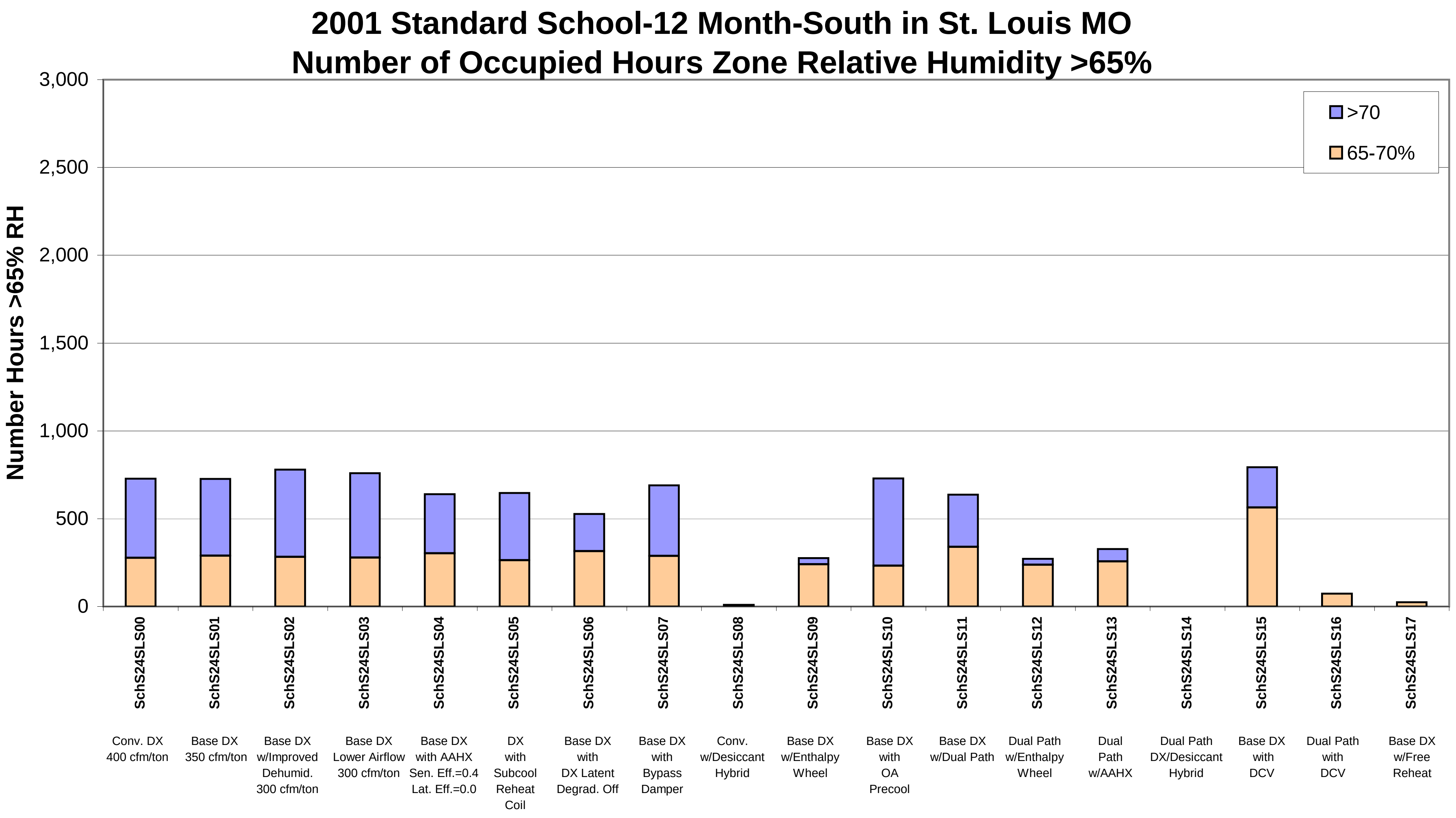


2001 Standard School-12 Month-South in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%

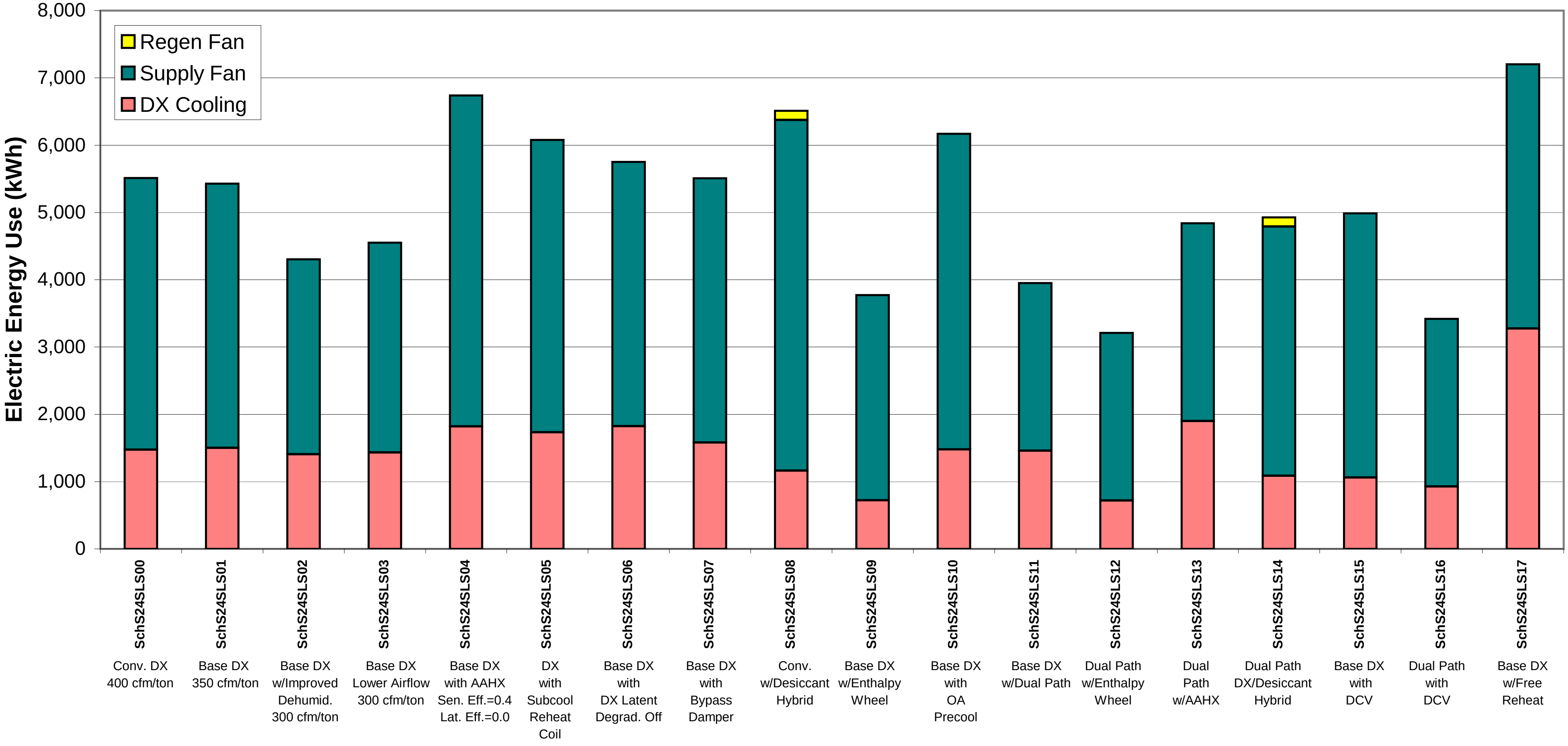


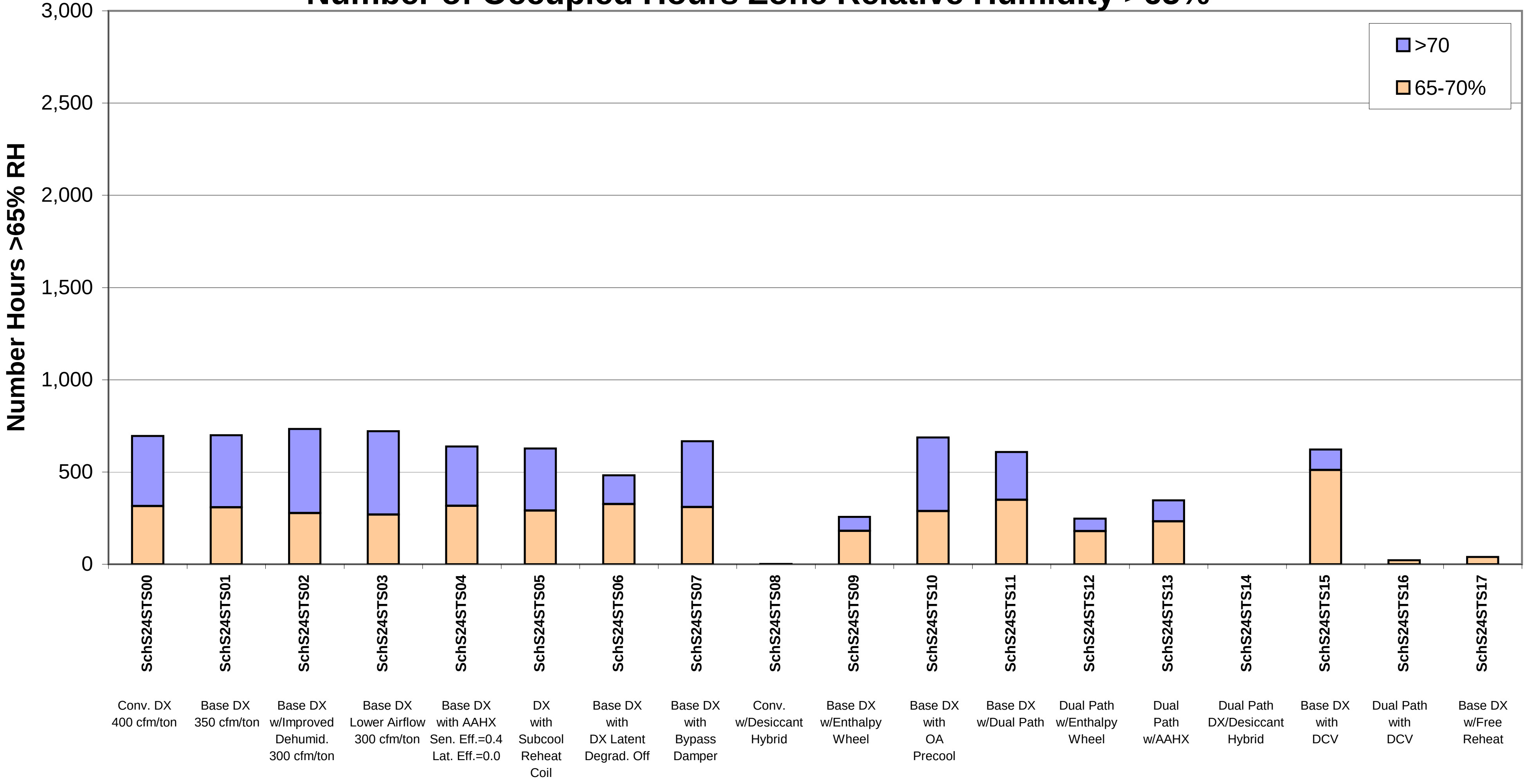
2001 Standard School-12 Month-South in Shreveport LA
Annual HVAC System Electric Energy Use




2001 Standard School-12 Month-South in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24SLS00
SchS24SLS01
SchS24SLS02
SchS24SLS03
SchS24SLS04
SchS24SLS05
SchS24SLS06
SchS24SLS07
SchS24SLS08
SchS24SLS09
SchS24SLS10
SchS24SLS11
SchS24SLS12
SchS24SLS13
SchS24SLS14
SchS24SLS15
SchS24SLS16
SchS24SLS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

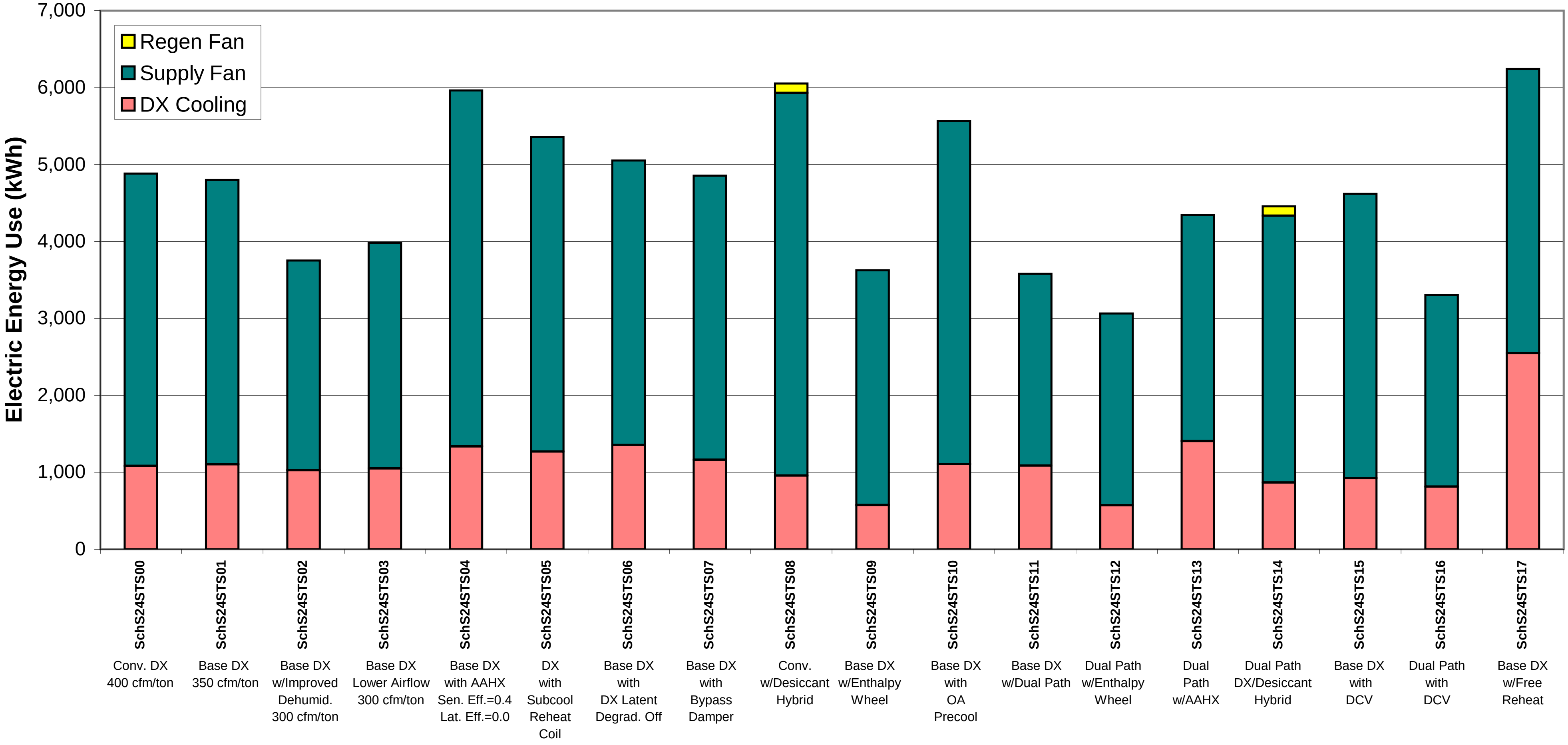
2001 Standard School-12 Month-South in St. Louis MO
Annual HVAC System Electric Energy Use



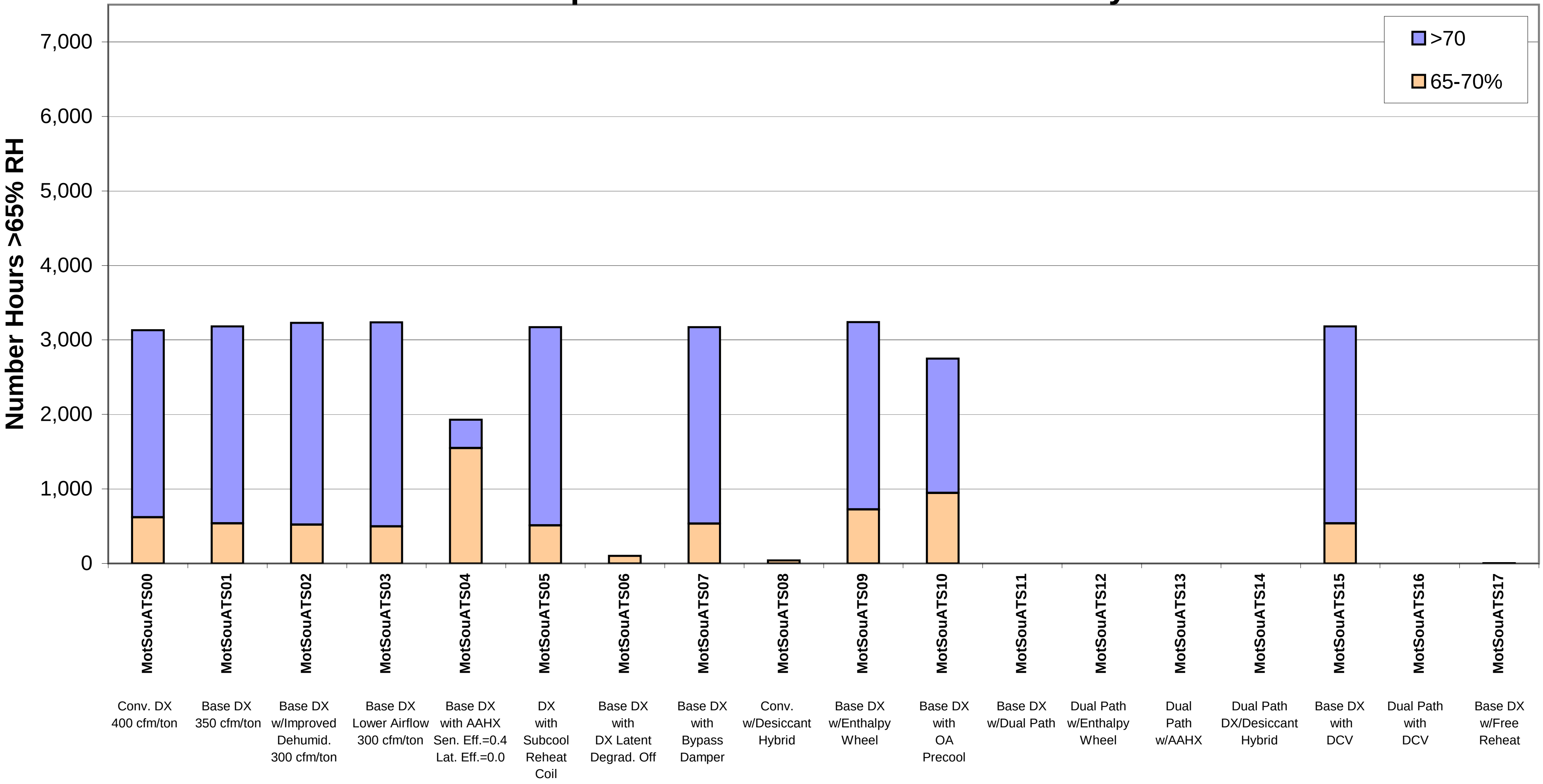


2001 Standard School-12 Month-South in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%

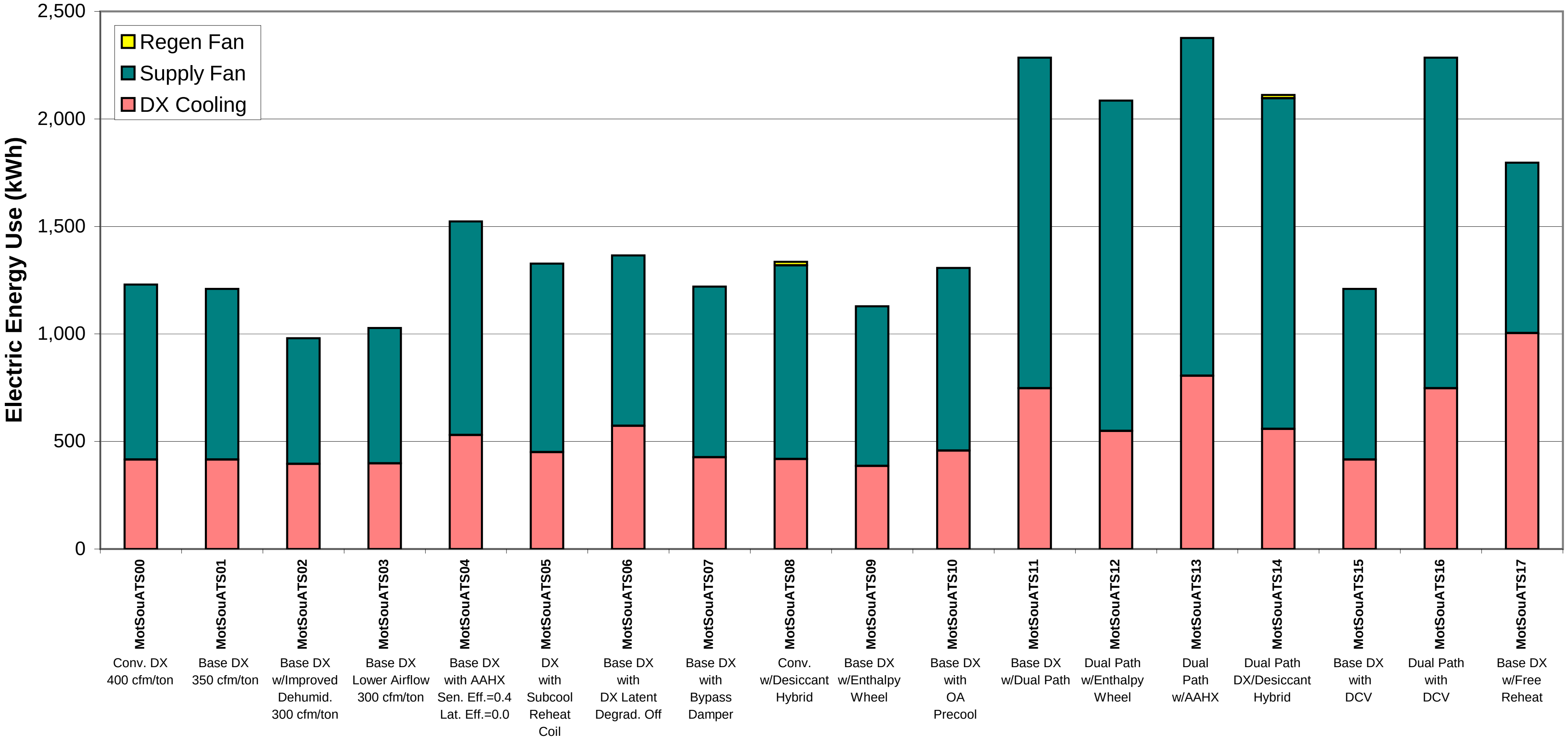
2001 Standard School-12 Month-South in Washington DC
Annual HVAC System Electric Energy Use



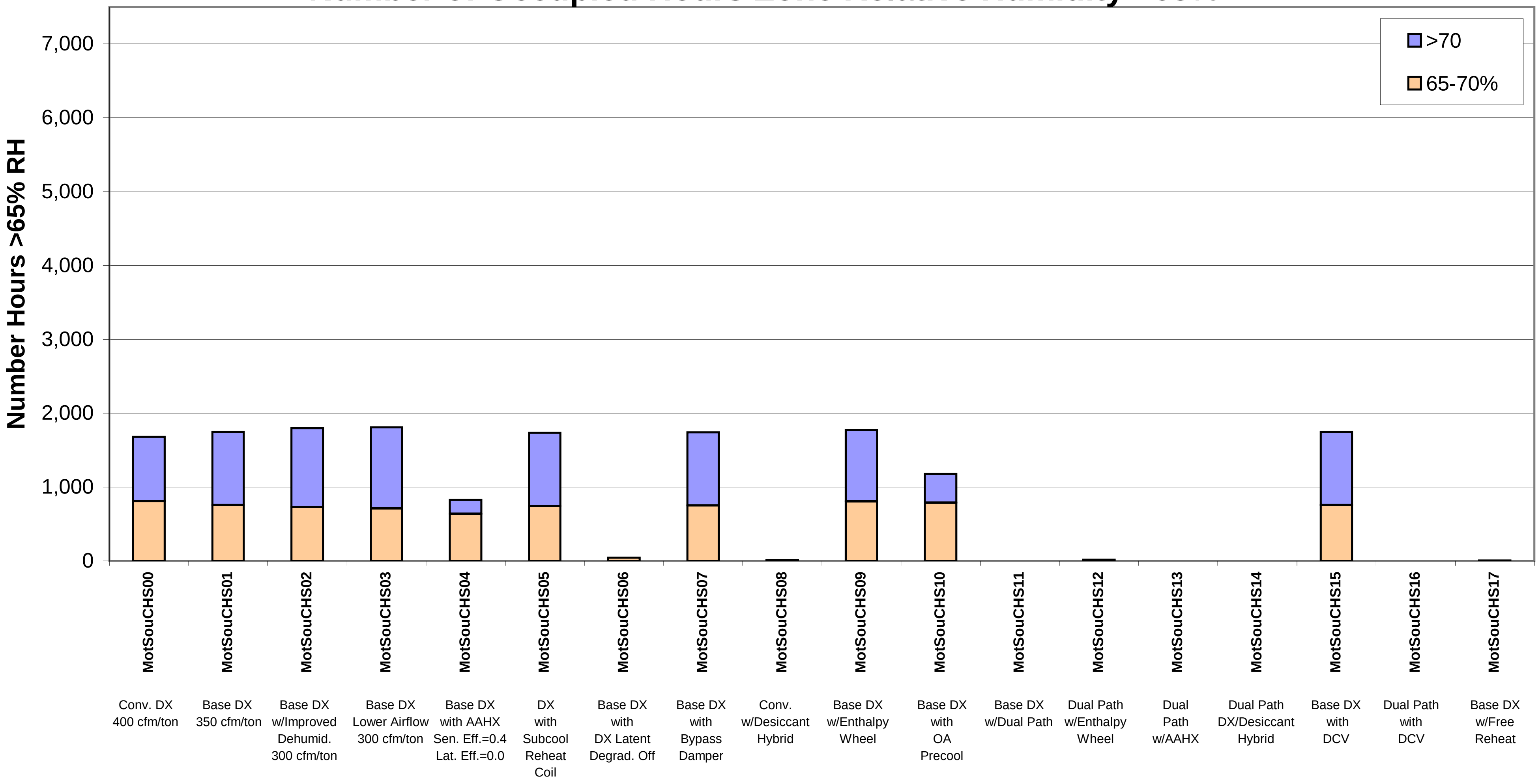
2001 Standard Motel-South in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



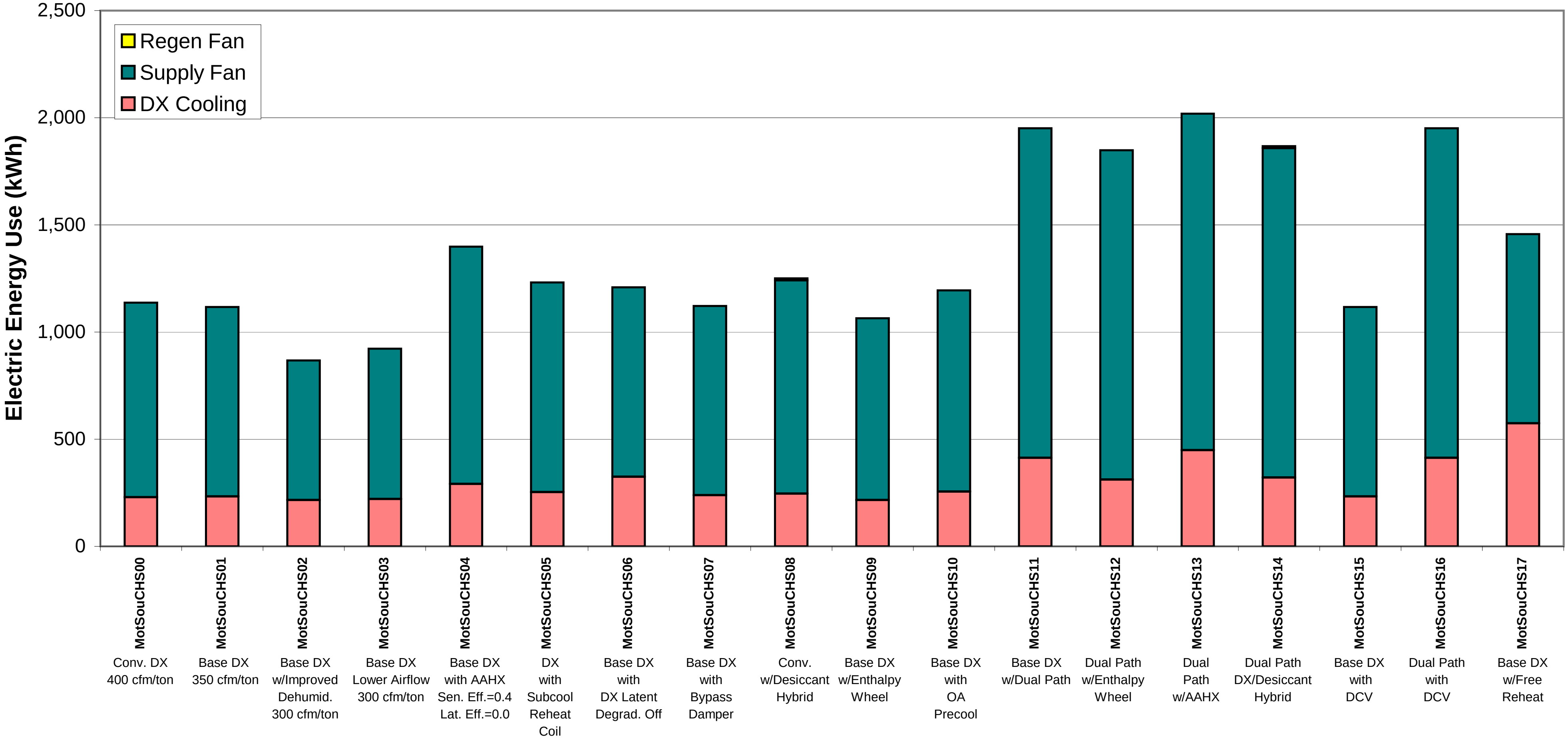
2001 Standard Motel-South in Atlanta GA
Annual HVAC System Electric Energy Use

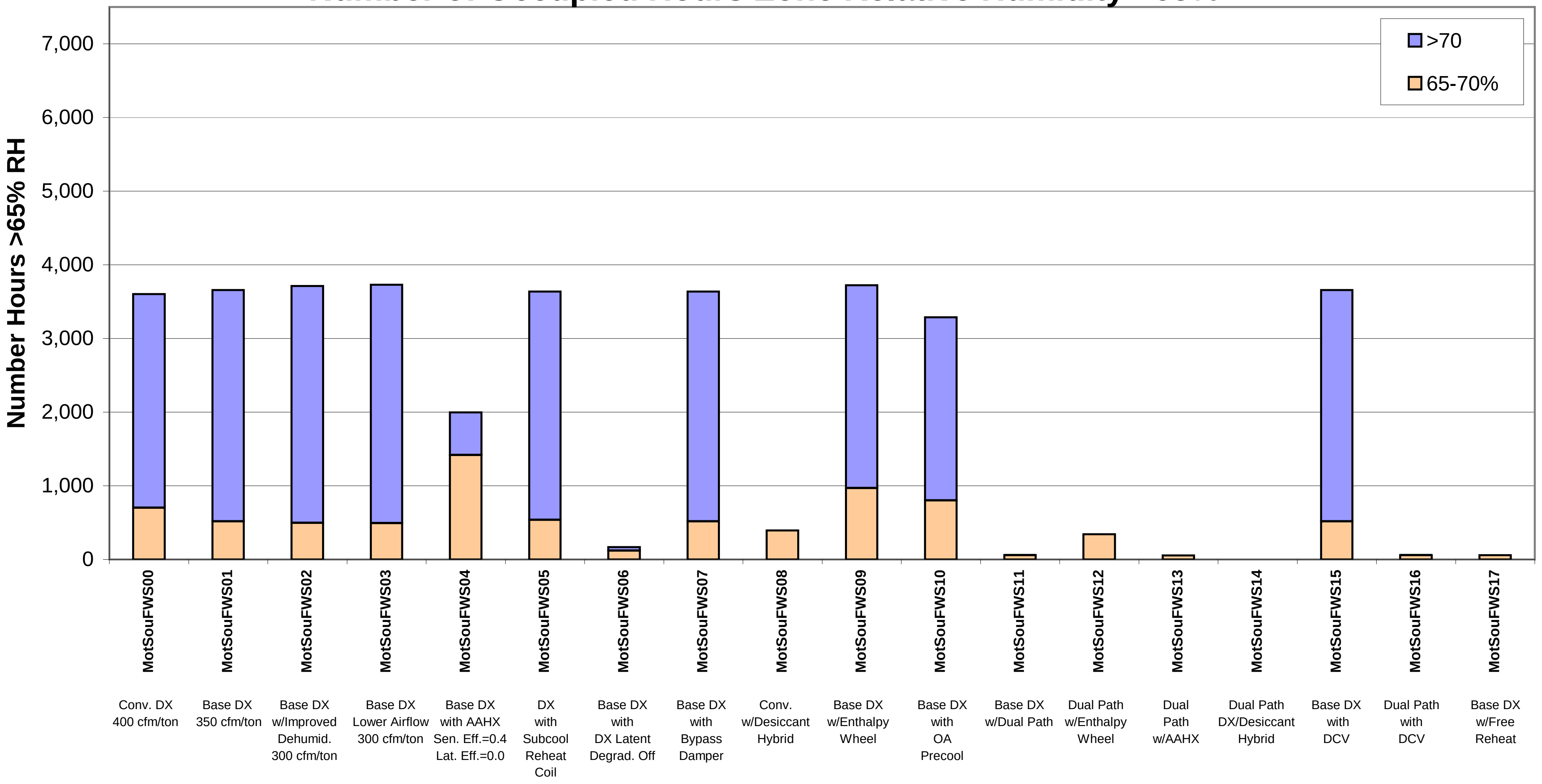


2001 Standard Motel-South in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



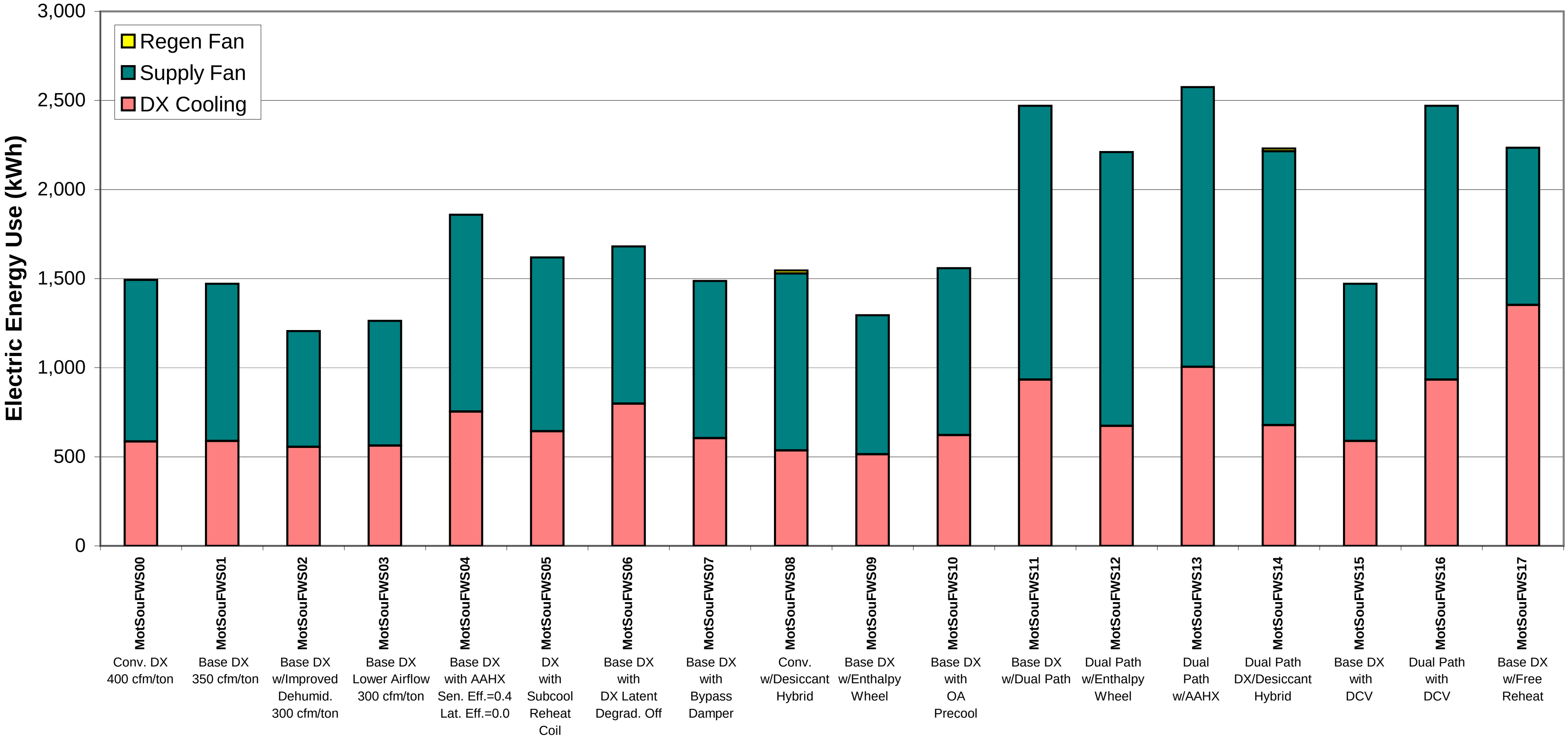
2001 Standard Motel-South in Chicago IL
Annual HVAC System Electric Energy Use



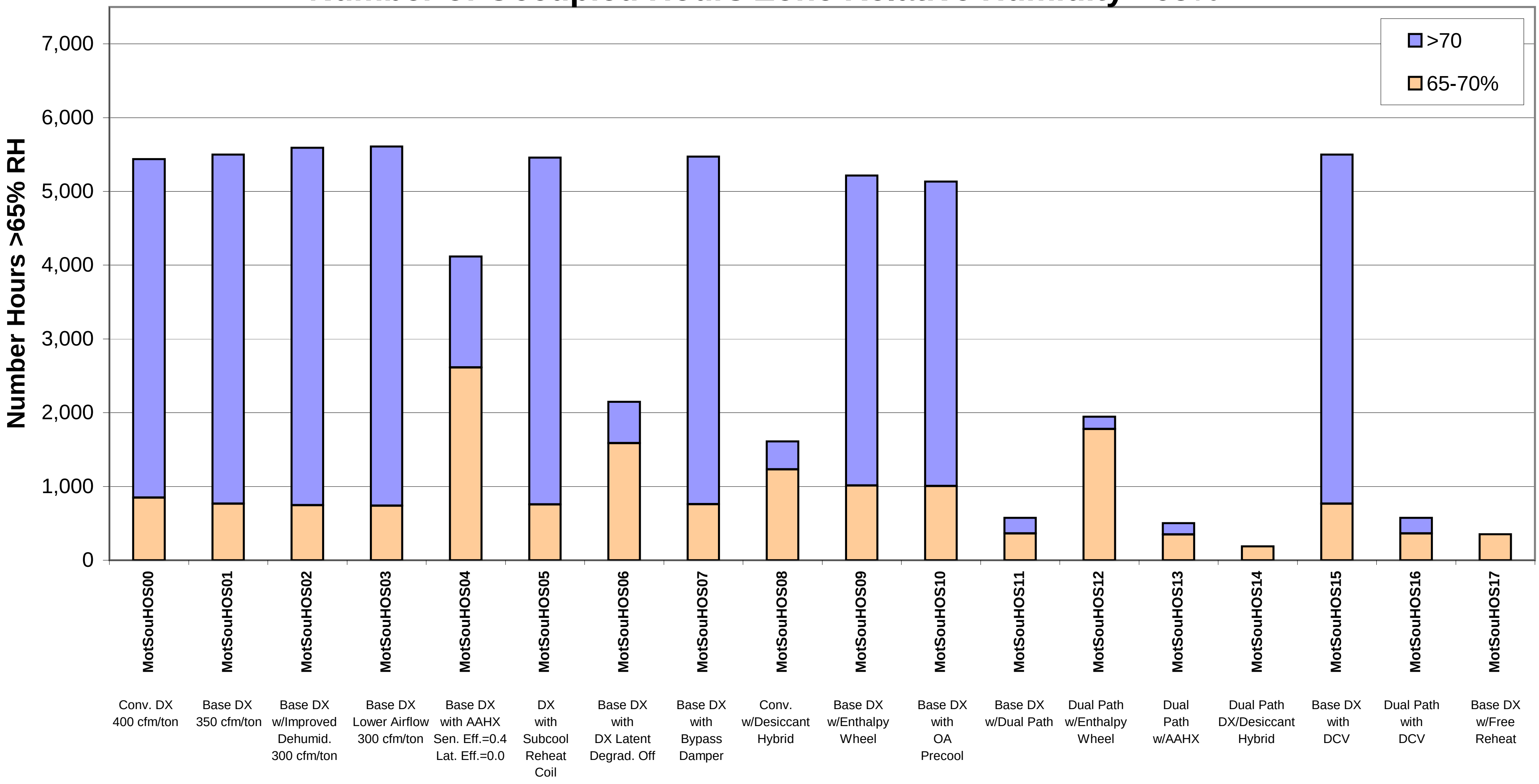


2001 Standard Motel-South in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%

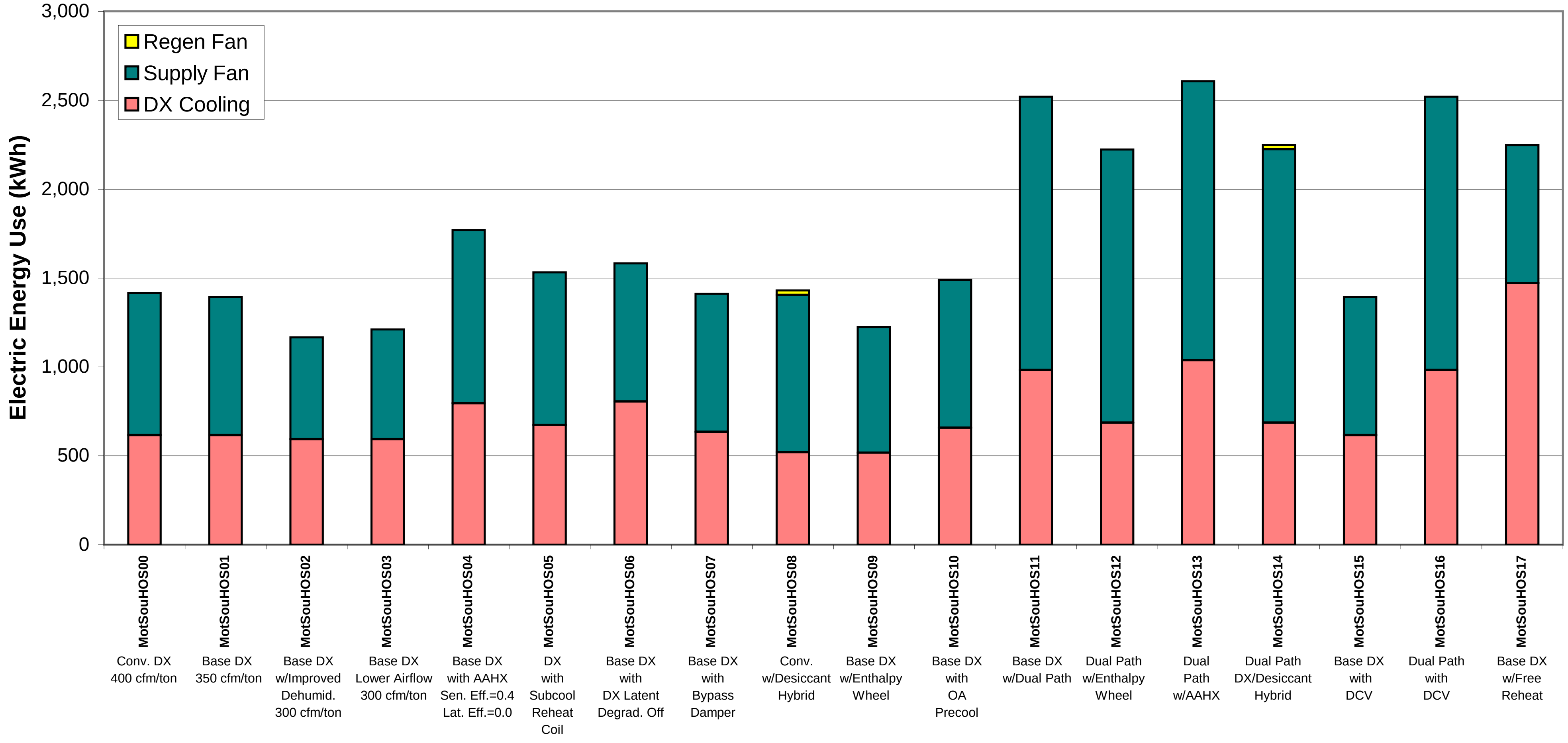
2001 Standard Motel-South in Fort Worth TX
Annual HVAC System Electric Energy Use



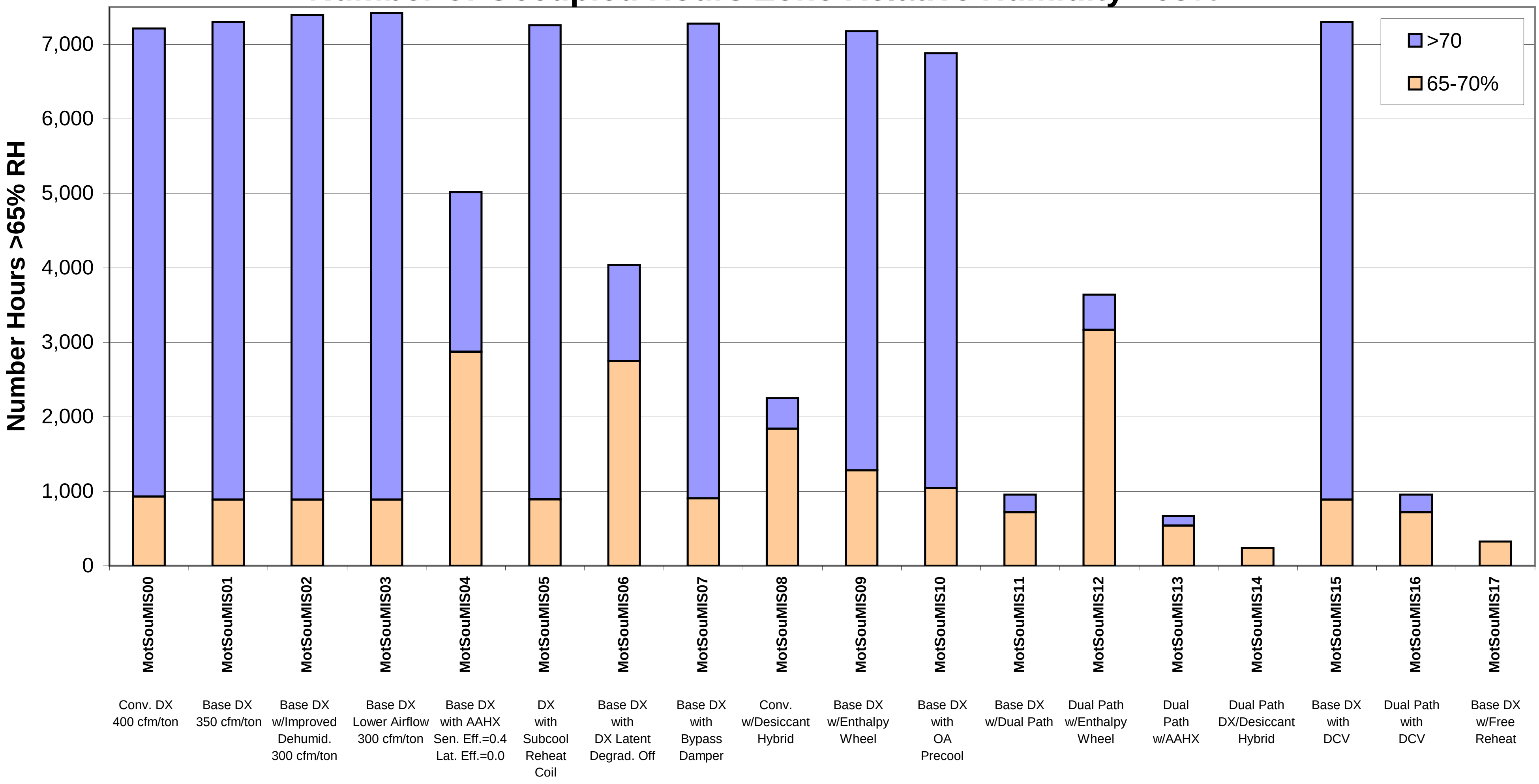
2001 Standard Motel-South in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



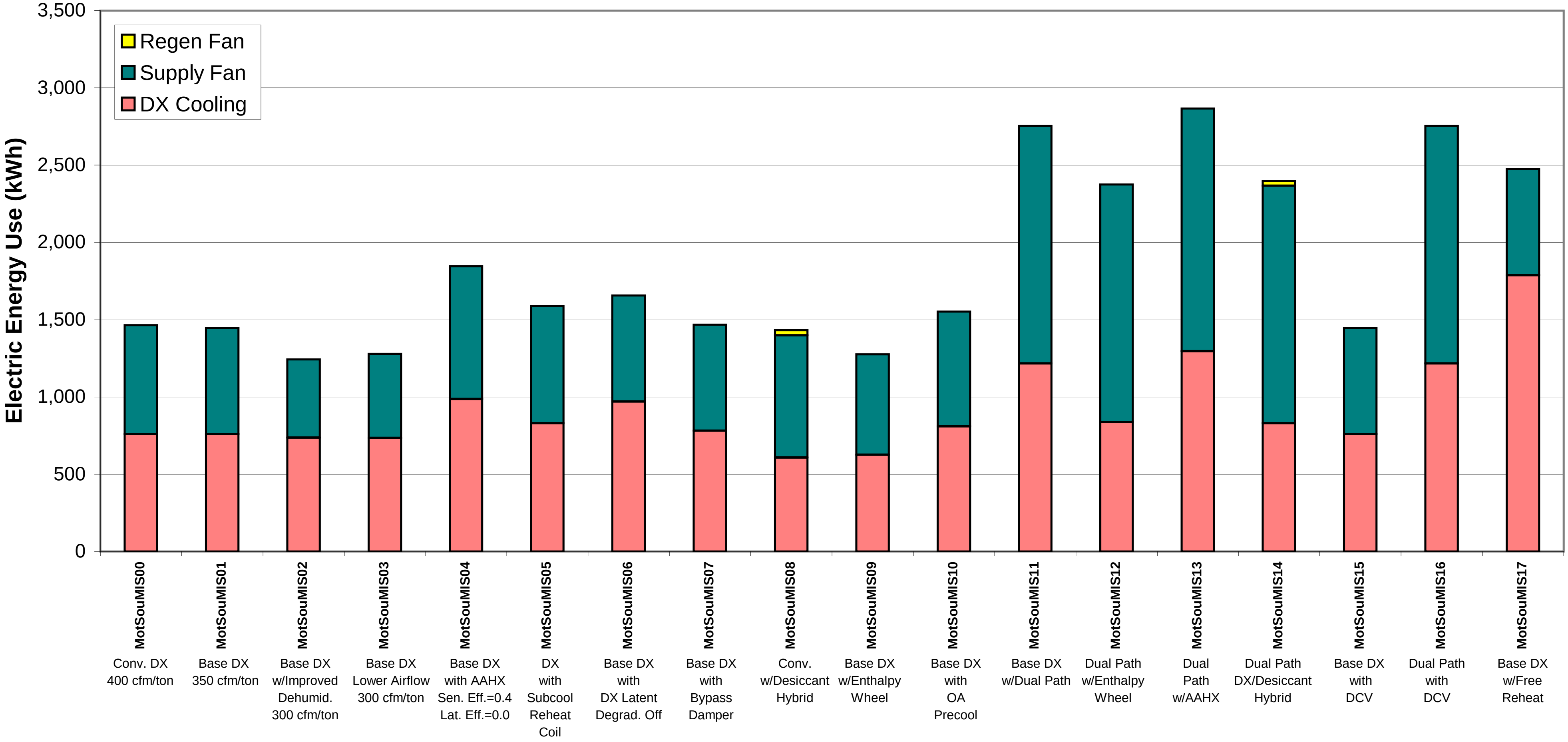
2001 Standard Motel-South in Houston TX
Annual HVAC System Electric Energy Use



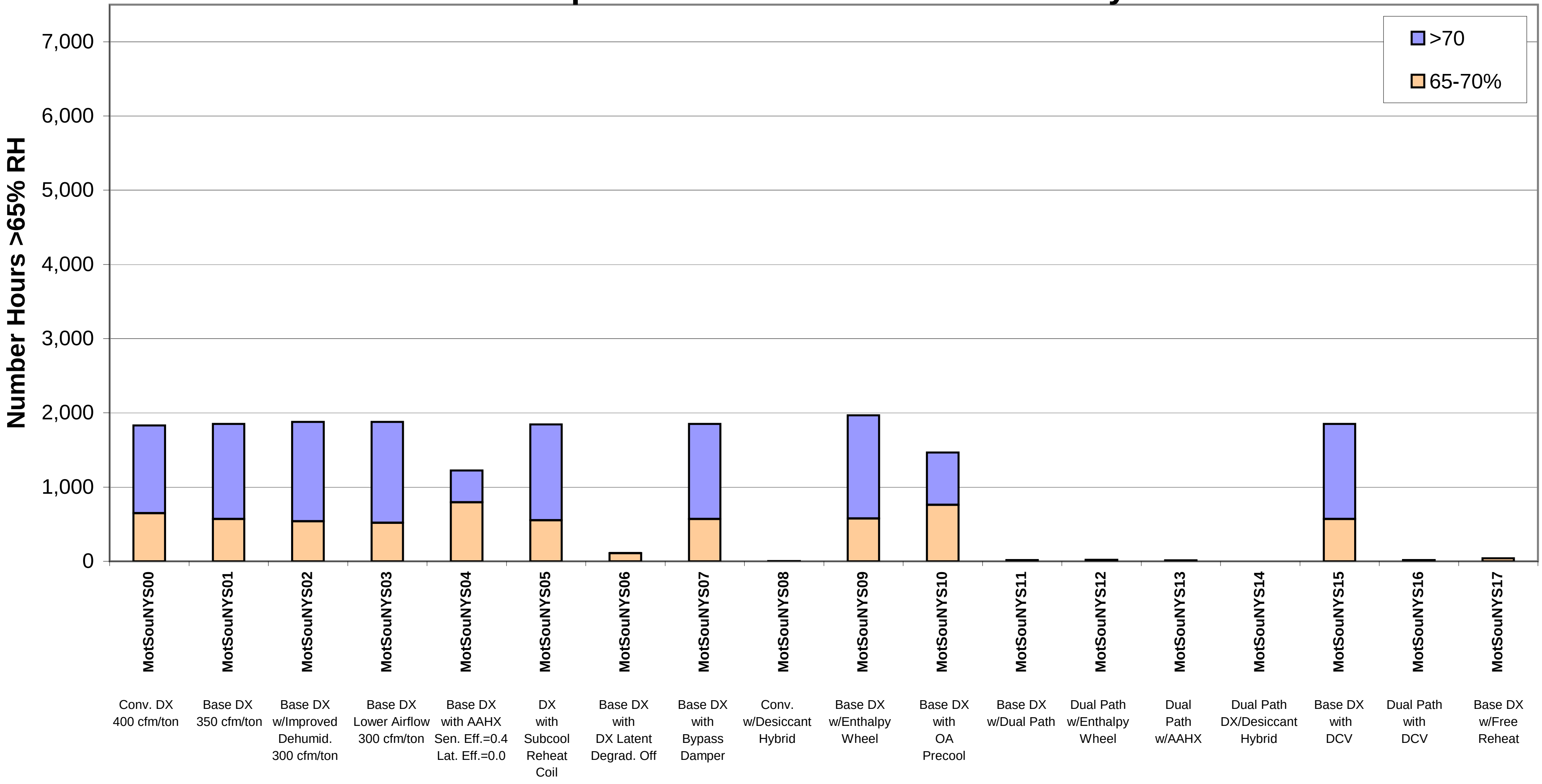
2001 Standard Motel-South in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



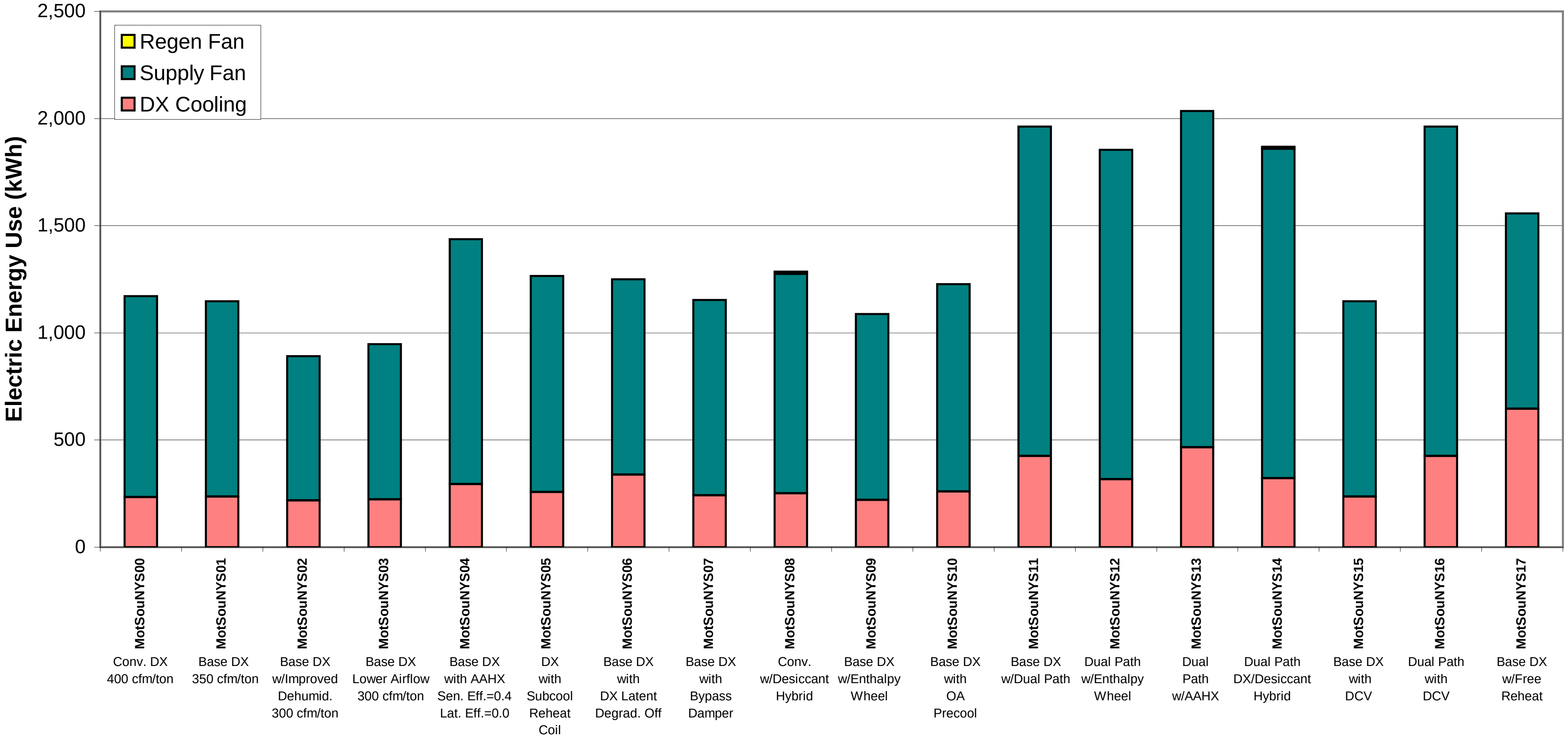
2001 Standard Motel-South in Miami FL
Annual HVAC System Electric Energy Use



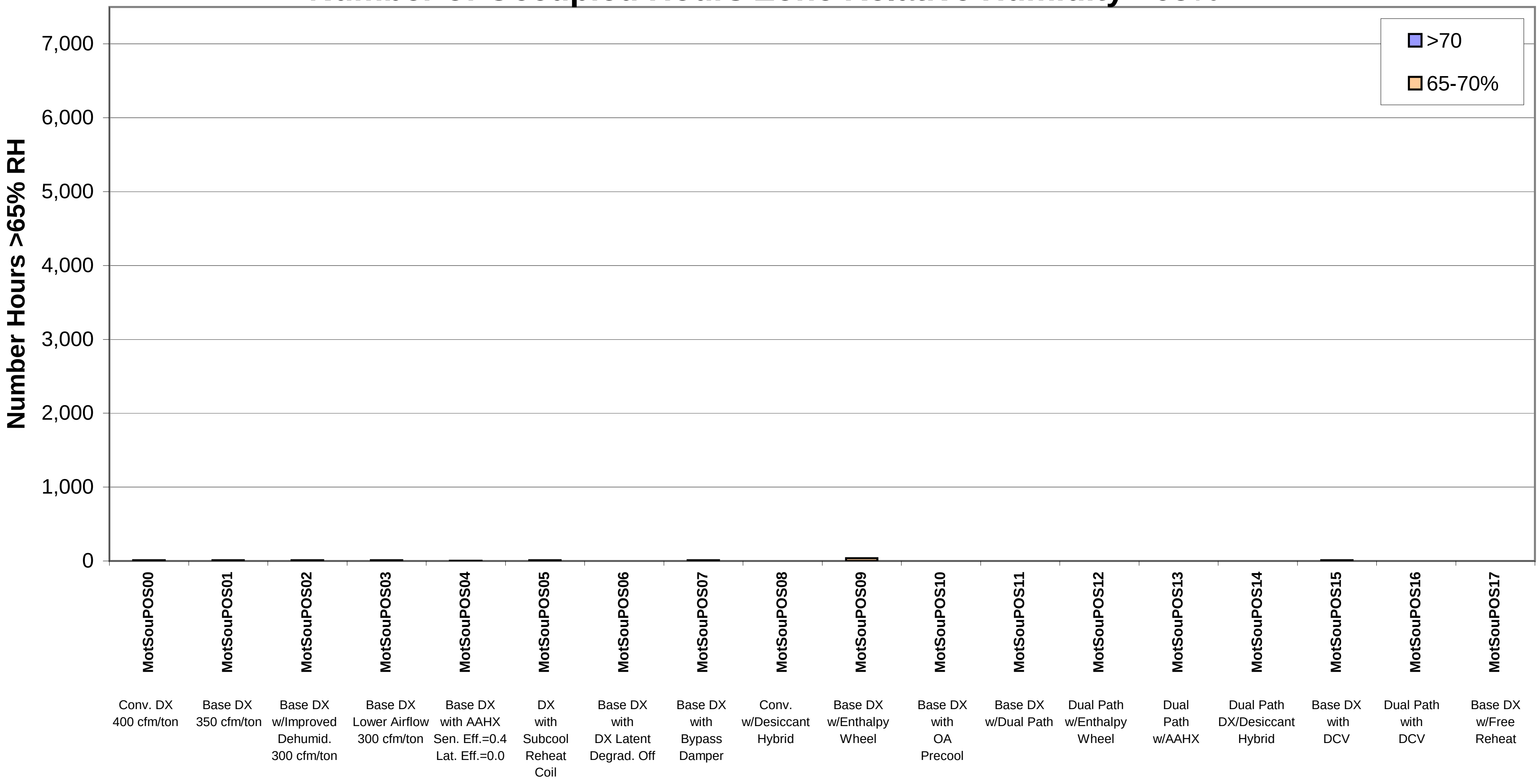
2001 Standard Motel-South in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



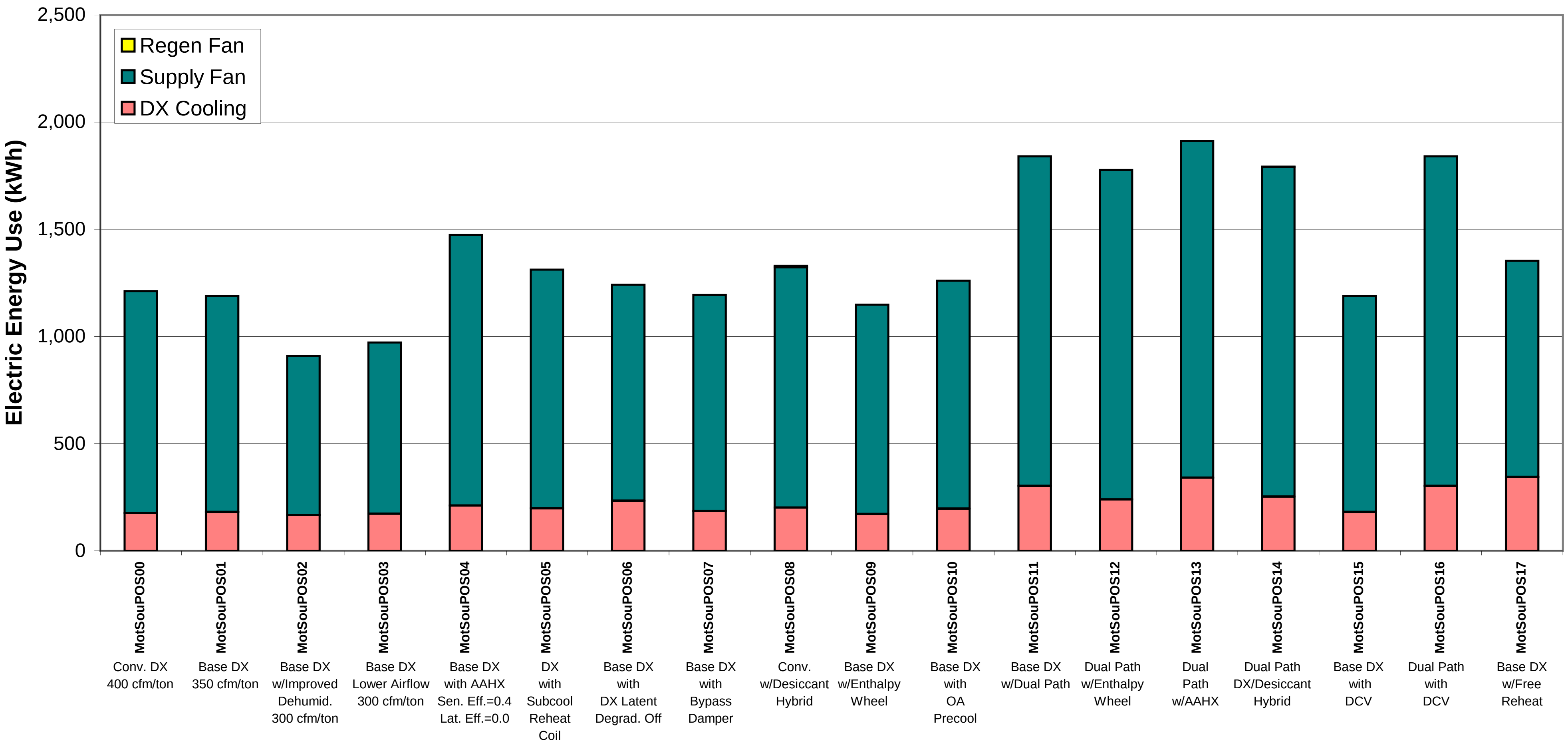
2001 Standard Motel-South in New York NY
Annual HVAC System Electric Energy Use



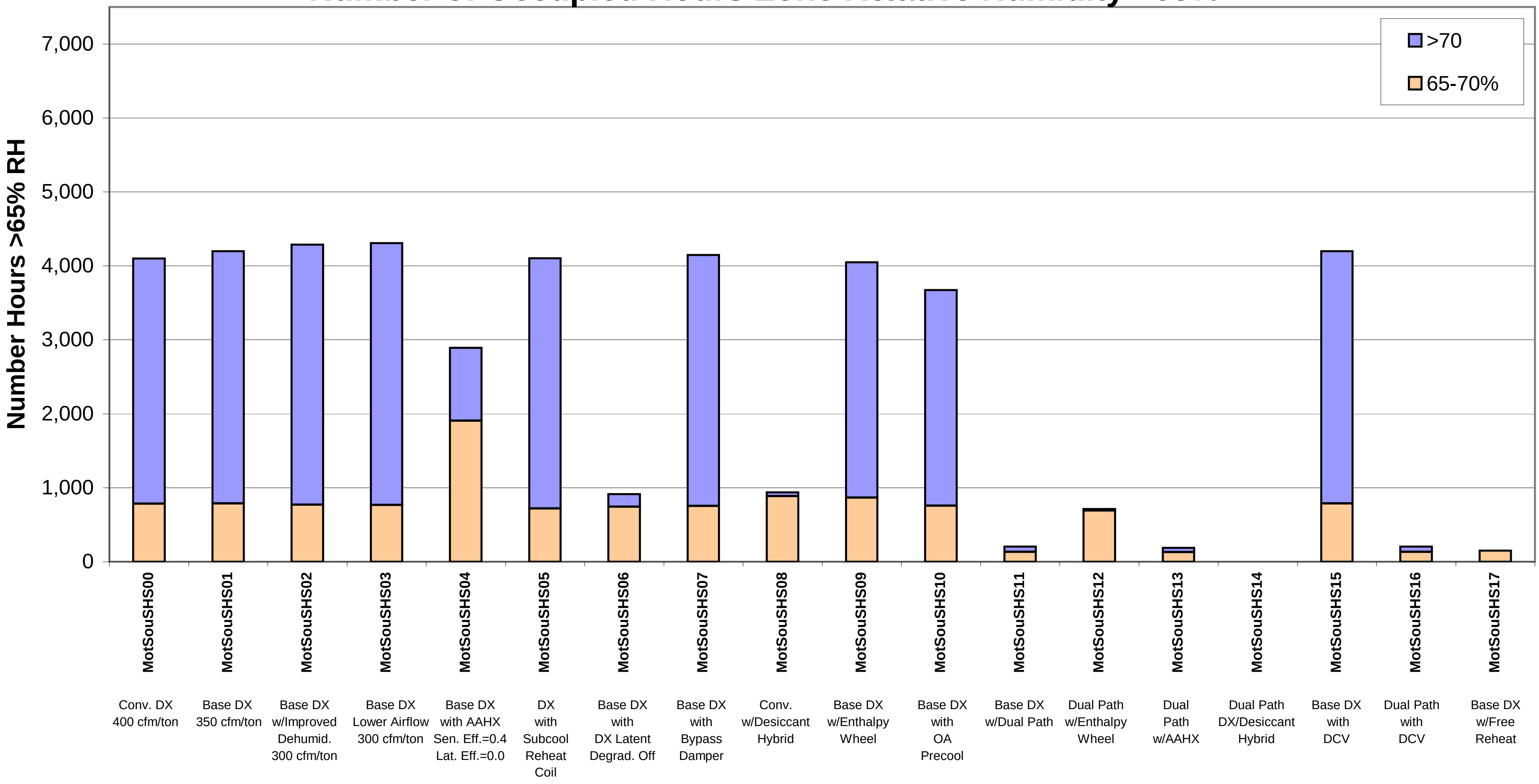
2001 Standard Motel-South in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



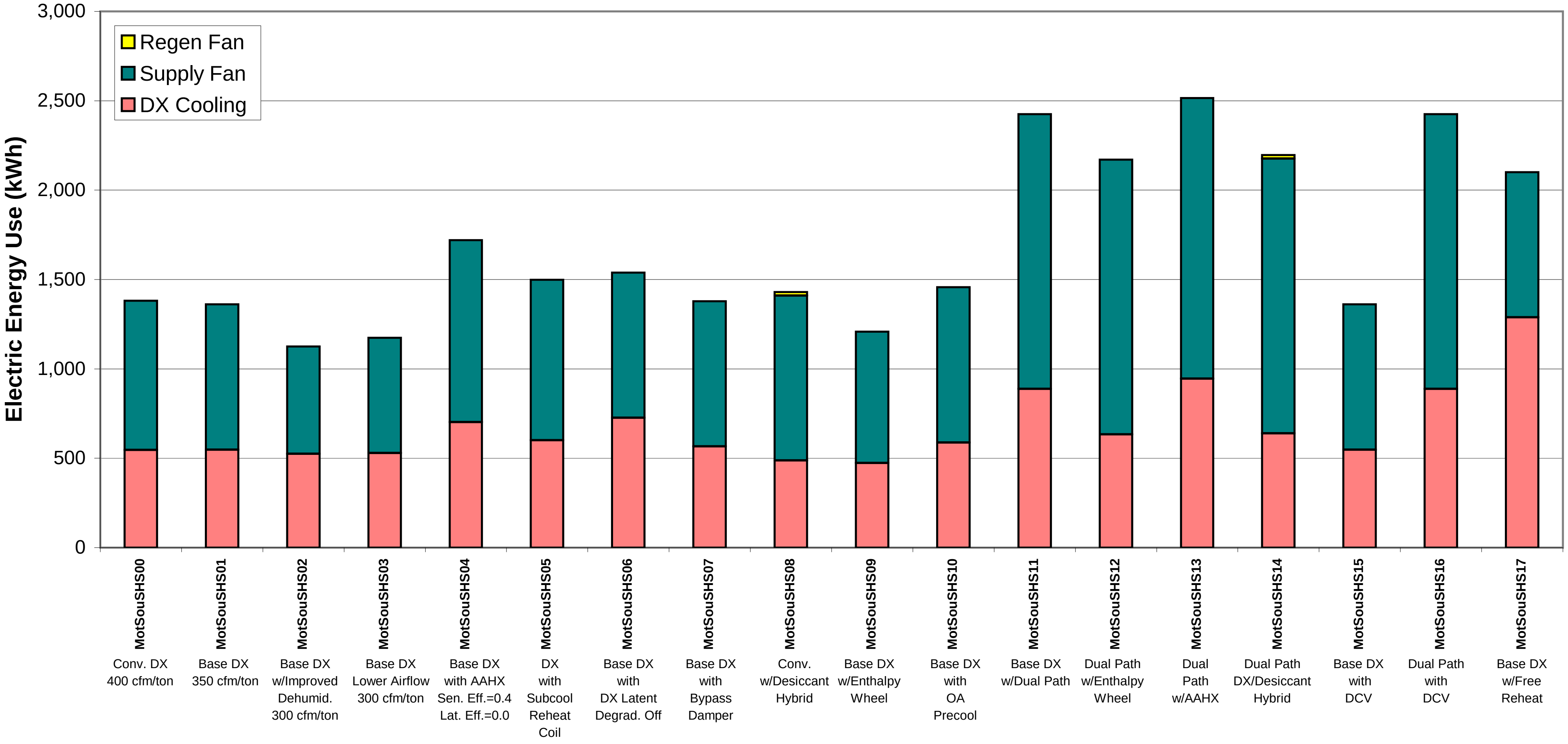
2001 Standard Motel-South in Portland OR
Annual HVAC System Electric Energy Use



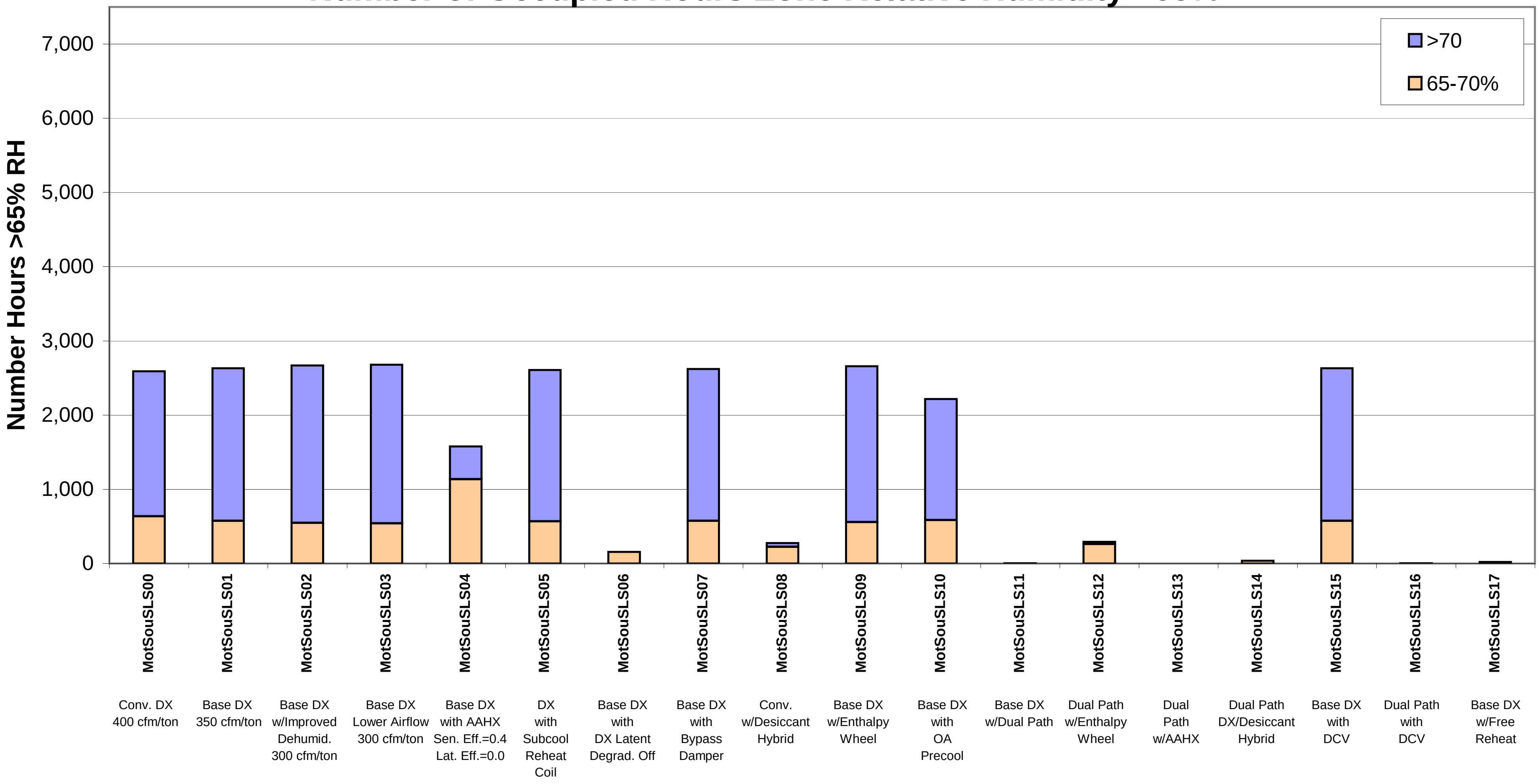
2001 Standard Motel-South in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



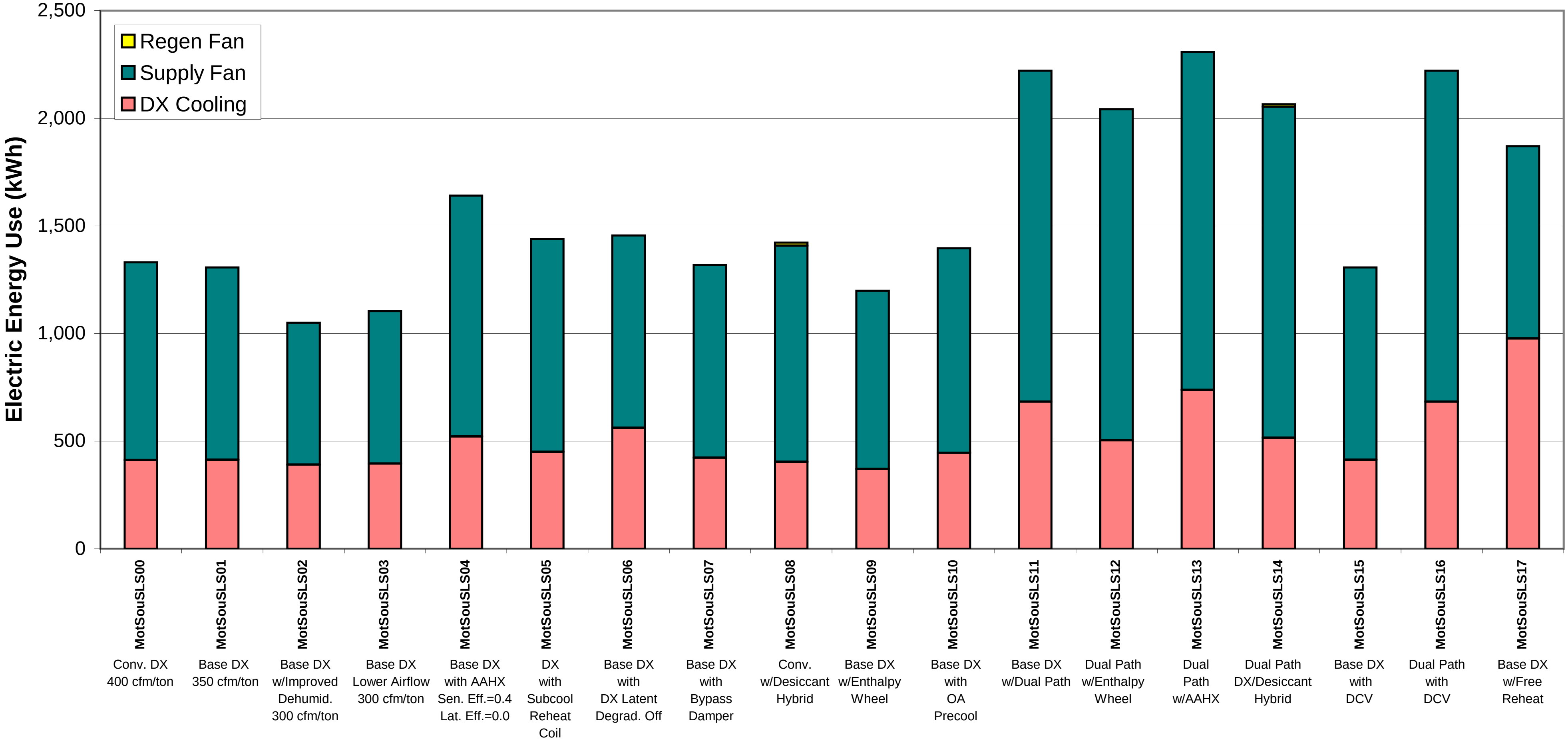
2001 Standard Motel-South in Shreveport LA
Annual HVAC System Electric Energy Use



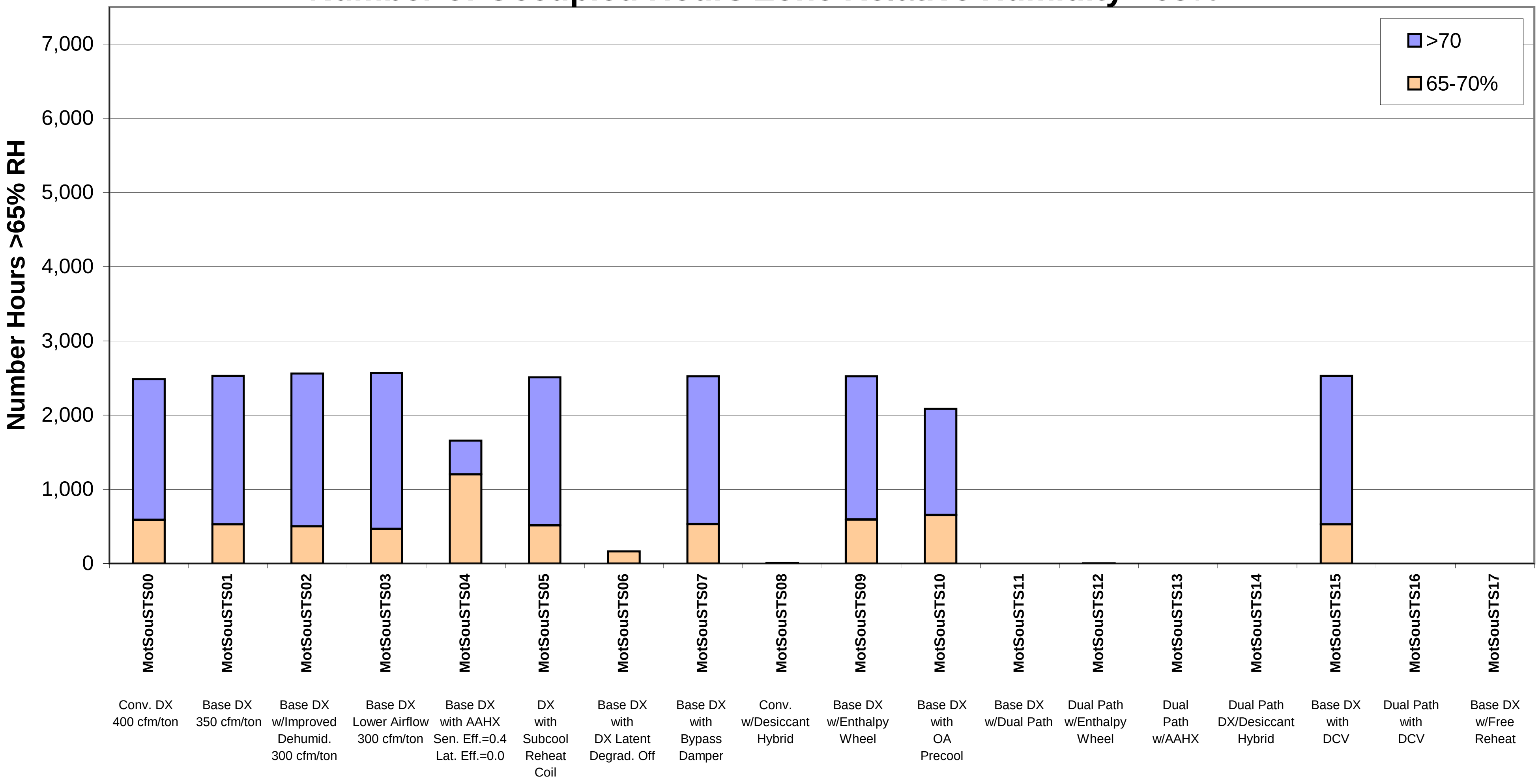
2001 Standard Motel-South in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



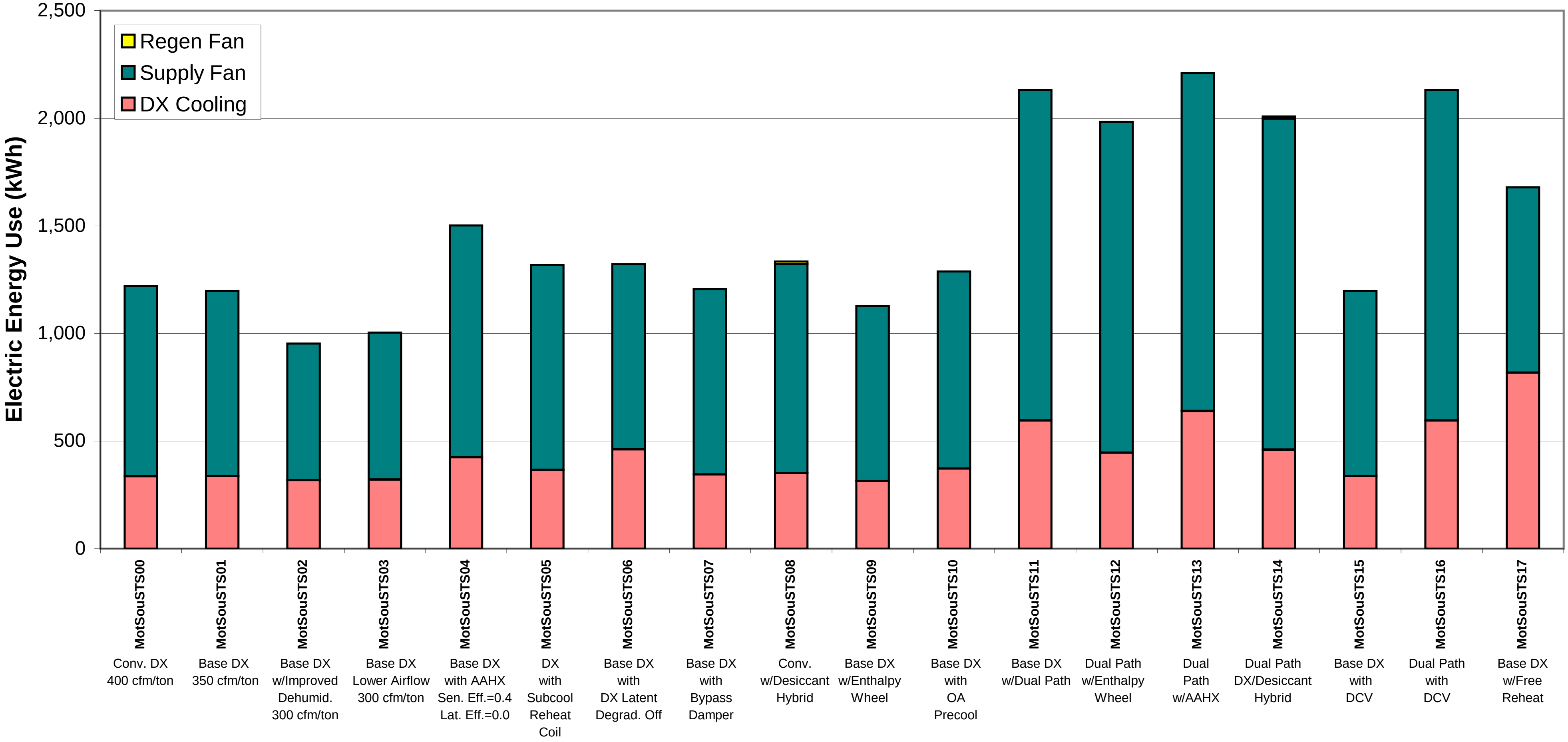
2001 Standard Motel-South in St. Louis MO
Annual HVAC System Electric Energy Use



2001 Standard Motel-South in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



2001 Standard Motel-South in Washington DC
Annual HVAC System Electric Energy Use



Office

2001 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	229	134	45	41	10	12	6	2	1	0
01	Base DX	228	111	44	43	7	14	5	5	1	0
02	DX w/Improved Dehumid.	284	135	49	66	8	17	7	5	0	0
03	Base DX w/Lower Airflow	314	148	58	84	10	23	9	9	1	0
04	Base DX w/AAHX	113	54	21	28	2	4	3	0	0	0
05	Base DX w/Subcool Reheat	128	63	29	29	2	9	2	0	0	0
06	Base DX w/o Lat. Coil Degrad.	8	5	2	0	0	0	0	0	0	0
07	Base DX w/Bypass Damper	160	81	30	32	3	8	3	1	0	0
08	Base DX w/Desiccant	0	0	0	0	0	0	0	0	0	0
09	Base DX w/Enthalpy Wheel	0	0	0	0	0	0	0	0	0	0
10	Base DX w/OA Precool	450	349	142	238	19	18	69	36	4	0
11	Dual Path	0	4	0	0	0	0	0	0	0	0
12	Dual Path w/Enthalpy Wheel	0	0	0	0	0	0	0	0	0	0
13	Dual Path w/AAHX	0	1	0	0	0	0	0	0	0	0
14	Dual Path w/Desiccant	0	0	0	0	0	0	0	0	0	0
15	Base DX w/DCV	0	0	0	0	0	0	0	0	0	0
16	Dual Path w/DCV	0	0	0	0	0	0	0	0	0	0
17	Base DX w/Free Reheat	0	1	0	0	0	0	0	0	0	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	40	41	40	44	38	46	43	61	47	38
01	Base DX	41	43	41	45	40	47	44	63	48	40
02	DX w/Improved Dehumid.	43	45	43	47	42	50	48	66	52	43
03	Base DX w/Lower Airflow	40	42	41	44	39	47	44	62	48	40
04	Base DX w/AAHX	50	52	49	54	47	54	51	74	56	46
05	Base DX w/Subcool Reheat	44	46	44	48	42	49	47	67	51	42
06	Base DX w/o Lat. Coil Degrad.	43	44	43	46	41	48	45	65	49	41
07	Base DX w/Bypass Damper	43	45	43	47	42	49	47	66	51	42
08	Base DX w/Desiccant	67	58	55	56	49	54	50	71	52	45
09	Base DX w/Enthalpy Wheel	36	36	35	38	34	39	35	55	40	37
10	Base DX w/OA Precool	45	47	45	49	44	51	49	69	53	44
11	Dual Path	45	46	44	49	43	51	49	67	52	43
12	Dual Path w/Enthalpy Wheel	37	37	36	39	36	40	37	57	42	39
13	Dual Path w/AAHX	49	50	48	53	47	55	52	72	56	47
14	Dual Path w/Desiccant	68	60	56	58	52	56	54	74	55	49
15	Base DX w/DCV	38	40	38	42	36	41	39	57	42	37
16	Dual Path w/DCV	41	43	41	46	39	44	43	60	45	40
17	Base DX w/Free Reheat	48	48	45	49	42	50	47	66	50	41

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

Office

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.62	1.68	1.67	1.75	1.50	1.90	1.59	2.47	1.84	1.29
01	Base DX	1.65	1.70	1.69	1.77	1.51	1.90	1.59	2.47	1.85	1.28
02	DX w/Improved Dehumid.	1.47	1.51	1.52	1.56	1.39	1.78	1.49	2.20	1.72	1.17
03	Base DX w/Lower Airflow	1.54	1.58	1.58	1.63	1.43	1.81	1.52	2.27	1.75	1.20
04	Base DX w/AAHX	1.99	2.03	1.98	2.09	1.72	2.10	1.76	2.79	2.02	1.41
05	Base DX w/Subcool Reheat	1.81	1.85	1.82	1.91	1.60	1.99	1.66	2.61	1.92	1.33
06	Base DX w/o Lat. Coil Degrad.	1.73	1.77	1.75	1.84	1.55	1.94	1.63	2.52	1.88	1.31
07	Base DX w/Bypass Damper	1.70	1.74	1.72	1.80	1.53	1.92	1.61	2.48	1.86	1.28
08	Base DX w/Desiccant	3.09	2.39	2.29	2.19	1.83	1.98	1.61	2.51	1.65	1.25
09	Base DX w/Enthalpy Wheel	1.37	1.38	1.38	1.44	1.24	1.41	1.12	2.01	1.35	1.14
10	Base DX w/OA Precool	1.72	1.77	1.75	1.82	1.58	1.98	1.65	2.58	1.92	1.35
11	Dual Path	1.56	1.59	1.58	1.66	1.41	1.79	1.51	2.22	1.71	1.15
12	Dual Path w/Enthalpy Wheel	1.25	1.24	1.24	1.31	1.12	1.28	1.02	1.80	1.21	1.04
13	Dual Path w/AAHX	1.75	1.75	1.72	1.82	1.53	1.90	1.60	2.40	1.81	1.23
14	Dual Path w/Desiccant	2.81	2.16	2.06	1.97	1.66	1.77	1.46	2.22	1.48	1.15
15	Base DX w/DCV	1.45	1.48	1.46	1.58	1.27	1.46	1.20	2.07	1.38	1.08
16	Dual Path w/DCV	1.33	1.34	1.32	1.43	1.12	1.29	1.07	1.74	1.19	0.90
17	Base DX w/Free Reheat	2.08	2.01	1.89	1.96	1.61	1.99	1.67	2.57	1.89	1.29

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	66	67	66	69	59	64	68	63	69	54
01	Base DX	67	68	67	70	60	64	69	63	69	53
02	DX w/Improved Dehumid.	60	60	59	61	53	57	62	57	63	47
03	Base DX w/Lower Airflow	63	63	62	64	55	59	64	58	64	49
04	Base DX w/AAHX	82	81	79	83	70	73	79	71	76	60
05	Base DX w/Subcool Reheat	74	74	72	76	64	68	73	67	72	56
06	Base DX w/o Lat. Coil Degrad.	71	70	69	73	61	65	70	65	70	55
07	Base DX w/Bypass Damper	69	69	68	71	60	64	70	64	69	54
08	Base DX w/Desiccant	103	91	83	84	69	67	70	64	63	54
09	Base DX w/Enthalpy Wheel	56	55	54	57	50	50	52	51	52	48
10	Base DX w/OA Precool	70	70	69	72	63	67	72	66	72	57
11	Dual Path	64	63	62	65	55	58	63	57	63	47
12	Dual Path w/Enthalpy Wheel	50	49	49	52	45	45	47	46	46	44
13	Dual Path w/AAHX	72	69	68	72	60	64	69	62	67	51
14	Dual Path w/Desiccant	94	83	76	76	63	60	64	57	57	50
15	Base DX w/DCV	59	59	59	63	53	54	57	52	54	47
16	Dual Path w/DCV	54	53	53	57	46	46	50	44	46	39
17	Base DX w/Free Reheat	85	80	75	77	64	68	73	66	71	54

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

MI = Miami FL
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Office

2001 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	8.6	9.3	9.4	10.5	8.7	9.0	9.2	9.4	8.6	9.0
01	Base DX	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
02	DX w/Improved Dehumid.	9.4	10.1	10.2	11.4	9.4	9.8	10.0	10.2	9.4	9.8
03	Base DX w/Lower Airflow	9.7	10.4	10.6	11.8	9.7	10.2	10.3	10.5	9.7	10.2
04	Base DX w/AAHX	9.2	9.9	10.0	11.2	9.3	9.7	9.8	10.0	9.2	9.7
05	Base DX w/Subcool Reheat	9.2	9.9	10.0	11.1	9.2	9.6	9.8	10.0	9.2	9.6
06	Base DX w/o Lat. Coil Degrad.	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
07	Base DX w/Bypass Damper	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
08	Base DX w/Desiccant	8.7	9.3	9.4	10.5	8.7	9.1	9.2	9.4	8.7	9.1
09	Base DX w/Enthalpy Wheel	7.2	7.2	7.3	8.0	6.9	7.4	7.2	7.8	7.1	7.7
10	Base DX w/OA Precool	8.9	9.6	9.7	10.8	8.9	9.3	9.4	9.7	8.9	9.3
11	Dual Path	9.2	9.9	10.0	11.0	9.2	9.6	9.7	9.9	9.2	9.6
12	Dual Path w/Enthalpy Wheel	6.9	7.0	7.0	7.7	6.7	7.1	6.9	7.5	6.9	7.4
13	Dual Path w/AAHX	9.2	9.8	9.9	11.0	9.2	9.6	9.7	9.9	9.2	9.6
14	Dual Path w/Desiccant	8.8	9.4	9.5	10.6	8.8	9.2	9.3	9.5	8.8	9.2
15	Base DX w/DCV	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
16	Dual Path w/DCV	9.2	9.9	10.0	11.0	9.2	9.6	9.7	9.9	9.2	9.6
17	Base DX w/Free Reheat	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	16	17	16	18	17	18	20	26	20	20
01	Base DX	17	18	17	20	18	20	21	27	22	21
02	DX w/Improved Dehumid.	22	23	21	24	22	24	26	34	27	26
03	Base DX w/Lower Airflow	18	20	18	21	19	21	22	29	23	22
04	Base DX w/AAHX	21	23	21	24	22	24	26	34	27	26
05	Base DX w/Subcool Reheat	19	20	18	21	19	21	23	29	23	23
06	Base DX w/o Lat. Coil Degrad.	18	19	18	20	18	20	22	28	22	22
07	Base DX w/Bypass Damper	19	20	19	22	20	22	23	30	24	23
08	Base DX w/Desiccant	23	23	22	24	23	25	27	35	28	27
09	Base DX w/Enthalpy Wheel	17	17	15	17	17	18	19	26	21	20
10	Base DX w/OA Precool	20	22	20	23	21	23	25	32	25	25
11	Dual Path	22	23	22	25	23	25	27	35	28	27
12	Dual Path w/Enthalpy Wheel	20	20	18	20	20	22	23	31	24	24
13	Dual Path w/AAHX	24	25	23	27	25	27	29	38	30	29
14	Dual Path w/Desiccant	27	28	26	30	28	30	33	42	34	33
15	Base DX w/DCV	18	19	17	20	18	20	22	28	22	21
16	Dual Path w/DCV	22	24	22	25	23	25	27	35	28	27
17	Base DX w/Free Reheat	18	20	18	21	19	21	23	29	23	22

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

MI = Miami FL
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Office

2001 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
01	Base DX	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
02	DX w/Improved Dehumid.	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
03	Base DX w/Lower Airflow	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
04	Base DX w/AAHX	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
05	Base DX w/Subcool Reheat	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
06	Base DX w/o Lat. Coil Degrad.	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
07	Base DX w/Bypass Damper	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
08	Base DX w/Desiccant	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
09	Base DX w/Enthalpy Wheel	4.7	4.7	4.8	5.2	4.5	4.9	4.7	5.1	4.7	5.0
10	Base DX w/OA Precool	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
11	Dual Path	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
12	Dual Path w/Enthalpy Wheel	4.7	4.8	4.8	5.3	4.6	4.9	4.8	5.1	4.7	5.1
13	Dual Path w/AAHX	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
14	Dual Path w/Desiccant	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
15	Base DX w/DCV	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
16	Dual Path w/DCV	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3
17	Base DX w/Free Reheat	6.1	6.5	6.6	7.3	6.1	6.4	6.4	6.6	6.0	6.3

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
00	Conventional DX	2159	1864	1766	1681	1590	1457	1533	1276	1356	1154
01	Base DX	2200	1892	1791	1702	1603	1461	1542	1270	1355	1139
02	DX w/Improved Dehumid.	1932	1630	1536	1443	1359	1219	1296	1024	1110	904
03	Base DX w/Lower Airflow	2029	1720	1621	1526	1430	1285	1366	1086	1175	956
04	Base DX w/AAHX	2696	2324	2197	2084	1964	1791	1891	1560	1665	1400
05	Base DX w/Subcool Reheat	2432	2092	1971	1873	1752	1602	1690	1396	1482	1241
06	Base DX w/o Lat. Coil Degrad.	2312	1976	1865	1780	1666	1514	1599	1314	1400	1178
07	Base DX w/Bypass Damper	2266	1942	1831	1739	1630	1483	1567	1285	1370	1140
08	Base DX w/Desiccant	2115	1865	1793	1708	1701	1563	1623	1397	1487	1303
09	Base DX w/Enthalpy Wheel	1801	1530	1464	1384	1402	1293	1316	1151	1228	1079
10	Base DX w/OA Precool	2303	1978	1873	1758	1705	1559	1636	1356	1451	1249
11	Dual Path	2067	1736	1631	1570	1421	1271	1353	1060	1121	892
12	Dual Path w/Enthalpy Wheel	1625	1364	1301	1242	1236	1143	1162	1008	1066	946
13	Dual Path w/AAHX	2341	1951	1832	1759	1625	1452	1541	1218	1298	1056
14	Dual Path w/Desiccant	1974	1733	1660	1601	1553	1426	1484	1258	1327	1161
15	Base DX w/DCV	1928	1715	1658	1600	1557	1438	1494	1268	1335	1196
16	Dual Path w/DCV	1753	1532	1466	1440	1315	1201	1266	1017	1057	916
17	Base DX w/Free Reheat	2814	2293	2057	1913	1749	1584	1675	1352	1422	1144

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Office

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
00	Conventional DX	1.1	1.1	1.2	1.0	1.2	1.2	1.2	1.0	1.1	0.9
01	Base DX	1.2	1.1	1.3	1.1	1.3	1.3	1.3	1.0	1.1	0.9
02	DX w/Improved Dehumid.	1.1	1.1	1.2	1.1	1.1	1.2	1.2	1.0	1.1	0.9
03	Base DX w/Lower Airflow	1.1	1.1	1.2	1.1	1.2	1.3	1.3	1.0	1.1	0.9
04	Base DX w/AAHX	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.1
05	Base DX w/Subcool Reheat	1.3	1.3	1.4	1.4	1.3	1.3	1.4	1.2	1.3	1.0
06	Base DX w/o Lat. Coil Degrad.	1.2	1.2	1.3	1.2	1.3	1.3	1.3	1.1	1.2	0.9
07	Base DX w/Bypass Damper	1.2	1.2	1.3	1.2	1.3	1.3	1.3	1.1	1.2	0.9
08	Base DX w/Desiccant	1.0	0.9	1.0	0.9	1.0	1.1	1.1	0.9	1.0	0.8
09	Base DX w/Enthalpy Wheel	0.9	0.8	0.9	0.8	0.9	0.9	1.0	0.8	0.9	0.8
10	Base DX w/OA Precool	1.2	1.2	1.3	1.1	1.2	1.3	1.3	1.1	1.2	0.9
11	Dual Path	1.1	1.1	1.2	1.0	1.2	1.2	1.2	1.0	1.1	0.9
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.9	0.8	0.9	0.9	0.9	0.7	0.8	0.7
13	Dual Path w/AAHX	1.1	1.2	1.3	1.1	1.2	1.2	1.2	1.1	1.2	1.0
14	Dual Path w/Desiccant	0.9	0.9	1.0	0.9	1.0	1.0	1.0	0.8	0.9	0.8
15	Base DX w/DCV	1.0	0.9	1.1	1.0	1.0	1.0	1.1	0.9	1.0	0.8
16	Dual Path w/DCV	1.0	1.0	1.1	1.0	1.0	1.1	1.1	0.9	1.0	0.8
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	0.9

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
00	Conventional DX	309	807	949	851	1359	1958	2129	2284	3161	1921
01	Base DX	311	812	955	857	1367	1968	2139	2298	3176	1932
02	DX w/Improved Dehumid.	337	861	1014	917	1437	2072	2239	2431	3314	2052
03	Base DX w/Lower Airflow	332	851	1002	905	1423	2051	2219	2404	3286	2028
04	Base DX w/AAHX	286	763	899	801	1296	1871	2041	2170	3036	1821
05	Base DX w/Subcool Reheat	301	791	931	833	1335	1928	2098	2244	3116	1886
06	Base DX w/o Lat. Coil Degrad.	310	806	952	855	1365	1967	2138	2297	3174	1931
07	Base DX w/Bypass Damper	311	812	955	857	1367	1968	2139	2298	3176	1932
08	Base DX w/Desiccant	4448	3292	2637	2142	2050	1976	2059	1980	2190	1495
09	Base DX w/Enthalpy Wheel	314	646	762	708	959	1110	1122	1451	1740	1587
10	Base DX w/OA Precool	313	814	959	862	1374	1977	2149	2312	3187	1946
11	Dual Path	328	828	976	874	1405	2026	2194	2370	3252	1998
12	Dual Path w/Enthalpy Wheel	306	622	731	678	924	1062	1078	1392	1669	1535
13	Dual Path w/AAHX	315	805	950	851	1371	1982	2150	2315	3188	1946
14	Dual Path w/Desiccant	3943	2847	2275	1744	1841	1712	1832	1672	1975	1448
15	Base DX w/DCV	278	512	596	532	781	995	1042	1201	1604	1122
16	Dual Path w/DCV	292	514	593	527	783	996	1053	1201	1616	1122
17	Base DX w/Free Reheat	309	805	953	856	1367	1968	2138	2298	3175	1932

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Office

2001 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	8.6	9.3	9.4	10.5	8.7	9.0	9.2	9.4	8.6	9.0
01	Base DX	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
02	DX w/Improved Dehumid.	9.4	10.1	10.2	11.4	9.4	9.8	10.0	10.2	9.4	9.8
03	Base DX w/Lower Airflow	9.7	10.4	10.6	11.8	9.7	10.2	10.3	10.5	9.7	10.2
04	Base DX w/AAHX	9.2	9.9	10.0	11.2	9.3	9.7	9.8	10.0	9.2	9.7
05	Base DX w/Subcool Reheat	9.2	9.9	10.0	11.1	9.2	9.6	9.8	10.0	9.2	9.6
06	Base DX w/o Lat. Coil Degrad.	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
07	Base DX w/Bypass Damper	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
08	Base DX w/Desiccant	8.7	9.3	9.4	10.5	8.7	9.1	9.2	9.4	8.6	9.1
09	Base DX w/Enthalpy Wheel	7.2	7.2	7.2	8.0	6.9	7.4	7.2	7.8	7.1	7.7
10	Base DX w/OA Precool	7.4	8.0	8.2	9.3	7.4	7.8	7.9	8.1	7.3	7.8
11	Dual Path	5.6	5.5	5.5	5.5	5.6	5.5	5.5	5.5	5.6	5.5
12	Dual Path w/Enthalpy Wheel	2.2	2.2	2.2	2.1	2.2	2.2	2.2	2.2	2.2	2.2
13	Dual Path w/AAHX	5.1	5.1	5.1	5.0	5.1	5.1	5.1	5.1	5.1	5.1
14	Dual Path w/Desiccant	2.1	2.0	2.0	1.9	2.1	2.0	2.0	2.0	2.1	2.0
15	Base DX w/DCV	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6
16	Dual Path w/DCV	5.6	5.5	5.5	5.5	5.6	5.5	5.5	5.5	5.6	5.5
17	Base DX w/Free Reheat	9.2	9.9	10.0	11.1	9.2	9.6	9.7	9.9	9.1	9.6

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
11	Dual Path	3.6	4.3	4.4	5.6	3.7	4.1	4.2	4.4	3.6	4.1
12	Dual Path w/Enthalpy Wheel	4.7	4.8	4.8	5.5	4.5	4.9	4.7	5.3	4.7	5.2
13	Dual Path w/AAHX	4.1	4.8	4.9	6.0	4.1	4.5	4.6	4.8	4.1	4.5
14	Dual Path w/Desiccant	6.7	7.4	7.5	8.7	6.7	7.1	7.3	7.5	6.7	7.1
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	3.6	4.3	4.4	5.6	3.7	4.1	4.2	4.4	3.6	4.1
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Restaurant

2001 Standard

Occupied Hours when RH>65%

[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	4550	3669	2662	2092	2011	1489	1911	947	819	40
01	Base DX	4554	3656	2650	2039	2015	1489	1459	946	813	40
02	DX w/Improved Dehumid.	4598	3698	2722	2167	2063	1540	1530	1007	855	45
03	Base DX w/Lower Airflow	4583	3658	2684	2114	2049	1520	1489	987	844	44
04	Base DX w/AAHX	3992	3218	2273	1939	1887	1361	1245	926	711	44
05	Base DX w/Subcool Reheat	4442	3486	2505	1729	1888	1369	1340	872	755	39
06	Base DX w/o Lat. Coil Degrad.	4140	3287	2304	1398	1650	1206	1171	730	623	36
07	Base DX w/Bypass Damper	4500	3563	2572	1853	1948	1432	1389	910	783	40
08	Base DX w/Desiccant	53	234	63	4	0	4	51	0	7	0
09	Base DX w/Enthalpy Wheel	4485	3675	2621	1821	2057	1542	1459	1042	774	44
10	Base DX w/OA Precool	4521	3810	3017	2250	2012	1508	1960	965	838	40
11	Dual Path	4525	3581	2604	1989	1936	1436	1431	921	808	47
12	Dual Path w/Enthalpy Wheel	4551	3760	2834	2255	2279	1690	1716	1130	913	49
13	Dual Path w/AAHX	3433	2812	1988	1131	1445	1112	1023	793	662	44
14	Dual Path w/Desiccant	0	8	0	0	0	0	0	0	0	0
15	Base DX w/DCV	4549	3645	2861	3580	2290	1825	1891	1329	1295	27
16	Dual Path w/DCV	4575	3675	2880	2529	2273	1803	1867	1343	1277	25
17	Base DX w/Free Reheat	465	625	430	249	416	336	266	257	232	37

Life Cycle Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	163	197	203	228	203	283	247	319	266	206
01	Base DX	165	200	206	232	206	286	250	323	269	209
02	DX w/Improved Dehumid.	168	202	208	232	211	292	260	324	277	219
03	Base DX w/Lower Airflow	158	192	199	223	202	283	248	313	267	208
04	Base DX w/AAHX	207	241	241	273	232	312	277	364	296	231
05	Base DX w/Subcool Reheat	182	217	220	251	216	296	260	339	279	217
06	Base DX w/o Lat. Coil Degrad.	174	208	212	241	211	290	254	329	273	211
07	Base DX w/Bypass Damper	174	209	214	243	213	293	258	333	277	216
08	Base DX w/Desiccant	572	437	416	386	368	368	329	412	291	255
09	Base DX w/Enthalpy Wheel	142	154	157	157	162	178	156	239	171	189
10	Base DX w/OA Precool	202	222	226	241	233	316	271	367	308	243
11	Dual Path	203	220	224	222	248	332	295	371	330	267
12	Dual Path w/Enthalpy Wheel	133	146	150	149	160	177	159	228	171	191
13	Dual Path w/AAHX	237	250	249	256	268	352	315	400	350	283
14	Dual Path w/Desiccant	559	428	408	380	365	366	334	400	292	261
15	Base DX w/DCV	135	151	142	180	127	135	135	200	138	118
16	Dual Path w/DCV	171	168	154	160	162	174	175	241	193	170
17	Base DX w/Free Reheat	233	255	247	272	232	308	270	350	284	214

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
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SH = Shreveport LA
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Restaurant

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	7.64	9.45	10.12	10.83	10.02	15.29	12.27	16.33	13.74	9.94
01	Base DX	7.56	9.37	10.07	10.78	9.97	15.25	12.13	16.22	13.70	9.91
02	DX w/Improved Dehumid.	6.78	8.43	9.19	9.46	9.31	14.62	11.58	14.82	13.09	9.43
03	Base DX w/Lower Airflow	6.83	8.58	9.37	9.79	9.46	14.76	11.70	15.14	13.21	9.54
04	Base DX w/AAHX	9.54	11.19	11.54	12.40	10.83	16.05	12.88	17.69	14.46	10.38
05	Base DX w/Subcool Reheat	8.49	10.24	10.81	11.72	10.42	15.65	12.52	16.93	14.06	10.11
06	Base DX w/o Lat. Coil Degrad.	8.12	9.87	10.49	11.40	10.30	15.49	12.36	16.60	13.89	9.97
07	Base DX w/Bypass Damper	7.79	9.57	10.23	10.96	10.05	15.32	12.20	16.29	13.75	9.91
08	Base DX w/Desiccant	32.24	22.45	21.60	18.45	17.87	17.42	13.88	17.67	11.20	9.30
09	Base DX w/Enthalpy Wheel	5.64	6.50	7.07	6.93	6.86	7.78	5.89	10.40	6.55	8.10
10	Base DX w/OA Precool	9.08	10.30	10.89	10.64	11.02	16.42	12.94	18.08	15.04	10.93
11	Dual Path	6.14	7.43	8.34	7.98	8.99	14.36	11.24	14.06	12.86	9.21
12	Dual Path w/Enthalpy Wheel	4.07	5.00	5.73	5.50	5.74	6.66	5.00	8.23	5.38	7.19
13	Dual Path w/AAHX	7.84	8.84	9.48	9.45	9.68	14.97	11.81	15.06	13.38	9.51
14	Dual Path w/Desiccant	30.12	20.52	19.83	16.52	16.38	16.01	12.72	15.00	9.82	8.38
15	Base DX w/DCV	5.35	5.85	5.53	7.04	4.42	4.78	4.07	7.61	4.50	3.47
16	Dual Path w/DCV	3.81	3.69	3.43	3.59	3.00	3.40	2.80	4.96	3.31	2.38
17	Base DX w/Free Reheat	12.07	12.96	12.66	13.22	11.58	16.52	13.24	17.73	14.43	9.95

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	315	370	377	421	349	433	461	429	481	375
01	Base DX	312	366	374	419	346	431	455	426	479	372
02	DX w/Improved Dehumid.	278	327	334	364	310	397	418	392	450	344
03	Base DX w/Lower Airflow	281	334	342	378	318	404	427	400	456	350
04	Base DX w/AAHX	396	440	439	485	391	472	503	461	513	401
05	Base DX w/Subcool Reheat	351	402	406	457	369	451	479	443	495	384
06	Base DX w/o Lat. Coil Degrad.	335	387	392	444	362	441	468	435	487	375
07	Base DX w/Bypass Damper	321	374	381	426	350	434	459	428	481	373
08	Base DX w/Desiccant	945	822	712	689	573	509	531	458	415	375
09	Base DX w/Enthalpy Wheel	231	254	263	267	254	254	253	268	249	314
10	Base DX w/OA Precool	376	404	407	413	394	479	494	472	535	424
11	Dual Path	251	287	296	303	291	379	393	374	438	330
12	Dual Path w/Enthalpy Wheel	165	193	205	209	197	199	198	215	196	263
13	Dual Path w/AAHX	323	344	345	363	327	410	428	398	462	348
14	Dual Path w/Desiccant	860	745	638	611	501	441	462	393	353	320
15	Base DX w/DCV	224	236	232	284	202	197	215	188	185	169
16	Dual Path w/DCV	159	149	142	144	133	132	140	124	133	113
17	Base DX w/Free Reheat	501	512	483	517	421	485	516	463	510	374

** Source Energy = Gas Energy + Electric Energy/31.3%*

Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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Restaurant

2001 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	28.4	33.0	33.6	41.2	29.9	30.0	32.0	30.2	28.2	28.2
01	Base DX	30.1	35.0	35.6	43.8	31.8	31.8	34.0	32.1	29.9	29.9
02	DX w/Improved Dehumid.	30.8	35.8	36.5	44.8	32.5	32.6	34.8	32.9	30.6	30.7
03	Base DX w/Lower Airflow	31.9	37.1	37.7	46.4	33.6	33.7	36.0	34.0	31.7	31.7
04	Base DX w/AAHX	30.3	35.2	35.9	44.1	32.0	32.0	34.2	32.3	30.1	30.1
05	Base DX w/Subcool Reheat	30.2	35.1	35.7	43.9	31.9	31.9	34.0	32.2	30.0	30.0
06	Base DX w/o Lat. Coil Degrad.	30.1	35.0	35.6	43.8	31.8	31.8	34.0	32.1	29.9	29.9
07	Base DX w/Bypass Damper	30.1	35.0	35.6	43.8	31.8	31.8	34.0	32.1	29.9	29.9
08	Base DX w/Desiccant	28.6	33.2	33.8	41.5	30.2	30.2	32.2	30.5	28.4	28.5
09	Base DX w/Enthalpy Wheel	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3
10	Base DX w/OA Precool	31.7	32.7	33.3	41.5	31.7	31.7	31.7	31.7	31.7	31.7
11	Dual Path	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
12	Dual Path w/Enthalpy Wheel	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8
13	Dual Path w/AAHX	44.3	44.3	44.3	45.7	44.3	44.3	44.3	44.3	44.3	44.3
14	Dual Path w/Desiccant	29.4	34.0	34.7	42.3	31.0	31.1	33.1	31.3	29.3	29.3
15	Base DX w/DCV	30.1	35.0	35.6	43.8	31.8	31.8	34.0	32.1	29.9	29.9
16	Dual Path w/DCV	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
17	Base DX w/Free Reheat	30.1	35.0	35.6	43.8	31.8	31.8	34.0	32.1	29.9	29.9

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	54	62	57	73	58	61	70	83	66	62
01	Base DX	57	65	61	77	61	65	74	89	71	66
02	DX w/Improved Dehumid.	71	81	75	96	76	80	92	110	87	82
03	Base DX w/Lower Airflow	60	69	64	82	65	69	78	94	75	70
04	Base DX w/AAHX	70	80	75	95	76	80	91	109	87	81
05	Base DX w/Subcool Reheat	61	70	65	82	65	69	79	94	75	70
06	Base DX w/o Lat. Coil Degrad.	58	66	61	78	62	65	75	89	71	67
07	Base DX w/Bypass Damper	63	72	67	85	68	71	81	98	78	72
08	Base DX w/Desiccant	104	111	103	120	109	115	128	157	129	121
09	Base DX w/Enthalpy Wheel	62	61	55	57	63	66	71	90	77	72
10	Base DX w/OA Precool	73	74	69	89	74	78	84	106	91	84
11	Dual Path	115	113	104	107	117	124	132	168	143	134
12	Dual Path w/Enthalpy Wheel	75	74	68	70	77	81	86	109	94	87
13	Dual Path w/AAHX	125	123	113	120	128	134	144	182	156	145
14	Dual Path w/Desiccant	121	130	120	142	127	134	149	183	150	140
15	Base DX w/DCV	59	67	63	79	63	67	76	92	73	68
16	Dual Path w/DCV	117	115	105	109	119	126	135	170	146	136
17	Base DX w/Free Reheat	61	69	65	82	65	69	79	94	75	70

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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Restaurant

2001 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
01	Base DX	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
02	DX w/Improved Dehumid.	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
03	Base DX w/Lower Airflow	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
04	Base DX w/AAHX	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
05	Base DX w/Subcool Reheat	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
06	Base DX w/o Lat. Coil Degrad.	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
07	Base DX w/Bypass Damper	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
08	Base DX w/Desiccant	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
09	Base DX w/Enthalpy Wheel	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
10	Base DX w/OA Precool	22.5	23.1	23.6	28.9	22.5	22.5	22.5	22.5	22.5	22.5
11	Dual Path	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
12	Dual Path w/Enthalpy Wheel	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
13	Dual Path w/AAHX	27.9	27.9	27.9	28.9	27.9	27.9	27.9	27.9	27.9	27.9
14	Dual Path w/Desiccant	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
15	Base DX w/DCV	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8
16	Dual Path w/DCV	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
17	Base DX w/Free Reheat	19.9	23.1	23.6	28.9	21.0	21.0	22.4	21.2	19.8	19.8

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
00	Conventional DX	3196	2653	2420	2303	2095	1951	2083	1795	1825	1633
01	Base DX	3160	2622	2394	2283	2065	1920	2058	1761	1795	1600
02	DX w/Improved Dehumid.	2798	2235	1994	1841	1649	1517	1654	1357	1398	1211
03	Base DX w/Lower Airflow	2825	2300	2074	1947	1739	1604	1742	1446	1486	1297
04	Base DX w/AAHX	4039	3319	3008	2808	2566	2394	2568	2186	2235	1992
05	Base DX w/Subcool Reheat	3570	2954	2695	2581	2315	2147	2309	1962	1998	1765
06	Base DX w/o Lat. Coil Degrad.	3403	2803	2547	2462	2216	2022	2177	1852	1877	1632
07	Base DX w/Bypass Damper	3258	2692	2452	2336	2102	1948	2095	1777	1814	1603
08	Base DX w/Desiccant	3408	2925	2753	2542	2690	2532	2550	2413	2463	2273
09	Base DX w/Enthalpy Wheel	2313	1825	1703	1391	1763	1668	1623	1572	1691	1583
10	Base DX w/OA Precool	3821	2942	2664	2222	2530	2373	2357	2198	2368	2163
11	Dual Path	2509	1835	1610	1335	1416	1273	1340	1113	1206	1017
12	Dual Path w/Enthalpy Wheel	1611	1242	1142	934	1143	1061	1050	981	1056	963
13	Dual Path w/AAHX	3264	2369	2071	1794	1799	1615	1706	1396	1511	1260
14	Dual Path w/Desiccant	2588	2253	2095	2000	1932	1791	1856	1683	1686	1513
15	Base DX w/DCV	2320	2095	2017	2021	1948	1847	1890	1747	1759	1704
16	Dual Path w/DCV	1641	1292	1206	996	1247	1158	1138	1056	1138	1081
17	Base DX w/Free Reheat	5129	3923	3354	2988	2800	2458	2623	2123	2116	1623

**All systems are normalized by the same tons in a given city to provide common comparison point.*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
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Restaurant

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*

[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
00	Conventional DX	1.1	1.1	1.0	0.9	1.0	1.2	1.1	0.9	1.0	0.7
01	Base DX	1.1	1.0	1.1	0.9	1.0	1.2	1.1	1.0	1.0	0.8
02	DX w/Improved Dehumid.	1.1	1.1	1.1	0.9	1.0	1.2	1.1	0.9	1.0	0.7
03	Base DX w/Lower Airflow	1.1	1.0	1.1	0.9	1.0	1.2	1.1	0.9	1.0	0.8
04	Base DX w/AAHX	1.3	1.4	1.4	1.2	1.4	1.4	1.4	1.3	1.3	0.9
05	Base DX w/Subcool Reheat	1.3	1.3	1.4	1.1	1.3	1.3	1.4	1.1	1.3	0.9
06	Base DX w/o Lat. Coil Degrad.	1.1	1.1	1.1	1.0	1.1	1.2	1.2	1.0	1.1	0.8
07	Base DX w/Bypass Damper	1.1	1.1	1.2	1.0	1.1	1.3	1.2	1.0	1.1	0.9
08	Base DX w/Desiccant	0.8	0.8	0.7	0.6	0.7	0.8	0.8	0.6	0.7	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.5	0.5	0.4	0.5	0.6	0.6	0.5	0.6	0.5
10	Base DX w/OA Precool	1.2	1.1	1.1	0.8	1.0	1.2	1.1	0.9	1.1	0.8
11	Dual Path	0.9	0.9	0.9	0.7	0.9	1.0	1.0	0.8	0.9	0.7
12	Dual Path w/Enthalpy Wheel	0.4	0.4	0.4	0.3	0.4	0.5	0.5	0.4	0.4	0.4
13	Dual Path w/AAHX	1.3	1.2	1.2	0.9	1.1	1.5	1.4	1.0	1.1	0.9
14	Dual Path w/Desiccant	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.6	0.5
15	Base DX w/DCV	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.5	0.6	0.5
16	Dual Path w/DCV	0.5	0.5	0.5	0.4	0.5	0.6	0.5	0.4	0.5	0.4
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.1	1.3	1.3	1.3	1.2	1.2	0.8

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
00	Conventional DX	268	2088	2839	2260	4293	7389	6912	7623	10252	7298
01	Base DX	272	2100	2856	2279	4312	7411	6837	7648	10280	7329
02	DX w/Improved Dehumid.	308	2219	3012	2445	4507	7634	7046	7891	10577	7623
03	Base DX w/Lower Airflow	299	2195	2980	2411	4467	7586	7002	7852	10502	7563
04	Base DX w/AAHX	244	1988	2701	2122	4122	7187	6627	7388	10028	7022
05	Base DX w/Subcool Reheat	259	2054	2790	2210	4234	7314	6747	7539	10173	7199
06	Base DX w/o Lat. Coil Degrad.	272	2098	2854	2278	4311	7409	6836	7648	10279	7328
07	Base DX w/Bypass Damper	272	2100	2856	2279	4312	7411	6837	7648	10280	7329
08	Base DX w/Desiccant	20501	14168	11200	7620	9466	7907	7503	6553	6012	5280
09	Base DX w/Enthalpy Wheel	285	1437	1954	1670	2377	2648	2279	3313	2916	5422
10	Base DX w/OA Precool	273	2143	2925	2333	4337	7474	7028	7684	10325	7258
11	Dual Path	331	2330	3161	2651	4654	7852	7284	8110	10793	7782
12	Dual Path w/Enthalpy Wheel	322	1544	2095	1788	2561	2871	2485	3570	3195	5727
13	Dual Path w/AAHX	308	2265	3077	2557	4541	7718	7152	7957	10622	7605
14	Dual Path w/Desiccant	20300	14094	11208	7569	9602	8144	7677	6882	6405	5868
15	Base DX w/DCV	28	61	67	43	130	276	299	289	565	191
16	Dual Path w/DCV	40	118	139	118	219	451	479	481	796	312
17	Base DX w/Free Reheat	270	2095	2851	2278	4311	7409	6836	7647	10278	7329

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Restaurant

2001 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	28.3	32.9	33.5	41.2	29.9	30.0	32.0	30.2	28.2	28.2
01	Base DX	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
02	DX w/Improved Dehumid.	30.8	35.8	36.5	44.8	32.5	32.6	34.8	32.9	30.6	30.6
03	Base DX w/Lower Airflow	31.9	37.1	37.7	46.3	33.6	33.7	36.0	34.0	31.7	31.7
04	Base DX w/AAHX	30.3	35.2	35.9	44.1	32.0	32.0	34.2	32.3	30.1	30.1
05	Base DX w/Subcool Reheat	30.2	35.1	35.7	43.9	31.8	31.9	34.0	32.2	30.0	30.0
06	Base DX w/o Lat. Coil Degrad.	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
07	Base DX w/Bypass Damper	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
08	Base DX w/Desiccant	28.6	33.2	33.8	41.5	30.2	30.2	32.2	30.5	28.4	28.5
09	Base DX w/Enthalpy Wheel	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3
10	Base DX w/OA Precool	19.3	20.3	20.9	29.0	19.3	19.3	19.3	19.3	19.3	19.3
11	Dual Path	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0
12	Dual Path w/Enthalpy Wheel	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
13	Dual Path w/AAHX	43.5	43.5	43.5	43.4	43.5	43.5	43.5	43.5	43.5	43.5
14	Dual Path w/Desiccant	19.5	19.2	19.1	18.7	19.4	19.4	19.2	19.4	19.5	19.5
15	Base DX w/DCV	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9
16	Dual Path w/DCV	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0	47.0
17	Base DX w/Free Reheat	30.1	35.0	35.6	43.7	31.8	31.8	33.9	32.1	29.9	29.9

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	2.3	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	10.0	14.9	15.5	23.6	11.6	11.7	13.8	12.0	9.8	9.8
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Retail

2001 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2384	1636	1169	699	599	455	471	257	233	0
01	Base DX	2279	1519	1066	675	580	438	441	280	226	0
02	DX w/Improved Dehumid.	2361	1653	1153	775	693	519	512	334	261	0
03	Base DX w/Lower Airflow	2273	1573	1082	755	706	514	483	340	266	0
04	Base DX w/AAHX	928	803	542	528	331	289	235	237	157	0
05	Base DX w/Subcool Reheat	1896	1167	777	454	373	281	312	203	179	0
06	Base DX w/o Lat. Coil Degrad.	1341	657	406	99	55	95	133	39	31	0
07	Base DX w/Bypass Damper	1958	1233	829	537	417	331	334	238	195	0
08	Base DX w/Desiccant	0	0	0	0	0	0	0	0	0	0
09	Base DX w/Enthalpy Wheel	19	5	14	1	5	4	1	2	0	0
10	Base DX w/OA Precool	2337	1724	1294	1180	794	620	730	260	217	0
11	Dual Path	653	252	78	38	13	25	2	18	6	0
12	Dual Path w/Enthalpy Wheel	4	5	11	0	5	0	0	0	0	0
13	Dual Path w/AAHX	241	169	53	19	6	0	2	6	3	0
14	Dual Path w/Desiccant	0	0	0	0	0	0	0	0	0	0
15	Base DX w/DCV	2279	1519	1066	675	580	438	441	280	226	0
16	Dual Path w/DCV	653	252	78	38	13	25	2	18	6	0
17	Base DX w/Free Reheat	3	12	10	2	0	0	1	4	0	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	622	676	650	711	618	779	729	1013	786	618
01	Base DX	640	695	667	732	635	797	749	1035	805	636
02	DX w/Improved Dehumid.	663	719	690	753	670	840	805	1072	857	691
03	Base DX w/Lower Airflow	624	678	652	712	627	791	750	1009	802	637
04	Base DX w/AAHX	791	846	801	879	747	912	866	1209	923	738
05	Base DX w/Subcool Reheat	701	757	722	794	678	840	791	1100	847	668
06	Base DX w/o Lat. Coil Degrad.	665	718	688	756	652	812	762	1057	818	642
07	Base DX w/Bypass Damper	679	736	704	774	669	833	788	1083	843	669
08	Base DX w/Desiccant	1457	1173	1109	1070	1008	1038	973	1282	933	793
09	Base DX w/Enthalpy Wheel	524	528	504	535	497	554	505	799	567	563
10	Base DX w/OA Precool	711	765	733	797	703	872	822	1150	887	711
11	Dual Path	636	703	677	745	663	835	808	1045	854	689
12	Dual Path w/Enthalpy Wheel	520	523	500	533	504	564	525	797	583	587
13	Dual Path w/AAHX	785	842	799	875	769	939	911	1194	961	776
14	Dual Path w/Desiccant	1425	1161	1076	1053	956	1009	976	1283	948	849
15	Base DX w/DCV	663	718	688	753	658	821	776	1068	833	662
16	Dual Path w/DCV	659	725	698	766	686	860	834	1078	882	716
17	Base DX w/Free Reheat	856	870	799	862	719	876	821	1135	867	660

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

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Retail

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	25.35	27.42	27.09	28.59	24.14	33.63	28.05	42.00	31.81	21.31
01	Base DX	25.50	27.53	27.18	28.73	24.13	33.60	28.08	41.74	31.73	21.19
02	DX w/Improved Dehumid.	22.45	24.15	24.12	24.88	21.79	31.35	26.18	37.06	29.51	19.51
03	Base DX w/Lower Airflow	23.22	25.07	24.96	25.99	22.40	31.89	26.70	38.12	30.06	19.88
04	Base DX w/AAHX	31.61	33.21	32.01	33.88	27.35	36.60	30.70	46.95	34.41	23.07
05	Base DX w/Subcool Reheat	28.52	30.46	29.71	31.65	25.83	35.18	29.44	44.33	33.06	21.96
06	Base DX w/o Lat. Coil Degrad.	27.20	29.08	28.57	30.38	25.28	34.60	28.91	43.28	32.61	21.61
07	Base DX w/Bypass Damper	26.28	28.23	27.78	29.40	24.49	33.90	28.38	42.06	31.94	21.22
08	Base DX w/Desiccant	71.65	50.71	48.69	43.03	39.73	39.68	32.19	44.60	28.30	20.65
09	Base DX w/Enthalpy Wheel	18.72	19.19	19.10	19.78	16.84	19.02	14.78	28.20	16.98	17.39
10	Base DX w/OA Precool	27.52	29.10	28.72	29.66	25.86	35.54	29.44	45.11	33.83	22.95
11	Dual Path	18.90	21.44	21.78	22.89	19.59	29.27	24.56	32.81	27.22	17.48
12	Dual Path w/Enthalpy Wheel	15.30	15.81	16.04	16.64	14.21	16.34	12.61	23.27	14.24	15.24
13	Dual Path w/AAHX	25.39	27.32	26.76	28.38	22.98	32.32	27.24	37.55	29.84	18.96
14	Dual Path w/Desiccant	64.07	44.09	41.14	35.73	30.67	31.65	25.84	36.32	22.65	18.14
15	Base DX w/DCV	25.50	27.53	27.18	28.73	24.13	33.60	28.08	41.74	31.73	21.19
16	Dual Path w/DCV	18.90	21.44	21.78	22.89	19.59	29.27	24.56	32.81	27.22	17.48
17	Base DX w/Free Reheat	39.39	38.42	35.15	36.44	28.81	37.80	31.59	46.85	34.54	21.44

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1056	1092	1076	1134	954	1090	1179	1080	1169	882
01	Base DX	1062	1096	1079	1140	953	1087	1179	1074	1165	875
02	DX w/Improved Dehumid.	932	958	943	981	832	971	1057	961	1063	777
03	Base DX w/Lower Airflow	965	996	980	1027	862	999	1089	987	1088	798
04	Base DX w/AAHX	1320	1328	1288	1350	1112	1233	1340	1200	1287	981
05	Base DX w/Subcool Reheat	1189	1216	1188	1259	1036	1162	1262	1137	1225	918
06	Base DX w/o Lat. Coil Degrad.	1133	1159	1137	1206	1006	1130	1225	1112	1203	895
07	Base DX w/Bypass Damper	1095	1125	1104	1167	969	1100	1195	1082	1174	876
08	Base DX w/Desiccant	2218	1896	1693	1635	1386	1270	1335	1138	1085	906
09	Base DX w/Enthalpy Wheel	777	766	761	785	700	701	708	712	673	732
10	Base DX w/OA Precool	1146	1160	1142	1177	1030	1165	1249	1158	1252	958
11	Dual Path	781	846	837	898	713	858	947	860	954	657
12	Dual Path w/Enthalpy Wheel	632	628	628	656	571	575	579	592	552	615
13	Dual Path w/AAHX	1055	1085	1051	1122	879	1001	1105	975	1071	740
14	Dual Path w/Desiccant	1978	1651	1442	1368	1104	1030	1092	926	872	774
15	Base DX w/DCV	1062	1096	1079	1140	953	1087	1179	1074	1165	875
16	Dual Path w/DCV	781	846	837	898	713	858	947	860	954	657
17	Base DX w/Free Reheat	1645	1537	1415	1451	1170	1267	1373	1200	1284	887

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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Retail

2001 Standard

Net Total DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	137.2	151.9	153.4	170.8	140.0	144.2	148.7	148.0	138.3	141.2
01	Base DX	145.7	161.3	162.9	181.4	148.7	153.1	157.9	157.1	146.9	149.9
02	DX w/Improved Dehumid.	149.2	165.2	166.8	185.8	152.3	156.8	161.7	160.9	150.4	153.5
03	Base DX w/Lower Airflow	154.4	170.9	172.5	192.1	157.5	162.2	167.2	166.4	155.6	158.8
04	Base DX w/AAHX	146.7	162.4	164.0	182.7	149.7	154.2	159.0	158.2	147.9	150.9
05	Base DX w/Subcool Reheat	146.1	161.8	163.3	181.9	149.1	153.6	158.3	157.6	147.3	150.3
06	Base DX w/o Lat. Coil Degrad.	145.7	161.3	162.9	181.4	148.7	153.1	157.9	157.1	146.9	149.9
07	Base DX w/Bypass Damper	145.7	161.3	162.9	181.4	148.7	153.1	157.9	157.1	146.9	149.9
08	Base DX w/Desiccant	138.1	152.8	154.2	171.7	140.9	145.1	149.5	148.8	139.2	142.0
09	Base DX w/Enthalpy Wheel	93.8	93.7	93.0	100.5	90.4	96.0	92.6	101.1	95.0	100.3
10	Base DX w/OA Precool	138.5	154.1	155.6	174.2	141.5	145.9	150.7	149.9	139.7	142.7
11	Dual Path	152.0	166.7	168.2	185.6	154.8	159.0	163.5	162.8	153.2	156.0
12	Dual Path w/Enthalpy Wheel	92.3	92.2	91.5	98.6	89.0	94.3	91.2	99.2	93.4	98.4
13	Dual Path w/AAHX	151.5	166.2	167.6	185.1	154.3	158.5	162.9	162.2	152.6	155.4
14	Dual Path w/Desiccant	140.7	155.4	156.8	174.3	143.5	147.7	152.1	151.4	141.8	144.6
15	Base DX w/DCV	145.7	161.3	162.9	181.4	148.7	153.1	157.9	157.1	146.9	149.9
16	Dual Path w/DCV	152.0	166.7	168.2	185.6	154.8	159.0	163.5	162.8	153.2	156.0
17	Base DX w/Free Reheat	145.7	161.3	162.9	181.4	148.7	153.1	157.9	157.1	146.9	149.9

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	260	284	262	302	271	294	324	408	327	311
01	Base DX	276	301	278	320	288	312	344	434	347	330
02	DX w/Improved Dehumid.	342	373	344	397	356	386	426	537	430	409
03	Base DX w/Lower Airflow	292	319	294	339	305	330	364	459	367	349
04	Base DX w/AAHX	340	371	342	394	354	384	424	534	427	406
05	Base DX w/Subcool Reheat	294	321	296	341	306	332	367	462	369	351
06	Base DX w/o Lat. Coil Degrad.	276	302	278	321	288	312	345	435	347	330
07	Base DX w/Bypass Damper	304	332	306	353	317	343	379	477	382	363
08	Base DX w/Desiccant	420	441	406	451	434	465	508	641	526	496
09	Base DX w/Enthalpy Wheel	257	253	230	251	256	280	293	394	323	312
10	Base DX w/OA Precool	317	348	321	372	331	360	397	501	399	380
11	Dual Path	366	395	364	416	380	411	452	571	459	436
12	Dual Path w/Enthalpy Wheel	301	297	269	295	299	329	343	463	378	367
13	Dual Path w/AAHX	422	451	415	468	438	472	517	652	529	501
14	Dual Path w/Desiccant	496	524	482	538	514	552	603	761	622	588
15	Base DX w/DCV	299	324	298	342	311	336	370	467	375	356
16	Dual Path w/DCV	388	418	385	438	404	436	479	604	487	462
17	Base DX w/Free Reheat	293	320	295	340	306	331	366	461	368	350

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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Retail

2001 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
01	Base DX	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
02	DX w/Improved Dehumid.	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
03	Base DX w/Lower Airflow	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
04	Base DX w/AAHX	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
05	Base DX w/Subcool Reheat	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
06	Base DX w/o Lat. Coil Degrad.	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
07	Base DX w/Bypass Damper	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
08	Base DX w/Desiccant	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
09	Base DX w/Enthalpy Wheel	61.3	61.3	60.8	65.8	59.1	62.8	60.6	66.2	62.1	65.6
10	Base DX w/OA Precool	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
11	Dual Path	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
12	Dual Path w/Enthalpy Wheel	62.3	62.3	61.8	66.8	60.1	63.8	61.6	67.2	63.1	66.6
13	Dual Path w/AAHX	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
14	Dual Path w/Desiccant	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
15	Base DX w/DCV	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
16	Dual Path w/DCV	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1
17	Base DX w/Free Reheat	96.3	106.6	107.7	119.9	98.3	101.3	104.4	103.9	97.1	99.1

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.9
00	Conventional DX	2241	1933	1810	1737	1598	1468	1548	1305	1342	1172
01	Base DX	2254	1939	1814	1744	1592	1458	1542	1288	1328	1151
02	DX w/Improved Dehumid.	1971	1652	1528	1445	1306	1180	1262	1014	1054	889
03	Base DX w/Lower Airflow	2043	1728	1604	1530	1376	1246	1333	1077	1119	947
04	Base DX w/AAHX	2811	2404	2240	2131	1953	1795	1901	1585	1636	1425
05	Base DX w/Subcool Reheat	2529	2176	2034	1960	1778	1626	1723	1432	1475	1264
06	Base DX w/o Lat. Coil Degrad.	2407	2062	1927	1859	1704	1546	1633	1364	1407	1194
07	Base DX w/Bypass Damper	2324	1994	1863	1791	1627	1484	1575	1304	1347	1154
08	Base DX w/Desiccant	2204	1946	1862	1777	1785	1664	1701	1536	1577	1440
09	Base DX w/Enthalpy Wheel	1638	1369	1294	1206	1273	1184	1173	1089	1135	1026
10	Base DX w/OA Precool	2434	2058	1928	1801	1746	1608	1671	1443	1497	1309
11	Dual Path	1640	1412	1296	1278	1016	898	998	752	750	566
12	Dual Path w/Enthalpy Wheel	1324	1092	1023	970	983	905	899	824	847	745
13	Dual Path w/AAHX	2231	1888	1723	1678	1387	1215	1336	1014	1037	777
14	Dual Path w/Desiccant	1941	1723	1640	1586	1533	1400	1450	1266	1291	1133
15	Base DX w/DCV	2254	1939	1814	1744	1592	1458	1542	1288	1328	1151
16	Dual Path w/DCV	1640	1412	1296	1278	1016	898	998	752	750	566
17	Base DX w/Free Reheat	3508	2798	2461	2282	2050	1826	1927	1539	1582	1177

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Retail

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.9
00	Conventional DX	1.0	1.0	1.0	0.9	1.0	1.0	1.0	0.9	0.9	0.7
01	Base DX	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.9	1.0	0.7
02	DX w/Improved Dehumid.	1.0	1.0	1.0	0.9	1.0	1.0	1.0	0.8	0.9	0.7
03	Base DX w/Lower Airflow	1.0	1.0	1.0	0.9	1.0	1.1	1.1	0.9	0.9	0.7
04	Base DX w/AAHX	1.3	1.3	1.4	1.2	1.3	1.4	1.4	1.1	1.2	0.9
05	Base DX w/Subcool Reheat	1.1	1.1	1.2	1.1	1.2	1.3	1.4	1.0	1.1	0.8
06	Base DX w/o Lat. Coil Degrad.	1.0	1.0	1.1	1.0	1.1	1.1	1.1	0.9	1.0	0.8
07	Base DX w/Bypass Damper	1.0	1.0	1.1	1.0	1.1	1.1	1.1	0.9	1.0	0.8
08	Base DX w/Desiccant	0.8	0.7	0.7	0.6	0.7	0.8	0.8	0.6	0.7	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.5	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.5
10	Base DX w/OA Precool	1.1	1.0	1.0	0.8	1.0	1.1	1.1	0.8	1.0	0.7
11	Dual Path	0.9	0.9	0.9	0.8	0.9	1.0	1.0	0.7	0.8	0.6
12	Dual Path w/Enthalpy Wheel	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.4
13	Dual Path w/AAHX	1.1	1.1	1.2	1.1	1.2	1.2	1.2	1.0	1.1	0.8
14	Dual Path w/Desiccant	0.7	0.7	0.7	0.6	0.7	0.8	0.7	0.6	0.7	0.6
15	Base DX w/DCV	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.9	1.0	0.7
16	Dual Path w/DCV	0.9	0.9	0.9	0.8	0.9	1.0	1.0	0.7	0.8	0.6
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	0.8

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.9
00	Conventional DX	88	598	822	704	1315	2428	2528	2707	3675	2141
01	Base DX	89	604	829	714	1324	2441	2542	2721	3693	2160
02	DX w/Improved Dehumid.	103	663	910	793	1421	2574	2663	2882	3866	2342
03	Base DX w/Lower Airflow	100	653	894	772	1404	2543	2640	2845	3831	2302
04	Base DX w/AAHX	78	553	756	638	1243	2320	2421	2574	3534	1994
05	Base DX w/Subcool Reheat	84	586	797	678	1290	2393	2489	2660	3626	2090
06	Base DX w/o Lat. Coil Degrad.	89	601	828	713	1324	2441	2542	2721	3692	2159
07	Base DX w/Bypass Damper	89	604	829	714	1324	2441	2542	2721	3693	2160
08	Base DX w/Desiccant	8184	5542	4448	3342	3621	2977	3025	2335	2350	1444
09	Base DX w/Enthalpy Wheel	97	374	541	475	644	795	735	1053	959	1604
10	Base DX w/OA Precool	92	618	852	733	1349	2475	2575	2762	3741	2211
11	Dual Path	125	737	1001	870	1551	2738	2809	3075	4101	2576
12	Dual Path w/Enthalpy Wheel	108	407	591	521	702	865	798	1139	1053	1724
13	Dual Path w/AAHX	113	698	951	826	1483	2655	2734	2968	3982	2457
14	Dual Path w/Desiccant	7376	4734	3615	2474	2527	2255	2288	1849	1810	1543
15	Base DX w/DCV	89	604	829	714	1324	2441	2542	2721	3693	2160
16	Dual Path w/DCV	125	737	1001	870	1551	2738	2809	3075	4101	2576
17	Base DX w/Free Reheat	87	594	826	711	1324	2441	2541	2721	3692	2160

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Retail

2001 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System										
00	Conventional DX	137.2	151.9	153.3	170.8	140.0	144.2	148.6	147.9	138.3	141.1
01	Base DX	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.8
02	DX w/Improved Dehumid.	149.2	165.1	166.7	185.7	152.2	156.8	161.6	160.9	150.4	153.5
03	Base DX w/Lower Airflow	154.3	170.8	172.5	192.1	157.4	162.2	167.2	166.4	155.6	158.7
04	Base DX w/AAHX	146.7	162.4	163.9	182.6	149.7	154.2	158.9	158.2	147.9	150.9
05	Base DX w/Subcool Reheat	146.1	161.7	163.3	181.9	149.1	153.6	158.3	157.5	147.3	150.3
06	Base DX w/o Lat. Coil Degrad.	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.8
07	Base DX w/Bypass Damper	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.8
08	Base DX w/Desiccant	138.1	152.7	154.2	171.6	140.8	145.0	149.5	148.8	139.2	142.0
09	Base DX w/Enthalpy Wheel	93.8	93.7	93.0	100.5	90.3	96.0	92.6	101.1	94.9	100.2
10	Base DX w/OA Precool	99.2	114.8	116.4	134.9	102.2	106.7	111.4	110.6	100.4	103.4
11	Dual Path	148.5	147.6	147.5	146.4	148.3	148.1	147.8	147.8	148.4	148.3
12	Dual Path w/Enthalpy Wheel	61.6	61.6	61.7	61.2	61.8	61.5	61.7	61.2	61.5	61.2
13	Dual Path w/AAHX	136.8	135.8	135.7	134.6	136.6	136.3	136.0	136.1	136.7	136.5
14	Dual Path w/Desiccant	58.5	57.6	57.5	56.3	58.3	58.0	57.8	57.8	58.4	58.2
15	Base DX w/DCV	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.8
16	Dual Path w/DCV	148.5	147.6	147.5	146.4	148.3	148.1	147.8	147.8	148.4	148.3
17	Base DX w/Free Reheat	145.7	161.2	162.8	181.3	148.6	153.1	157.8	157.1	146.9	149.8

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	39.2	39.2	39.2	39.2	39.2	39.2	39.2	39.2	39.2	39.2
11	Dual Path	3.5	19.1	20.6	39.2	6.4	10.9	15.7	14.9	4.7	7.7
12	Dual Path w/Enthalpy Wheel	30.6	30.6	29.8	37.4	27.2	32.8	29.5	38.0	31.8	37.1
13	Dual Path w/AAHX	14.7	30.3	31.9	50.4	17.7	22.1	26.9	26.1	15.9	18.9
14	Dual Path w/Desiccant	82.2	97.8	99.3	117.9	85.1	89.6	94.3	93.6	83.3	86.3
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	3.5	19.1	20.6	39.2	6.4	10.9	15.7	14.9	4.7	7.7
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Theater

2001 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3193	2700	2069	1507	1439	1137	1336	832	597	35
01	Base DX	3240	2698	2069	1660	1448	1130	1335	765	595	35
02	DX w/Improved Dehumid.	3260	2726	2107	1743	1490	1160	1370	800	622	37
03	Base DX w/Lower Airflow	3261	2711	2097	1676	1471	1148	1146	789	606	37
04	Base DX w/AAHX	3231	2551	2022	1377	1414	1081	1022	743	544	40
05	Base DX w/Subcool Reheat	3208	2625	1998	1423	1378	1069	1022	793	542	33
06	Base DX w/o Lat. Coil Degrad.	3061	2480	1841	1075	1303	1094	896	703	471	32
07	Base DX w/Bypass Damper	3232	2666	2045	1282	1416	1097	1073	806	565	35
08	Base DX w/Desiccant	123	280	167	14	9	15	91	0	9	0
09	Base DX w/Enthalpy Wheel	3238	2658	2017	1780	1631	1225	1255	898	680	78
10	Base DX w/OA Precool	3277	2707	2090	1788	1458	1143	1340	838	604	33
11	Dual Path	3253	2712	2059	1482	1423	1113	1079	852	601	33
12	Dual Path w/Enthalpy Wheel	3270	2679	2046	1810	1646	1237	1272	911	703	90
13	Dual Path w/AAHX	2967	2317	1660	929	1277	1013	901	791	523	37
14	Dual Path w/Desiccant	57	70	21	0	0	9	36	0	9	0
15	Base DX w/DCV	3275	3036	2664	2305	2040	1904	2155	965	817	62
16	Dual Path w/DCV	3335	3115	2113	2381	2044	1921	2199	989	824	73
17	Base DX w/Free Reheat	537	548	311	159	248	264	243	199	208	30

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	317	387	396	425	389	543	485	621	521	405
01	Base DX	321	394	403	435	397	551	495	629	530	414
02	DX w/Improved Dehumid.	333	408	416	446	416	574	526	647	557	441
03	Base DX w/Lower Airflow	310	383	393	423	392	549	493	615	529	415
04	Base DX w/AAHX	404	477	474	514	453	606	553	716	588	463
05	Base DX w/Subcool Reheat	354	427	431	470	418	571	514	663	550	429
06	Base DX w/o Lat. Coil Degrad.	337	408	414	449	408	562	499	641	535	416
07	Base DX w/Bypass Damper	341	415	422	457	414	568	513	654	549	430
08	Base DX w/Desiccant	1107	873	827	748	753	763	695	865	617	549
09	Base DX w/Enthalpy Wheel	298	322	327	326	342	379	341	506	373	397
10	Base DX w/OA Precool	408	440	443	474	469	628	548	743	629	501
11	Dual Path	436	471	471	475	522	687	624	789	704	578
12	Dual Path w/Enthalpy Wheel	286	312	319	316	343	383	353	493	380	409
13	Dual Path w/AAHX	506	531	522	531	565	728	667	851	748	615
14	Dual Path w/Desiccant	1088	863	818	740	753	767	713	854	629	569
15	Base DX w/DCV	289	327	306	348	280	318	321	443	326	271
16	Dual Path w/DCV	402	400	368	383	398	447	447	594	494	430
17	Base DX w/Free Reheat	459	511	489	517	457	600	538	691	561	426

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

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Theater

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	12.94	16.34	17.62	18.27	17.15	27.17	21.59	28.86	24.81	17.51
01	Base DX	12.65	16.18	17.48	18.25	17.07	27.09	21.52	28.53	24.74	17.46
02	DX w/Improved Dehumid.	11.13	14.42	15.89	16.09	15.92	26.09	20.59	26.14	23.70	16.68
03	Base DX w/Lower Airflow	11.23	14.70	16.17	16.64	16.15	26.28	20.59	26.65	23.91	16.86
04	Base DX w/AAHX	16.12	19.31	20.06	20.95	18.57	28.42	22.64	31.11	25.97	18.30
05	Base DX w/Subcool Reheat	14.30	17.73	18.79	19.92	17.86	27.77	22.03	29.89	25.33	17.82
06	Base DX w/o Lat. Coil Degrad.	13.67	17.07	18.26	19.20	17.83	27.80	21.75	29.32	25.02	17.56
07	Base DX w/Bypass Damper	13.02	16.51	17.75	18.58	17.21	27.20	21.46	28.76	24.80	17.47
08	Base DX w/Desiccant	58.17	40.89	39.19	32.09	33.03	32.72	25.75	32.69	20.30	17.05
09	Base DX w/Enthalpy Wheel	9.77	11.57	12.85	12.41	12.50	14.46	11.02	19.15	12.16	14.71
10	Base DX w/OA Precool	15.46	17.83	18.92	19.31	19.27	29.47	22.98	32.62	27.38	19.60
11	Dual Path	10.02	12.67	14.37	14.04	15.37	25.61	19.77	24.96	23.31	16.35
12	Dual Path w/Enthalpy Wheel	6.71	8.64	10.24	9.63	10.31	12.30	9.28	14.92	9.87	12.94
13	Dual Path w/AAHX	13.12	15.10	16.30	16.27	16.55	26.58	20.74	26.69	24.19	16.88
14	Dual Path w/Desiccant	53.99	36.91	35.57	28.14	29.96	29.77	23.31	27.48	17.58	15.13
15	Base DX w/DCV	9.75	10.91	10.28	11.66	8.44	10.46	8.83	14.85	9.91	6.93
16	Dual Path w/DCV	7.02	7.14	6.72	7.09	6.24	8.50	6.87	10.70	8.17	5.47
17	Base DX w/Free Reheat	21.69	23.65	22.92	23.24	20.64	29.86	23.74	31.94	26.16	17.62

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	537	640	656	709	602	765	811	758	864	660
01	Base DX	525	633	649	707	597	760	806	749	861	656
02	DX w/Improved Dehumid.	460	561	577	618	533	703	742	692	811	608
03	Base DX w/Lower Airflow	464	572	590	641	546	715	751	704	821	619
04	Base DX w/AAHX	671	761	763	819	676	830	886	811	918	706
05	Base DX w/Subcool Reheat	594	696	707	776	638	795	845	783	888	678
06	Base DX w/o Lat. Coil Degrad.	568	669	682	746	629	784	825	769	873	661
07	Base DX w/Bypass Damper	540	646	661	721	603	765	809	755	863	657
08	Base DX w/Desiccant	1697	1495	1288	1194	1050	942	976	849	749	685
09	Base DX w/Enthalpy Wheel	403	452	476	479	462	467	469	493	460	571
10	Base DX w/OA Precool	643	699	708	749	699	862	882	851	974	765
11	Dual Path	413	488	508	533	502	673	690	665	792	587
12	Dual Path w/Enthalpy Wheel	274	333	361	365	351	361	361	391	357	474
13	Dual Path w/AAHX	544	588	593	624	562	723	751	707	832	620
14	Dual Path w/Desiccant	1531	1336	1138	1035	906	807	838	723	628	575
15	Base DX w/DCV	408	439	425	469	368	385	425	373	386	319
16	Dual Path w/DCV	293	285	270	282	257	284	300	273	306	237
17	Base DX w/Free Reheat	904	935	880	910	763	879	935	833	921	664

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

MI = Miami FL
HO = Houston TX
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Theater

2001 Standard

Net Total DX Cooling Capacity*

[tons]

Case	System	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
00	Conventional DX	69.9	81.8	83.3	92.3	73.1	73.0	79.2	73.9	68.5	68.8
01	Base DX	74.3	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
02	DX w/Improved Dehumid.	76.1	88.9	90.6	100.3	79.4	79.4	86.1	80.4	74.5	74.8
03	Base DX w/Lower Airflow	78.7	92.0	93.7	103.8	82.2	82.1	89.1	83.2	77.0	77.3
04	Base DX w/AAHX	74.8	87.4	89.1	98.7	78.1	78.1	84.7	79.0	73.2	73.5
05	Base DX w/Subcool Reheat	74.5	87.1	88.7	98.3	77.8	77.8	84.3	78.7	72.9	73.2
06	Base DX w/o Lat. Coil Degrad.	74.3	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
07	Base DX w/Bypass Damper	74.3	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
08	Base DX w/Desiccant	70.6	82.5	84.0	93.0	73.8	73.7	79.9	74.6	69.2	69.5
09	Base DX w/Enthalpy Wheel	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
10	Base DX w/OA Precool	81.6	81.6	82.6	92.1	81.6	81.6	81.6	81.6	81.6	81.6
11	Dual Path	121.8	121.8	121.8	121.8	121.8	121.8	121.8	121.8	121.8	121.8
12	Dual Path w/Enthalpy Wheel	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4
13	Dual Path w/AAHX	112.7	112.7	112.7	112.7	112.7	112.7	112.7	112.7	112.7	112.7
14	Dual Path w/Desiccant	72.8	84.6	86.1	95.1	75.9	75.8	82.0	76.8	71.3	71.6
15	Base DX w/DCV	74.3	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
16	Dual Path w/DCV	121.8	121.8	121.8	121.8	121.8	121.8	121.8	121.8	121.8	121.8
17	Base DX w/Free Reheat	74.3	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0

Location ==> (columns MI to PO)

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

Case	System	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
00	Conventional DX	132	153	142	163	141	149	173	204	162	151
01	Base DX	141	162	151	173	150	158	183	217	172	161
02	DX w/Improved Dehumid.	174	201	187	214	186	196	227	269	213	199
03	Base DX w/Lower Airflow	149	172	160	183	159	167	194	230	182	170
04	Base DX w/AAHX	173	200	186	213	185	194	226	267	211	198
05	Base DX w/Subcool Reheat	150	173	161	184	160	168	195	231	183	171
06	Base DX w/o Lat. Coil Degrad.	141	163	151	174	151	159	184	218	172	161
07	Base DX w/Bypass Damper	155	179	166	190	165	174	202	239	189	177
08	Base DX w/Desiccant	262	281	259	284	274	288	322	394	324	302
09	Base DX w/Enthalpy Wheel	158	156	143	148	162	170	182	231	197	184
10	Base DX w/OA Precool	187	184	170	197	191	201	215	272	233	217
11	Dual Path	293	289	264	273	299	315	337	427	365	340
12	Dual Path w/Enthalpy Wheel	190	188	171	177	194	205	219	277	237	221
13	Dual Path w/AAHX	318	314	287	297	325	342	366	464	397	370
14	Dual Path w/Desiccant	304	328	302	333	318	334	375	457	374	349
15	Base DX w/DCV	150	171	159	182	159	168	194	230	183	171
16	Dual Path w/DCV	302	298	272	282	309	325	348	440	377	351
17	Base DX w/Free Reheat	149	172	160	184	159	168	195	230	182	171

Location ==> (columns MI to PO)

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

MI = Miami FL
HO = Houston TX
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PO = Portland OR

Theater

2001 Standard

Net Sensible DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
01	Base DX	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
02	DX w/Improved Dehumid.	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
03	Base DX w/Lower Airflow	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
04	Base DX w/AAHX	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
05	Base DX w/Subcool Reheat	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
06	Base DX w/o Lat. Coil Degrad.	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
07	Base DX w/Bypass Damper	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
08	Base DX w/Desiccant	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
09	Base DX w/Enthalpy Wheel	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2	32.2
10	Base DX w/OA Precool	57.8	57.8	58.5	64.8	57.8	57.8	57.8	57.8	57.8	57.8
11	Dual Path	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0
12	Dual Path w/Enthalpy Wheel	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8	34.8
13	Dual Path w/AAHX	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0
14	Dual Path w/Desiccant	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
15	Base DX w/DCV	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3
16	Dual Path w/DCV	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0	77.0
17	Base DX w/Free Reheat	49.1	57.4	58.5	64.8	51.3	51.3	55.6	51.9	48.1	48.3

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	74.2	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
00	Conventional DX	2222	1864	1701	1707	1508	1383	1485	1285	1286	1183
01	Base DX	2171	1838	1675	1692	1484	1359	1462	1263	1263	1159
02	DX w/Improved Dehumid.	1892	1549	1381	1367	1179	1066	1166	969	974	877
03	Base DX w/Lower Airflow	1912	1597	1436	1448	1243	1128	1237	1033	1038	940
04	Base DX w/AAHX	2794	2323	2111	2090	1845	1696	1836	1570	1576	1445
05	Base DX w/Subcool Reheat	2465	2076	1892	1924	1667	1522	1653	1404	1407	1282
06	Base DX w/o Lat. Coil Degrad.	2352	1968	1792	1823	1599	1429	1557	1326	1314	1182
07	Base DX w/Bypass Damper	2236	1885	1715	1742	1510	1377	1496	1270	1275	1163
08	Base DX w/Desiccant	2418	2089	1961	1884	1948	1834	1837	1756	1778	1666
09	Base DX w/Enthalpy Wheel	1656	1302	1216	1113	1306	1231	1187	1177	1252	1197
10	Base DX w/OA Precool	2670	2066	1867	1813	1896	1765	1726	1648	1761	1646
11	Dual Path	1689	1263	1098	1059	1021	903	950	799	854	754
12	Dual Path w/Enthalpy Wheel	1105	846	778	717	814	750	737	708	748	704
13	Dual Path w/AAHX	2245	1640	1430	1369	1292	1143	1207	1002	1072	938
14	Dual Path w/Desiccant	1775	1561	1450	1411	1359	1259	1305	1195	1176	1077
15	Base DX w/DCV	1711	1535	1446	1444	1375	1284	1336	1222	1213	1170
16	Dual Path w/DCV	1226	955	859	805	883	806	799	746	792	748
17	Base DX w/Free Reheat	3771	2933	2499	2346	2155	1841	1965	1598	1522	1195

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Theater

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	74.2	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
00	Conventional DX	1.0	1.0	1.0	0.9	1.0	1.1	1.1	0.8	1.0	0.7
01	Base DX	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.9	1.0	0.8
02	DX w/Improved Dehumid.	1.1	1.1	1.0	0.9	1.0	1.2	1.1	0.8	1.0	0.7
03	Base DX w/Lower Airflow	1.0	1.0	1.0	1.0	1.0	1.1	1.1	0.9	1.0	0.8
04	Base DX w/AAHX	1.3	1.4	1.4	1.3	1.4	1.4	1.4	1.1	1.3	0.9
05	Base DX w/Subcool Reheat	1.1	1.3	1.2	1.2	1.3	1.3	1.4	1.0	1.1	0.9
06	Base DX w/o Lat. Coil Degrad.	1.0	1.1	1.0	1.0	1.1	1.2	1.1	0.9	1.0	0.8
07	Base DX w/Bypass Damper	1.0	1.1	1.1	1.0	1.1	1.2	1.1	0.9	1.0	0.8
08	Base DX w/Desiccant	0.7	0.7	0.7	0.6	0.7	0.8	0.8	0.6	0.7	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.6	0.5
10	Base DX w/OA Precool	1.1	1.1	1.0	0.8	1.0	1.2	1.1	0.8	1.1	0.8
11	Dual Path	0.8	0.9	0.8	0.7	0.9	1.0	0.9	0.7	0.9	0.7
12	Dual Path w/Enthalpy Wheel	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4
13	Dual Path w/AAHX	1.1	1.1	1.1	1.0	1.1	1.4	1.2	1.0	1.2	0.9
14	Dual Path w/Desiccant	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.5	0.6	0.5
15	Base DX w/DCV	0.7	0.8	0.8	0.7	0.8	0.9	0.8	0.6	0.7	0.6
16	Dual Path w/DCV	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.5	0.7	0.5
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	0.9

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	74.2	86.8	88.4	98.0	77.6	77.5	84.1	78.5	72.7	73.0
00	Conventional DX	131	1412	1981	1781	2943	5449	4904	5548	7777	5260
01	Base DX	133	1422	1993	1816	2957	5468	4922	5513	7803	5285
02	DX w/Improved Dehumid.	150	1507	2115	1940	3112	5664	5095	5725	8042	5530
03	Base DX w/Lower Airflow	146	1488	2085	1912	3074	5616	4978	5675	7982	5478
04	Base DX w/AAHX	116	1342	1881	1682	2820	5291	4679	5322	7593	5063
05	Base DX w/Subcool Reheat	127	1388	1947	1770	2899	5394	4775	5488	7715	5192
06	Base DX w/o Lat. Coil Degrad.	130	1420	1993	1793	3006	5553	4842	5567	7802	5284
07	Base DX w/Bypass Damper	133	1422	1993	1793	2957	5468	4843	5568	7803	5285
08	Base DX w/Desiccant	15137	10552	8298	6165	7317	6288	5742	5211	4623	4058
09	Base DX w/Enthalpy Wheel	141	1048	1495	1338	1788	2088	1791	2522	2319	3998
10	Base DX w/OA Precool	129	1452	2041	1857	2958	5478	4978	5575	7763	5221
11	Dual Path	162	1592	2233	2059	3209	5796	5176	5921	8159	5640
12	Dual Path w/Enthalpy Wheel	160	1128	1600	1437	1926	2264	1944	2716	2527	4237
13	Dual Path w/AAHX	150	1530	2140	1996	3120	5677	5079	5802	8019	5491
14	Dual Path w/Desiccant	14954	10407	8235	6061	7340	6394	5795	5388	4877	4432
15	Base DX w/DCV	27	152	188	170	358	866	793	847	1426	625
16	Dual Path w/DCV	31	235	307	304	494	1091	1015	1093	1676	859
17	Base DX w/Free Reheat	131	1406	1964	1791	2955	5464	4841	5511	7801	5284

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SL = St. Louis MO
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Theater

2001 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	69.9	81.7	83.3	92.3	73.0	73.0	79.2	73.9	68.5	68.7
01	Base DX	74.2	86.8	88.4	98.0	77.5	77.5	84.1	78.5	72.7	73.0
02	DX w/Improved Dehumid.	76.0	88.9	90.5	100.3	79.4	79.4	86.1	80.4	74.5	74.8
03	Base DX w/Lower Airflow	78.6	92.0	93.7	103.8	82.2	82.1	89.0	83.1	77.0	77.3
04	Base DX w/AAHX	74.8	87.4	89.0	98.6	78.1	78.1	84.6	79.0	73.2	73.5
05	Base DX w/Subcool Reheat	74.5	87.1	88.7	98.2	77.8	77.7	84.3	78.7	72.9	73.2
06	Base DX w/o Lat. Coil Degrad.	74.2	86.8	88.4	98.0	77.5	77.5	84.1	78.5	72.7	73.0
07	Base DX w/Bypass Damper	74.2	86.8	88.4	98.0	77.5	77.5	84.1	78.5	72.7	73.0
08	Base DX w/Desiccant	70.6	82.4	84.0	93.0	73.7	73.7	79.9	74.6	69.2	69.4
09	Base DX w/Enthalpy Wheel	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6	49.6
10	Base DX w/OA Precool	49.6	49.6	50.6	60.2	49.6	49.6	49.6	49.6	49.6	49.6
11	Dual Path	121.0	121.0	121.0	121.0	121.0	121.0	121.0	121.0	121.0	121.0
12	Dual Path w/Enthalpy Wheel	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6	51.6
13	Dual Path w/AAHX	112.0	112.0	112.0	112.0	112.0	112.0	112.0	112.0	112.0	112.0
14	Dual Path w/Desiccant	50.3	49.5	49.4	48.8	50.1	50.1	49.7	50.0	50.4	50.4
15	Base DX w/DCV	74.2	86.8	88.4	98.0	77.5	77.5	84.1	78.5	72.7	73.0
16	Dual Path w/DCV	121.0	121.0	121.0	121.0	121.0	121.0	121.0	121.0	121.0	121.0
17	Base DX w/Free Reheat	74.2	86.8	88.4	98.0	77.5	77.5	84.1	78.5	72.7	73.0

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9	31.9
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	22.5	35.0	36.7	46.2	25.8	25.7	32.3	26.7	20.9	21.2
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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School-9 Month-South

2001 Standard

Occupied Hours when RH>65%

[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2595	1858	1343	1110	923	638	624	371	341	0
01	Base DX	2601	1868	1345	1104	939	643	630	375	351	0
02	DX w/Improved Dehumid.	2645	1916	1391	1167	978	685	683	409	370	0
03	Base DX w/Lower Airflow	2638	1908	1383	1150	977	671	676	406	368	0
04	Base DX w/AAHX	2449	1792	1267	1067	906	596	597	359	329	0
05	Base DX w/Subcool Reheat	2532	1783	1248	944	877	574	565	343	314	0
06	Base DX w/o Lat. Coil Degrad.	2285	1566	1038	719	688	454	448	225	210	0
07	Base DX w/Bypass Damper	2574	1825	1300	1031	914	603	601	360	331	0
08	Base DX w/Desiccant	59	146	32	0	0	0	15	0	0	0
09	Base DX w/Enthalpy Wheel	1599	1100	808	708	657	397	510	212	210	0
10	Base DX w/OA Precool	2555	1818	1326	1090	902	633	637	349	323	0
11	Dual Path	2509	1785	1231	992	850	564	566	314	301	0
12	Dual Path w/Enthalpy Wheel	1595	1097	800	687	651	388	491	189	201	0
13	Dual Path w/AAHX	1824	1249	858	441	594	344	324	215	202	0
14	Dual Path w/Desiccant	5	3	0	0	0	0	0	0	0	0
15	Base DX w/DCV	2312	1673	1314	1280	911	670	792	375	383	0
16	Dual Path w/DCV	1422	888	690	663	574	393	586	290	311	0
17	Base DX w/Free Reheat	118	155	105	19	72	49	25	45	16	0

Life Cycle Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	13	16	16	17	16	21	20	26	21	17
01	Base DX	14	16	16	17	16	22	20	26	21	18
02	DX w/Improved Dehumid.	14	17	17	18	17	23	22	27	23	19
03	Base DX w/Lower Airflow	13	16	16	17	16	22	20	26	21	18
04	Base DX w/AAHX	17	20	19	21	19	24	23	30	24	20
05	Base DX w/Subcool Reheat	15	18	17	19	17	22	21	28	22	18
06	Base DX w/o Lat. Coil Degrad.	15	17	17	18	17	22	21	27	22	18
07	Base DX w/Bypass Damper	15	17	17	18	17	22	21	27	22	19
08	Base DX w/Desiccant	39	31	29	28	26	27	25	33	24	22
09	Base DX w/Enthalpy Wheel	11	12	12	12	12	13	12	19	14	15
10	Base DX w/OA Precool	15	18	18	19	18	23	22	29	23	20
11	Dual Path	19	20	20	20	22	27	26	33	29	24
12	Dual Path w/Enthalpy Wheel	14	14	14	14	15	16	15	22	17	18
13	Dual Path w/AAHX	22	22	22	21	23	29	27	35	30	25
14	Dual Path w/Desiccant	39	31	29	28	27	28	27	33	25	24
15	Base DX w/DCV	12	13	13	14	12	13	13	19	13	12
16	Dual Path w/DCV	17	17	16	16	17	18	18	25	20	18
17	Base DX w/Free Reheat	19	20	19	20	18	23	22	28	23	18

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
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School-9 Month-South

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.51	0.62	0.65	0.65	0.63	0.97	0.79	1.10	0.90	0.65
01	Base DX	0.50	0.61	0.65	0.65	0.63	0.96	0.78	1.09	0.90	0.65
02	DX w/Improved Dehumid.	0.44	0.54	0.58	0.56	0.58	0.92	0.75	0.99	0.85	0.62
03	Base DX w/Lower Airflow	0.45	0.55	0.60	0.58	0.59	0.93	0.75	1.01	0.86	0.63
04	Base DX w/AAHX	0.62	0.72	0.74	0.74	0.69	1.01	0.83	1.19	0.95	0.69
05	Base DX w/Subcool Reheat	0.56	0.67	0.70	0.70	0.66	0.99	0.81	1.14	0.92	0.67
06	Base DX w/o Lat. Coil Degrad.	0.54	0.64	0.68	0.68	0.65	0.98	0.80	1.11	0.91	0.65
07	Base DX w/Bypass Damper	0.52	0.62	0.66	0.65	0.63	0.97	0.79	1.09	0.90	0.65
08	Base DX w/Desiccant	1.91	1.30	1.25	1.08	1.01	0.98	0.79	1.08	0.69	0.60
09	Base DX w/Enthalpy Wheel	0.36	0.40	0.43	0.42	0.41	0.48	0.36	0.67	0.42	0.53
10	Base DX w/OA Precool	0.57	0.67	0.70	0.70	0.69	1.03	0.83	1.19	0.96	0.71
11	Dual Path	0.44	0.51	0.56	0.52	0.58	0.91	0.73	0.97	0.85	0.61
12	Dual Path w/Enthalpy Wheel	0.32	0.36	0.39	0.38	0.38	0.44	0.32	0.59	0.38	0.48
13	Dual Path w/AAHX	0.54	0.59	0.63	0.59	0.62	0.95	0.77	1.03	0.88	0.63
14	Dual Path w/Desiccant	1.78	1.17	1.13	0.95	0.91	0.89	0.71	0.91	0.60	0.54
15	Base DX w/DCV	0.37	0.40	0.39	0.44	0.31	0.34	0.28	0.55	0.31	0.27
16	Dual Path w/DCV	0.30	0.29	0.28	0.28	0.24	0.26	0.21	0.39	0.25	0.20
17	Base DX w/Free Reheat	0.82	0.86	0.84	0.83	0.74	1.05	0.86	1.19	0.95	0.65

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	21	24	25	25	22	28	30	29	32	25
01	Base DX	21	24	24	25	22	28	30	29	32	25
02	DX w/Improved Dehumid.	18	21	21	22	20	25	27	26	30	23
03	Base DX w/Lower Airflow	18	21	22	22	20	26	28	27	30	23
04	Base DX w/AAHX	26	28	28	29	25	31	33	31	34	27
05	Base DX w/Subcool Reheat	23	26	26	27	24	29	31	30	33	26
06	Base DX w/o Lat. Coil Degrad.	22	25	25	27	23	28	30	29	32	25
07	Base DX w/Bypass Damper	21	24	25	25	22	28	30	29	32	25
08	Base DX w/Desiccant	57	48	42	40	34	30	32	28	26	25
09	Base DX w/Enthalpy Wheel	14	16	16	16	15	16	15	17	16	20
10	Base DX w/OA Precool	23	26	27	27	25	30	32	31	34	27
11	Dual Path	18	20	20	20	19	25	26	26	29	22
12	Dual Path w/Enthalpy Wheel	13	14	15	14	14	14	14	15	14	18
13	Dual Path w/AAHX	22	23	23	23	21	27	28	27	31	23
14	Dual Path w/Desiccant	52	43	37	35	29	26	27	24	22	21
15	Base DX w/DCV	15	16	16	18	14	14	15	14	13	13
16	Dual Path w/DCV	12	12	11	11	11	10	11	10	10	9
17	Base DX w/Free Reheat	34	34	32	32	27	31	34	31	34	25

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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School-9 Month-South

2001 Standard

Net Total DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3.2	3.8	3.8	4.3	3.5	3.5	3.7	3.6	3.3	3.5
01	Base DX	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
02	DX w/Improved Dehumid.	3.5	4.1	4.2	4.6	3.8	3.8	4.1	3.9	3.6	3.8
03	Base DX w/Lower Airflow	3.6	4.2	4.3	4.8	3.9	4.0	4.2	4.1	3.8	4.0
04	Base DX w/AAHX	3.5	4.0	4.1	4.6	3.7	3.8	4.0	3.9	3.6	3.8
05	Base DX w/Subcool Reheat	3.4	4.0	4.1	4.6	3.7	3.7	4.0	3.8	3.6	3.8
06	Base DX w/o Lat. Coil Degrad.	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
07	Base DX w/Bypass Damper	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
08	Base DX w/Desiccant	3.3	3.8	3.9	4.3	3.5	3.5	3.8	3.6	3.4	3.6
09	Base DX w/Enthalpy Wheel	1.9	1.9	1.9	2.0	1.9	1.9	1.9	2.1	1.9	2.2
10	Base DX w/OA Precool	3.2	3.8	3.8	4.3	3.5	3.5	3.7	3.6	3.3	3.5
11	Dual Path	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
12	Dual Path w/Enthalpy Wheel	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
13	Dual Path w/AAHX	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
14	Dual Path w/Desiccant	3.3	3.9	3.9	4.4	3.6	3.6	3.8	3.7	3.5	3.6
15	Base DX w/DCV	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
16	Dual Path w/DCV	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
17	Base DX w/Free Reheat	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	6	7	7	8	7	7	8	10	8	8
01	Base DX	6	7	7	8	7	8	9	11	8	8
02	DX w/Improved Dehumid.	8	9	9	10	9	9	11	13	10	10
03	Base DX w/Lower Airflow	7	8	7	8	8	8	9	11	9	9
04	Base DX w/AAHX	8	9	9	10	9	9	11	13	10	10
05	Base DX w/Subcool Reheat	7	8	7	9	8	8	9	11	9	9
06	Base DX w/o Lat. Coil Degrad.	7	8	7	9	8	8	9	11	9	9
07	Base DX w/Bypass Damper	7	8	8	9	8	8	10	12	9	9
08	Base DX w/Desiccant	11	12	11	12	12	13	14	17	14	14
09	Base DX w/Enthalpy Wheel	6	6	6	6	6	7	7	9	8	8
10	Base DX w/OA Precool	7	9	8	9	8	9	10	12	9	9
11	Dual Path	13	13	12	12	13	14	15	19	16	15
12	Dual Path w/Enthalpy Wheel	9	9	8	8	9	10	10	13	11	11
13	Dual Path w/AAHX	14	14	13	13	14	15	16	20	17	16
14	Dual Path w/Desiccant	13	14	13	14	14	15	16	20	17	16
15	Base DX w/DCV	7	8	7	8	7	8	9	11	9	8
16	Dual Path w/DCV	13	13	12	12	13	14	15	19	16	15
17	Base DX w/Free Reheat	7	8	7	9	8	8	9	11	9	9

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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School-9 Month-South

2001 Standard

Net Sensible DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
01	Base DX	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
02	DX w/Improved Dehumid.	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
03	Base DX w/Lower Airflow	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
04	Base DX w/AAHX	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
05	Base DX w/Subcool Reheat	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
06	Base DX w/o Lat. Coil Degrad.	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
07	Base DX w/Bypass Damper	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
08	Base DX w/Desiccant	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
09	Base DX w/Enthalpy Wheel	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4
10	Base DX w/OA Precool	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
11	Dual Path	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
12	Dual Path w/Enthalpy Wheel	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
13	Dual Path w/AAHX	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
14	Dual Path w/Desiccant	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
15	Base DX w/DCV	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
16	Dual Path w/DCV	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
17	Base DX w/Free Reheat	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
00	Conventional DX	1840	1525	1414	1348	1207	1165	1201	1061	1090	985
01	Base DX	1819	1505	1397	1330	1184	1145	1180	1038	1069	962
02	DX w/Improved Dehumid.	1569	1246	1136	1058	923	891	923	786	818	719
03	Base DX w/Lower Airflow	1603	1295	1191	1119	978	946	978	841	873	771
04	Base DX w/AAHX	2288	1876	1736	1641	1469	1423	1466	1291	1330	1202
05	Base DX w/Subcool Reheat	2051	1693	1569	1494	1320	1276	1319	1152	1188	1062
06	Base DX w/o Lat. Coil Degrad.	1953	1606	1485	1426	1261	1198	1242	1078	1110	973
07	Base DX w/Bypass Damper	1868	1537	1424	1353	1197	1157	1195	1043	1077	962
08	Base DX w/Desiccant	1945	1678	1602	1529	1541	1463	1465	1372	1414	1303
09	Base DX w/Enthalpy Wheel	1248	978	923	826	922	880	843	836	880	842
10	Base DX w/OA Precool	2065	1677	1555	1466	1383	1331	1352	1224	1266	1146
11	Dual Path	1576	1142	1027	894	894	844	837	723	800	657
12	Dual Path w/Enthalpy Wheel	1095	847	795	700	781	741	713	670	735	643
13	Dual Path w/AAHX	1968	1415	1270	1107	1086	1022	1019	865	959	774
14	Dual Path w/Desiccant	1503	1316	1247	1205	1138	1072	1095	991	1005	922
15	Base DX w/DCV	1369	1247	1217	1198	1170	1131	1139	1041	1051	1024
16	Dual Path w/DCV	1111	877	837	745	855	809	776	707	770	702
17	Base DX w/Free Reheat	3049	2307	2003	1837	1616	1451	1524	1231	1274	971

**All systems are normalized by the same tons in a given city to provide common comparison point.*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
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ST = Washington DC
SL = St. Louis MO
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PO = Portland OR

School-9 Month-South

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
00	Conventional DX	1.0	1.0	1.0	0.9	0.9	1.0	1.0	0.8	0.9	0.7
01	Base DX	1.0	1.0	1.1	0.9	0.9	1.1	1.1	0.8	0.9	0.7
02	DX w/Improved Dehumid.	1.0	1.0	1.0	0.8	0.9	1.0	1.0	0.8	0.9	0.6
03	Base DX w/Lower Airflow	1.0	1.0	1.1	0.9	0.9	1.1	1.1	0.8	0.9	0.6
04	Base DX w/AAHX	1.3	1.3	1.4	1.1	1.2	1.4	1.4	1.0	1.2	0.8
05	Base DX w/Subcool Reheat	1.1	1.1	1.4	1.0	1.1	1.3	1.3	1.0	1.0	0.7
06	Base DX w/o Lat. Coil Degrad.	1.0	1.0	1.2	0.9	1.0	1.1	1.1	0.8	0.9	0.7
07	Base DX w/Bypass Damper	1.0	1.0	1.2	0.9	1.0	1.1	1.1	0.9	1.0	0.7
08	Base DX w/Desiccant	0.8	0.7	0.8	0.7	0.6	0.7	0.7	0.6	0.6	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.5
10	Base DX w/OA Precool	1.1	1.0	1.0	0.9	0.9	1.0	1.0	0.7	0.9	0.7
11	Dual Path	0.9	0.9	1.0	0.7	0.8	0.9	0.9	0.7	0.8	0.6
12	Dual Path w/Enthalpy Wheel	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.5	0.4
13	Dual Path w/AAHX	1.2	1.2	1.3	0.9	1.0	1.2	1.2	0.9	1.0	0.7
14	Dual Path w/Desiccant	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.6	0.5
15	Base DX w/DCV	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.5	0.6	0.5
16	Dual Path w/DCV	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.4	0.5	0.4
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.2	1.3	1.3	1.3	1.2	1.2	0.7

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
00	Conventional DX	204	1148	1506	1277	2238	3793	3692	4128	5482	3578
01	Base DX	208	1157	1516	1288	2252	3810	3709	4148	5500	3601
02	DX w/Improved Dehumid.	243	1243	1625	1399	2382	3980	3863	4346	5700	3822
03	Base DX w/Lower Airflow	235	1223	1602	1375	2353	3942	3828	4302	5658	3771
04	Base DX w/AAHX	176	1079	1417	1188	2133	3655	3567	3960	5315	3396
05	Base DX w/Subcool Reheat	194	1123	1474	1246	2202	3745	3649	4071	5423	3515
06	Base DX w/o Lat. Coil Degrad.	204	1152	1513	1287	2250	3808	3708	4147	5499	3599
07	Base DX w/Bypass Damper	208	1156	1516	1288	2252	3810	3709	4148	5500	3601
08	Base DX w/Desiccant	10326	6593	5235	4026	4187	3400	3305	2859	2803	2453
09	Base DX w/Enthalpy Wheel	225	759	1029	949	1229	1369	1167	1816	1626	2773
10	Base DX w/OA Precool	220	1184	1553	1321	2309	3880	3767	4224	5582	3687
11	Dual Path	242	1280	1678	1482	2413	4017	3928	4413	5726	3881
12	Dual Path w/Enthalpy Wheel	225	759	1029	951	1228	1363	1166	1836	1626	2823
13	Dual Path w/AAHX	224	1241	1630	1440	2354	3944	3861	4321	5628	3778
14	Dual Path w/Desiccant	10239	6533	5184	3947	4206	3490	3349	3040	2982	2751
15	Base DX w/DCV	59	77	85	70	120	157	156	209	283	193
16	Dual Path w/DCV	79	112	122	111	156	207	226	280	362	251
17	Base DX w/Free Reheat	195	1140	1509	1284	2250	3807	3708	4147	5497	3600

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SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

School-9 Month-South

2001 Standard

Net Total DX Cooling Capacity - Primary System
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3.2	3.8	3.8	4.3	3.5	3.5	3.7	3.6	3.3	3.5
01	Base DX	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
02	DX w/Improved Dehumid.	3.5	4.1	4.2	4.6	3.8	3.8	4.1	3.9	3.6	3.8
03	Base DX w/Lower Airflow	3.6	4.2	4.3	4.8	3.9	3.9	4.2	4.1	3.8	4.0
04	Base DX w/AAHX	3.5	4.0	4.1	4.6	3.7	3.8	4.0	3.9	3.6	3.8
05	Base DX w/Subcool Reheat	3.4	4.0	4.1	4.6	3.7	3.7	4.0	3.8	3.6	3.8
06	Base DX w/o Lat. Coil Degrad.	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
07	Base DX w/Bypass Damper	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
08	Base DX w/Desiccant	3.3	3.8	3.9	4.3	3.5	3.5	3.8	3.6	3.4	3.6
09	Base DX w/Enthalpy Wheel	1.9	1.9	1.9	2.0	1.9	1.9	1.9	2.1	1.9	2.2
10	Base DX w/OA Precool	2.0	2.5	2.6	3.1	2.2	2.3	2.5	2.4	2.1	2.3
11	Dual Path	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
12	Dual Path w/Enthalpy Wheel	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
13	Dual Path w/AAHX	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
14	Dual Path w/Desiccant	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
15	Base DX w/DCV	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
16	Dual Path w/DCV	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
17	Base DX w/Free Reheat	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7

Net Total DX Cooling Capacity - Secondary System
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	1.4	2.0	2.1	2.5	1.7	1.7	2.0	1.8	1.5	1.7
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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PO = Portland OR

School-12 Month-South

2001 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2540	1927	1386	1166	977	695	728	417	363	0
01	Base DX	2546	1922	1384	1128	986	700	727	416	371	0
02	DX w/Improved Dehumid.	2583	1966	1421	1197	1033	733	779	457	401	2
03	Base DX w/Lower Airflow	2580	1950	1413	1163	1028	721	759	450	399	1
04	Base DX w/AAHX	2301	1745	1232	1027	920	638	639	396	335	0
05	Base DX w/Subcool Reheat	2492	1829	1293	936	925	628	646	373	343	0
06	Base DX w/o Lat. Coil Degrad.	2289	1626	1142	716	739	482	527	243	238	0
07	Base DX w/Bypass Damper	2528	1871	1339	1019	963	667	690	395	359	0
08	Base DX w/Desiccant	24	53	13	0	0	1	10	0	1	0
09	Base DX w/Enthalpy Wheel	1608	1027	694	369	413	256	276	94	66	2
10	Base DX w/OA Precool	2507	1903	1389	1203	961	687	729	416	354	0
11	Dual Path	2473	1867	1293	980	902	609	637	341	315	2
12	Dual Path w/Enthalpy Wheel	1605	1025	678	321	408	247	272	66	61	2
13	Dual Path w/AAHX	1687	1147	792	382	522	346	327	192	175	1
14	Dual Path w/Desiccant	12	4	0	0	0	0	0	0	0	0
15	Base DX w/DCV	2180	1639	1293	1190	841	622	793	436	326	0
16	Dual Path w/DCV	1177	449	227	20	9	22	73	9	3	0
17	Base DX w/Free Reheat	249	230	125	30	65	46	28	42	21	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	14	17	17	18	17	22	20	27	22	18
01	Base DX	14	17	17	19	17	22	21	28	22	18
02	DX w/Improved Dehumid.	15	18	18	19	18	24	22	29	24	20
03	Base DX w/Lower Airflow	14	17	17	18	17	22	21	27	22	18
04	Base DX w/AAHX	18	21	20	22	20	25	24	32	25	21
05	Base DX w/Subcool Reheat	16	19	19	20	18	23	22	29	23	19
06	Base DX w/o Lat. Coil Degrad.	16	18	18	20	18	23	22	29	23	19
07	Base DX w/Bypass Damper	15	18	18	20	18	23	22	29	23	19
08	Base DX w/Desiccant	42	34	32	30	29	29	28	35	26	23
09	Base DX w/Enthalpy Wheel	12	12	12	12	13	14	13	20	14	16
10	Base DX w/OA Precool	16	19	19	20	19	24	23	31	24	20
11	Dual Path	20	21	21	21	22	28	27	34	29	25
12	Dual Path w/Enthalpy Wheel	14	15	14	14	15	17	16	23	17	18
13	Dual Path w/AAHX	23	23	23	23	24	30	28	37	31	26
14	Dual Path w/Desiccant	42	34	32	30	29	30	29	36	27	25
15	Base DX w/DCV	12	14	13	15	12	13	13	19	14	13
16	Dual Path w/DCV	18	17	16	17	17	18	18	26	20	19
17	Base DX w/Free Reheat	20	22	21	22	19	24	23	30	24	19

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
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SL = St. Louis MO
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School-12 Month-South

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.56	0.69	0.72	0.74	0.69	1.03	0.85	1.20	0.97	0.71
01	Base DX	0.56	0.68	0.72	0.73	0.69	1.03	0.85	1.19	0.96	0.70
02	DX w/Improved Dehumid.	0.49	0.61	0.65	0.64	0.64	0.98	0.80	1.08	0.91	0.67
03	Base DX w/Lower Airflow	0.50	0.62	0.66	0.66	0.65	0.99	0.81	1.11	0.92	0.67
04	Base DX w/AAHX	0.69	0.81	0.83	0.85	0.75	1.09	0.90	1.31	1.02	0.74
05	Base DX w/Subcool Reheat	0.62	0.75	0.78	0.80	0.72	1.06	0.88	1.25	0.99	0.72
06	Base DX w/o Lat. Coil Degrad.	0.59	0.72	0.75	0.77	0.71	1.04	0.87	1.22	0.98	0.71
07	Base DX w/Bypass Damper	0.57	0.70	0.73	0.74	0.69	1.03	0.85	1.20	0.96	0.70
08	Base DX w/Desiccant	2.15	1.49	1.45	1.23	1.18	1.17	0.96	1.26	0.82	0.66
09	Base DX w/Enthalpy Wheel	0.38	0.43	0.47	0.46	0.46	0.52	0.40	0.75	0.47	0.57
10	Base DX w/OA Precool	0.63	0.74	0.78	0.78	0.75	1.09	0.90	1.30	1.03	0.76
11	Dual Path	0.49	0.57	0.62	0.59	0.63	0.97	0.79	1.06	0.91	0.66
12	Dual Path w/Enthalpy Wheel	0.34	0.39	0.43	0.41	0.42	0.48	0.37	0.66	0.43	0.53
13	Dual Path w/AAHX	0.60	0.67	0.70	0.68	0.68	1.02	0.84	1.13	0.95	0.68
14	Dual Path w/Desiccant	2.02	1.37	1.33	1.09	1.07	1.06	0.87	1.07	0.71	0.59
15	Base DX w/DCV	0.39	0.44	0.42	0.48	0.34	0.37	0.31	0.61	0.35	0.30
16	Dual Path w/DCV	0.32	0.31	0.30	0.31	0.26	0.28	0.23	0.44	0.28	0.22
17	Base DX w/Free Reheat	0.90	0.97	0.94	0.94	0.82	1.13	0.95	1.32	1.03	0.71

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	23	27	27	29	25	30	33	31	34	27
01	Base DX	23	27	27	29	25	30	33	31	34	27
02	DX w/Improved Dehumid.	20	24	24	25	22	27	30	29	32	25
03	Base DX w/Lower Airflow	20	24	25	26	22	28	30	29	32	25
04	Base DX w/AAHX	28	32	32	33	28	33	36	34	37	30
05	Base DX w/Subcool Reheat	26	29	30	31	26	32	34	33	35	28
06	Base DX w/o Lat. Coil Degrad.	24	28	28	30	26	31	34	32	35	27
07	Base DX w/Bypass Damper	23	27	28	29	25	30	33	31	34	27
08	Base DX w/Desiccant	64	55	49	46	39	35	38	32	30	27
09	Base DX w/Enthalpy Wheel	15	17	18	18	17	17	17	19	18	22
10	Base DX w/OA Precool	26	29	30	31	27	33	35	34	37	30
11	Dual Path	20	22	23	23	22	27	29	28	32	24
12	Dual Path w/Enthalpy Wheel	14	15	16	16	15	15	15	17	16	20
13	Dual Path w/AAHX	25	26	26	26	24	29	31	30	33	25
14	Dual Path w/Desiccant	58	50	43	40	34	30	32	28	26	23
15	Base DX w/DCV	16	18	18	19	16	15	17	15	14	14
16	Dual Path w/DCV	13	13	12	12	12	11	12	11	11	10
17	Base DX w/Free Reheat	37	38	36	37	31	35	38	34	37	27

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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School-12 Month-South

2001 Standard

Net Total DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3.2	3.8	3.8	4.3	3.5	3.5	3.7	3.6	3.3	3.5
01	Base DX	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
02	DX w/Improved Dehumid.	3.5	4.1	4.2	4.6	3.8	3.8	4.1	3.9	3.6	3.8
03	Base DX w/Lower Airflow	3.6	4.2	4.3	4.8	3.9	4.0	4.2	4.1	3.8	4.0
04	Base DX w/AAHX	3.5	4.0	4.1	4.6	3.7	3.8	4.0	3.9	3.6	3.8
05	Base DX w/Subcool Reheat	3.4	4.0	4.1	4.6	3.7	3.7	4.0	3.8	3.6	3.8
06	Base DX w/o Lat. Coil Degrad.	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
07	Base DX w/Bypass Damper	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
08	Base DX w/Desiccant	3.3	3.8	3.9	4.3	3.5	3.5	3.8	3.6	3.4	3.6
09	Base DX w/Enthalpy Wheel	1.9	1.9	1.9	2.0	1.9	1.9	1.9	2.1	1.9	2.2
10	Base DX w/OA Precool	3.2	3.8	3.8	4.3	3.5	3.5	3.7	3.6	3.3	3.5
11	Dual Path	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
12	Dual Path w/Enthalpy Wheel	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
13	Dual Path w/AAHX	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
14	Dual Path w/Desiccant	3.3	3.9	3.9	4.4	3.6	3.6	3.8	3.7	3.5	3.6
15	Base DX w/DCV	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7
16	Dual Path w/DCV	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
17	Base DX w/Free Reheat	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.6	3.7

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	6	7	7	8	7	7	8	10	8	8
01	Base DX	6	7	7	8	7	8	9	11	8	8
02	DX w/Improved Dehumid.	8	9	9	10	9	9	11	13	10	10
03	Base DX w/Lower Airflow	7	8	7	8	8	8	9	11	9	9
04	Base DX w/AAHX	8	9	9	10	9	9	11	13	10	10
05	Base DX w/Subcool Reheat	7	8	7	9	8	8	9	11	9	9
06	Base DX w/o Lat. Coil Degrad.	7	8	7	9	8	8	9	11	9	9
07	Base DX w/Bypass Damper	7	8	8	9	8	8	10	12	9	9
08	Base DX w/Desiccant	11	12	11	12	12	13	14	17	14	14
09	Base DX w/Enthalpy Wheel	6	6	6	6	6	7	7	9	8	8
10	Base DX w/OA Precool	7	9	8	9	8	9	10	12	9	9
11	Dual Path	13	13	12	12	13	14	15	19	16	15
12	Dual Path w/Enthalpy Wheel	9	9	8	8	9	10	10	13	11	11
13	Dual Path w/AAHX	14	14	13	13	14	15	16	20	17	16
14	Dual Path w/Desiccant	13	14	13	14	14	15	16	20	17	16
15	Base DX w/DCV	7	8	7	8	7	8	9	11	9	8
16	Dual Path w/DCV	13	13	12	12	13	14	15	19	16	15
17	Base DX w/Free Reheat	7	8	7	9	8	8	9	11	9	9

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
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NY = New York NY
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PO = Portland OR

School-12 Month-South

2001 Standard

Net Sensible DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
01	Base DX	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
02	DX w/Improved Dehumid.	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
03	Base DX w/Lower Airflow	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
04	Base DX w/AAHX	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
05	Base DX w/Subcool Reheat	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
06	Base DX w/o Lat. Coil Degrad.	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
07	Base DX w/Bypass Damper	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
08	Base DX w/Desiccant	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
09	Base DX w/Enthalpy Wheel	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4
10	Base DX w/OA Precool	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
11	Dual Path	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
12	Dual Path w/Enthalpy Wheel	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
13	Dual Path w/AAHX	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
14	Dual Path w/Desiccant	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
15	Base DX w/DCV	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5
16	Dual Path w/DCV	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
17	Base DX w/Free Reheat	2.3	2.6	2.7	3.0	2.4	2.5	2.6	2.5	2.3	2.5

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
00	Conventional DX	2042	1741	1619	1564	1379	1309	1390	1215	1242	1102
01	Base DX	2017	1719	1600	1550	1357	1287	1369	1191	1220	1077
02	DX w/Improved Dehumid.	1744	1438	1316	1250	1069	1006	1086	914	944	810
03	Base DX w/Lower Airflow	1778	1490	1375	1322	1131	1068	1148	975	1005	869
04	Base DX w/AAHX	2540	2150	1995	1913	1684	1599	1700	1480	1516	1344
05	Base DX w/Subcool Reheat	2276	1935	1800	1749	1514	1437	1533	1325	1357	1188
06	Base DX w/o Lat. Coil Degrad.	2167	1836	1701	1662	1450	1355	1451	1246	1276	1095
07	Base DX w/Bypass Damper	2071	1759	1634	1584	1375	1303	1389	1201	1232	1078
08	Base DX w/Desiccant	2115	1852	1771	1694	1708	1624	1643	1540	1584	1446
09	Base DX w/Enthalpy Wheel	1335	1072	1015	922	1029	973	952	945	990	936
10	Base DX w/OA Precool	2281	1899	1768	1677	1574	1492	1555	1392	1437	1276
11	Dual Path	1751	1321	1195	1070	1041	960	996	848	930	743
12	Dual Path w/Enthalpy Wheel	1169	930	876	785	875	822	809	763	831	719
13	Dual Path w/AAHX	2194	1648	1487	1336	1271	1165	1221	1020	1119	877
14	Dual Path w/Desiccant	1638	1461	1386	1346	1272	1196	1243	1125	1139	1027
15	Base DX w/DCV	1463	1360	1329	1319	1282	1239	1258	1163	1172	1135
16	Dual Path w/DCV	1175	951	909	823	938	886	862	801	868	786
17	Base DX w/Free Reheat	3332	2620	2301	2142	1886	1675	1817	1450	1488	1091

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School-12 Month-South

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
00	Conventional DX	1.1	1.0	1.0	0.9	0.9	1.0	1.1	0.9	1.0	0.7
01	Base DX	1.1	1.0	1.1	0.9	1.0	1.0	1.1	0.9	1.0	0.8
02	DX w/Improved Dehumid.	1.1	1.0	1.0	0.9	0.9	1.0	1.1	0.9	1.0	0.7
03	Base DX w/Lower Airflow	1.1	1.0	1.1	0.9	0.9	1.0	1.1	0.9	1.0	0.7
04	Base DX w/AAHX	1.3	1.3	1.4	1.2	1.2	1.3	1.4	1.2	1.3	0.9
05	Base DX w/Subcool Reheat	1.3	1.1	1.4	1.1	1.1	1.1	1.4	1.1	1.2	0.8
06	Base DX w/o Lat. Coil Degrad.	1.1	1.0	1.2	1.0	1.0	1.0	1.2	1.0	1.0	0.8
07	Base DX w/Bypass Damper	1.1	1.0	1.2	1.0	1.0	1.1	1.2	1.0	1.0	0.8
08	Base DX w/Desiccant	0.8	0.7	0.8	0.7	0.7	0.7	0.8	0.6	0.8	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.6	0.5
10	Base DX w/OA Precool	1.2	1.0	1.0	0.9	1.0	1.0	1.2	0.9	1.1	0.8
11	Dual Path	1.0	0.9	1.0	0.8	0.8	0.9	1.1	0.8	0.9	0.7
12	Dual Path w/Enthalpy Wheel	0.5	0.5	0.5	0.4	0.5	0.5	0.6	0.5	0.5	0.4
13	Dual Path w/AAHX	1.3	1.2	1.4	1.0	1.1	1.2	1.4	1.0	1.2	0.9
14	Dual Path w/Desiccant	0.7	0.7	0.7	0.6	0.6	0.7	0.8	0.6	0.7	0.5
15	Base DX w/DCV	0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.6	0.6	0.5
16	Dual Path w/DCV	0.6	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.6	0.5
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	0.8

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
00	Conventional DX	217	1201	1558	1329	2331	3930	3841	4318	5678	3786
01	Base DX	221	1210	1569	1341	2346	3948	3860	4339	5697	3810
02	DX w/Improved Dehumid.	258	1302	1682	1457	2482	4123	4023	4537	5900	4040
03	Base DX w/Lower Airflow	250	1281	1658	1431	2453	4084	3986	4494	5856	3988
04	Base DX w/AAHX	188	1129	1466	1237	2220	3788	3709	4149	5508	3598
05	Base DX w/Subcool Reheat	207	1175	1525	1297	2293	3880	3796	4260	5618	3721
06	Base DX w/o Lat. Coil Degrad.	217	1205	1565	1339	2344	3945	3858	4338	5695	3808
07	Base DX w/Bypass Damper	221	1210	1569	1341	2346	3947	3860	4339	5697	3810
08	Base DX w/Desiccant	11815	7822	6286	4711	5076	4231	4211	3562	3513	2676
09	Base DX w/Enthalpy Wheel	240	815	1085	1006	1327	1499	1321	2001	1820	2988
10	Base DX w/OA Precool	234	1239	1606	1375	2405	4018	3919	4411	5777	3897
11	Dual Path	258	1342	1737	1543	2516	4162	4090	4602	5925	4100
12	Dual Path w/Enthalpy Wheel	240	815	1085	1009	1325	1493	1319	2023	1820	3042
13	Dual Path w/AAHX	237	1300	1687	1498	2453	4085	4018	4511	5826	3994
14	Dual Path w/Desiccant	11771	7811	6255	4605	5059	4292	4217	3696	3658	2982
15	Base DX w/DCV	61	80	89	72	125	166	160	221	301	211
16	Dual Path w/DCV	82	121	131	118	167	222	235	308	394	285
17	Base DX w/Free Reheat	207	1194	1560	1337	2343	3944	3858	4338	5694	3810

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School-12 Month-South

2001 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3.2	3.8	3.8	4.3	3.5	3.5	3.7	3.6	3.3	3.5
01	Base DX	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
02	DX w/Improved Dehumid.	3.5	4.1	4.2	4.6	3.8	3.8	4.1	3.9	3.6	3.8
03	Base DX w/Lower Airflow	3.6	4.2	4.3	4.8	3.9	3.9	4.2	4.1	3.8	4.0
04	Base DX w/AAHX	3.5	4.0	4.1	4.6	3.7	3.8	4.0	3.9	3.6	3.8
05	Base DX w/Subcool Reheat	3.4	4.0	4.1	4.6	3.7	3.7	4.0	3.8	3.6	3.8
06	Base DX w/o Lat. Coil Degrad.	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
07	Base DX w/Bypass Damper	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
08	Base DX w/Desiccant	3.3	3.8	3.9	4.3	3.5	3.5	3.8	3.6	3.4	3.6
09	Base DX w/Enthalpy Wheel	1.9	1.9	1.9	2.0	1.9	1.9	1.9	2.1	1.9	2.2
10	Base DX w/OA Precool	2.0	2.5	2.6	3.1	2.2	2.3	2.5	2.4	2.1	2.3
11	Dual Path	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
12	Dual Path w/Enthalpy Wheel	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
13	Dual Path w/AAHX	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
14	Dual Path w/Desiccant	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
15	Base DX w/DCV	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7
16	Dual Path w/DCV	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
17	Base DX w/Free Reheat	3.4	4.0	4.1	4.5	3.7	3.7	4.0	3.8	3.5	3.7

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	1.4	2.0	2.1	2.5	1.7	1.7	2.0	1.8	1.5	1.7
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Motel-South

2001 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	7212	5438	4098	3602	3129	2484	2592	1831	1680	9
01	Base DX	7296	5500	4200	3656	3183	2531	2632	1850	1748	10
02	DX w/Improved Dehumid.	7394	5591	4286	3711	3229	2559	2668	1878	1798	11
03	Base DX w/Lower Airflow	7420	5610	4309	3729	3237	2568	2678	1880	1811	11
04	Base DX w/AAHX	5014	4119	2892	1997	1929	1656	1578	1223	827	2
05	Base DX w/Subcool Reheat	7255	5458	4103	3636	3173	2509	2608	1844	1736	9
06	Base DX w/o Lat. Coil Degrad.	4041	2149	915	167	101	163	156	113	46	0
07	Base DX w/Bypass Damper	7277	5471	4146	3638	3172	2523	2621	1850	1742	10
08	Base DX w/Desiccant	2248	1612	939	393	42	11	276	5	14	0
09	Base DX w/Enthalpy Wheel	7174	5214	4048	3721	3239	2521	2657	1968	1773	38
10	Base DX w/OA Precool	6882	5135	3673	3287	2748	2085	2216	1467	1177	0
11	Dual Path	954	574	203	60	0	0	2	16	0	0
12	Dual Path w/Enthalpy Wheel	3639	1947	713	342	1	3	293	21	16	0
13	Dual Path w/AAHX	670	503	186	54	0	0	1	13	0	0
14	Dual Path w/Desiccant	240	187	0	0	0	0	38	0	0	0
15	Base DX w/DCV	7296	5500	4200	3656	3183	2531	2632	1850	1748	10
16	Dual Path w/DCV	954	574	203	60	0	0	2	16	0	0
17	Base DX w/Free Reheat	466	610	280	76	5	0	22	48	6	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2	3	3	3	2	3	3	4	3	3
01	Base DX	2	3	3	3	3	3	3	4	3	3
02	DX w/Improved Dehumid.	2	3	3	3	3	3	3	4	3	3
03	Base DX w/Lower Airflow	2	2	2	3	2	3	3	4	3	3
04	Base DX w/AAHX	3	3	3	3	3	4	3	5	4	3
05	Base DX w/Subcool Reheat	3	3	3	3	3	3	3	5	4	3
06	Base DX w/o Lat. Coil Degrad.	3	3	3	4	3	4	4	5	4	4
07	Base DX w/Bypass Damper	2	3	3	3	3	3	3	5	4	3
08	Base DX w/Desiccant	5	4	4	4	4	4	4	5	4	3
09	Base DX w/Enthalpy Wheel	2	2	2	2	2	3	2	4	3	3
10	Base DX w/OA Precool	3	3	3	3	3	3	3	5	4	3
11	Dual Path	5	5	5	5	5	5	5	8	6	5
12	Dual Path w/Enthalpy Wheel	5	5	4	4	4	5	4	7	5	4
13	Dual Path w/AAHX	5	5	5	5	5	5	5	8	6	5
14	Dual Path w/Desiccant	7	6	5	5	5	5	5	7	5	4
15	Base DX w/DCV	2	3	3	3	3	3	3	4	3	3
16	Dual Path w/DCV	5	5	5	5	5	5	5	8	6	5
17	Base DX w/Free Reheat	3	4	3	4	3	4	3	5	4	3

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

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Motel-South

2001 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.11	0.13	0.13	0.14	0.12	0.15	0.13	0.22	0.16	0.12
01	Base DX	0.11	0.12	0.13	0.13	0.12	0.15	0.13	0.21	0.16	0.12
02	DX w/Improved Dehumid.	0.10	0.11	0.11	0.12	0.10	0.14	0.12	0.19	0.14	0.11
03	Base DX w/Lower Airflow	0.10	0.11	0.11	0.12	0.11	0.14	0.12	0.19	0.15	0.11
04	Base DX w/AAHX	0.14	0.15	0.15	0.16	0.14	0.17	0.15	0.25	0.17	0.13
05	Base DX w/Subcool Reheat	0.12	0.14	0.14	0.15	0.12	0.16	0.14	0.23	0.16	0.12
06	Base DX w/o Lat. Coil Degrad.	0.13	0.14	0.14	0.15	0.13	0.16	0.14	0.23	0.16	0.12
07	Base DX w/Bypass Damper	0.11	0.13	0.13	0.14	0.12	0.15	0.13	0.21	0.16	0.12
08	Base DX w/Desiccant	0.28	0.22	0.21	0.19	0.19	0.19	0.16	0.24	0.16	0.12
09	Base DX w/Enthalpy Wheel	0.10	0.11	0.11	0.11	0.10	0.11	0.09	0.18	0.11	0.10
10	Base DX w/OA Precool	0.12	0.13	0.13	0.14	0.12	0.16	0.14	0.22	0.16	0.12
11	Dual Path	0.21	0.21	0.20	0.21	0.18	0.21	0.17	0.31	0.21	0.15
12	Dual Path w/Enthalpy Wheel	0.18	0.18	0.17	0.18	0.15	0.16	0.13	0.26	0.16	0.14
13	Dual Path w/AAHX	0.22	0.22	0.21	0.22	0.19	0.22	0.18	0.32	0.21	0.15
14	Dual Path w/Desiccant	0.33	0.26	0.25	0.23	0.21	0.21	0.18	0.30	0.18	0.14
15	Base DX w/DCV	0.11	0.12	0.13	0.13	0.12	0.15	0.13	0.21	0.16	0.12
16	Dual Path w/DCV	0.21	0.21	0.20	0.21	0.18	0.21	0.17	0.31	0.21	0.15
17	Base DX w/Free Reheat	0.19	0.19	0.18	0.19	0.16	0.19	0.16	0.27	0.18	0.13

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	4.7	5.0	5.0	5.4	4.8	5.3	5.8	5.5	5.9	5.2
01	Base DX	4.7	5.0	5.0	5.3	4.7	5.2	5.8	5.4	5.9	5.1
02	DX w/Improved Dehumid.	4.0	4.3	4.3	4.6	4.1	4.6	5.0	4.8	5.2	4.4
03	Base DX w/Lower Airflow	4.2	4.4	4.4	4.7	4.2	4.7	5.2	4.9	5.4	4.6
04	Base DX w/AAHX	5.9	6.1	6.1	6.5	5.7	6.1	6.7	6.2	6.6	5.9
05	Base DX w/Subcool Reheat	5.1	5.4	5.4	5.8	5.1	5.6	6.1	5.8	6.2	5.5
06	Base DX w/o Lat. Coil Degrad.	5.3	5.6	5.5	6.0	5.2	5.6	6.2	5.8	6.2	5.3
07	Base DX w/Bypass Damper	4.8	5.0	5.0	5.4	4.8	5.3	5.8	5.5	5.9	5.1
08	Base DX w/Desiccant	8.8	8.1	7.5	7.4	6.7	6.3	6.8	6.2	5.9	5.4
09	Base DX w/Enthalpy Wheel	4.1	4.2	4.3	4.6	4.1	4.2	4.5	4.5	4.4	4.7
10	Base DX w/OA Precool	5.0	5.3	5.3	5.6	5.0	5.5	6.1	5.7	6.1	5.4
11	Dual Path	8.8	8.4	8.2	8.3	7.9	7.9	8.4	7.7	8.1	6.9
12	Dual Path w/Enthalpy Wheel	7.6	7.3	7.1	7.3	6.9	6.7	7.0	6.6	6.6	6.3
13	Dual Path w/AAHX	9.2	8.7	8.5	8.7	8.2	8.2	8.7	7.9	8.3	7.1
14	Dual Path w/Desiccant	11.5	10.2	9.3	9.1	8.5	7.8	8.2	7.4	7.3	6.4
15	Base DX w/DCV	4.7	5.0	5.0	5.3	4.7	5.2	5.8	5.4	5.9	5.1
16	Dual Path w/DCV	8.8	8.4	8.2	8.3	7.9	7.9	8.4	7.7	8.1	6.9
17	Base DX w/Free Reheat	8.0	7.7	7.3	7.8	6.6	6.8	7.6	6.8	7.0	5.6

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
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ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

Motel-South

2001 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.5
01	Base DX	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
02	DX w/Improved Dehumid.	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.6
03	Base DX w/Lower Airflow	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
04	Base DX w/AAHX	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.6
05	Base DX w/Subcool Reheat	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
06	Base DX w/o Lat. Coil Degrad.	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
07	Base DX w/Bypass Damper	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
08	Base DX w/Desiccant	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.5
09	Base DX w/Enthalpy Wheel	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
10	Base DX w/OA Precool	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.5
11	Dual Path	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
14	Dual Path w/Desiccant	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
15	Base DX w/DCV	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
16	Dual Path w/DCV	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
17	Base DX w/Free Reheat	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1	1	1	1	1	1	1	1	1	1
01	Base DX	1	1	1	1	1	1	1	1	1	1
02	DX w/Improved Dehumid.	1	1	1	1	1	1	1	2	1	2
03	Base DX w/Lower Airflow	1	1	1	1	1	1	1	1	1	1
04	Base DX w/AAHX	1	1	1	1	1	1	1	2	1	2
05	Base DX w/Subcool Reheat	1	1	1	1	1	1	1	1	1	1
06	Base DX w/o Lat. Coil Degrad.	1	1	1	1	1	2	2	2	2	2
07	Base DX w/Bypass Damper	1	1	1	1	1	1	1	2	1	1
08	Base DX w/Desiccant	1	1	1	1	1	1	1	2	1	1
09	Base DX w/Enthalpy Wheel	1	1	1	1	1	1	1	1	1	1
10	Base DX w/OA Precool	1	1	1	1	1	1	1	2	1	1
11	Dual Path	2	2	2	2	2	2	2	3	3	3
12	Dual Path w/Enthalpy Wheel	2	2	2	2	2	2	2	3	3	2
13	Dual Path w/AAHX	2	2	2	2	2	2	3	3	3	3
14	Dual Path w/Desiccant	2	2	2	2	2	2	2	3	3	2
15	Base DX w/DCV	1	1	1	1	1	1	1	1	1	1
16	Dual Path w/DCV	2	2	2	2	2	2	3	3	3	3
17	Base DX w/Free Reheat	1	1	1	1	1	1	1	1	1	1

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
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ST = Washington DC
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Motel-South

2001 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
01	Base DX	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
02	DX w/Improved Dehumid.	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
03	Base DX w/Lower Airflow	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
04	Base DX w/AAHX	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
05	Base DX w/Subcool Reheat	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
06	Base DX w/o Lat. Coil Degrad.	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
07	Base DX w/Bypass Damper	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
08	Base DX w/Desiccant	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
09	Base DX w/Enthalpy Wheel	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3
10	Base DX w/OA Precool	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
11	Dual Path	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
12	Dual Path w/Enthalpy Wheel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
13	Dual Path w/AAHX	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
14	Dual Path w/Desiccant	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
15	Base DX w/DCV	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
16	Dual Path w/DCV	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
17	Base DX w/Free Reheat	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
00	Conventional DX	3871	3304	3085	3068	2815	2573	2700	2329	2335	2182
01	Base DX	3821	3252	3038	3025	2767	2525	2653	2283	2291	2140
02	DX w/Improved Dehumid.	3284	2723	2511	2479	2243	2010	2133	1772	1781	1639
03	Base DX w/Lower Airflow	3380	2826	2621	2597	2350	2116	2242	1883	1894	1750
04	Base DX w/AAHX	4877	4131	3841	3820	3486	3167	3331	2857	2870	2652
05	Base DX w/Subcool Reheat	4197	3578	3346	3327	3037	2779	2920	2518	2527	2362
06	Base DX w/o Lat. Coil Degrad.	4375	3695	3435	3453	3124	2786	2954	2486	2481	2235
07	Base DX w/Bypass Damper	3879	3296	3078	3057	2791	2542	2674	2294	2303	2148
08	Base DX w/Desiccant	3782	3339	3194	3178	3058	2813	2887	2558	2567	2393
09	Base DX w/Enthalpy Wheel	3371	2856	2698	2661	2583	2375	2433	2163	2184	2068
10	Base DX w/OA Precool	4100	3481	3252	3205	2990	2716	2833	2441	2452	2269
11	Dual Path	7277	5882	5415	5077	5227	4494	4507	3903	4003	3313
12	Dual Path w/Enthalpy Wheel	6275	5190	4845	4542	4772	4181	4143	3688	3794	3199
13	Dual Path w/AAHX	7572	6087	5614	5292	5437	4659	4686	4049	4144	3441
14	Dual Path w/Desiccant	6337	5250	4905	4586	4832	4233	4191	3716	3832	3226
15	Base DX w/DCV	3821	3252	3038	3025	2767	2525	2653	2283	2291	2140
16	Dual Path w/DCV	7277	5882	5415	5077	5227	4494	4507	3903	4003	3313
17	Base DX w/Free Reheat	6539	5247	4689	4595	4112	3538	3796	3098	2991	2436

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Motel-South

2001 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*

[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
00	Conventional DX	1.1	1.0	1.1	1.0	0.9	1.0	1.1	0.8	0.8	0.8
01	Base DX	1.1	1.0	1.2	1.0	0.9	1.0	1.1	0.8	0.8	0.8
02	DX w/Improved Dehumid.	1.0	1.0	1.1	1.0	0.9	0.9	1.0	0.7	0.8	0.7
03	Base DX w/Lower Airflow	1.1	1.0	1.2	1.0	0.9	0.9	1.1	0.7	0.8	0.8
04	Base DX w/AAHX	1.3	1.3	1.4	1.2	1.2	1.2	1.4	1.0	1.1	1.0
05	Base DX w/Subcool Reheat	1.2	1.2	1.4	1.1	1.0	1.1	1.3	0.9	0.9	0.9
06	Base DX w/o Lat. Coil Degrad.	1.1	1.1	1.2	1.1	1.0	1.1	1.2	0.9	0.9	0.9
07	Base DX w/Bypass Damper	1.1	1.1	1.2	1.1	1.0	1.0	1.1	0.8	0.9	0.9
08	Base DX w/Desiccant	1.0	0.9	1.0	0.9	0.9	0.8	1.0	0.7	0.8	0.7
09	Base DX w/Enthalpy Wheel	1.0	0.9	1.0	0.9	0.9	0.9	0.9	0.7	0.8	0.8
10	Base DX w/OA Precool	1.1	1.1	1.2	1.1	1.0	1.0	1.1	0.8	0.9	0.8
11	Dual Path	1.5	1.3	1.5	1.3	1.3	1.2	1.3	1.0	1.1	1.0
12	Dual Path w/Enthalpy Wheel	1.3	1.1	1.2	1.1	1.1	1.0	1.0	0.9	1.0	0.9
13	Dual Path w/AAHX	1.5	1.4	1.5	1.3	1.3	1.3	1.3	1.1	1.2	1.1
14	Dual Path w/Desiccant	1.3	1.1	1.2	1.1	1.1	1.0	1.1	0.9	1.0	0.9
15	Base DX w/DCV	1.1	1.0	1.2	1.0	0.9	1.0	1.1	0.8	0.8	0.8
16	Dual Path w/DCV	1.5	1.3	1.5	1.3	1.3	1.2	1.3	1.0	1.1	1.0
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.2	1.3	1.3	1.1	1.2	1.0

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
00	Conventional DX	158	1182	1400	1288	1941	2951	3198	3514	4713	2356
01	Base DX	162	1194	1414	1302	1958	2972	3219	3545	4745	2387
02	DX w/Improved Dehumid.	189	1304	1548	1442	2119	3185	3423	3830	5049	2680
03	Base DX w/Lower Airflow	183	1279	1520	1411	2083	3139	3379	3769	4982	2616
04	Base DX w/AAHX	134	1092	1290	1174	1812	2775	3029	3279	4458	2116
05	Base DX w/Subcool Reheat	152	1152	1362	1248	1895	2890	3138	3431	4623	2273
06	Base DX w/o Lat. Coil Degrad.	147	1180	1405	1292	1950	2968	3216	3543	4741	2382
07	Base DX w/Bypass Damper	162	1194	1414	1302	1958	2972	3219	3545	4745	2387
08	Base DX w/Desiccant	11269	8325	6494	5128	5500	4289	4508	4091	3994	2143
09	Base DX w/Enthalpy Wheel	163	789	880	874	1114	1259	1431	2019	2144	1767
10	Base DX w/OA Precool	161	1203	1427	1314	1974	2994	3239	3572	4773	2412
11	Dual Path	54	805	989	933	1429	2369	2681	2843	3915	1826
12	Dual Path w/Enthalpy Wheel	51	395	454	469	603	740	916	1325	1367	1185
13	Dual Path w/AAHX	50	787	968	912	1404	2339	2653	2807	3872	1791
14	Dual Path w/Desiccant	10145	7018	5155	4026	3921	3020	3309	2886	2684	1276
15	Base DX w/DCV	162	1194	1414	1302	1958	2972	3219	3545	4745	2387
16	Dual Path w/DCV	54	805	989	933	1429	2369	2681	2843	3915	1826
17	Base DX w/Free Reheat	130	1171	1403	1296	1954	2971	3217	3544	4741	2386

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Motel-South

2001 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.5
01	Base DX	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
02	DX w/Improved Dehumid.	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.6
03	Base DX w/Lower Airflow	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
04	Base DX w/AAHX	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.6
05	Base DX w/Subcool Reheat	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
06	Base DX w/o Lat. Coil Degrad.	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
07	Base DX w/Bypass Damper	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
08	Base DX w/Desiccant	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.5	0.5
09	Base DX w/Enthalpy Wheel	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
10	Base DX w/OA Precool	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
11	Dual Path	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
12	Dual Path w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	Dual Path w/AAHX	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14	Dual Path w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	Base DX w/DCV	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6
16	Dual Path w/DCV	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
17	Base DX w/Free Reheat	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.6

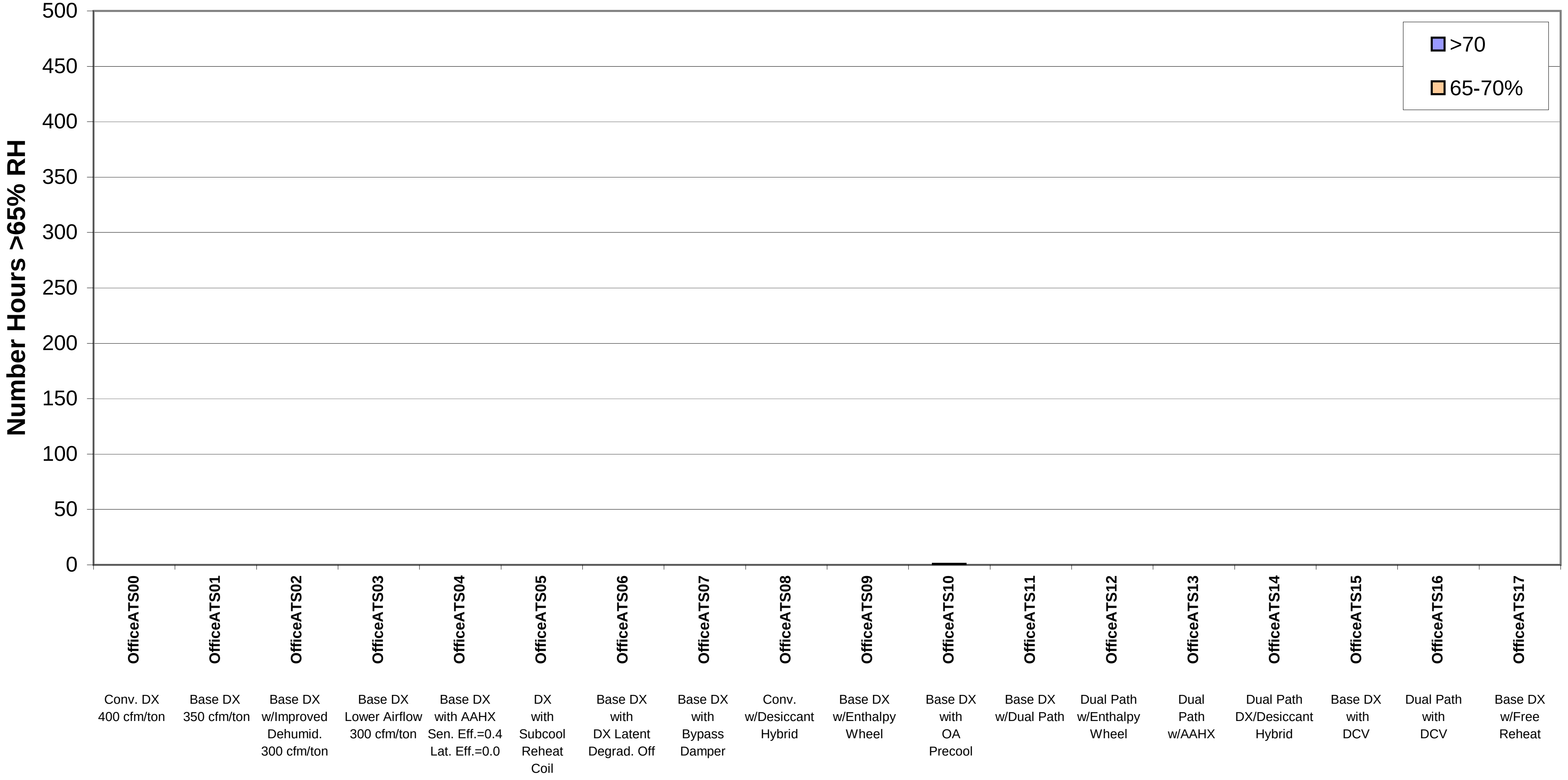
Net Total DX Cooling Capacity - Secondary System

[tons]

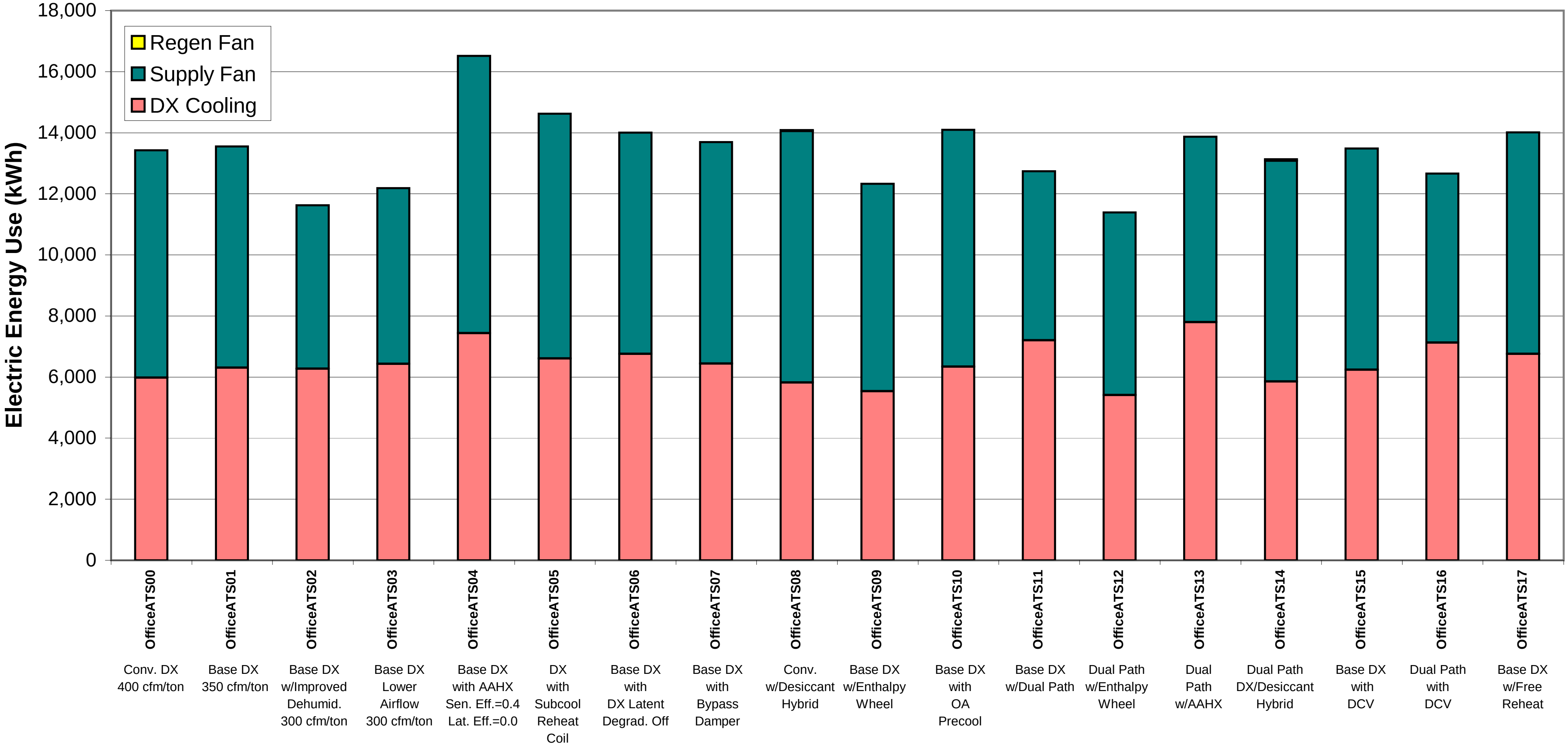
	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

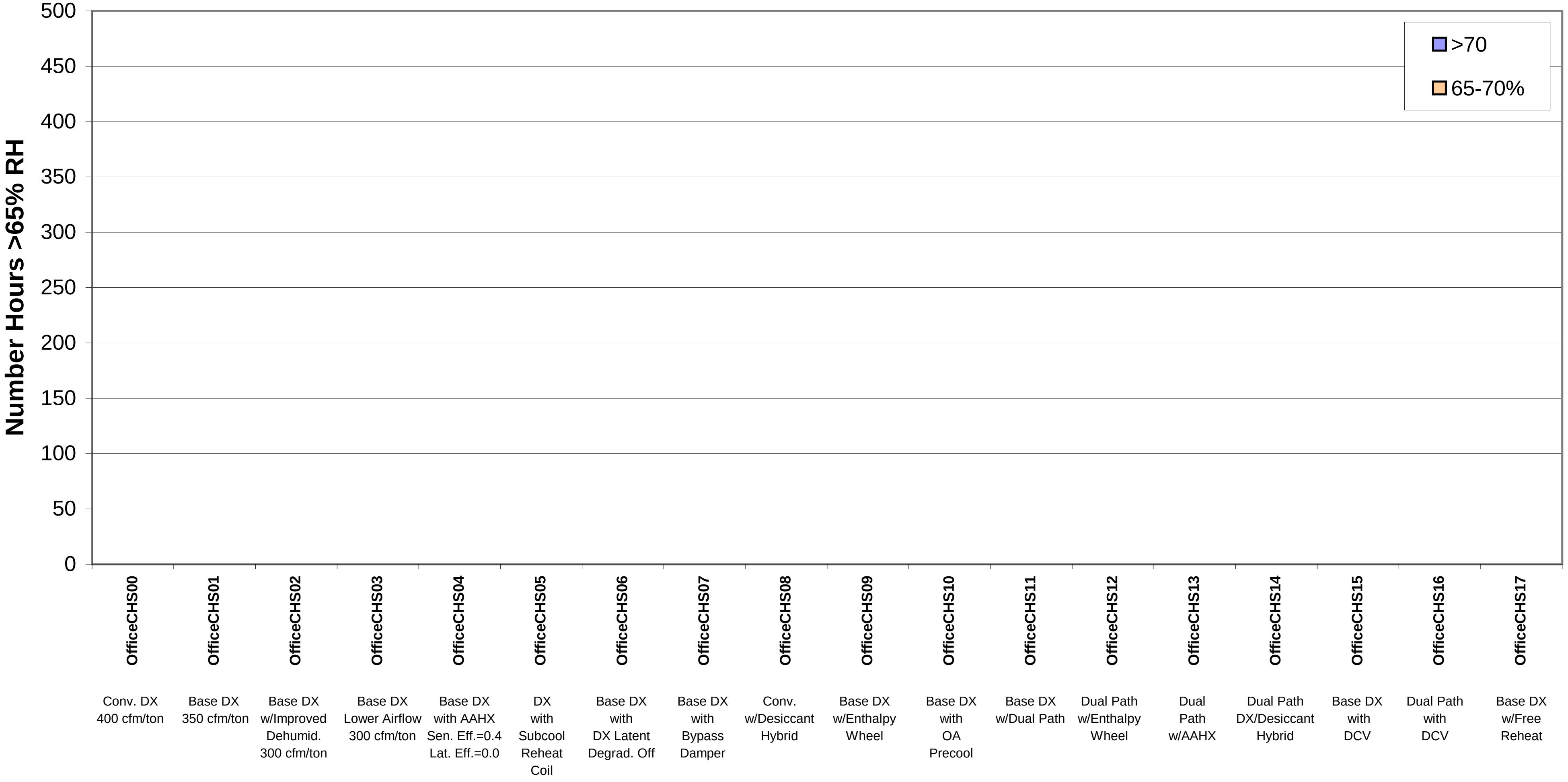
2004 Standard Office in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



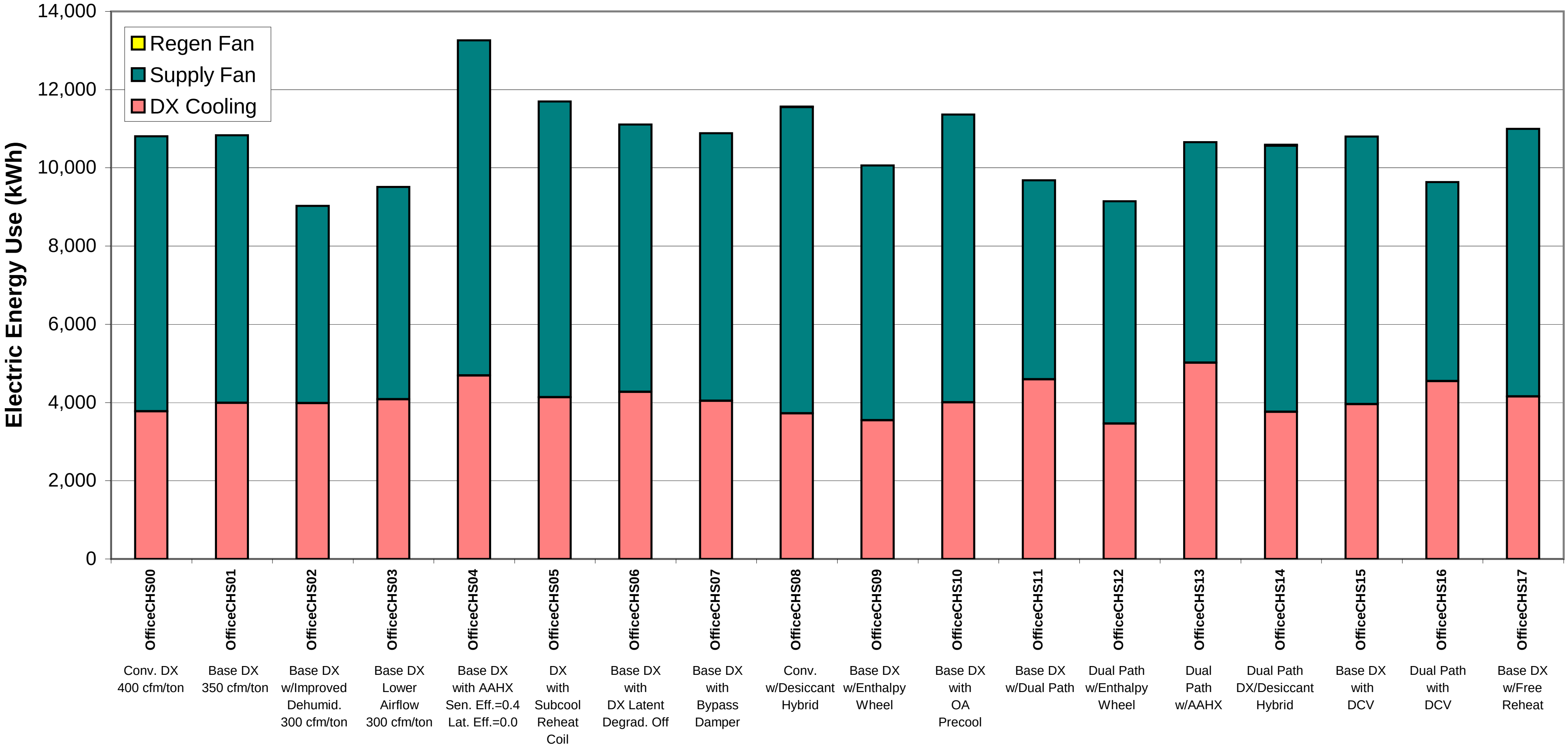
2004 Standard Office in Atlanta GA
Annual HVAC System Electric Energy Use

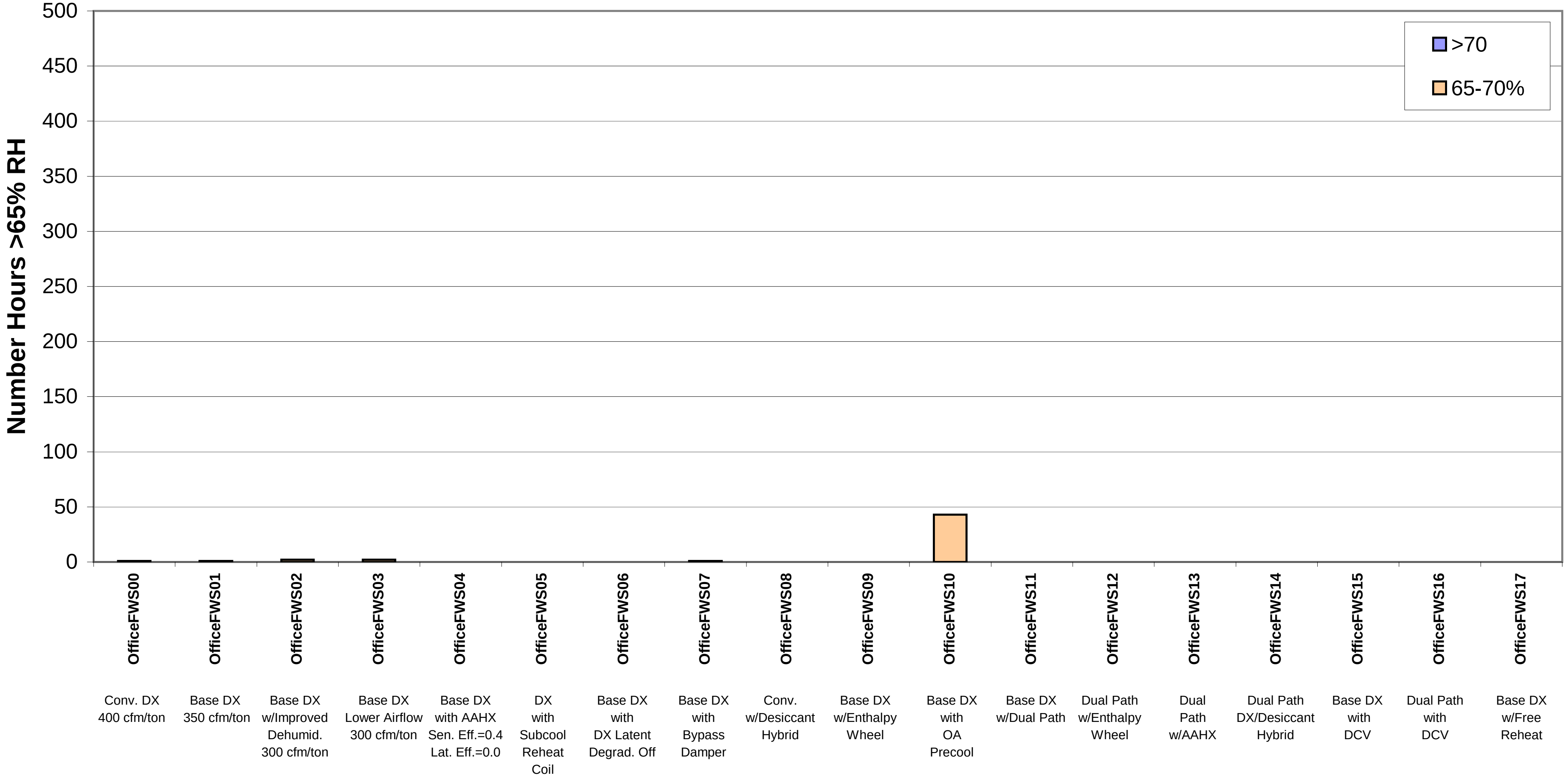


2004 Standard Office in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



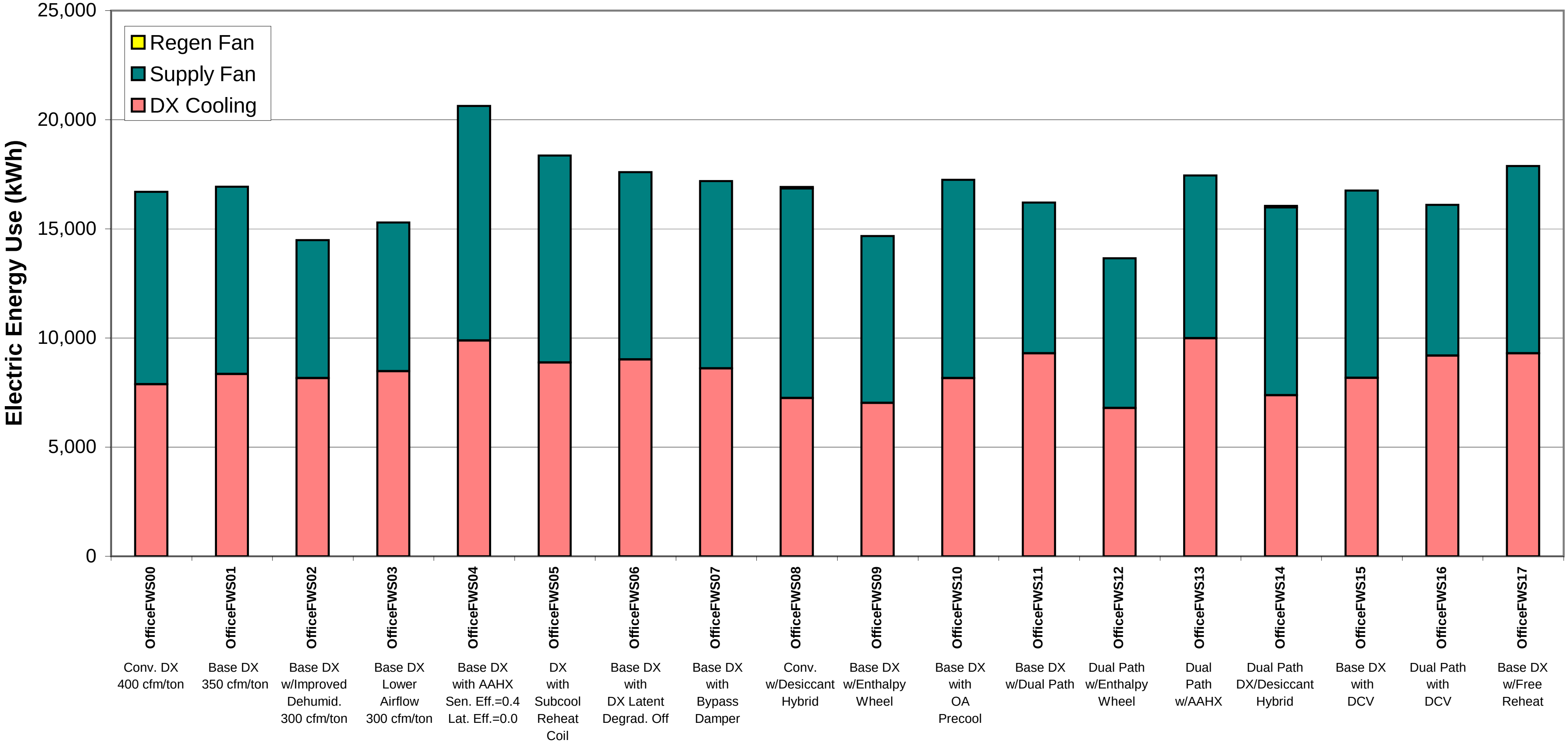
2004 Standard Office in Chicago IL
Annual HVAC System Electric Energy Use



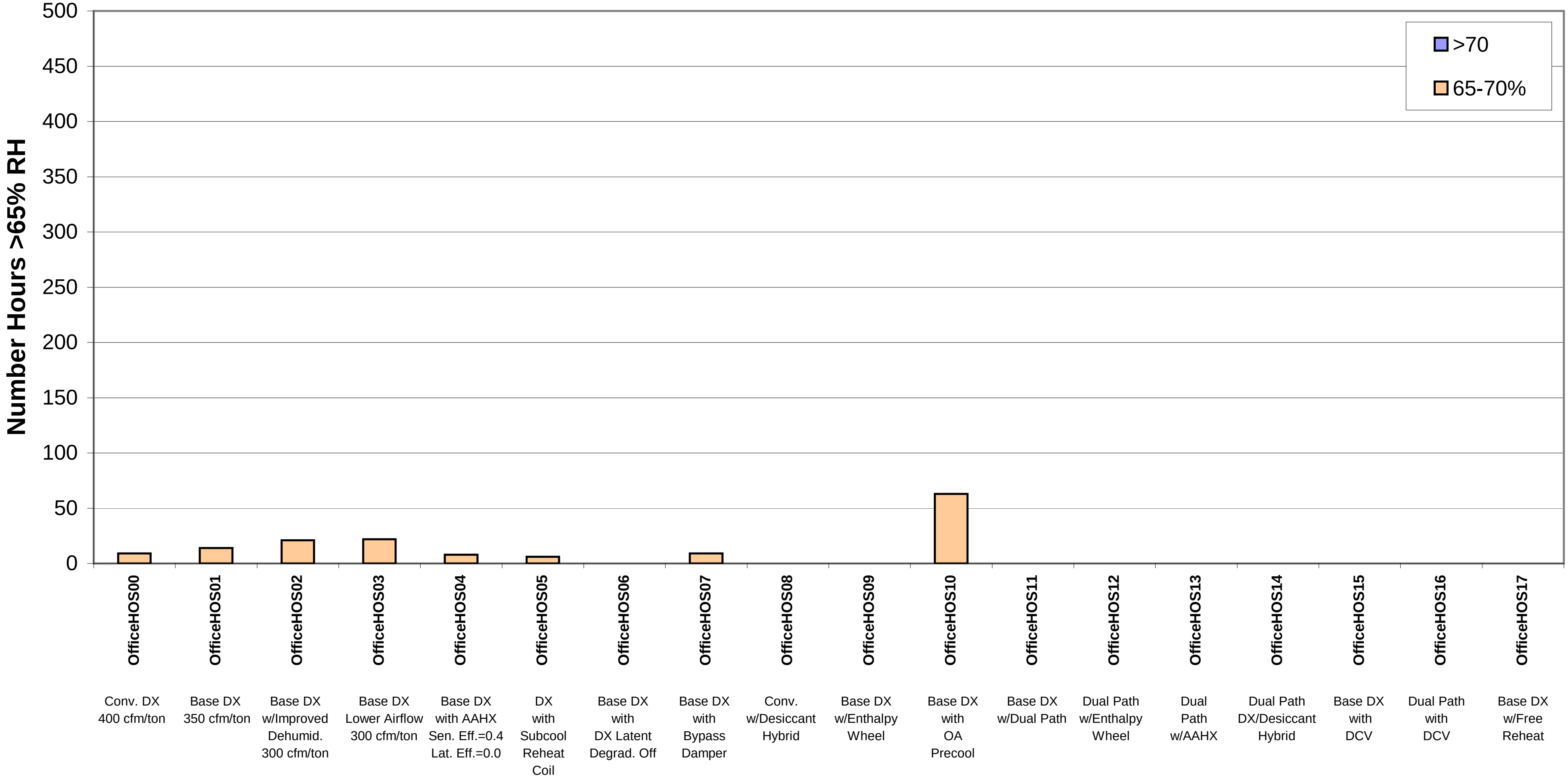


2004 Standard Office in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%

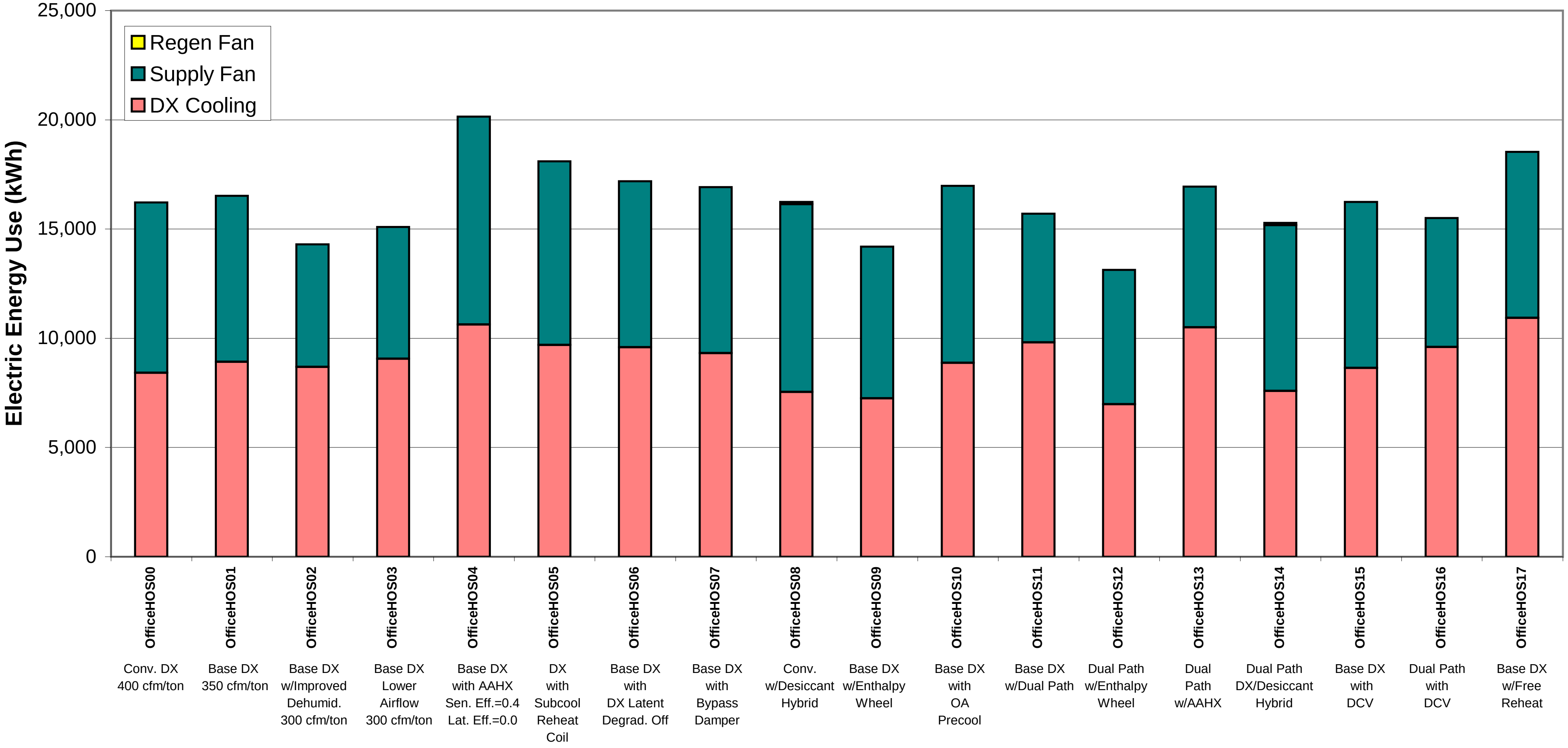
2004 Standard Office in Fort Worth TX
Annual HVAC System Electric Energy Use



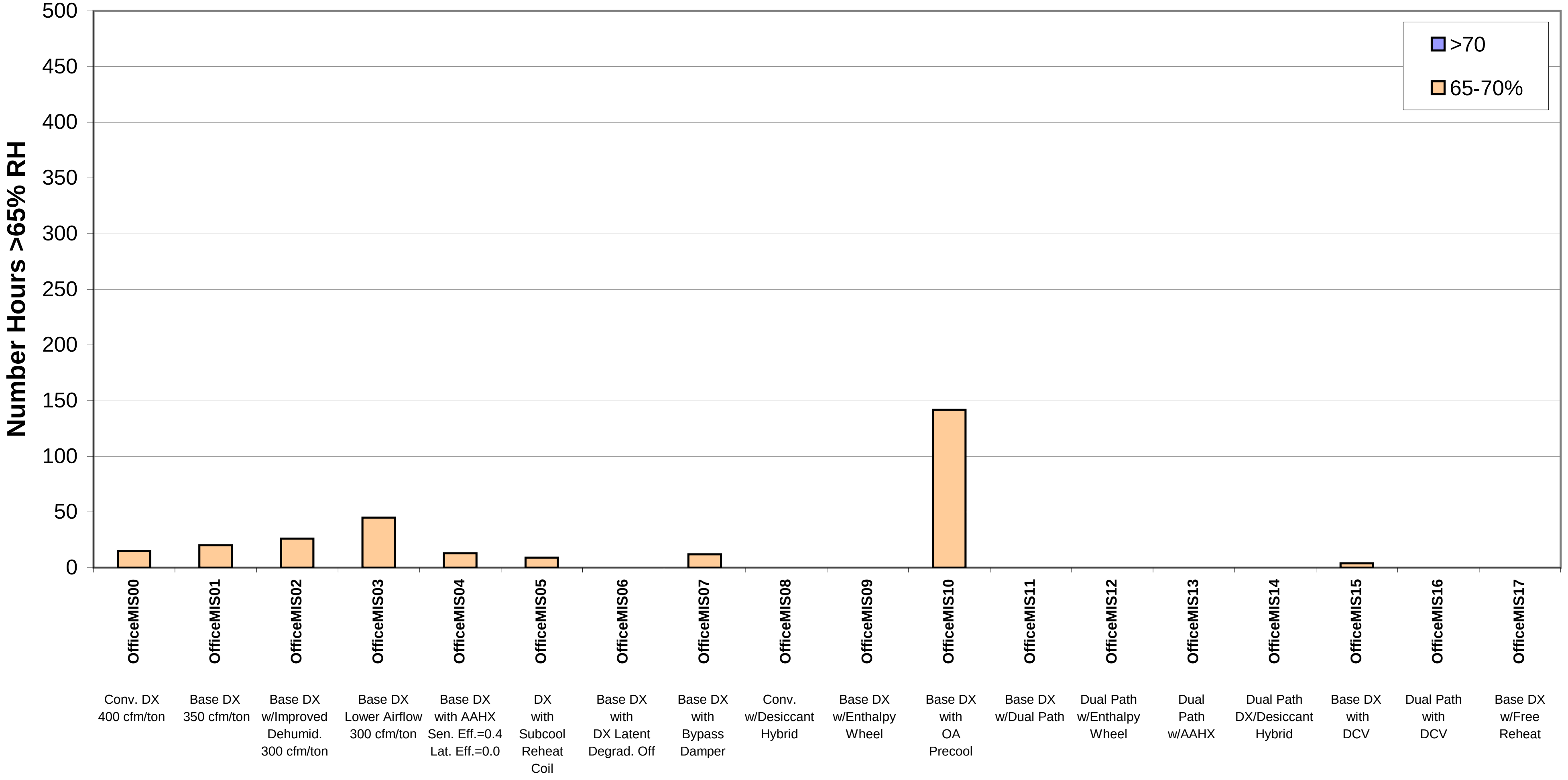
2004 Standard Office in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



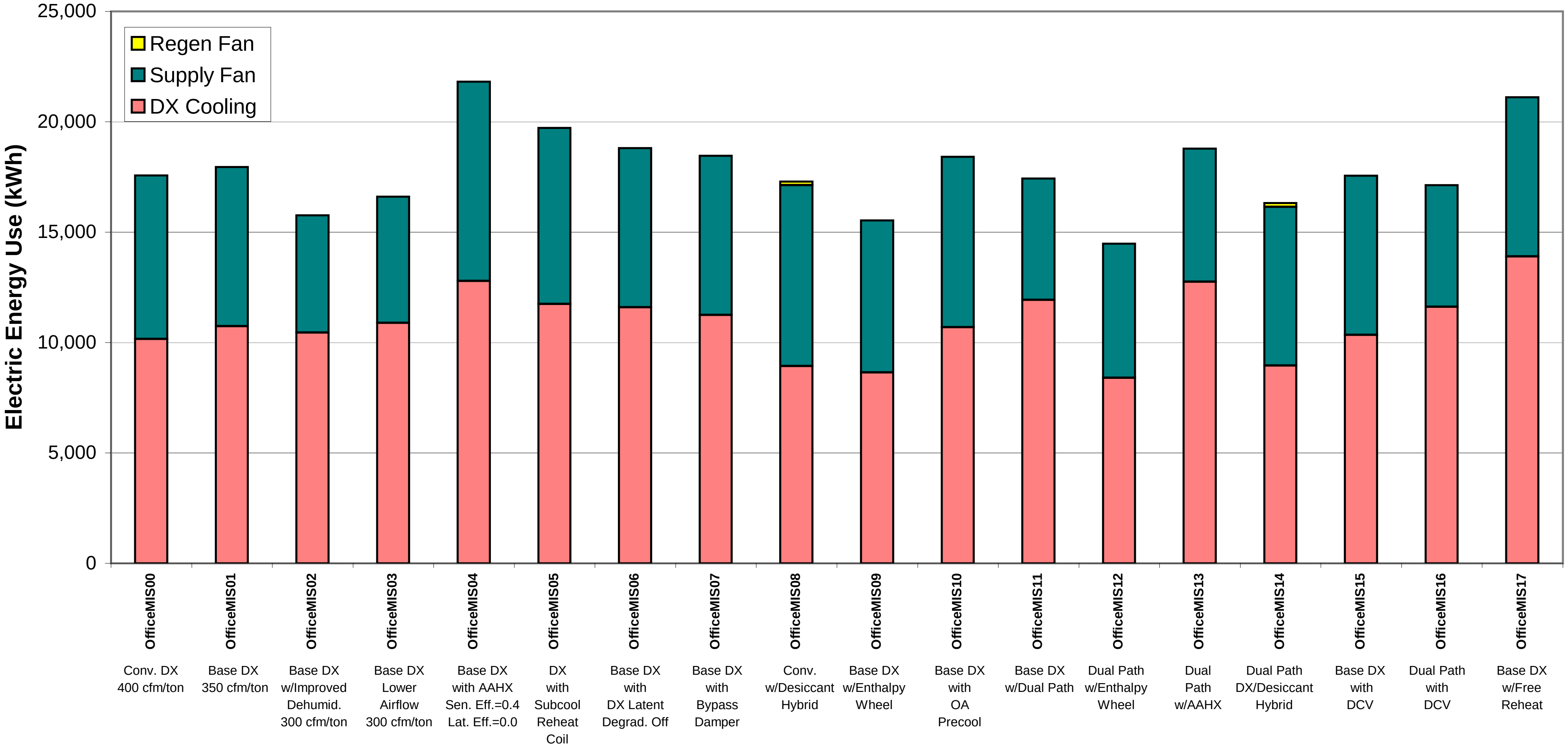
2004 Standard Office in Houston TX
Annual HVAC System Electric Energy Use



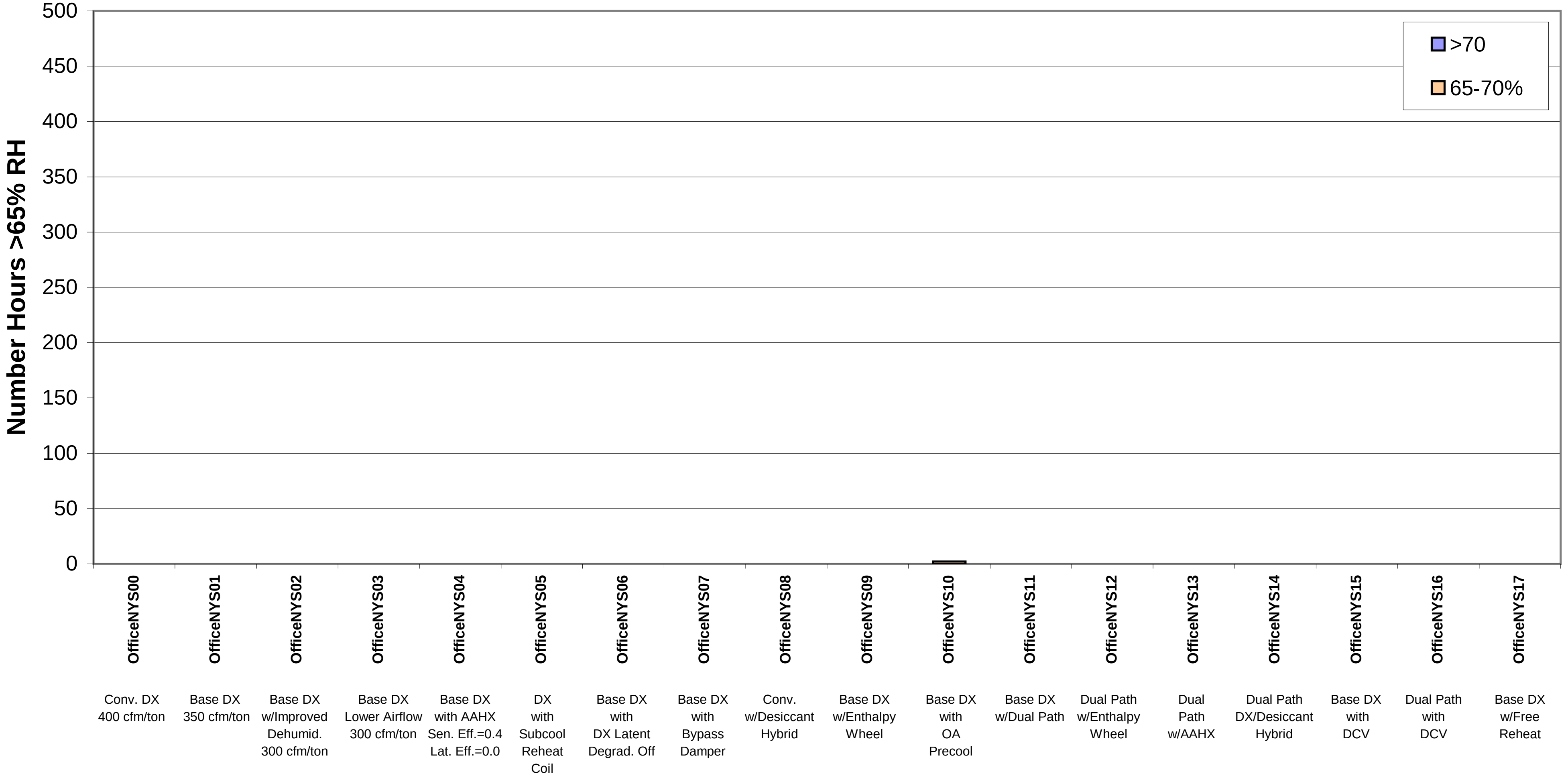
2004 Standard Office in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



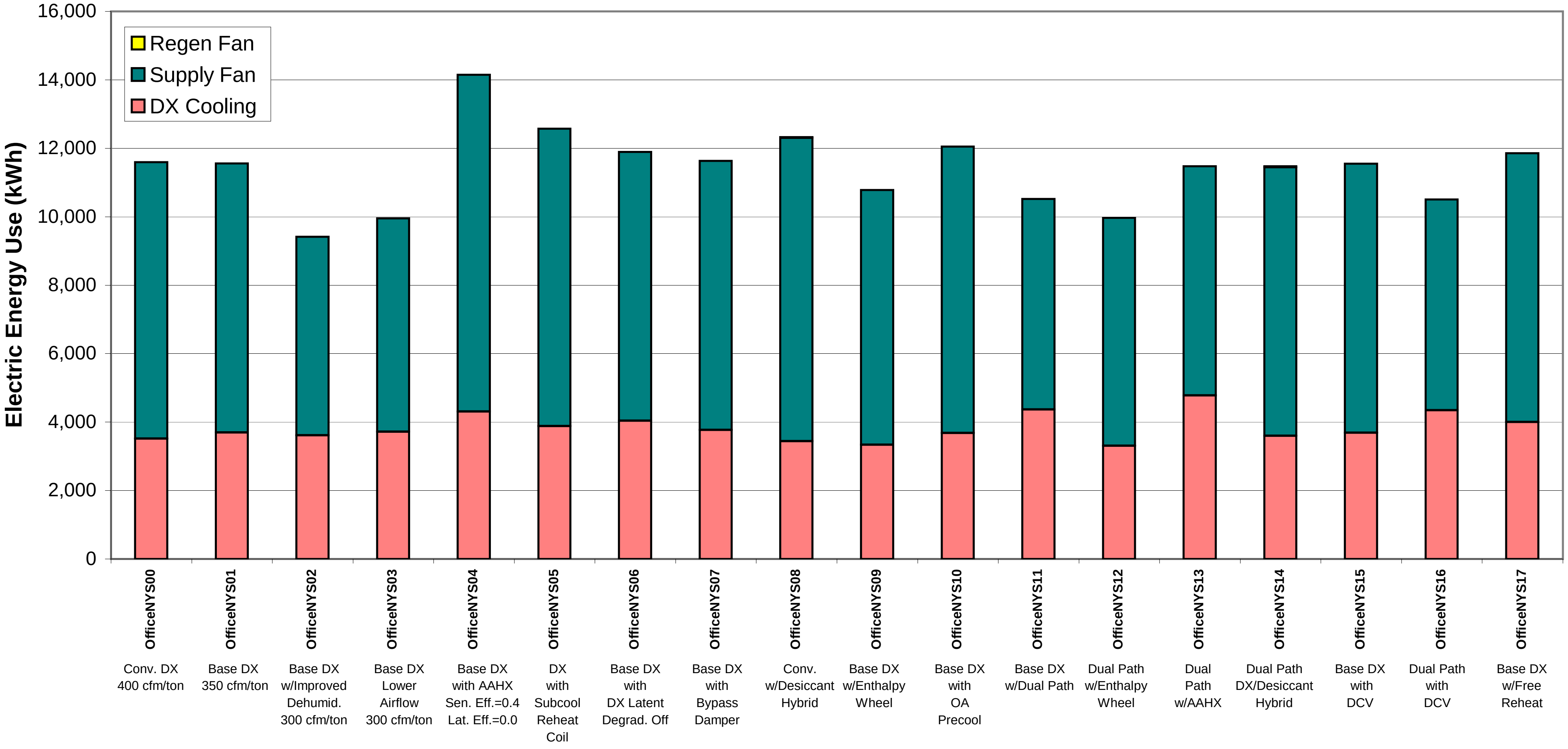
2004 Standard Office in Miami FL
Annual HVAC System Electric Energy Use



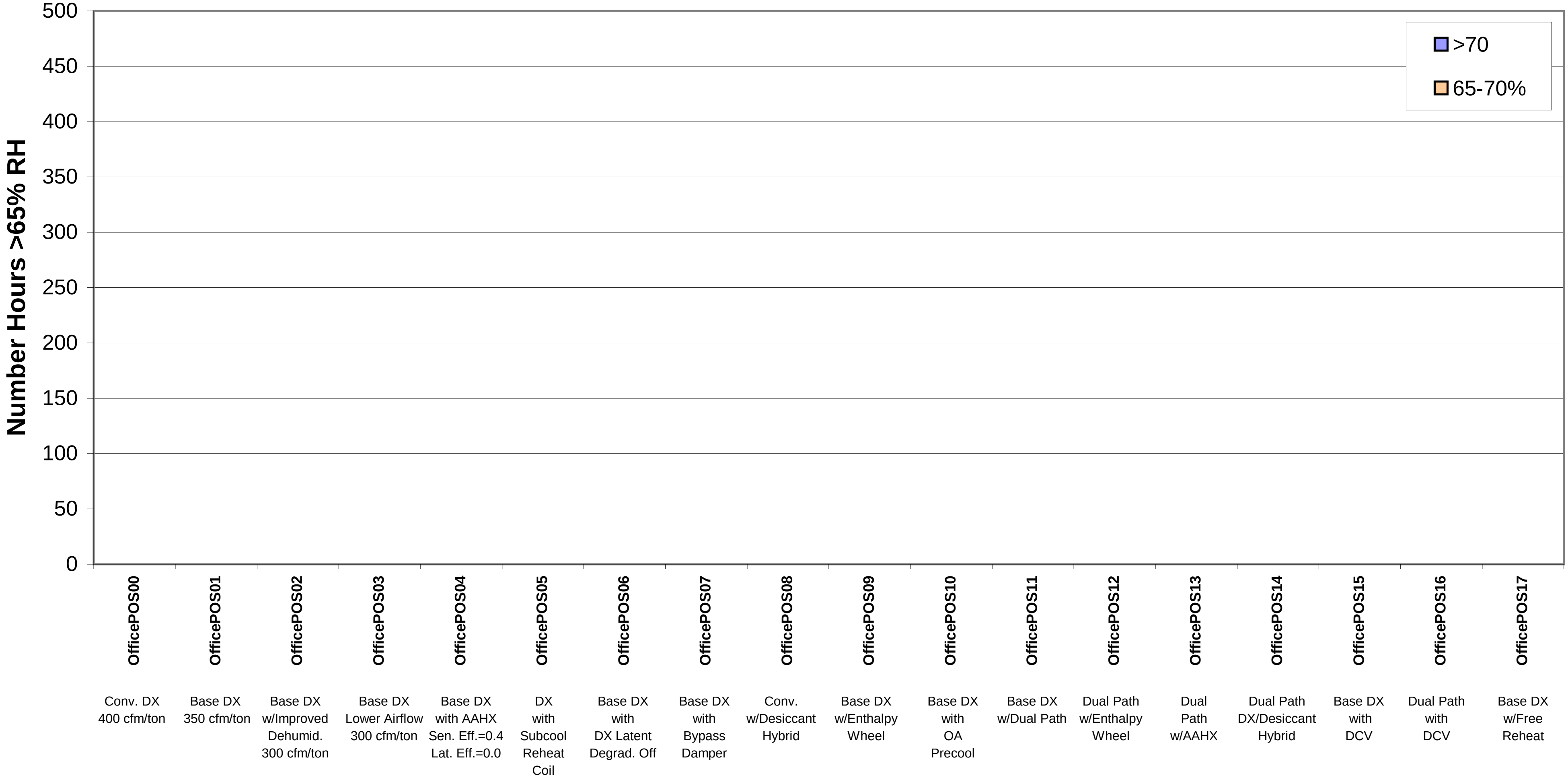
2004 Standard Office in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



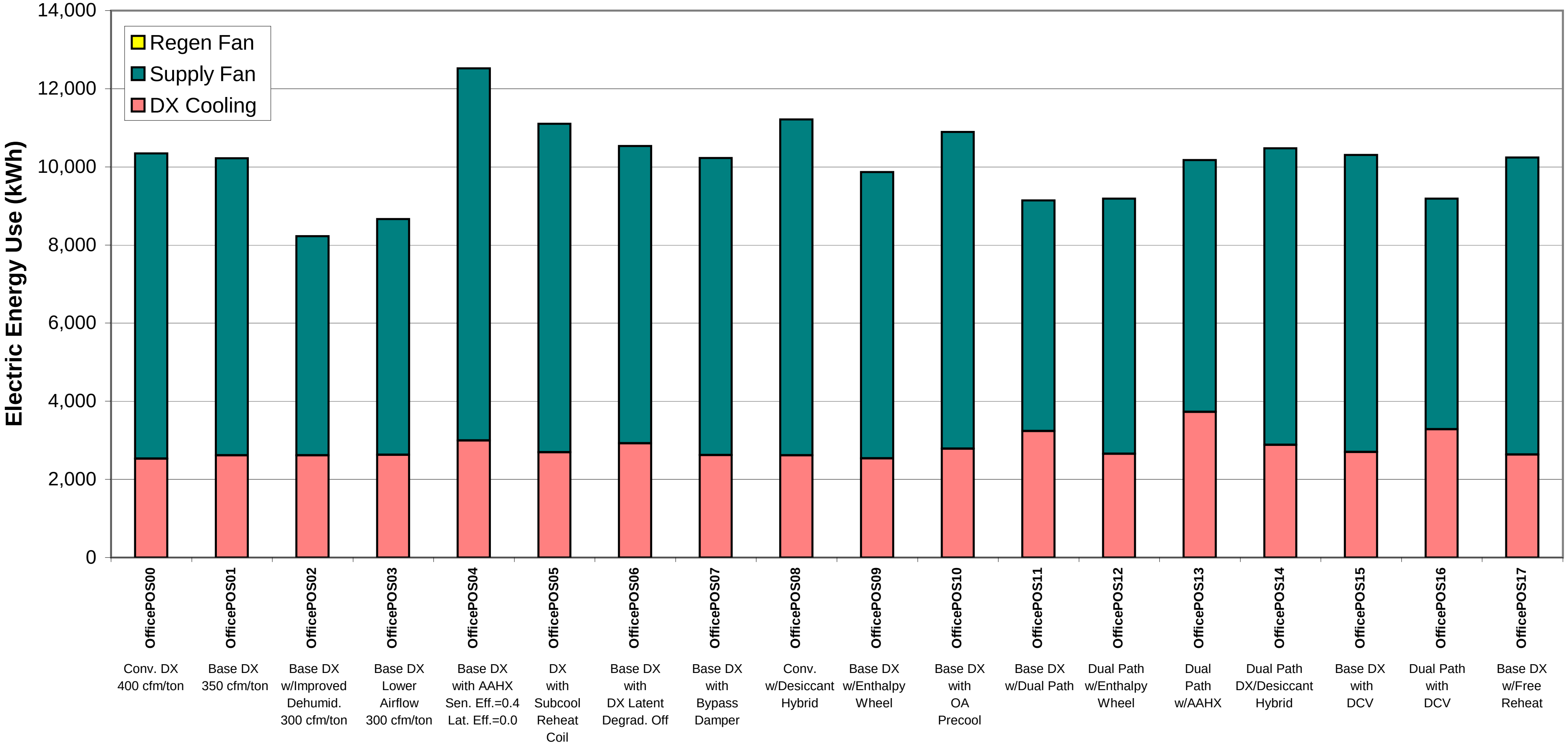
2004 Standard Office in New York NY
Annual HVAC System Electric Energy Use



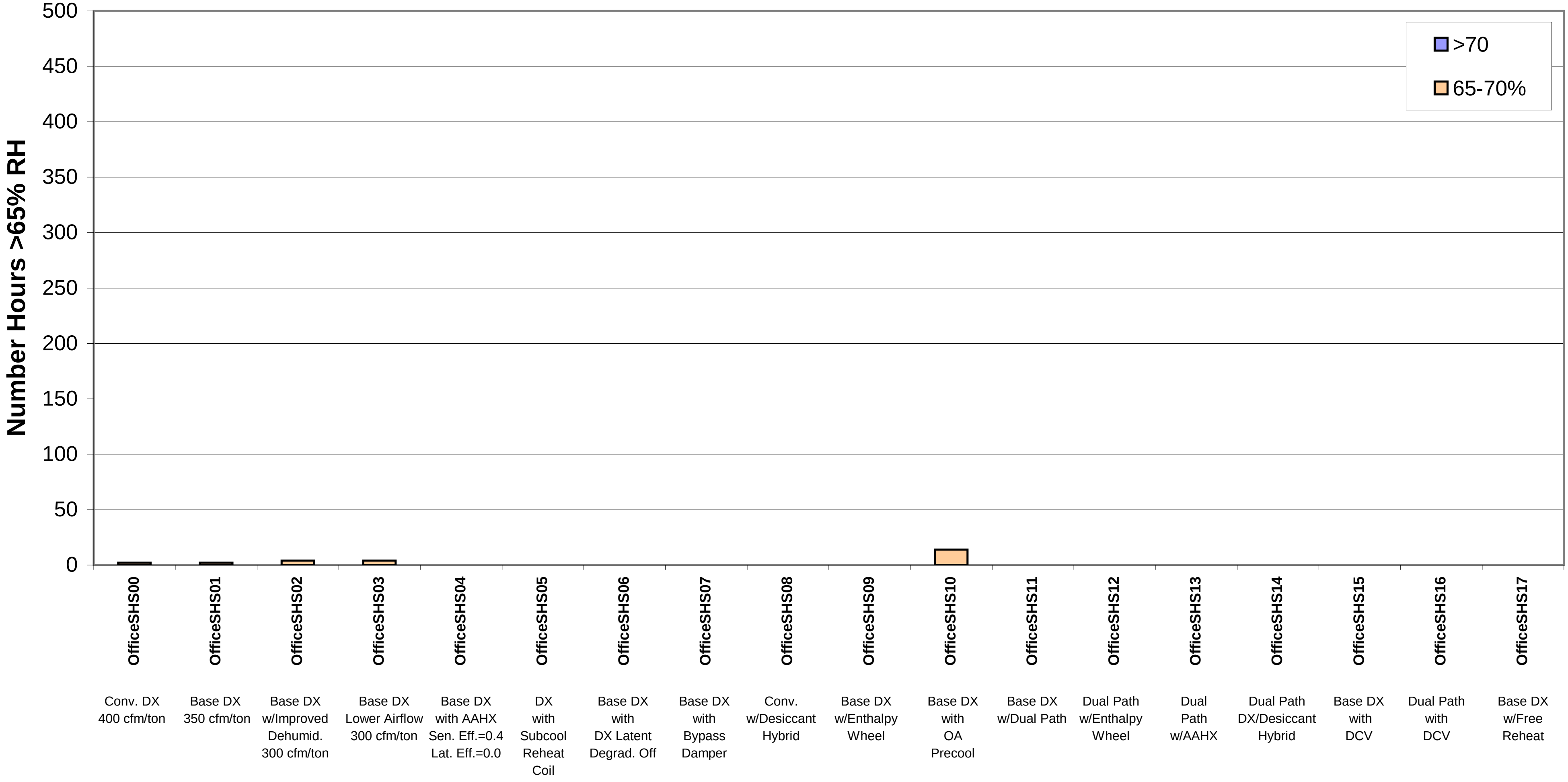
2004 Standard Office in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



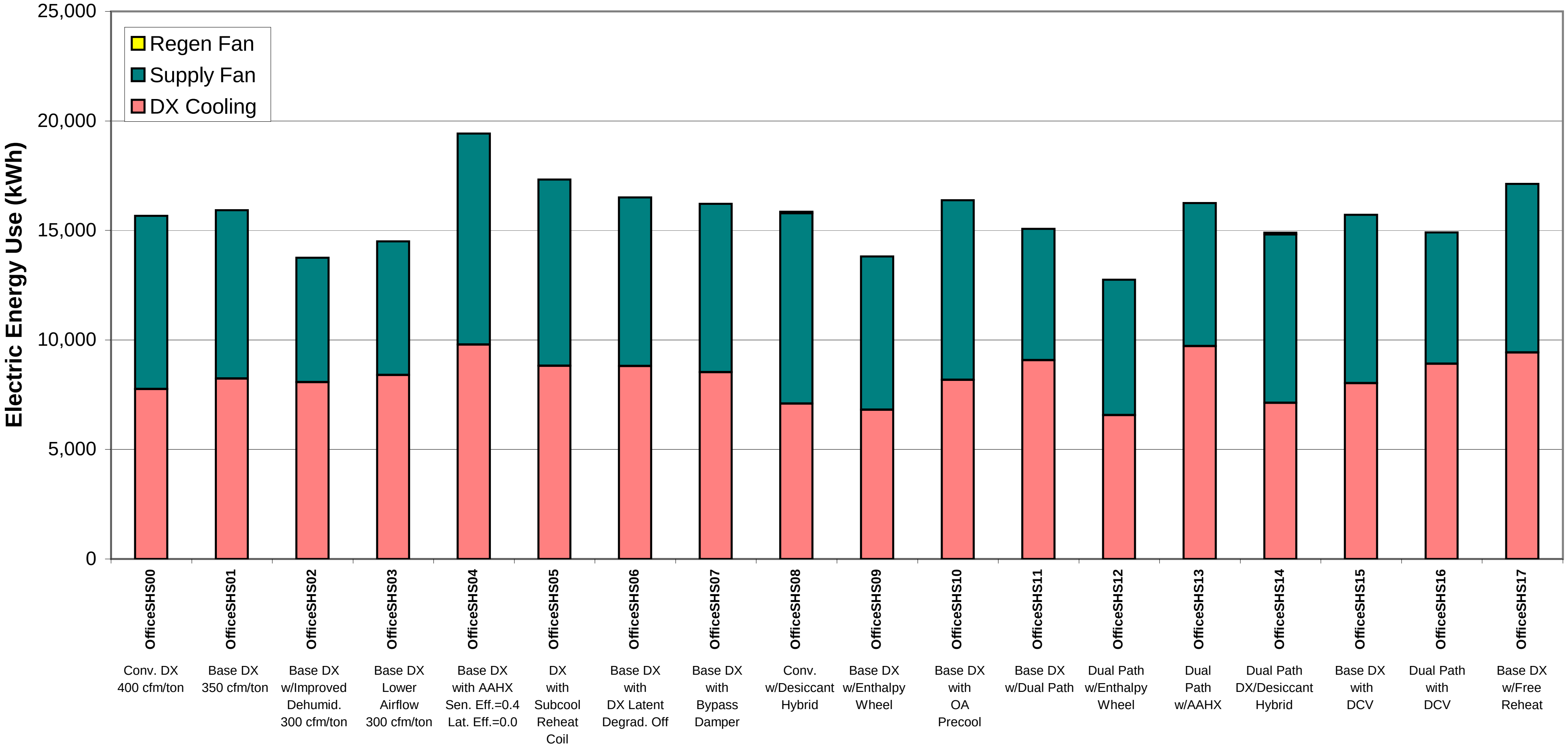
2004 Standard Office in Portland OR
Annual HVAC System Electric Energy Use



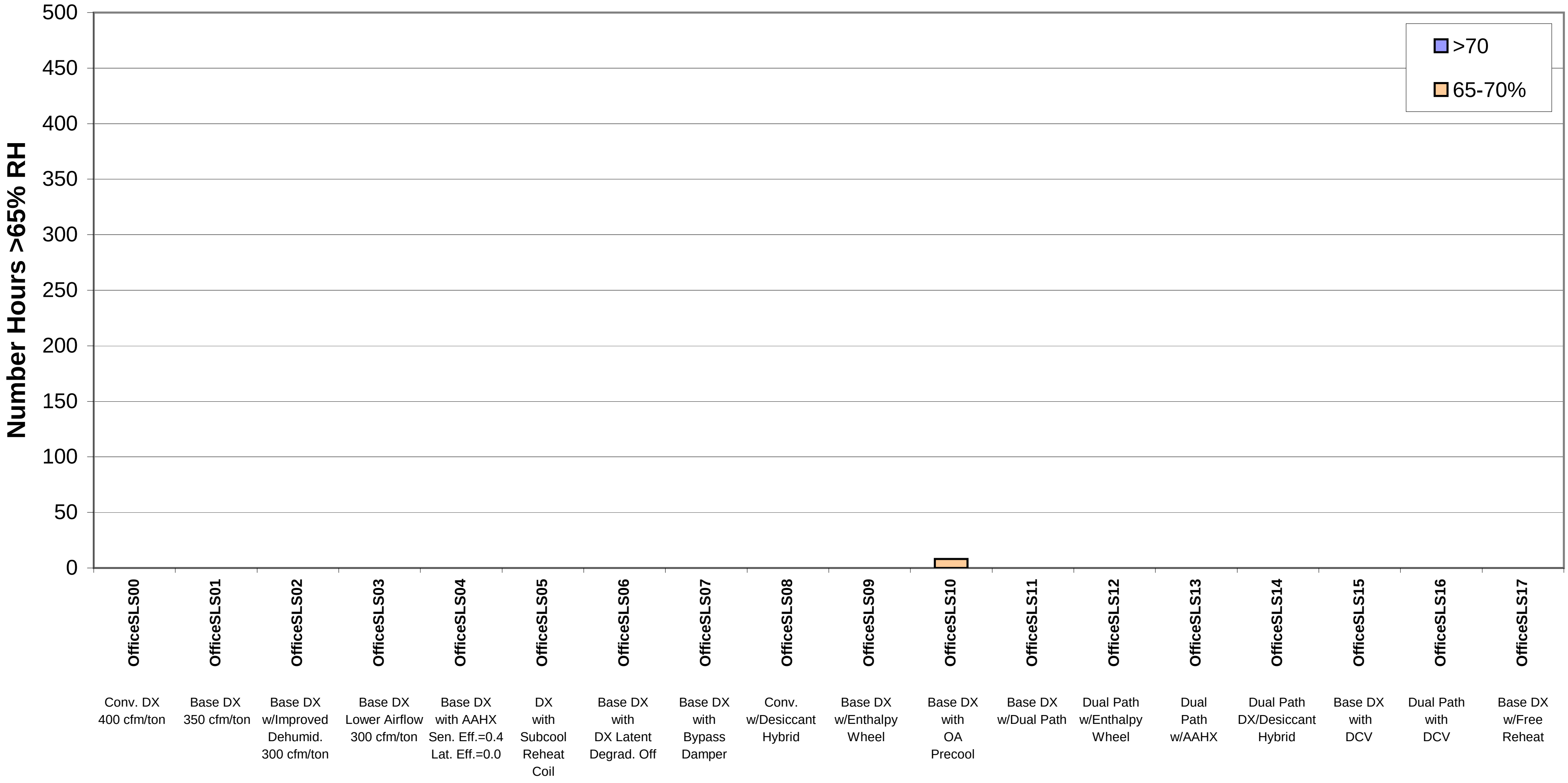
2004 Standard Office in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



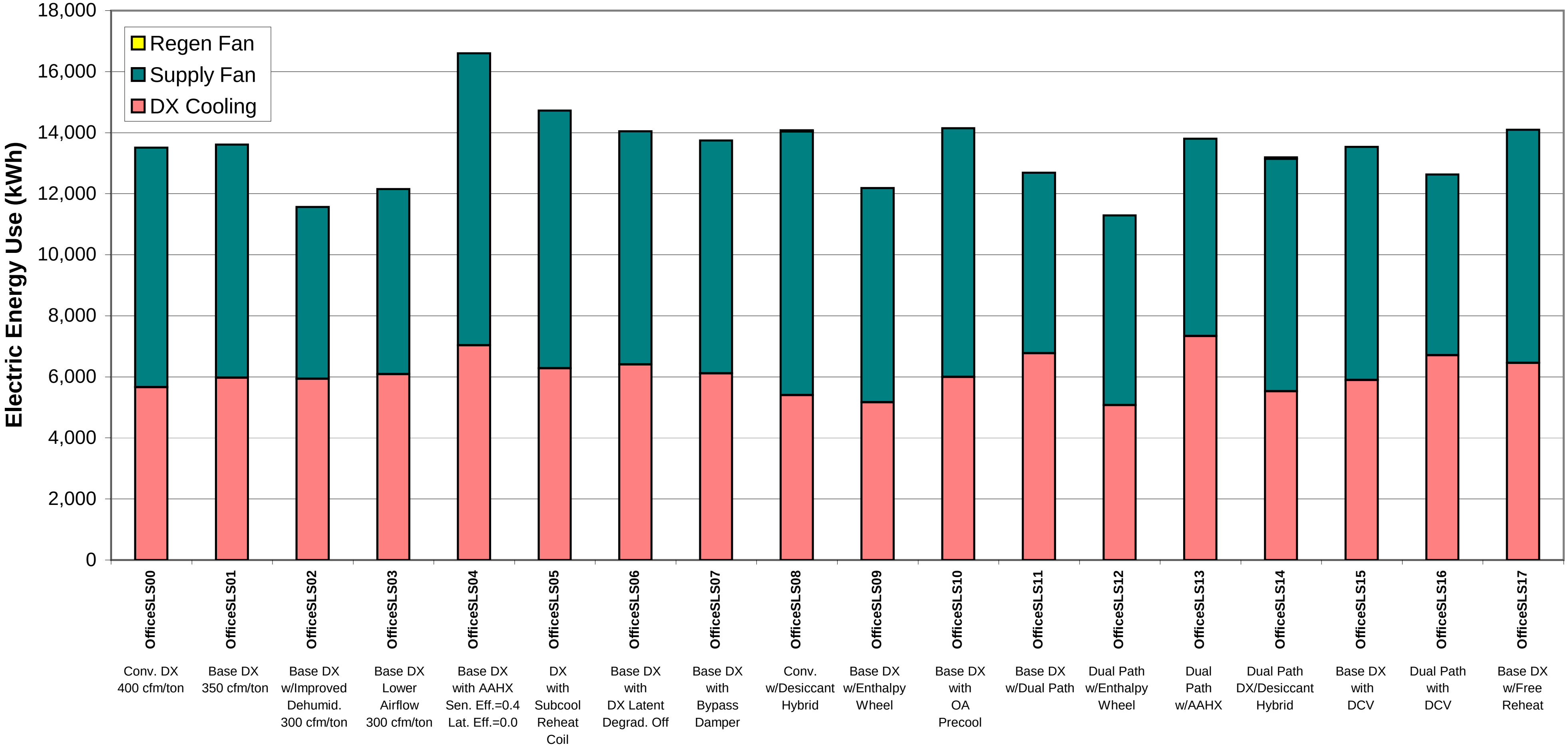
2004 Standard Office in Shreveport LA
Annual HVAC System Electric Energy Use



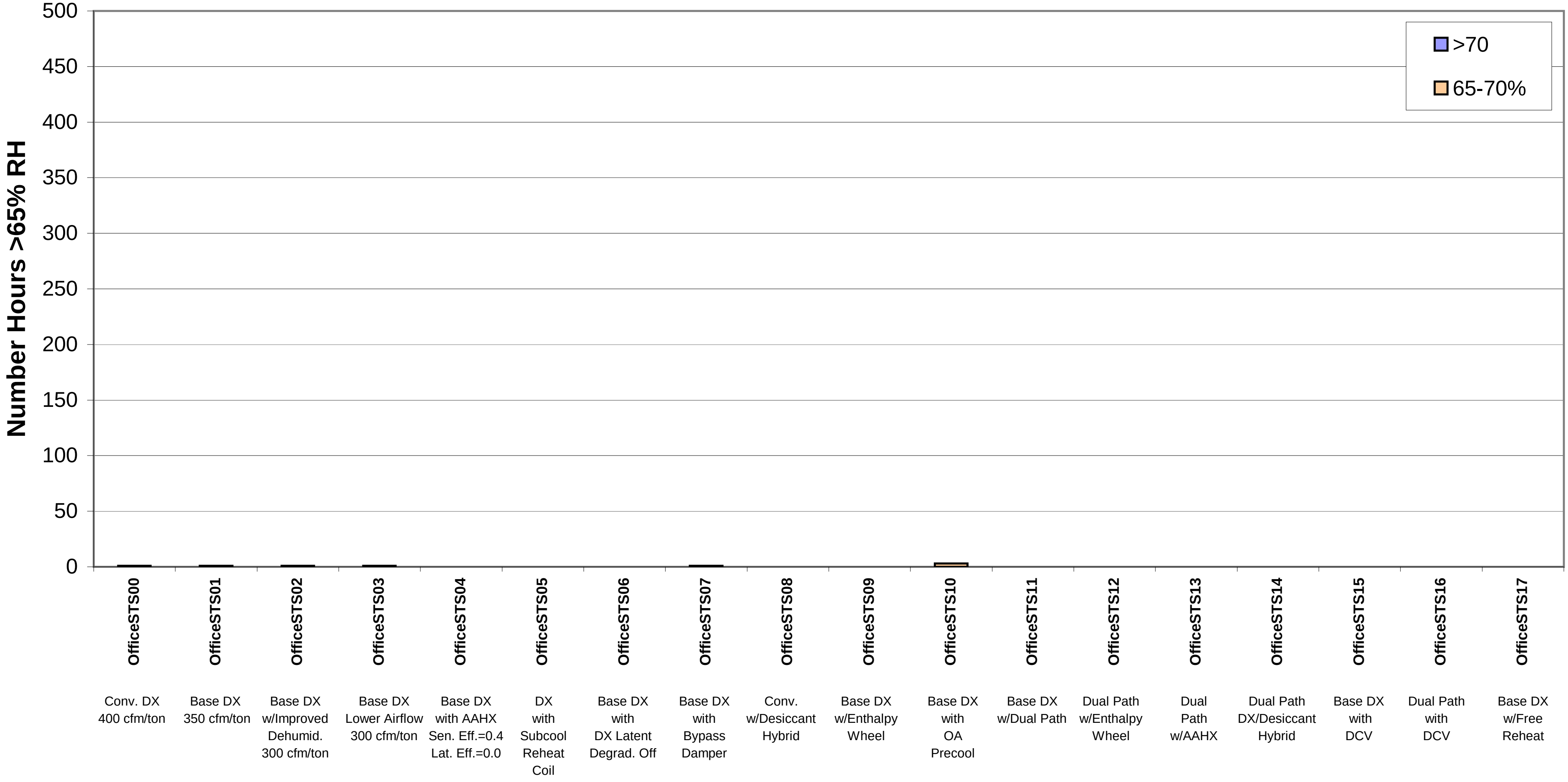
2004 Standard Office in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



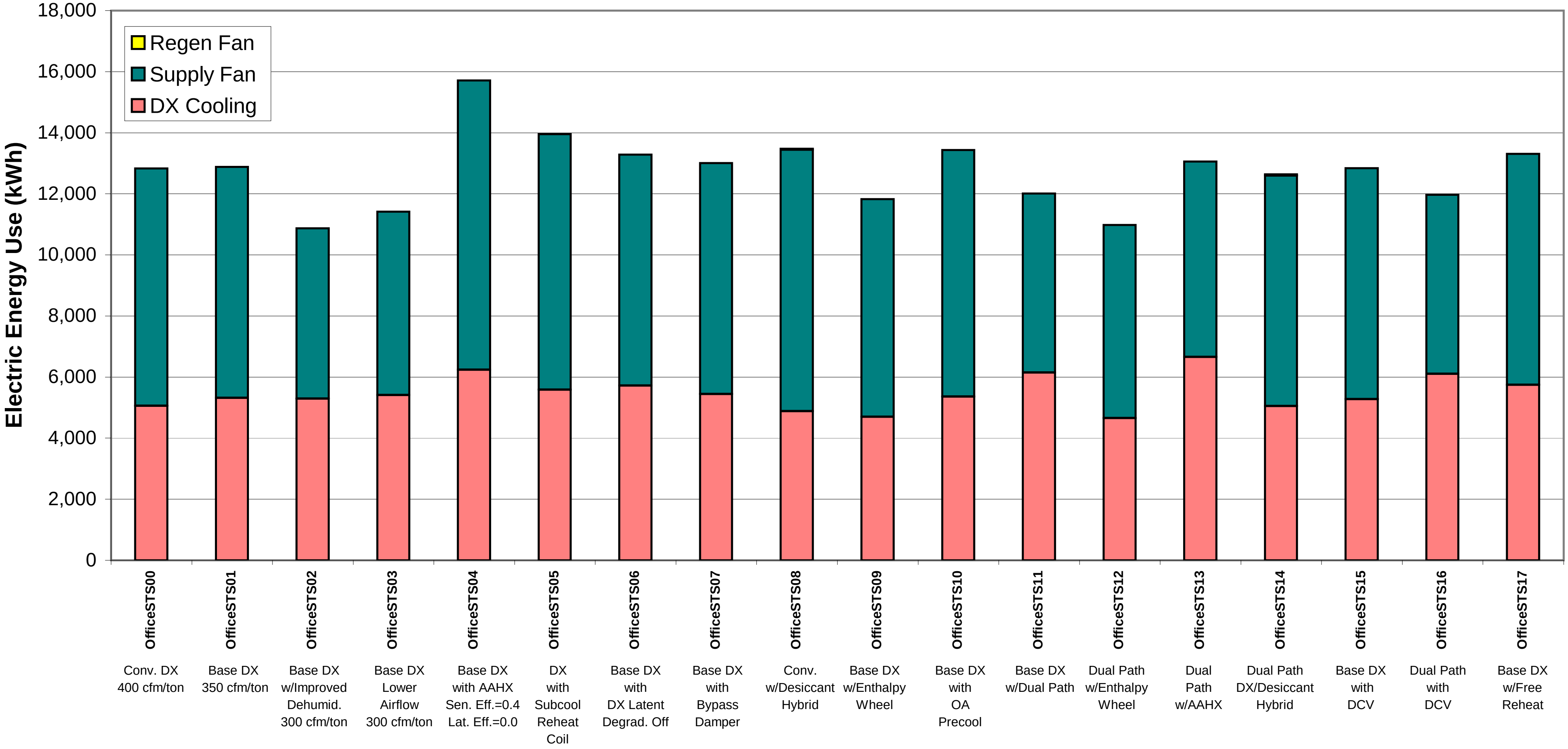
2004 Standard Office in St. Louis MO
Annual HVAC System Electric Energy Use



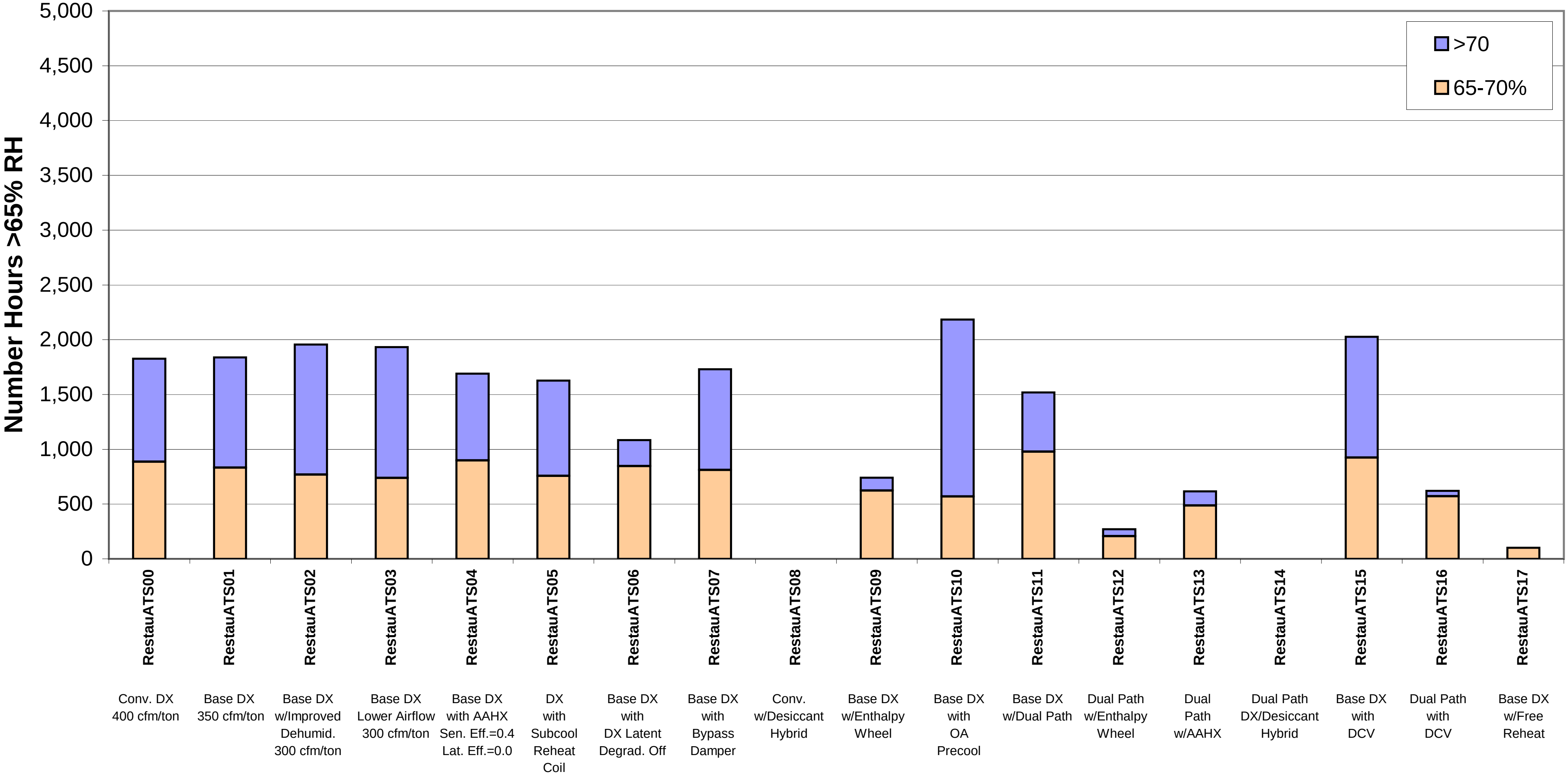
2004 Standard Office in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



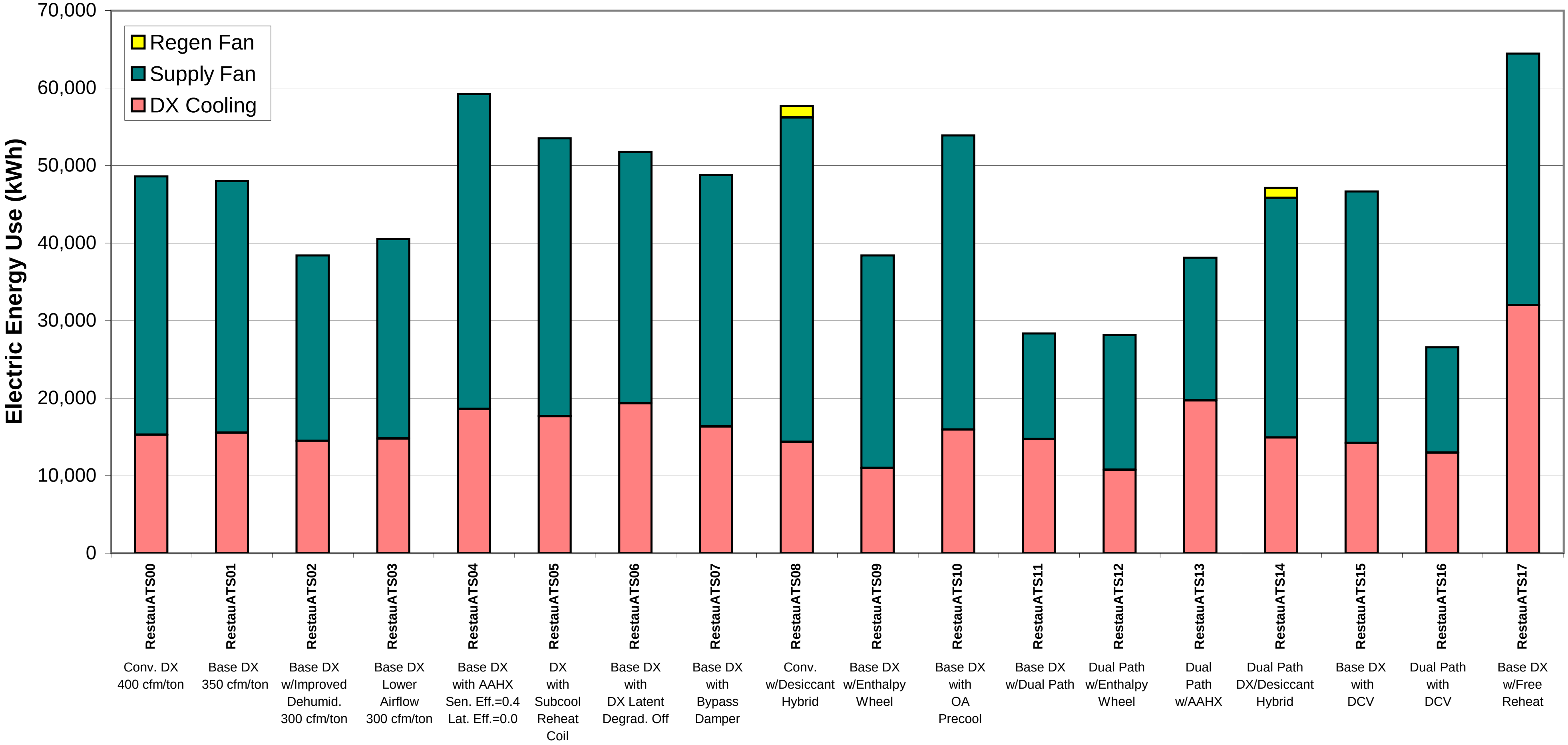
2004 Standard Office in Washington DC
Annual HVAC System Electric Energy Use

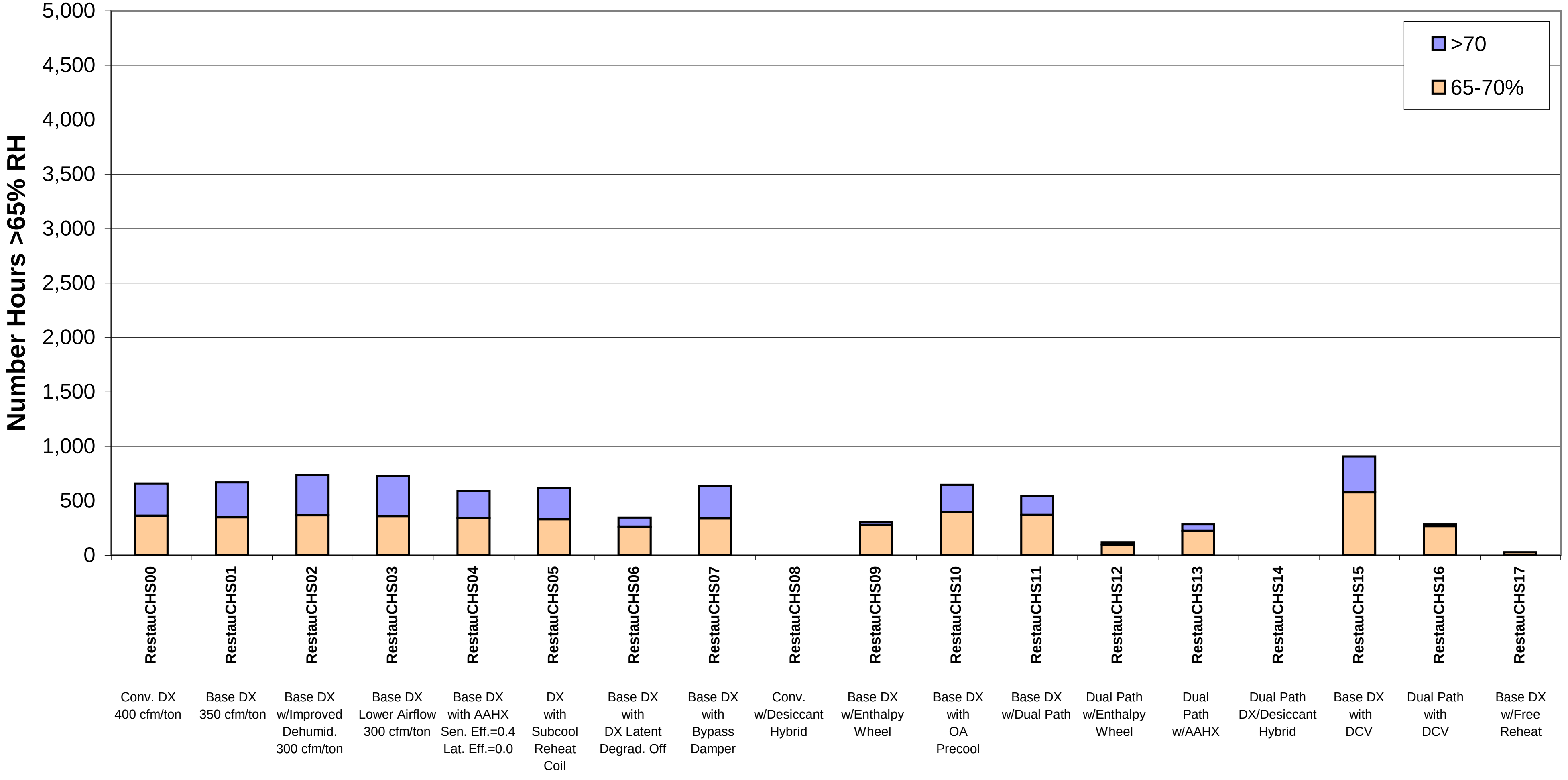


2004 Standard Restaurant in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



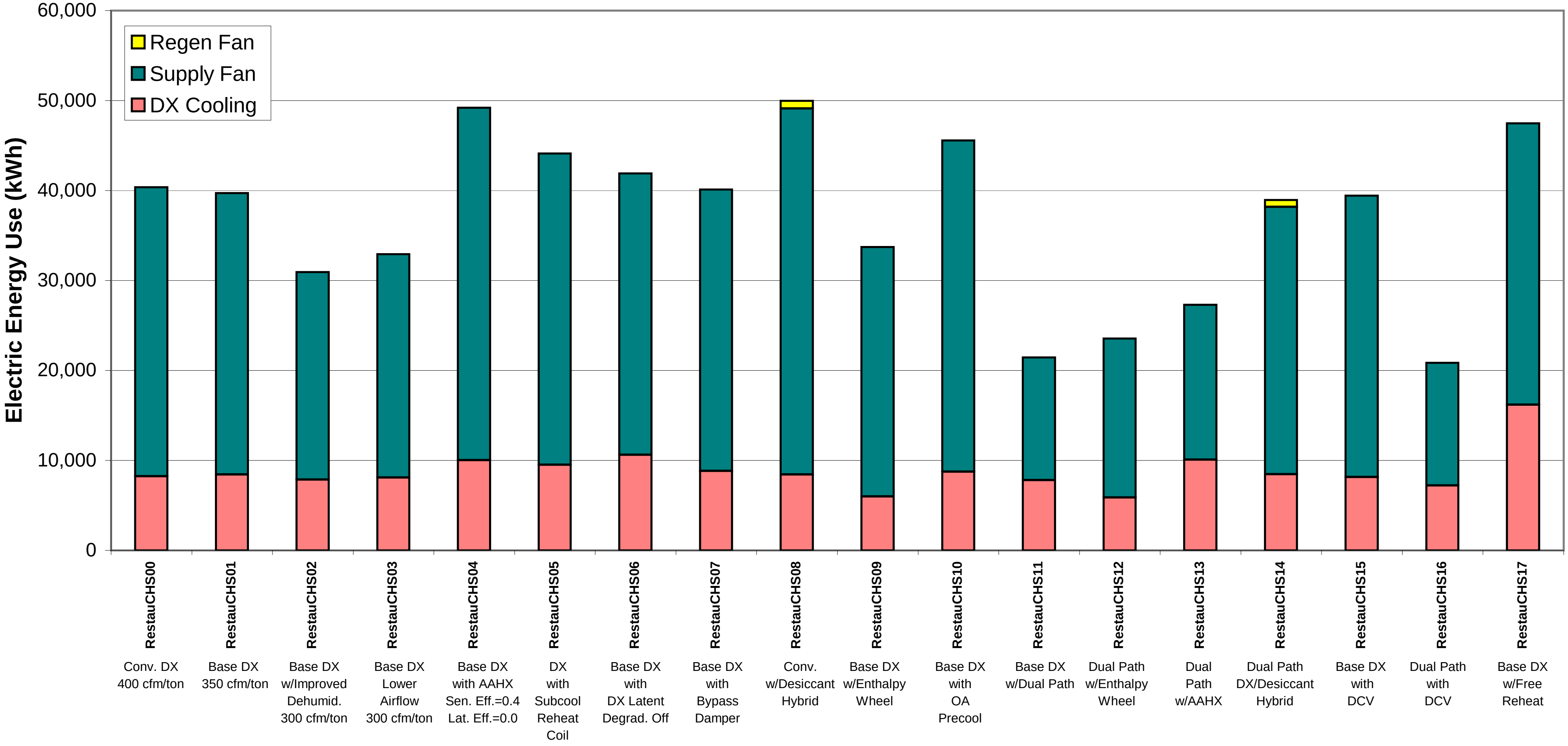
2004 Standard Restaurant in Atlanta GA
Annual HVAC System Electric Energy Use



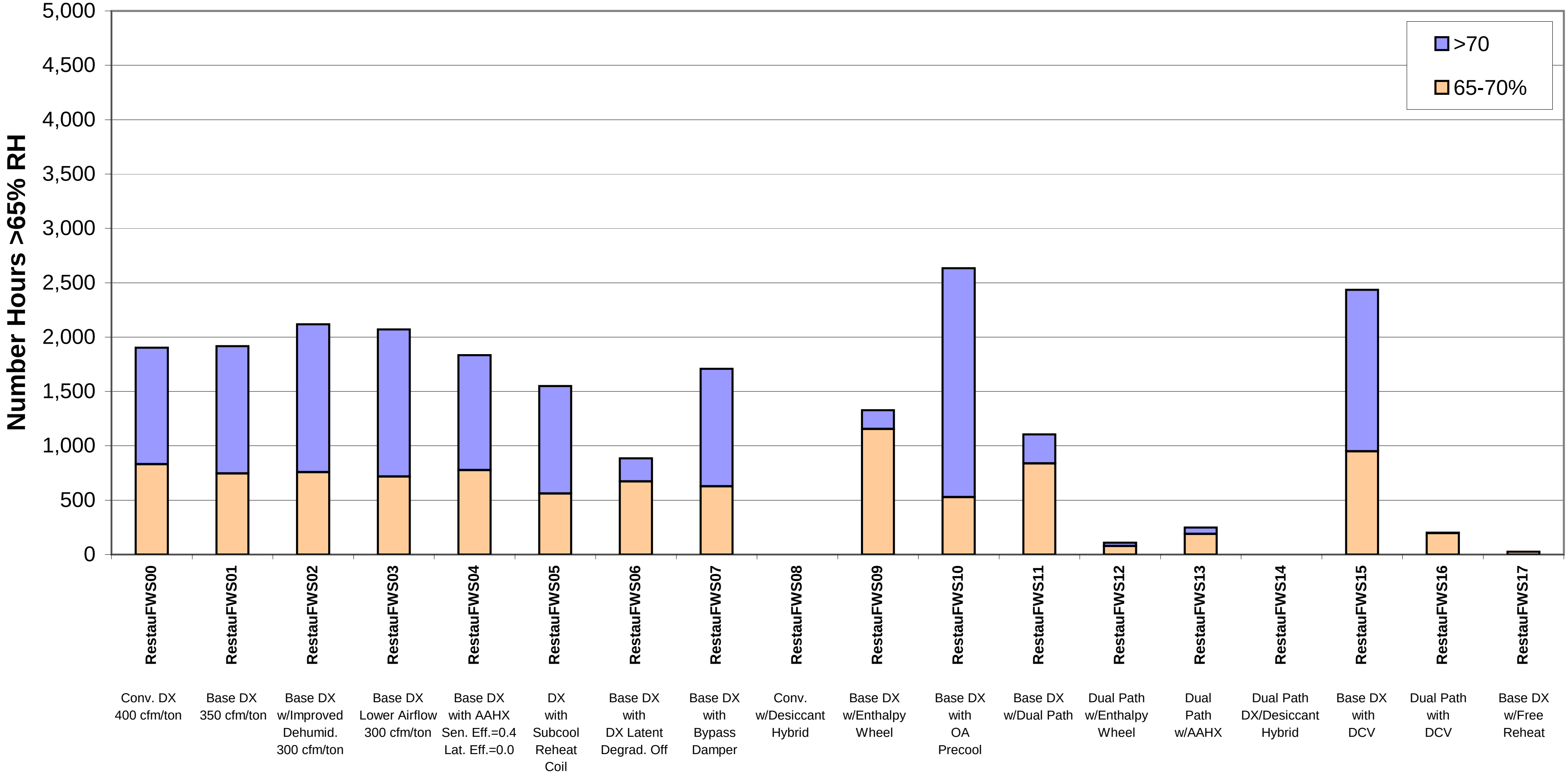


2004 Standard Restaurant in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%

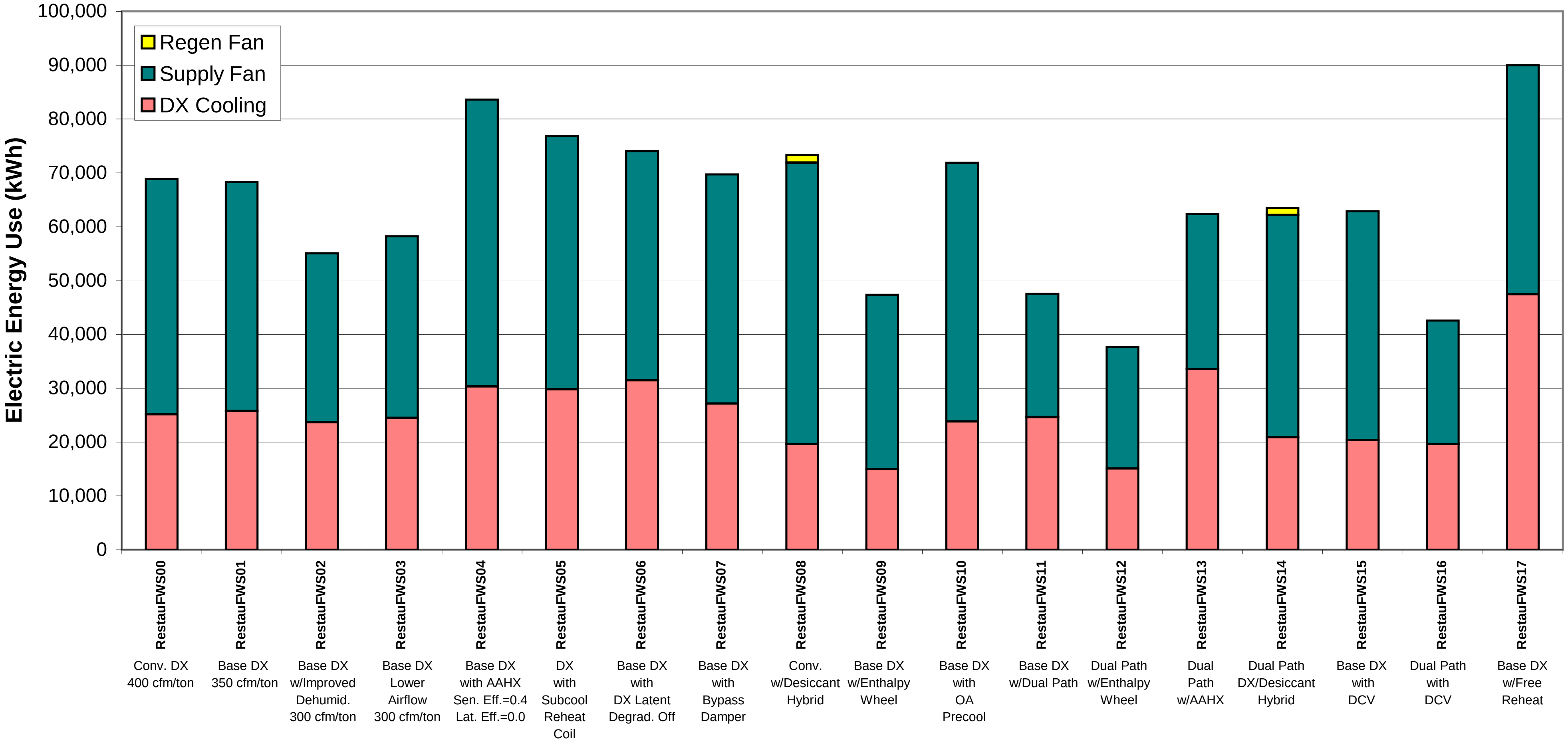
2004 Standard Restaurant in Chicago IL
Annual HVAC System Electric Energy Use

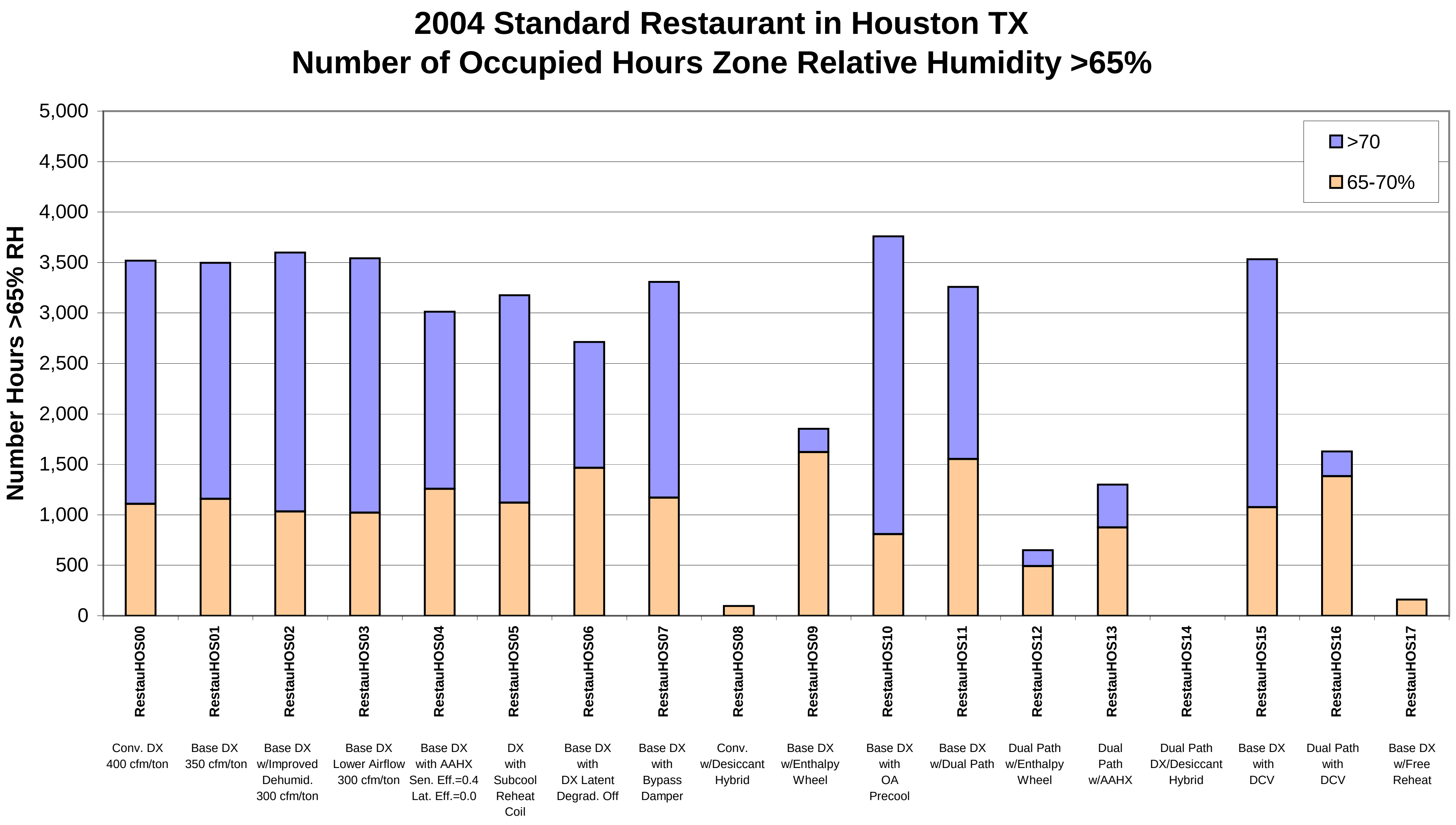


2004 Standard Restaurant in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



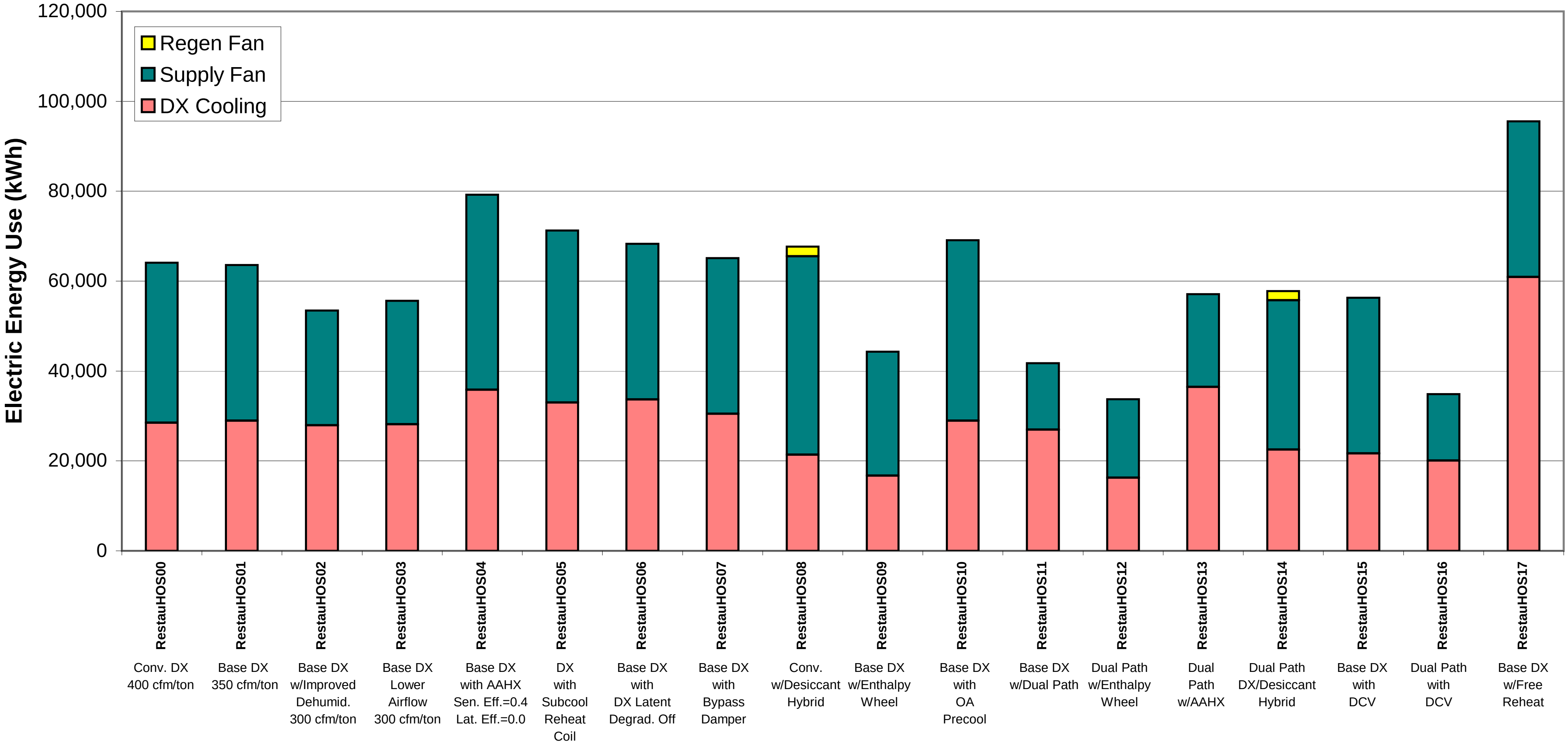
2004 Standard Restaurant in Fort Worth TX
Annual HVAC System Electric Energy Use



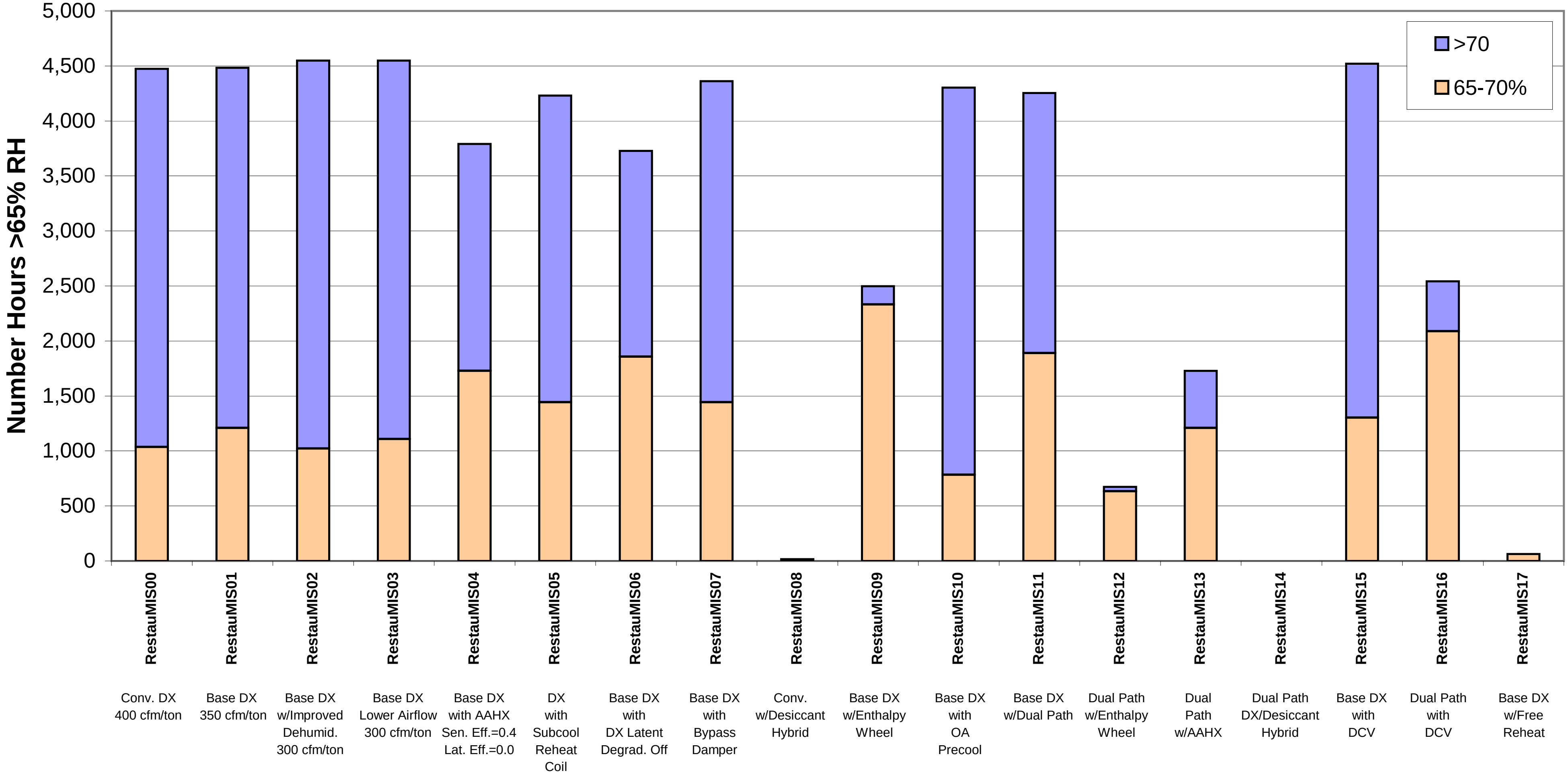


2004 Standard Restaurant in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%

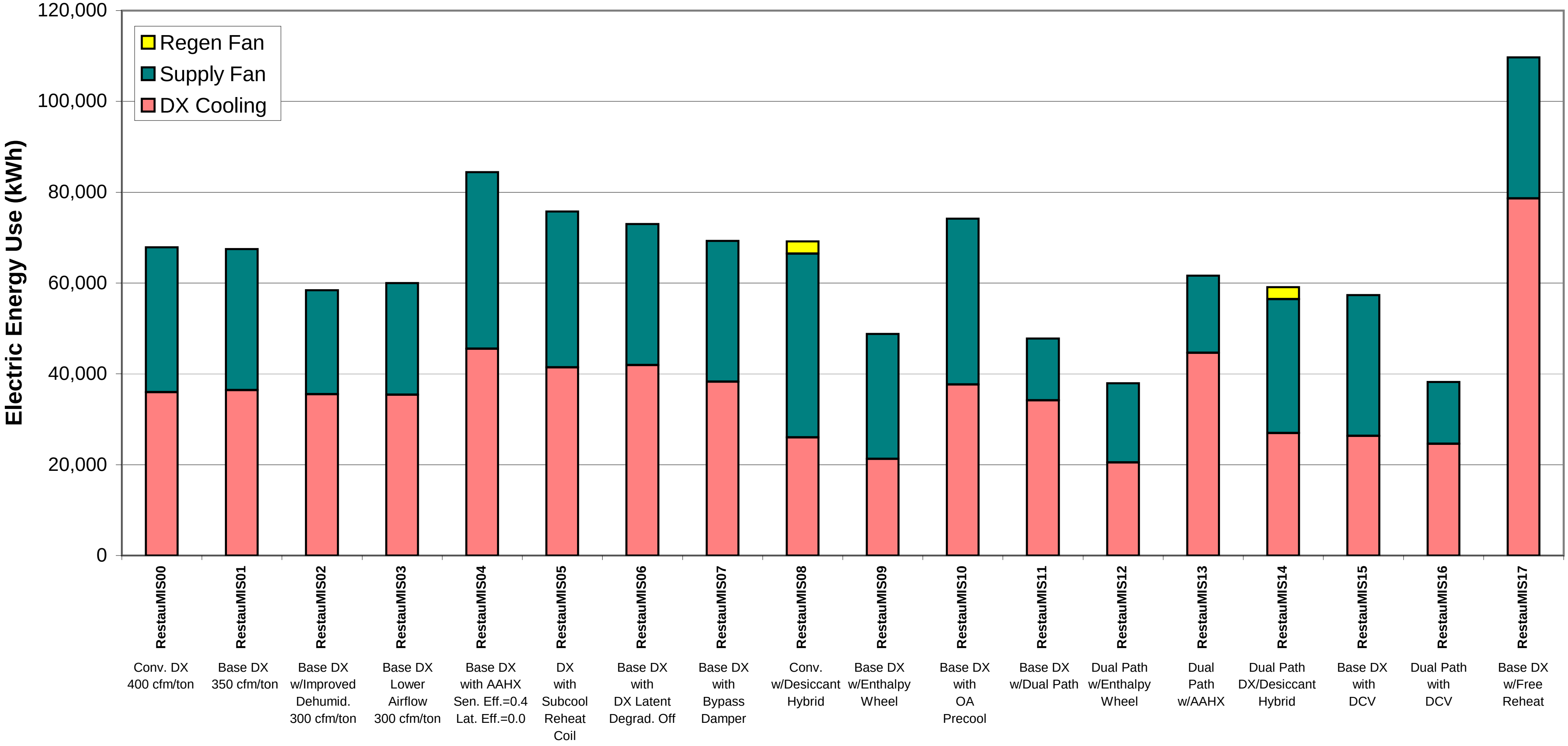
2004 Standard Restaurant in Houston TX
Annual HVAC System Electric Energy Use



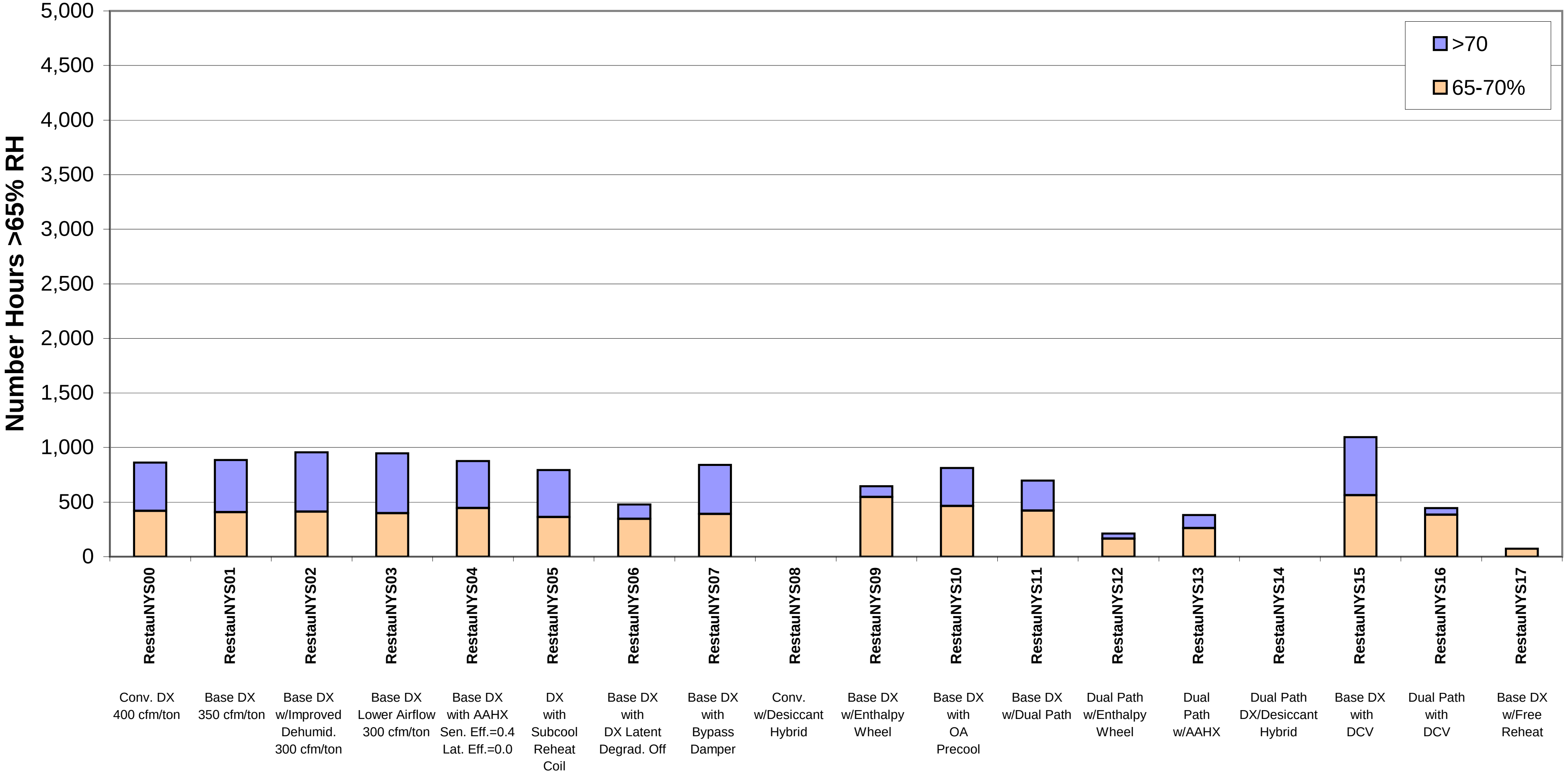
2004 Standard Restaurant in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



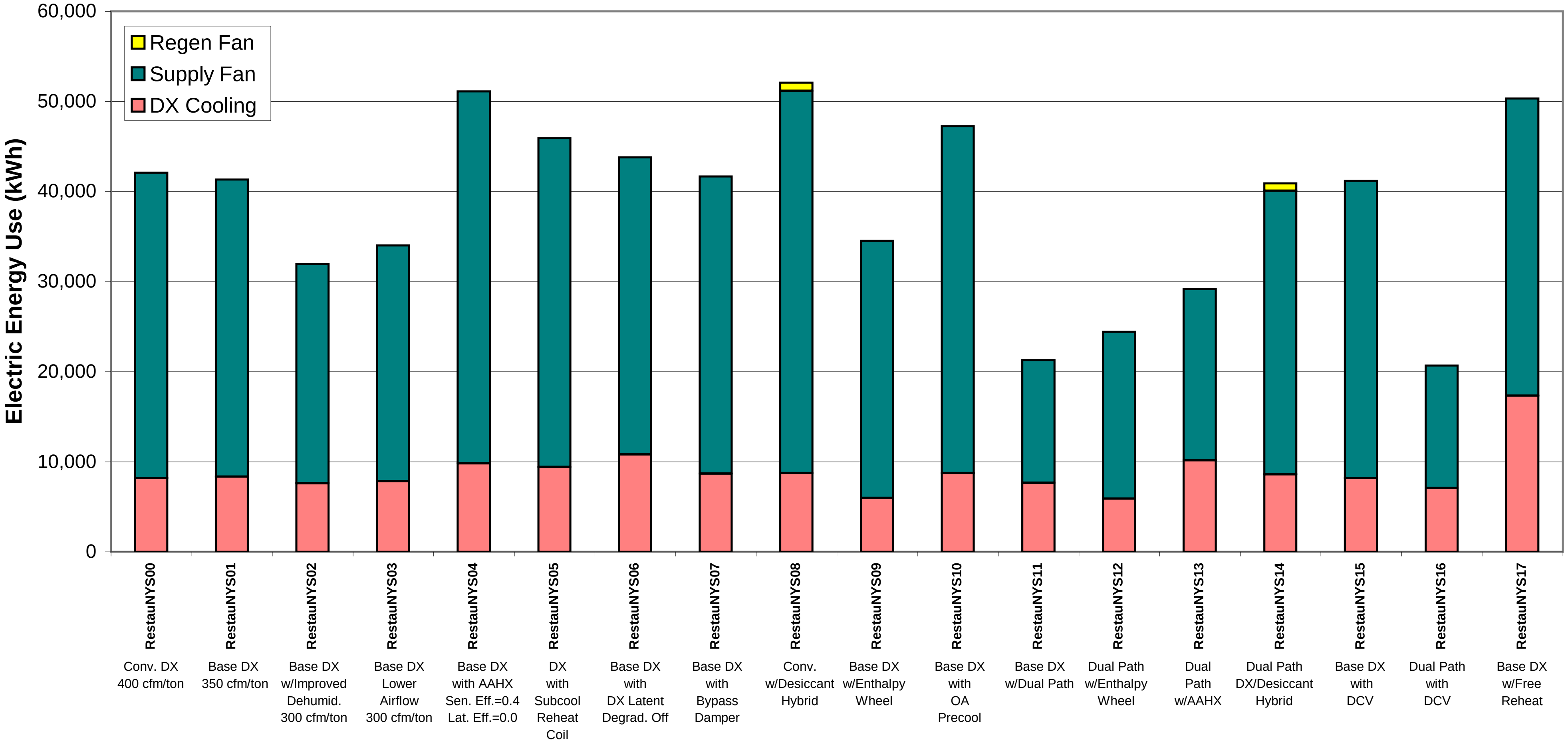
2004 Standard Restaurant in Miami FL
Annual HVAC System Electric Energy Use



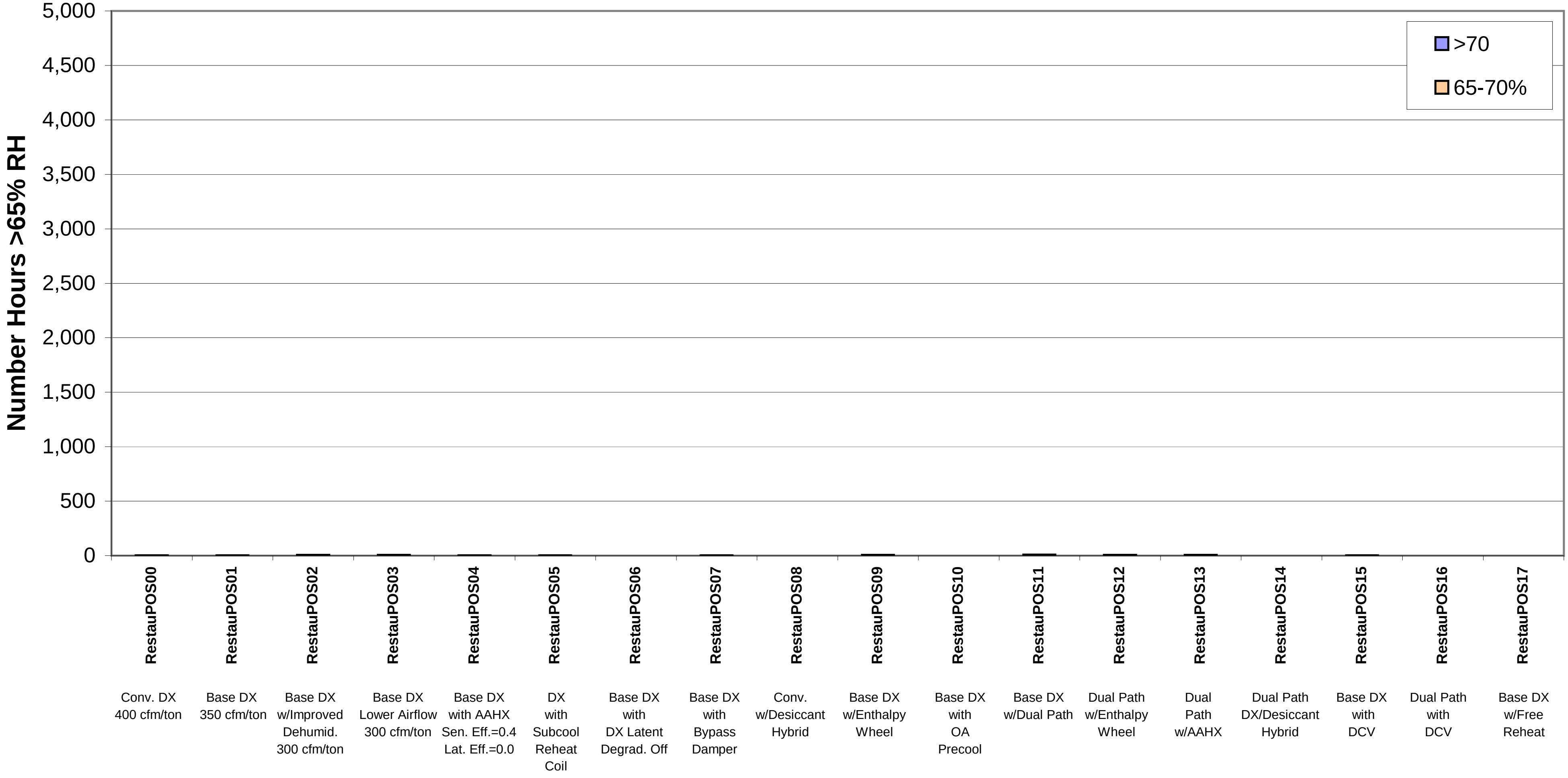
2004 Standard Restaurant in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



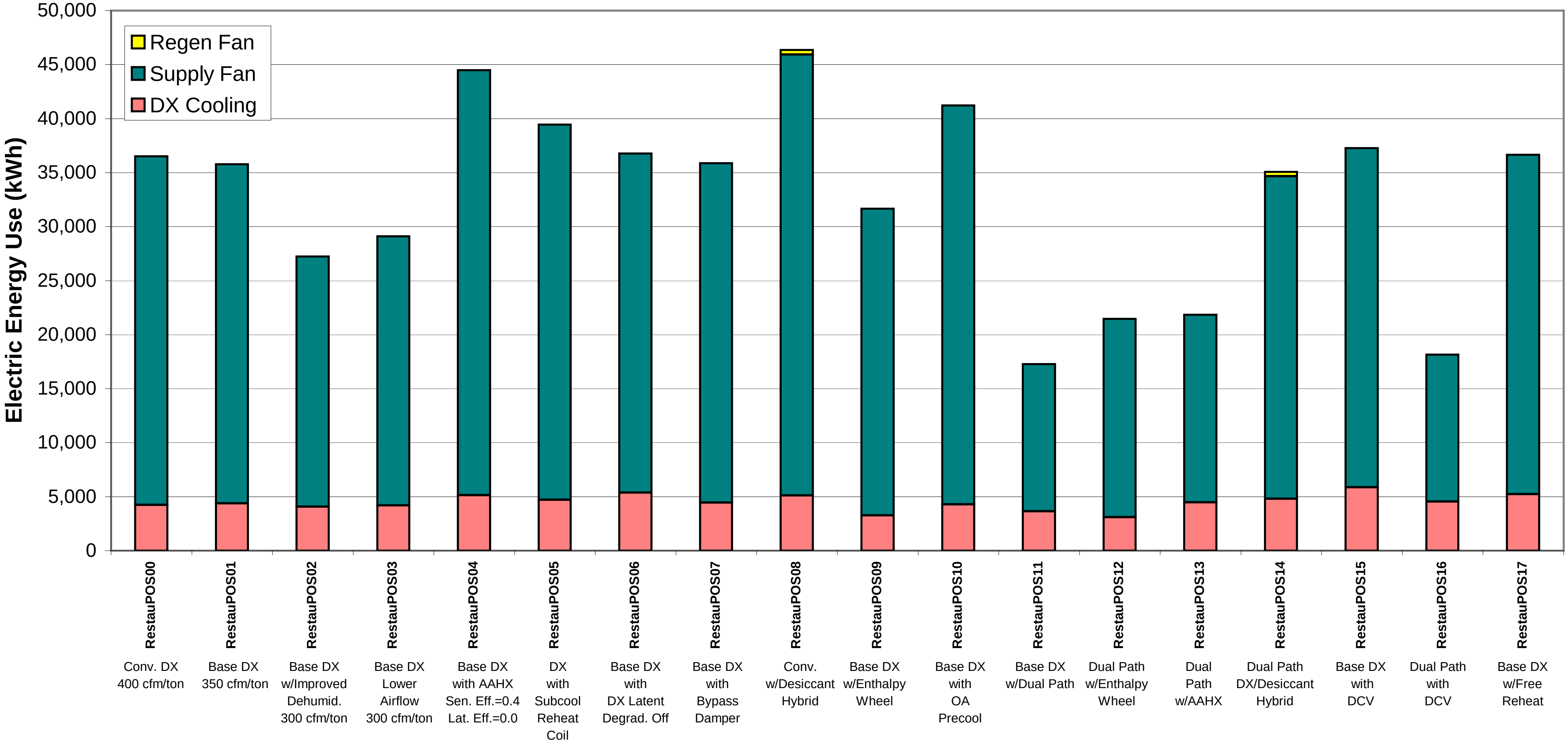
2004 Standard Restaurant in New York NY
Annual HVAC System Electric Energy Use



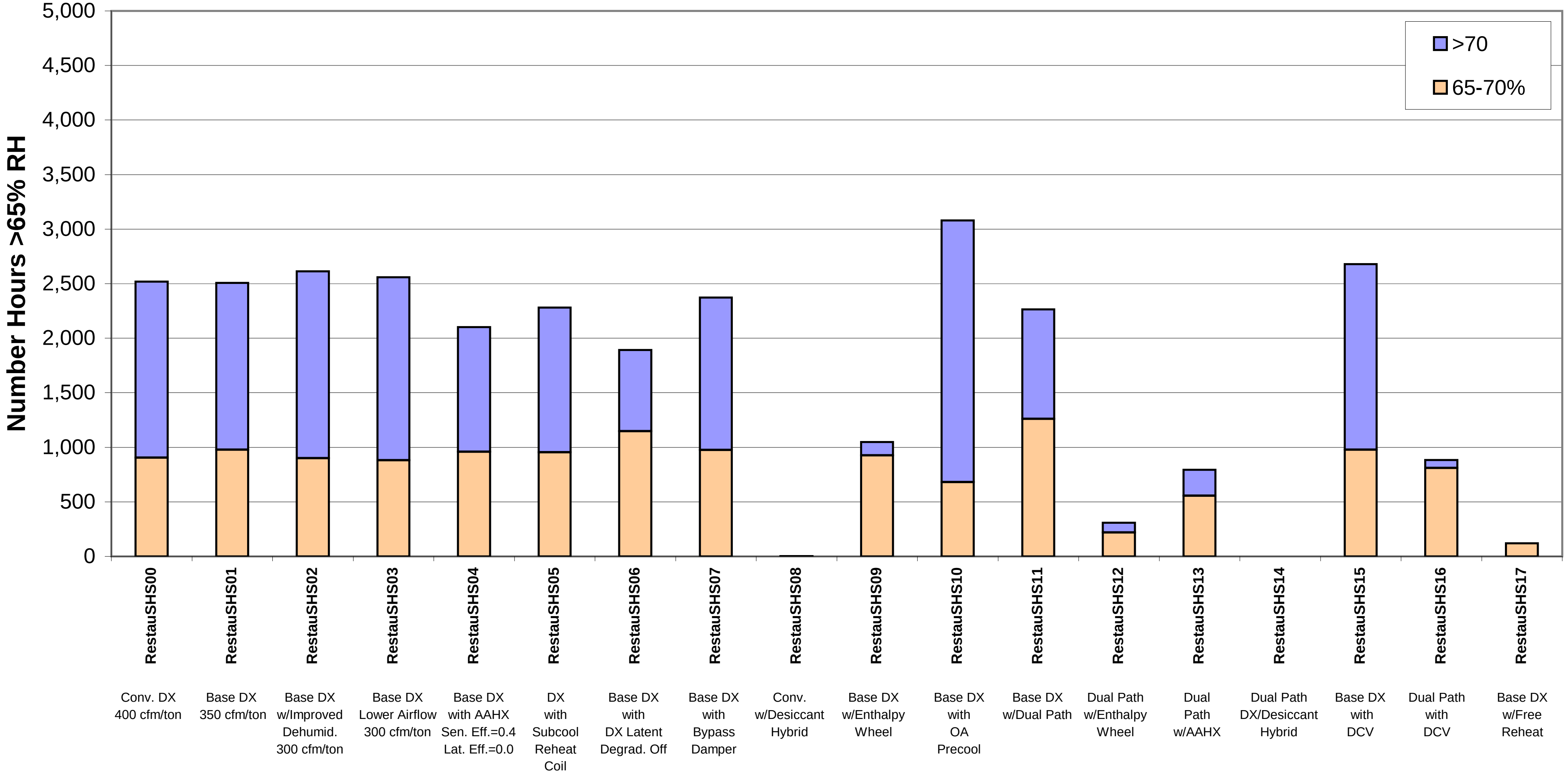
2004 Standard Restaurant in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



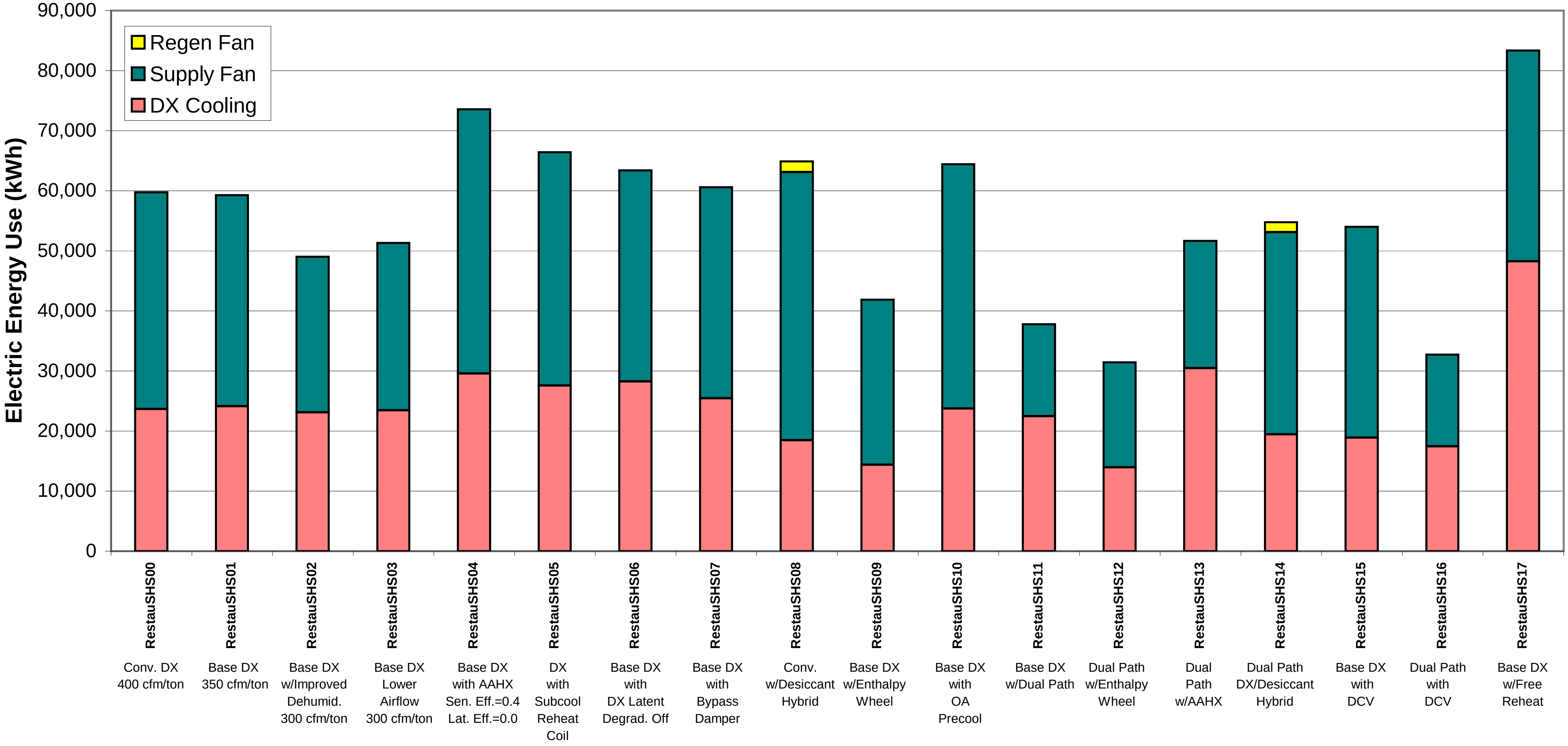
2004 Standard Restaurant in Portland OR
Annual HVAC System Electric Energy Use



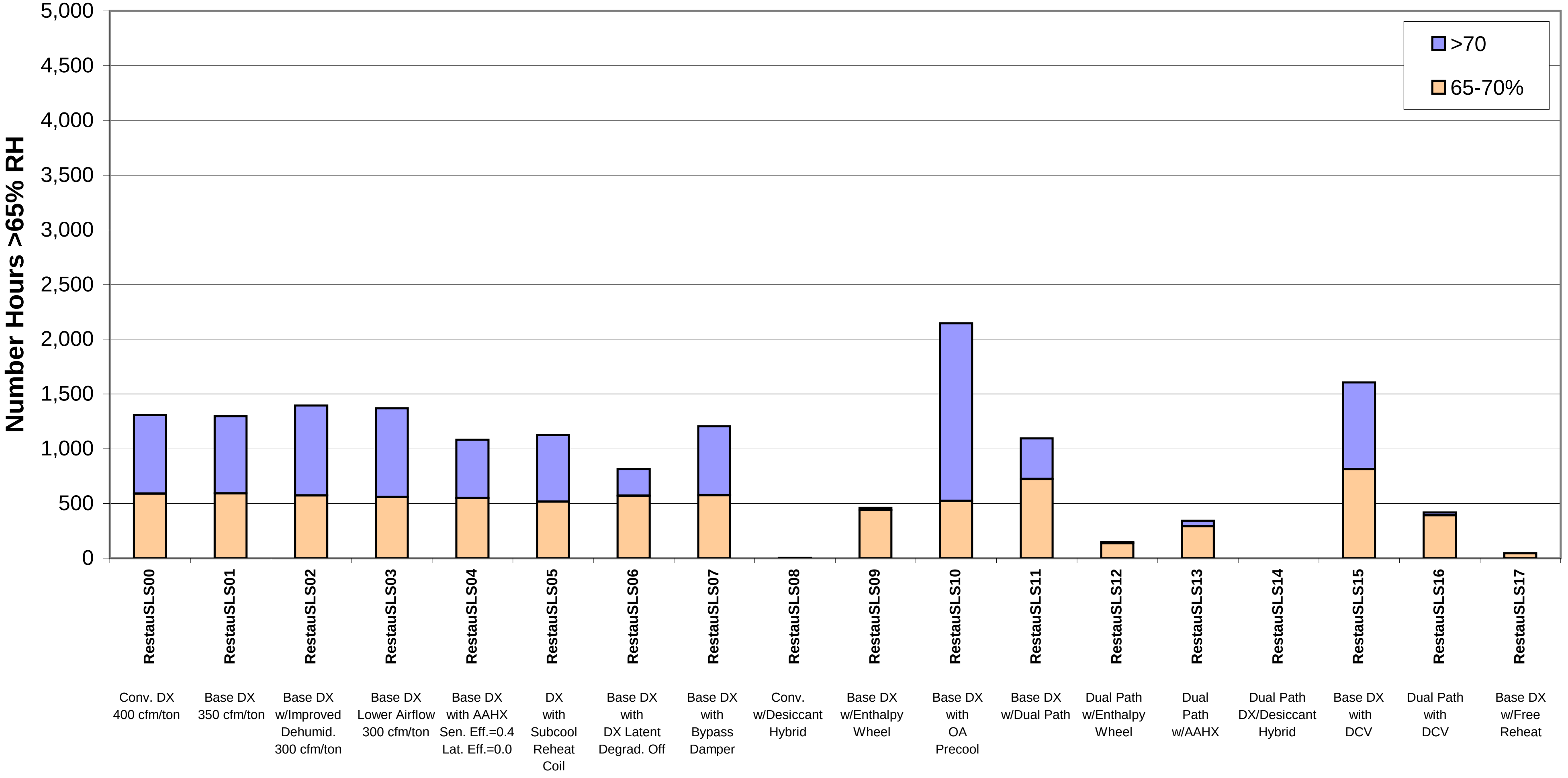
2004 Standard Restaurant in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



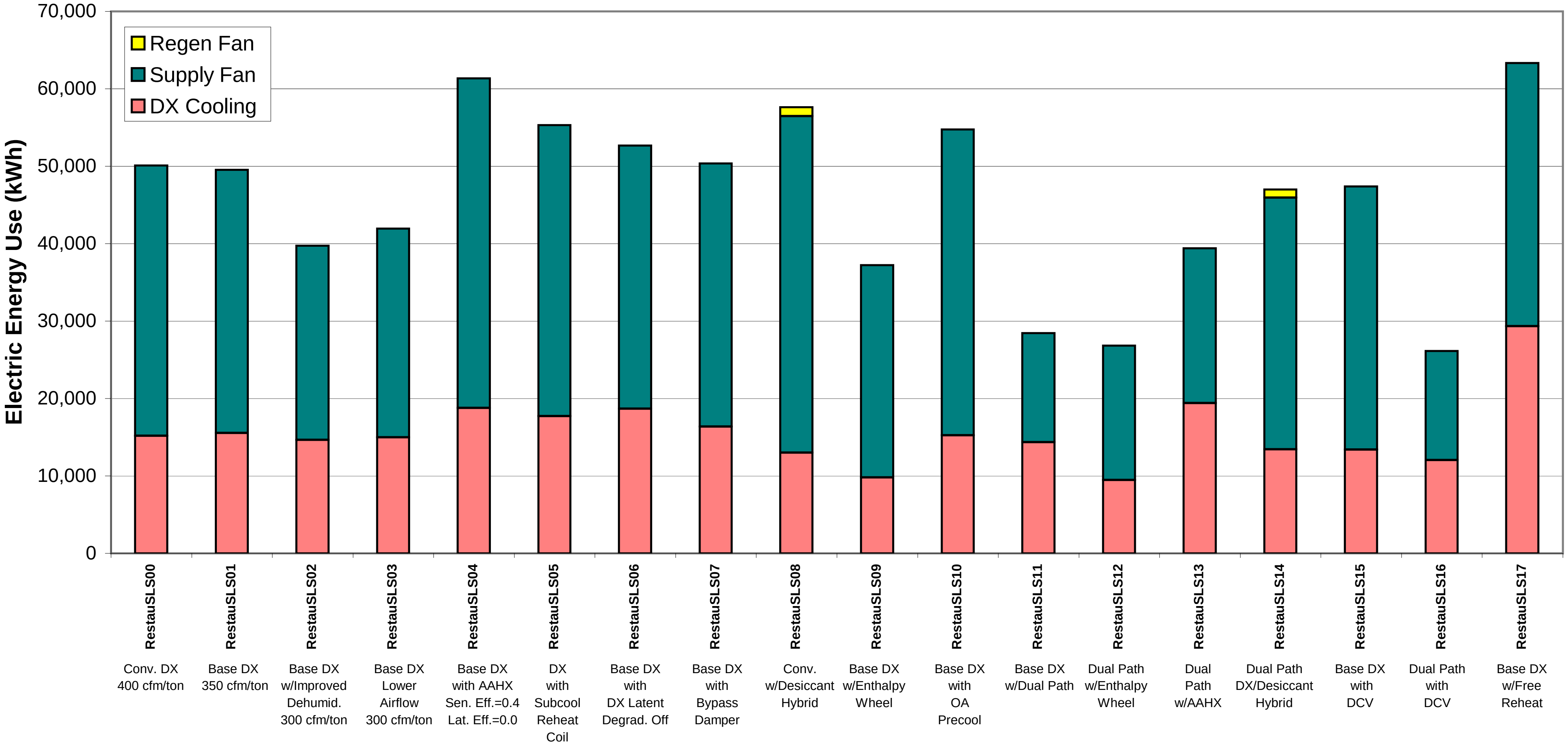
2004 Standard Restaurant in Shreveport LA
Annual HVAC System Electric Energy Use



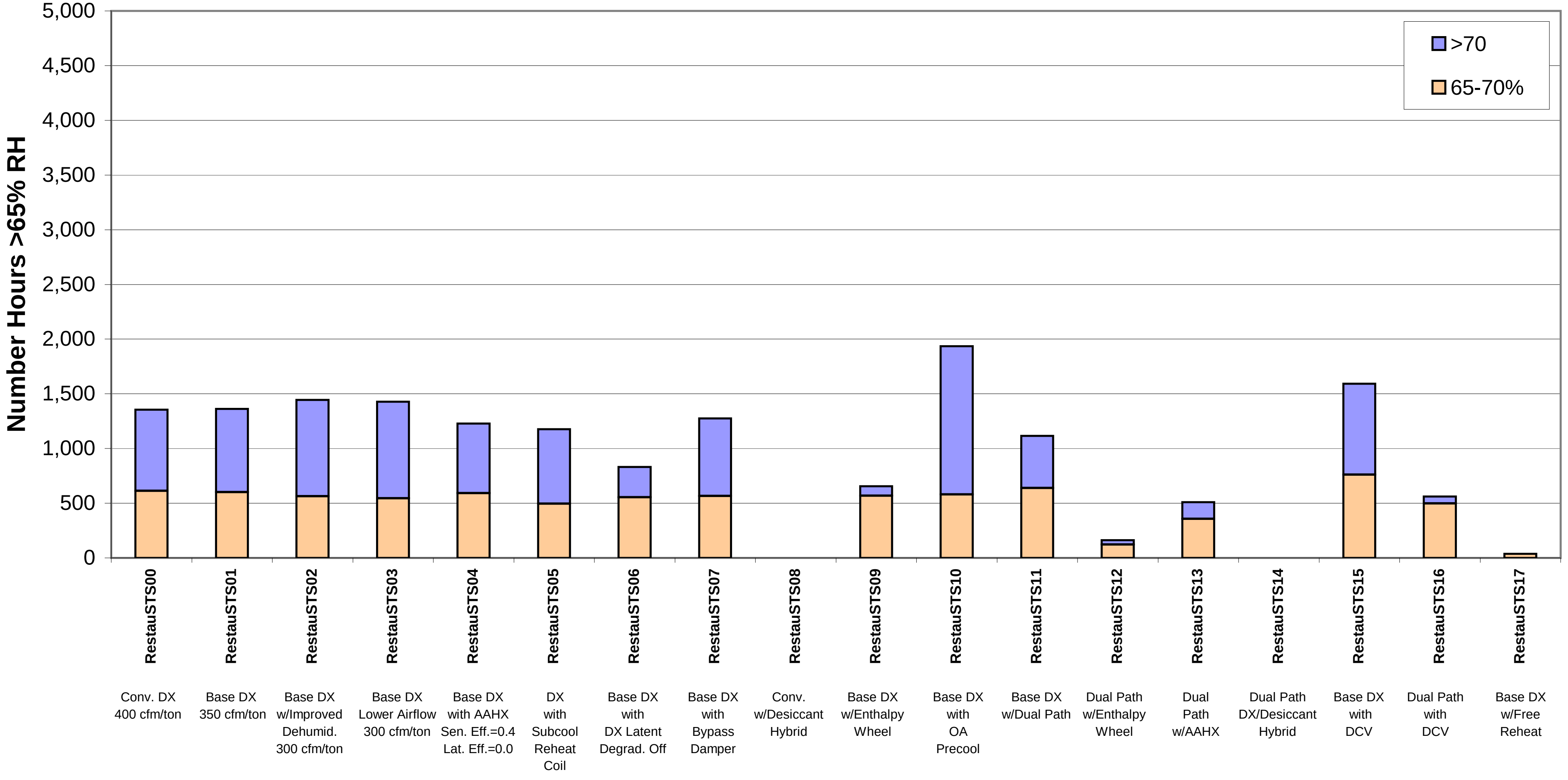
2004 Standard Restaurant in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



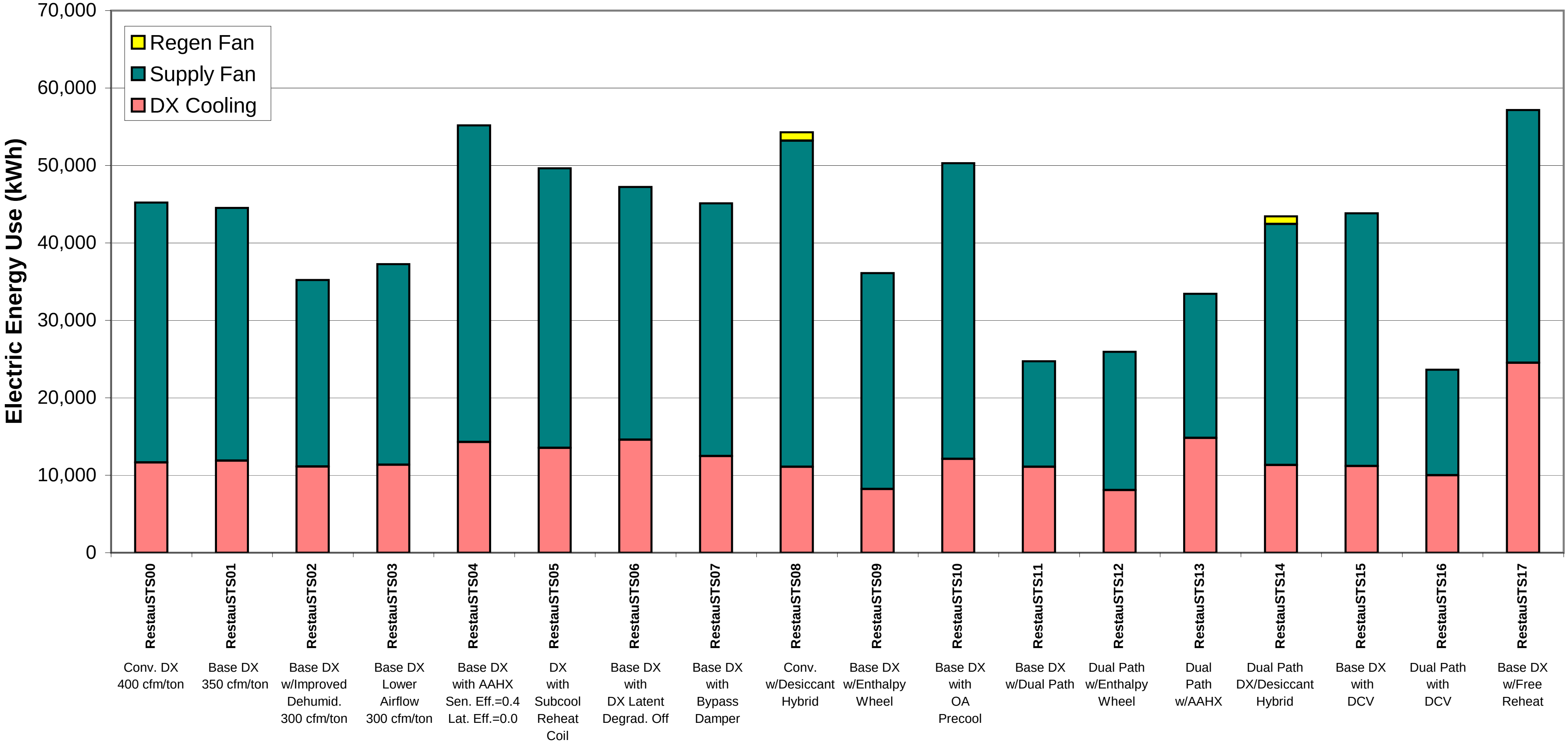
2004 Standard Restaurant in St. Louis MO
Annual HVAC System Electric Energy Use



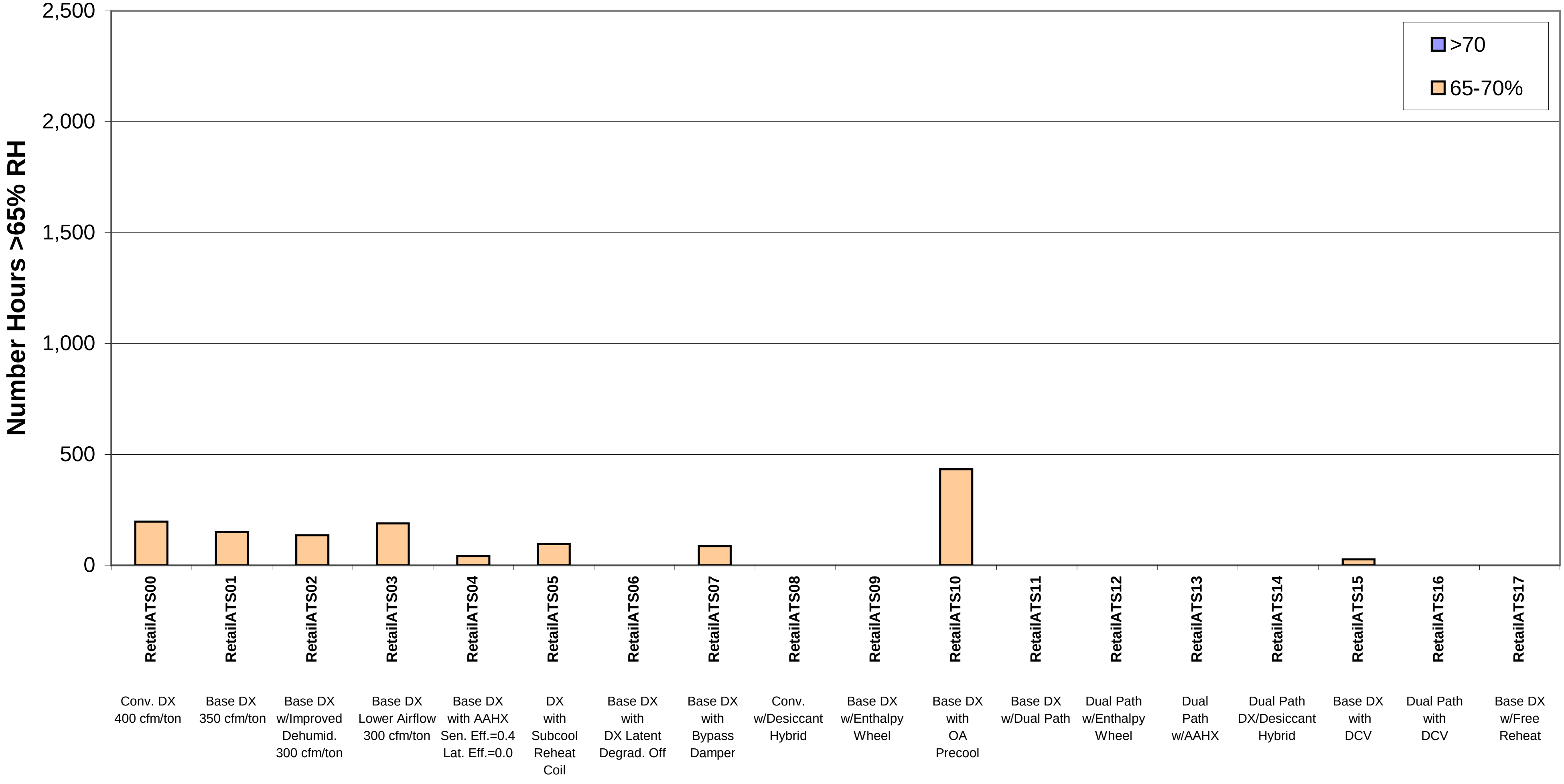
2004 Standard Restaurant in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



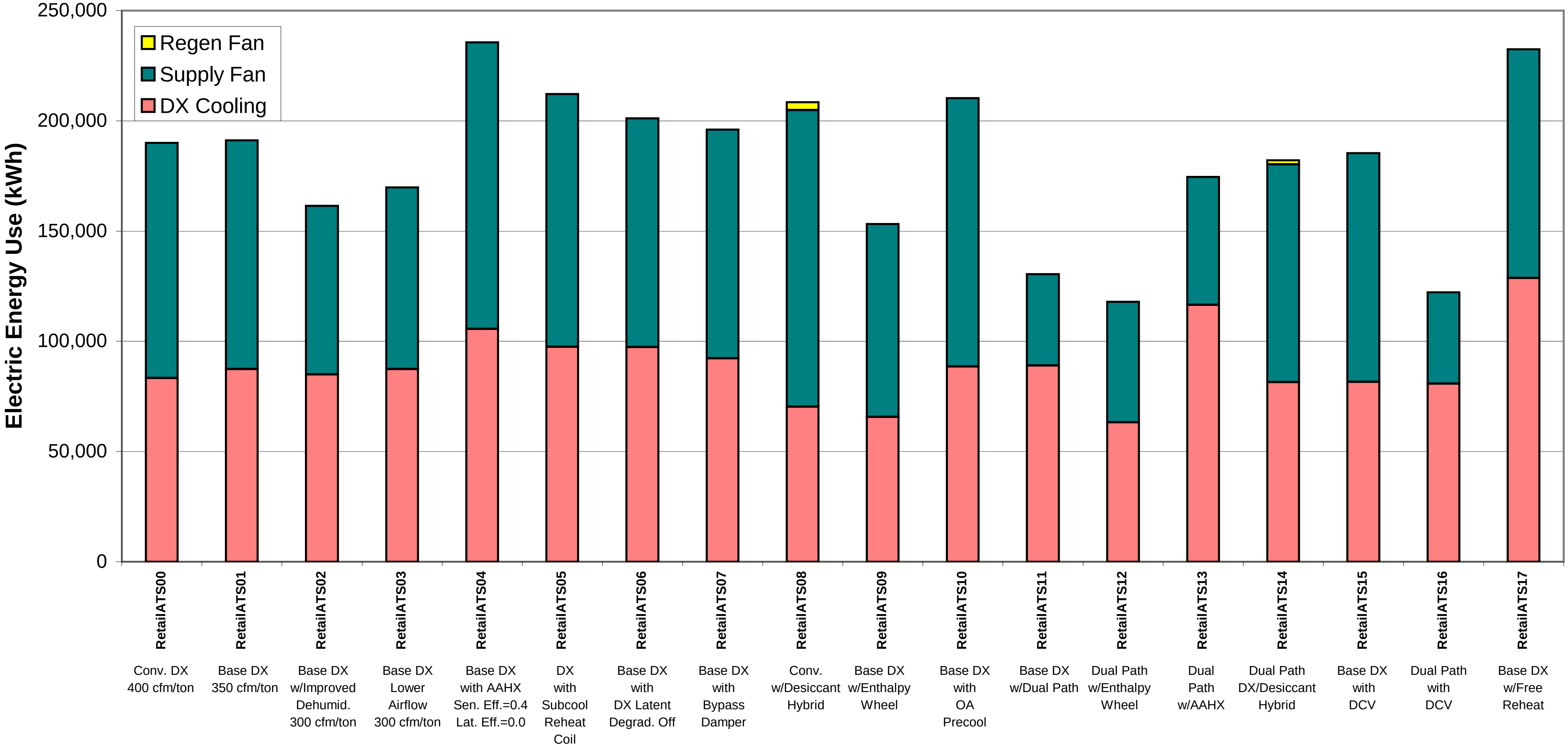
2004 Standard Restaurant in Washington DC
Annual HVAC System Electric Energy Use



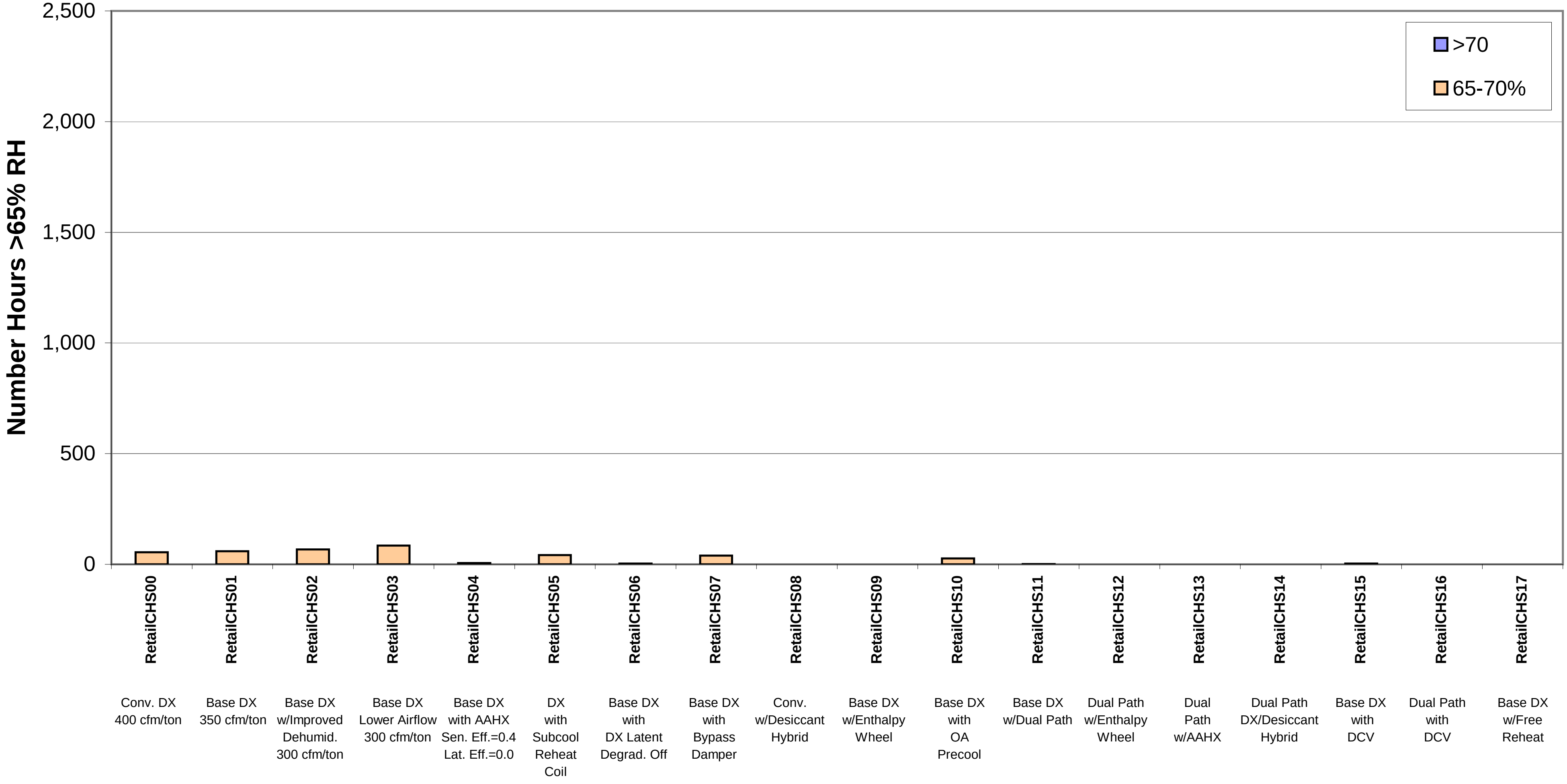
2004 Standard Retail in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



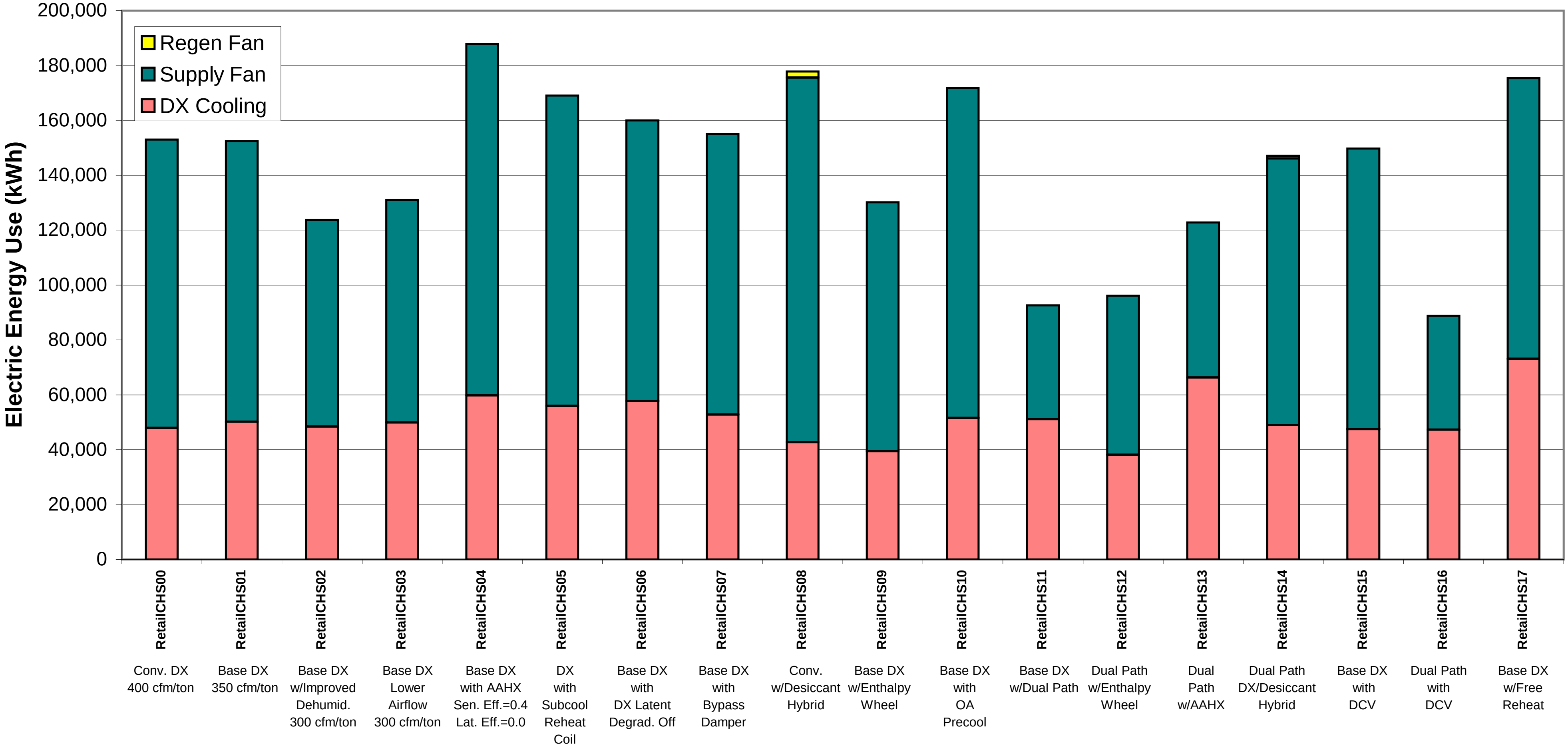
2004 Standard Retail in Atlanta GA
Annual HVAC System Electric Energy Use



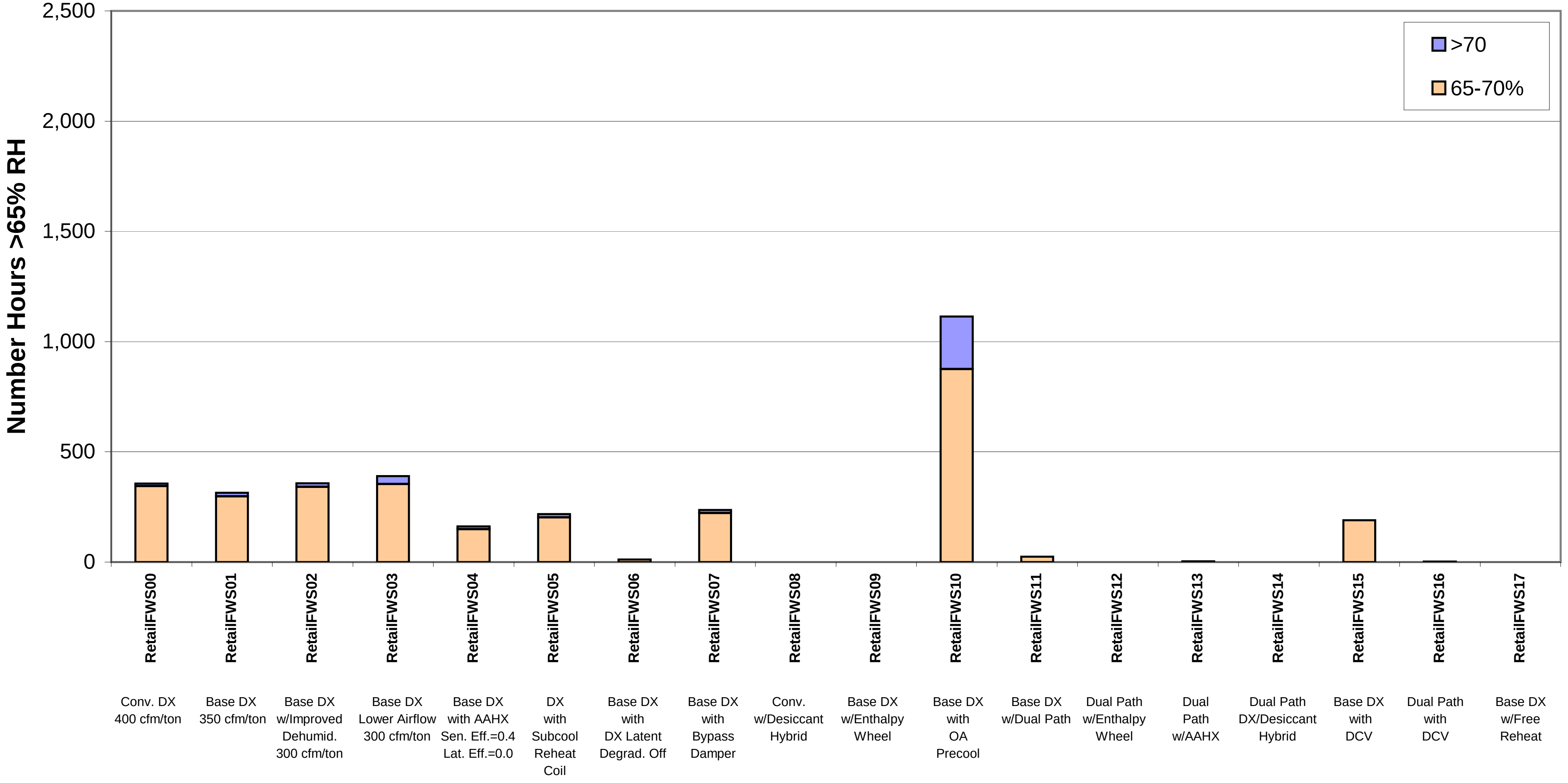
2004 Standard Retail in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



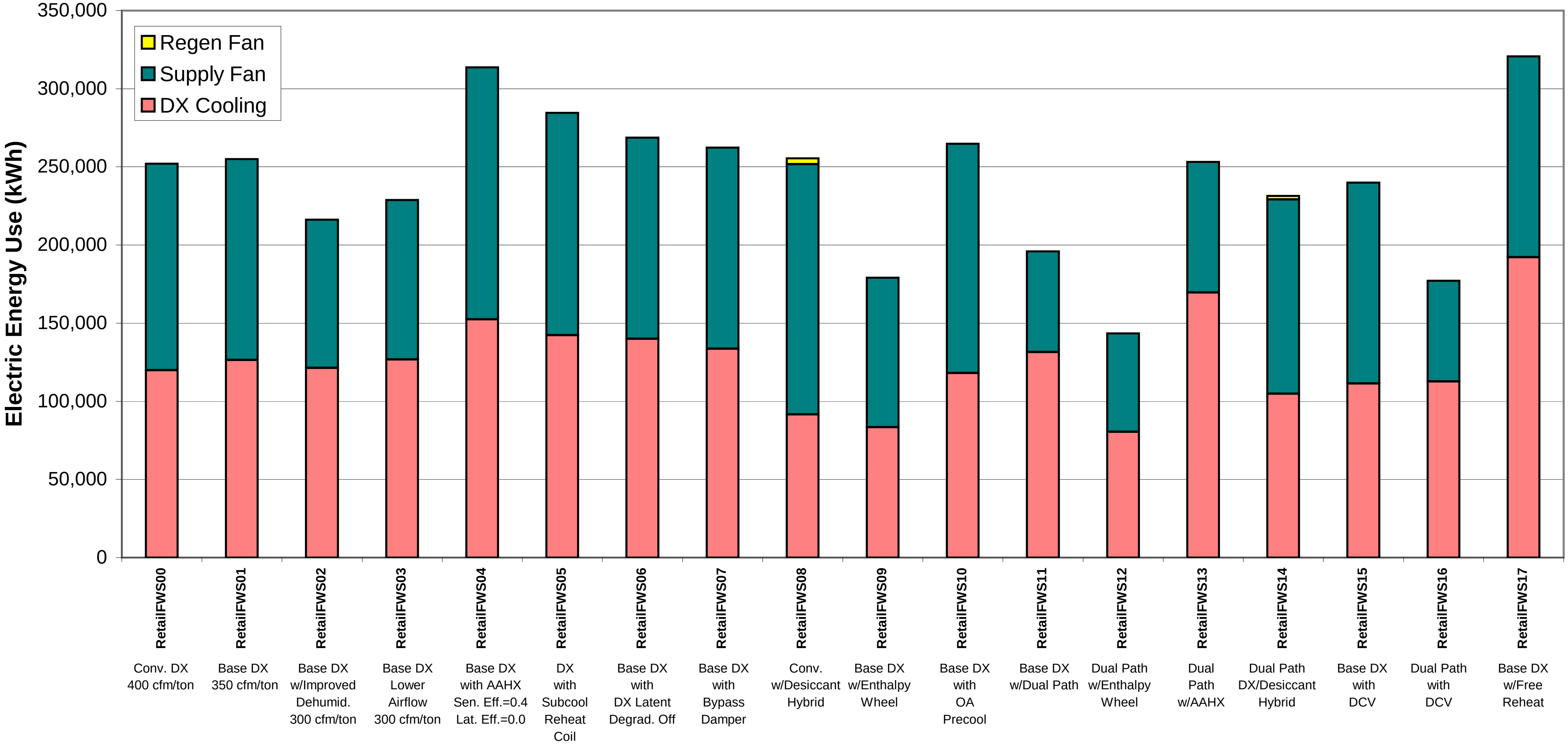
2004 Standard Retail in Chicago IL
Annual HVAC System Electric Energy Use

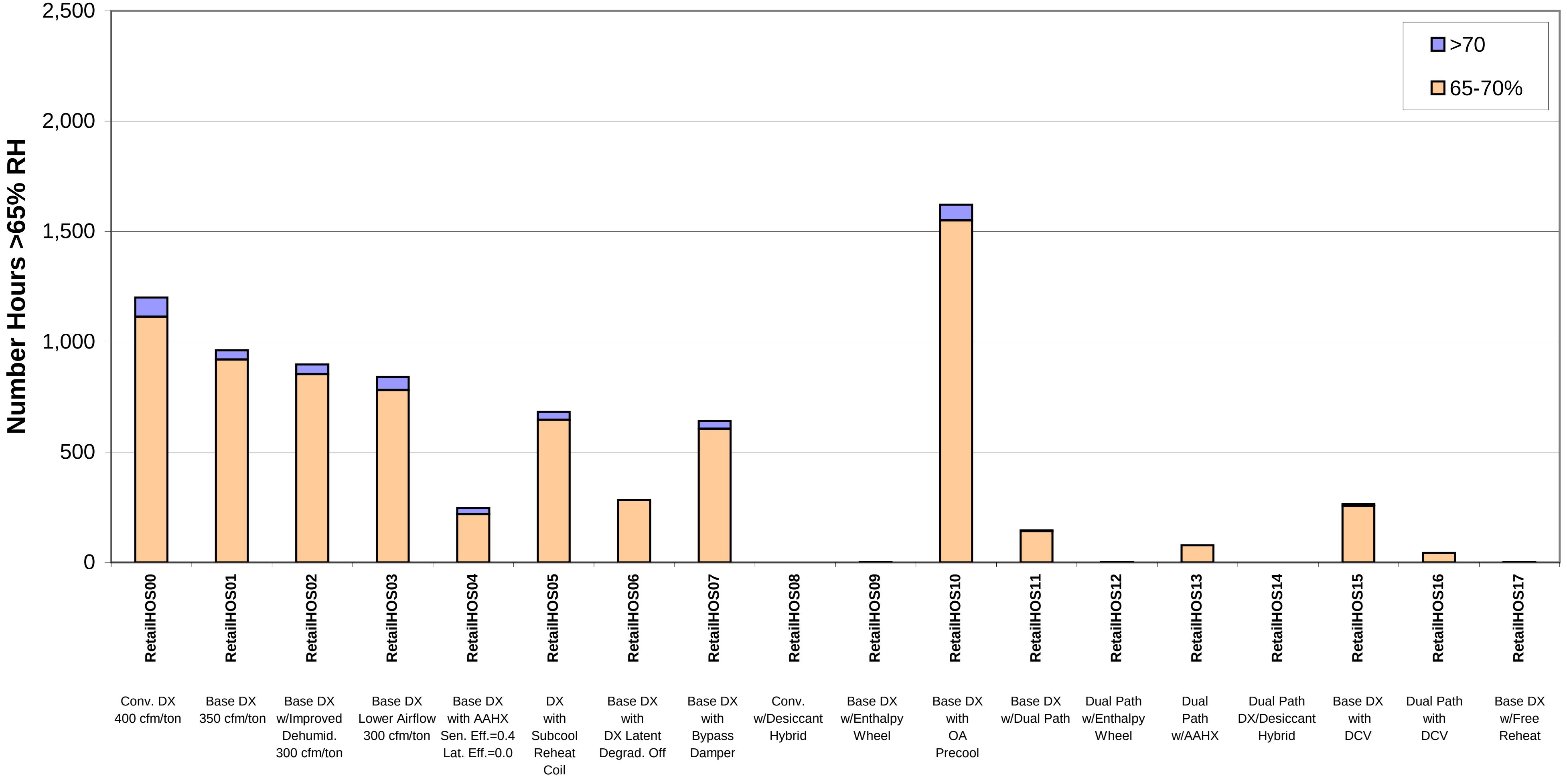


2004 Standard Retail in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



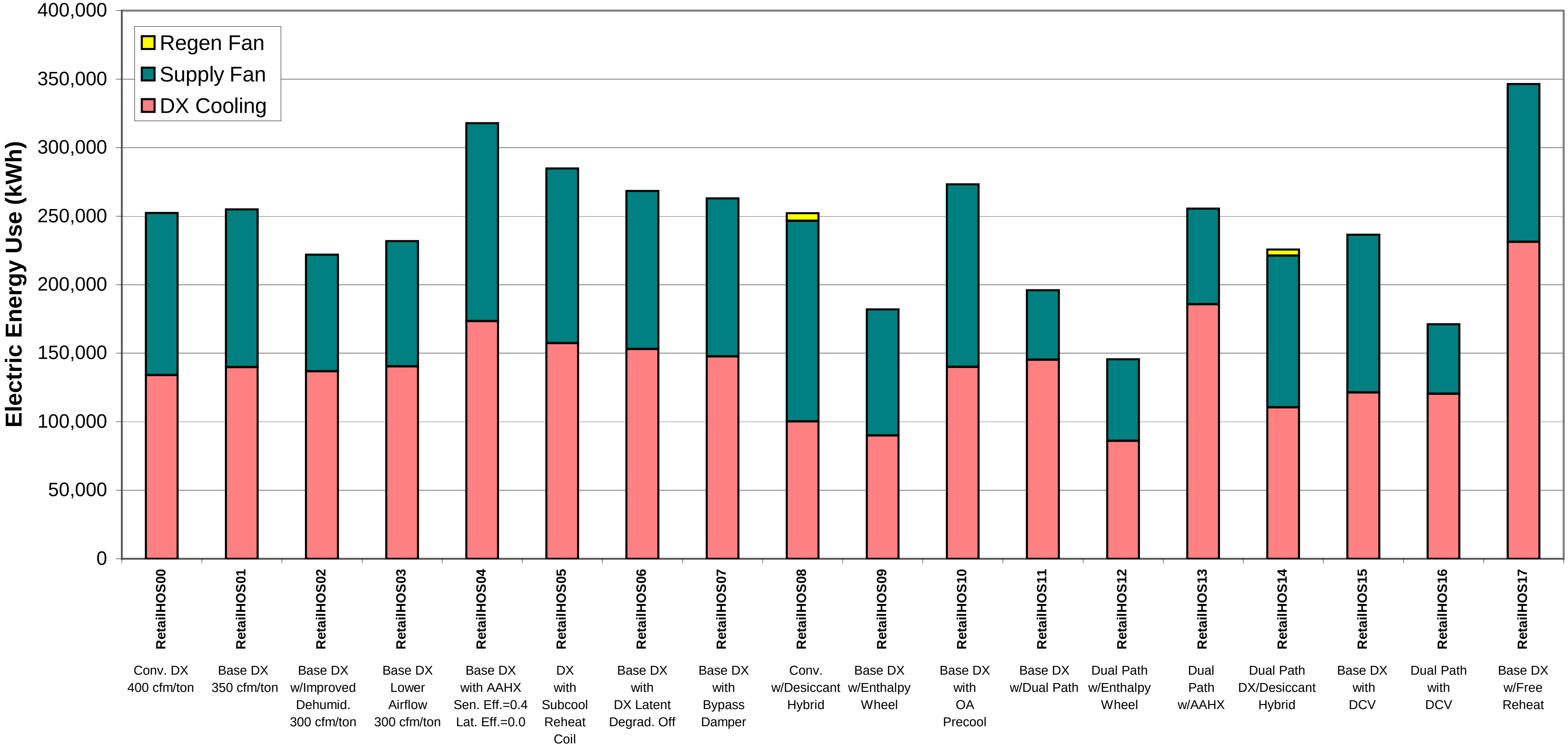
2004 Standard Retail in Fort Worth TX
Annual HVAC System Electric Energy Use



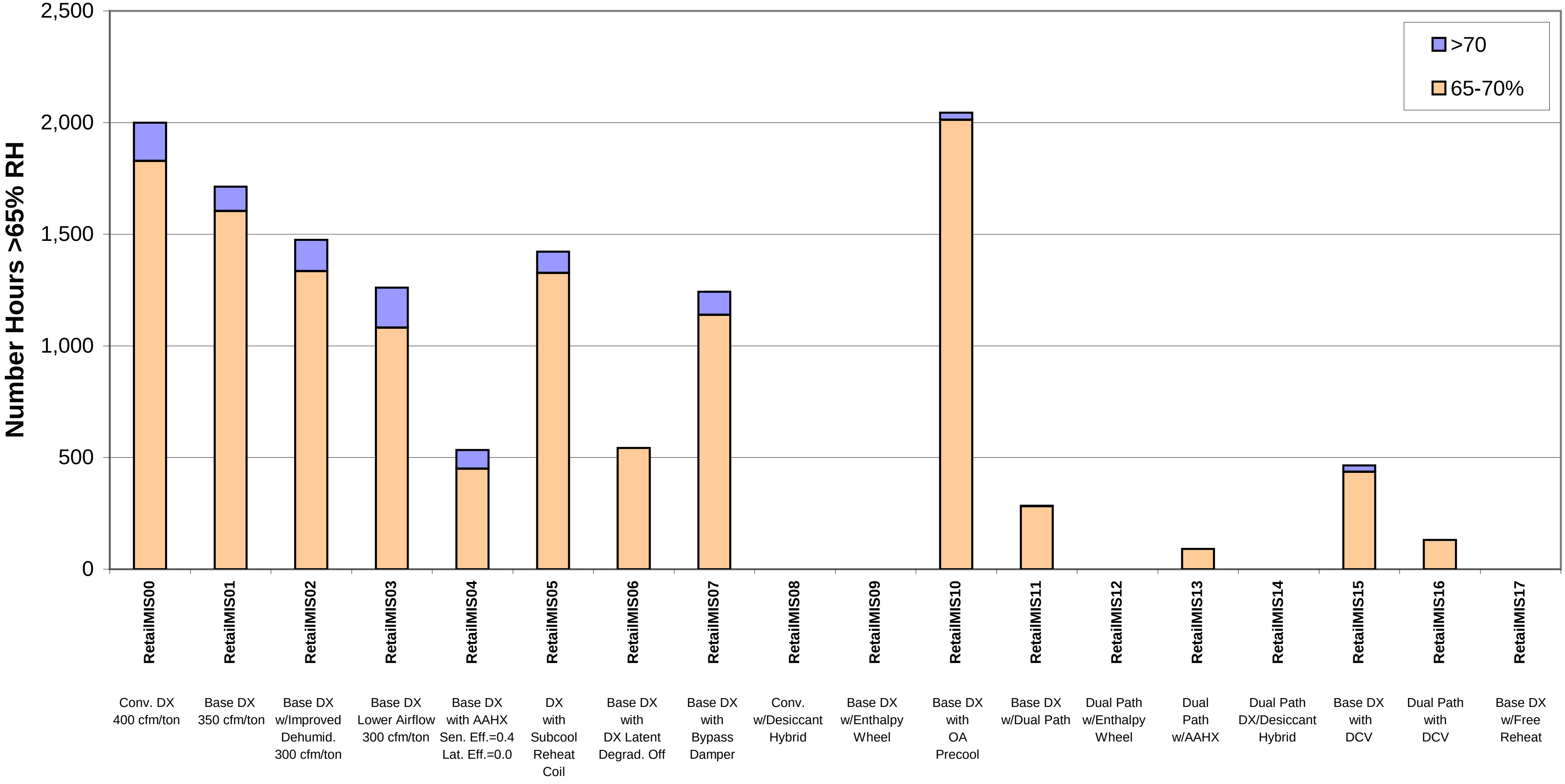


2004 Standard Retail in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%

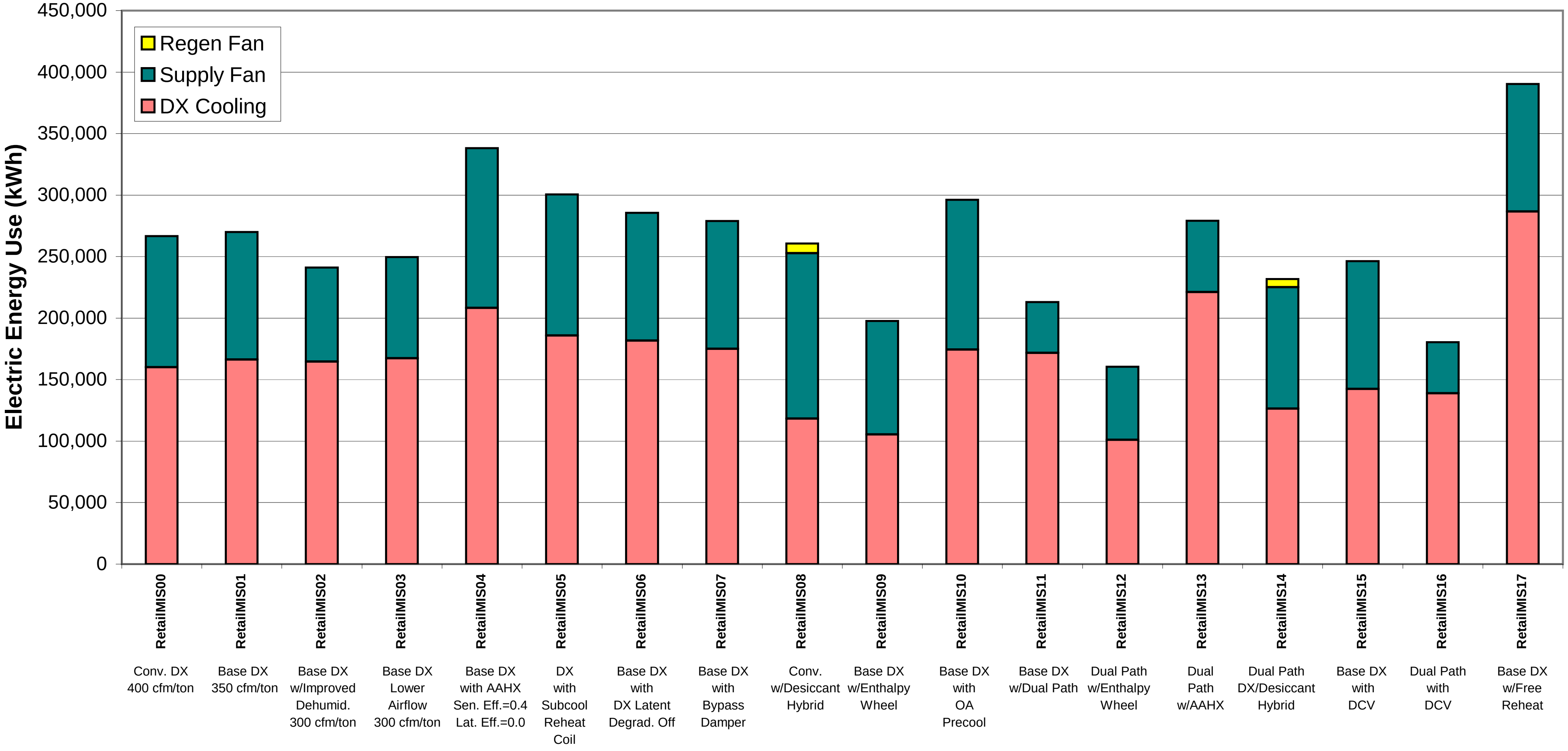
2004 Standard Retail in Houston TX
Annual HVAC System Electric Energy Use

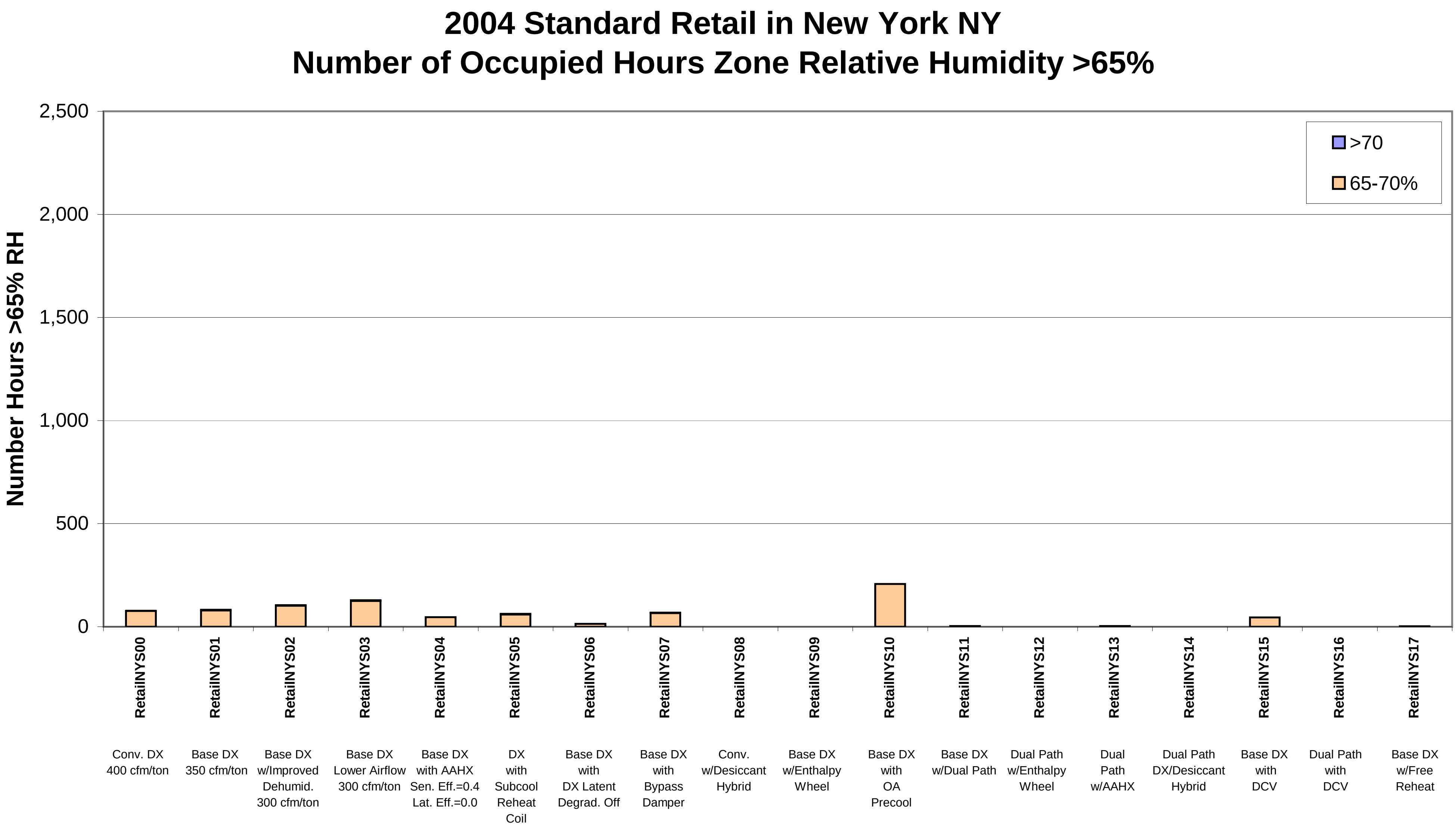


2004 Standard Retail in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



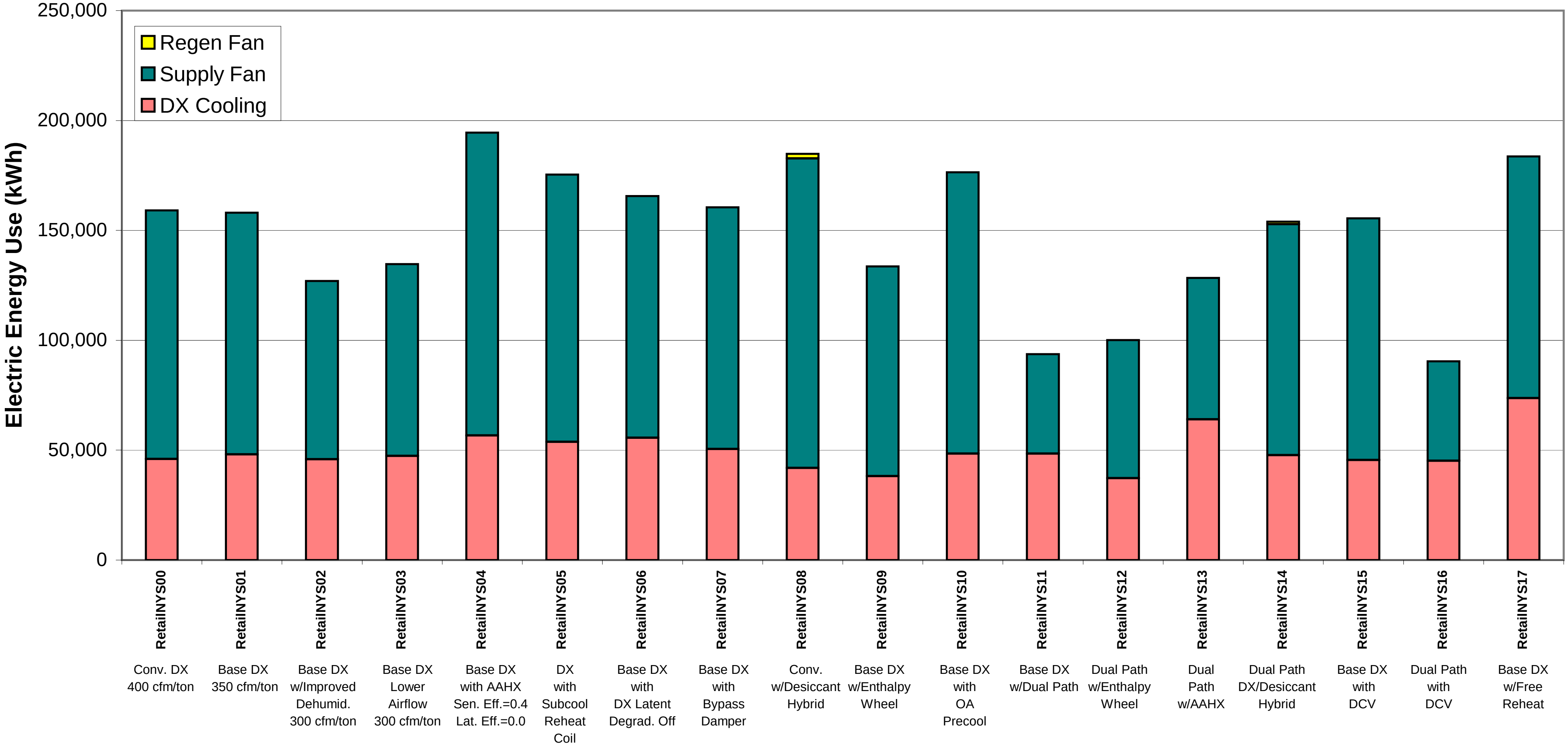
2004 Standard Retail in Miami FL
Annual HVAC System Electric Energy Use



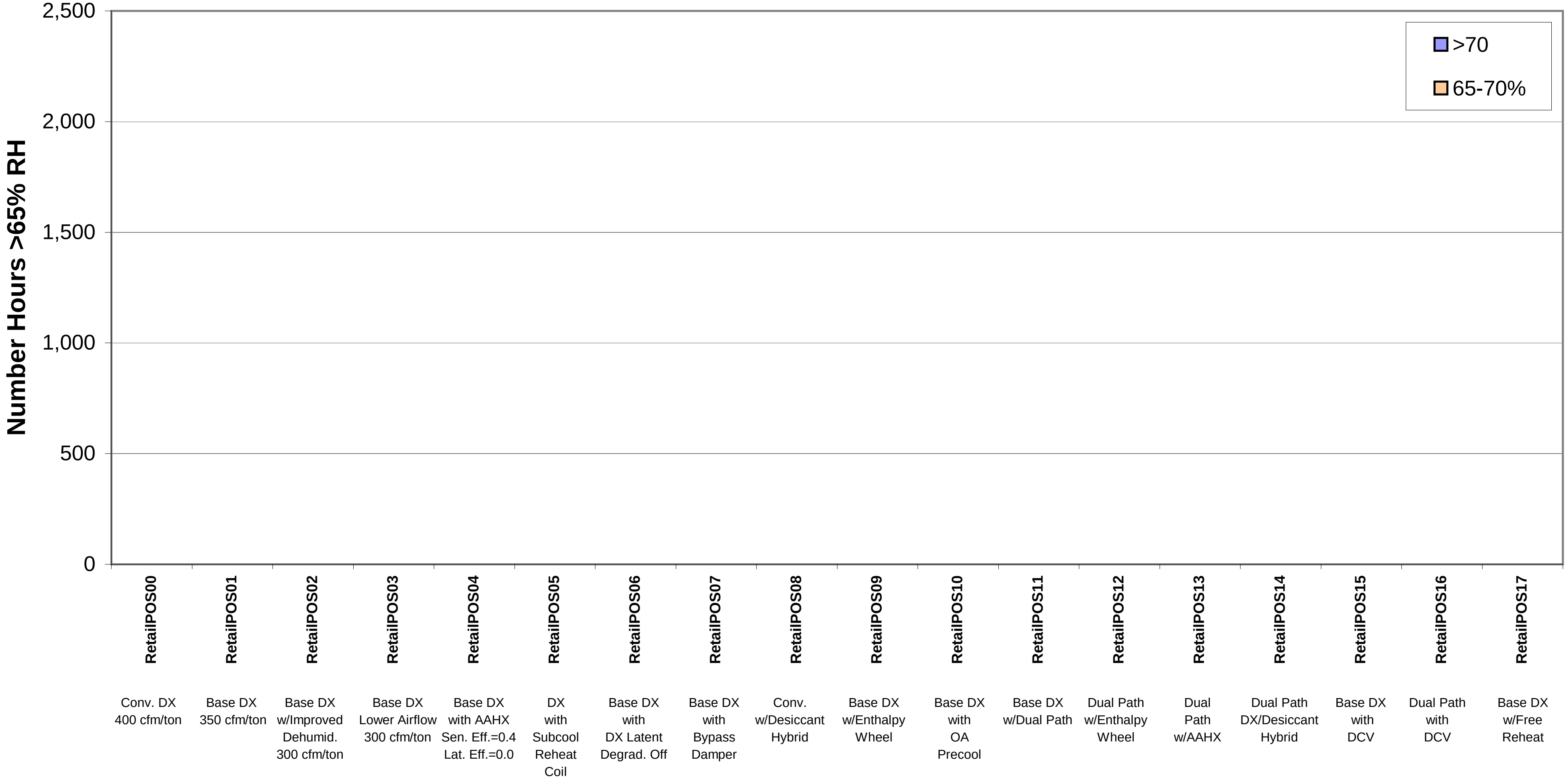


2004 Standard Retail in New York NY
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
2,500
2,000
1,500
1,000
500
0
>70
65-70%
RetailNYS00
RetailNYS01
RetailNYS02
RetailNYS03
RetailNYS04
RetailNYS05
RetailNYS06
RetailNYS07
RetailNYS08
RetailNYS09
RetailNYS10
RetailNYS11
RetailNYS12
RetailNYS13
RetailNYS14
RetailNYS15
RetailNYS16
RetailNYS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

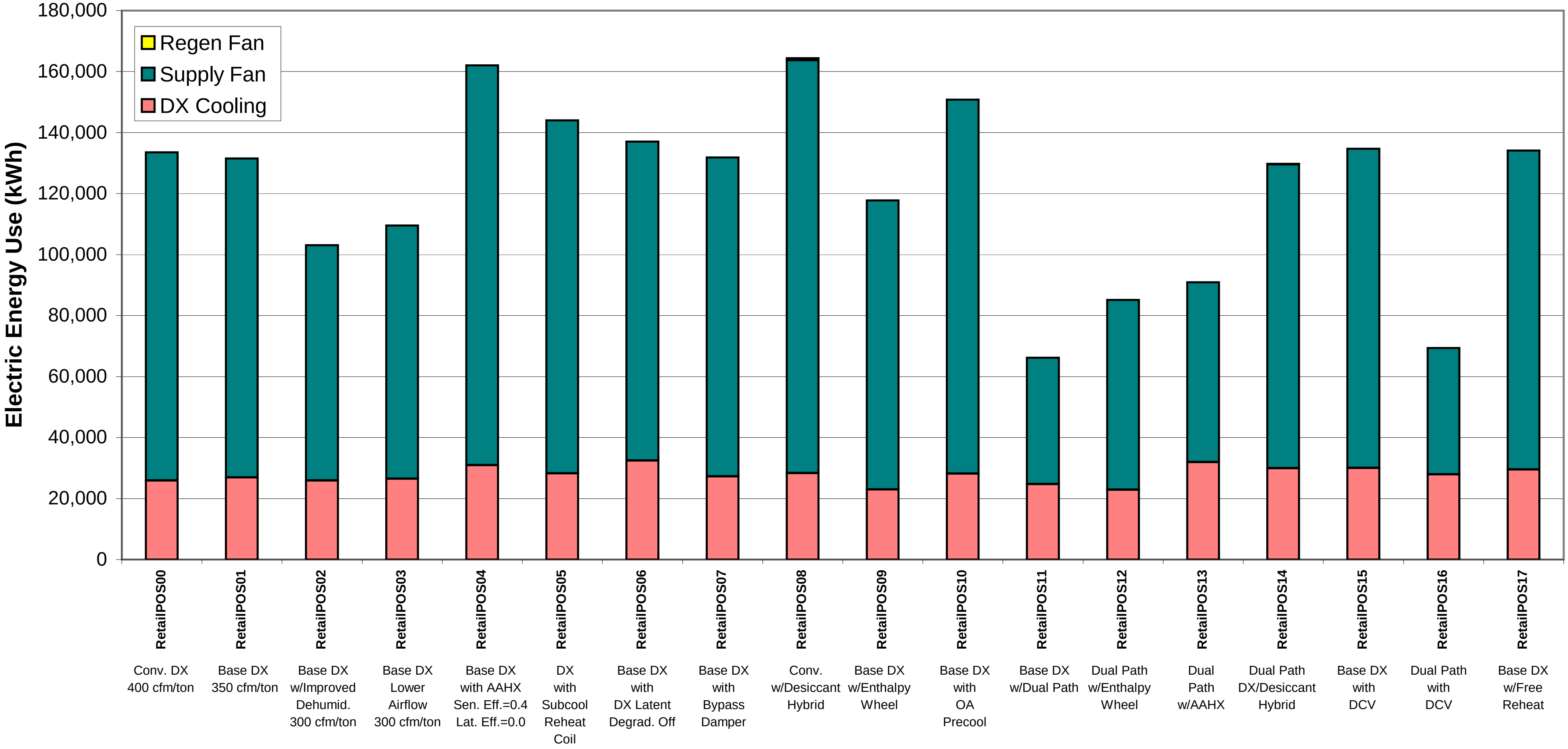
2004 Standard Retail in New York NY
Annual HVAC System Electric Energy Use



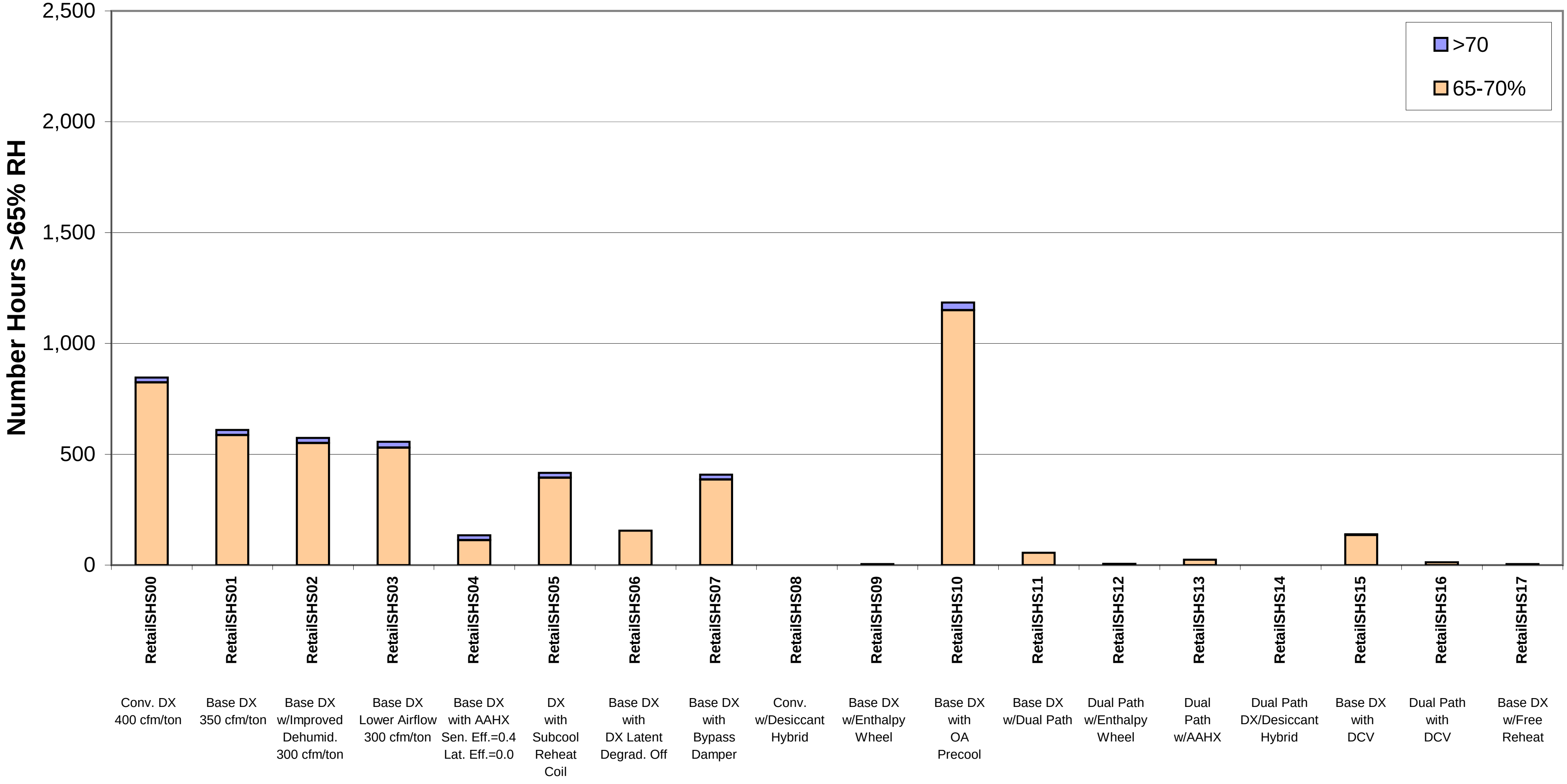
2004 Standard Retail in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



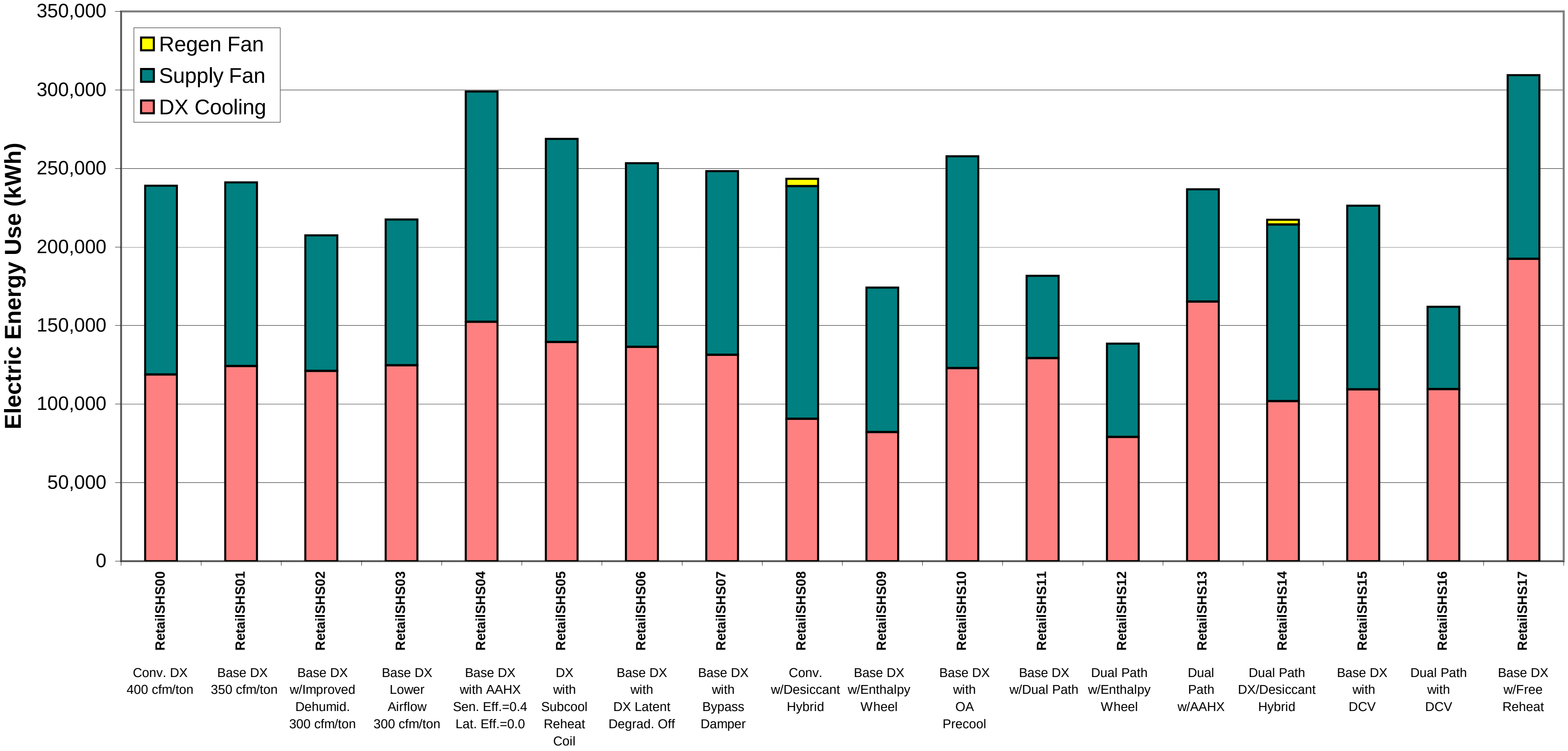
2004 Standard Retail in Portland OR
Annual HVAC System Electric Energy Use



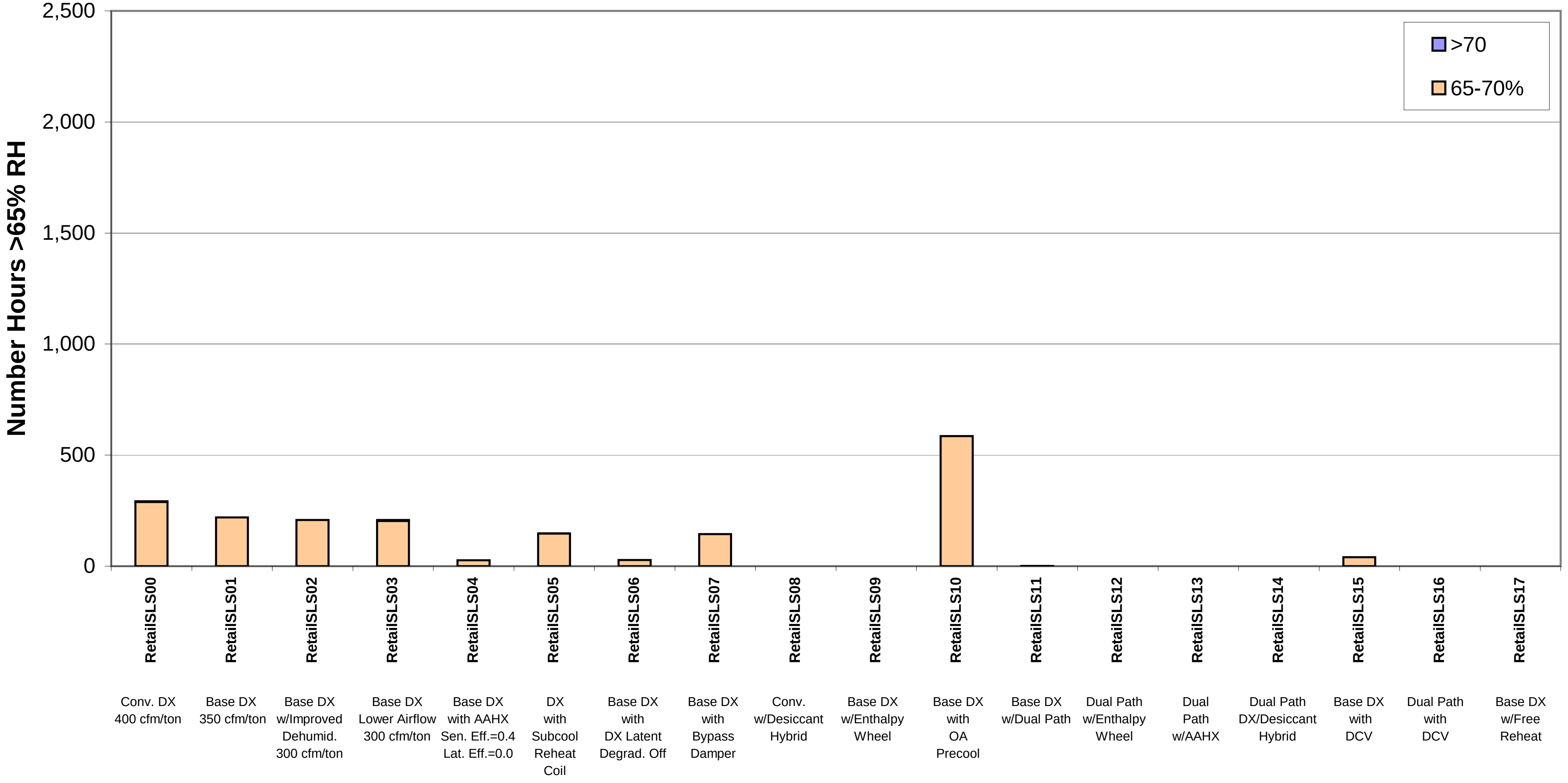
2004 Standard Retail in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



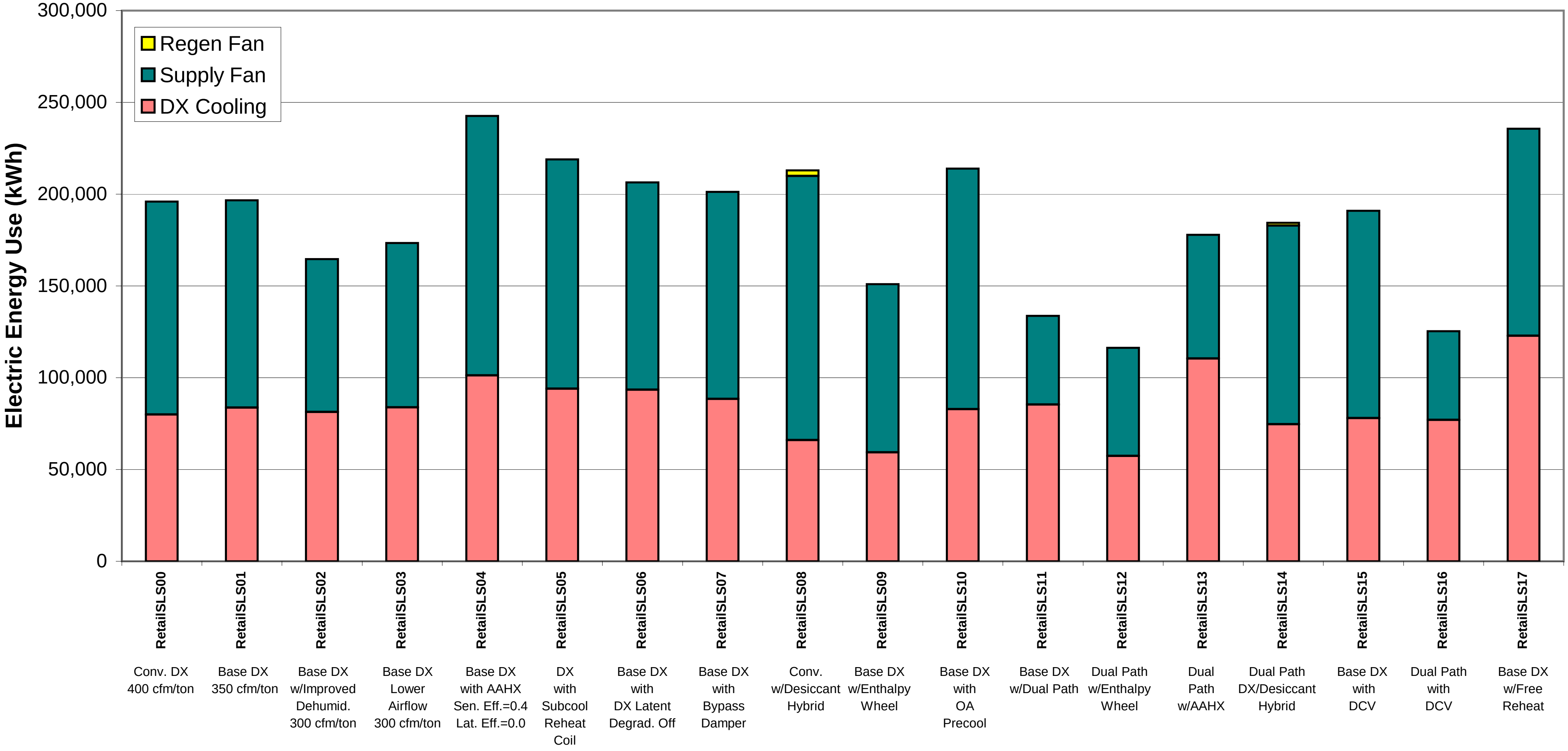
2004 Standard Retail in Shreveport LA
Annual HVAC System Electric Energy Use

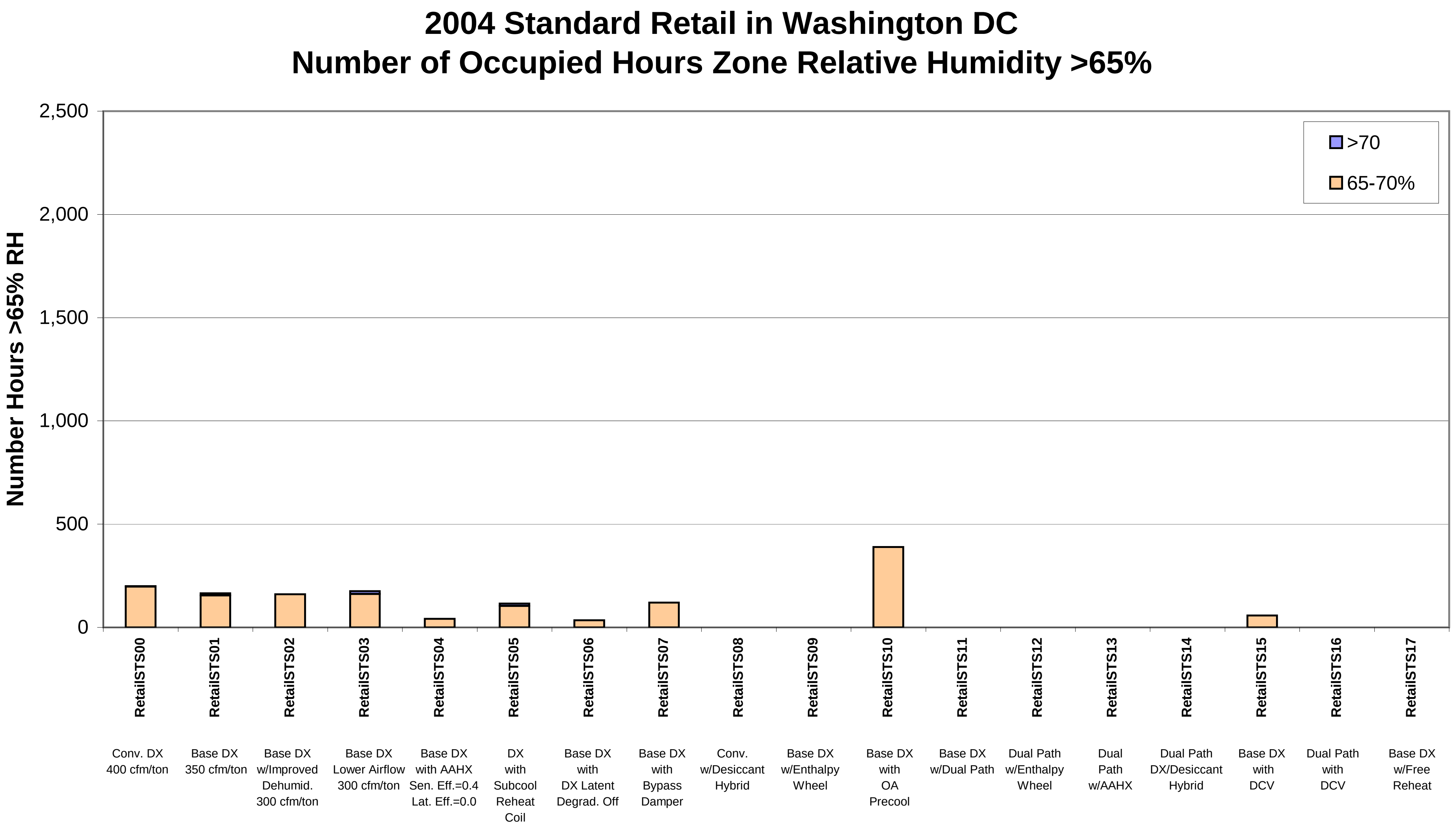


2004 Standard Retail in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



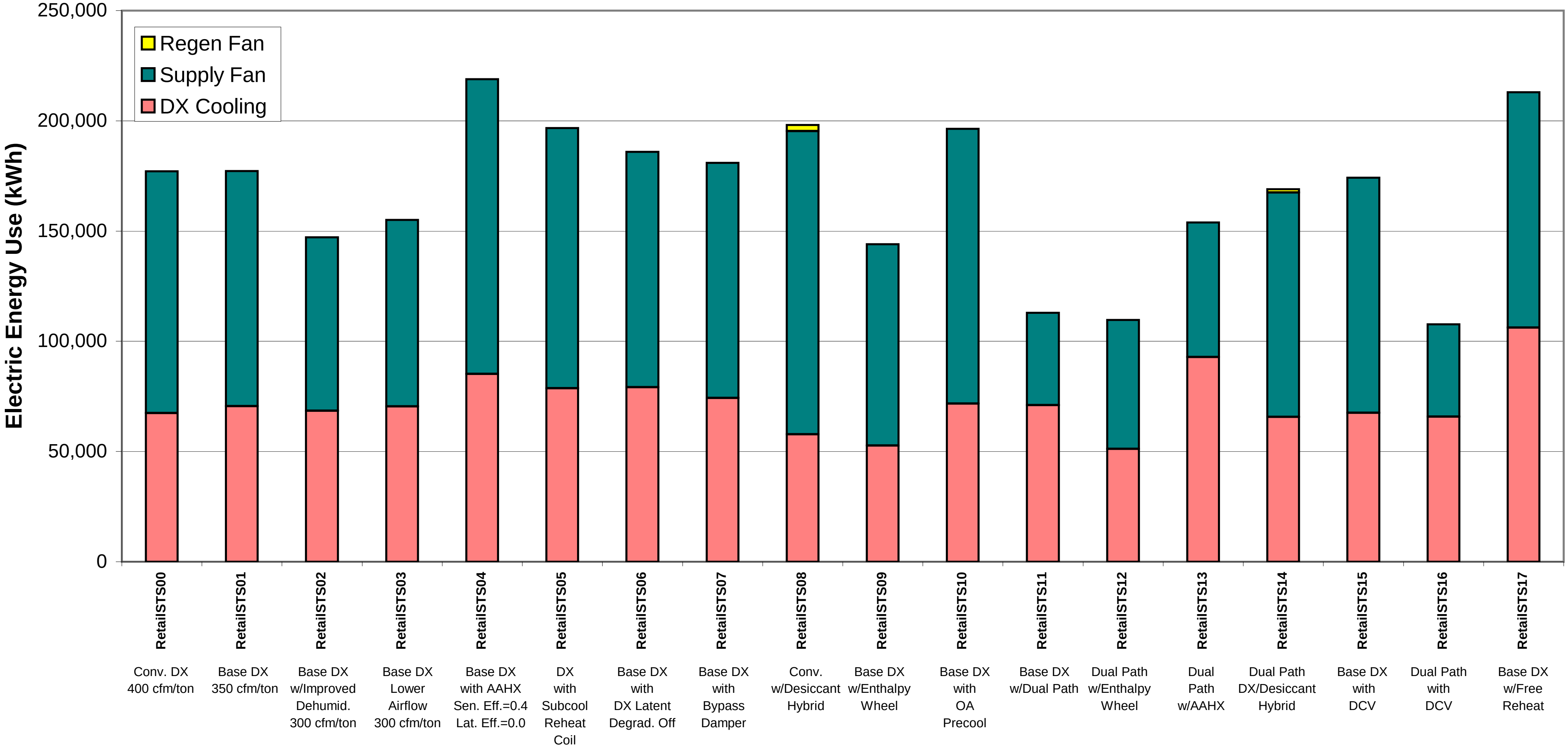
2004 Standard Retail in St. Louis MO
Annual HVAC System Electric Energy Use



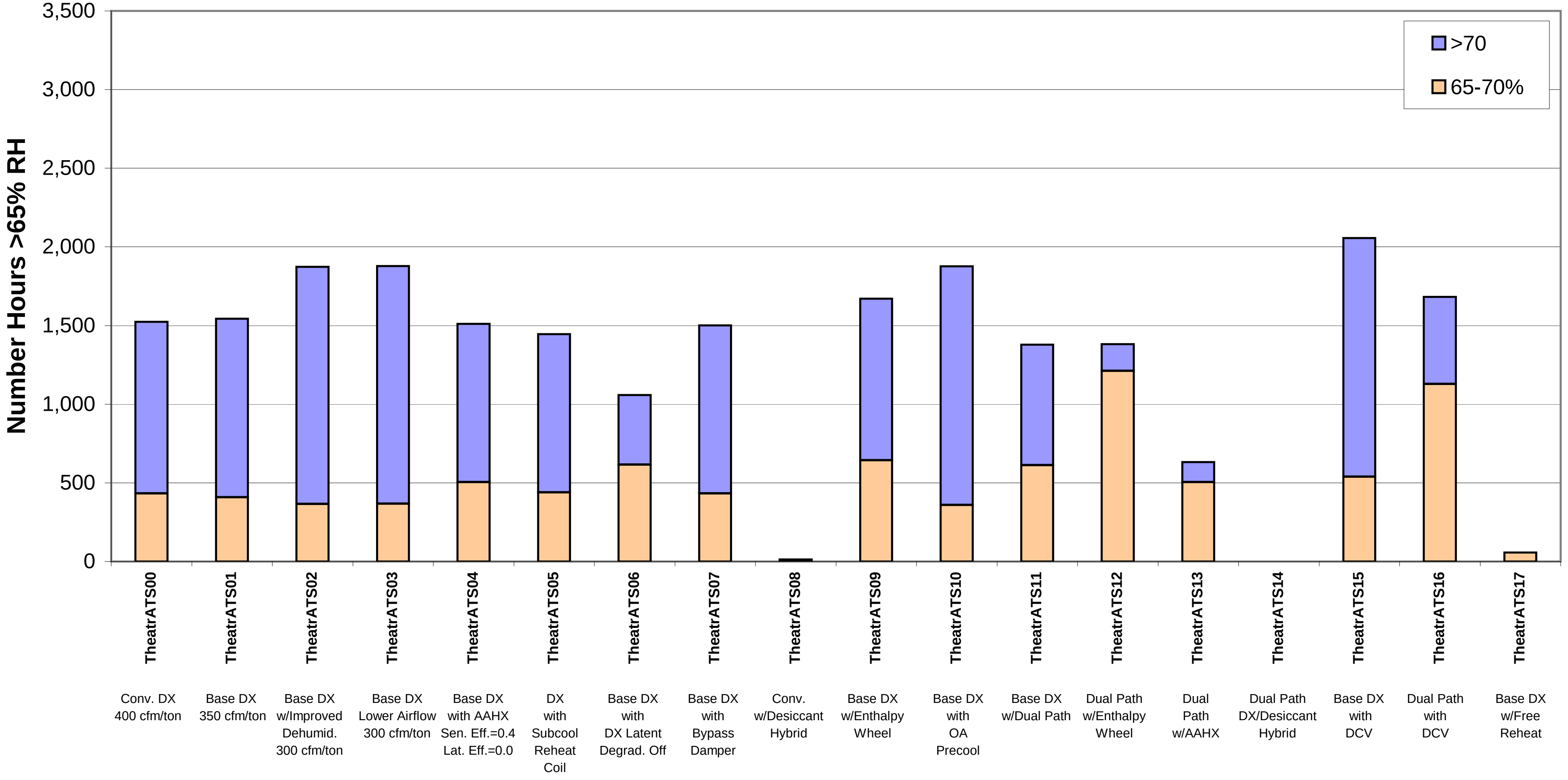


2004 Standard Retail in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%

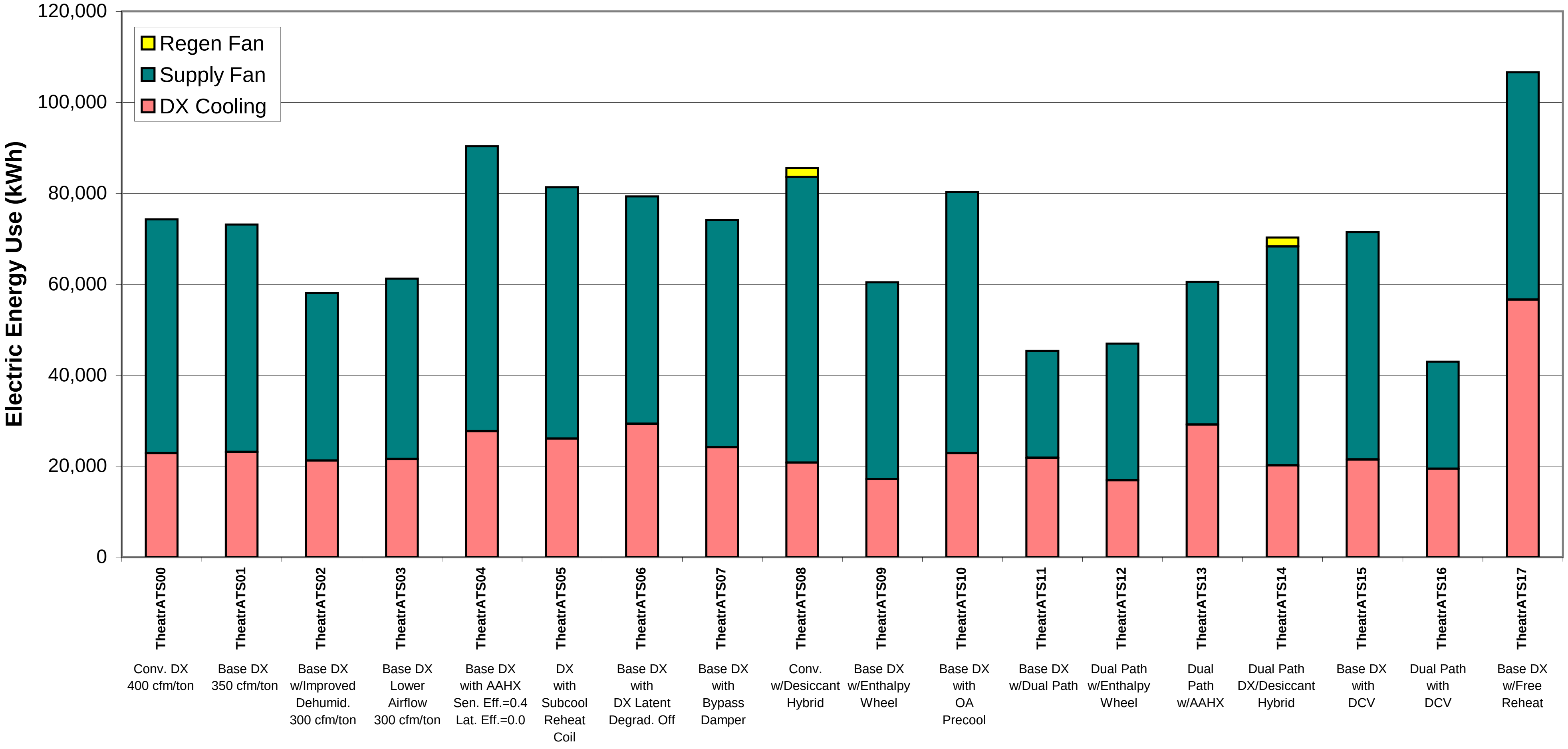
2004 Standard Retail in Washington DC
Annual HVAC System Electric Energy Use



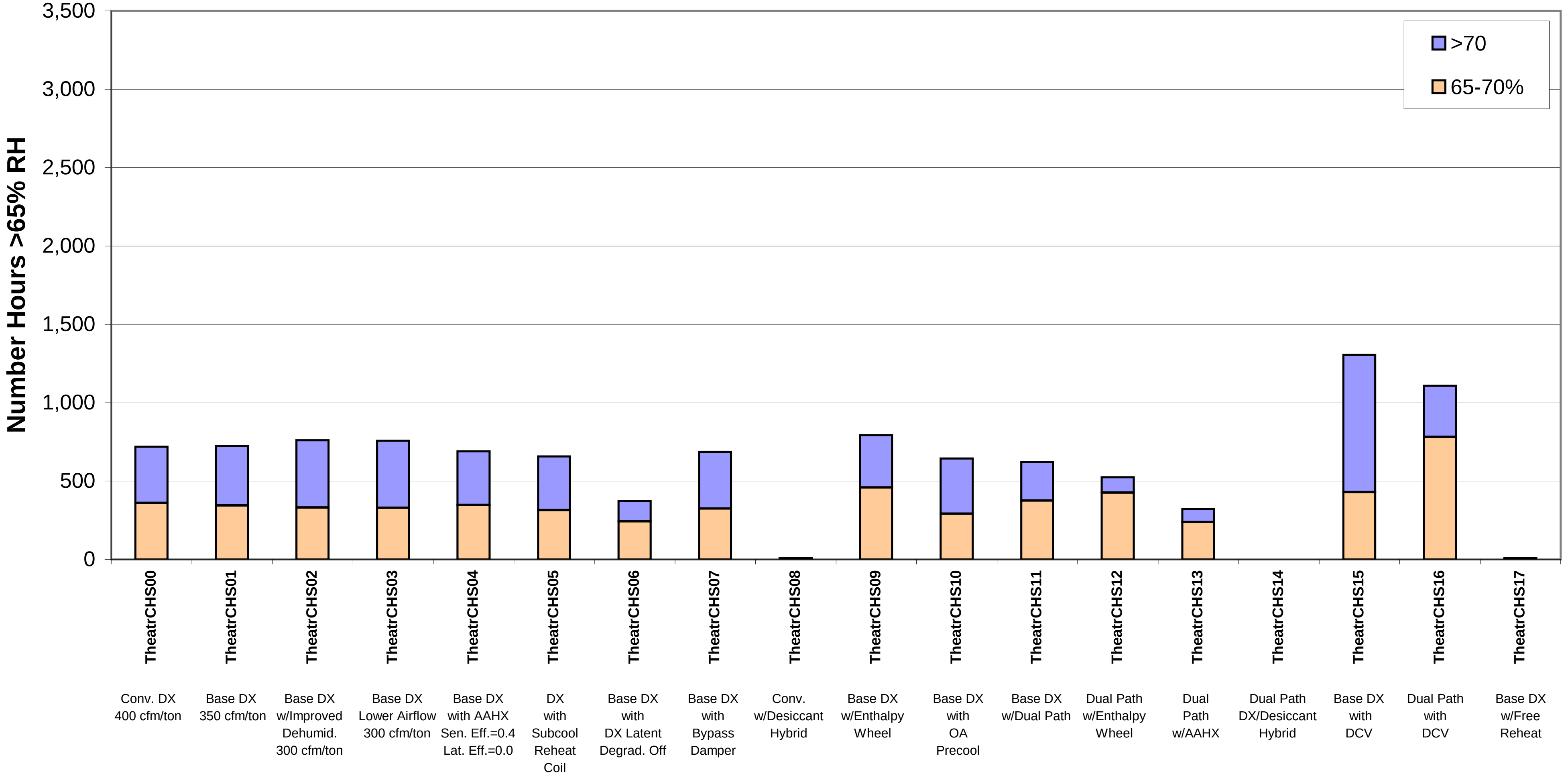
2004 Standard Theater in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



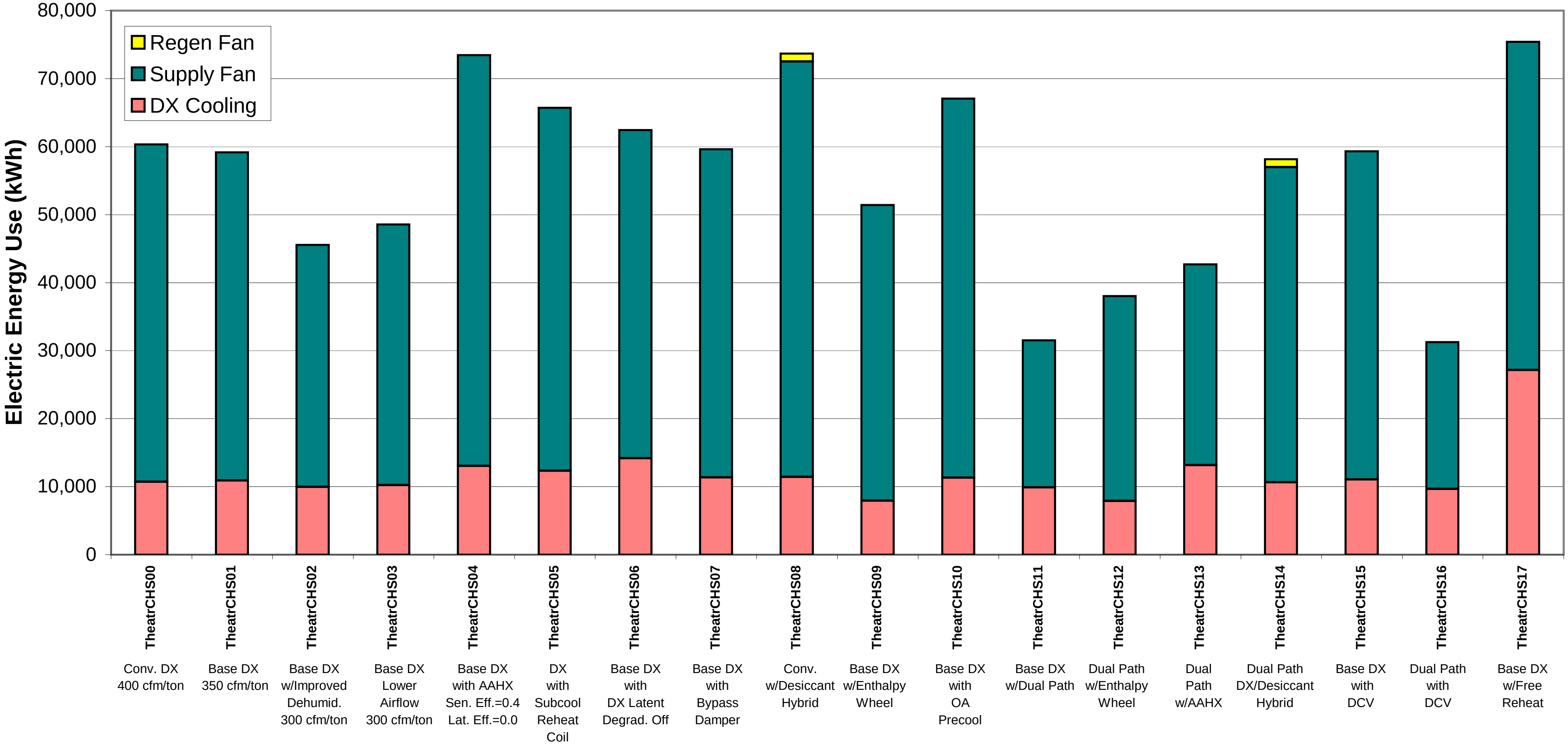
2004 Standard Theater in Atlanta GA
Annual HVAC System Electric Energy Use



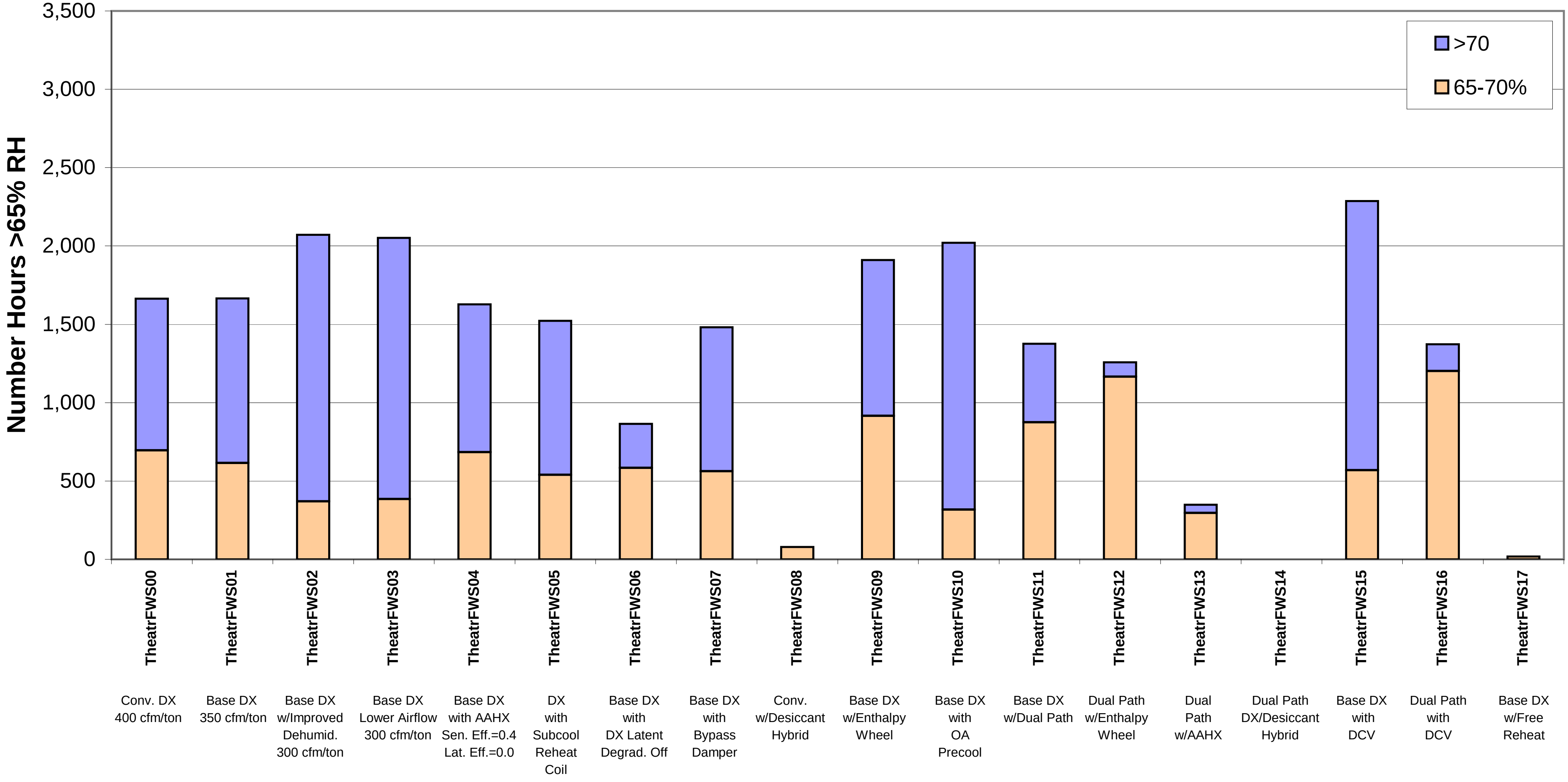
2004 Standard Theater in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



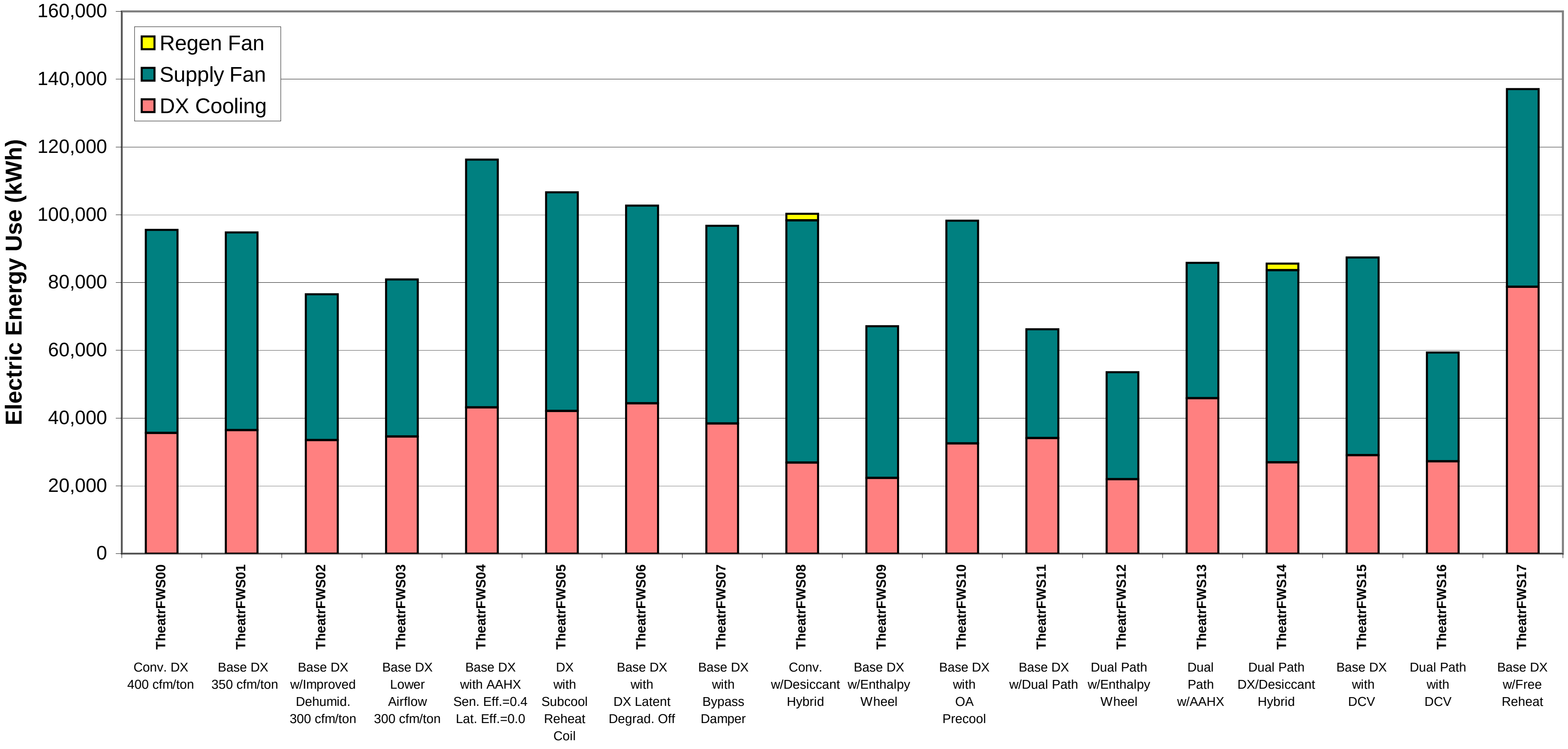
2004 Standard Theater in Chicago IL
Annual HVAC System Electric Energy Use



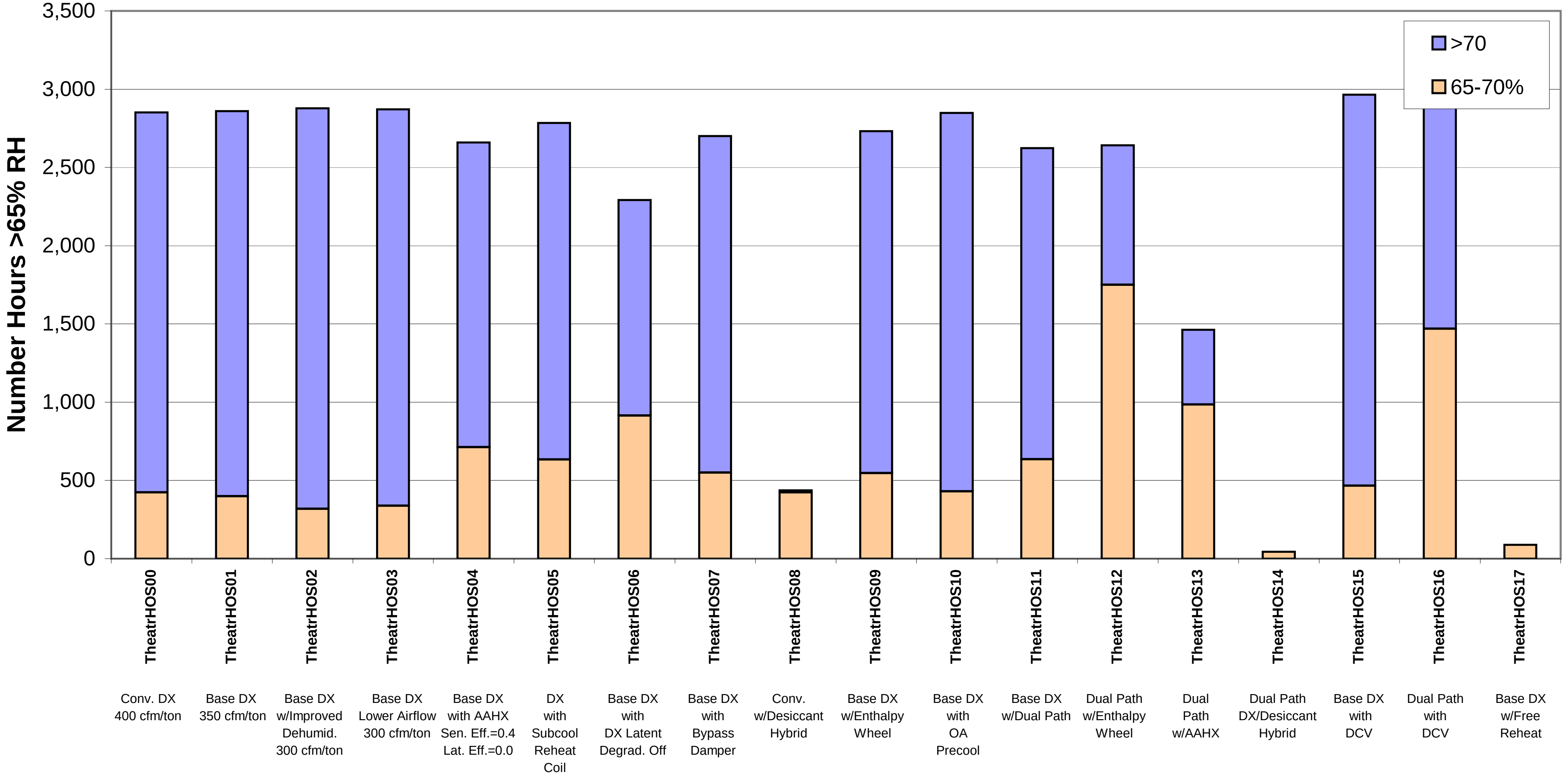
2004 Standard Theater in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



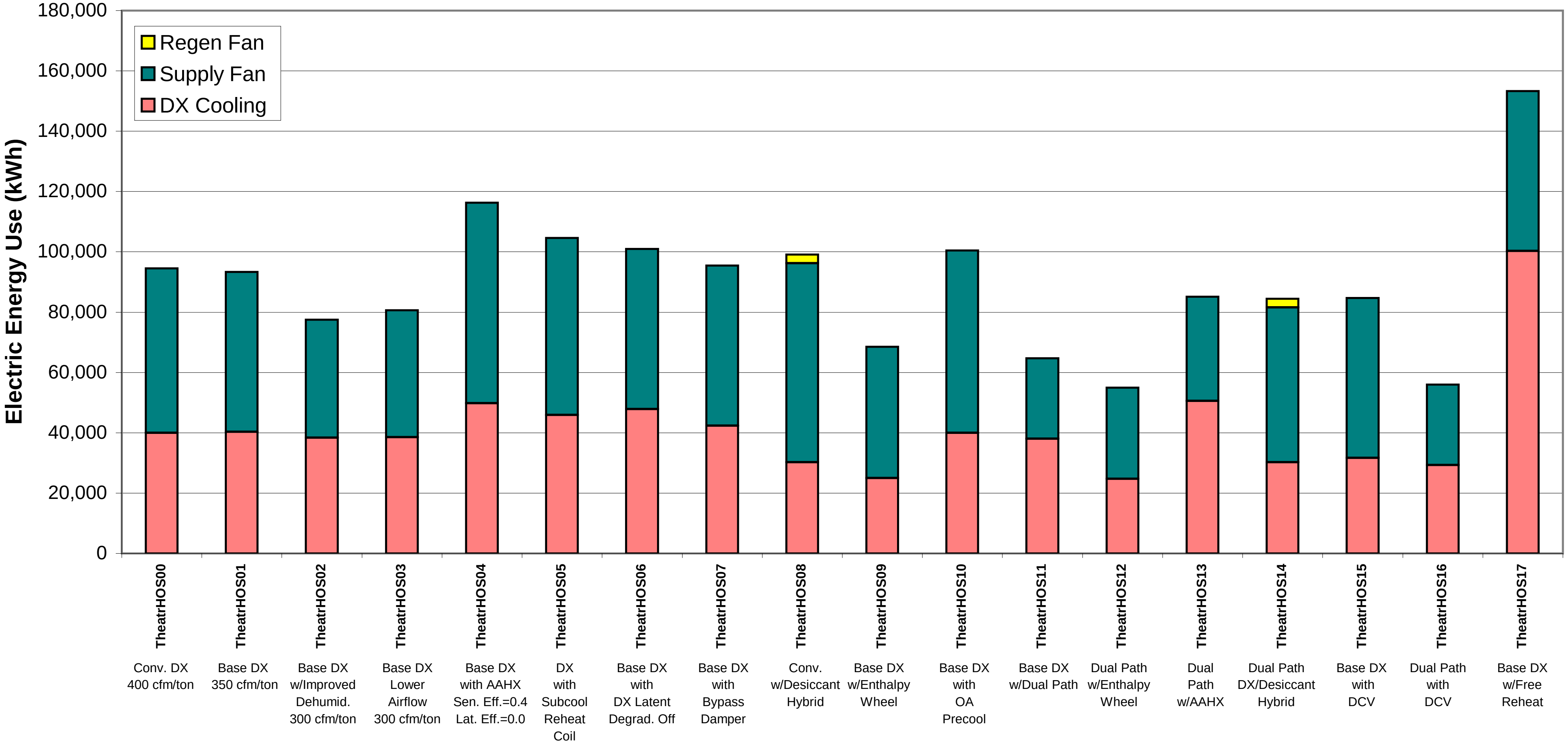
2004 Standard Theater in Fort Worth TX
Annual HVAC System Electric Energy Use

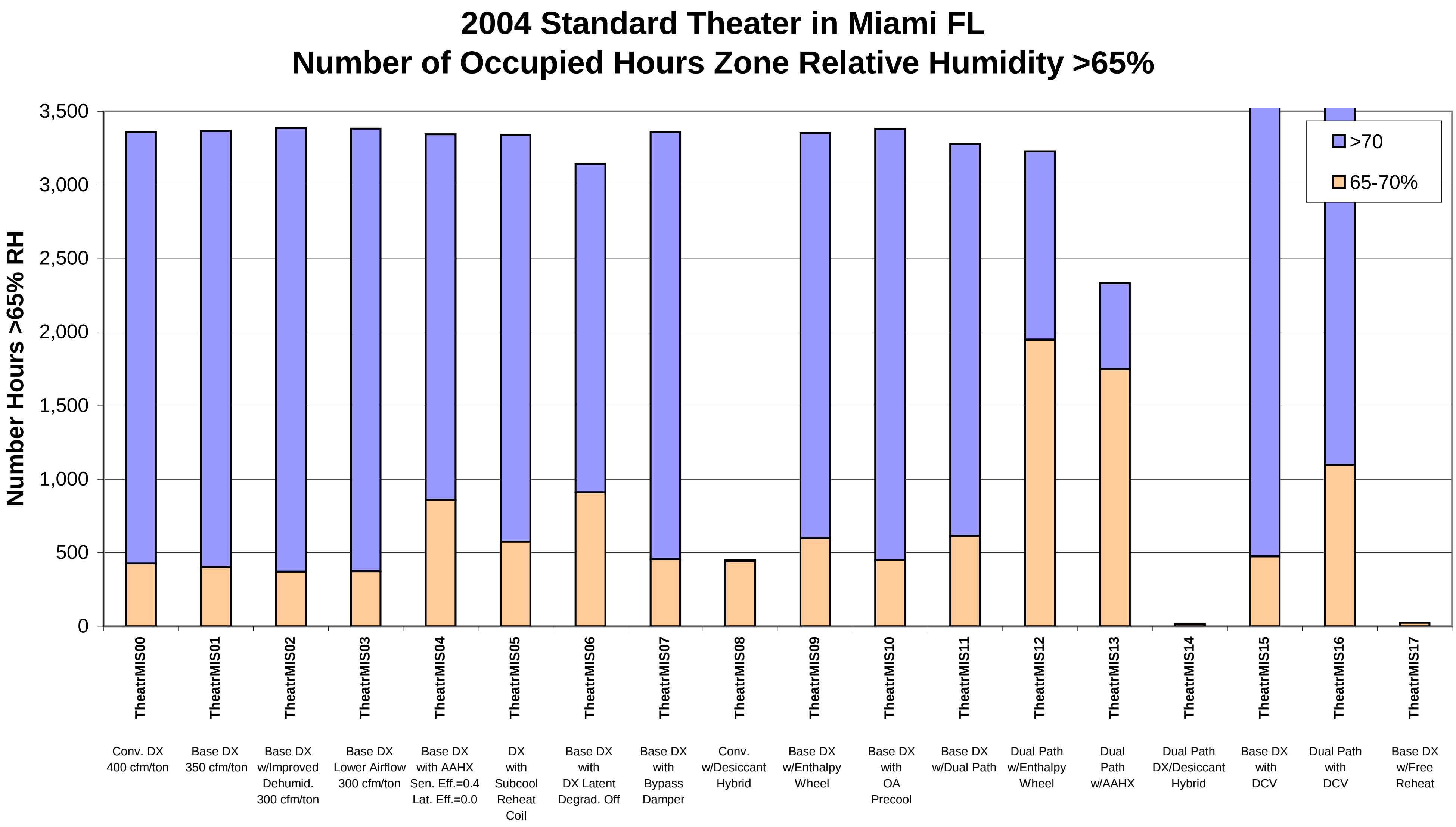


2004 Standard Theater in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%

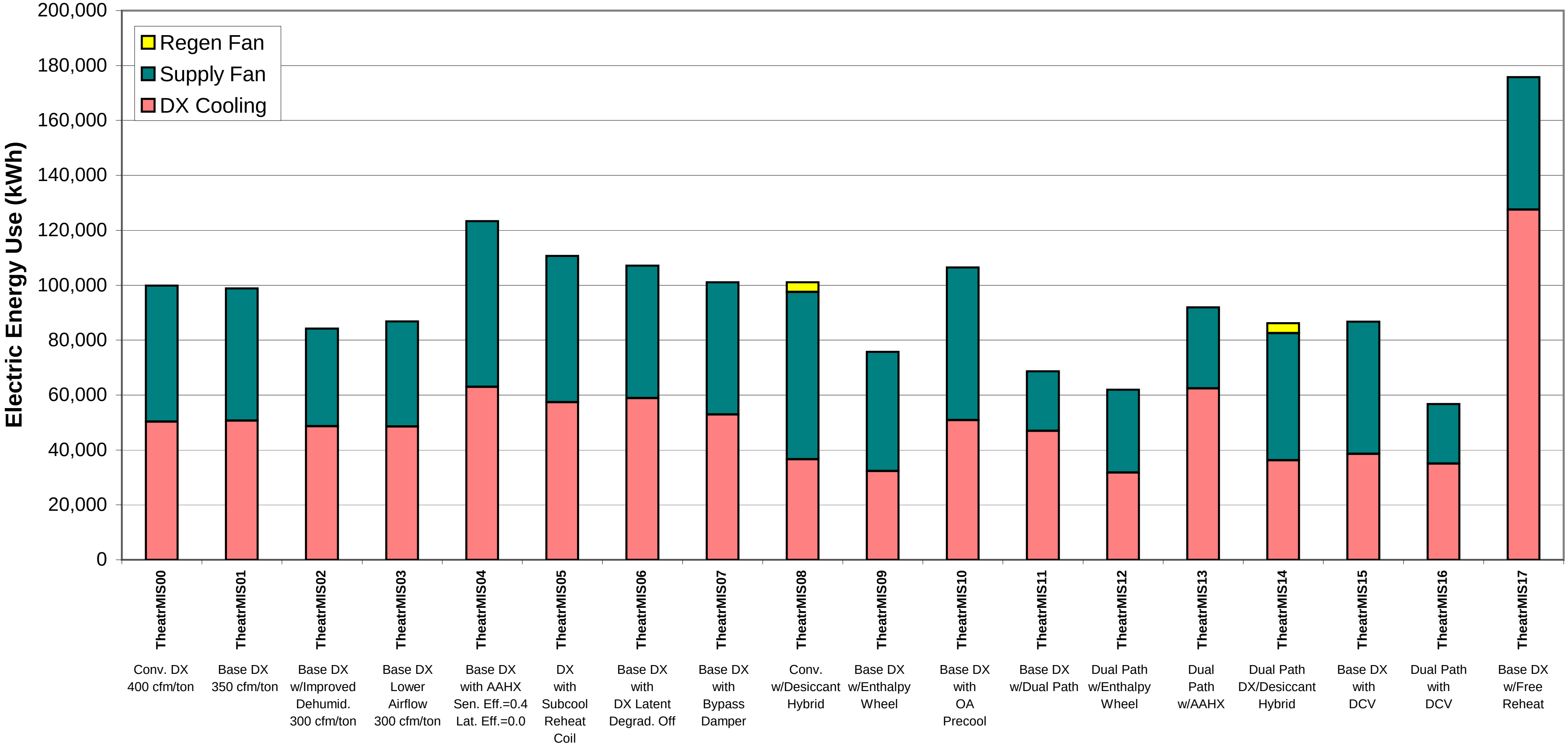


2004 Standard Theater in Houston TX
Annual HVAC System Electric Energy Use

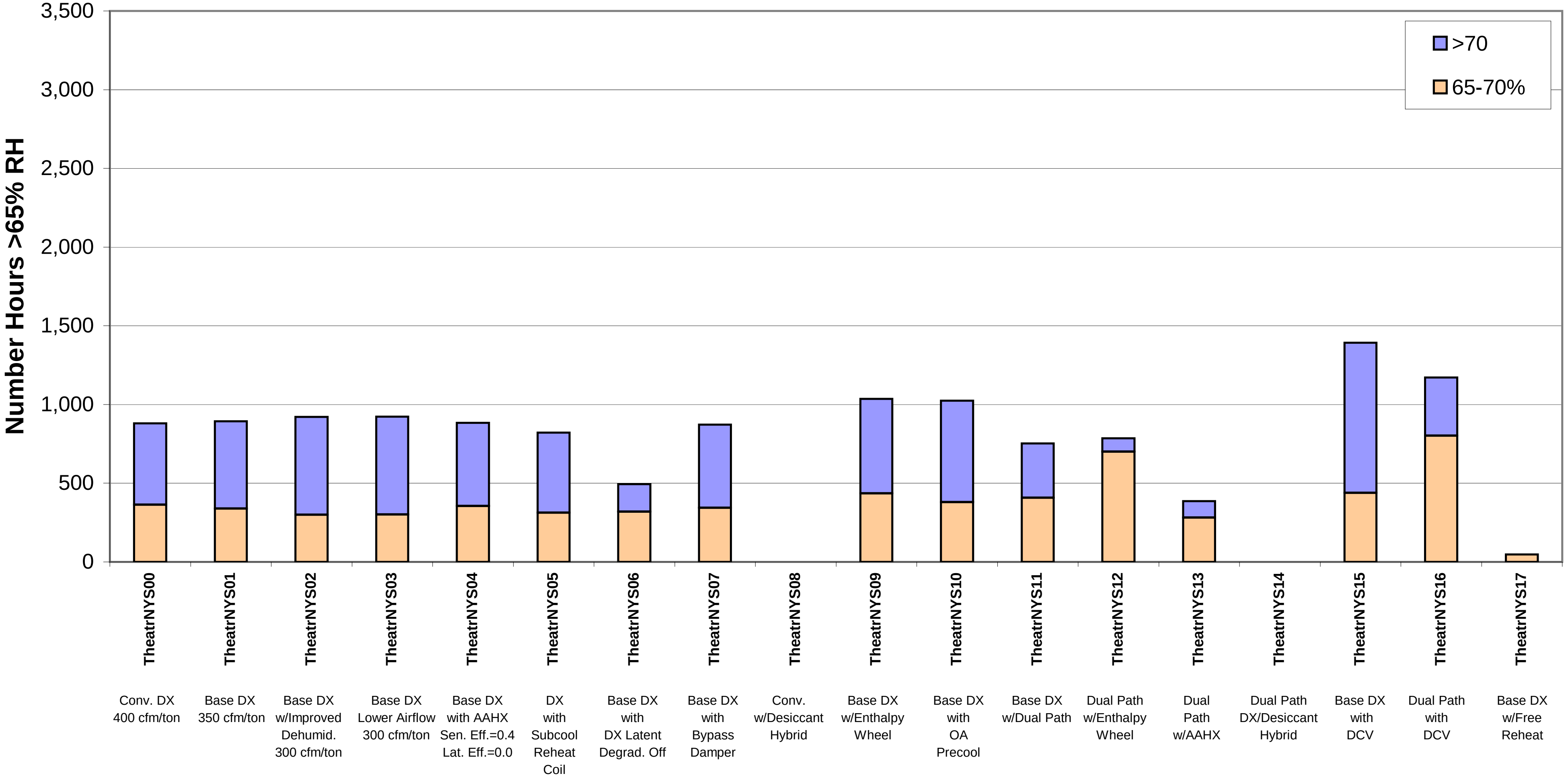



2004 Standard Theater in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,500
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
TheatrMIS00
TheatrMIS01
TheatrMIS02
TheatrMIS03
TheatrMIS04
TheatrMIS05
TheatrMIS06
TheatrMIS07
TheatrMIS08
TheatrMIS09
TheatrMIS10
TheatrMIS11
TheatrMIS12
TheatrMIS13
TheatrMIS14
TheatrMIS15
TheatrMIS16
TheatrMIS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

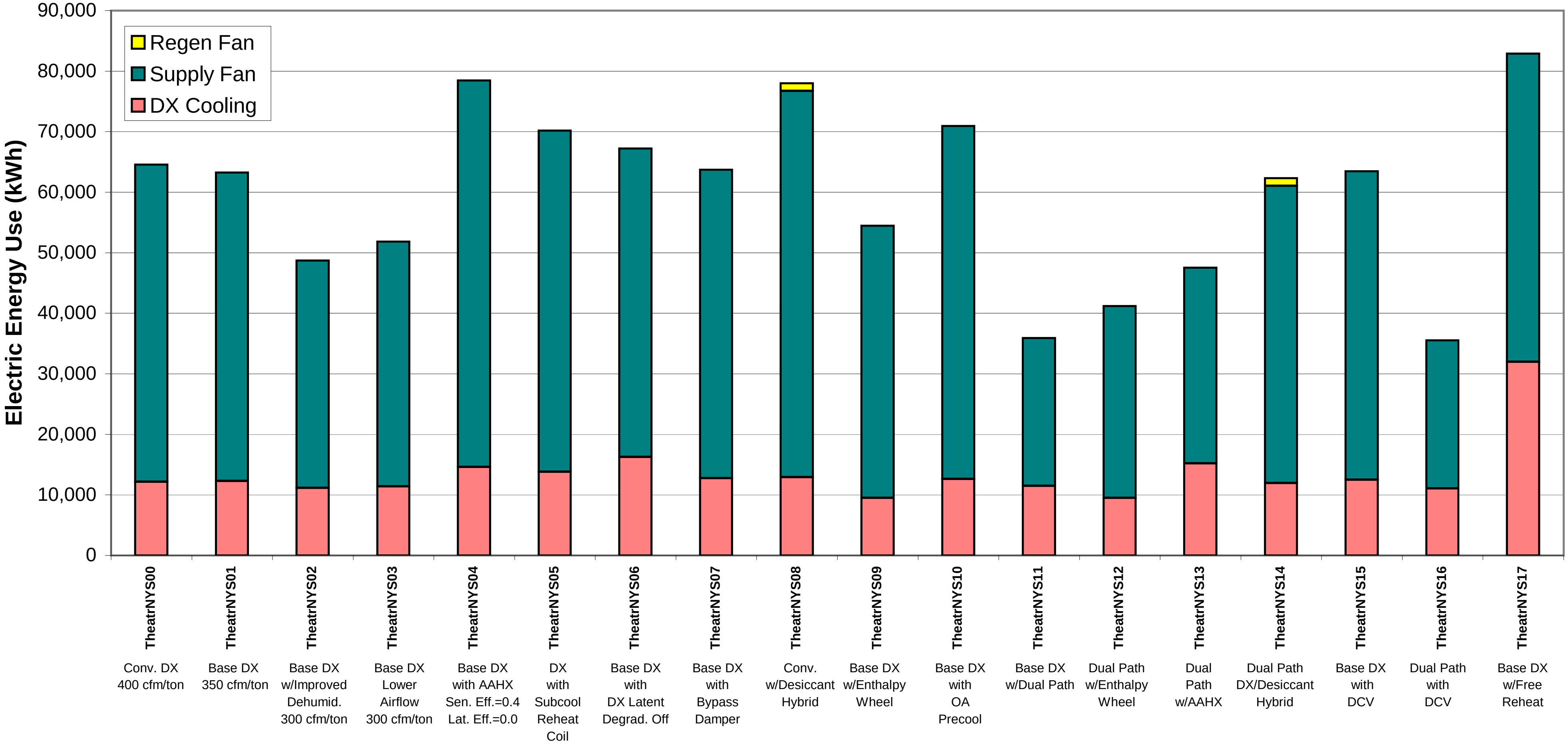
2004 Standard Theater in Miami FL
Annual HVAC System Electric Energy Use



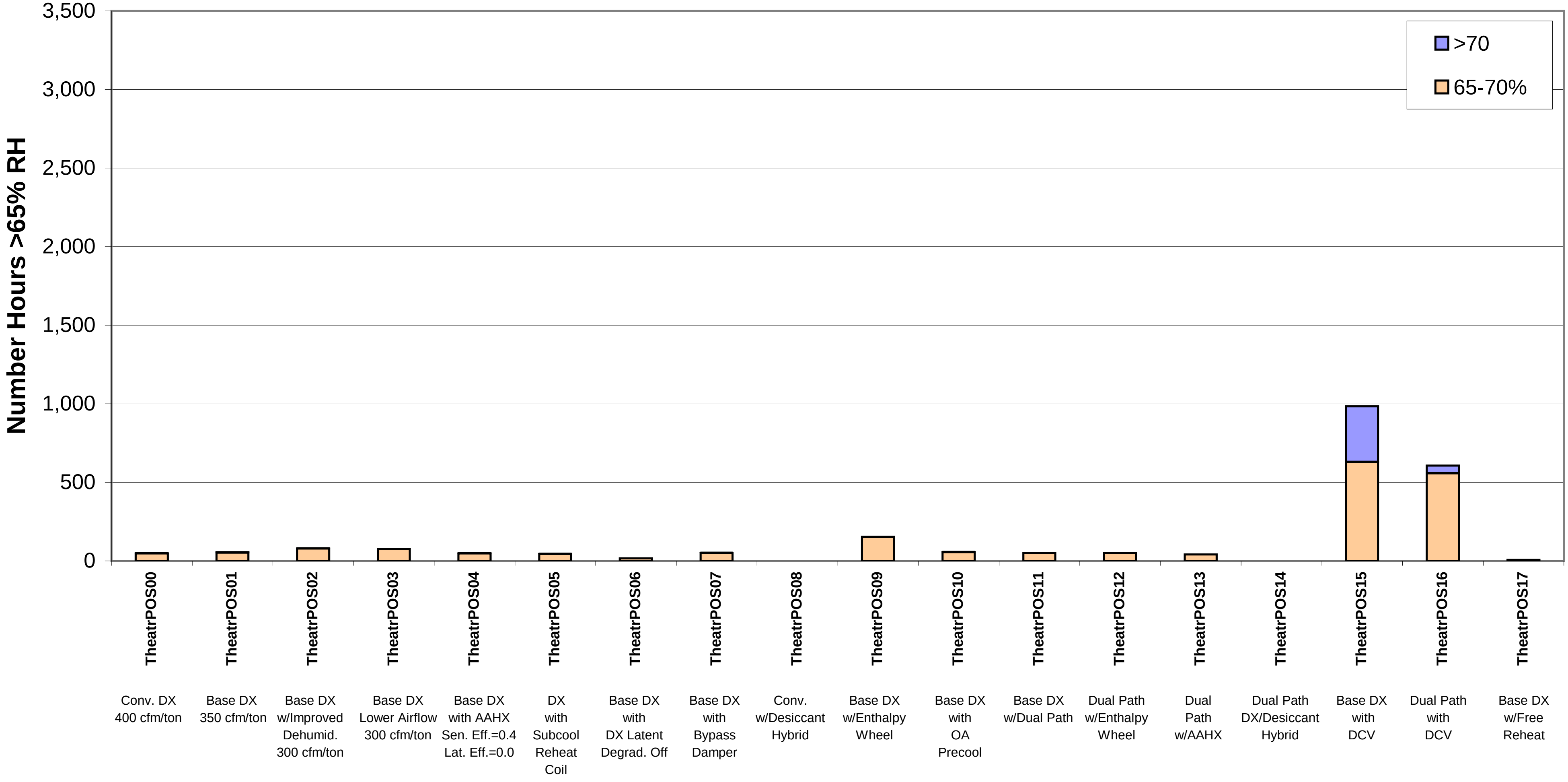
2004 Standard Theater in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



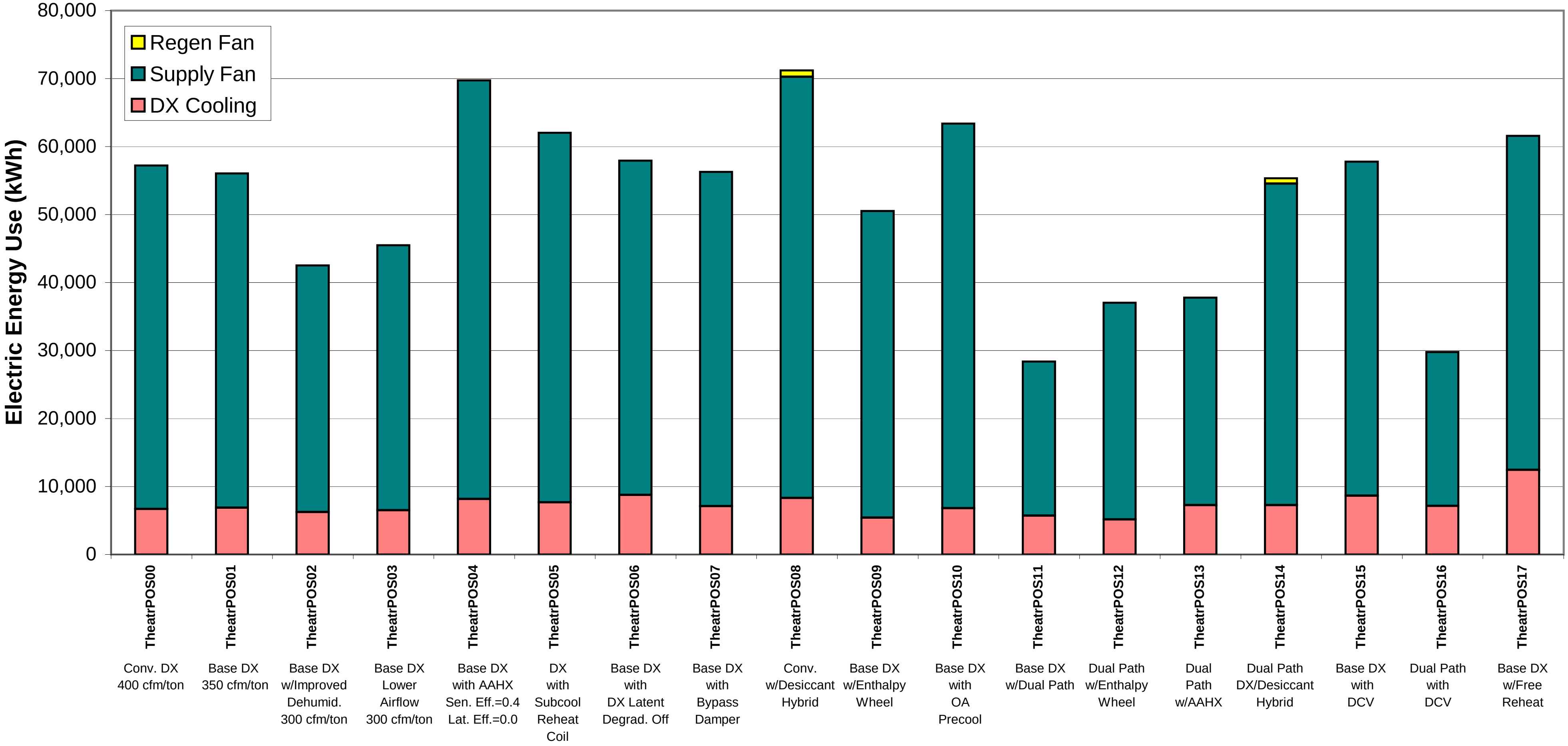
2004 Standard Theater in New York NY
Annual HVAC System Electric Energy Use



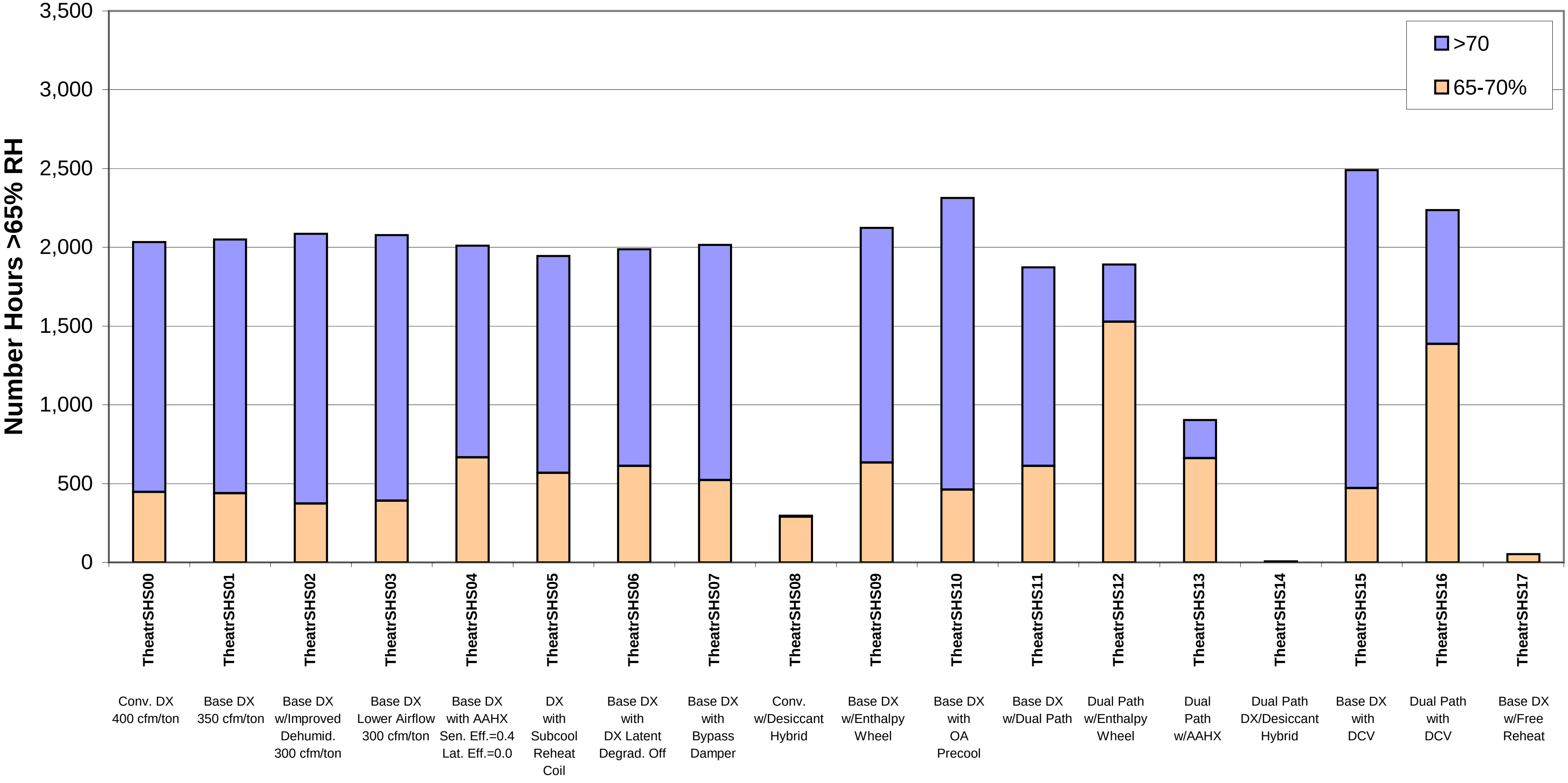
2004 Standard Theater in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



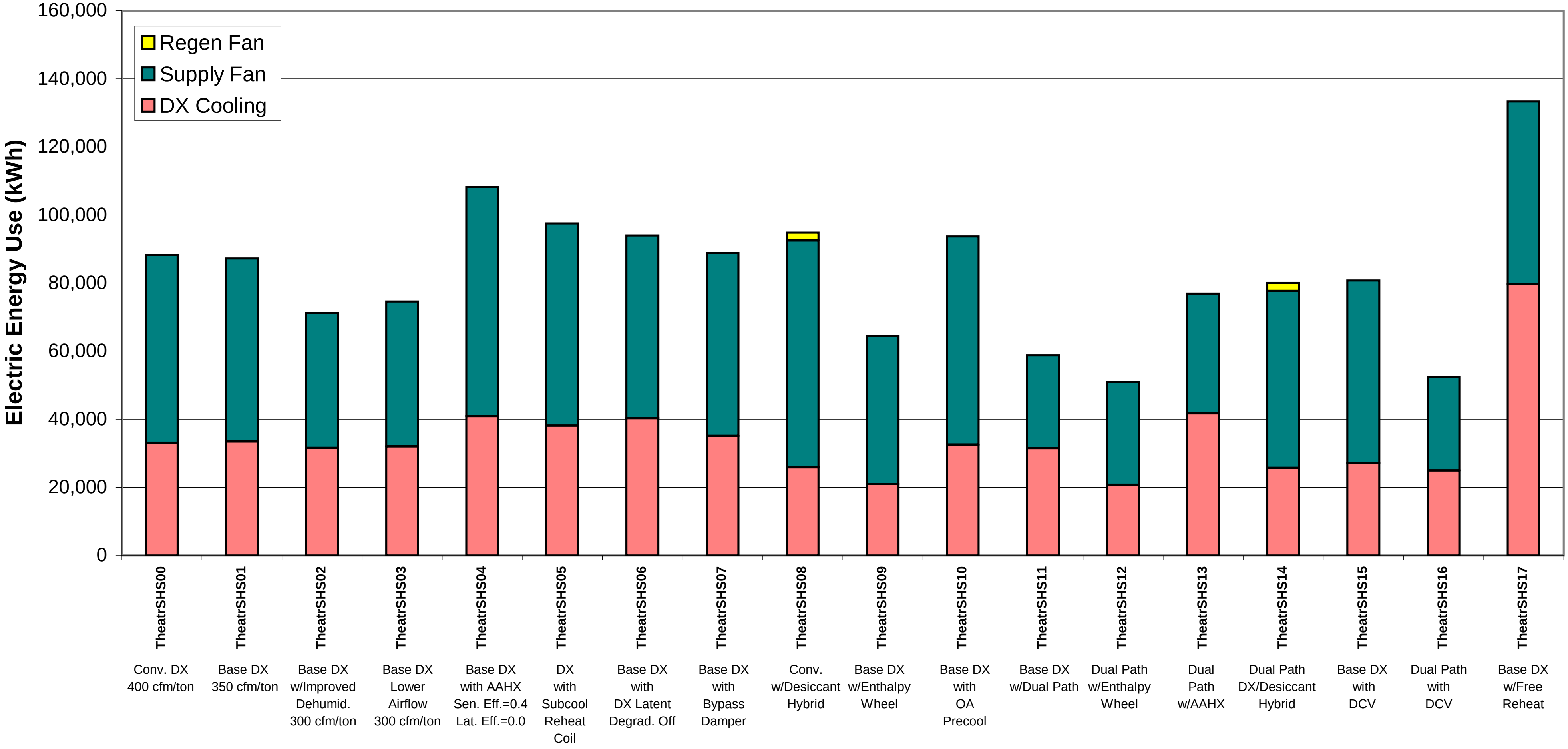
2004 Standard Theater in Portland OR
Annual HVAC System Electric Energy Use

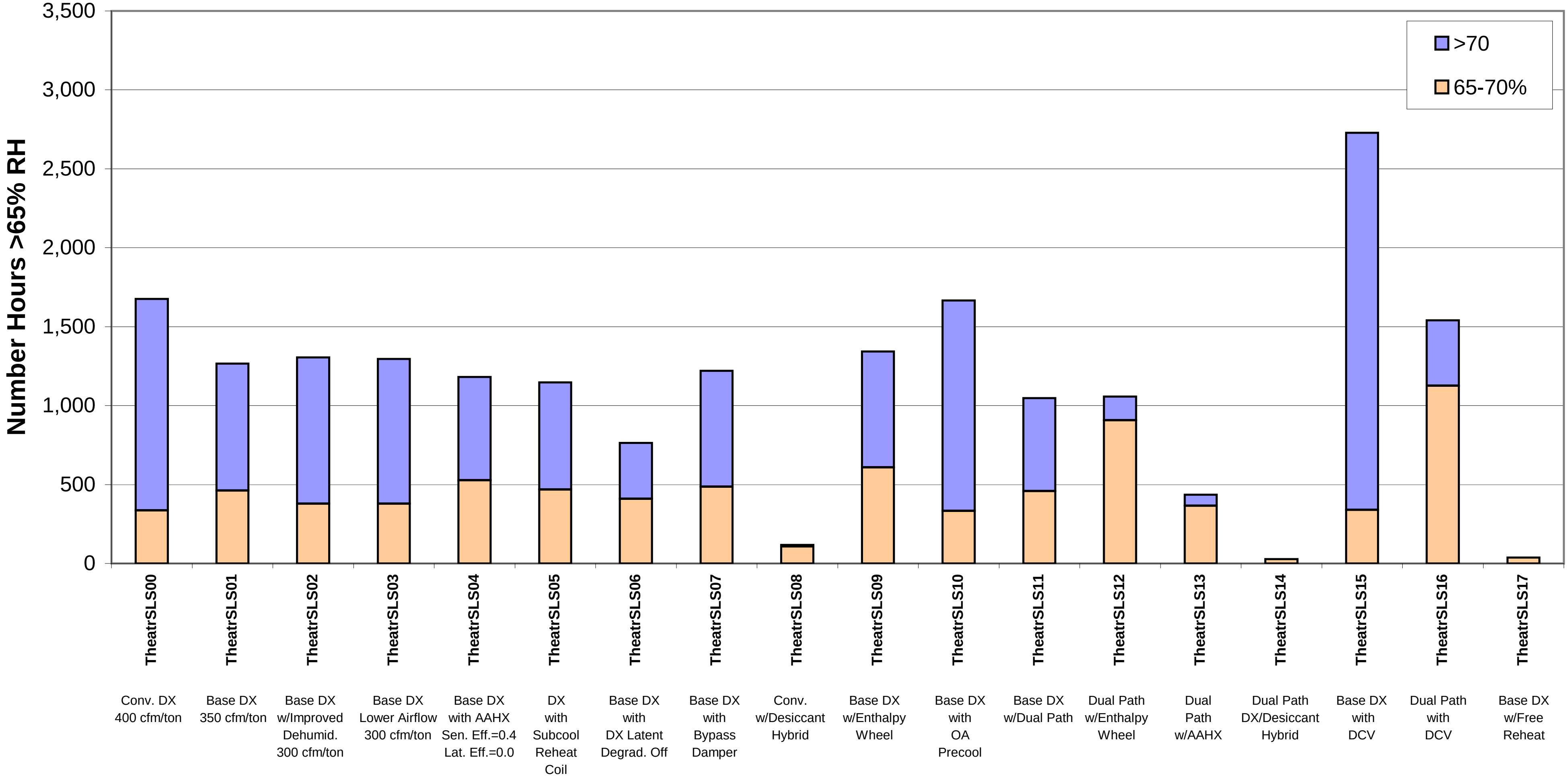


2004 Standard Theater in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



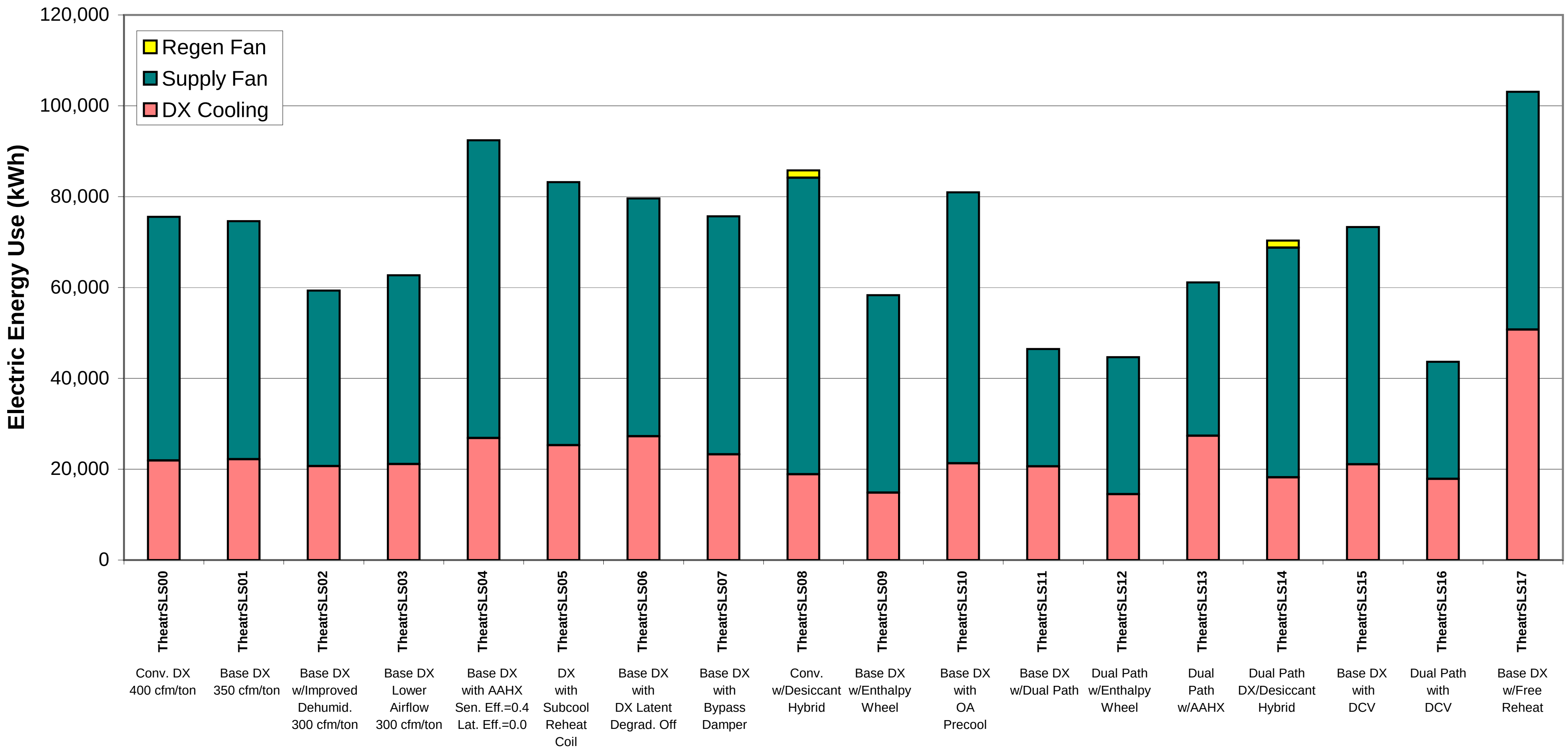
2004 Standard Theater in Shreveport LA
Annual HVAC System Electric Energy Use



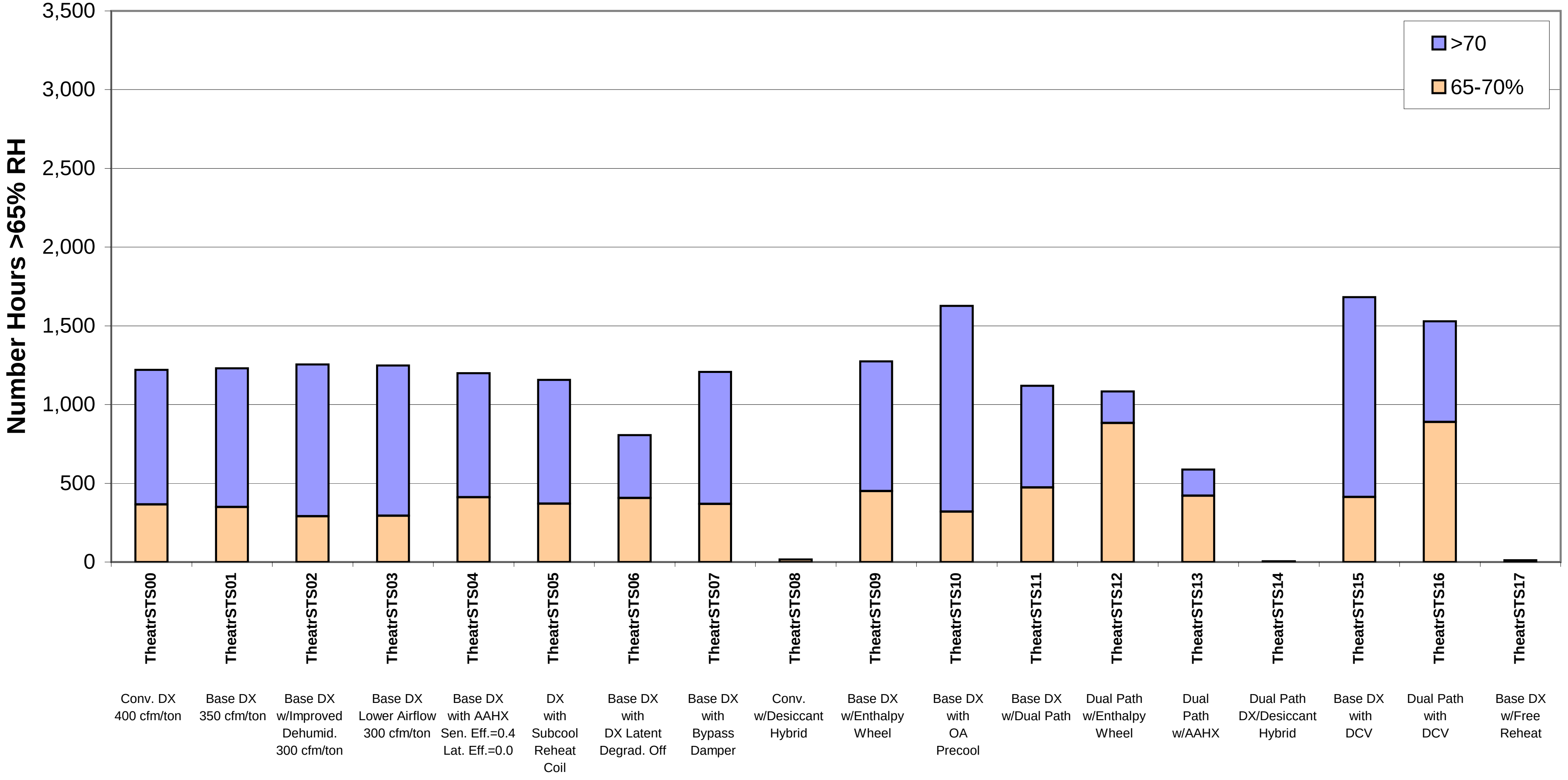


2004 Standard Theater in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%

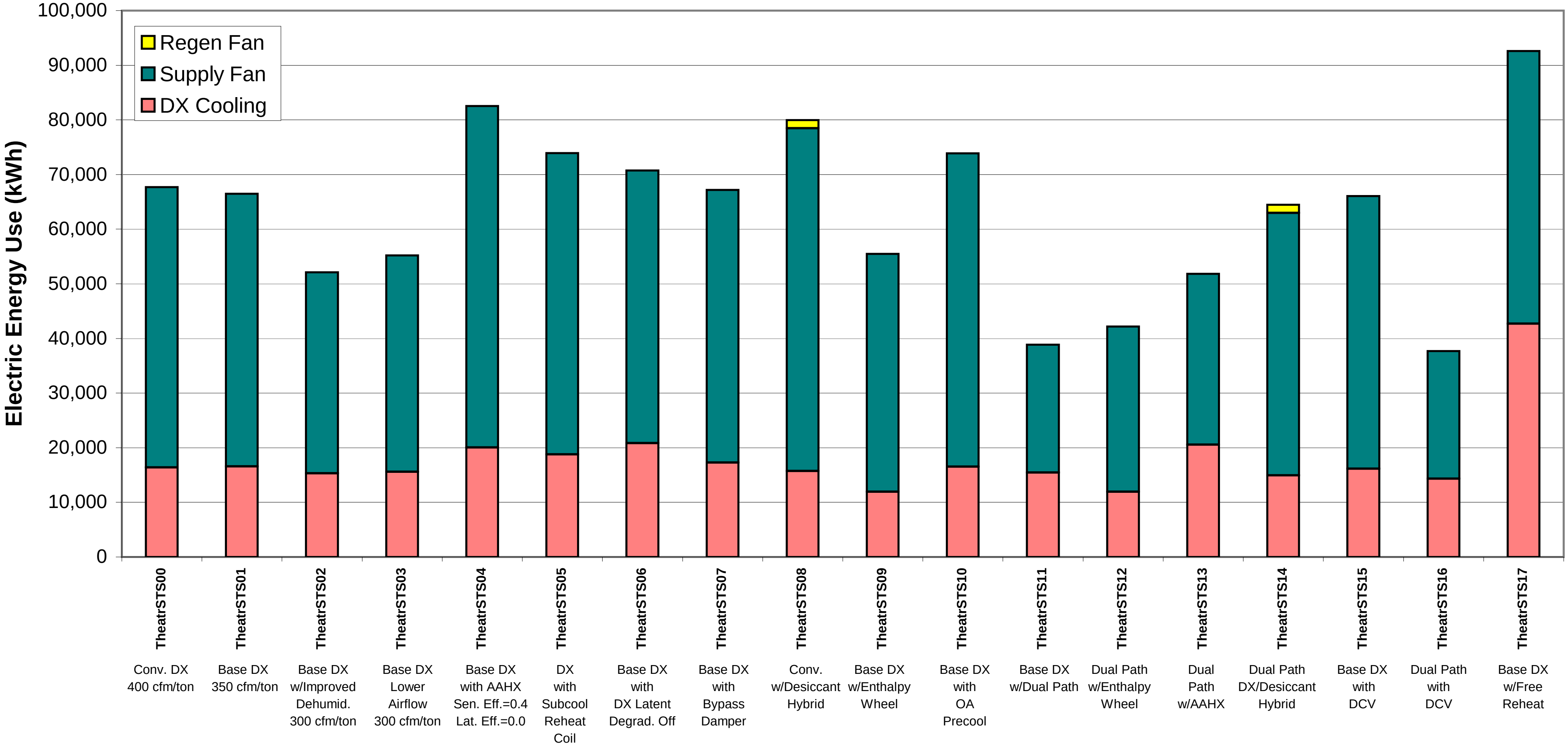
2004 Standard Theater in St. Louis MO
Annual HVAC System Electric Energy Use



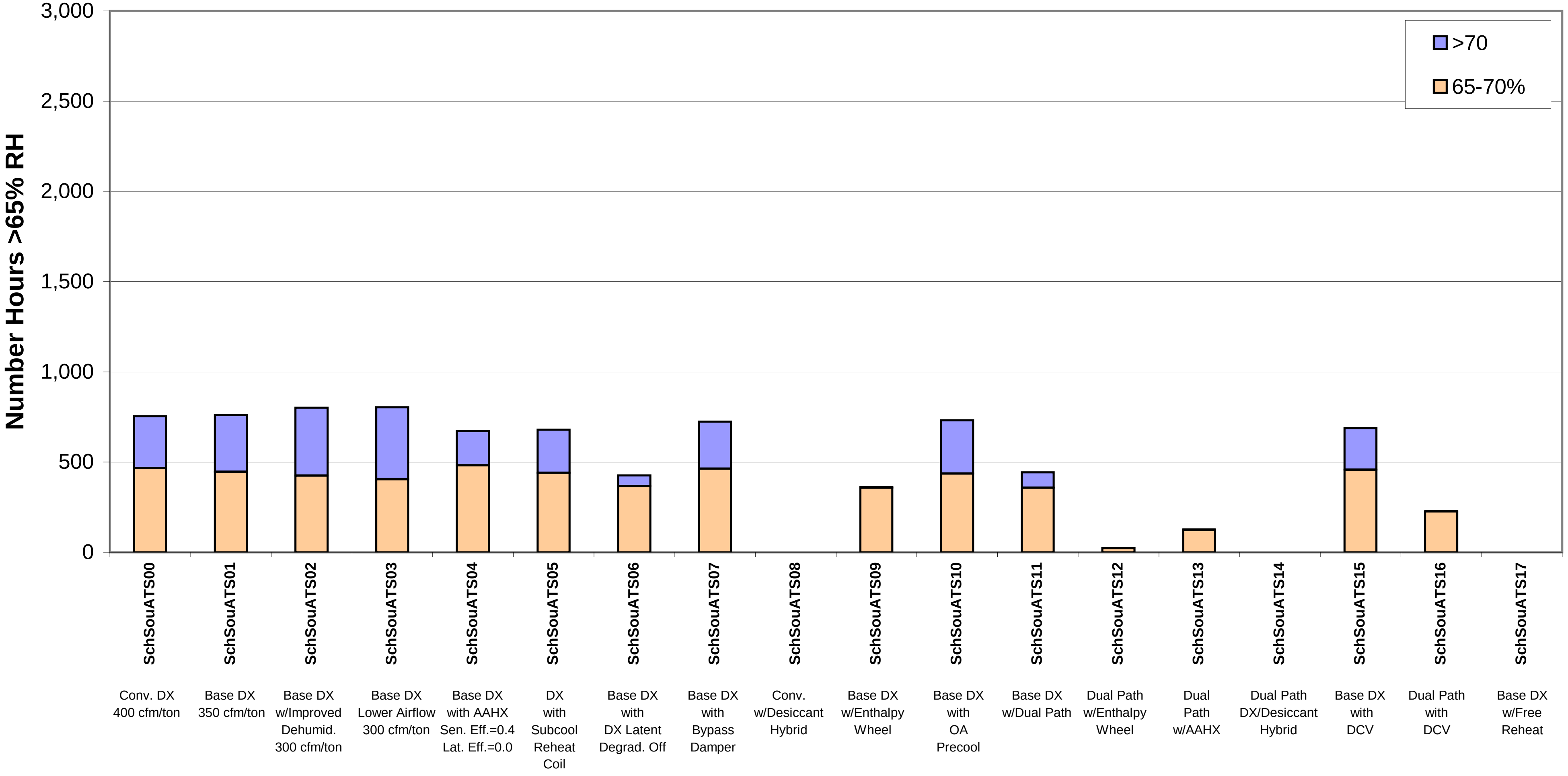
2004 Standard Theater in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



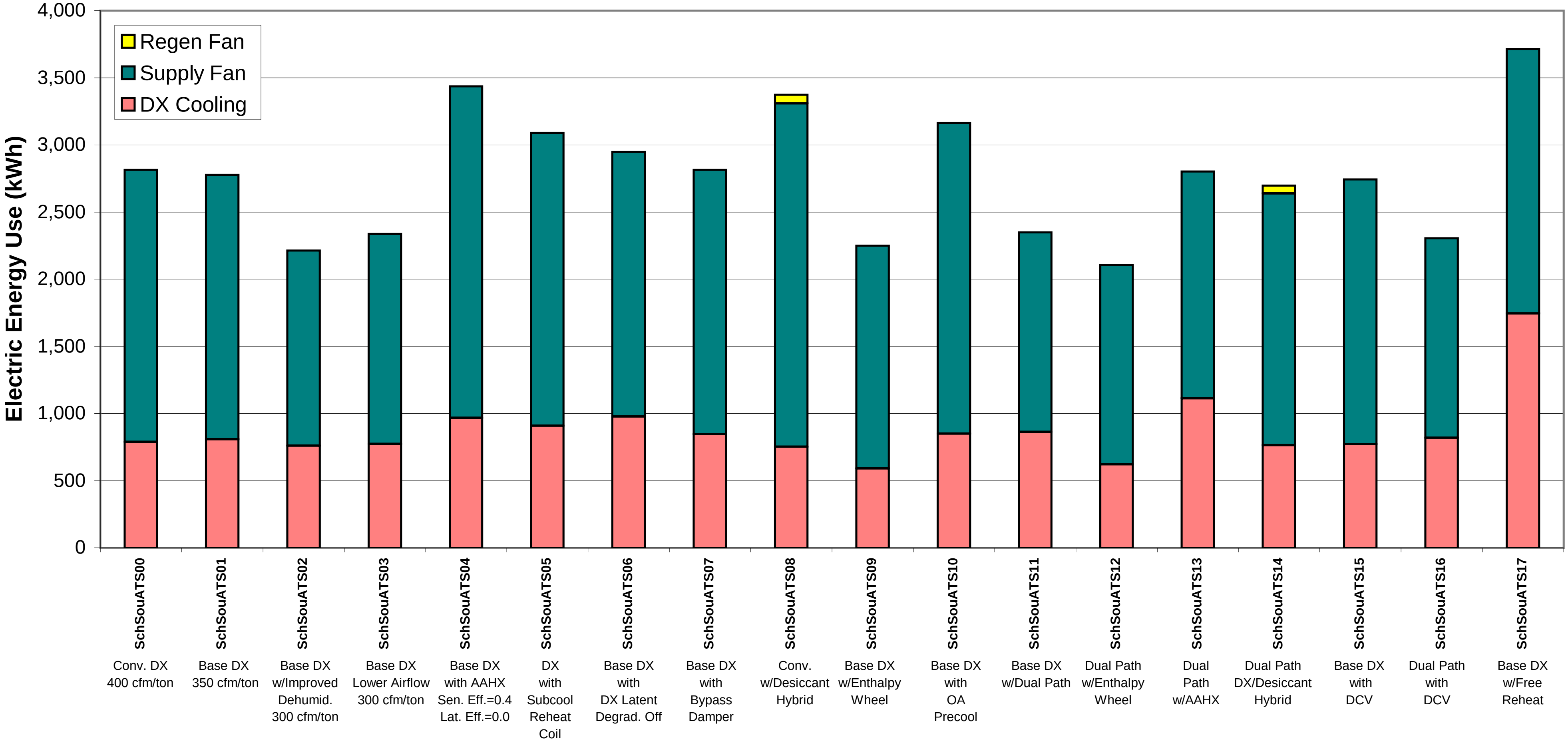
2004 Standard Theater in Washington DC
Annual HVAC System Electric Energy Use



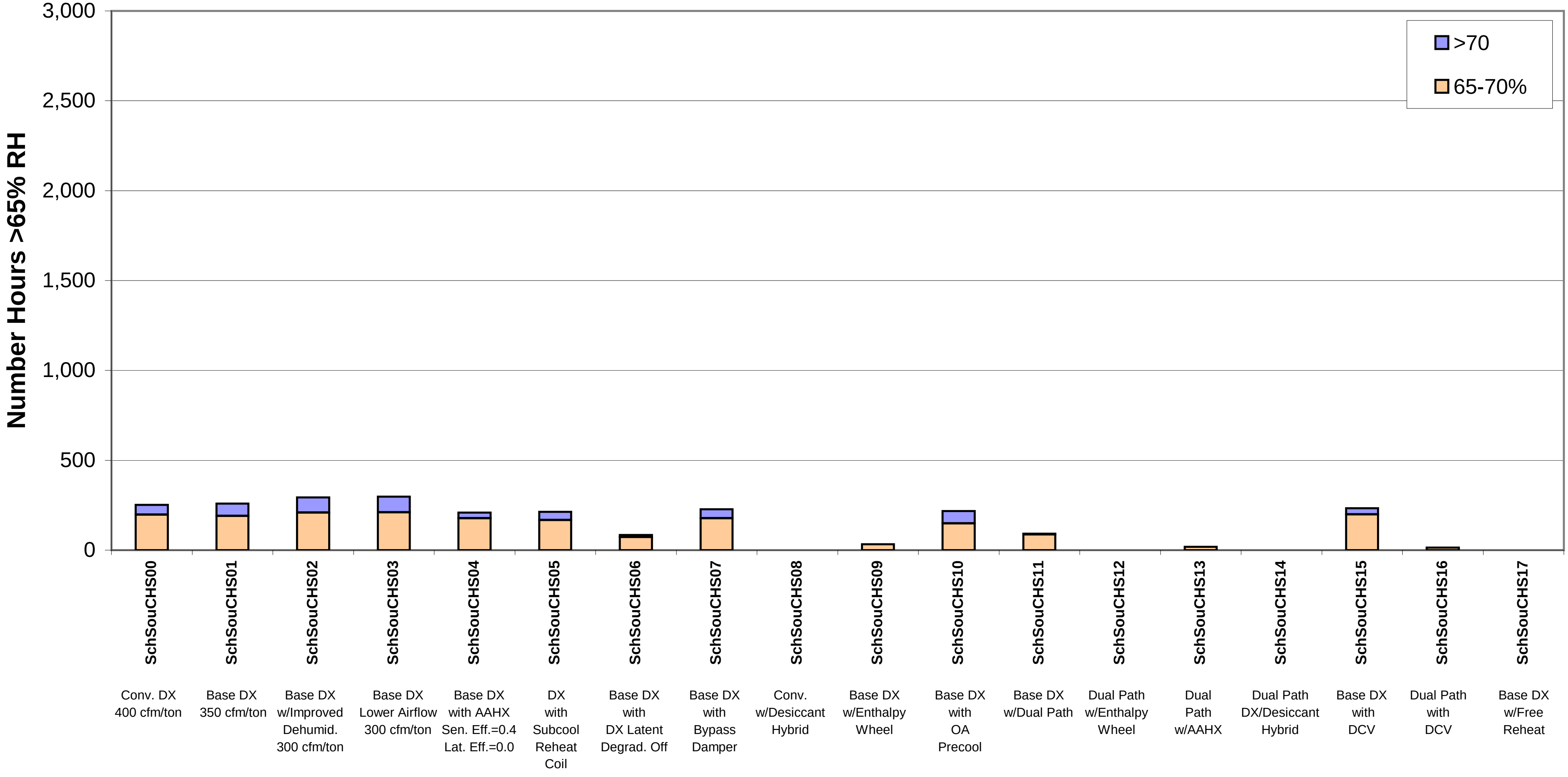
2004 Standard School-9 Month-South in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%

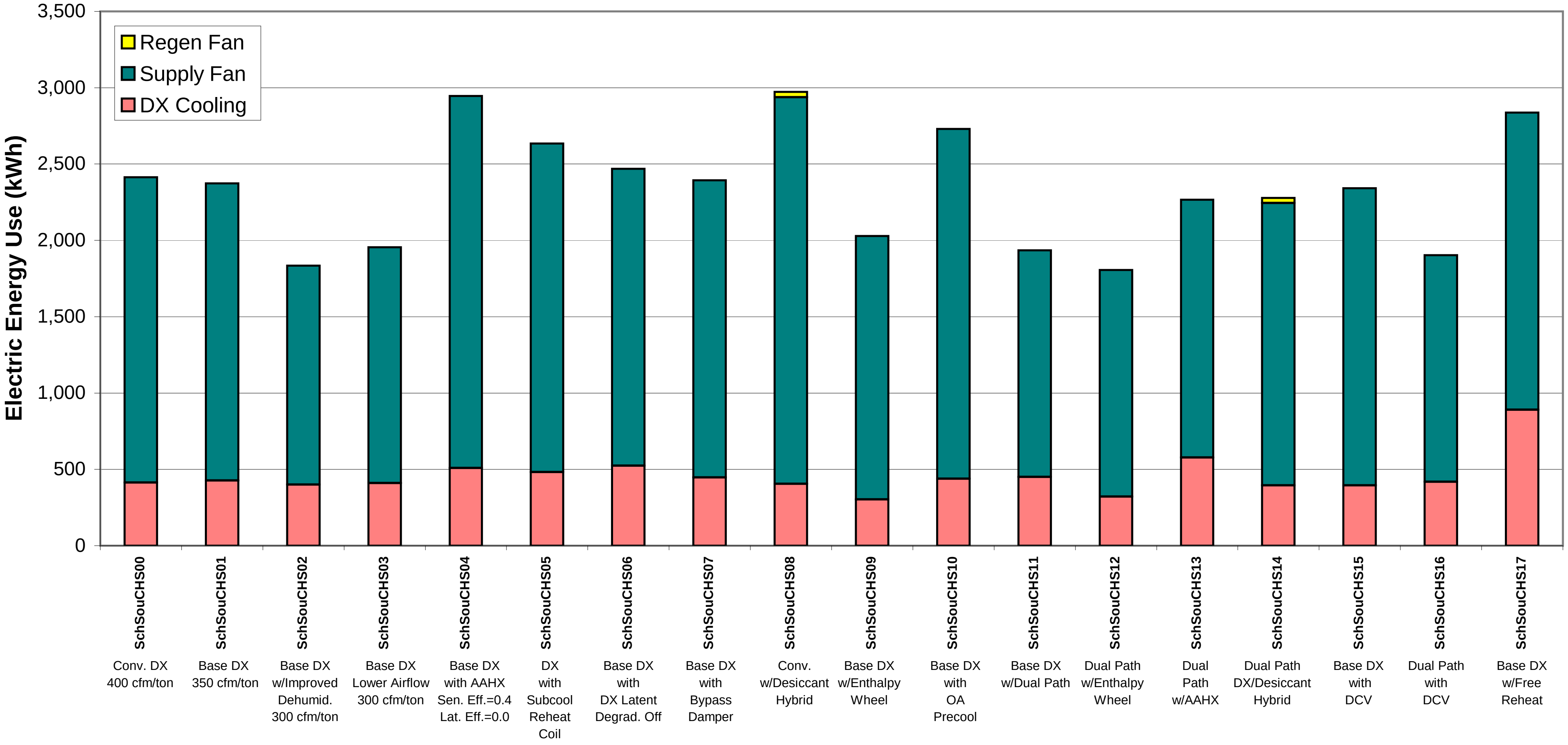


2004 Standard School-9 Month-South in Atlanta GA
Annual HVAC System Electric Energy Use



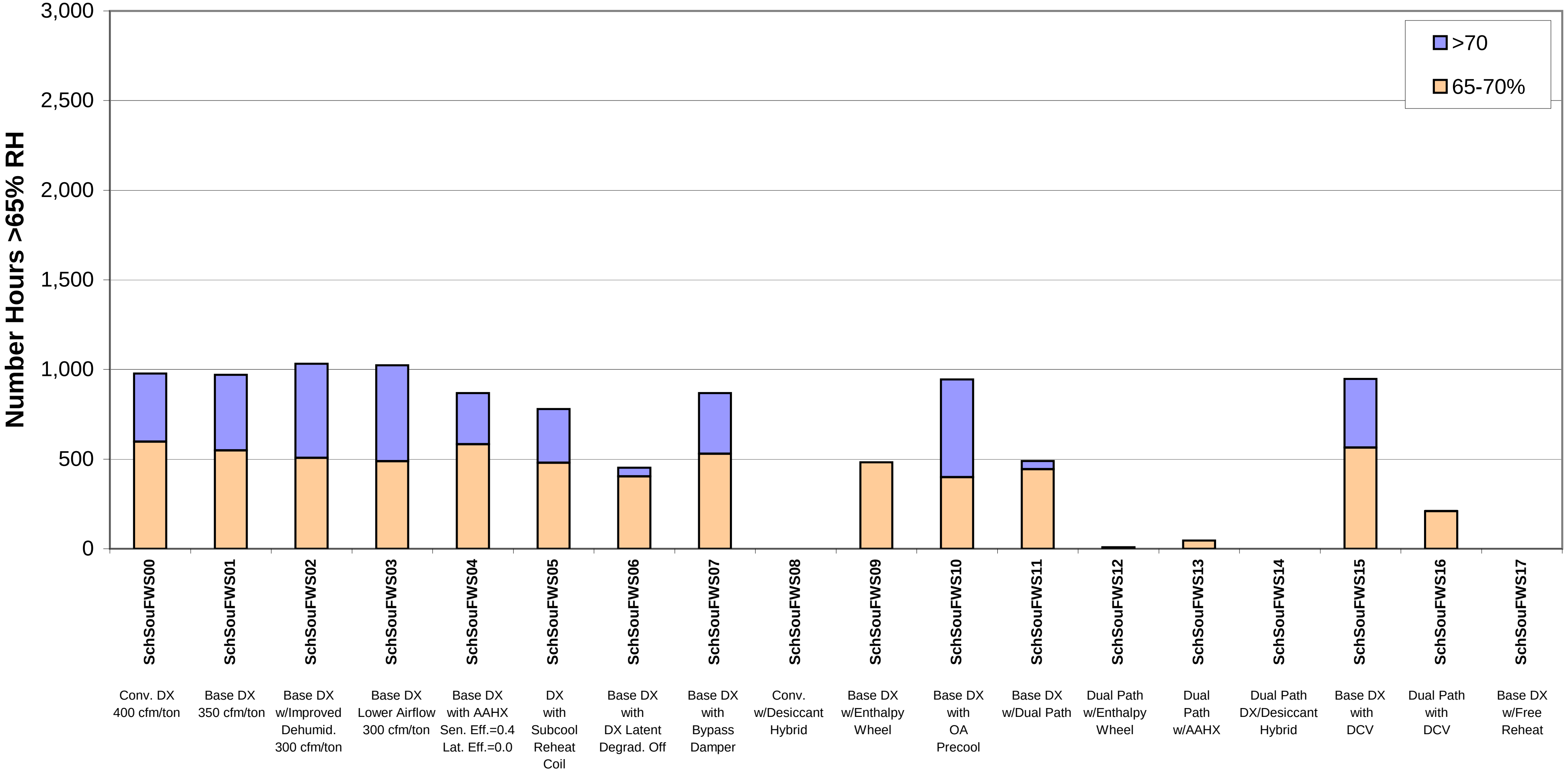
2004 Standard School-9 Month-South in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



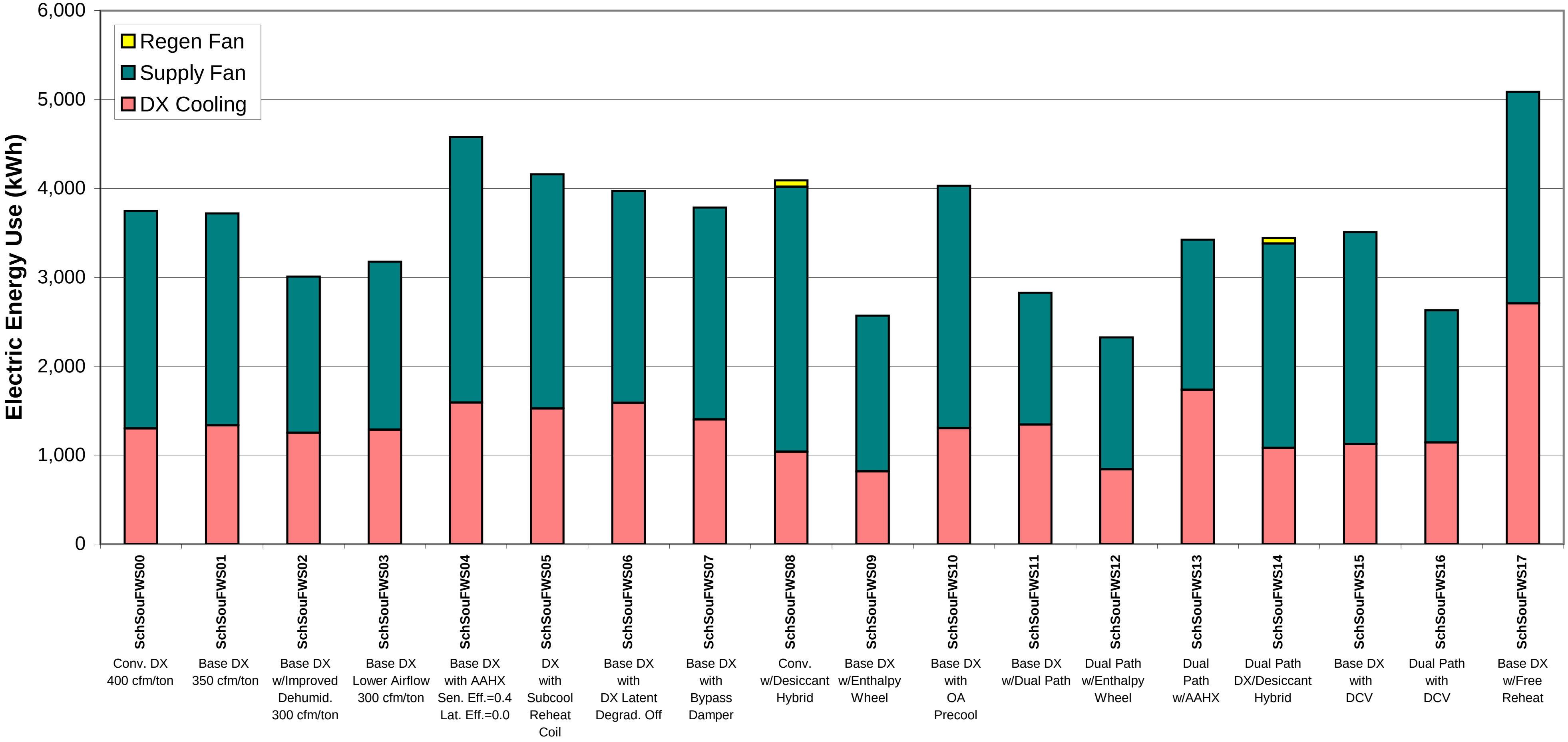


2004 Standard School-9 Month-South in Chicago IL
Annual HVAC System Electric Energy Use

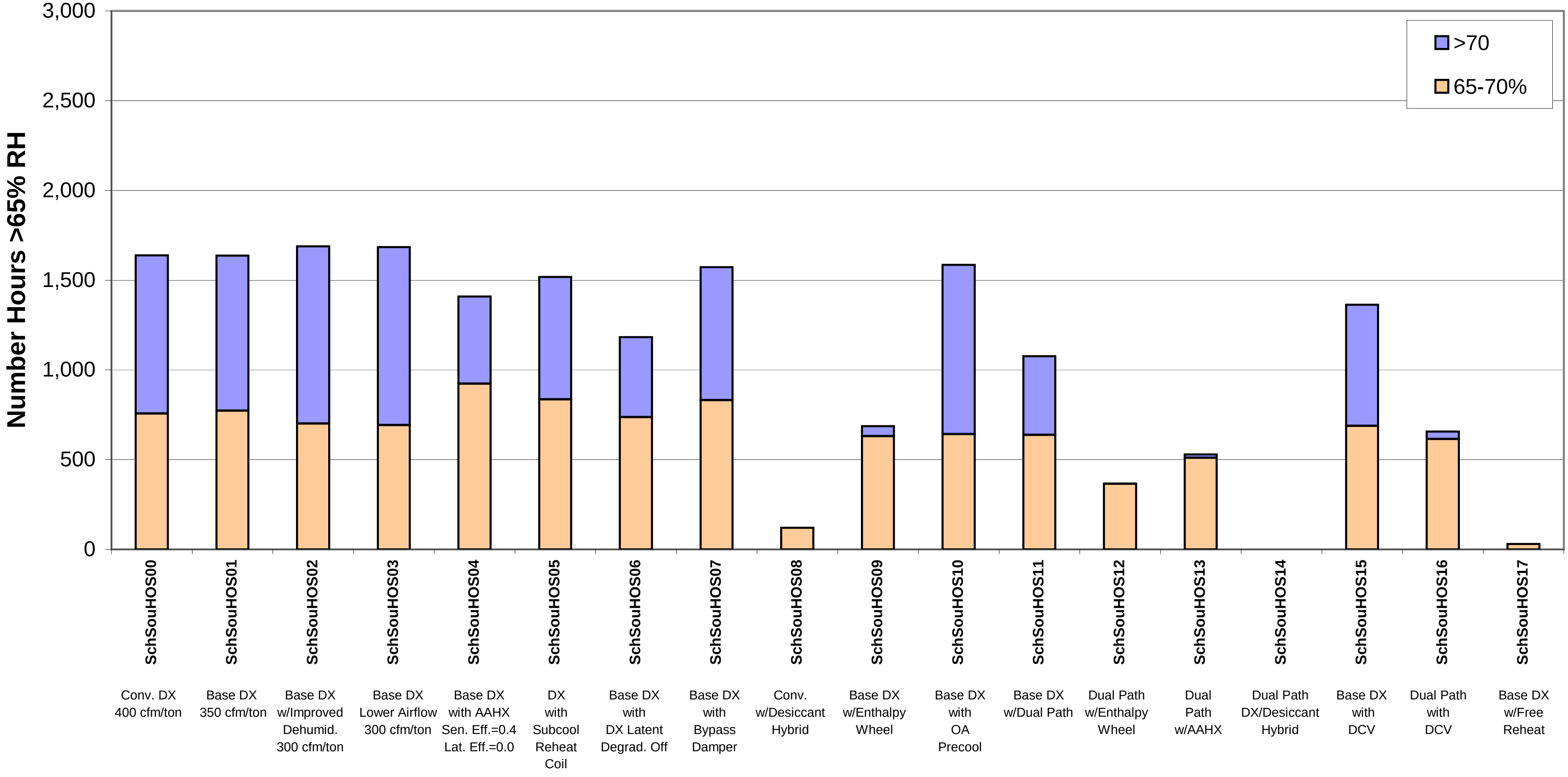
2004 Standard School-9 Month-South in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



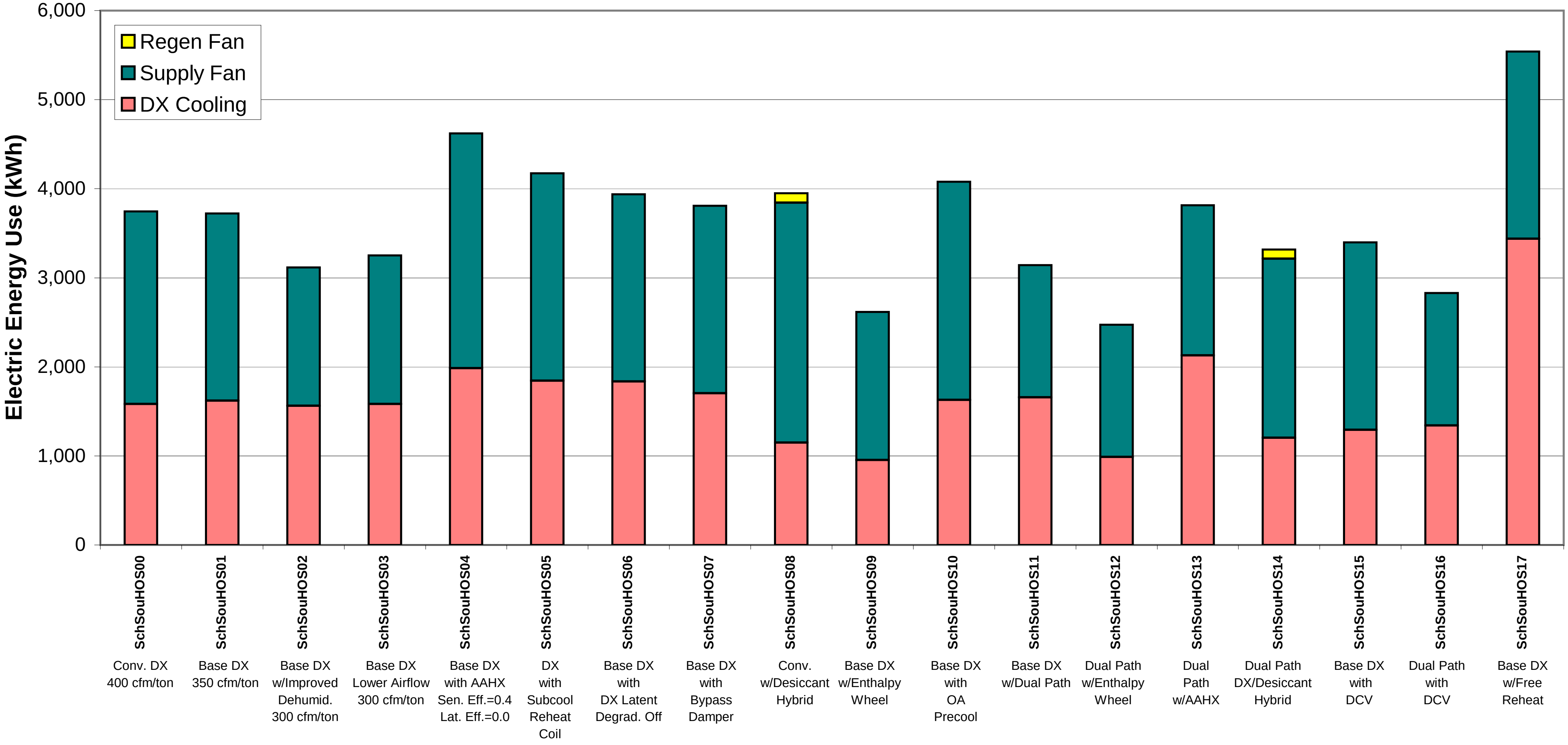
2004 Standard School-9 Month-South in Fort Worth TX
Annual HVAC System Electric Energy Use



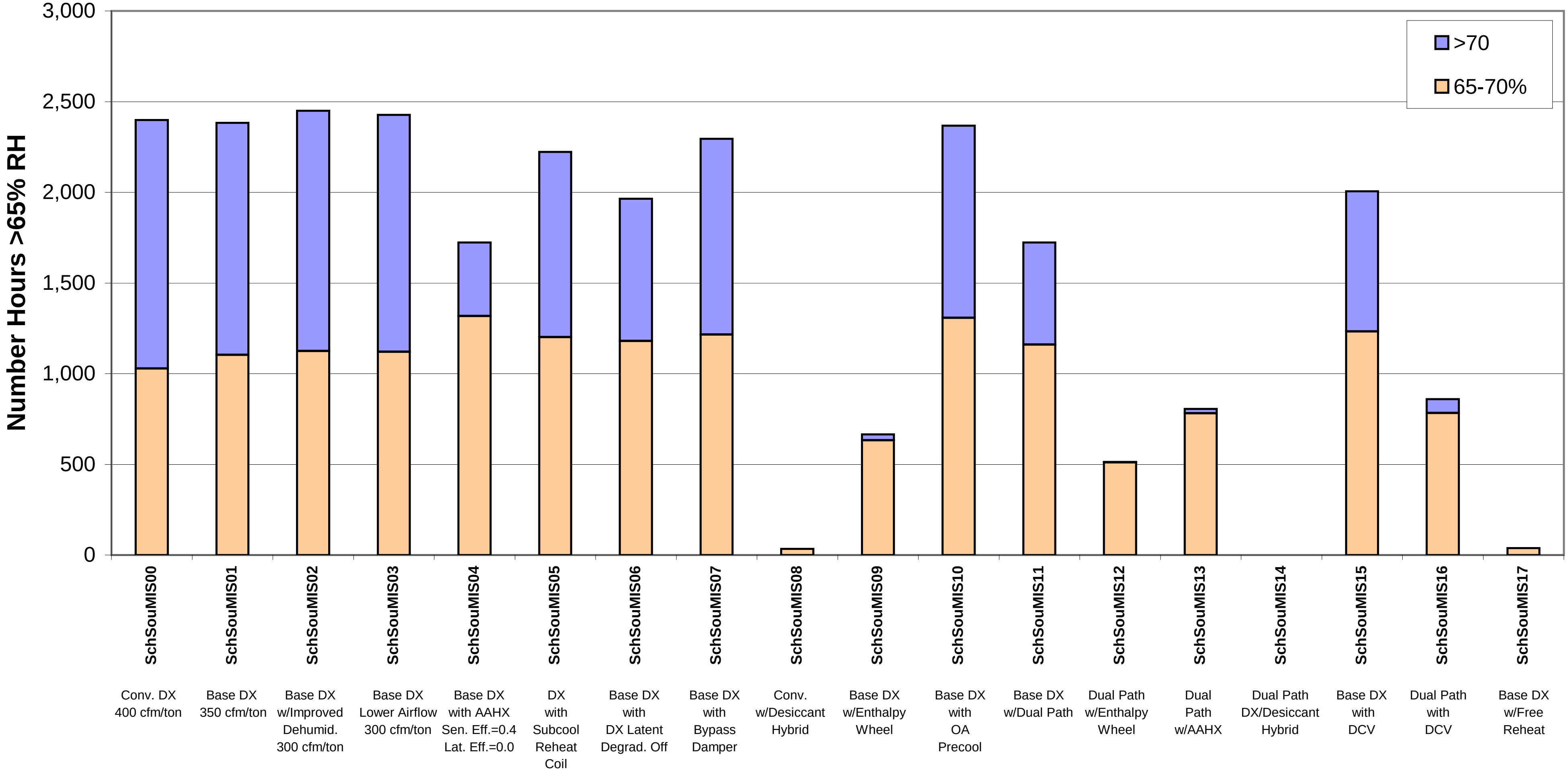
2004 Standard School-9 Month-South in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



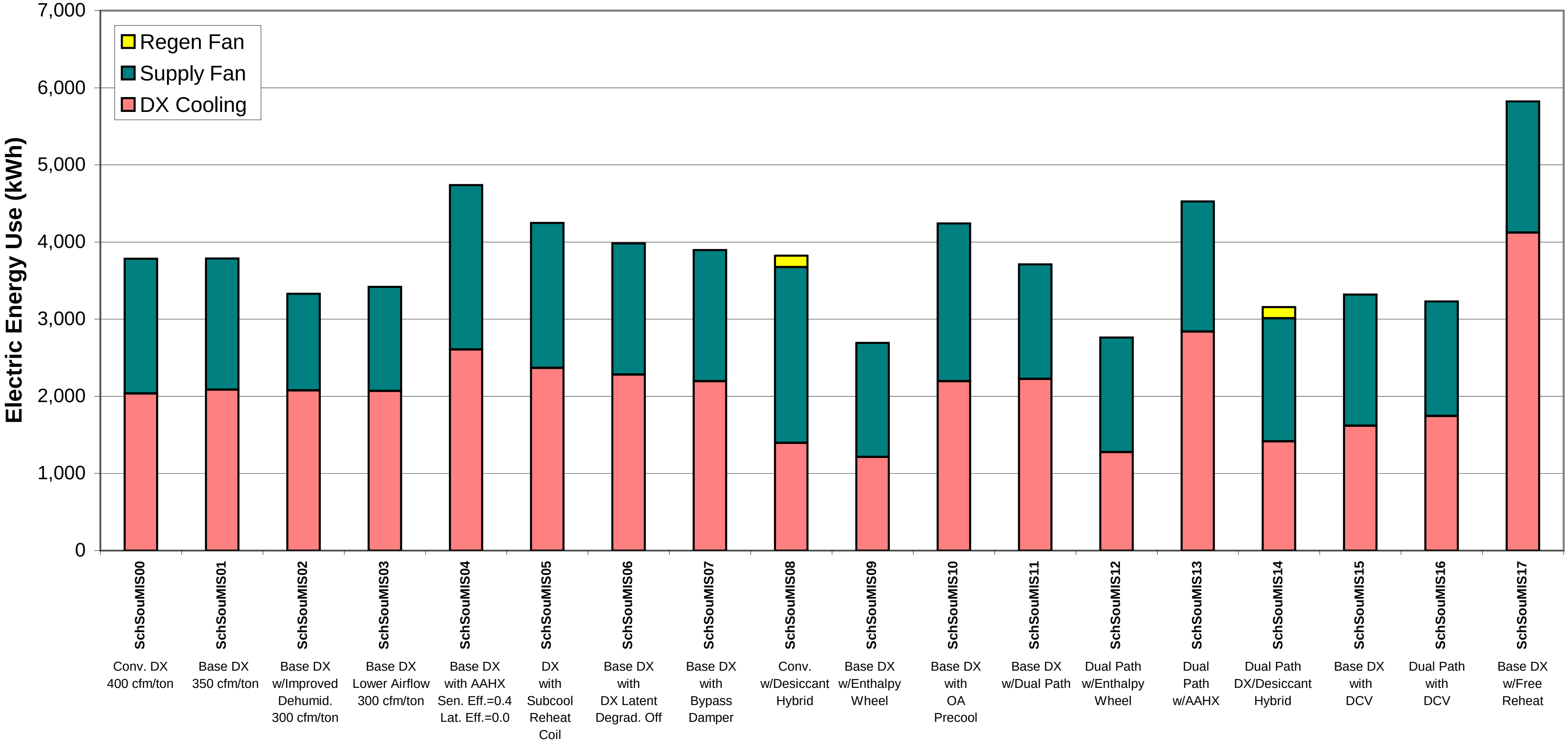
2004 Standard School-9 Month-South in Houston TX
Annual HVAC System Electric Energy Use



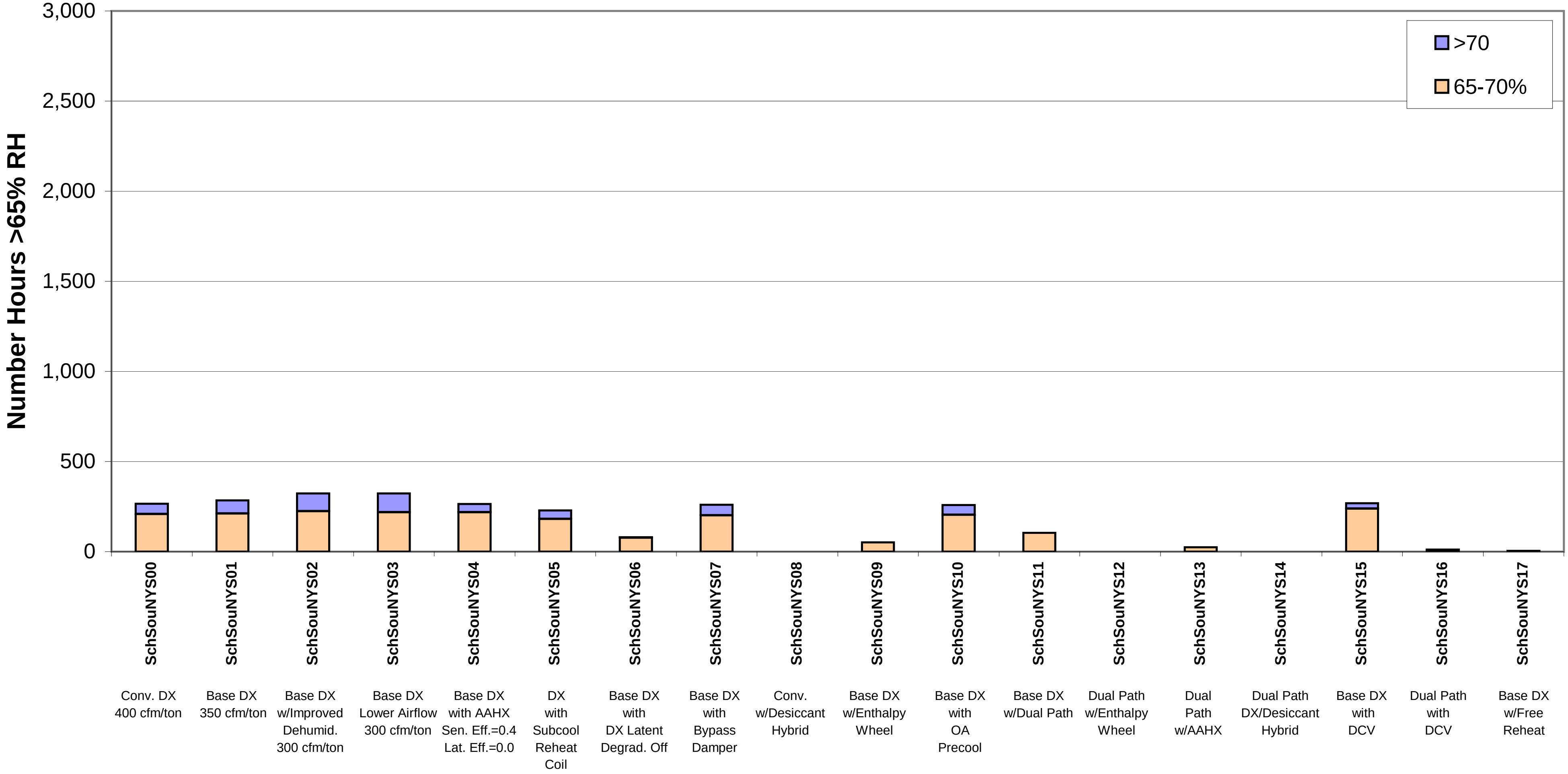
2004 Standard School-9 Month-South in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



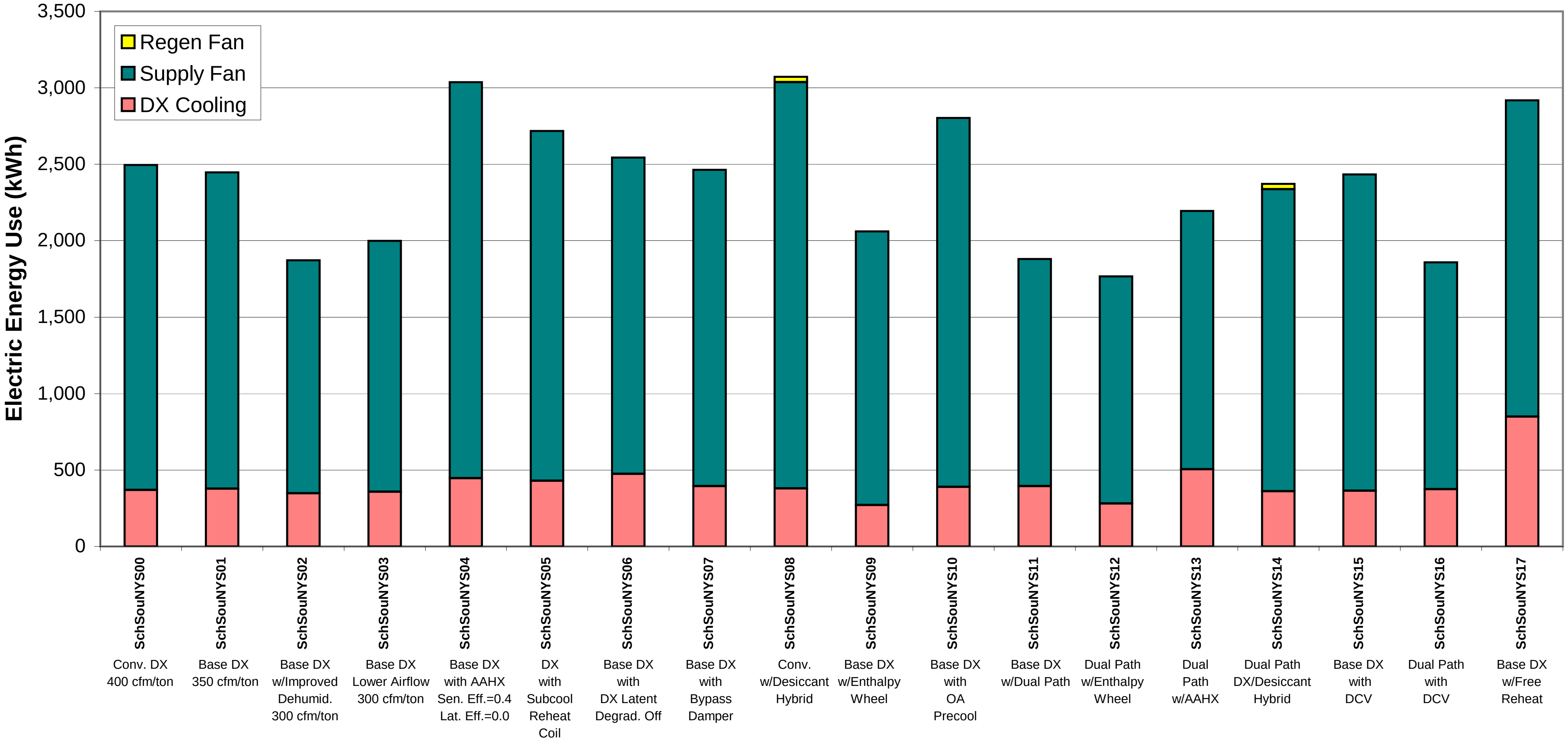
2004 Standard School-9 Month-South in Miami FL
Annual HVAC System Electric Energy Use



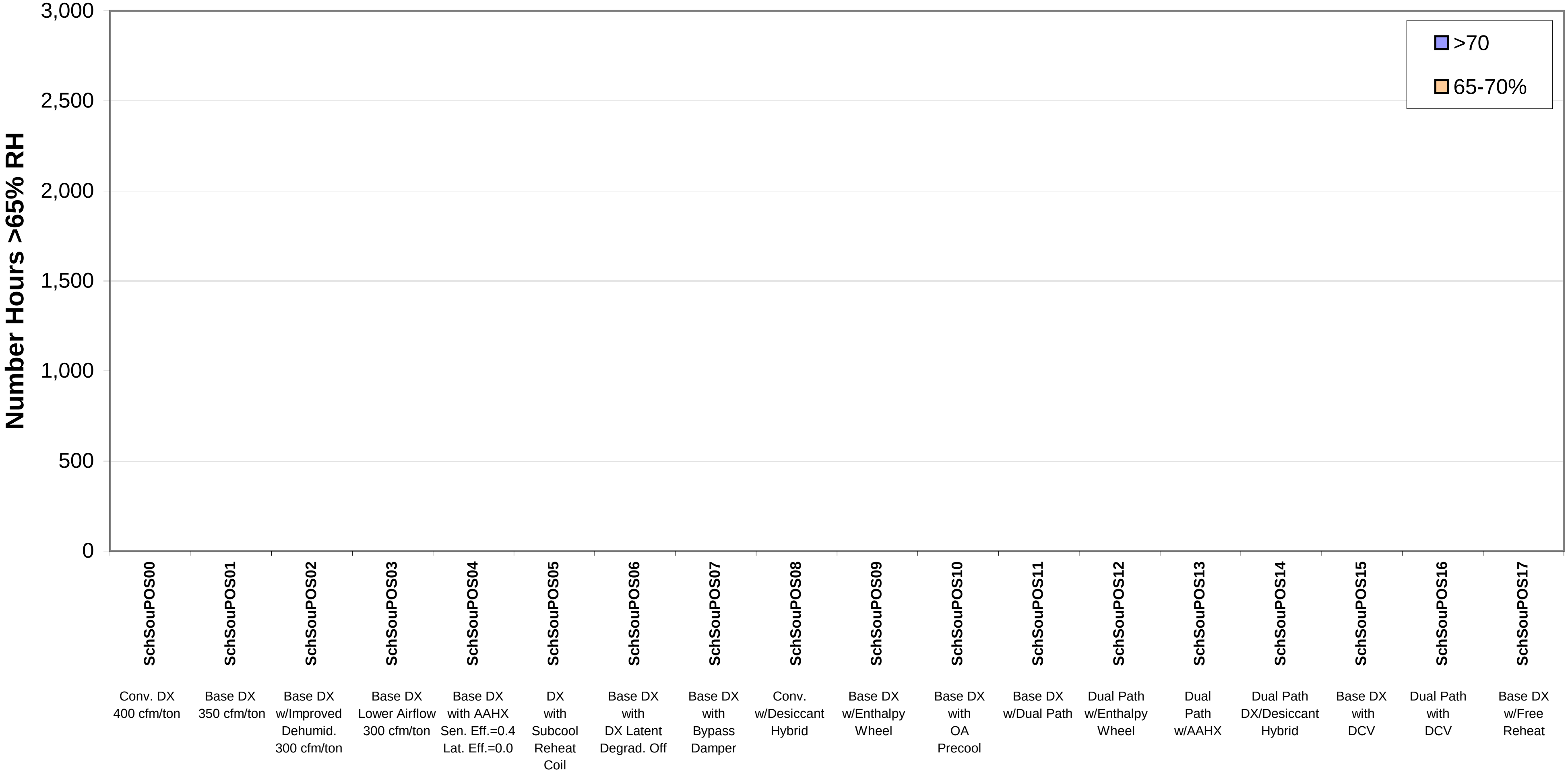
2004 Standard School-9 Month-South in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



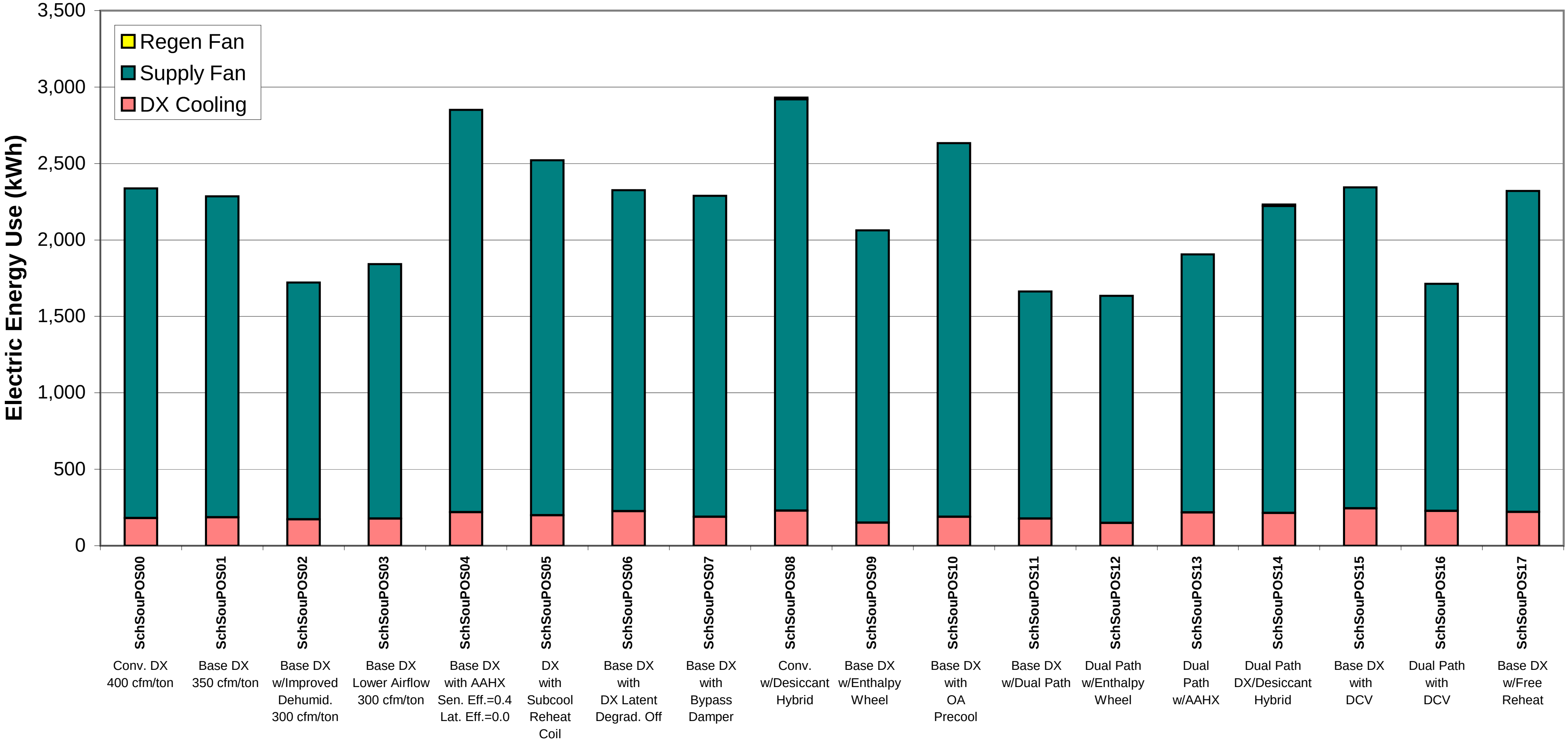
2004 Standard School-9 Month-South in New York NY
Annual HVAC System Electric Energy Use



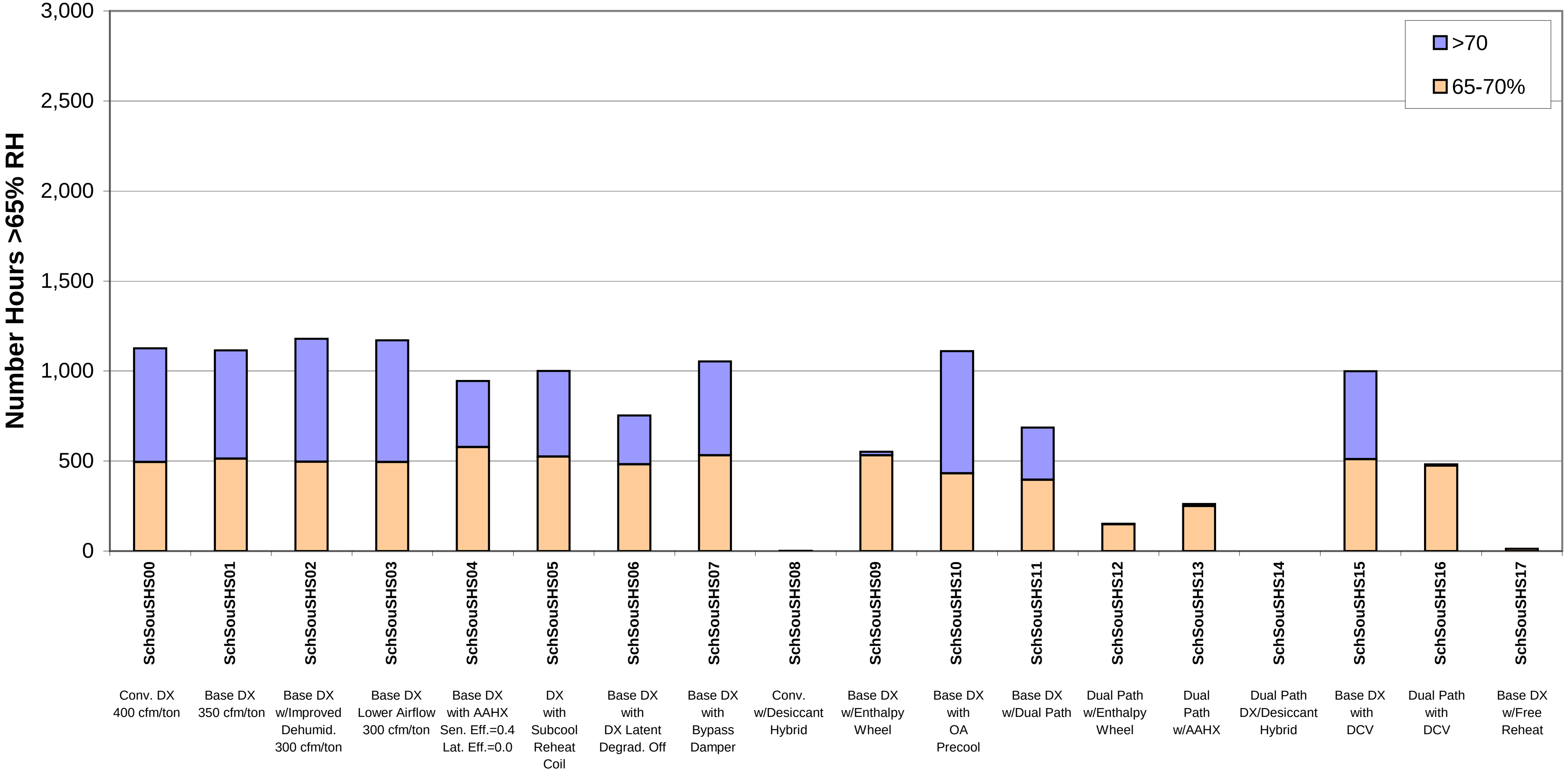
2004 Standard School-9 Month-South in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



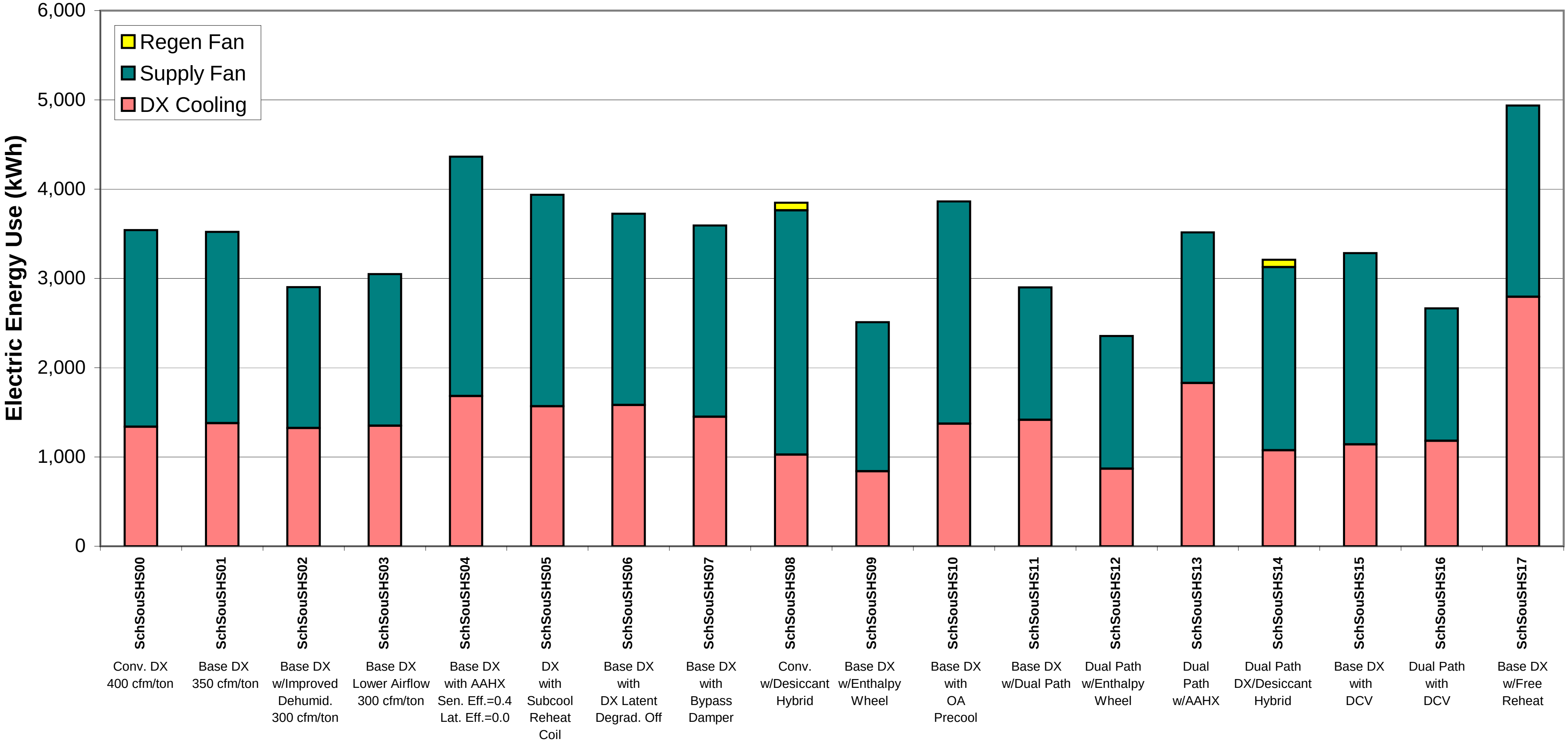
2004 Standard School-9 Month-South in Portland OR
Annual HVAC System Electric Energy Use



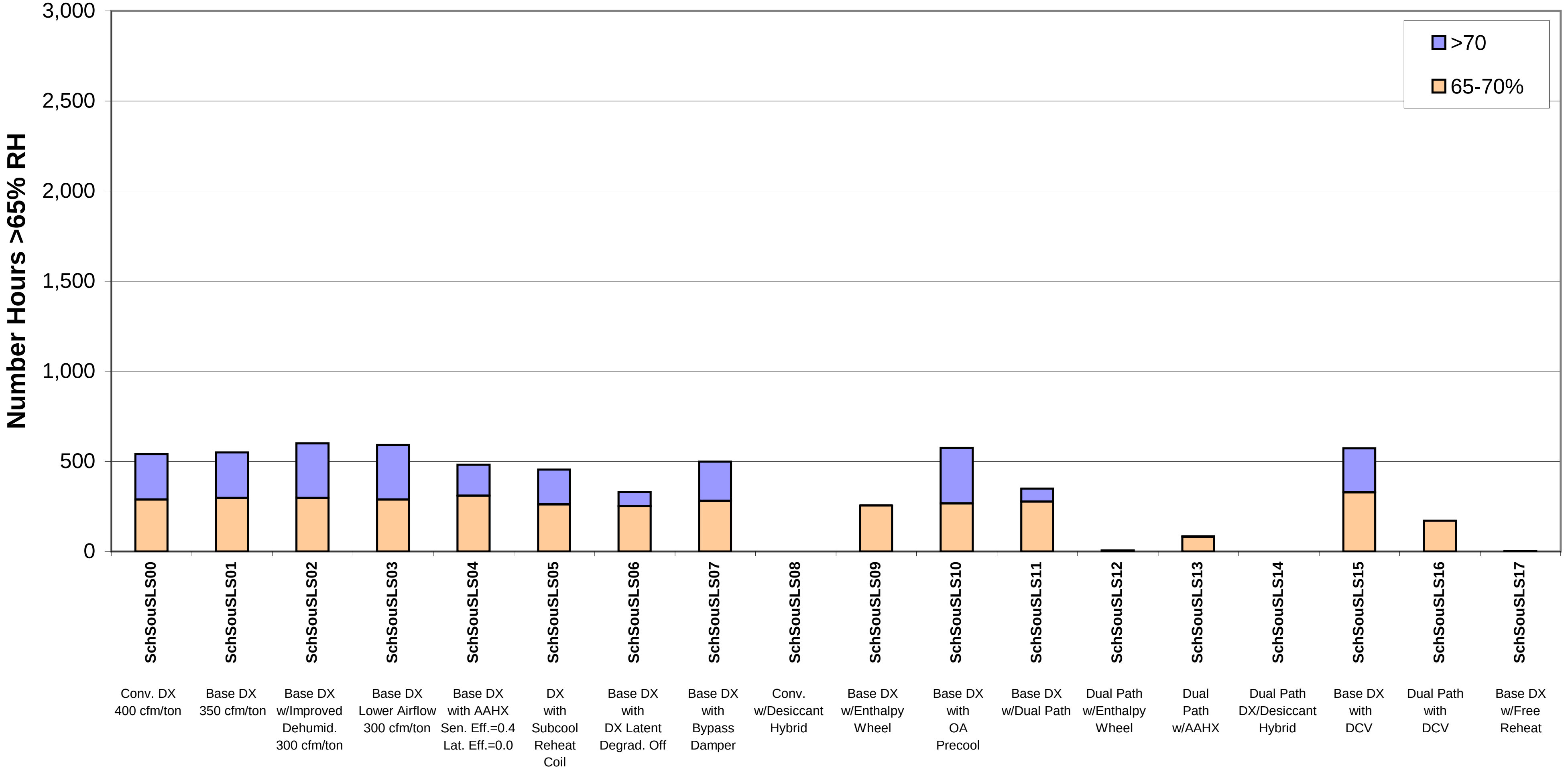
2004 Standard School-9 Month-South in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



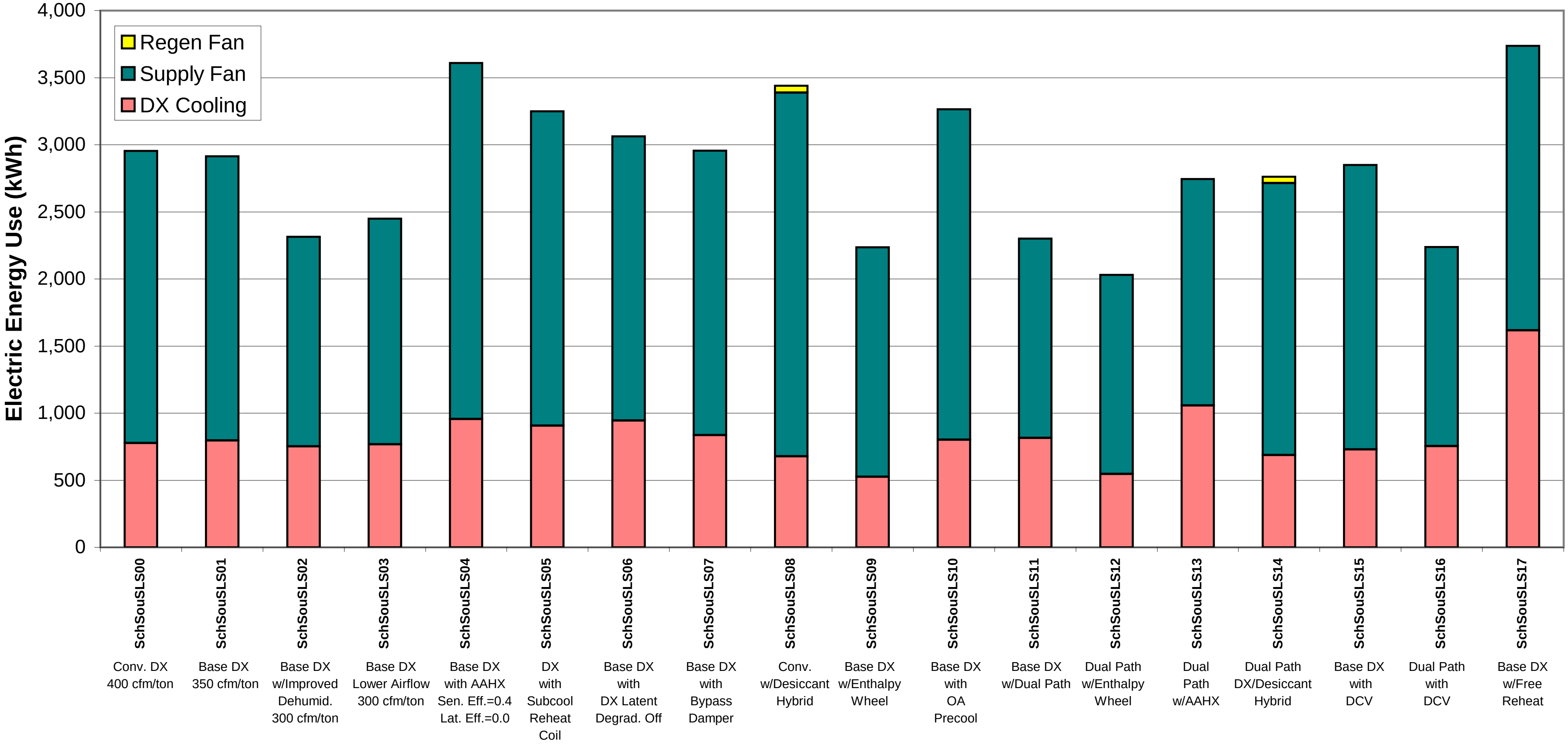
2004 Standard School-9 Month-South in Shreveport LA
Annual HVAC System Electric Energy Use

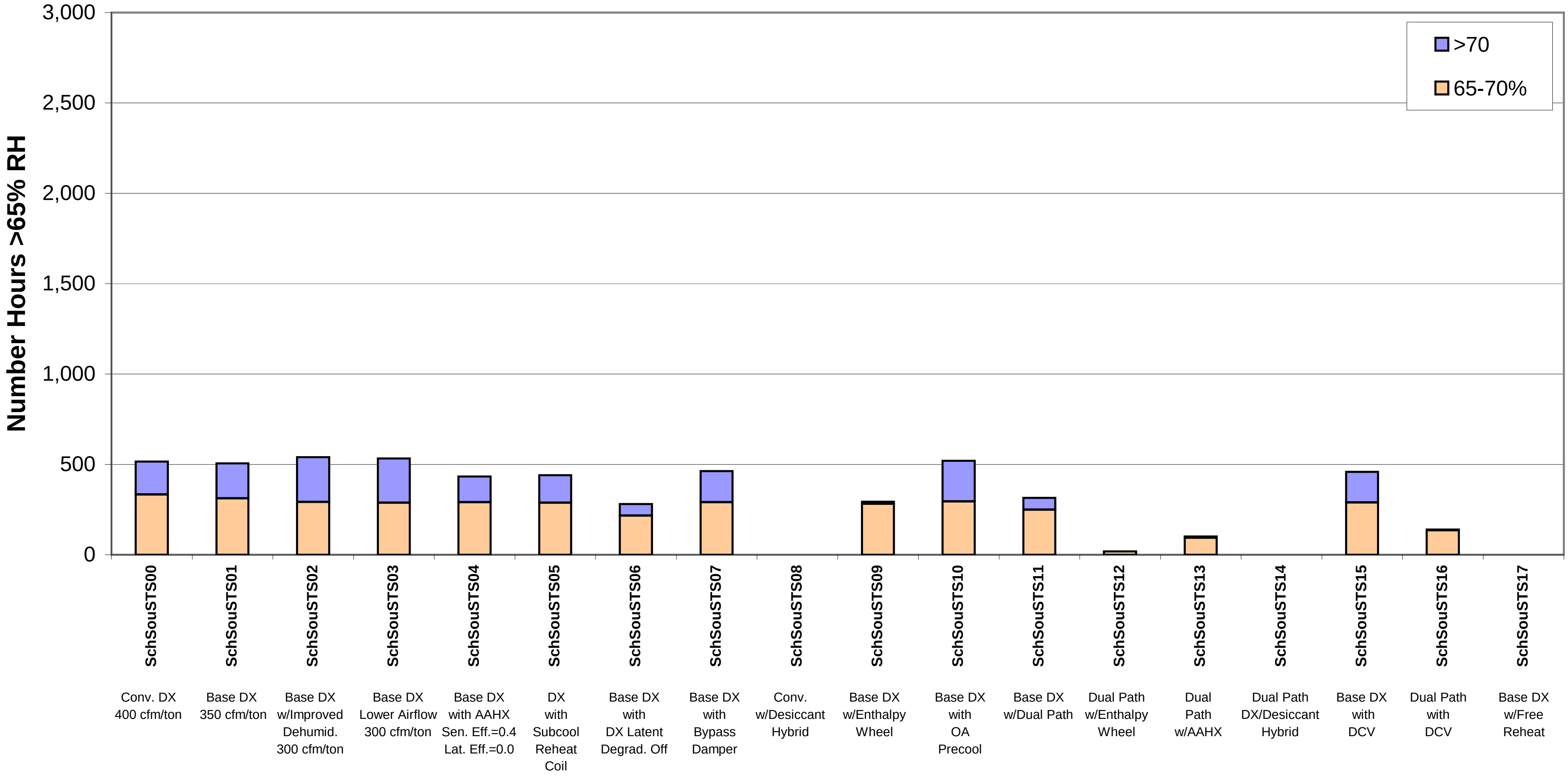


2004 Standard School-9 Month-South in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



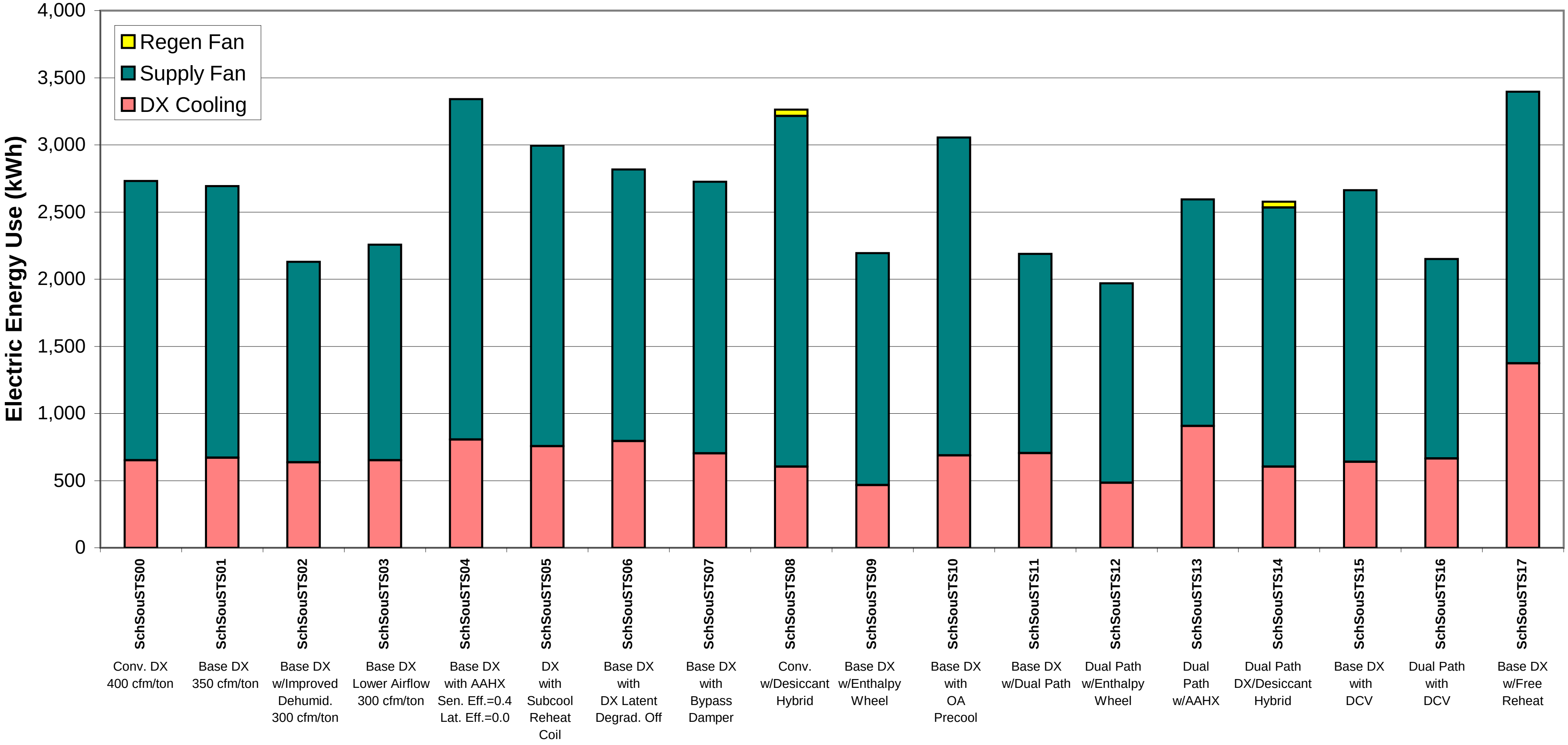
2004 Standard School-9 Month-South in St. Louis MO
Annual HVAC System Electric Energy Use

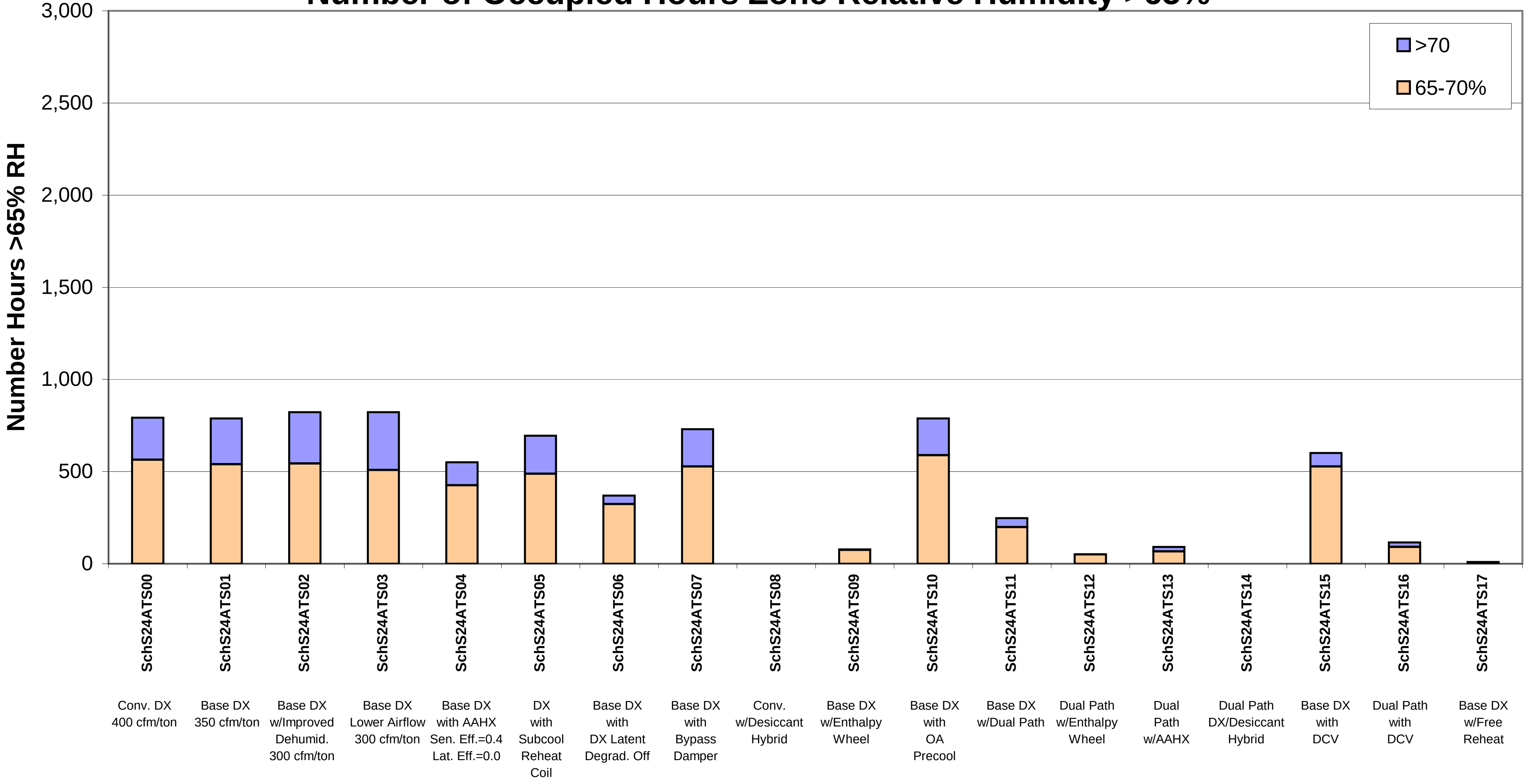




2004 Standard School-9 Month-South in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%

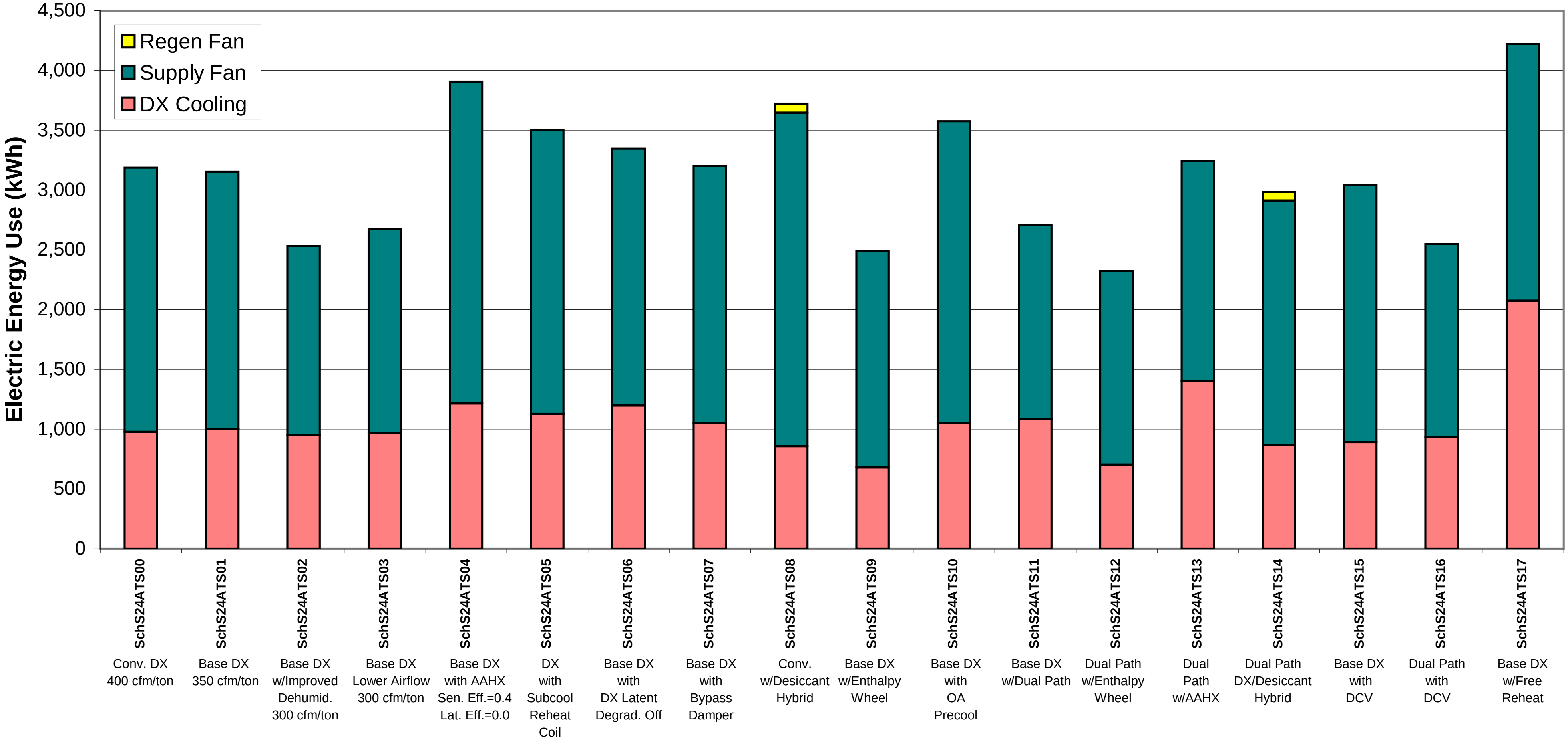
2004 Standard School-9 Month-South in Washington DC
Annual HVAC System Electric Energy Use

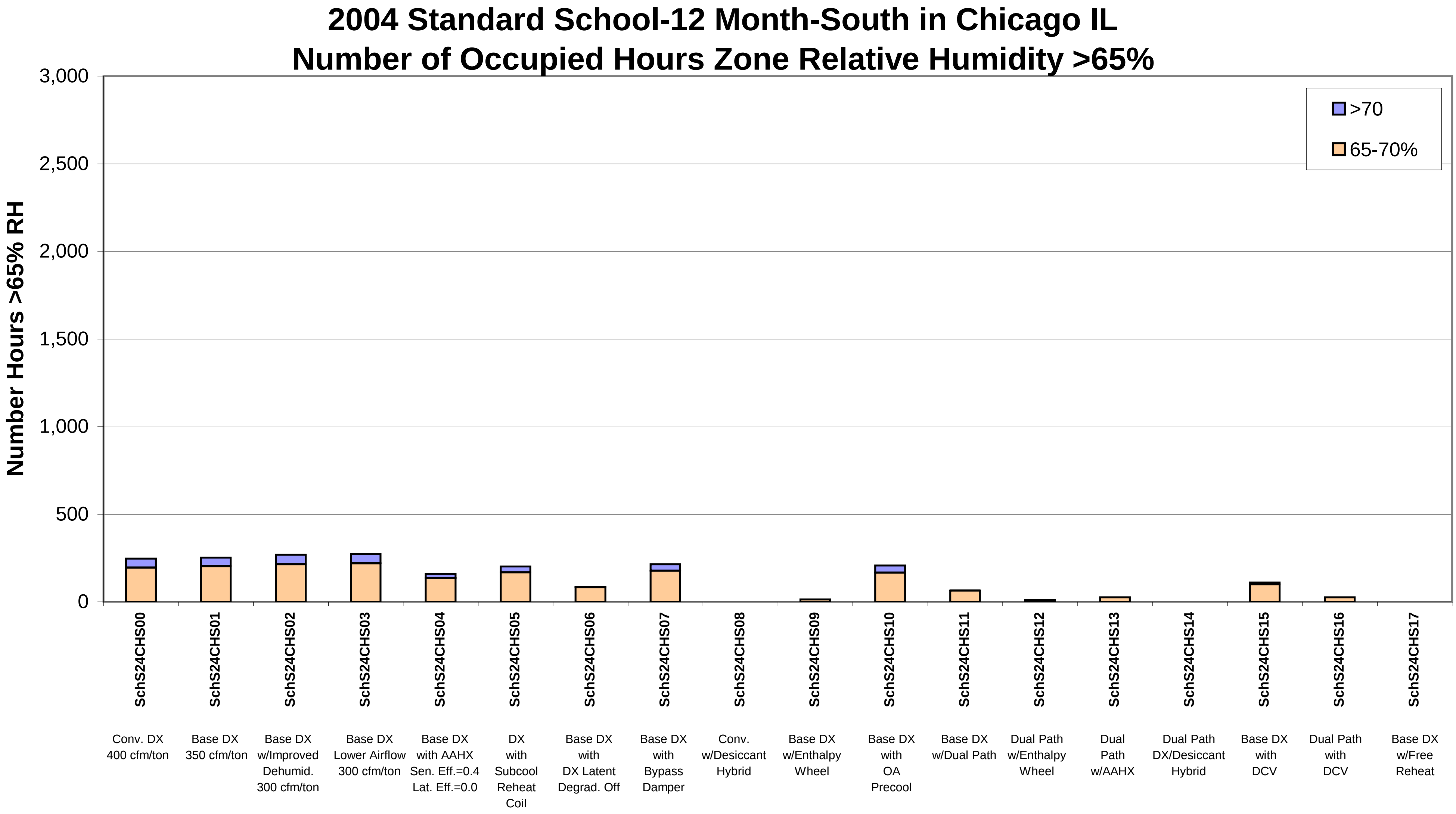




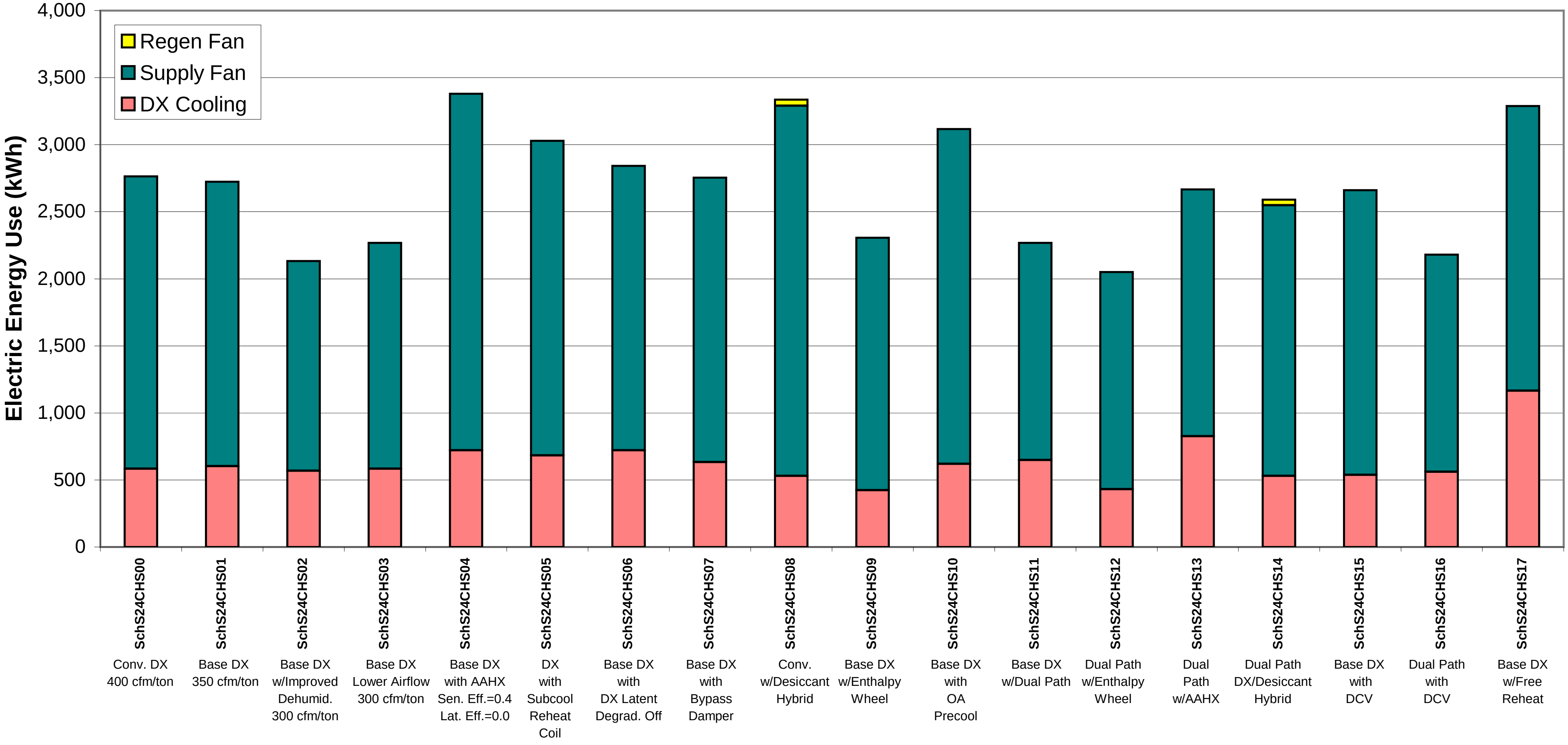
2004 Standard School-12 Month-South in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%

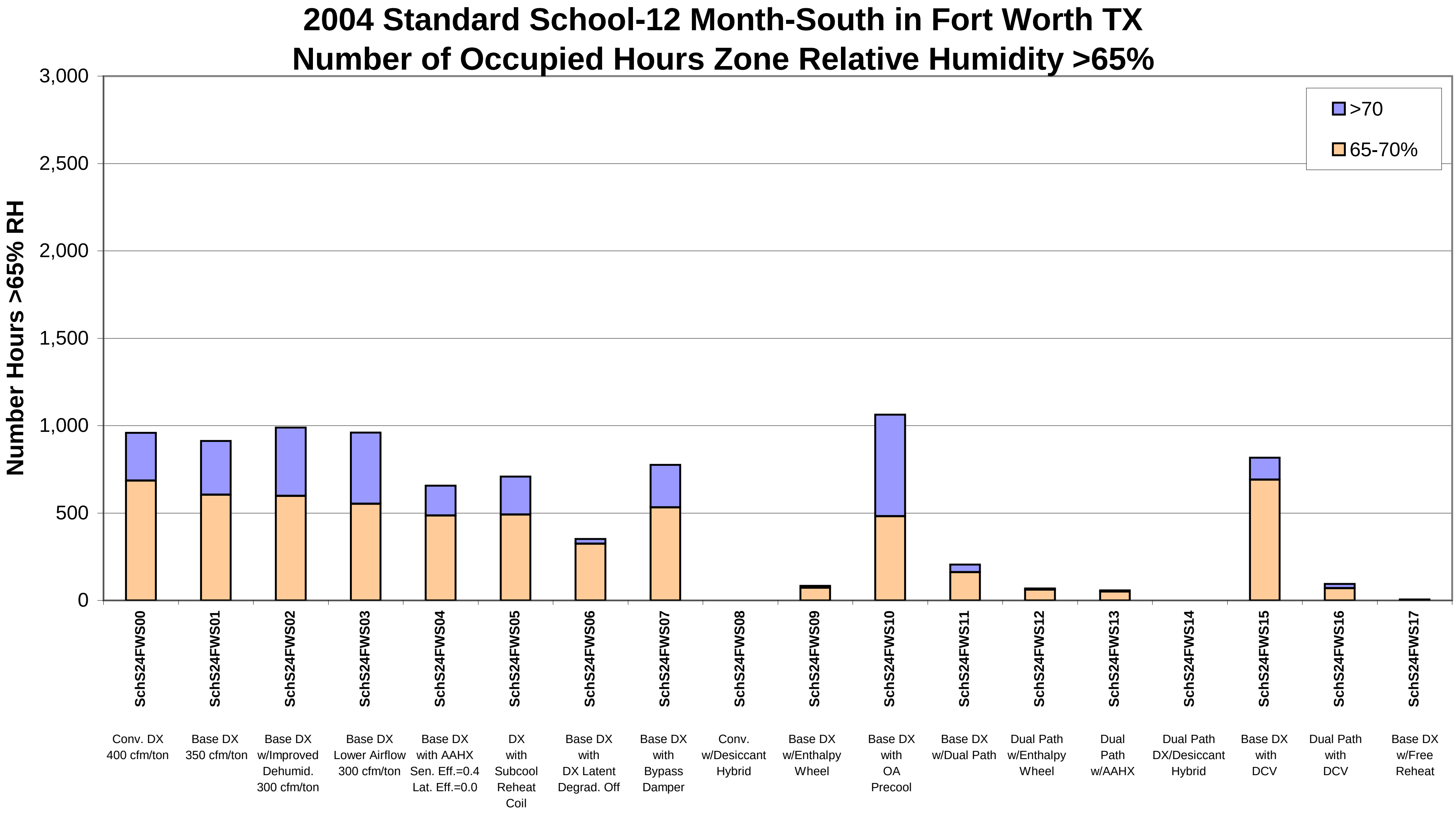
2004 Standard School-12 Month-South in Atlanta GA
Annual HVAC System Electric Energy Use



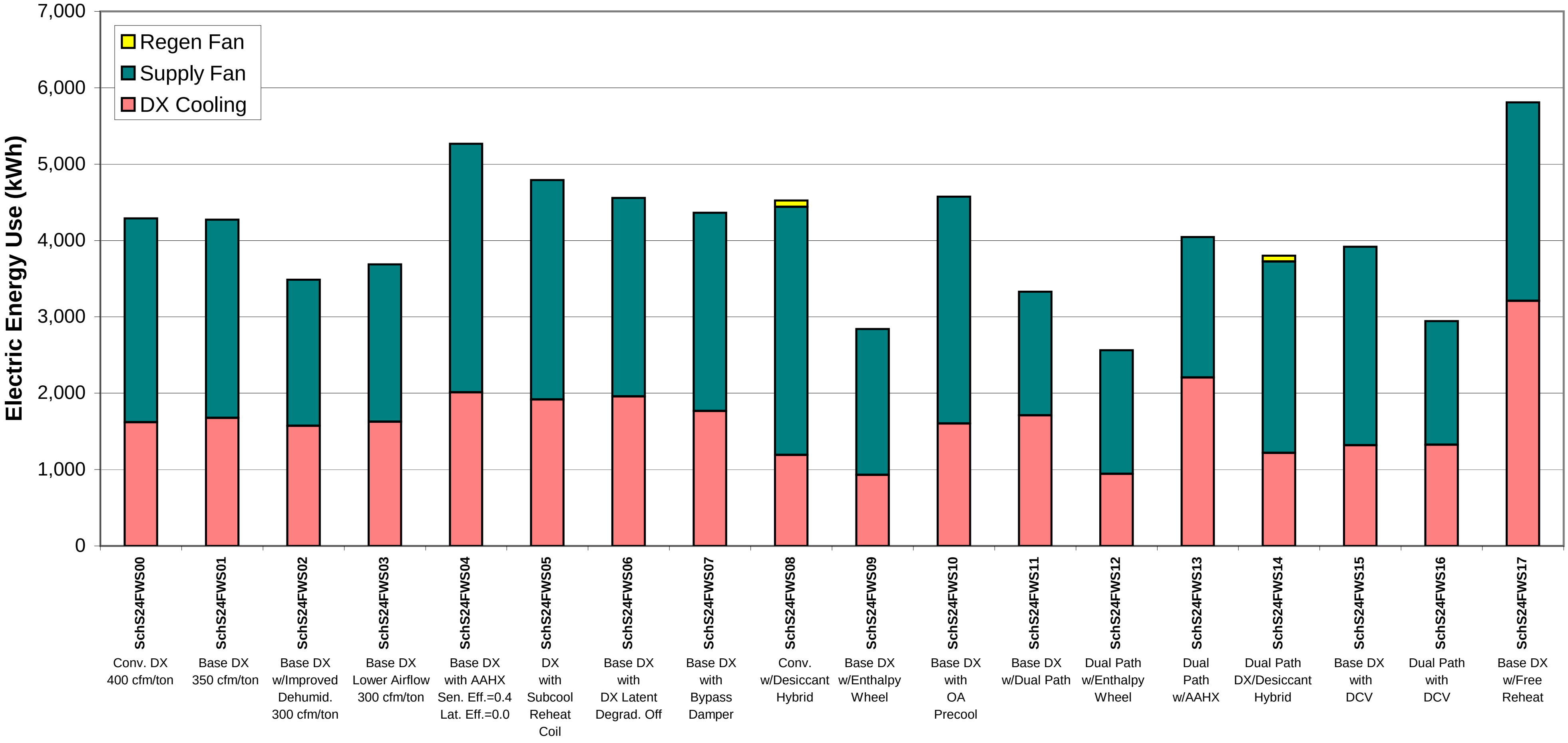

2004 Standard School-12 Month-South in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24CHS00
SchS24CHS01
SchS24CHS02
SchS24CHS03
SchS24CHS04
SchS24CHS05
SchS24CHS06
SchS24CHS07
SchS24CHS08
SchS24CHS09
SchS24CHS10
SchS24CHS11
SchS24CHS12
SchS24CHS13
SchS24CHS14
SchS24CHS15
SchS24CHS16
SchS24CHS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

2004 Standard School-12 Month-South in Chicago IL
Annual HVAC System Electric Energy Use

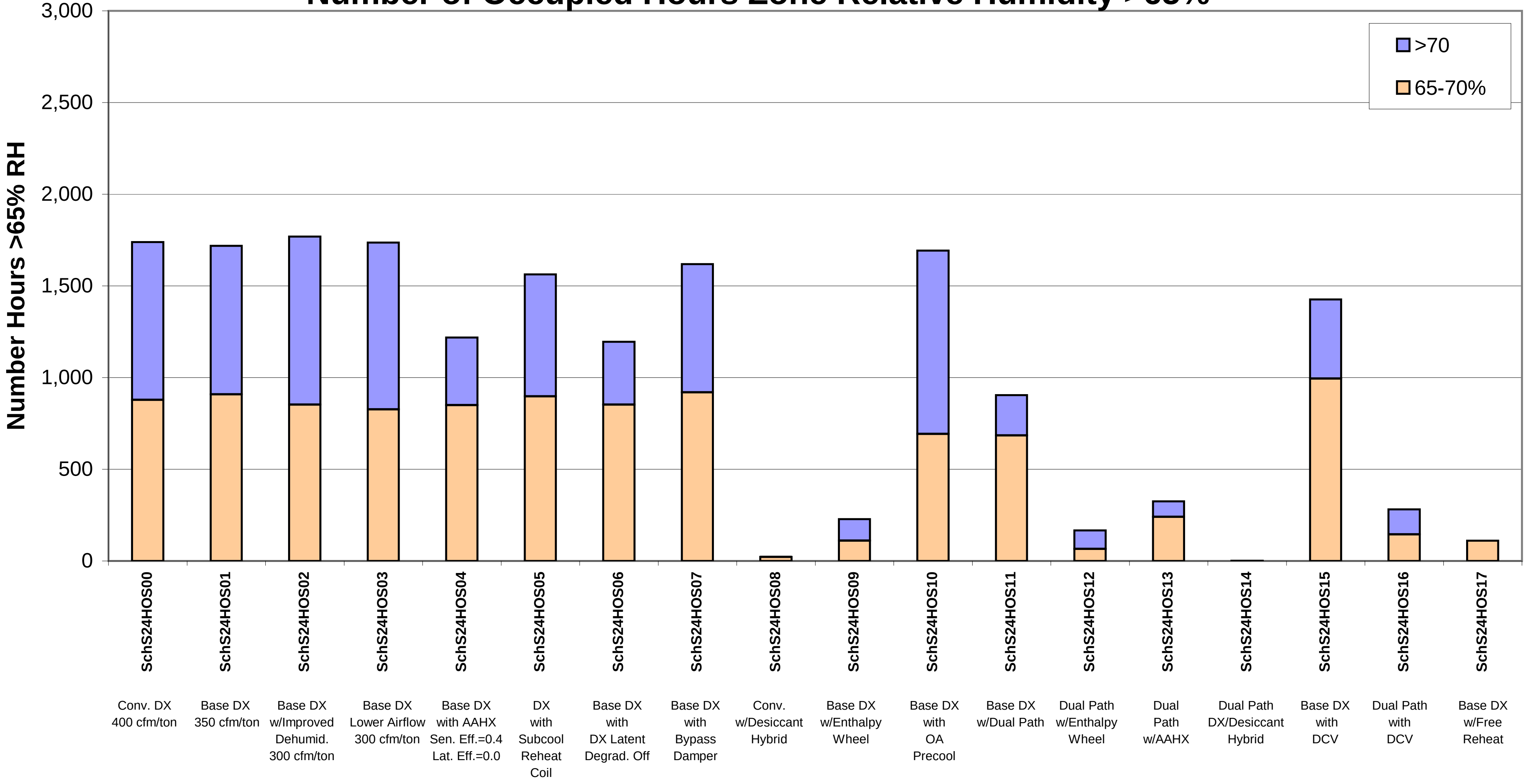



2004 Standard School-12 Month-South in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24FWS00
SchS24FWS01
SchS24FWS02
SchS24FWS03
SchS24FWS04
SchS24FWS05
SchS24FWS06
SchS24FWS07
SchS24FWS08
SchS24FWS09
SchS24FWS10
SchS24FWS11
SchS24FWS12
SchS24FWS13
SchS24FWS14
SchS24FWS15
SchS24FWS16
SchS24FWS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

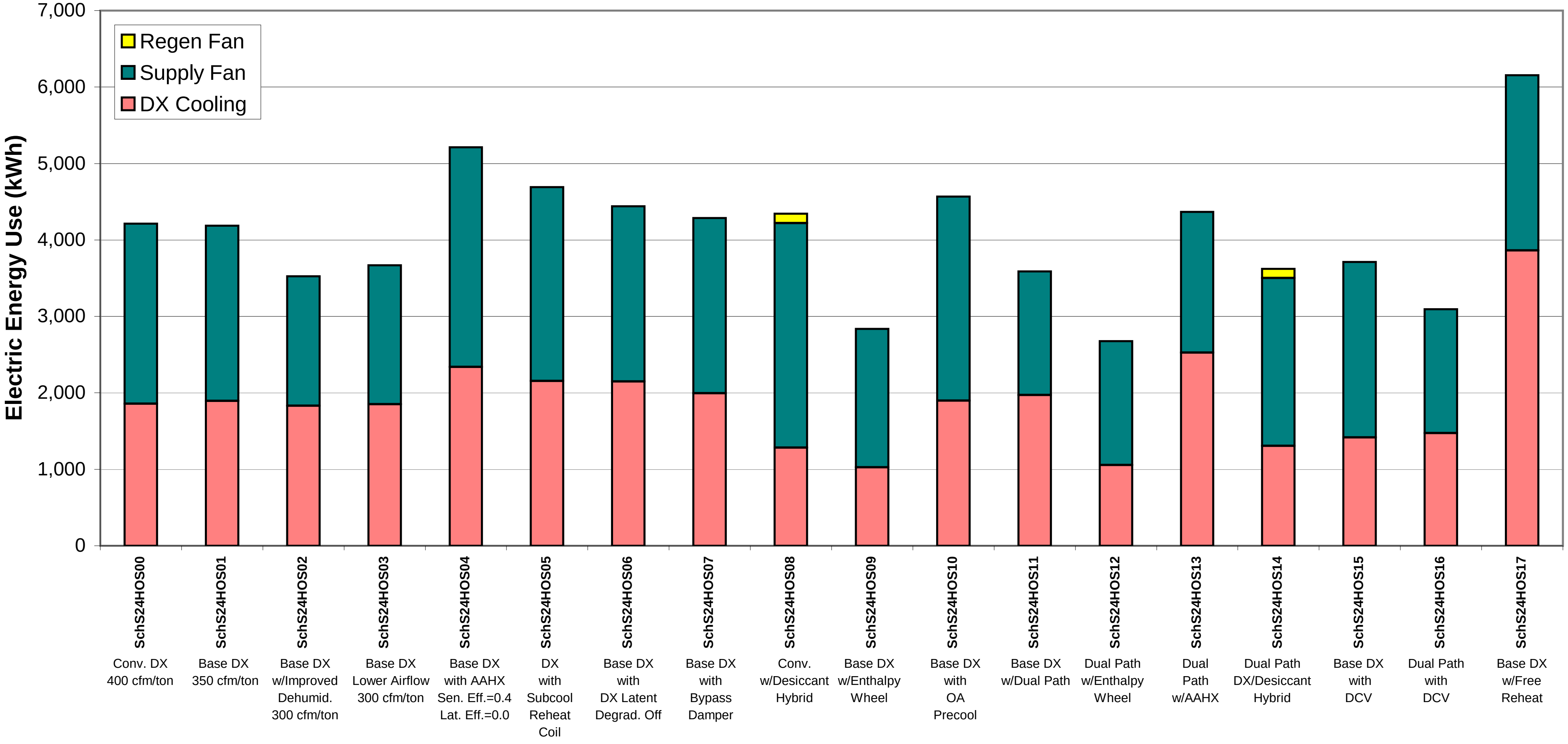
2004 Standard School-12 Month-South in Fort Worth TX
Annual HVAC System Electric Energy Use

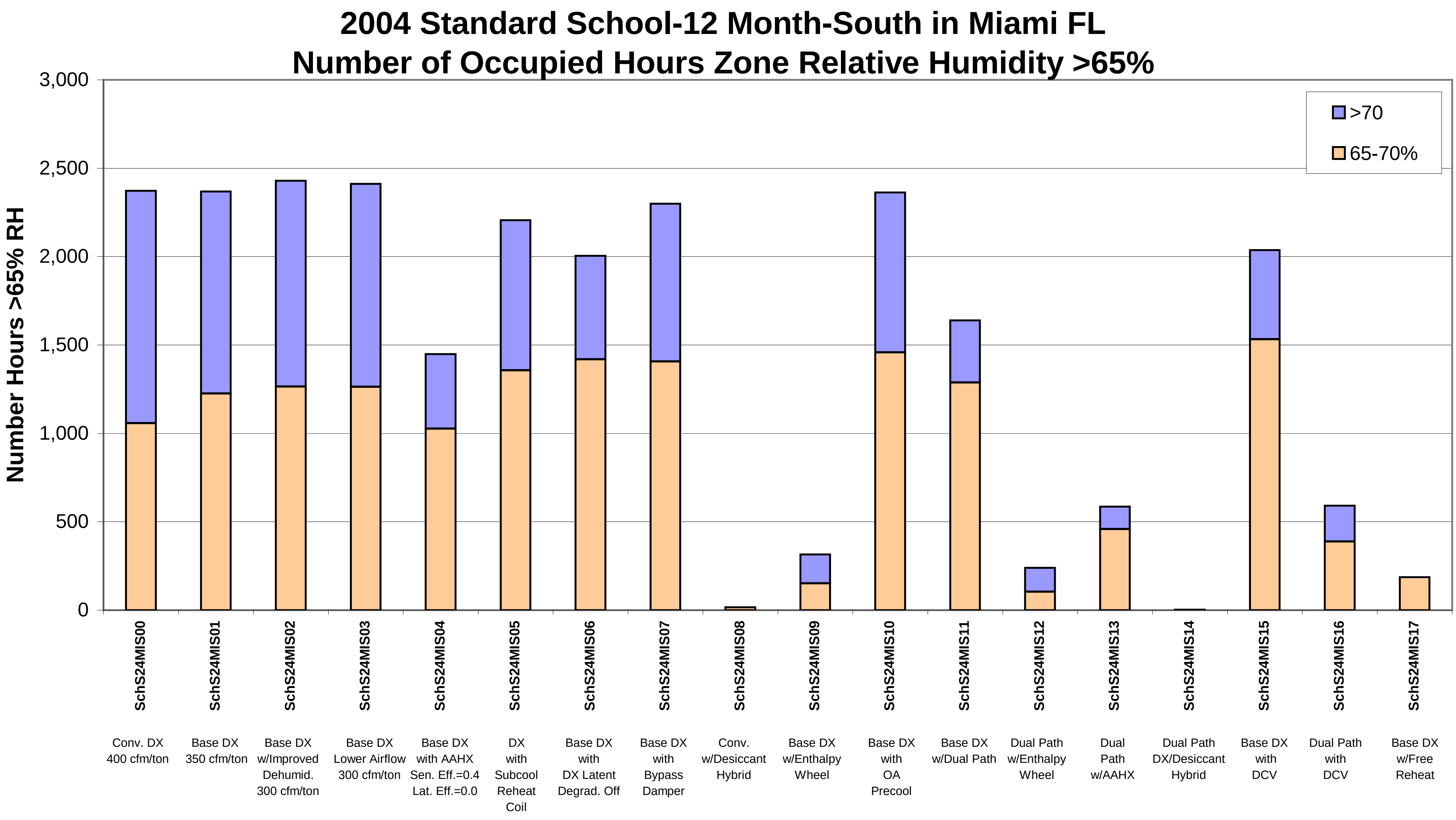


2004 Standard School-12 Month-South in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%

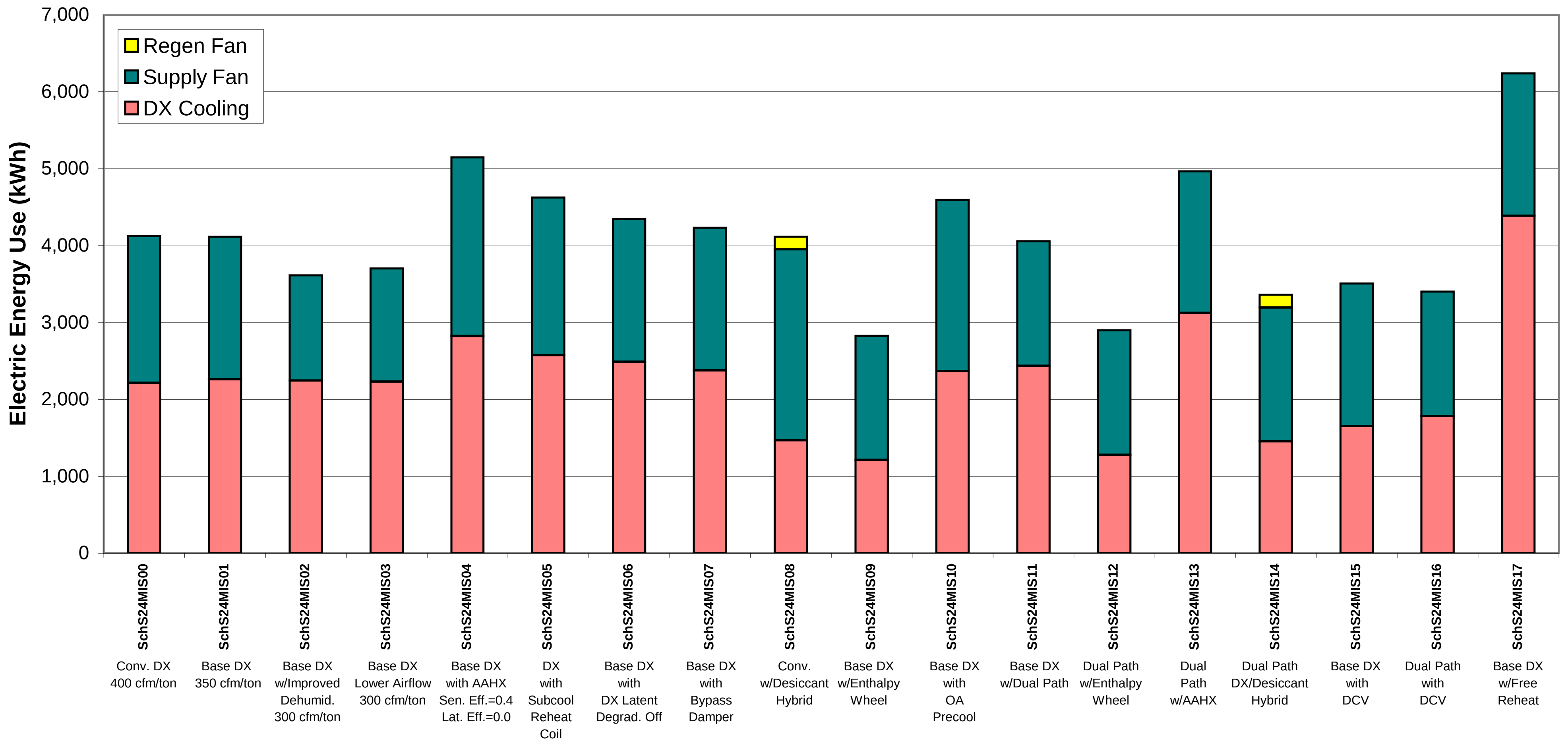


2004 Standard School-12 Month-South in Houston TX
Annual HVAC System Electric Energy Use

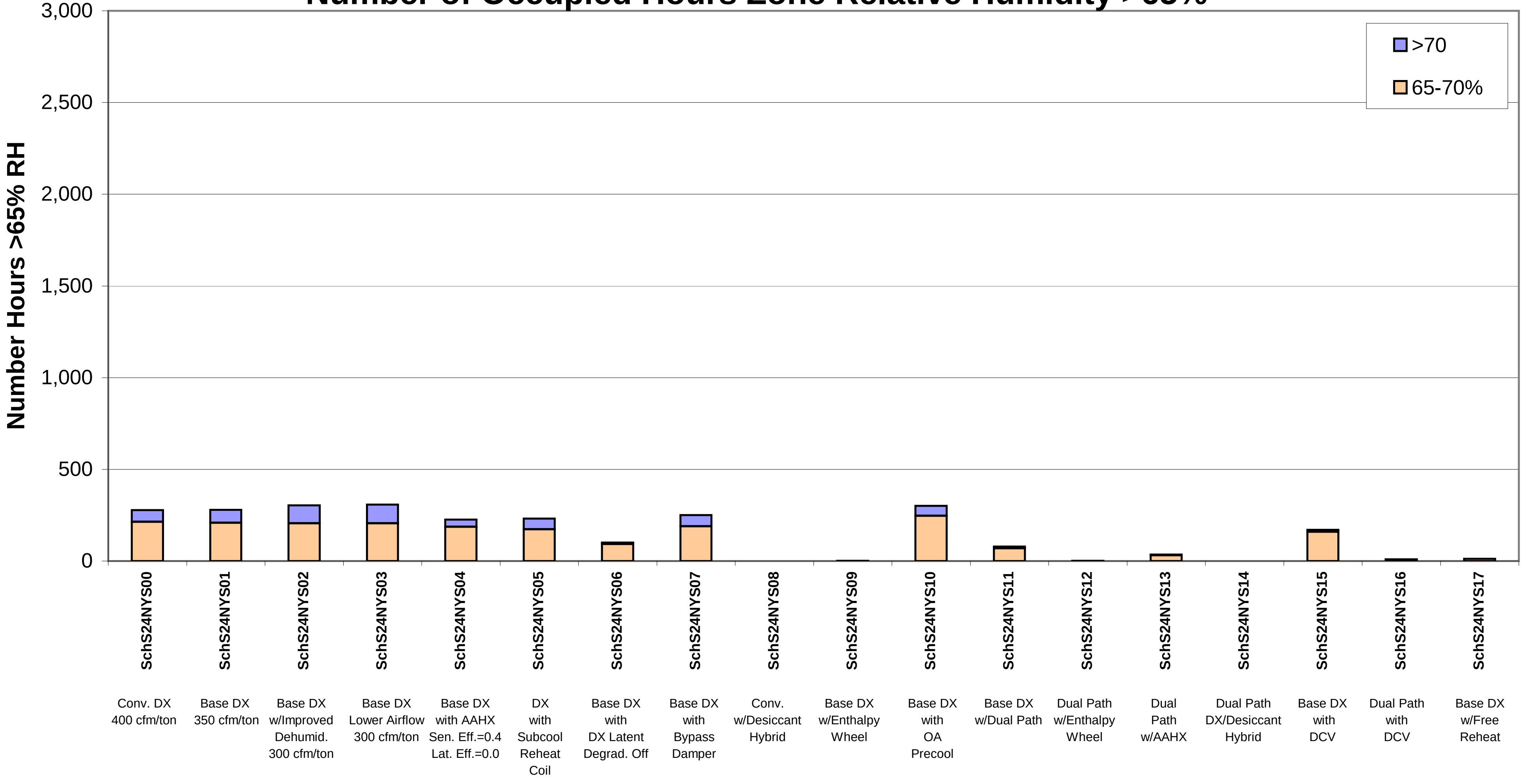



2004 Standard School-12 Month-South in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24MIS00
SchS24MIS01
SchS24MIS02
SchS24MIS03
SchS24MIS04
SchS24MIS05
SchS24MIS06
SchS24MIS07
SchS24MIS08
SchS24MIS09
SchS24MIS10
SchS24MIS11
SchS24MIS12
SchS24MIS13
SchS24MIS14
SchS24MIS15
SchS24MIS16
SchS24MIS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

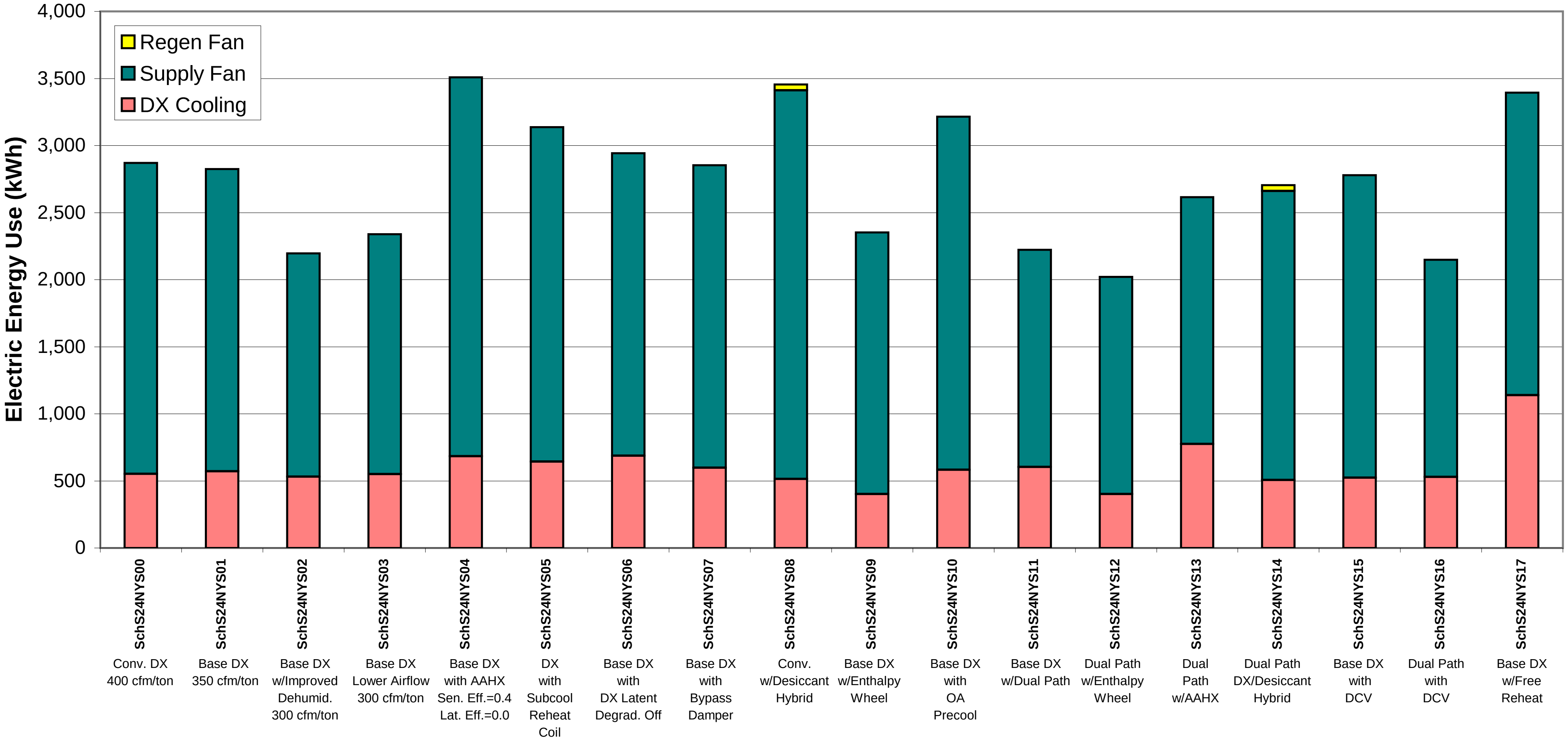
2004 Standard School-12 Month-South in Miami FL
Annual HVAC System Electric Energy Use

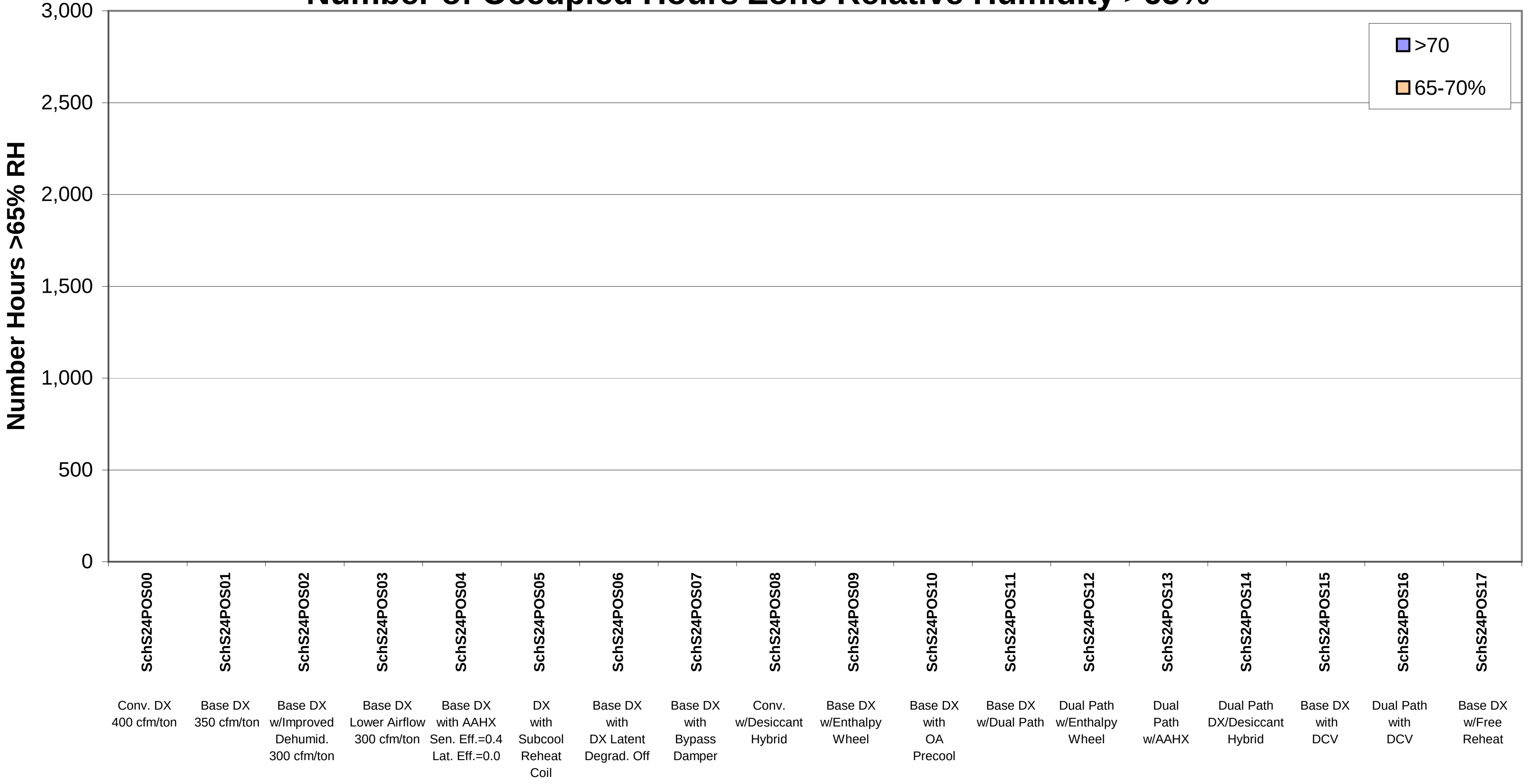


2004 Standard School-12 Month-South in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



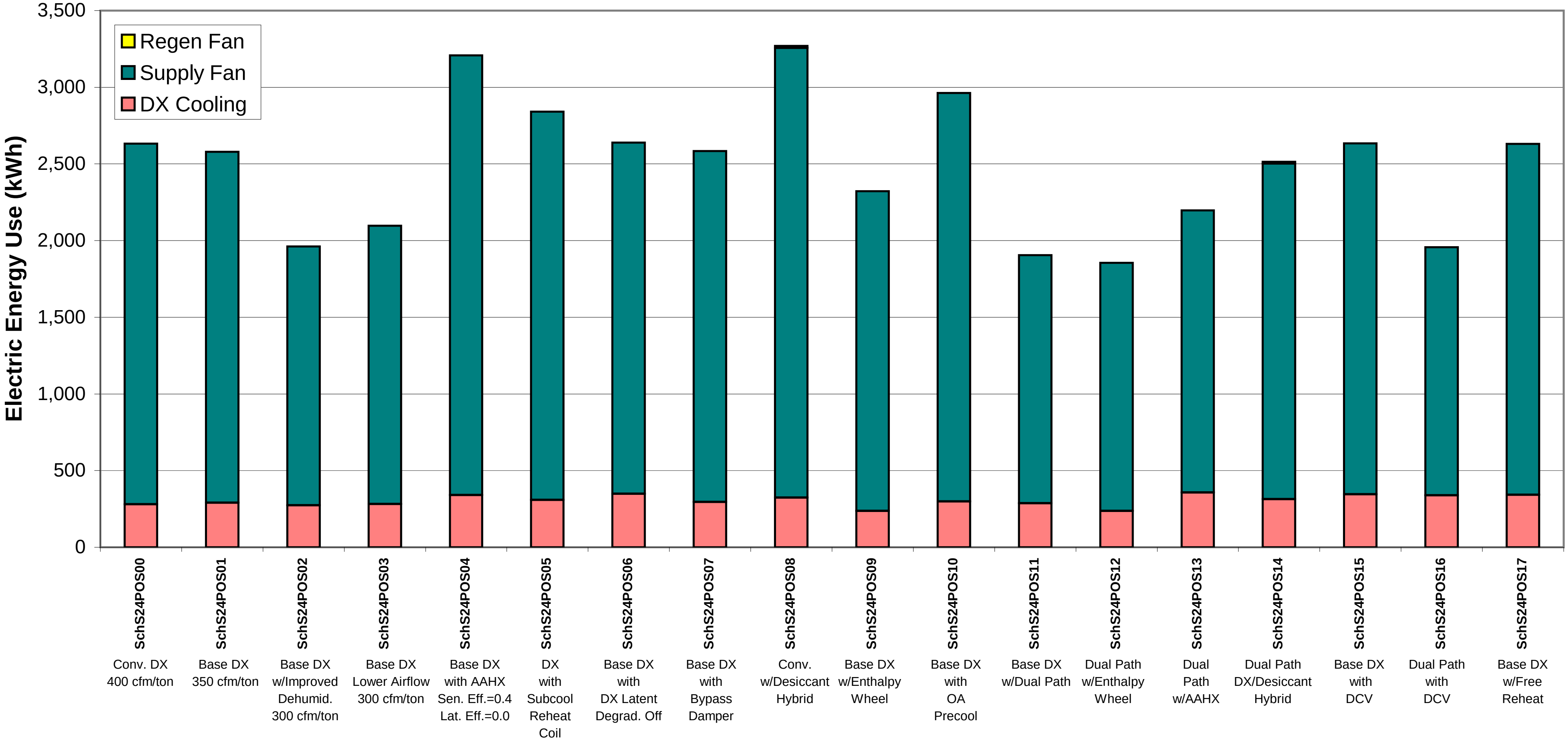
2004 Standard School-12 Month-South in New York NY
Annual HVAC System Electric Energy Use

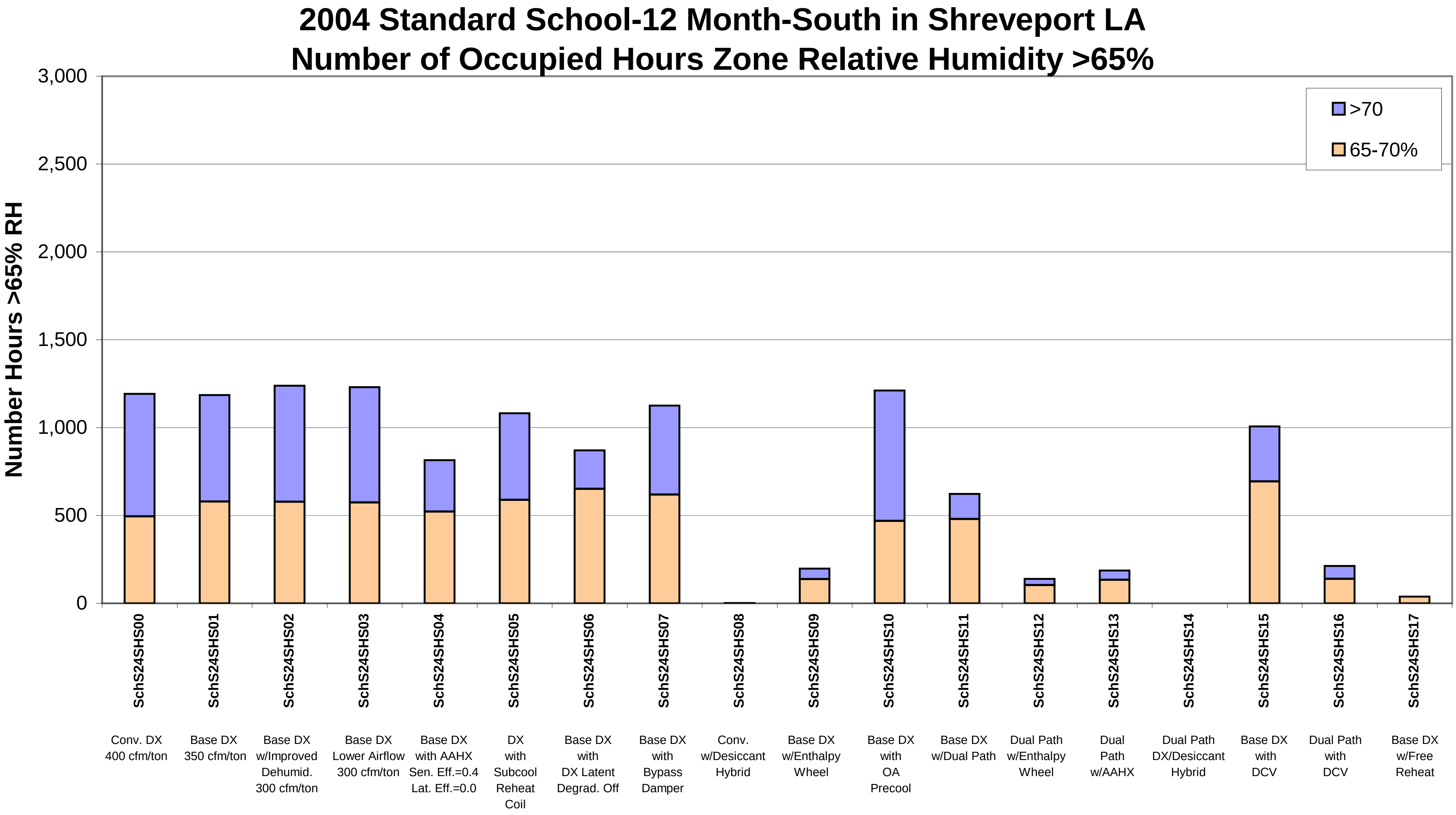




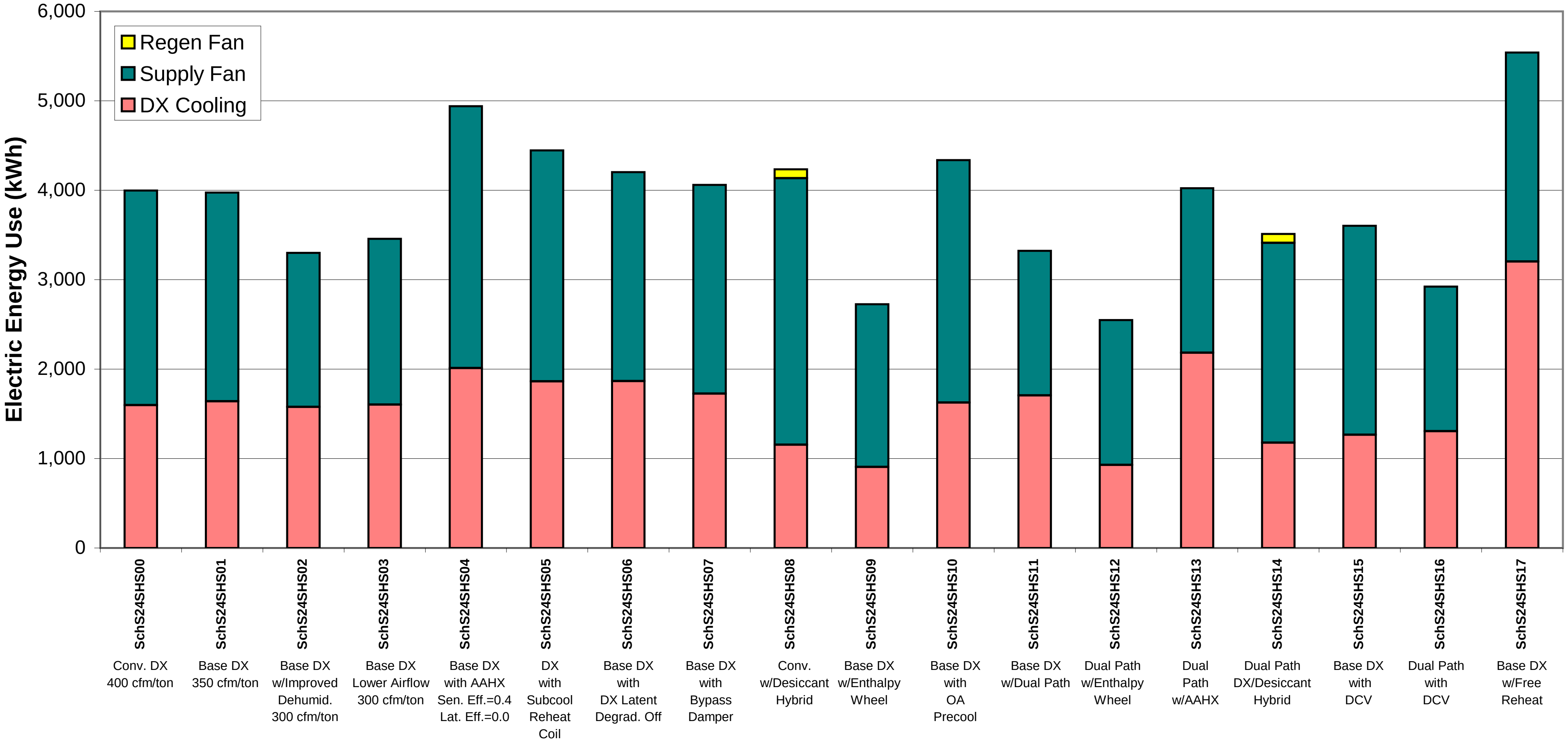
2004 Standard School-12 Month-South in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%

2004 Standard School-12 Month-South in Portland OR
Annual HVAC System Electric Energy Use

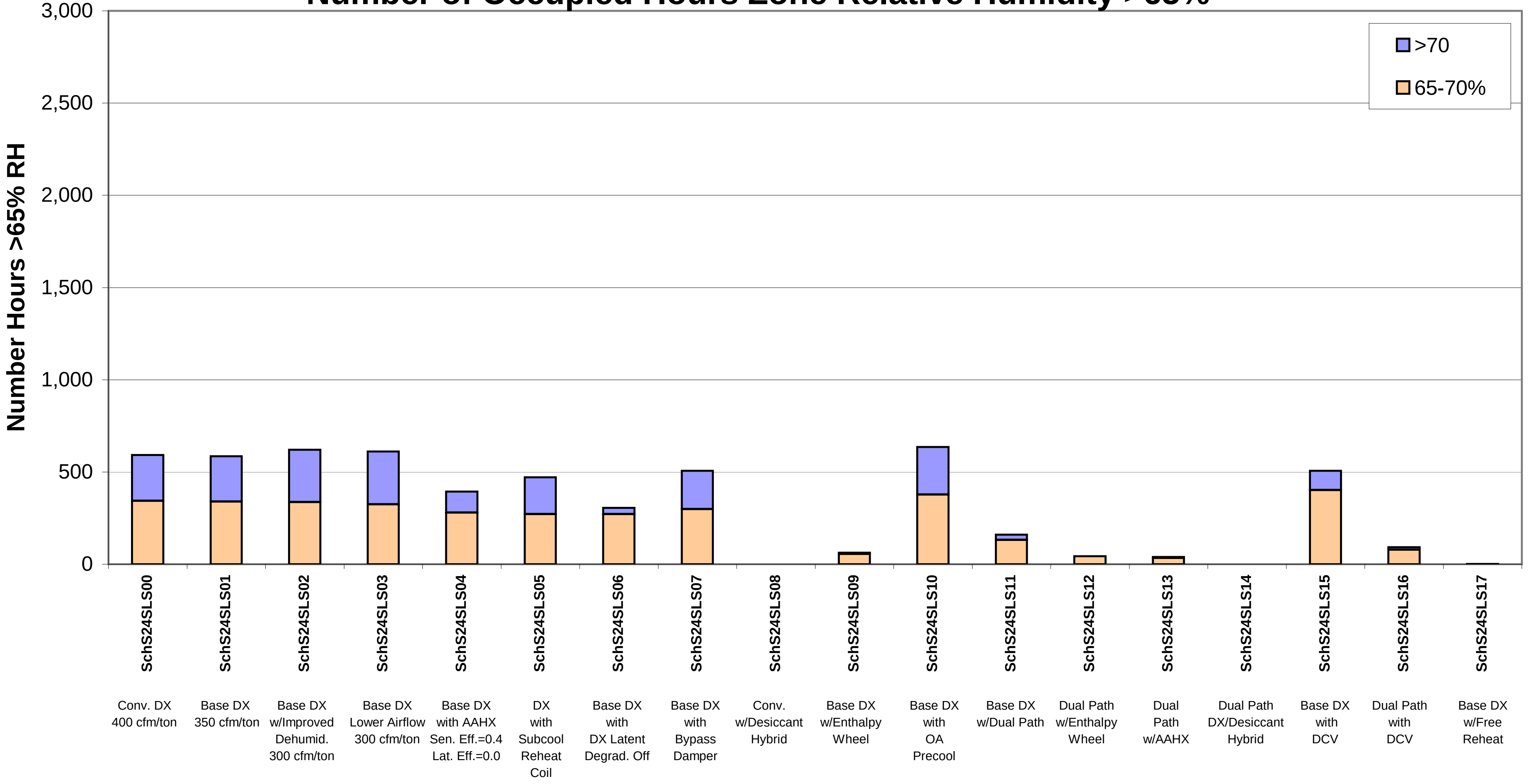



2004 Standard School-12 Month-South in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24SHS00
SchS24SHS01
SchS24SHS02
SchS24SHS03
SchS24SHS04
SchS24SHS05
SchS24SHS06
SchS24SHS07
SchS24SHS08
SchS24SHS09
SchS24SHS10
SchS24SHS11
SchS24SHS12
SchS24SHS13
SchS24SHS14
SchS24SHS15
SchS24SHS16
SchS24SHS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

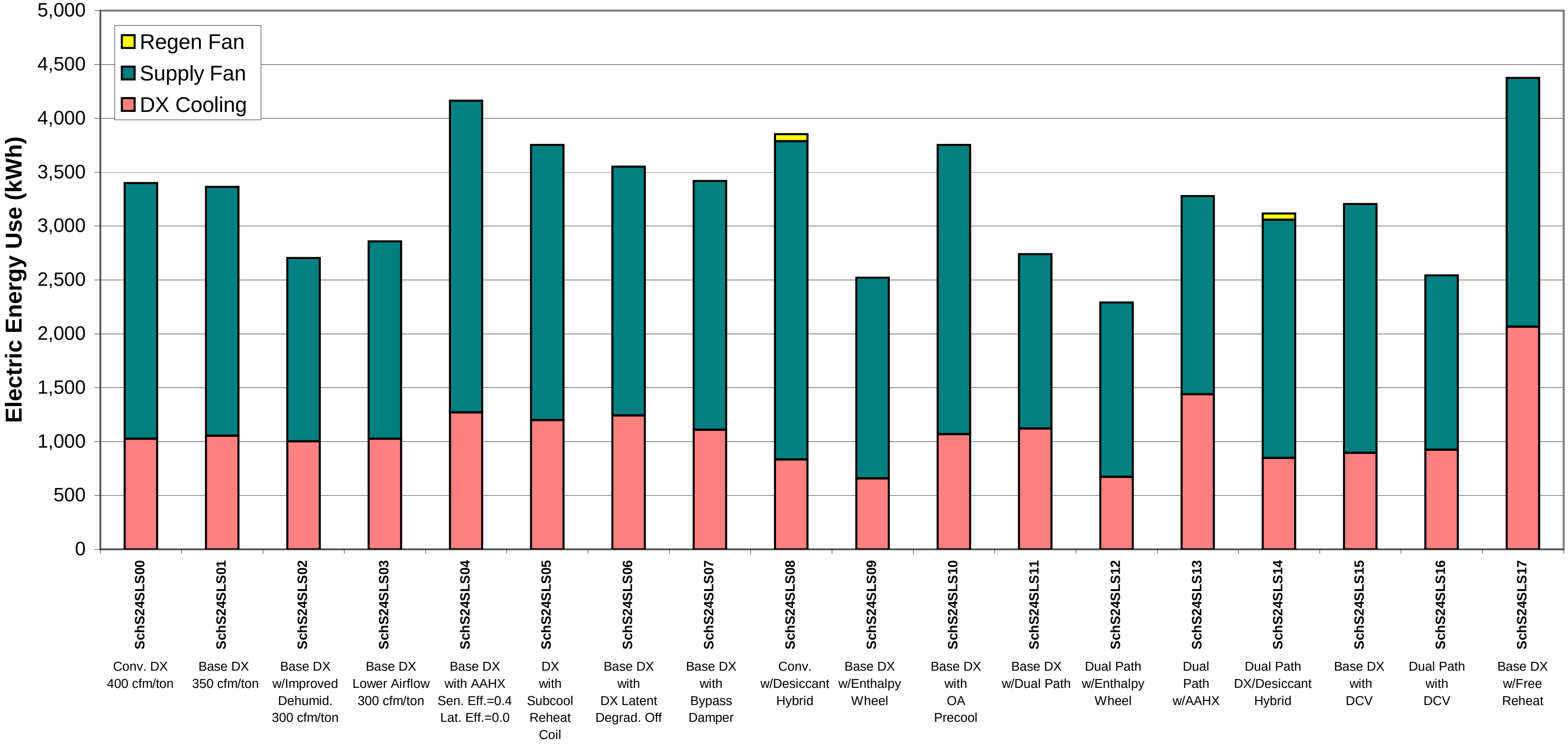
2004 Standard School-12 Month-South in Shreveport LA
Annual HVAC System Electric Energy Use

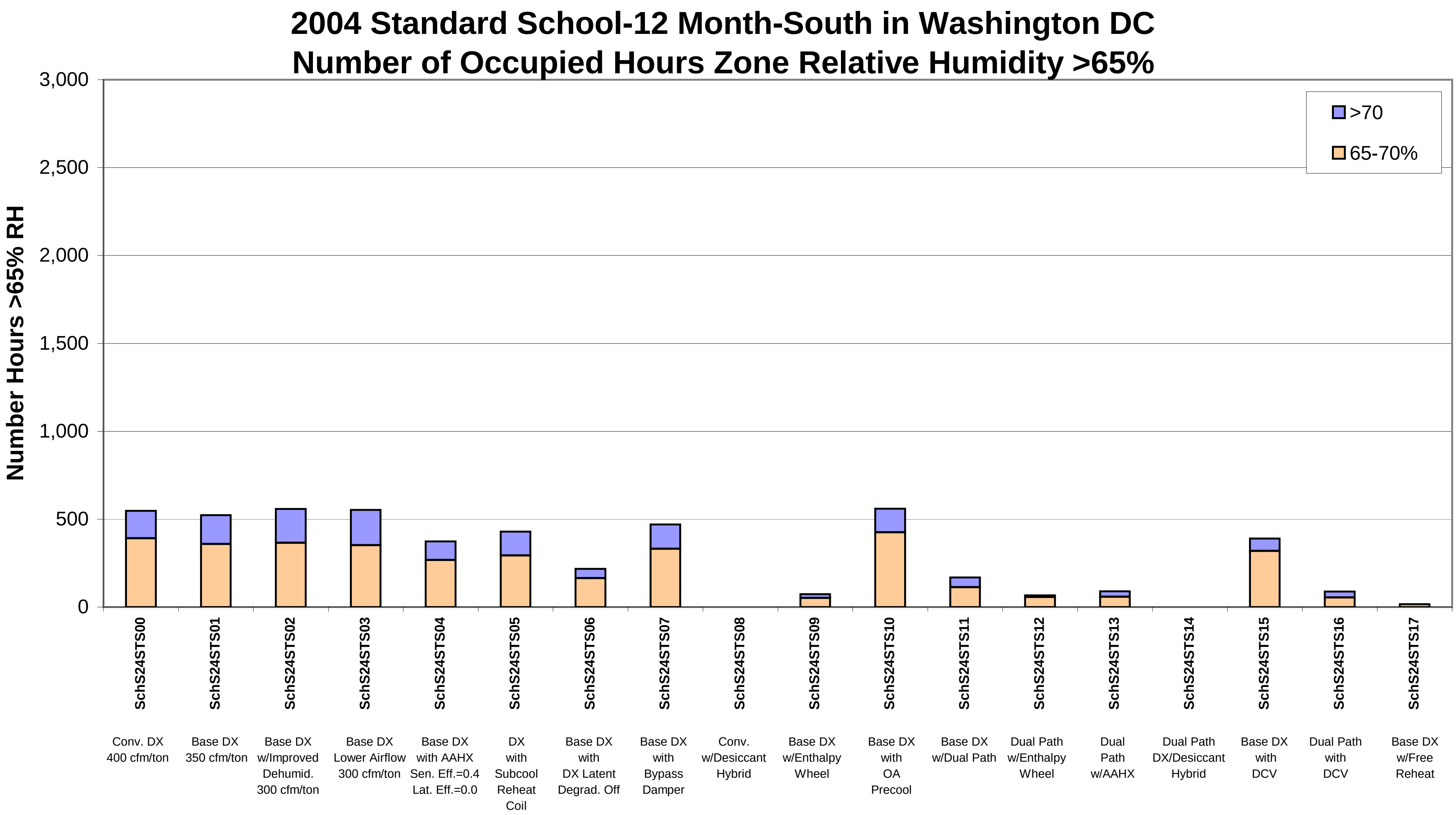


2004 Standard School-12 Month-South in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



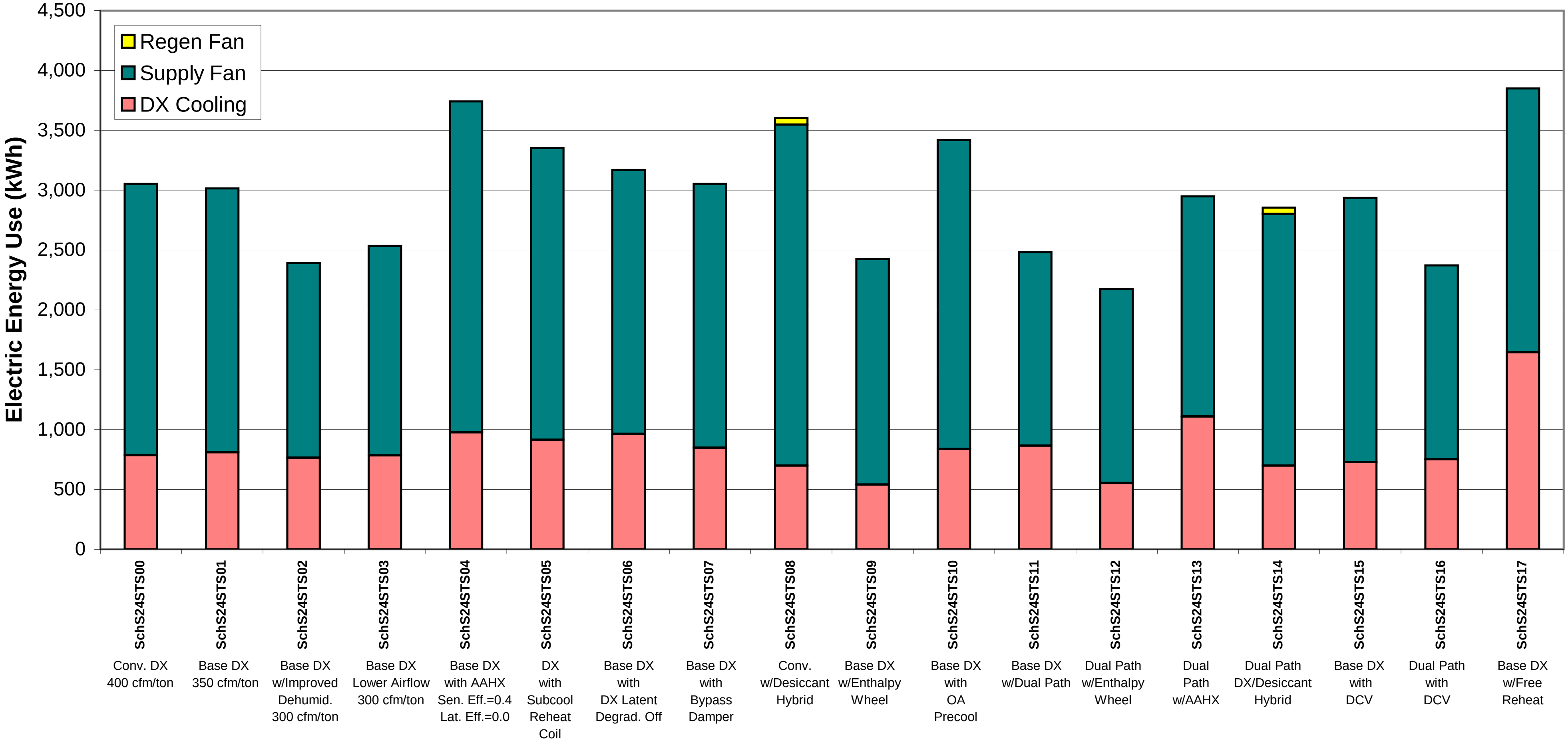
2004 Standard School-12 Month-South in St. Louis MO
Annual HVAC System Electric Energy Use



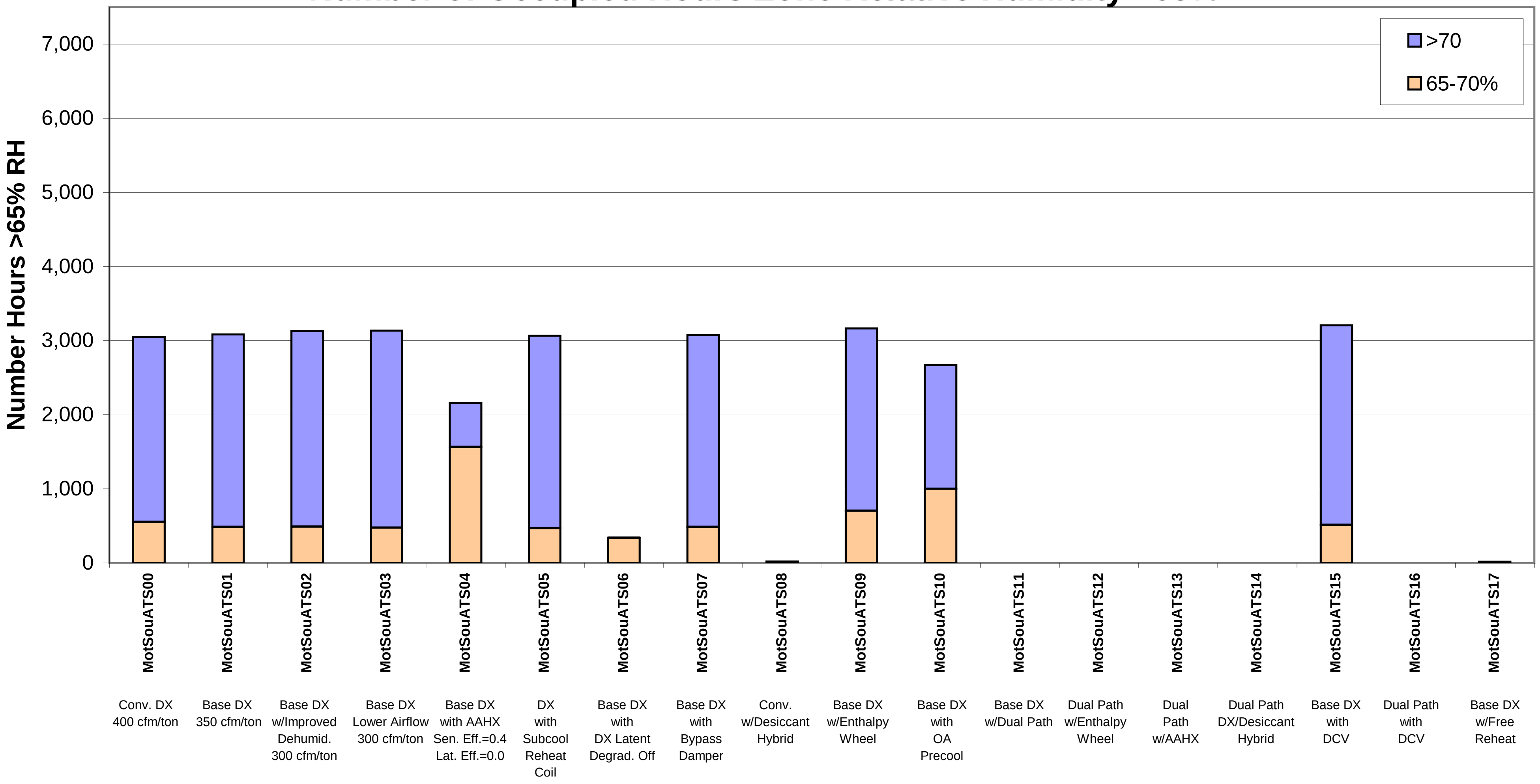


2004 Standard School-12 Month-South in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%
Number Hours >65% RH
3,000
2,500
2,000
1,500
1,000
500
0
>70
65-70%
SchS24STS00
SchS24STS01
SchS24STS02
SchS24STS03
SchS24STS04
SchS24STS05
SchS24STS06
SchS24STS07
SchS24STS08
SchS24STS09
SchS24STS10
SchS24STS11
SchS24STS12
SchS24STS13
SchS24STS14
SchS24STS15
SchS24STS16
SchS24STS17
Conv. DX 400 cfm/ton
Base DX 350 cfm/ton
Base DX w/Improved Dehumid. 300 cfm/ton
Base DX Lower Airflow 300 cfm/ton
Base DX with AAHX Sen. Eff.=0.4 Lat. Eff.=0.0
DX with Subcool Reheat Coil
Base DX with DX Latent Degrad. Off
Base DX with Bypass Damper
Conv. w/Desiccant Hybrid
Base DX w/Enthalpy Wheel
Base DX with OA Precool
Base DX w/Dual Path
Dual Path w/Enthalpy Wheel
Dual Path w/AAHX
Dual Path DX/Desiccant Hybrid
Base DX with DCV
Dual Path with DCV
Base DX w/Free Reheat

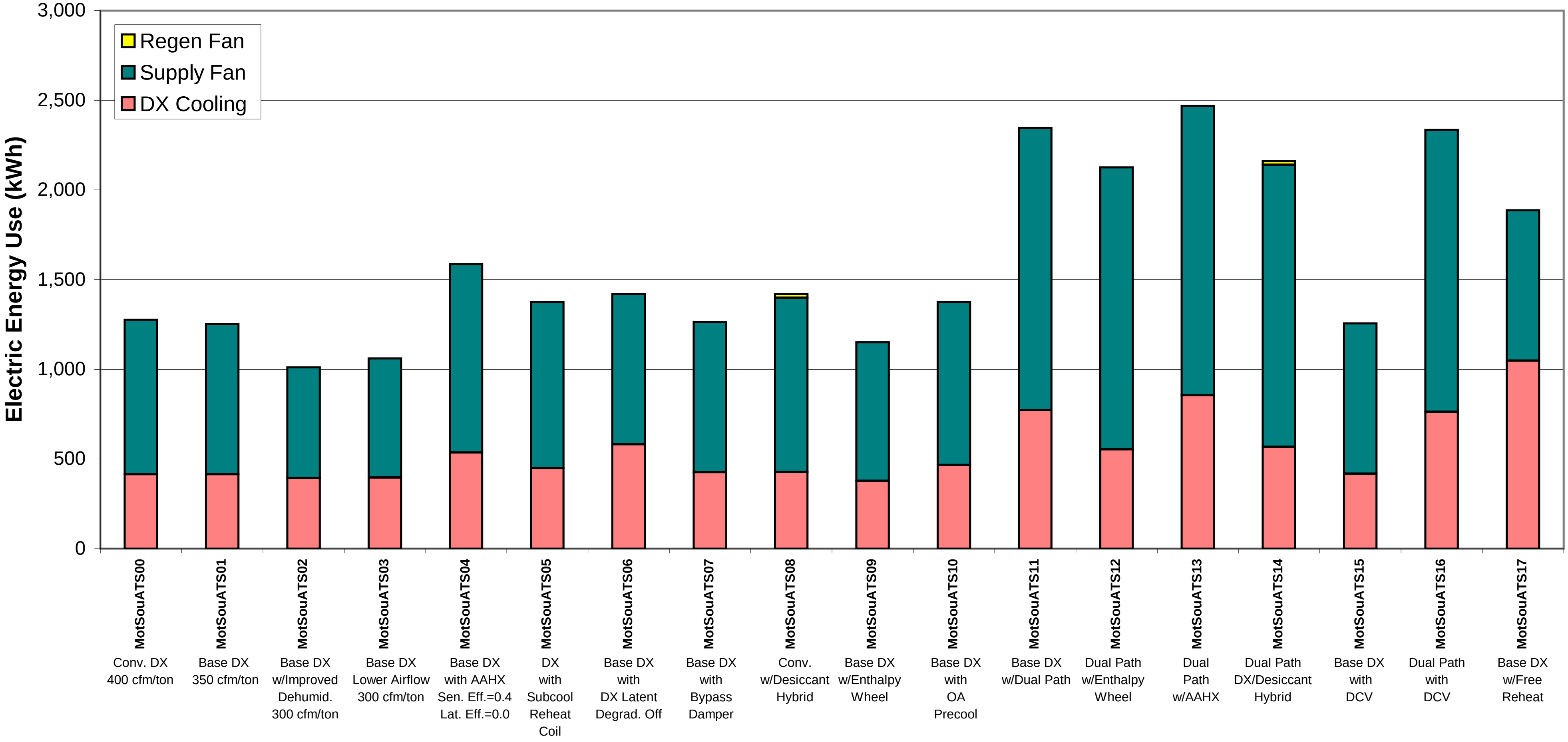
2004 Standard School-12 Month-South in Washington DC
Annual HVAC System Electric Energy Use



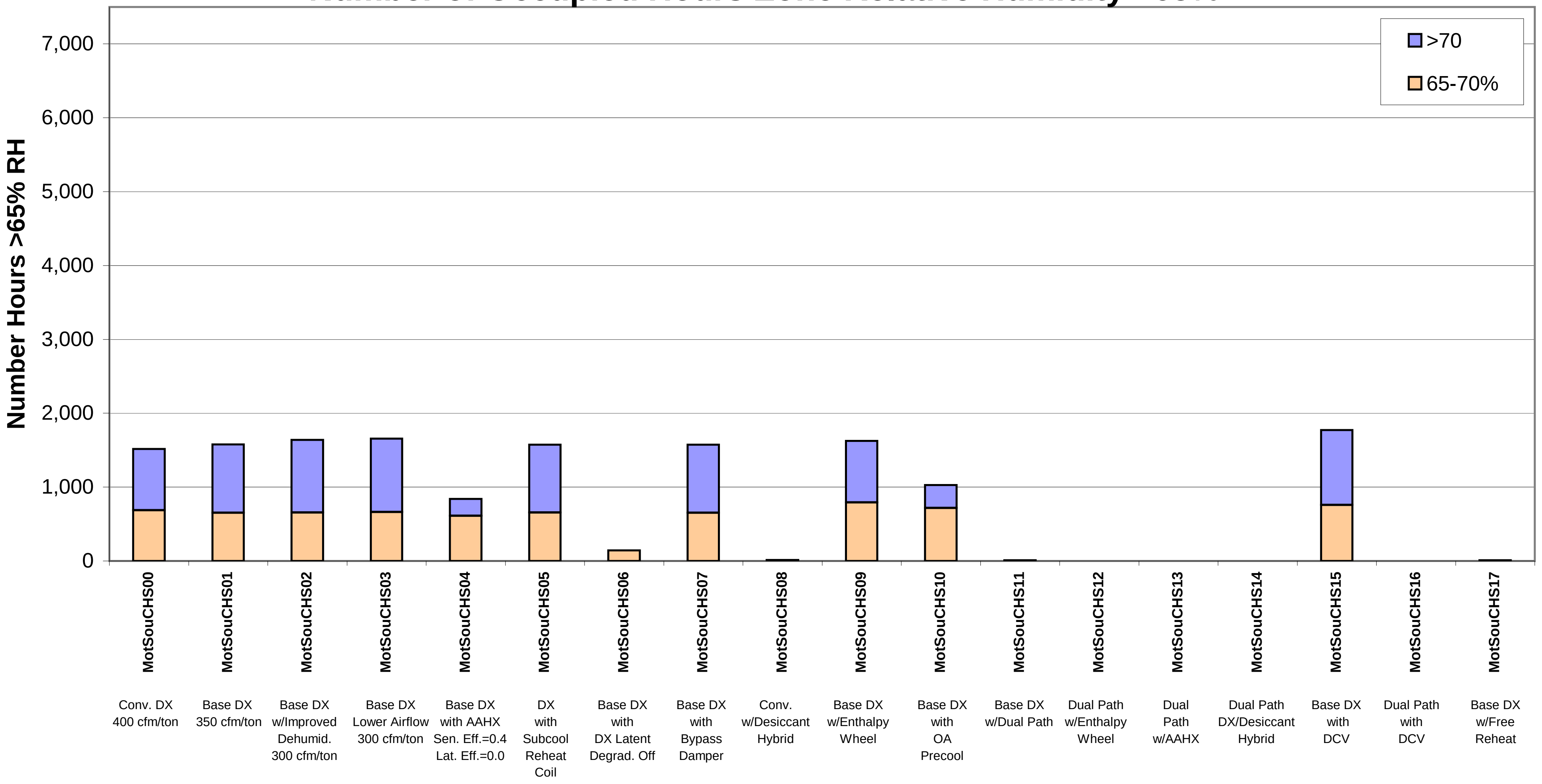
2004 Standard Motel-South in Atlanta GA
Number of Occupied Hours Zone Relative Humidity >65%



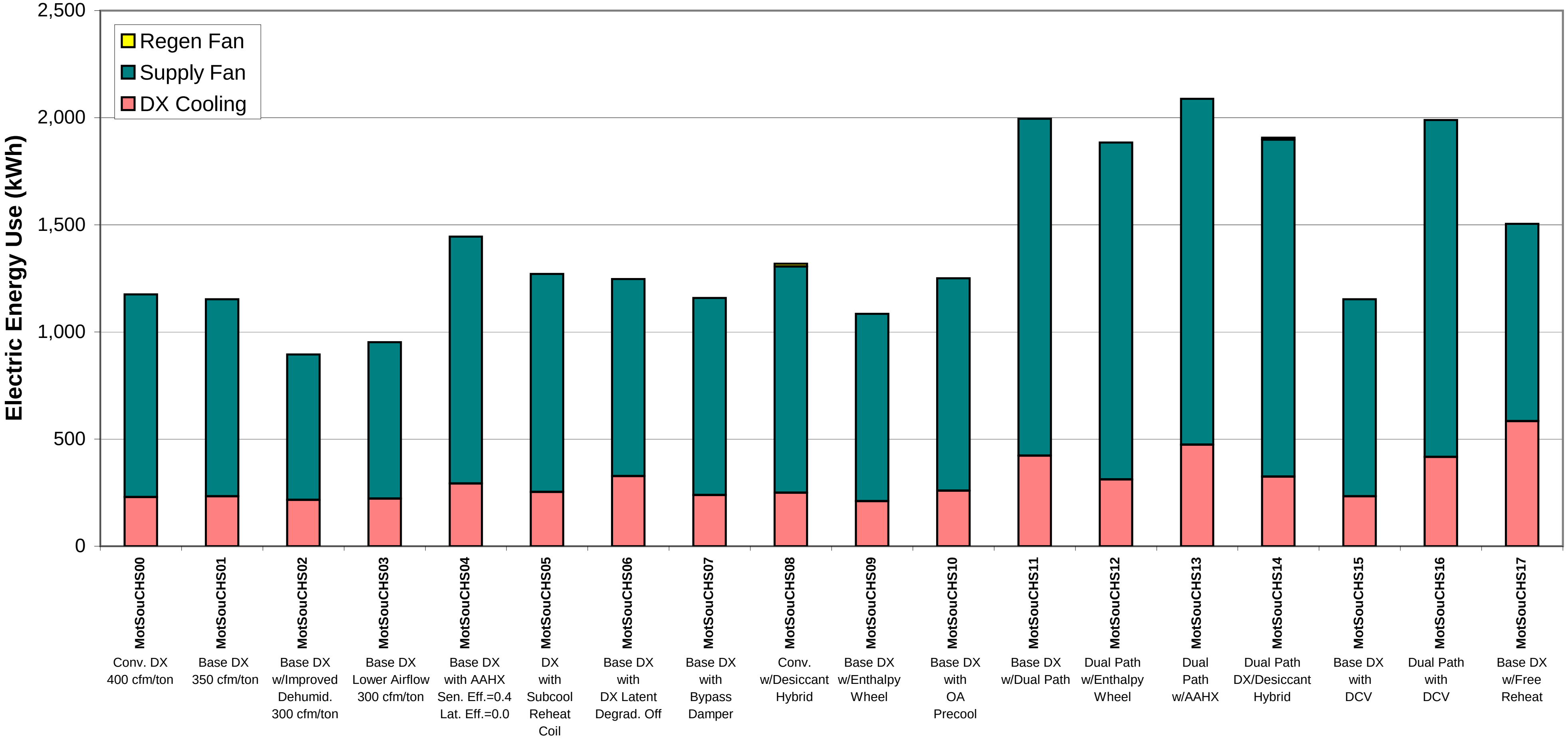
2004 Standard Motel-South in Atlanta GA
Annual HVAC System Electric Energy Use



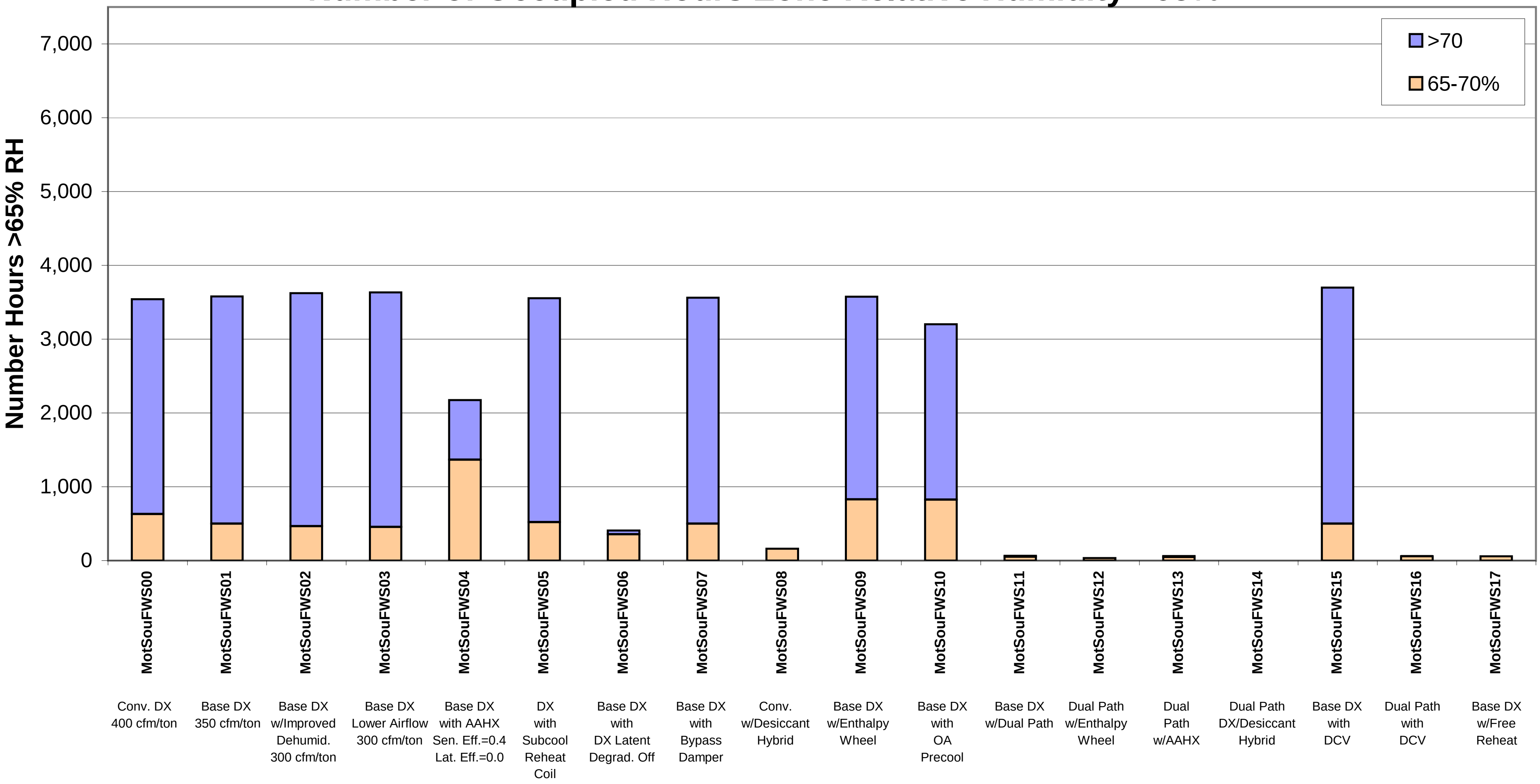
2004 Standard Motel-South in Chicago IL
Number of Occupied Hours Zone Relative Humidity >65%



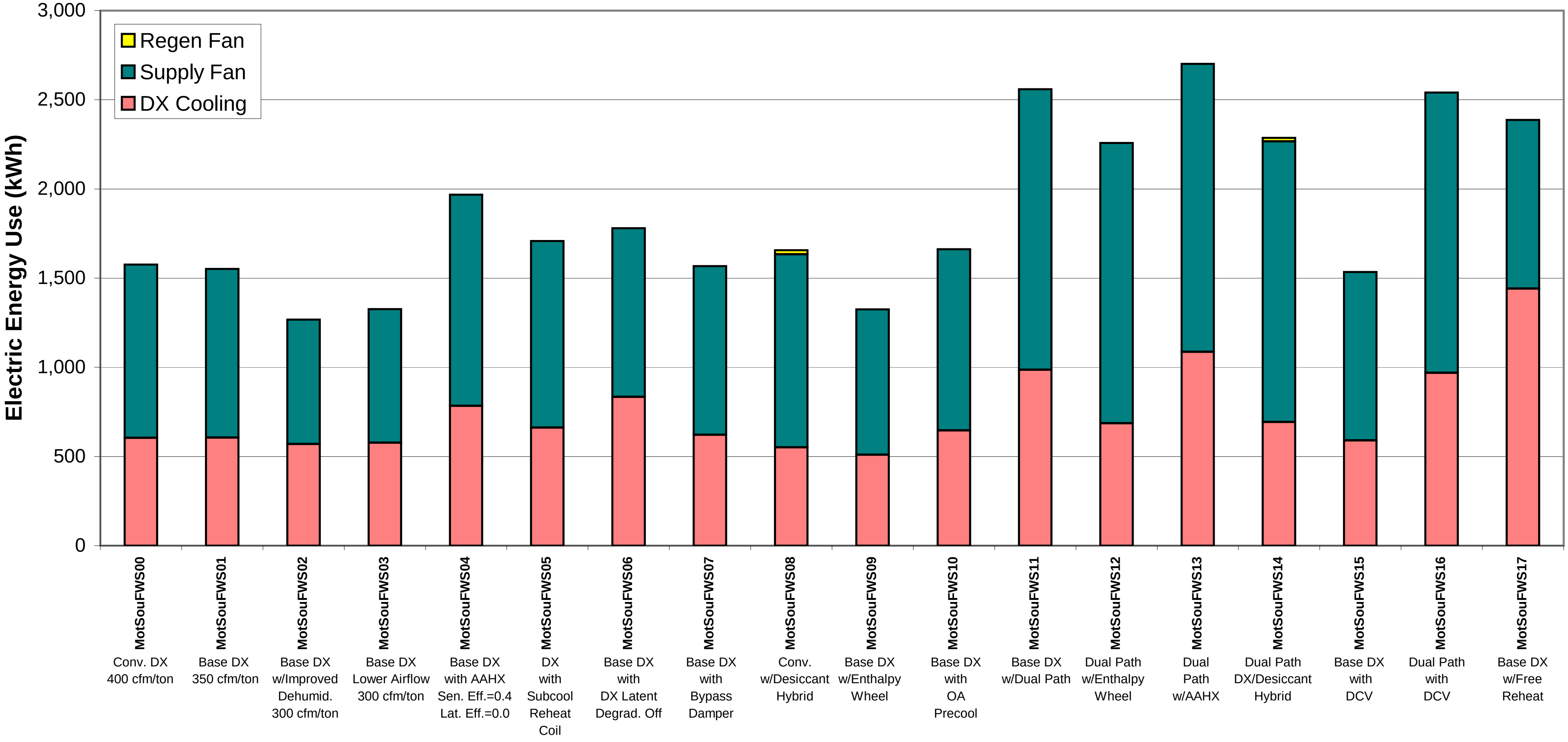
2004 Standard Motel-South in Chicago IL
Annual HVAC System Electric Energy Use



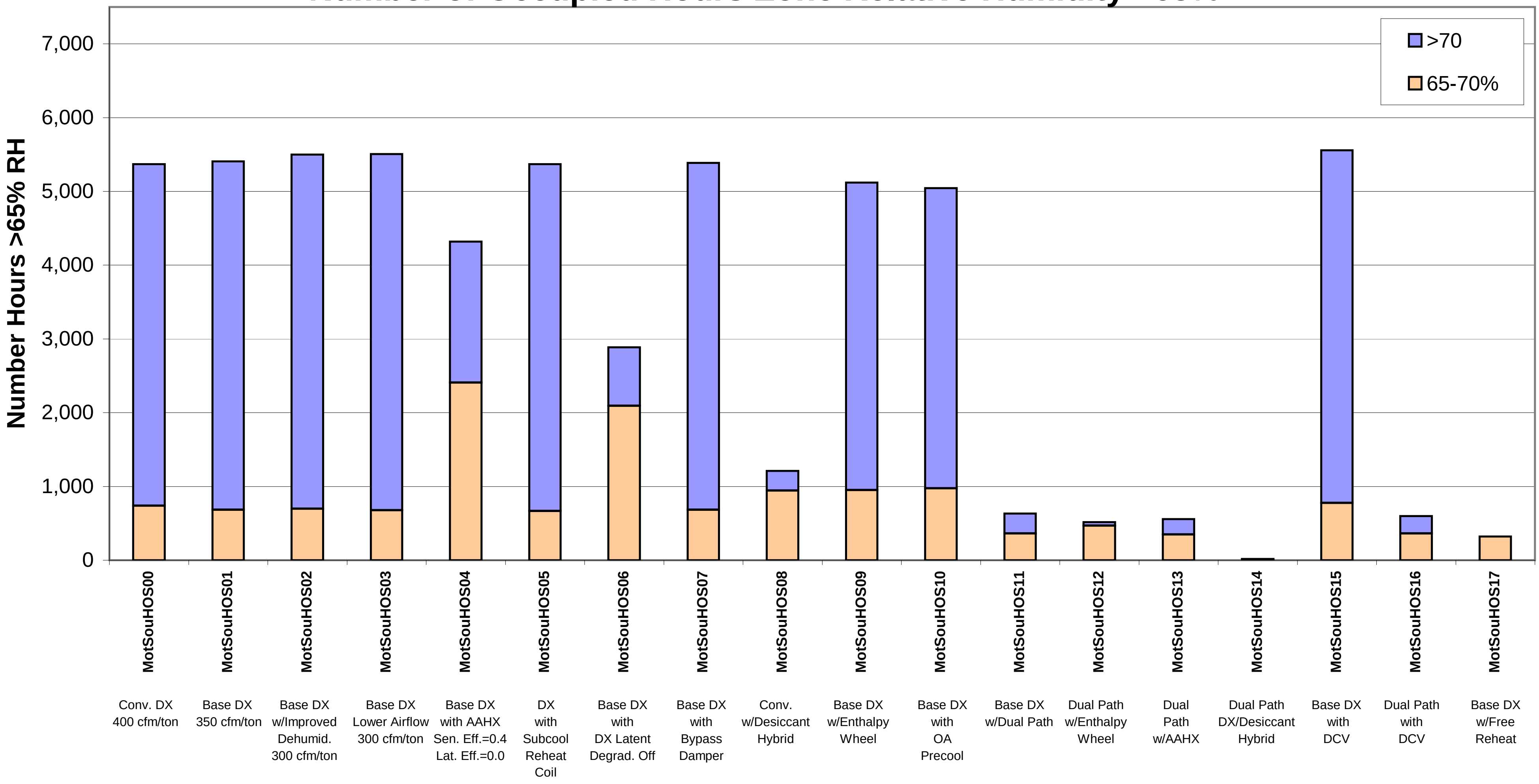
2004 Standard Motel-South in Fort Worth TX
Number of Occupied Hours Zone Relative Humidity >65%



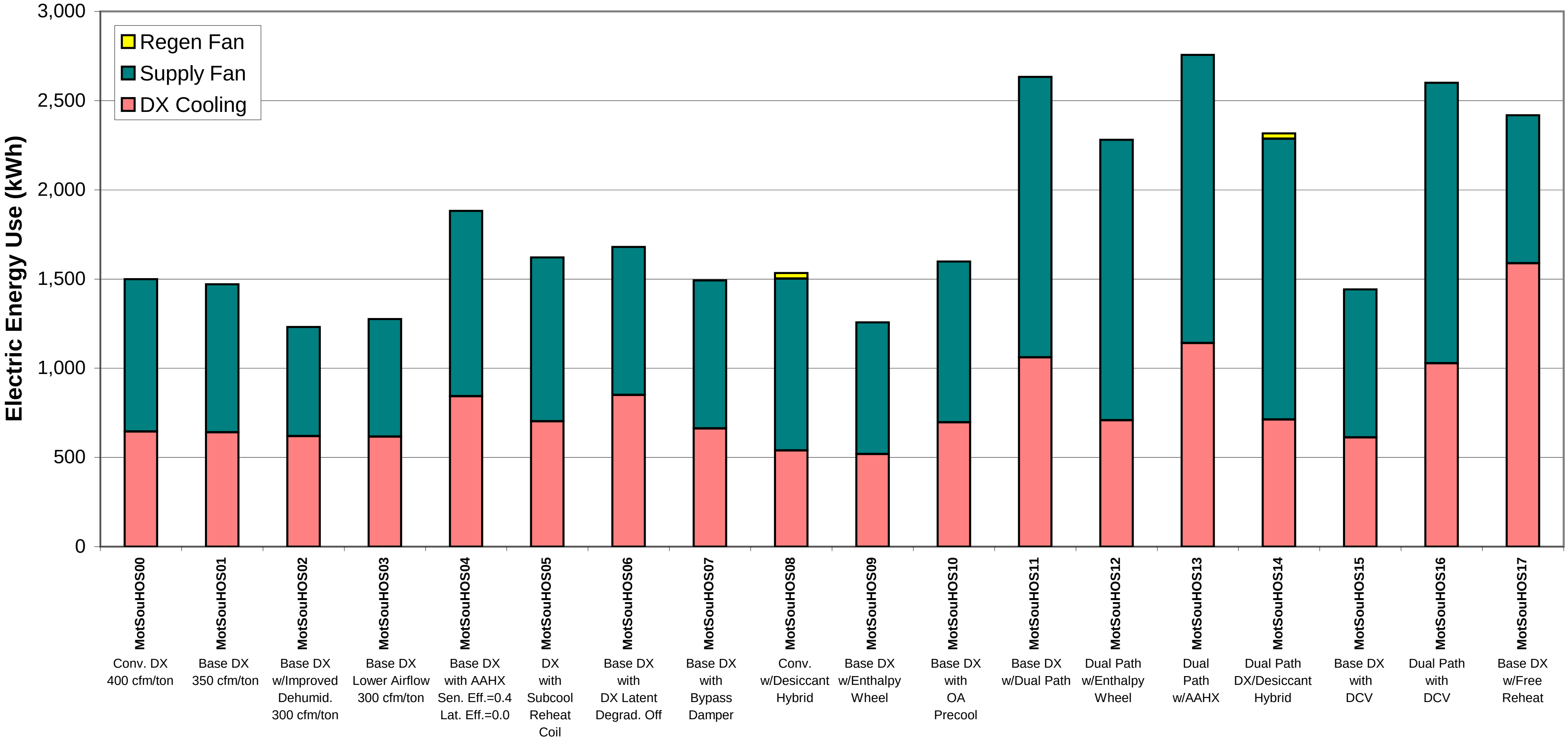
2004 Standard Motel-South in Fort Worth TX
Annual HVAC System Electric Energy Use



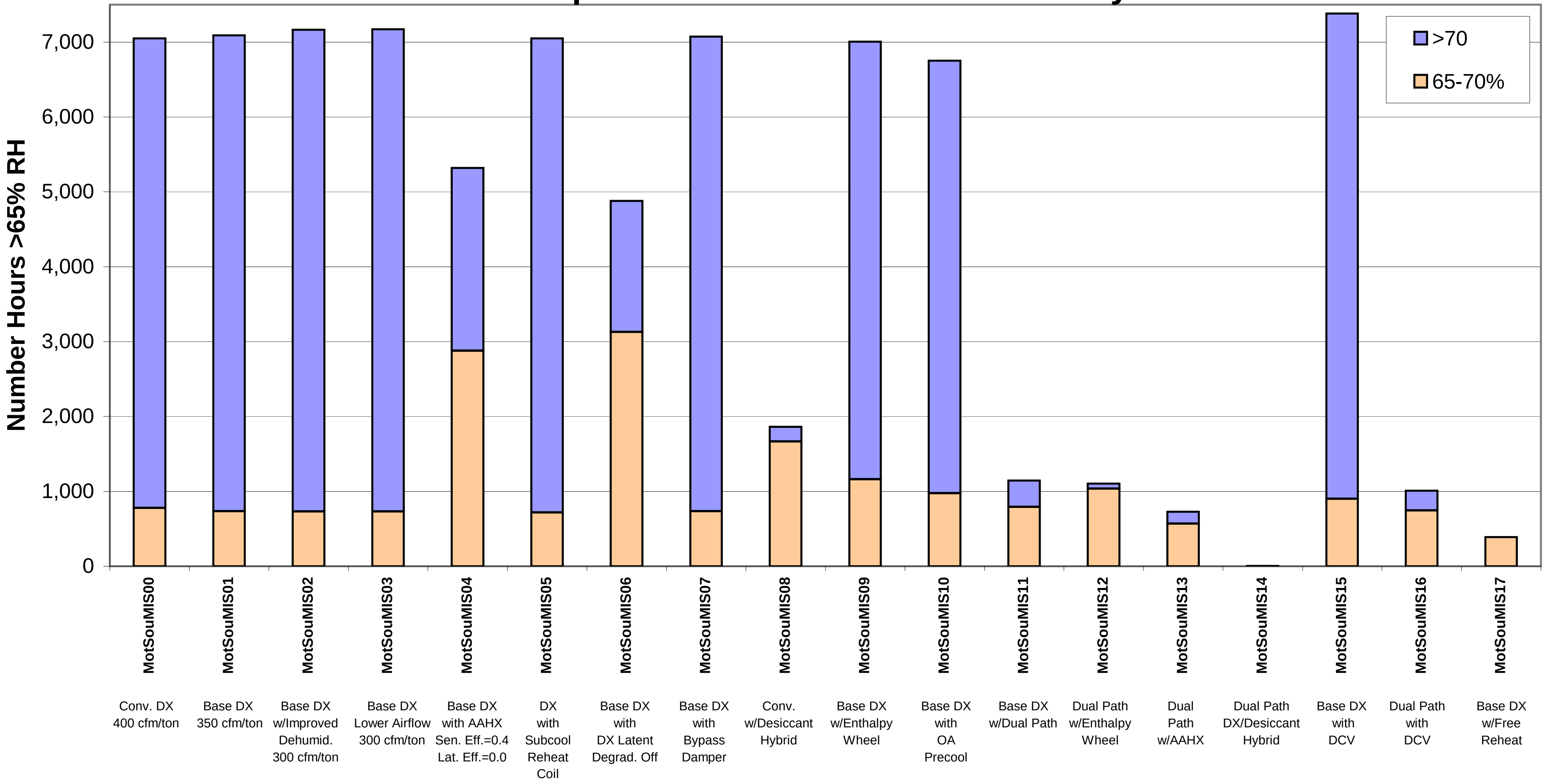
2004 Standard Motel-South in Houston TX
Number of Occupied Hours Zone Relative Humidity >65%



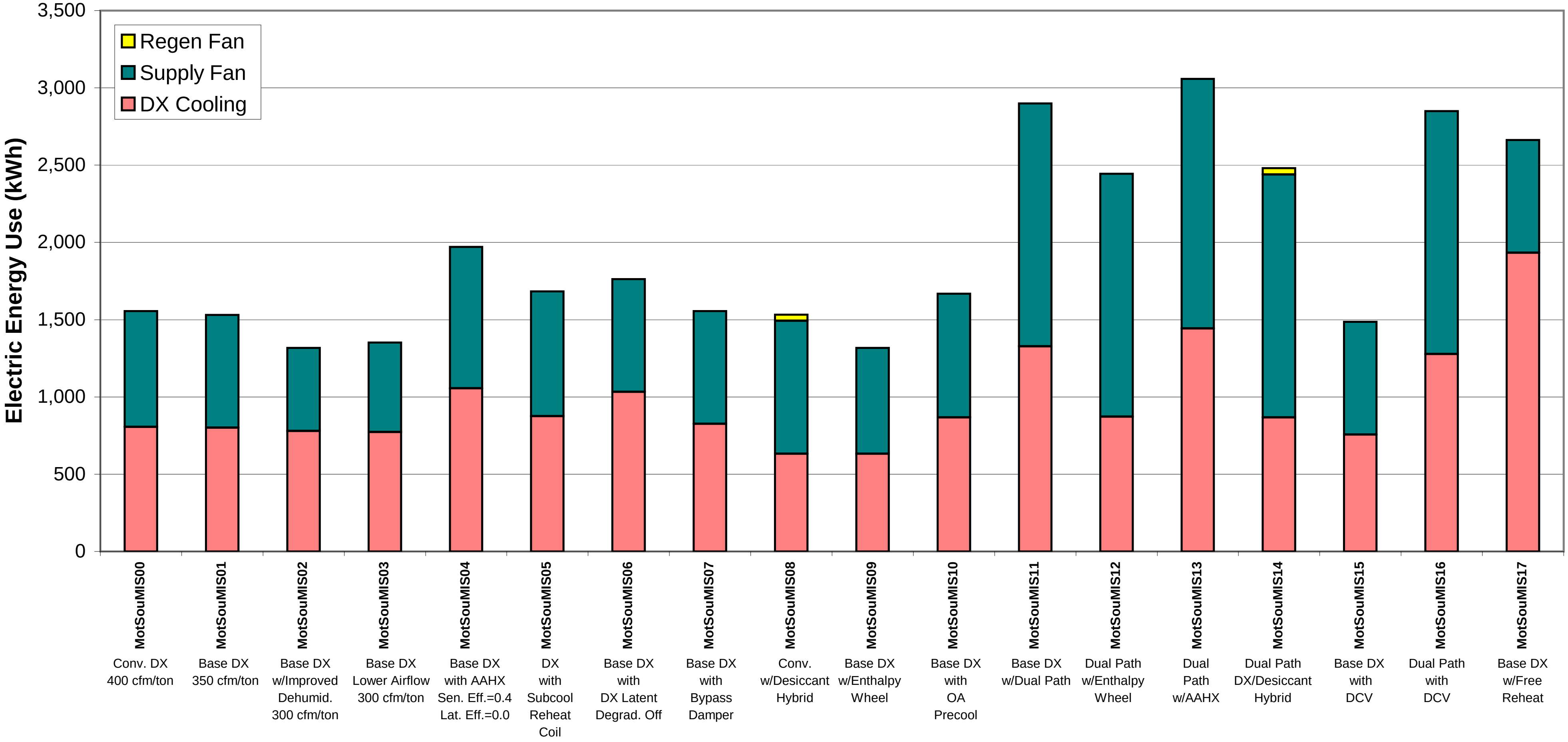
2004 Standard Motel-South in Houston TX
Annual HVAC System Electric Energy Use



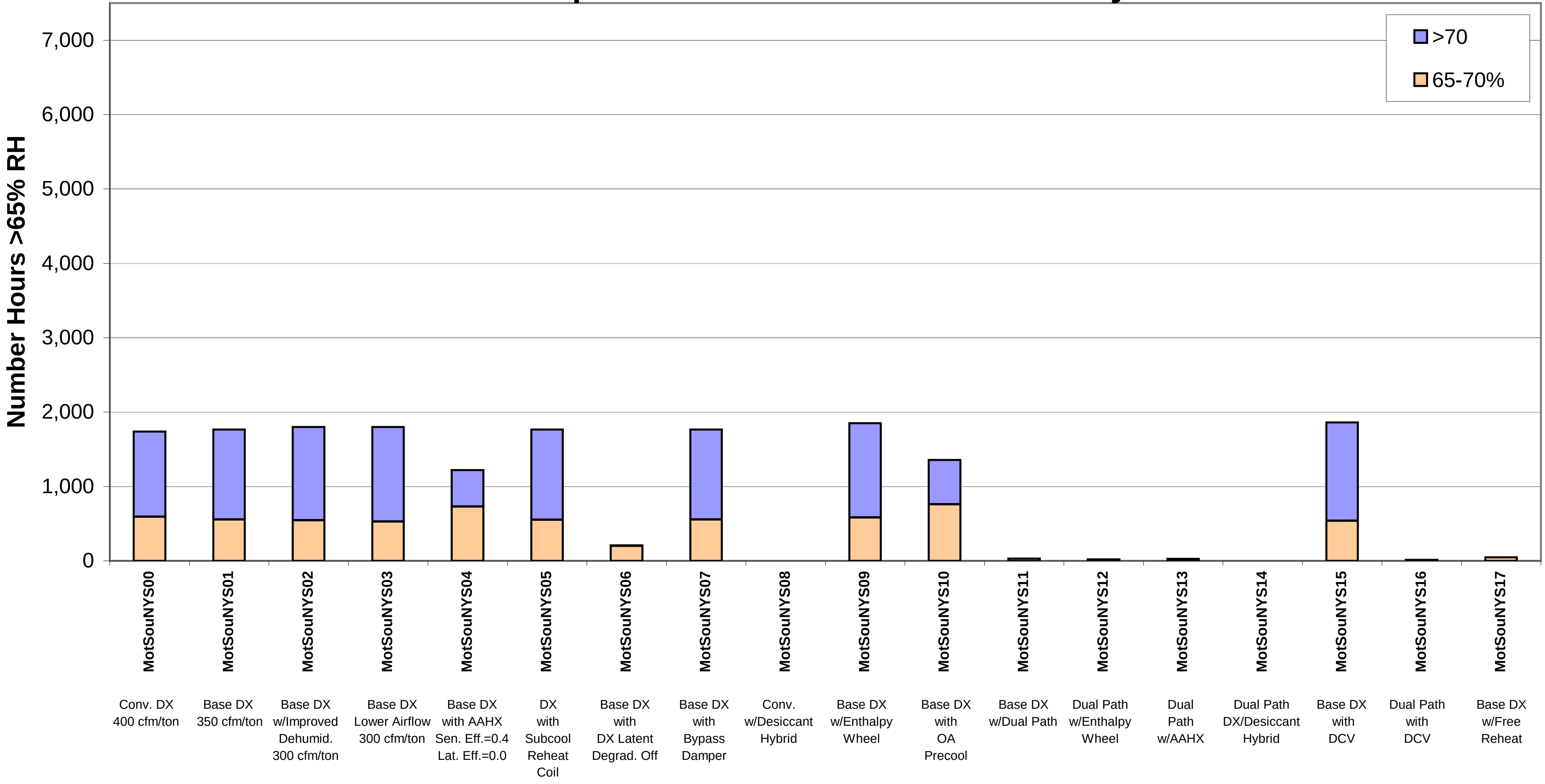
2004 Standard Motel-South in Miami FL
Number of Occupied Hours Zone Relative Humidity >65%



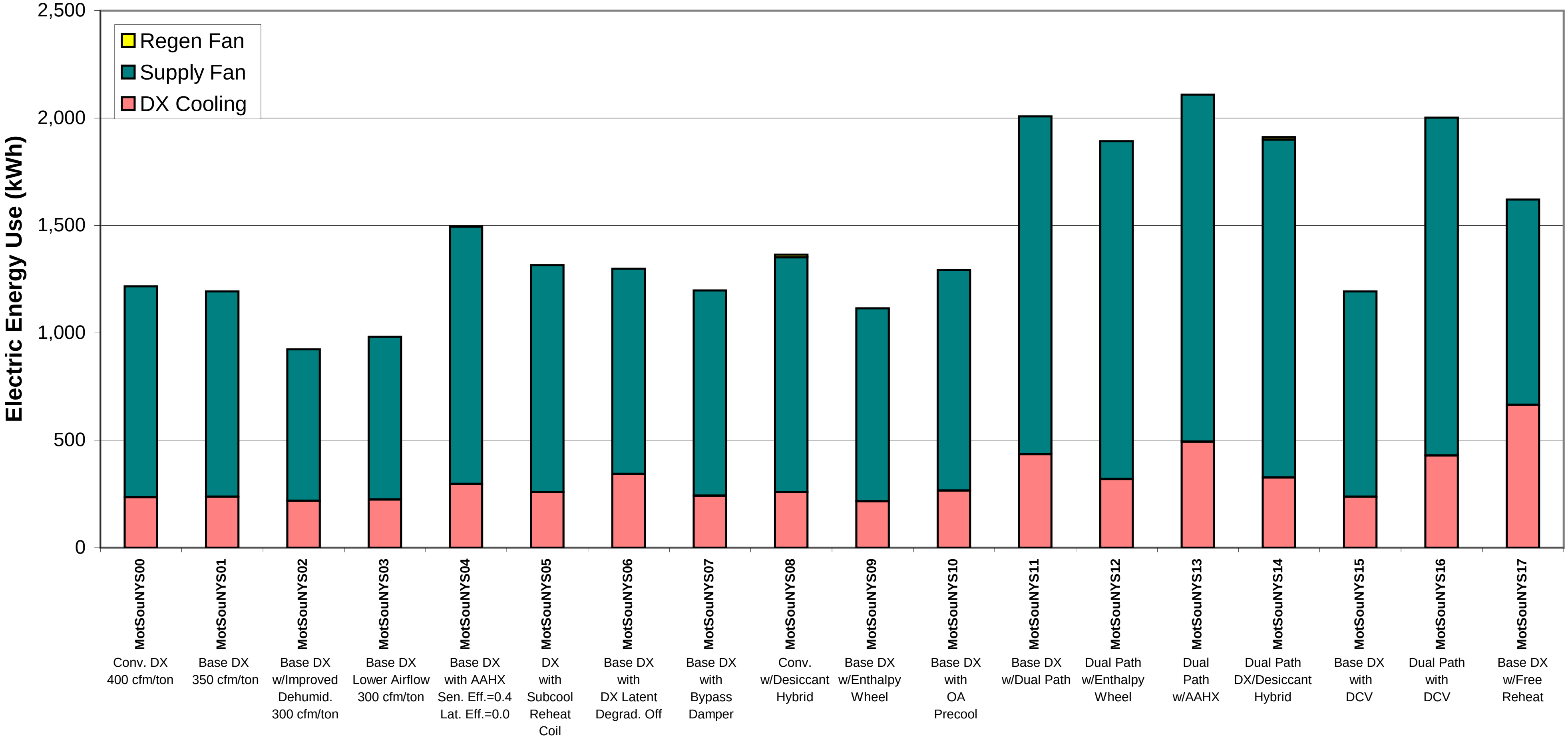
2004 Standard Motel-South in Miami FL
Annual HVAC System Electric Energy Use



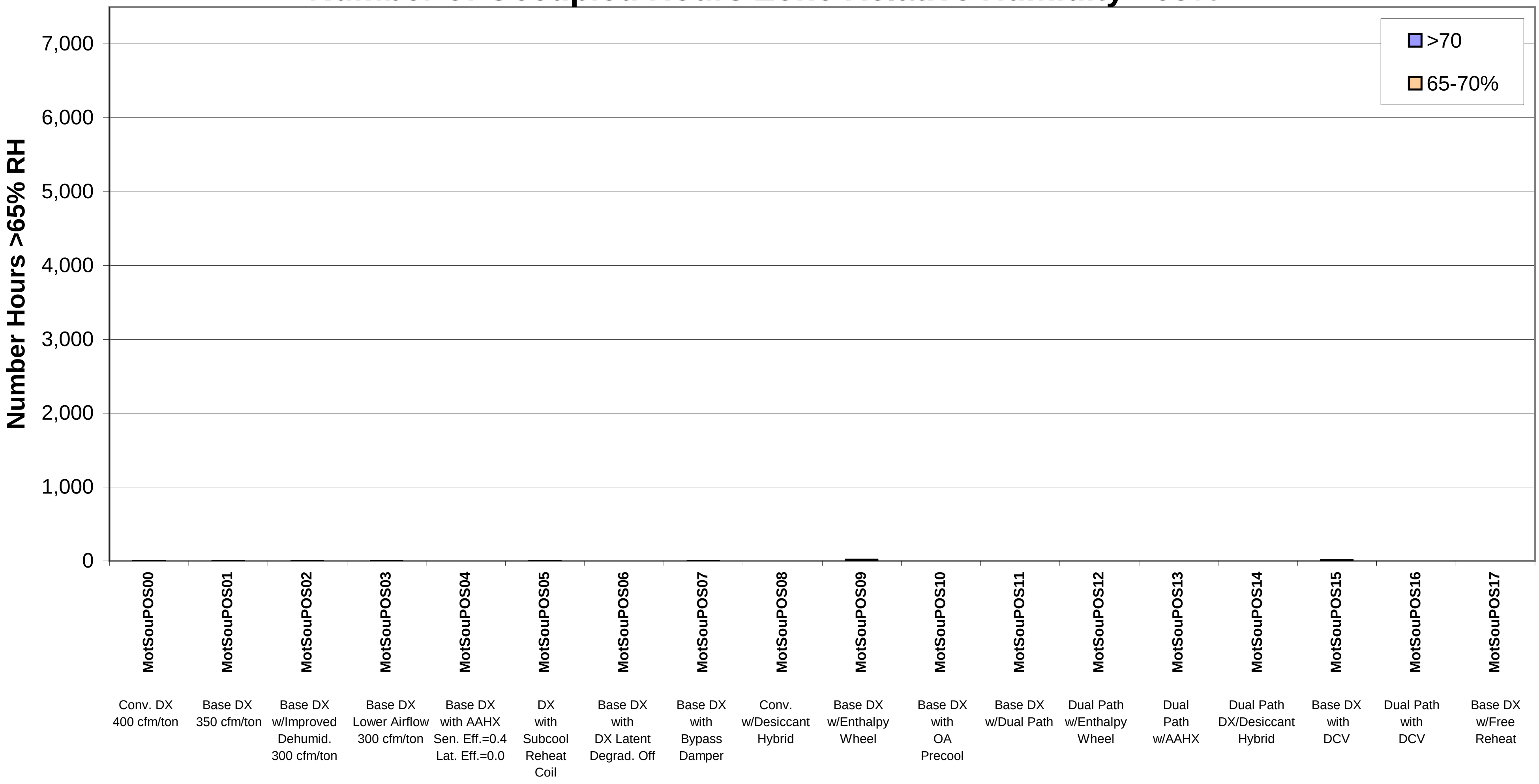
2004 Standard Motel-South in New York NY
Number of Occupied Hours Zone Relative Humidity >65%



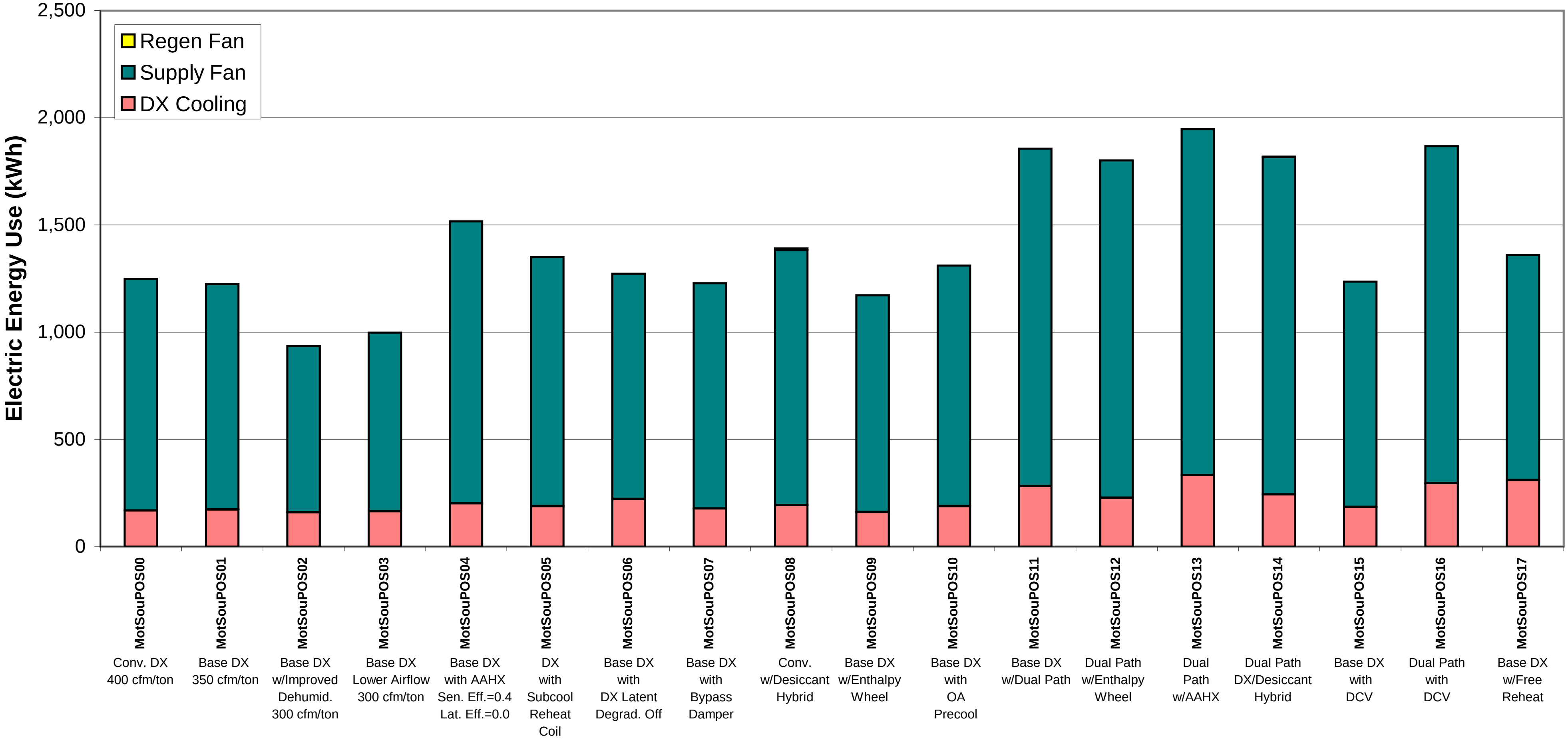
2004 Standard Motel-South in New York NY
Annual HVAC System Electric Energy Use



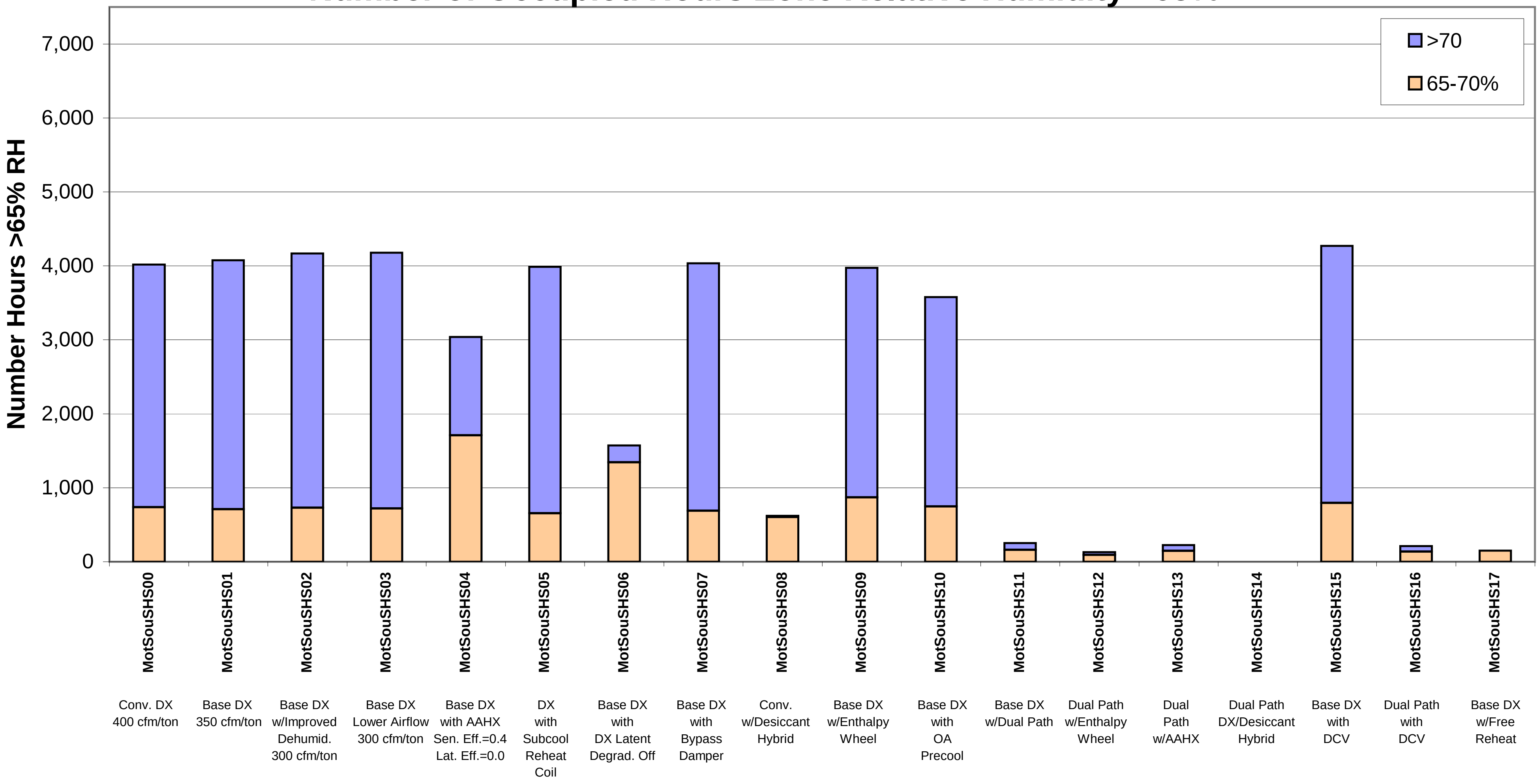
2004 Standard Motel-South in Portland OR
Number of Occupied Hours Zone Relative Humidity >65%



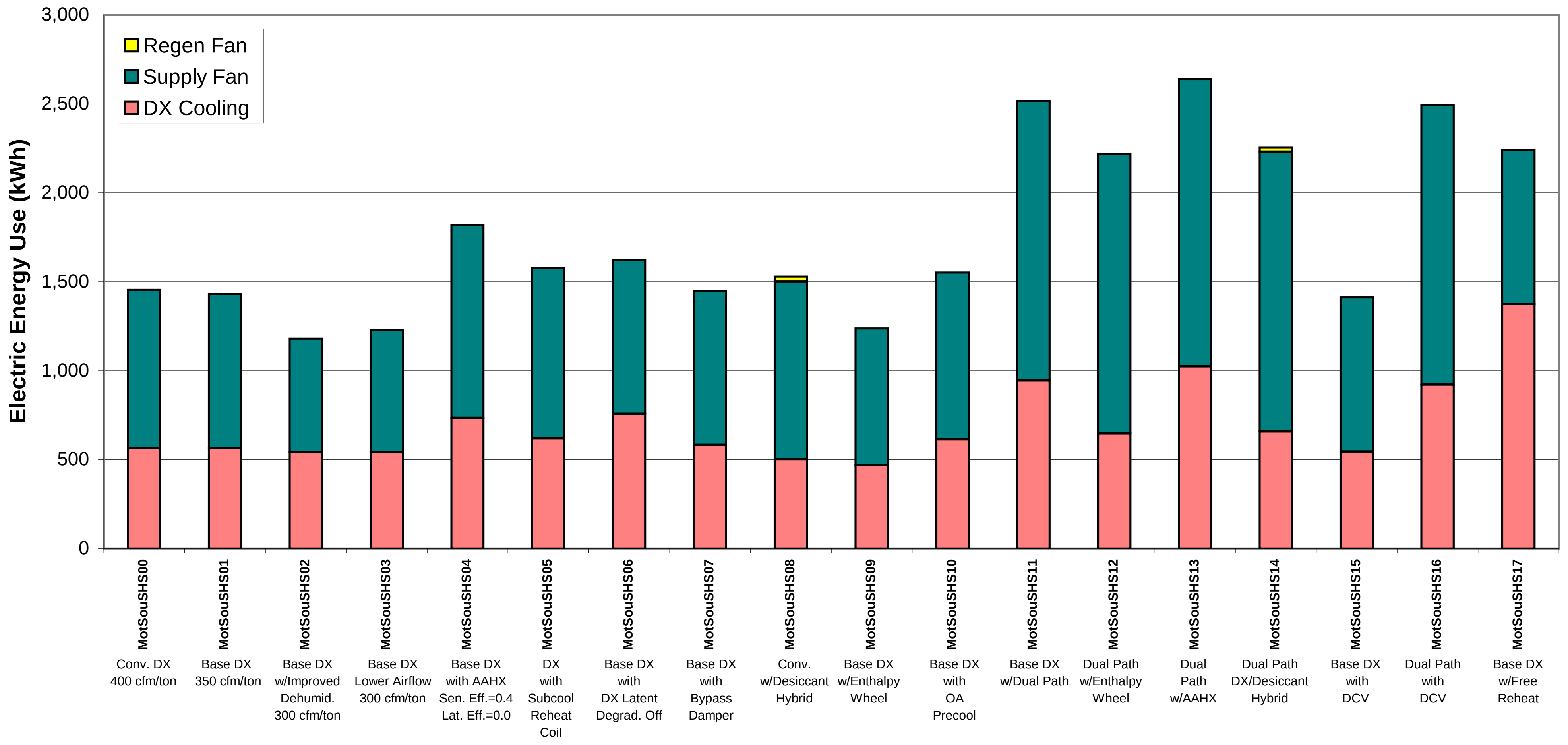
2004 Standard Motel-South in Portland OR
Annual HVAC System Electric Energy Use



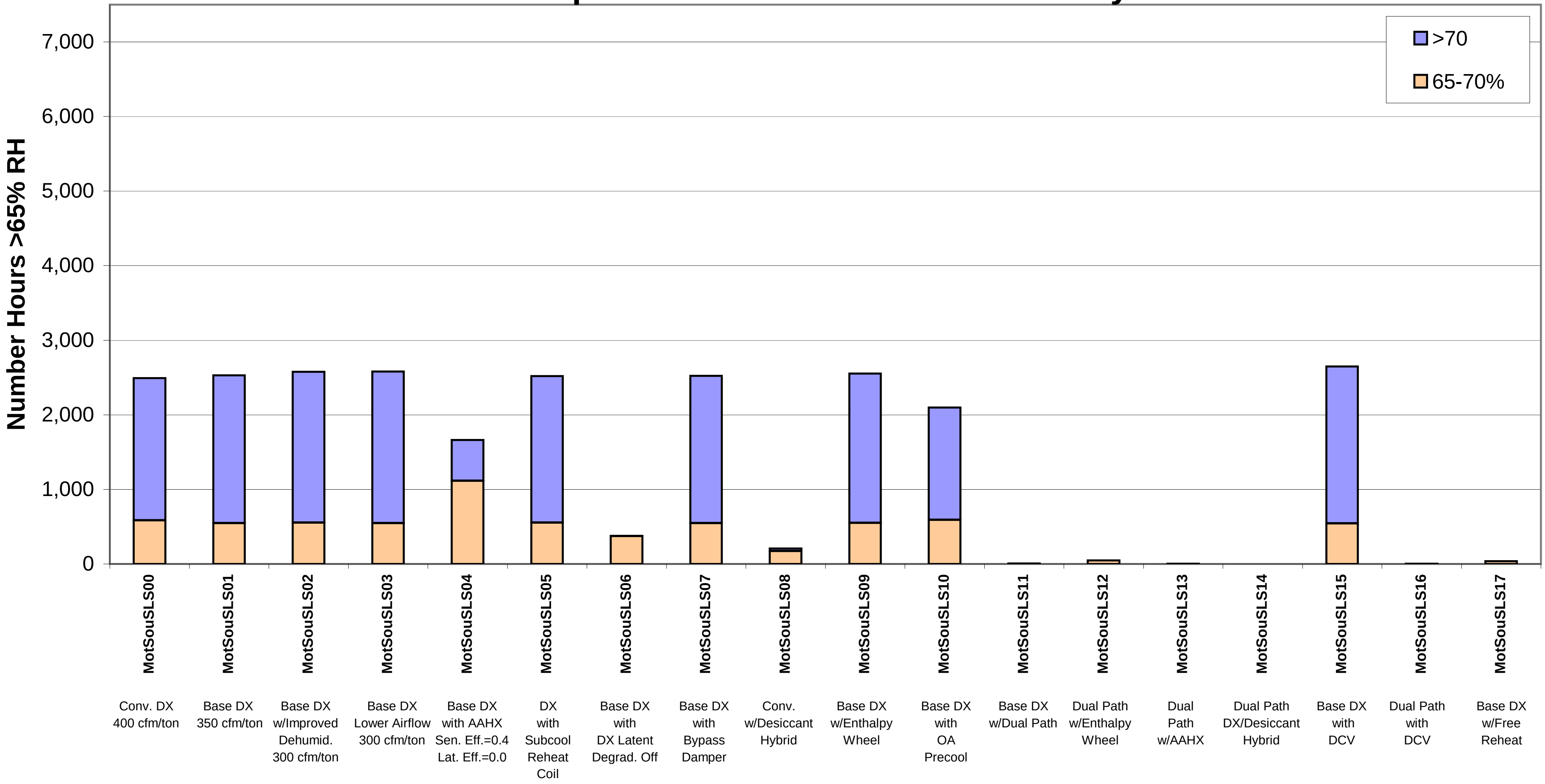
2004 Standard Motel-South in Shreveport LA
Number of Occupied Hours Zone Relative Humidity >65%



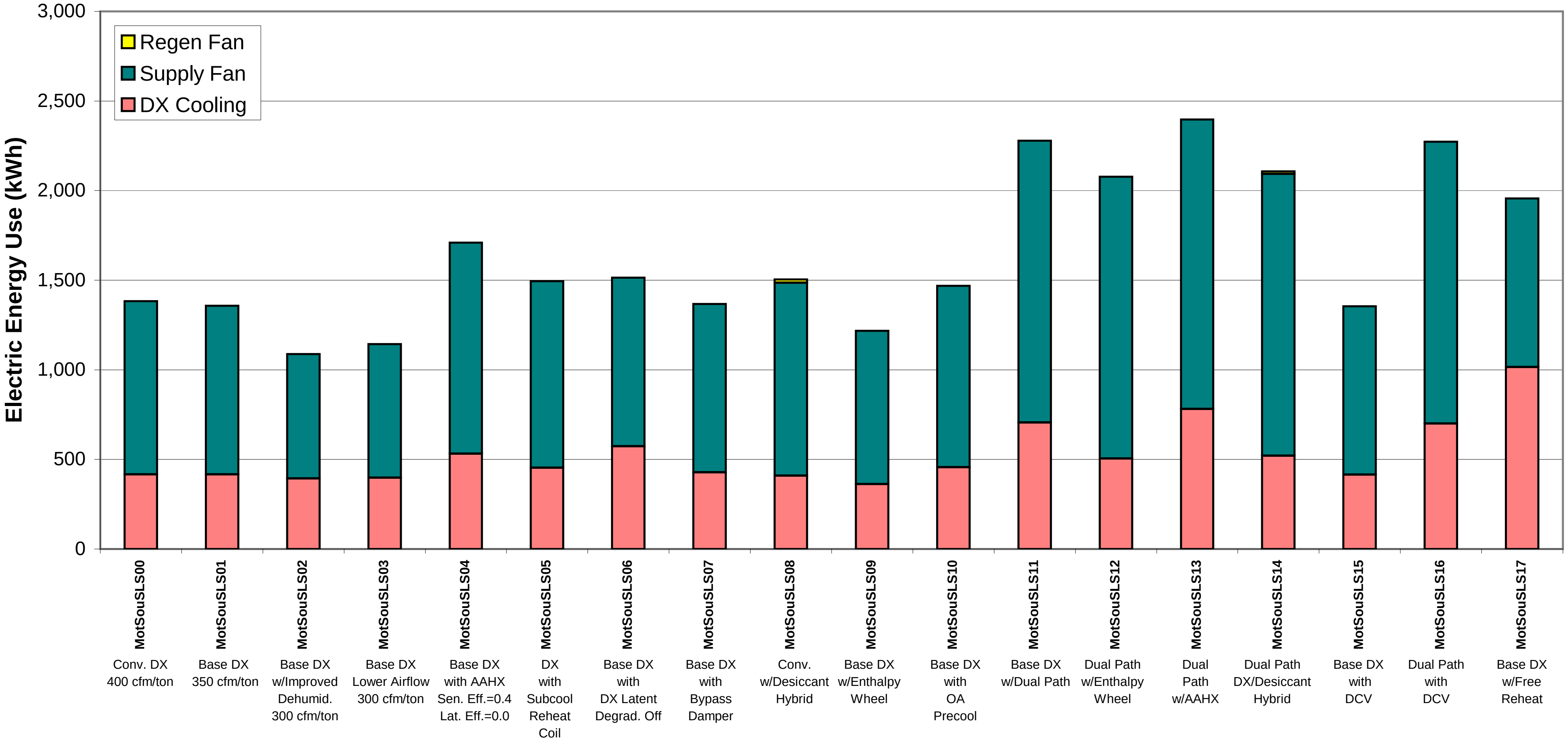
2004 Standard Motel-South in Shreveport LA
Annual HVAC System Electric Energy Use



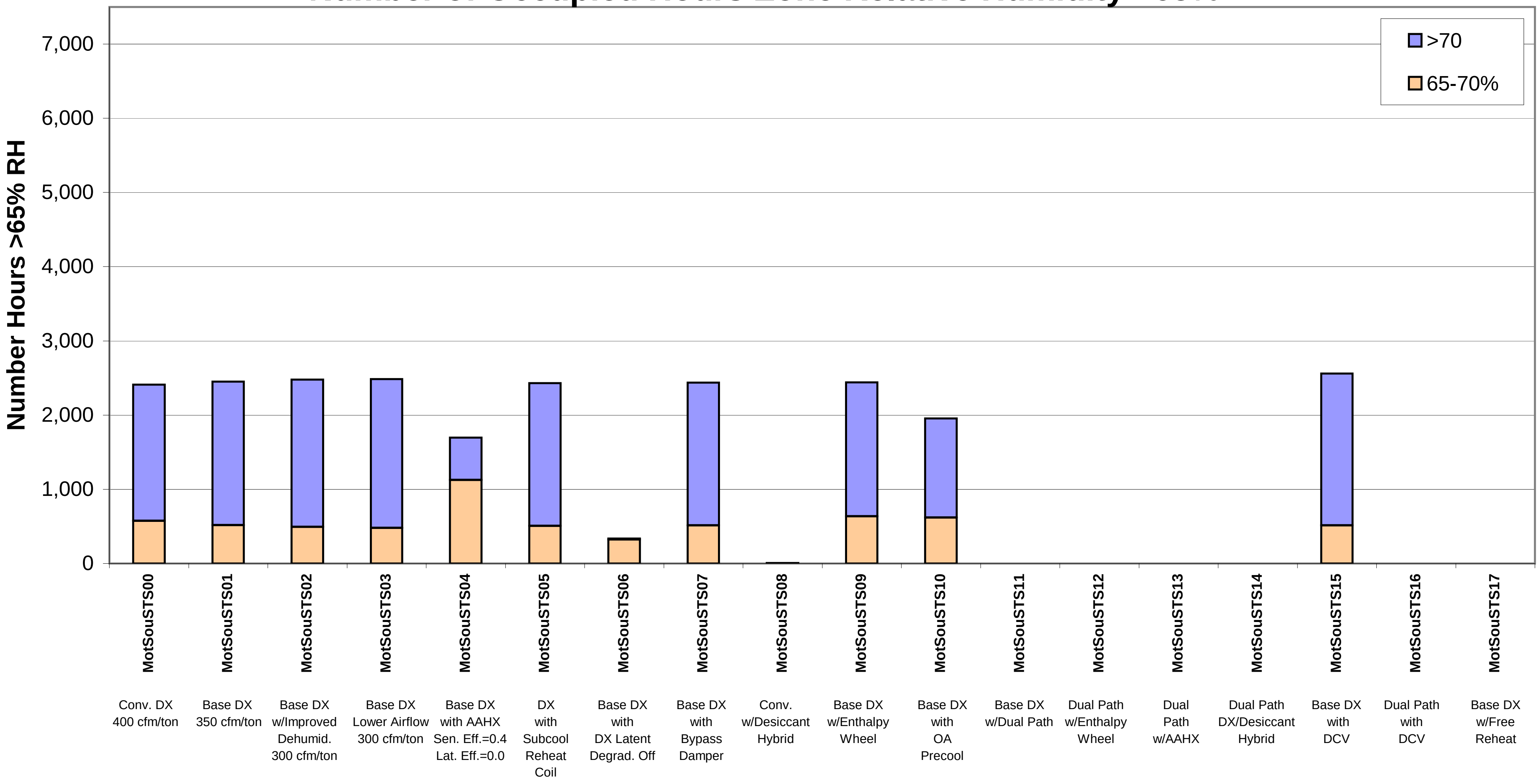
2004 Standard Motel-South in St. Louis MO
Number of Occupied Hours Zone Relative Humidity >65%



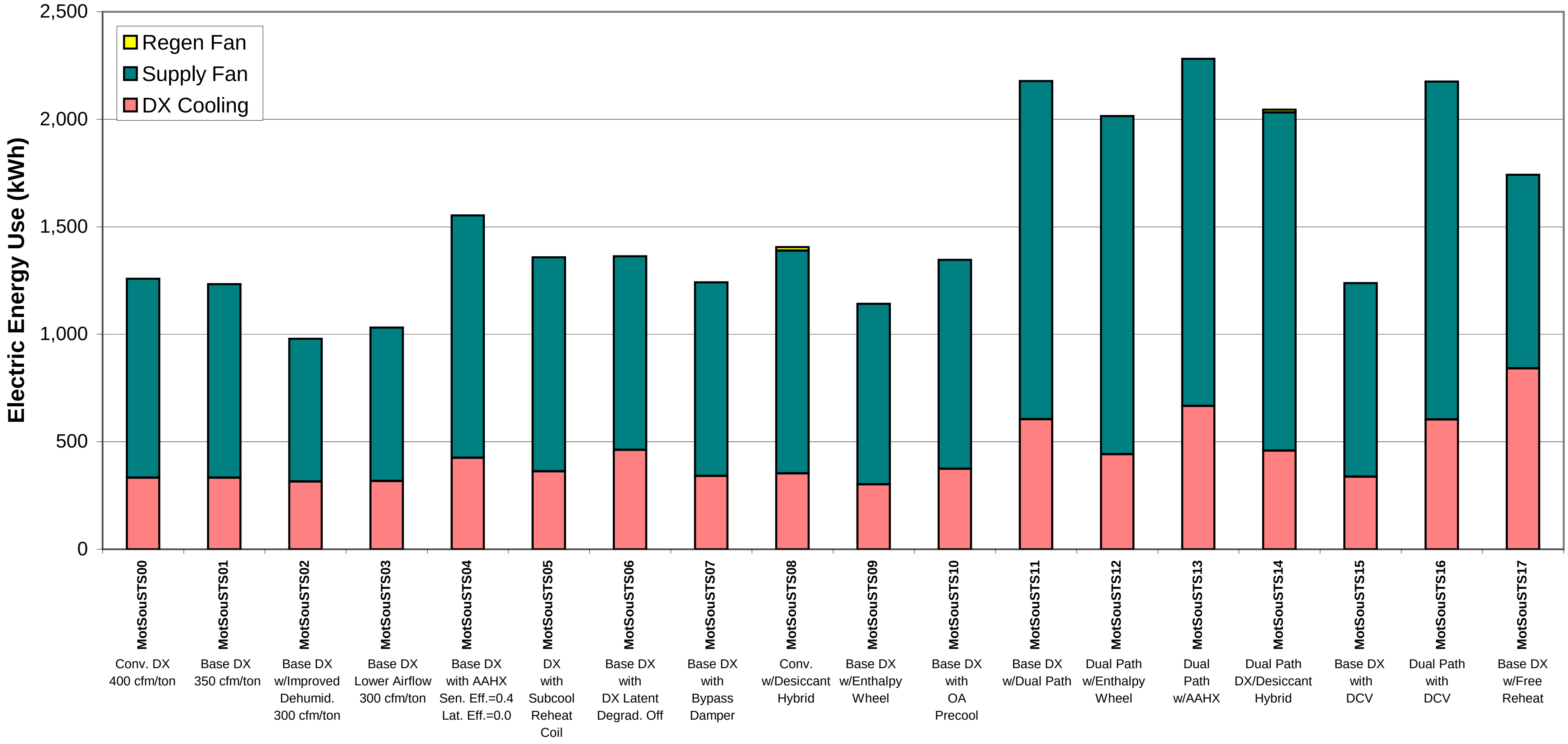
2004 Standard Motel-South in St. Louis MO
Annual HVAC System Electric Energy Use



2004 Standard Motel-South in Washington DC
Number of Occupied Hours Zone Relative Humidity >65%



2004 Standard Motel-South in Washington DC
Annual HVAC System Electric Energy Use



Office

2004 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	15	9	2	1	0	1	0	0	0	0
01	Base DX	20	14	2	1	0	1	0	0	0	0
02	DX w/Improved Dehumid.	26	21	4	2	0	1	0	0	0	0
03	Base DX w/Lower Airflow	45	22	4	2	0	1	0	0	0	0
04	Base DX w/AAHX	13	8	0	0	0	0	0	0	0	0
05	Base DX w/Subcool Reheat	9	6	0	0	0	0	0	0	0	0
06	Base DX w/o Lat. Coil Degrad.	0	0	0	0	0	0	0	0	0	0
07	Base DX w/Bypass Damper	12	9	0	1	0	1	0	0	0	0
08	Base DX w/Desiccant	0	0	0	0	0	0	0	0	0	0
09	Base DX w/Enthalpy Wheel	0	0	0	0	0	0	0	0	0	0
10	Base DX w/OA Precool	142	63	14	43	1	3	8	2	0	0
11	Dual Path	0	0	0	0	0	0	0	0	0	0
12	Dual Path w/Enthalpy Wheel	0	0	0	0	0	0	0	0	0	0
13	Dual Path w/AAHX	0	0	0	0	0	0	0	0	0	0
14	Dual Path w/Desiccant	0	0	0	0	0	0	0	0	0	0
15	Base DX w/DCV	4	0	0	0	0	0	0	0	0	0
16	Dual Path w/DCV	0	0	0	0	0	0	0	0	0	0
17	Base DX w/Free Reheat	0	0	0	0	0	0	0	0	0	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	35	36	35	38	34	39	36	53	39	34
01	Base DX	37	37	36	40	35	40	38	55	40	35
02	DX w/Improved Dehumid.	38	39	38	41	37	43	41	57	42	38
03	Base DX w/Lower Airflow	36	37	36	39	35	40	38	54	40	35
04	Base DX w/AAHX	44	45	43	48	41	47	44	65	46	41
05	Base DX w/Subcool Reheat	39	40	39	42	37	42	40	58	42	37
06	Base DX w/o Lat. Coil Degrad.	38	39	37	41	36	41	39	56	41	36
07	Base DX w/Bypass Damper	39	40	38	42	37	42	40	57	42	37
08	Base DX w/Desiccant	51	45	43	45	40	44	41	59	41	38
09	Base DX w/Enthalpy Wheel	33	33	32	35	32	36	33	50	35	33
10	Base DX w/OA Precool	40	41	39	43	38	44	42	60	44	39
11	Dual Path	40	40	39	43	38	43	41	59	43	38
12	Dual Path w/Enthalpy Wheel	35	35	33	37	33	37	35	52	37	36
13	Dual Path w/AAHX	42	43	41	45	40	46	44	62	45	41
14	Dual Path w/Desiccant	54	48	46	48	44	47	45	63	45	42
15	Base DX w/DCV	37	37	36	40	35	40	37	55	39	35
16	Dual Path w/DCV	40	40	39	43	38	43	41	58	42	38
17	Base DX w/Free Reheat	41	41	38	42	36	42	39	57	41	36

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

Office

2004 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.45	1.47	1.46	1.54	1.31	1.59	1.32	2.12	1.50	1.12
01	Base DX	1.48	1.50	1.48	1.56	1.32	1.59	1.32	2.12	1.50	1.11
02	DX w/Improved Dehumid.	1.32	1.33	1.33	1.39	1.21	1.48	1.23	1.87	1.39	1.01
03	Base DX w/Lower Airflow	1.38	1.39	1.39	1.45	1.24	1.51	1.26	1.94	1.42	1.03
04	Base DX w/AAHX	1.76	1.77	1.73	1.84	1.51	1.77	1.47	2.42	1.66	1.24
05	Base DX w/Subcool Reheat	1.61	1.62	1.58	1.67	1.39	1.66	1.38	2.24	1.55	1.16
06	Base DX w/o Lat. Coil Degrad.	1.54	1.55	1.53	1.62	1.35	1.62	1.35	2.16	1.52	1.13
07	Base DX w/Bypass Damper	1.52	1.53	1.51	1.59	1.33	1.60	1.33	2.13	1.51	1.11
08	Base DX w/Desiccant	2.25	1.84	1.75	1.75	1.44	1.61	1.30	2.15	1.37	1.10
09	Base DX w/Enthalpy Wheel	1.29	1.29	1.29	1.36	1.16	1.33	1.06	1.86	1.23	1.03
10	Base DX w/OA Precool	1.51	1.53	1.52	1.59	1.36	1.64	1.36	2.18	1.54	1.16
11	Dual Path	1.43	1.42	1.40	1.49	1.25	1.51	1.25	1.96	1.39	1.02
12	Dual Path w/Enthalpy Wheel	1.20	1.19	1.19	1.26	1.07	1.22	0.97	1.71	1.12	0.95
13	Dual Path w/AAHX	1.53	1.52	1.49	1.59	1.32	1.58	1.31	2.08	1.46	1.08
14	Dual Path w/Desiccant	2.19	1.76	1.70	1.69	1.43	1.54	1.26	1.99	1.29	1.02
15	Base DX w/DCV	1.44	1.46	1.45	1.53	1.28	1.52	1.26	2.06	1.43	1.08
16	Dual Path w/DCV	1.41	1.39	1.37	1.47	1.21	1.44	1.19	1.89	1.32	0.99
17	Base DX w/Free Reheat	1.72	1.65	1.57	1.64	1.35	1.63	1.35	2.16	1.51	1.11

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	59	58	58	61	53	55	58	54	56	48
01	Base DX	60	59	59	62	53	55	59	54	56	47
02	DX w/Improved Dehumid.	53	53	52	55	47	49	53	48	52	42
03	Base DX w/Lower Airflow	56	55	54	57	49	51	55	50	53	43
04	Base DX w/AAHX	72	71	69	73	62	63	68	61	63	54
05	Base DX w/Subcool Reheat	66	64	63	66	56	58	62	57	59	50
06	Base DX w/o Lat. Coil Degrad.	63	61	60	64	55	56	60	55	57	48
07	Base DX w/Bypass Damper	62	61	60	63	54	56	59	54	57	47
08	Base DX w/Desiccant	79	71	66	68	57	56	59	55	53	48
09	Base DX w/Enthalpy Wheel	52	51	51	54	47	48	49	47	47	44
10	Base DX w/OA Precool	62	61	60	63	55	57	61	56	58	49
11	Dual Path	58	56	56	59	50	52	55	50	52	43
12	Dual Path w/Enthalpy Wheel	49	47	47	50	44	44	45	43	43	41
13	Dual Path w/AAHX	63	60	59	63	54	55	59	53	55	46
14	Dual Path w/Desiccant	76	68	64	66	55	54	56	50	50	45
15	Base DX w/DCV	59	58	57	61	52	54	57	52	54	46
16	Dual Path w/DCV	57	55	54	58	49	50	54	48	50	42
17	Base DX w/Free Reheat	70	66	62	65	55	56	60	55	57	47

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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Office

2004 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	7.7	8.1	8.2	9.1	7.7	8.0	8.1	8.3	7.2	8.1
01	Base DX	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
02	DX w/Improved Dehumid.	8.4	8.8	8.9	9.9	8.4	8.7	8.8	9.1	7.8	8.8
03	Base DX w/Lower Airflow	8.6	9.1	9.2	10.3	8.7	9.0	9.1	9.4	8.1	9.1
04	Base DX w/AAHX	8.2	8.7	8.8	9.8	8.3	8.6	8.6	8.9	7.7	8.7
05	Base DX w/Subcool Reheat	8.2	8.6	8.7	9.7	8.2	8.6	8.6	8.9	7.6	8.6
06	Base DX w/o Lat. Coil Degrad.	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
07	Base DX w/Bypass Damper	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
08	Base DX w/Desiccant	7.7	8.1	8.2	9.2	7.7	8.1	8.1	8.4	7.2	8.1
09	Base DX w/Enthalpy Wheel	6.9	7.0	7.0	7.8	6.8	7.2	7.0	7.5	6.4	7.4
10	Base DX w/OA Precool	8.0	8.4	8.5	9.5	8.0	8.4	8.4	8.7	7.5	8.4
11	Dual Path	8.0	8.4	8.5	9.5	8.1	8.4	8.4	8.7	7.5	8.4
12	Dual Path w/Enthalpy Wheel	6.6	6.7	6.7	7.4	6.5	6.9	6.7	7.2	6.1	7.1
13	Dual Path w/AAHX	8.0	8.4	8.5	9.5	8.1	8.4	8.4	8.7	7.5	8.4
14	Dual Path w/Desiccant	7.8	8.2	8.3	9.2	7.8	8.1	8.1	8.4	7.3	8.2
15	Base DX w/DCV	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
16	Dual Path w/DCV	8.0	8.4	8.5	9.5	8.1	8.4	8.4	8.7	7.5	8.4
17	Base DX w/Free Reheat	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	15	15	14	16	15	16	18	23	17	18
01	Base DX	15	16	15	17	16	17	19	24	18	19
02	DX w/Improved Dehumid.	19	20	18	21	20	22	23	30	22	23
03	Base DX w/Lower Airflow	16	17	16	18	17	18	20	26	19	20
04	Base DX w/AAHX	19	20	18	21	20	21	23	30	22	23
05	Base DX w/Subcool Reheat	16	17	16	18	17	19	20	26	19	20
06	Base DX w/o Lat. Coil Degrad.	16	17	15	18	16	18	19	25	19	20
07	Base DX w/Bypass Damper	17	18	16	19	17	19	21	27	20	21
08	Base DX w/Desiccant	18	19	17	20	19	20	22	29	22	22
09	Base DX w/Enthalpy Wheel	15	15	14	16	15	17	17	23	17	19
10	Base DX w/OA Precool	18	19	18	20	19	21	22	29	21	22
11	Dual Path	19	20	19	21	20	22	23	30	23	24
12	Dual Path w/Enthalpy Wheel	18	18	16	18	18	20	21	28	21	22
13	Dual Path w/AAHX	21	21	20	22	21	23	25	32	24	25
14	Dual Path w/Desiccant	22	23	21	24	23	25	27	35	26	27
15	Base DX w/DCV	16	16	15	18	16	18	19	25	19	19
16	Dual Path w/DCV	20	20	19	22	20	22	24	31	23	24
17	Base DX w/Free Reheat	16	17	16	18	17	18	20	26	19	20

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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Office

2004 Standard

Net Sensible DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
01	Base DX	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
02	DX w/Improved Dehumid.	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
03	Base DX w/Lower Airflow	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
04	Base DX w/AAHX	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
05	Base DX w/Subcool Reheat	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
06	Base DX w/o Lat. Coil Degrad.	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
07	Base DX w/Bypass Damper	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
08	Base DX w/Desiccant	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
09	Base DX w/Enthalpy Wheel	4.6	4.6	4.6	5.1	4.5	4.7	4.6	5.0	4.2	4.9
10	Base DX w/OA Precool	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
11	Dual Path	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
12	Dual Path w/Enthalpy Wheel	4.6	4.6	4.7	5.2	4.5	4.8	4.6	5.0	4.2	4.9
13	Dual Path w/AAHX	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
14	Dual Path w/Desiccant	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
15	Base DX w/DCV	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
16	Dual Path w/DCV	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7
17	Base DX w/Free Reheat	5.4	5.7	5.8	6.4	5.4	5.6	5.7	5.8	5.0	5.7

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
00	Conventional DX	2155	1888	1801	1720	1639	1504	1581	1311	1418	1203
01	Base DX	2203	1922	1831	1745	1654	1510	1592	1306	1422	1189
02	DX w/Improved Dehumid.	1934	1664	1581	1493	1419	1274	1353	1064	1185	956
03	Base DX w/Lower Airflow	2038	1757	1667	1575	1488	1338	1422	1125	1248	1007
04	Base DX w/AAHX	2677	2345	2233	2126	2016	1842	1942	1600	1740	1457
05	Base DX w/Subcool Reheat	2420	2107	1992	1892	1785	1635	1722	1421	1535	1292
06	Base DX w/o Lat. Coil Degrad.	2307	2000	1897	1813	1710	1557	1643	1345	1458	1225
07	Base DX w/Bypass Damper	2265	1969	1864	1771	1671	1524	1608	1315	1428	1190
08	Base DX w/Desiccant	2122	1890	1823	1744	1720	1579	1647	1394	1518	1305
09	Base DX w/Enthalpy Wheel	1905	1652	1587	1512	1505	1386	1426	1219	1320	1147
10	Base DX w/OA Precool	2258	1976	1883	1778	1721	1575	1655	1362	1492	1267
11	Dual Path	2138	1828	1733	1670	1555	1407	1485	1190	1271	1063
12	Dual Path w/Enthalpy Wheel	1776	1528	1466	1407	1390	1287	1321	1126	1200	1069
13	Dual Path w/AAHX	2305	1972	1868	1797	1693	1531	1615	1298	1399	1183
14	Dual Path w/Desiccant	2002	1779	1713	1654	1603	1482	1544	1297	1390	1218
15	Base DX w/DCV	2154	1890	1807	1726	1646	1505	1583	1305	1417	1199
16	Dual Path w/DCV	2101	1804	1714	1659	1546	1402	1477	1187	1265	1069
17	Base DX w/Free Reheat	2590	2157	1968	1843	1710	1560	1649	1341	1443	1191

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Office

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*

[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
00	Conventional DX	1.1	1.1	1.2	1.1	1.2	1.2	1.2	1.0	1.1	0.9
01	Base DX	1.1	1.1	1.3	1.1	1.3	1.3	1.3	1.0	1.2	0.9
02	DX w/Improved Dehumid.	1.1	1.1	1.2	1.1	1.1	1.2	1.2	1.0	1.1	0.9
03	Base DX w/Lower Airflow	1.1	1.1	1.3	1.1	1.2	1.3	1.3	1.0	1.2	0.9
04	Base DX w/AAHX	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.2
05	Base DX w/Subcool Reheat	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.1	1.2	1.0
06	Base DX w/o Lat. Coil Degrad.	1.2	1.2	1.3	1.2	1.3	1.3	1.3	1.1	1.2	0.9
07	Base DX w/Bypass Damper	1.2	1.2	1.3	1.2	1.3	1.3	1.3	1.1	1.2	0.9
08	Base DX w/Desiccant	1.0	1.0	1.1	1.0	1.1	1.1	1.1	0.9	1.0	0.8
09	Base DX w/Enthalpy Wheel	0.9	0.9	1.0	0.9	1.0	1.0	1.0	0.9	1.0	0.8
10	Base DX w/OA Precool	1.2	1.2	1.3	1.1	1.3	1.3	1.3	1.1	1.2	0.9
11	Dual Path	1.1	1.1	1.2	1.0	1.2	1.2	1.2	1.0	1.1	0.9
12	Dual Path w/Enthalpy Wheel	0.9	0.9	1.0	0.9	0.9	0.9	1.0	0.8	0.9	0.8
13	Dual Path w/AAHX	1.1	1.1	1.2	1.1	1.2	1.2	1.2	1.0	1.2	1.0
14	Dual Path w/Desiccant	0.9	0.9	1.1	0.9	1.0	1.0	1.1	0.8	1.0	0.8
15	Base DX w/DCV	1.1	1.1	1.2	1.1	1.2	1.2	1.3	1.0	1.2	0.9
16	Dual Path w/DCV	1.0	1.0	1.1	1.0	1.1	1.1	1.2	1.0	1.1	0.9
17	Base DX w/Free Reheat	1.2	1.2	1.3	1.2	1.3	1.3	1.3	1.1	1.2	0.9

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
00	Conventional DX	338	763	891	802	1187	1628	1787	1923	2851	1682
01	Base DX	341	767	896	807	1193	1636	1796	1933	2863	1692
02	DX w/Improved Dehumid.	365	810	943	856	1251	1717	1882	2039	2982	1786
03	Base DX w/Lower Airflow	361	802	934	846	1240	1702	1865	2020	2959	1767
04	Base DX w/AAHX	317	726	849	760	1134	1556	1711	1829	2744	1601
05	Base DX w/Subcool Reheat	330	750	876	787	1168	1602	1759	1889	2812	1652
06	Base DX w/o Lat. Coil Degrad.	340	762	893	805	1192	1636	1795	1932	2861	1690
07	Base DX w/Bypass Damper	341	767	896	807	1193	1636	1796	1933	2863	1692
08	Base DX w/Desiccant	2894	2217	1789	1484	1444	1565	1610	1708	2100	1423
09	Base DX w/Enthalpy Wheel	343	670	784	723	965	1150	1178	1449	1955	1480
10	Base DX w/OA Precool	342	767	897	808	1195	1639	1800	1939	2867	1696
11	Dual Path	328	726	847	760	1144	1584	1743	1862	2779	1621
12	Dual Path w/Enthalpy Wheel	316	609	710	653	878	1043	1070	1310	1780	1350
13	Dual Path w/AAHX	319	712	832	746	1126	1558	1718	1832	2736	1592
14	Dual Path w/Desiccant	2922	2213	1838	1483	1596	1553	1667	1554	2056	1304
15	Base DX w/DCV	334	712	831	747	1089	1465	1598	1739	2563	1549
16	Dual Path w/DCV	321	669	779	698	1037	1406	1541	1659	2471	1471
17	Base DX w/Free Reheat	340	764	895	806	1193	1636	1796	1933	2863	1692

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Office

2004 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	7.7	8.1	8.2	9.1	7.7	8.0	8.0	8.3	7.2	8.1
01	Base DX	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
02	DX w/Improved Dehumid.	8.3	8.8	8.9	9.9	8.4	8.7	8.8	9.1	7.8	8.8
03	Base DX w/Lower Airflow	8.6	9.1	9.2	10.3	8.7	9.0	9.1	9.4	8.1	9.1
04	Base DX w/AAHX	8.2	8.7	8.8	9.8	8.2	8.6	8.6	8.9	7.7	8.7
05	Base DX w/Subcool Reheat	8.2	8.6	8.7	9.7	8.2	8.6	8.6	8.9	7.6	8.6
06	Base DX w/o Lat. Coil Degrad.	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
07	Base DX w/Bypass Damper	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
08	Base DX w/Desiccant	7.7	8.1	8.2	9.2	7.7	8.1	8.1	8.4	7.2	8.1
09	Base DX w/Enthalpy Wheel	6.9	7.0	7.0	7.8	6.8	7.2	7.0	7.5	6.4	7.4
10	Base DX w/OA Precool	7.1	7.5	7.6	8.6	7.1	7.4	7.4	7.7	6.5	7.5
11	Dual Path	3.2	3.2	3.2	3.1	3.2	3.2	3.2	3.2	3.3	3.2
12	Dual Path w/Enthalpy Wheel	1.2	1.2	1.2	1.1	1.2	1.2	1.2	1.1	1.2	1.1
13	Dual Path w/AAHX	3.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.0	2.9
14	Dual Path w/Desiccant	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.1	1.1
15	Base DX w/DCV	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6
16	Dual Path w/DCV	3.2	3.2	3.2	3.1	3.2	3.2	3.2	3.2	3.3	3.2
17	Base DX w/Free Reheat	8.2	8.6	8.7	9.7	8.2	8.5	8.5	8.8	7.6	8.6

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
11	Dual Path	4.8	5.2	5.3	6.4	4.8	5.2	5.2	5.5	4.3	5.2
12	Dual Path w/Enthalpy Wheel	5.4	5.5	5.6	6.3	5.3	5.7	5.5	6.0	4.9	5.9
13	Dual Path w/AAHX	5.1	5.5	5.6	6.6	5.1	5.4	5.5	5.8	4.5	5.5
14	Dual Path w/Desiccant	6.7	7.1	7.2	8.2	6.7	7.0	7.1	7.4	6.1	7.1
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	4.8	5.2	5.3	6.4	4.8	5.2	5.2	5.5	4.3	5.2
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Restaurant

2004 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	4473	3518	2518	1903	1827	1354	1308	862	661	2
01	Base DX	4483	3498	2506	1917	1839	1363	1296	885	670	2
02	DX w/Improved Dehumid.	4549	3598	2612	2117	1955	1445	1395	957	738	6
03	Base DX w/Lower Airflow	4548	3541	2560	2070	1932	1427	1369	946	729	6
04	Base DX w/AAHX	3790	3013	2101	1835	1689	1229	1083	876	593	2
05	Base DX w/Subcool Reheat	4230	3175	2281	1551	1627	1177	1126	793	618	2
06	Base DX w/o Lat. Coil Degrad.	3727	2713	1892	886	1083	831	815	477	346	0
07	Base DX w/Bypass Damper	4362	3308	2372	1709	1729	1276	1205	841	638	2
08	Base DX w/Desiccant	17	97	3	1	0	0	5	0	0	0
09	Base DX w/Enthalpy Wheel	2498	1852	1049	1327	740	655	461	645	307	6
10	Base DX w/OA Precool	4302	3759	3080	2634	2183	1936	2146	813	649	0
11	Dual Path	4254	3259	2264	1104	1519	1115	1094	698	544	10
12	Dual Path w/Enthalpy Wheel	674	649	308	110	270	162	149	213	121	6
13	Dual Path w/AAHX	1729	1300	795	249	616	510	344	381	282	7
14	Dual Path w/Desiccant	0	0	0	0	0	0	0	0	0	0
15	Base DX w/DCV	4521	3532	2680	2435	2026	1592	1606	1095	909	2
16	Dual Path w/DCV	2542	1628	884	202	620	562	418	446	284	0
17	Base DX w/Free Reheat	85	217	155	40	116	40	49	91	30	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	114	128	126	144	123	163	145	198	159	122
01	Base DX	116	130	128	147	125	165	147	200	162	124
02	DX w/Improved Dehumid.	117	131	129	146	129	170	154	201	168	131
03	Base DX w/Lower Airflow	111	125	123	140	123	163	146	193	160	123
04	Base DX w/AAHX	144	157	152	174	144	184	167	230	181	141
05	Base DX w/Subcool Reheat	128	141	138	159	133	172	155	212	169	130
06	Base DX w/o Lat. Coil Degrad.	123	136	133	154	130	168	151	206	165	126
07	Base DX w/Bypass Damper	122	136	134	154	131	170	153	207	168	129
08	Base DX w/Desiccant	322	250	235	226	210	209	189	247	174	148
09	Base DX w/Enthalpy Wheel	93	96	94	107	94	102	90	145	101	106
10	Base DX w/OA Precool	130	144	141	160	139	180	161	222	177	137
11	Dual Path	113	123	122	142	128	168	152	192	170	133
12	Dual Path w/Enthalpy Wheel	88	91	90	104	92	100	90	138	100	106
13	Dual Path w/AAHX	133	148	144	166	143	184	170	217	182	143
14	Dual Path w/Desiccant	313	245	228	220	203	205	189	242	174	153
15	Base DX w/DCV	106	113	105	127	97	109	105	154	112	91
16	Dual Path w/DCV	103	104	98	121	97	110	108	144	119	97
17	Base DX w/Free Reheat	165	169	157	175	144	181	162	221	173	128

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
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Restaurant

2004 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	5.30	5.97	6.04	6.62	5.70	8.23	6.65	9.57	7.68	5.29
01	Base DX	5.27	5.94	6.02	6.59	5.67	8.21	6.63	9.49	7.65	5.27
02	DX w/Improved Dehumid.	4.61	5.22	5.37	5.68	5.17	7.75	6.24	8.50	7.17	4.92
03	Base DX w/Lower Airflow	4.72	5.37	5.51	5.90	5.28	7.85	6.33	8.72	7.28	4.99
04	Base DX w/AAHX	6.54	7.11	6.99	7.68	6.30	8.77	7.16	10.56	8.19	5.64
05	Base DX w/Subcool Reheat	5.89	6.52	6.51	7.21	5.99	8.49	6.90	10.00	7.90	5.43
06	Base DX w/o Lat. Coil Degrad.	5.69	6.31	6.33	7.04	5.93	8.41	6.81	9.81	7.81	5.33
07	Base DX w/Bypass Damper	5.41	6.06	6.12	6.70	5.73	8.25	6.68	9.54	7.68	5.27
08	Base DX w/Desiccant	17.80	12.61	11.97	10.59	9.92	9.58	7.70	10.43	6.51	5.05
09	Base DX w/Enthalpy Wheel	3.87	4.10	4.17	4.55	3.85	4.19	3.25	6.13	3.73	4.19
10	Base DX w/OA Precool	5.79	6.40	6.46	6.92	6.17	8.77	7.03	10.32	8.14	5.68
11	Dual Path	3.83	4.39	4.68	5.19	4.69	7.28	5.81	7.41	6.68	4.52
12	Dual Path w/Enthalpy Wheel	3.06	3.32	3.46	3.85	3.24	3.58	2.75	4.95	3.08	3.67
13	Dual Path w/AAHX	4.87	5.55	5.64	6.29	5.27	7.78	6.32	8.29	7.03	4.72
14	Dual Path w/Desiccant	16.38	11.38	10.68	9.23	8.55	8.37	6.71	8.83	5.56	4.48
15	Base DX w/DCV	4.41	4.61	4.33	5.13	3.63	4.25	3.59	6.18	4.09	2.86
16	Dual Path w/DCV	2.98	3.01	2.87	3.63	2.46	3.15	2.65	3.90	3.03	1.91
17	Base DX w/Free Reheat	8.48	8.46	7.84	8.30	6.80	9.15	7.43	10.66	8.23	5.32

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	220	236	233	261	214	251	268	248	277	211
01	Base DX	219	235	232	259	213	250	266	246	275	209
02	DX w/Improved Dehumid.	191	205	203	222	186	225	240	222	253	189
03	Base DX w/Lower Airflow	196	211	210	231	192	231	246	228	258	193
04	Base DX w/AAHX	273	282	275	304	245	279	299	272	300	231
05	Base DX w/Subcool Reheat	245	258	254	285	229	264	283	258	287	219
06	Base DX w/o Lat. Coil Degrad.	237	250	245	278	225	259	276	254	282	213
07	Base DX w/Bypass Damper	225	240	236	264	215	252	269	247	276	210
08	Base DX w/Desiccant	538	467	406	400	333	295	309	268	247	214
09	Base DX w/Enthalpy Wheel	160	162	162	179	153	148	150	156	146	170
10	Base DX w/OA Precool	241	253	250	272	234	271	286	267	295	229
11	Dual Path	158	171	172	201	159	199	210	196	230	165
12	Dual Path w/Enthalpy Wheel	126	130	131	150	123	119	120	127	117	142
13	Dual Path w/AAHX	201	218	214	246	188	223	242	218	246	176
14	Dual Path w/Desiccant	489	420	359	348	284	252	265	228	208	183
15	Base DX w/DCV	184	185	179	206	160	162	176	155	162	134
16	Dual Path w/DCV	124	120	116	145	101	106	116	100	113	82
17	Base DX w/Free Reheat	354	337	309	329	265	290	310	275	300	212

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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Restaurant

2004 Standard

Net Total DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	20.4	22.7	23.0	27.9	21.3	21.4	22.3	21.6	20.5	20.6
01	Base DX	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
02	DX w/Improved Dehumid.	22.1	24.7	25.1	30.3	23.1	23.3	24.2	23.5	22.3	22.4
03	Base DX w/Lower Airflow	22.9	25.5	25.9	31.4	23.9	24.1	25.0	24.3	23.0	23.2
04	Base DX w/AAHX	21.8	24.3	24.6	29.8	22.7	22.9	23.8	23.1	21.9	22.0
05	Base DX w/Subcool Reheat	21.7	24.2	24.5	29.7	22.7	22.8	23.7	23.0	21.8	21.9
06	Base DX w/o Lat. Coil Degrad.	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
07	Base DX w/Bypass Damper	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
08	Base DX w/Desiccant	20.5	22.8	23.2	28.0	21.4	21.5	22.4	21.8	20.6	20.7
09	Base DX w/Enthalpy Wheel	13.4	13.4	13.4	16.8	13.3	13.7	13.3	14.1	13.5	14.0
10	Base DX w/OA Precool	20.5	23.0	23.3	28.5	21.4	21.6	22.5	21.8	20.6	20.7
11	Dual Path	24.3	25.1	25.4	30.3	24.3	24.3	24.6	24.3	24.3	24.3
12	Dual Path w/Enthalpy Wheel	13.2	13.3	13.2	16.5	13.2	13.5	13.1	13.9	13.3	13.8
13	Dual Path w/AAHX	22.6	25.0	25.3	30.2	23.5	23.7	24.5	23.9	22.7	22.9
14	Dual Path w/Desiccant	20.9	23.3	23.6	28.5	21.8	21.9	22.8	22.2	21.0	21.2
15	Base DX w/DCV	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
16	Dual Path w/DCV	24.3	25.1	25.4	30.3	24.3	24.3	24.6	24.3	24.3	24.3
17	Base DX w/Free Reheat	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	39	42	39	49	41	44	48	60	48	45
01	Base DX	41	45	42	52	44	46	51	63	51	48
02	DX w/Improved Dehumid.	51	56	52	65	54	57	64	79	64	60
03	Base DX w/Lower Airflow	43	48	44	55	46	49	55	67	54	51
04	Base DX w/AAHX	50	55	51	64	54	57	63	78	63	59
05	Base DX w/Subcool Reheat	44	48	44	56	47	49	55	68	55	51
06	Base DX w/o Lat. Coil Degrad.	42	46	42	53	44	47	52	64	52	49
07	Base DX w/Bypass Damper	45	50	46	58	48	51	57	70	56	53
08	Base DX w/Desiccant	64	67	62	73	67	71	78	97	80	75
09	Base DX w/Enthalpy Wheel	38	37	34	41	39	41	43	57	47	45
10	Base DX w/OA Precool	47	52	48	61	50	53	59	73	59	55
11	Dual Path	58	59	55	68	60	63	68	85	73	68
12	Dual Path w/Enthalpy Wheel	44	44	40	49	45	48	51	67	56	53
13	Dual Path w/AAHX	64	68	63	76	67	71	78	97	80	75
14	Dual Path w/Desiccant	75	80	74	87	79	84	92	114	94	88
15	Base DX w/DCV	43	47	43	54	45	48	53	66	53	50
16	Dual Path w/DCV	60	61	57	69	61	65	70	88	75	70
17	Base DX w/Free Reheat	44	48	44	56	46	49	55	67	55	51

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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Restaurant

2004 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
01	Base DX	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
02	DX w/Improved Dehumid.	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
03	Base DX w/Lower Airflow	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
04	Base DX w/AAHX	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
05	Base DX w/Subcool Reheat	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
06	Base DX w/o Lat. Coil Degrad.	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
07	Base DX w/Bypass Damper	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
08	Base DX w/Desiccant	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
09	Base DX w/Enthalpy Wheel	8.7	8.8	8.7	11.0	8.7	8.9	8.7	9.2	8.8	9.2
10	Base DX w/OA Precool	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
11	Dual Path	15.4	15.9	16.2	19.6	15.4	15.4	15.6	15.4	15.4	15.4
12	Dual Path w/Enthalpy Wheel	8.9	8.9	8.9	11.2	8.9	9.1	8.8	9.4	9.0	9.3
13	Dual Path w/AAHX	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
14	Dual Path w/Desiccant	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
15	Base DX w/DCV	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5
16	Dual Path w/DCV	15.4	15.9	16.2	19.6	15.4	15.4	15.6	15.4	15.4	15.4
17	Base DX w/Free Reheat	14.3	15.9	16.2	19.6	14.9	15.0	15.6	15.2	14.4	14.5

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
00	Conventional DX	3139	2658	2443	2326	2153	1990	2121	1834	1858	1670
01	Base DX	3122	2637	2423	2306	2125	1961	2097	1800	1828	1636
02	DX w/Improved Dehumid.	2702	2218	2004	1859	1701	1550	1681	1392	1424	1245
03	Base DX w/Lower Airflow	2776	2306	2098	1966	1794	1640	1776	1481	1515	1331
04	Base DX w/AAHX	3906	3286	3009	2823	2623	2430	2597	2227	2265	2034
05	Base DX w/Subcool Reheat	3505	2956	2716	2594	2370	2185	2342	2000	2030	1804
06	Base DX w/o Lat. Coil Degrad.	3377	2832	2592	2499	2294	2079	2229	1908	1928	1682
07	Base DX w/Bypass Damper	3206	2700	2477	2353	2160	1987	2132	1816	1846	1640
08	Base DX w/Desiccant	3204	2809	2655	2479	2556	2391	2441	2269	2301	2120
09	Base DX w/Enthalpy Wheel	2257	1837	1712	1600	1702	1590	1576	1504	1552	1448
10	Base DX w/OA Precool	3433	2866	2634	2427	2387	2214	2318	2059	2097	1885
11	Dual Path	2211	1731	1545	1606	1255	1089	1205	926	987	789
12	Dual Path w/Enthalpy Wheel	1755	1399	1285	1270	1246	1142	1135	1063	1083	982
13	Dual Path w/AAHX	2851	2369	2112	2106	1689	1473	1667	1270	1256	998
14	Dual Path w/Desiccant	2737	2398	2241	2144	2088	1914	1990	1783	1793	1604
15	Base DX w/DCV	2654	2335	2208	2123	2066	1929	2006	1794	1814	1705
16	Dual Path w/DCV	1767	1446	1339	1437	1177	1040	1107	901	959	830
17	Base DX w/Free Reheat	5074	3963	3409	3039	2855	2517	2681	2192	2184	1676

**All systems are normalized by the same tons in a given city to provide common comparison point.*

MI = Miami FL
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Restaurant

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
00	Conventional DX	1.0	1.0	1.0	0.8	0.9	1.1	1.1	0.8	0.9	0.7
01	Base DX	1.0	1.0	1.0	0.9	1.0	1.1	1.1	0.9	1.0	0.8
02	DX w/Improved Dehumid.	1.0	1.0	1.0	0.8	0.9	1.1	1.0	0.8	0.9	0.7
03	Base DX w/Lower Airflow	1.0	1.0	1.0	0.9	1.0	1.1	1.1	0.9	0.9	0.7
04	Base DX w/AAHX	1.3	1.3	1.4	1.1	1.3	1.4	1.4	1.1	1.3	0.9
05	Base DX w/Subcool Reheat	1.1	1.1	1.2	1.1	1.1	1.3	1.4	1.0	1.1	0.9
06	Base DX w/o Lat. Coil Degrad.	1.0	1.0	1.1	0.9	1.0	1.2	1.1	0.9	1.0	0.8
07	Base DX w/Bypass Damper	1.0	1.1	1.1	1.0	1.0	1.2	1.2	0.9	1.0	0.8
08	Base DX w/Desiccant	0.7	0.7	0.7	0.6	0.7	0.8	0.8	0.6	0.7	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.5
10	Base DX w/OA Precool	1.0	1.0	1.0	0.8	0.9	1.1	1.1	0.8	1.0	0.7
11	Dual Path	0.9	0.8	0.9	0.7	0.8	1.0	0.9	0.7	0.8	0.6
12	Dual Path w/Enthalpy Wheel	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.5	0.4
13	Dual Path w/AAHX	1.1	1.1	1.2	1.0	1.1	1.2	1.2	0.9	1.1	0.8
14	Dual Path w/Desiccant	0.7	0.7	0.7	0.6	0.7	0.8	0.7	0.6	0.7	0.5
15	Base DX w/DCV	0.7	0.8	0.8	0.7	0.8	0.8	0.8	0.6	0.7	0.6
16	Dual Path w/DCV	0.6	0.6	0.6	0.5	0.6	0.7	0.6	0.5	0.6	0.5
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.1	1.3	1.3	1.3	1.2	1.2	0.8

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
00	Conventional DX	156	1299	1739	1372	2613	4715	4552	4941	6789	4322
01	Base DX	159	1310	1755	1388	2632	4741	4574	4968	6818	4353
02	DX w/Improved Dehumid.	188	1422	1903	1542	2811	4969	4786	5238	7095	4645
03	Base DX w/Lower Airflow	181	1398	1871	1508	2771	4922	4744	5180	7034	4579
04	Base DX w/AAHX	137	1210	1622	1250	2466	4522	4376	4715	6559	4073
05	Base DX w/Subcool Reheat	149	1269	1698	1329	2563	4649	4491	4862	6707	4235
06	Base DX w/o Lat. Coil Degrad.	158	1307	1753	1387	2630	4740	4573	4968	6818	4352
07	Base DX w/Bypass Damper	159	1310	1755	1388	2632	4741	4574	4968	6818	4353
08	Base DX w/Desiccant	14638	10376	8121	5574	6603	5368	5295	4414	4016	3028
09	Base DX w/Enthalpy Wheel	180	864	1150	942	1336	1457	1323	1978	1744	3151
10	Base DX w/OA Precool	168	1349	1819	1445	2728	4875	4689	5040	6893	4439
11	Dual Path	225	1567	2088	1666	3047	5273	5060	5591	7418	5007
12	Dual Path w/Enthalpy Wheel	203	937	1243	1020	1452	1594	1451	2141	1916	3356
13	Dual Path w/AAHX	213	1489	1986	1583	2939	5127	4909	5418	7294	4870
14	Dual Path w/Desiccant	13871	9744	7515	4905	5892	4975	4848	4236	3841	3264
15	Base DX w/DCV	53	228	270	186	469	952	1021	1005	1641	666
16	Dual Path w/DCV	83	365	447	315	703	1344	1384	1463	2131	1085
17	Base DX w/Free Reheat	156	1302	1752	1386	2630	4740	4573	4968	6818	4353

**All systems are normalized by the same tons in a given city to provide common comparison point.*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

Restaurant

2004 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	20.4	22.7	23.0	27.9	21.3	21.4	22.2	21.6	20.5	20.6
01	Base DX	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
02	DX w/Improved Dehumid.	22.1	24.7	25.0	30.3	23.1	23.3	24.2	23.5	22.3	22.4
03	Base DX w/Lower Airflow	22.9	25.5	25.9	31.4	23.9	24.1	25.0	24.3	23.0	23.2
04	Base DX w/AAHX	21.8	24.3	24.6	29.8	22.7	22.9	23.8	23.1	21.9	22.0
05	Base DX w/Subcool Reheat	21.7	24.2	24.5	29.7	22.6	22.8	23.7	23.0	21.8	21.9
06	Base DX w/o Lat. Coil Degrad.	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
07	Base DX w/Bypass Damper	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
08	Base DX w/Desiccant	20.5	22.8	23.2	28.0	21.4	21.5	22.4	21.8	20.6	20.7
09	Base DX w/Enthalpy Wheel	13.4	13.4	13.4	16.8	13.3	13.7	13.3	14.1	13.5	14.0
10	Base DX w/OA Precool	14.3	16.7	17.1	22.3	15.2	15.3	16.3	15.6	14.4	14.5
11	Dual Path	23.5	23.5	23.5	23.2	23.5	23.5	23.5	23.5	23.5	23.5
12	Dual Path w/Enthalpy Wheel	9.9	9.9	9.9	9.7	9.9	9.8	9.9	9.8	9.9	9.8
13	Dual Path w/AAHX	21.8	21.6	21.6	21.3	21.7	21.7	21.6	21.7	21.8	21.8
14	Dual Path w/Desiccant	9.4	9.2	9.2	8.9	9.3	9.3	9.2	9.3	9.4	9.3
15	Base DX w/DCV	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9
16	Dual Path w/DCV	23.5	23.5	23.5	23.2	23.5	23.5	23.5	23.5	23.5	23.5
17	Base DX w/Free Reheat	21.6	24.1	24.5	29.6	22.6	22.7	23.6	23.0	21.7	21.9

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
11	Dual Path	0.8	1.6	1.9	7.1	0.8	0.8	1.1	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	3.4	3.4	3.4	6.8	3.3	3.6	3.3	4.1	3.5	4.0
13	Dual Path w/AAHX	0.8	3.3	3.7	8.9	1.8	1.9	2.9	2.2	1.0	1.1
14	Dual Path w/Desiccant	11.5	14.0	14.4	19.6	12.5	12.6	13.6	12.9	11.7	11.8
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	1.6	1.9	7.1	0.8	0.8	1.1	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Retail

2004 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2000	1201	846	356	196	200	292	78	54	0
01	Base DX	1713	961	610	314	150	165	220	82	59	0
02	DX w/Improved Dehumid.	1475	897	574	357	135	161	208	104	67	0
03	Base DX w/Lower Airflow	1261	842	556	390	188	176	208	129	85	0
04	Base DX w/AAHX	534	247	134	162	41	42	27	46	6	0
05	Base DX w/Subcool Reheat	1422	682	416	218	95	116	148	62	42	0
06	Base DX w/o Lat. Coil Degrad.	543	283	155	12	0	35	28	14	3	0
07	Base DX w/Bypass Damper	1242	640	408	236	85	120	144	68	39	0
08	Base DX w/Desiccant	0	0	0	0	0	0	0	0	0	0
09	Base DX w/Enthalpy Wheel	0	1	5	0	0	0	0	0	0	0
10	Base DX w/OA Precool	2044	1621	1185	1114	432	389	586	207	27	0
11	Dual Path	284	145	56	25	0	0	1	4	1	0
12	Dual Path w/Enthalpy Wheel	0	1	6	0	0	0	0	0	0	0
13	Dual Path w/AAHX	91	78	24	3	0	0	0	3	0	0
14	Dual Path w/Desiccant	0	0	0	0	0	0	0	0	0	0
15	Base DX w/DCV	465	265	139	190	27	58	41	45	3	0
16	Dual Path w/DCV	131	43	13	2	0	0	0	0	0	0
17	Base DX w/Free Reheat	0	1	5	0	0	0	0	2	0	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	490	528	507	548	471	591	561	766	595	457
01	Base DX	505	544	522	565	484	606	577	784	610	471
02	DX w/Improved Dehumid.	524	563	539	583	511	637	619	812	647	511
03	Base DX w/Lower Airflow	496	533	512	553	480	603	579	767	608	471
04	Base DX w/AAHX	626	664	628	683	571	693	667	916	699	546
05	Base DX w/Subcool Reheat	552	591	563	613	517	638	609	833	641	495
06	Base DX w/o Lat. Coil Degrad.	523	559	535	581	495	615	585	799	619	476
07	Base DX w/Bypass Damper	536	575	550	597	510	632	606	821	638	495
08	Base DX w/Desiccant	1136	911	861	825	768	792	749	974	707	594
09	Base DX w/Enthalpy Wheel	412	412	394	413	378	420	389	604	427	416
10	Base DX w/OA Precool	564	599	573	615	536	663	632	869	670	527
11	Dual Path	519	554	533	579	513	633	622	789	659	514
12	Dual Path w/Enthalpy Wheel	405	404	387	406	378	423	401	595	433	431
13	Dual Path w/AAHX	628	663	628	682	592	717	704	910	730	578
14	Dual Path w/Desiccant	1095	889	820	799	712	753	739	965	710	633
15	Base DX w/DCV	489	517	486	536	444	517	508	707	529	425
16	Dual Path w/DCV	492	519	489	542	466	539	550	706	575	462
17	Base DX w/Free Reheat	649	660	608	654	538	658	625	851	650	488

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
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Retail

2004 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	20.77	22.09	21.68	22.69	19.03	26.20	22.11	32.54	24.80	16.05
01	Base DX	21.03	22.32	21.88	22.96	19.14	26.28	22.20	32.49	24.82	15.99
02	DX w/Improved Dehumid.	18.90	19.89	19.62	20.19	17.52	24.69	20.85	29.12	23.19	14.76
03	Base DX w/Lower Airflow	19.53	20.63	20.32	21.13	18.00	25.15	21.26	29.96	23.62	15.04
04	Base DX w/AAHX	26.17	27.12	25.97	27.33	21.86	28.76	24.40	36.59	26.96	17.42
05	Base DX w/Subcool Reheat	23.33	24.59	23.84	25.18	20.45	27.47	23.30	34.47	25.87	16.57
06	Base DX w/o Lat. Coil Degrad.	22.21	23.36	22.80	24.03	19.82	26.92	22.76	33.47	25.38	16.35
07	Base DX w/Bypass Damper	21.71	22.94	22.42	23.53	19.47	26.55	22.47	32.81	25.01	16.01
08	Base DX w/Desiccant	56.59	40.05	38.35	33.83	30.81	30.88	25.33	34.47	21.99	15.61
09	Base DX w/Enthalpy Wheel	15.56	15.72	15.55	16.01	13.49	15.17	11.99	22.14	13.49	13.16
10	Base DX w/OA Precool	23.04	23.80	23.21	23.79	20.60	27.89	23.34	35.05	26.45	17.41
11	Dual Path	16.84	18.06	18.05	18.88	15.89	22.98	19.64	25.62	21.53	13.17
12	Dual Path w/Enthalpy Wheel	12.77	12.94	13.02	13.35	11.27	12.90	10.20	18.11	11.17	11.44
13	Dual Path w/AAHX	21.83	22.65	22.01	23.23	18.68	25.57	21.87	29.67	23.50	14.38
14	Dual Path w/Desiccant	49.82	34.20	31.55	27.51	22.95	23.86	19.69	27.78	17.28	13.63
15	Base DX w/DCV	19.16	19.75	18.80	20.24	15.61	19.38	16.67	26.12	18.34	12.04
16	Dual Path w/DCV	14.24	14.86	14.37	15.61	11.93	15.75	13.81	18.90	14.84	8.72
17	Base DX w/Free Reheat	30.19	29.51	27.04	28.14	21.97	28.93	24.46	35.82	26.54	16.16

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	864	881	864	901	756	852	935	837	911	666
01	Base DX	875	890	872	912	761	854	938	836	911	662
02	DX w/Improved Dehumid.	784	790	773	798	677	773	851	755	837	590
03	Base DX w/Lower Airflow	811	820	803	836	701	795	876	775	856	606
04	Base DX w/AAHX	1092	1085	1048	1090	894	974	1072	935	1008	742
05	Base DX w/Subcool Reheat	972	982	957	1002	825	911	1004	884	958	694
06	Base DX w/o Lat. Coil Degrad.	924	932	911	955	793	882	969	860	935	679
07	Base DX w/Bypass Damper	903	915	895	935	776	866	953	844	920	663
08	Base DX w/Desiccant	1761	1500	1338	1287	1079	988	1053	880	842	686
09	Base DX w/Enthalpy Wheel	645	628	623	636	563	558	575	559	533	555
10	Base DX w/OA Precool	959	949	927	945	825	920	998	899	979	729
11	Dual Path	697	715	701	743	590	682	769	671	759	498
12	Dual Path w/Enthalpy Wheel	527	515	513	528	456	455	471	461	432	463
13	Dual Path w/AAHX	907	901	871	920	725	803	900	770	846	564
14	Dual Path w/Desiccant	1553	1285	1119	1057	843	788	848	707	667	584
15	Base DX w/DCV	797	793	769	811	664	698	771	661	703	538
16	Dual Path w/DCV	589	593	577	622	479	514	588	487	543	358
17	Base DX w/Free Reheat	1259	1181	1090	1121	893	968	1063	918	984	670

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

MI = Miami FL
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SL = St. Louis MO
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PO = Portland OR

Retail

2004 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	101.8	113.1	114.8	126.2	101.8	104.7	110.8	107.9	100.3	102.7
01	Base DX	108.1	120.1	121.9	134.0	108.1	111.2	117.7	114.6	106.5	109.0
02	DX w/Improved Dehumid.	110.7	123.0	124.9	137.3	110.7	113.9	120.5	117.4	109.1	111.7
03	Base DX w/Lower Airflow	114.5	127.3	129.2	142.0	114.5	117.8	124.6	121.4	112.9	115.5
04	Base DX w/AAHX	108.9	121.0	122.8	135.0	108.9	112.0	118.5	115.4	107.3	109.8
05	Base DX w/Subcool Reheat	108.4	120.5	122.3	134.4	108.4	111.5	118.0	115.0	106.9	109.4
06	Base DX w/o Lat. Coil Degrad.	108.1	120.1	121.9	134.0	108.1	111.2	117.7	114.6	106.5	109.0
07	Base DX w/Bypass Damper	108.1	120.1	121.9	134.0	108.1	111.2	117.7	114.6	106.5	109.0
08	Base DX w/Desiccant	102.5	113.8	115.5	126.9	102.5	105.4	111.5	108.6	101.0	103.3
09	Base DX w/Enthalpy Wheel	68.0	67.9	67.9	71.5	63.0	67.0	67.2	71.3	66.4	70.7
10	Base DX w/OA Precool	102.5	114.6	116.3	128.5	102.5	105.6	112.1	109.0	101.0	103.5
11	Dual Path	115.7	124.6	126.3	137.7	115.7	116.2	122.3	119.4	115.7	115.7
12	Dual Path w/Enthalpy Wheel	67.0	67.0	67.0	70.4	62.4	66.2	66.4	70.2	65.6	69.6
13	Dual Path w/AAHX	112.8	124.2	125.8	137.3	112.8	115.7	121.8	119.0	111.4	113.7
14	Dual Path w/Desiccant	104.5	115.8	117.5	128.9	104.5	107.4	113.5	110.6	103.0	105.4
15	Base DX w/DCV	108.1	120.1	121.9	134.0	108.1	111.2	117.7	114.6	106.5	109.0
16	Dual Path w/DCV	115.7	124.6	126.3	137.7	115.7	116.2	122.3	119.4	115.7	115.7
17	Base DX w/Free Reheat	108.1	120.1	121.9	134.0	108.1	111.2	117.7	114.6	106.5	109.0

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	193	211	196	223	197	213	241	298	237	226
01	Base DX	205	224	208	237	209	226	256	316	251	240
02	DX w/Improved Dehumid.	254	278	258	293	259	281	318	392	312	297
03	Base DX w/Lower Airflow	217	238	220	251	222	240	272	335	266	254
04	Base DX w/AAHX	252	276	256	291	258	279	316	390	310	295
05	Base DX w/Subcool Reheat	218	239	222	252	223	241	273	337	268	256
06	Base DX w/o Lat. Coil Degrad.	205	225	209	237	210	227	257	317	252	241
07	Base DX w/Bypass Damper	225	247	229	261	230	249	282	348	277	264
08	Base DX w/Desiccant	316	333	307	338	323	346	384	478	391	369
09	Base DX w/Enthalpy Wheel	190	187	171	183	184	202	217	286	233	226
10	Base DX w/OA Precool	235	259	240	274	240	260	296	364	288	275
11	Dual Path	278	296	274	309	284	300	338	419	347	323
12	Dual Path w/Enthalpy Wheel	222	219	200	215	216	237	254	335	273	265
13	Dual Path w/AAHX	316	338	313	349	323	347	388	482	390	370
14	Dual Path w/Desiccant	374	395	365	403	381	409	455	566	461	436
15	Base DX w/DCV	215	235	218	247	220	238	269	332	265	252
16	Dual Path w/DCV	289	306	283	319	295	312	350	434	360	336
17	Base DX w/Free Reheat	218	238	221	251	222	241	272	336	267	255

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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CH = Chicago IL
PO = Portland OR

Retail

2004 Standard

Net Sensible DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
01	Base DX	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
02	DX w/Improved Dehumid.	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
03	Base DX w/Lower Airflow	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
04	Base DX w/AAHX	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
05	Base DX w/Subcool Reheat	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
06	Base DX w/o Lat. Coil Degrad.	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
07	Base DX w/Bypass Damper	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
08	Base DX w/Desiccant	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
09	Base DX w/Enthalpy Wheel	44.4	44.4	44.4	46.8	41.2	43.8	43.9	46.6	43.4	46.2
10	Base DX w/OA Precool	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
11	Dual Path	73.2	79.4	80.6	88.6	73.2	73.5	77.8	75.8	73.2	73.2
12	Dual Path w/Enthalpy Wheel	45.2	45.1	45.2	47.6	41.9	44.6	44.7	47.4	44.1	47.0
13	Dual Path w/AAHX	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
14	Dual Path w/Desiccant	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
15	Base DX w/DCV	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1
16	Dual Path w/DCV	73.2	79.4	80.6	88.6	73.2	73.5	77.8	75.8	73.2	73.2
17	Base DX w/Free Reheat	71.5	79.4	80.6	88.6	71.5	73.5	77.8	75.8	70.4	72.1

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
00	Conventional DX	2466	2102	1961	1881	1758	1594	1666	1388	1437	1225
01	Base DX	2498	2124	1979	1903	1769	1595	1672	1379	1431	1207
02	DX w/Improved Dehumid.	2231	1847	1701	1614	1494	1324	1399	1108	1162	946
03	Base DX w/Lower Airflow	2310	1931	1785	1708	1571	1395	1474	1175	1230	1005
04	Base DX w/AAHX	3129	2647	2453	2341	2180	1969	2063	1697	1763	1487
05	Base DX w/Subcool Reheat	2780	2371	2206	2124	1963	1770	1861	1531	1587	1321
06	Base DX w/o Lat. Coil Degrad.	2641	2235	2079	2005	1861	1672	1754	1445	1502	1258
07	Base DX w/Bypass Damper	2580	2190	2037	1957	1813	1628	1711	1401	1455	1210
08	Base DX w/Desiccant	2412	2101	1997	1908	1930	1783	1810	1614	1670	1508
09	Base DX w/Enthalpy Wheel	1828	1516	1429	1337	1417	1296	1283	1166	1222	1081
10	Base DX w/OA Precool	2740	2275	2116	1975	1946	1767	1818	1540	1613	1384
11	Dual Path	1972	1632	1490	1462	1207	1016	1136	817	869	607
12	Dual Path w/Enthalpy Wheel	1484	1212	1136	1071	1091	987	988	874	903	781
13	Dual Path w/AAHX	2582	2128	1943	1890	1615	1385	1512	1121	1153	834
14	Dual Path w/Desiccant	2146	1880	1784	1727	1685	1520	1568	1344	1381	1191
15	Base DX w/DCV	2278	1970	1856	1791	1715	1567	1623	1357	1406	1236
16	Dual Path w/DCV	1669	1425	1329	1322	1131	969	1065	790	833	637
17	Base DX w/Free Reheat	3612	2885	2539	2394	2151	1915	2004	1603	1646	1231

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Retail

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
00	Conventional DX	1.1	1.1	1.1	1.0	1.1	1.2	1.1	0.9	1.0	0.8
01	Base DX	1.1	1.1	1.1	1.0	1.1	1.2	1.2	1.0	1.1	0.8
02	DX w/Improved Dehumid.	1.1	1.1	1.1	1.0	1.1	1.2	1.1	0.9	1.0	0.8
03	Base DX w/Lower Airflow	1.1	1.1	1.1	1.0	1.1	1.2	1.2	1.0	1.1	0.8
04	Base DX w/AAHX	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.0
05	Base DX w/Subcool Reheat	1.3	1.3	1.4	1.2	1.3	1.3	1.4	1.1	1.3	0.9
06	Base DX w/o Lat. Coil Degrad.	1.1	1.1	1.2	1.1	1.2	1.3	1.2	1.0	1.1	0.8
07	Base DX w/Bypass Damper	1.1	1.1	1.2	1.1	1.2	1.3	1.3	1.0	1.1	0.8
08	Base DX w/Desiccant	0.9	0.8	0.9	0.8	0.9	0.9	0.9	0.8	0.8	0.7
09	Base DX w/Enthalpy Wheel	0.7	0.6	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.6
10	Base DX w/OA Precool	1.2	1.1	1.1	1.0	1.2	1.2	1.2	1.0	1.1	0.8
11	Dual Path	1.1	1.0	1.1	1.0	1.1	1.2	1.1	0.9	1.0	0.7
12	Dual Path w/Enthalpy Wheel	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.5	0.6	0.5
13	Dual Path w/AAHX	1.2	1.2	1.3	1.2	1.2	1.3	1.3	1.1	1.2	0.9
14	Dual Path w/Desiccant	0.8	0.8	0.8	0.7	0.8	0.9	0.8	0.7	0.8	0.7
15	Base DX w/DCV	0.9	0.9	1.0	0.9	1.0	1.0	1.0	0.9	0.9	0.7
16	Dual Path w/DCV	0.9	0.9	0.9	0.8	0.9	1.0	0.9	0.7	0.8	0.6
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	0.8

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
00	Conventional DX	112	618	823	715	1382	2576	2624	2868	3966	2194
01	Base DX	114	623	831	723	1388	2590	2637	2887	3984	2214
02	DX w/Improved Dehumid.	128	678	903	800	1488	2720	2762	3045	4142	2391
03	Base DX w/Lower Airflow	124	663	885	784	1464	2693	2736	3010	4109	2354
04	Base DX w/AAHX	102	575	765	658	1311	2468	2521	2736	3827	2055
05	Base DX w/Subcool Reheat	108	602	801	694	1355	2539	2589	2821	3923	2150
06	Base DX w/o Lat. Coil Degrad.	113	621	830	722	1388	2589	2636	2886	3982	2214
07	Base DX w/Bypass Damper	114	623	831	723	1388	2590	2637	2887	3984	2214
08	Base DX w/Desiccant	8585	5775	4599	3508	3816	3194	3172	2524	2565	1477
09	Base DX w/Enthalpy Wheel	122	383	543	479	685	879	791	1157	1097	1641
10	Base DX w/OA Precool	117	635	846	740	1421	2627	2672	2928	4034	2267
11	Dual Path	145	742	989	875	1604	2886	2903	3245	4350	2626
12	Dual Path w/Enthalpy Wheel	131	412	582	518	733	937	845	1233	1173	1755
13	Dual Path w/AAHX	137	705	939	829	1546	2795	2822	3135	4257	2513
14	Dual Path w/Desiccant	7515	4698	3481	2373	2416	2233	2198	1879	1849	1550
15	Base DX w/DCV	98	306	380	329	663	1269	1366	1429	2107	989
16	Dual Path w/DCV	120	383	484	418	816	1531	1597	1724	2438	1252
17	Base DX w/Free Reheat	112	612	827	721	1387	2589	2636	2887	3981	2214

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Retail

2004 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	101.8	113.1	114.8	126.2	101.8	104.7	110.8	107.9	100.3	102.7
01	Base DX	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
02	DX w/Improved Dehumid.	110.7	123.0	124.8	137.2	110.7	113.8	120.5	117.4	109.1	111.6
03	Base DX w/Lower Airflow	114.5	127.2	129.1	142.0	114.5	117.8	124.6	121.4	112.8	115.5
04	Base DX w/AAHX	108.8	120.9	122.7	134.9	108.8	111.9	118.4	115.4	107.3	109.8
05	Base DX w/Subcool Reheat	108.4	120.4	122.2	134.4	108.4	111.5	118.0	114.9	106.8	109.3
06	Base DX w/o Lat. Coil Degrad.	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
07	Base DX w/Bypass Damper	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
08	Base DX w/Desiccant	102.5	113.8	115.5	126.9	102.5	105.4	111.4	108.6	101.0	103.3
09	Base DX w/Enthalpy Wheel	67.9	67.9	67.9	71.5	63.0	67.0	67.2	71.3	66.4	70.6
10	Base DX w/OA Precool	72.2	84.2	86.0	98.1	72.2	75.3	81.7	78.7	70.6	73.1
11	Dual Path	114.9	114.4	114.3	113.5	114.9	114.9	114.5	114.7	114.9	114.9
12	Dual Path w/Enthalpy Wheel	47.9	47.9	47.9	47.7	48.2	48.0	48.0	47.7	48.0	47.7
13	Dual Path w/AAHX	106.0	105.3	105.2	104.4	106.0	105.8	105.4	105.6	106.1	105.9
14	Dual Path w/Desiccant	45.5	44.8	44.7	43.9	45.5	45.3	44.9	45.1	45.6	45.4
15	Base DX w/DCV	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0
16	Dual Path w/DCV	114.9	114.4	114.3	113.5	114.9	114.9	114.5	114.7	114.9	114.9
17	Base DX w/Free Reheat	108.1	120.1	121.9	134.0	108.1	111.2	117.6	114.6	106.5	109.0

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
11	Dual Path	0.8	10.2	12.0	24.1	0.8	1.2	7.7	4.7	0.8	0.8
12	Dual Path w/Enthalpy Wheel	19.1	19.1	19.1	22.7	14.2	18.2	18.4	22.5	17.5	21.8
13	Dual Path w/AAHX	6.8	18.8	20.6	32.8	6.8	9.9	16.4	13.3	5.2	7.7
14	Dual Path w/Desiccant	59.0	71.0	72.8	84.9	59.0	62.1	68.5	65.5	57.4	59.9
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	10.2	12.0	24.1	0.8	1.2	7.7	4.7	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Theater

2004 Standard

Occupied Hours when RH>65%

[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3359	2851	2034	1664	1523	1221	1675	880	720	50
01	Base DX	3367	2860	2049	1666	1544	1230	1267	893	724	55
02	DX w/Improved Dehumid.	3387	2878	2085	2072	1874	1254	1306	922	761	80
03	Base DX w/Lower Airflow	3383	2871	2078	2051	1878	1249	1296	923	757	77
04	Base DX w/AAHX	3344	2660	2010	1628	1510	1199	1181	884	690	49
05	Base DX w/Subcool Reheat	3340	2785	1944	1523	1445	1157	1147	822	657	46
06	Base DX w/o Lat. Coil Degrad.	3142	2292	1988	865	1059	806	763	494	372	17
07	Base DX w/Bypass Damper	3358	2700	2016	1482	1501	1208	1220	872	687	53
08	Base DX w/Desiccant	451	437	297	79	13	17	117	0	9	0
09	Base DX w/Enthalpy Wheel	3352	2731	2123	1911	1671	1274	1343	1035	794	154
10	Base DX w/OA Precool	3382	2849	2313	2020	1877	1627	1666	1025	644	57
11	Dual Path	3279	2624	1872	1376	1378	1120	1048	752	621	51
12	Dual Path w/Enthalpy Wheel	3229	2641	1890	1258	1382	1083	1057	786	524	51
13	Dual Path w/AAHX	2331	1462	904	349	632	588	435	386	322	41
14	Dual Path w/Desiccant	17	44	6	0	0	5	28	0	0	0
15	Base DX w/DCV	3626	2965	2490	2286	2057	1682	2728	1393	1307	983
16	Dual Path w/DCV	3649	2978	2236	1373	1683	1529	1541	1171	1109	607
17	Base DX w/Free Reheat	26	120	78	23	68	11	43	56	10	6

Life Cycle Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	193	211	204	222	199	249	233	319	253	200
01	Base DX	197	216	208	227	204	254	237	325	259	206
02	DX w/Improved Dehumid.	203	222	214	233	216	268	255	335	274	222
03	Base DX w/Lower Airflow	190	208	202	219	201	252	237	316	257	206
04	Base DX w/AAHX	244	262	249	272	239	289	274	380	295	238
05	Base DX w/Subcool Reheat	216	234	224	246	217	267	250	345	271	216
06	Base DX w/o Lat. Coil Degrad.	207	225	216	236	211	259	242	333	263	208
07	Base DX w/Bypass Damper	209	228	219	239	214	265	249	340	270	217
08	Base DX w/Desiccant	495	399	375	349	351	354	326	427	305	266
09	Base DX w/Enthalpy Wheel	167	170	163	170	166	180	167	258	184	184
10	Base DX w/OA Precool	219	239	230	248	227	281	262	363	285	230
11	Dual Path	193	215	209	228	212	266	255	326	272	222
12	Dual Path w/Enthalpy Wheel	167	169	163	170	169	184	173	257	189	191
13	Dual Path w/AAHX	235	254	242	264	242	294	284	368	302	247
14	Dual Path w/Desiccant	494	401	375	352	352	356	336	430	314	277
15	Base DX w/DCV	187	197	183	205	174	187	187	272	196	170
16	Dual Path w/DCV	183	195	181	204	178	194	201	268	207	181
17	Base DX w/Free Reheat	286	289	263	281	243	288	268	370	283	217

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

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Theater

2004 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	7.73	8.47	8.40	8.94	7.74	10.89	8.98	13.33	10.39	7.08
01	Base DX	7.66	8.39	8.34	8.90	7.69	10.84	8.86	13.20	10.34	7.04
02	DX w/Improved Dehumid.	6.58	7.25	7.31	7.66	6.95	10.15	8.23	11.64	9.60	6.45
03	Base DX w/Lower Airflow	6.76	7.48	7.53	7.97	7.12	10.29	8.37	11.97	9.77	6.59
04	Base DX w/AAHX	9.50	10.10	9.77	10.45	8.67	11.70	9.64	14.85	11.14	7.64
05	Base DX w/Subcool Reheat	8.55	9.24	9.05	9.80	8.17	11.26	9.25	13.96	10.71	7.31
06	Base DX w/o Lat. Coil Degrad.	8.27	8.98	8.89	9.52	8.11	11.15	9.15	13.71	10.58	7.16
07	Base DX w/Bypass Damper	7.83	8.55	8.46	9.05	7.76	10.89	8.92	13.26	10.37	7.05
08	Base DX w/Desiccant	25.19	18.15	17.28	14.69	14.89	14.62	11.69	16.05	9.93	7.83
09	Base DX w/Enthalpy Wheel	5.92	6.17	6.21	6.35	5.74	6.38	5.03	9.39	5.69	5.87
10	Base DX w/OA Precool	8.24	8.97	8.90	9.24	8.30	11.64	9.38	14.37	10.99	7.57
11	Dual Path	5.43	6.34	6.52	6.93	6.24	9.53	7.73	10.30	8.86	5.87
12	Dual Path w/Enthalpy Wheel	4.89	5.15	5.27	5.35	4.93	5.53	4.35	7.81	4.80	5.17
13	Dual Path w/AAHX	7.18	7.87	7.79	8.39	7.14	10.26	8.42	11.60	9.51	6.28
14	Dual Path w/Desiccant	23.44	16.49	15.54	12.99	13.14	12.90	10.29	13.64	8.47	6.62
15	Base DX w/DCV	6.69	6.88	6.41	7.13	5.39	5.92	5.13	9.17	5.73	4.28
16	Dual Path w/DCV	4.44	4.70	4.39	5.03	3.66	4.29	3.77	5.96	4.08	2.76
17	Base DX w/Free Reheat	13.51	13.11	11.83	12.24	9.99	12.78	10.50	15.75	11.56	7.40

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	322	337	330	353	303	345	374	343	379	292
01	Base DX	319	333	327	351	300	342	368	340	376	289
02	DX w/Improved Dehumid.	273	286	281	300	260	304	327	302	342	255
03	Base DX w/Lower Airflow	281	296	291	313	268	312	336	311	350	263
04	Base DX w/AAHX	397	403	390	415	350	386	418	380	413	324
05	Base DX w/Subcool Reheat	357	368	358	388	324	363	393	358	393	304
06	Base DX w/o Lat. Coil Degrad.	345	357	350	377	320	356	385	352	386	295
07	Base DX w/Bypass Damper	326	340	332	358	304	344	372	341	378	290
08	Base DX w/Desiccant	765	672	587	554	499	446	467	413	375	332
09	Base DX w/Enthalpy Wheel	246	245	243	251	233	227	234	238	222	245
10	Base DX w/OA Precool	344	357	350	365	326	371	393	369	403	315
11	Dual Path	225	249	246	270	223	270	293	270	307	220
12	Dual Path w/Enthalpy Wheel	202	204	202	210	193	187	193	200	183	208
13	Dual Path w/AAHX	298	312	301	330	268	307	335	302	337	244
14	Dual Path w/Desiccant	702	608	523	488	433	384	403	352	316	275
15	Base DX w/DCV	279	277	266	287	240	233	260	228	230	202
16	Dual Path w/DCV	184	188	179	201	155	153	175	151	155	122
17	Base DX w/Free Reheat	565	524	475	487	407	425	459	403	428	307

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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Theater

2004 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	43.7	48.2	48.8	53.0	45.4	45.2	47.3	46.1	43.5	44.6
01	Base DX	46.4	51.2	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
02	DX w/Improved Dehumid.	47.6	52.4	53.0	57.6	49.4	49.2	51.4	50.2	47.4	48.5
03	Base DX w/Lower Airflow	49.2	54.2	54.9	59.6	51.1	50.9	53.2	51.9	49.0	50.2
04	Base DX w/AAHX	46.8	51.5	52.2	56.7	48.5	48.3	50.6	49.3	46.6	47.7
05	Base DX w/Subcool Reheat	46.6	51.3	51.9	56.4	48.4	48.1	50.3	49.1	46.4	47.5
06	Base DX w/o Lat. Coil Degrad.	46.4	51.2	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
07	Base DX w/Bypass Damper	46.4	51.2	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
08	Base DX w/Desiccant	44.0	48.4	49.0	53.2	45.7	45.5	47.5	46.4	43.8	44.9
09	Base DX w/Enthalpy Wheel	31.2	31.3	31.3	32.5	31.1	31.2	31.0	32.5	31.0	32.8
10	Base DX w/OA Precool	44.3	49.0	49.7	54.1	46.1	45.9	48.1	46.9	44.1	45.2
11	Dual Path	48.1	52.5	53.1	57.3	49.8	49.6	51.6	50.5	47.9	49.0
12	Dual Path w/Enthalpy Wheel	30.5	30.6	30.6	31.8	30.4	30.5	30.4	31.8	30.3	32.0
13	Dual Path w/AAHX	47.9	52.4	53.0	57.2	49.6	49.4	51.5	50.3	47.7	48.8
14	Dual Path w/Desiccant	44.8	49.2	49.8	54.0	46.4	46.2	48.3	47.1	44.6	45.6
15	Base DX w/DCV	46.4	51.2	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
16	Dual Path w/DCV	48.1	52.5	53.1	57.3	49.8	49.6	51.6	50.5	47.9	49.0
17	Base DX w/Free Reheat	46.4	51.2	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	83	90	83	94	88	92	103	127	103	98
01	Base DX	88	96	88	99	93	98	109	135	109	104
02	DX w/Improved Dehumid.	109	118	110	123	116	121	136	168	135	129
03	Base DX w/Lower Airflow	93	101	94	105	99	104	116	143	116	110
04	Base DX w/AAHX	108	118	109	122	115	120	135	166	134	128
05	Base DX w/Subcool Reheat	94	102	94	106	99	104	117	144	116	111
06	Base DX w/o Lat. Coil Degrad.	89	96	89	100	94	98	110	136	110	105
07	Base DX w/Bypass Damper	97	105	97	109	103	108	120	149	120	115
08	Base DX w/Desiccant	130	136	126	137	136	143	157	196	161	153
09	Base DX w/Enthalpy Wheel	82	81	74	79	84	89	94	124	102	99
10	Base DX w/OA Precool	102	111	103	116	108	113	127	156	126	120
11	Dual Path	116	125	115	129	122	128	143	177	144	137
12	Dual Path w/Enthalpy Wheel	97	96	87	93	98	104	111	145	120	116
13	Dual Path w/AAHX	132	141	130	144	139	146	162	201	164	156
14	Dual Path w/Desiccant	154	163	150	164	161	170	187	233	191	181
15	Base DX w/DCV	92	99	92	103	97	102	114	140	114	108
16	Dual Path w/DCV	119	128	118	132	126	132	147	182	148	141
17	Base DX w/Free Reheat	93	102	94	106	99	104	116	144	116	111

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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Theater

2004 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
01	Base DX	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
02	DX w/Improved Dehumid.	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
03	Base DX w/Lower Airflow	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
04	Base DX w/AAHX	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
05	Base DX w/Subcool Reheat	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
06	Base DX w/o Lat. Coil Degrad.	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
07	Base DX w/Bypass Damper	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
08	Base DX w/Desiccant	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
09	Base DX w/Enthalpy Wheel	20.4	20.5	20.5	21.3	20.3	20.4	20.3	21.3	20.3	21.5
10	Base DX w/OA Precool	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
11	Dual Path	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
12	Dual Path w/Enthalpy Wheel	20.7	20.8	20.8	21.6	20.6	20.7	20.6	21.6	20.6	21.8
13	Dual Path w/AAHX	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
14	Dual Path w/Desiccant	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
15	Base DX w/DCV	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
16	Dual Path w/DCV	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3
17	Base DX w/Free Reheat	30.7	33.8	34.2	37.2	31.9	31.7	33.2	32.4	30.6	31.3

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	46.4	51.1	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
00	Conventional DX	2150	1848	1705	1699	1541	1410	1506	1318	1305	1208
01	Base DX	2129	1826	1684	1684	1518	1385	1486	1292	1280	1184
02	DX w/Improved Dehumid.	1814	1515	1375	1361	1206	1086	1182	995	986	898
03	Base DX w/Lower Airflow	1869	1577	1441	1438	1271	1150	1249	1059	1050	961
04	Base DX w/AAHX	2655	2274	2089	2067	1875	1720	1842	1602	1589	1473
05	Base DX w/Subcool Reheat	2384	2046	1884	1895	1688	1540	1658	1433	1421	1310
06	Base DX w/o Lat. Coil Degrad.	2306	1974	1815	1826	1646	1474	1587	1373	1350	1223
07	Base DX w/Bypass Damper	2176	1866	1715	1719	1539	1400	1507	1302	1290	1188
08	Base DX w/Desiccant	2179	1939	1832	1784	1776	1667	1710	1594	1594	1504
09	Base DX w/Enthalpy Wheel	1632	1340	1245	1193	1254	1156	1162	1113	1112	1067
10	Base DX w/OA Precool	2292	1964	1809	1746	1666	1539	1613	1449	1450	1338
11	Dual Path	1478	1266	1136	1177	941	809	925	733	681	599
12	Dual Path w/Enthalpy Wheel	1334	1075	984	951	975	879	890	841	822	782
13	Dual Path w/AAHX	1981	1665	1486	1526	1256	1080	1217	971	923	798
14	Dual Path w/Desiccant	1857	1653	1547	1522	1458	1344	1402	1274	1258	1169
15	Base DX w/DCV	1868	1656	1560	1554	1483	1376	1460	1296	1283	1220
16	Dual Path w/DCV	1221	1094	1010	1055	891	786	870	726	676	629
17	Base DX w/Free Reheat	3785	2998	2575	2437	2212	1930	2055	1694	1631	1301

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Theater

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	46.4	51.1	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
00	Conventional DX	0.9	1.0	0.9	0.9	0.9	1.0	1.0	0.7	0.9	0.7
01	Base DX	0.9	1.0	1.0	0.9	1.0	1.0	1.0	0.8	0.9	0.7
02	DX w/Improved Dehumid.	0.9	0.9	0.9	0.8	0.9	1.0	1.0	0.7	0.8	0.6
03	Base DX w/Lower Airflow	0.9	1.0	0.9	0.9	1.0	1.0	1.0	0.7	0.9	0.7
04	Base DX w/AAHX	1.1	1.3	1.2	1.2	1.3	1.4	1.3	0.9	1.2	0.9
05	Base DX w/Subcool Reheat	1.0	1.1	1.1	1.1	1.1	1.2	1.2	0.9	1.0	0.9
06	Base DX w/o Lat. Coil Degrad.	0.9	1.0	1.0	0.9	1.0	1.1	1.1	0.8	0.9	0.8
07	Base DX w/Bypass Damper	0.9	1.0	1.0	1.0	1.0	1.1	1.1	0.8	1.0	0.8
08	Base DX w/Desiccant	0.7	0.8	0.7	0.7	0.8	0.8	0.8	0.6	0.7	0.6
09	Base DX w/Enthalpy Wheel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
10	Base DX w/OA Precool	0.9	1.0	1.0	0.8	0.9	1.0	1.0	0.7	0.9	0.7
11	Dual Path	0.7	0.9	0.8	0.8	0.9	0.9	0.9	0.6	0.7	0.5
12	Dual Path w/Enthalpy Wheel	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.5	0.5
13	Dual Path w/AAHX	1.0	1.0	1.0	1.0	1.1	1.1	1.1	0.8	1.0	0.7
14	Dual Path w/Desiccant	0.6	0.7	0.7	0.6	0.7	0.7	0.7	0.5	0.6	0.5
15	Base DX w/DCV	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.7	0.8	0.6
16	Dual Path w/DCV	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.5	0.6	0.5
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.3	1.0

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	46.4	51.1	51.8	56.3	48.2	48.0	50.2	49.0	46.2	47.4
00	Conventional DX	73	677	931	855	1369	2684	2634	2792	4025	2303
01	Base DX	75	684	941	866	1382	2701	2593	2812	4046	2325
02	DX w/Improved Dehumid.	91	760	1039	991	1533	2875	2742	2998	4248	2520
03	Base DX w/Lower Airflow	87	744	1017	967	1509	2837	2710	2958	4207	2480
04	Base DX w/AAHX	66	617	853	779	1275	2549	2451	2636	3861	2134
05	Base DX w/Subcool Reheat	71	655	903	846	1336	2639	2535	2736	3967	2245
06	Base DX w/o Lat. Coil Degrad.	68	677	961	865	1382	2700	2593	2812	4046	2325
07	Base DX w/Bypass Damper	75	679	941	866	1382	2701	2593	2812	4046	2325
08	Base DX w/Desiccant	9514	6953	5488	4147	4682	3975	3846	3339	3014	2198
09	Base DX w/Enthalpy Wheel	86	507	718	642	822	1029	943	1306	1247	1774
10	Base DX w/OA Precool	78	699	981	907	1443	2818	2684	2910	4091	2367
11	Dual Path	114	823	1124	1042	1620	3043	2882	3181	4467	2742
12	Dual Path w/Enthalpy Wheel	96	546	766	690	881	1098	1004	1387	1333	1887
13	Dual Path w/AAHX	97	773	1063	984	1546	2939	2792	3063	4333	2609
14	Dual Path w/Desiccant	9178	6615	5149	3816	4318	3717	3557	3129	2816	2072
15	Base DX w/DCV	47	128	154	139	243	459	506	525	870	375
16	Dual Path w/DCV	70	188	230	207	365	678	710	763	1189	571
17	Base DX w/Free Reheat	71	670	937	864	1381	2698	2590	2811	4044	2324

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Theater

2004 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	43.7	48.2	48.8	53.0	45.4	45.2	47.3	46.1	43.5	44.6
01	Base DX	46.4	51.1	51.8	56.2	48.2	48.0	50.2	49.0	46.2	47.4
02	DX w/Improved Dehumid.	47.6	52.4	53.0	57.6	49.4	49.2	51.4	50.1	47.3	48.5
03	Base DX w/Lower Airflow	49.2	54.2	54.8	59.6	51.1	50.8	53.2	51.9	49.0	50.2
04	Base DX w/AAHX	46.8	51.5	52.1	56.6	48.5	48.3	50.5	49.3	46.5	47.7
05	Base DX w/Subcool Reheat	46.6	51.3	51.9	56.4	48.3	48.1	50.3	49.1	46.4	47.5
06	Base DX w/o Lat. Coil Degrad.	46.4	51.1	51.8	56.2	48.2	48.0	50.2	49.0	46.2	47.4
07	Base DX w/Bypass Damper	46.4	51.1	51.8	56.2	48.2	48.0	50.2	49.0	46.2	47.4
08	Base DX w/Desiccant	44.0	48.4	49.0	53.2	45.6	45.5	47.5	46.4	43.8	44.8
09	Base DX w/Enthalpy Wheel	31.2	31.3	31.2	32.5	31.1	31.2	31.0	32.5	31.0	32.8
10	Base DX w/OA Precool	32.8	37.5	38.1	42.6	34.5	34.3	36.5	35.3	32.6	33.7
11	Dual Path	43.5	43.2	43.1	42.9	43.3	43.4	43.2	43.3	43.5	43.4
12	Dual Path w/Enthalpy Wheel	17.9	17.9	17.9	17.8	17.9	17.9	17.9	17.8	17.9	17.8
13	Dual Path w/AAHX	40.0	39.7	39.7	39.4	39.9	39.9	39.8	39.8	40.0	39.9
14	Dual Path w/Desiccant	17.0	16.7	16.7	16.4	16.9	16.9	16.8	16.8	17.0	16.9
15	Base DX w/DCV	46.4	51.1	51.8	56.2	48.2	48.0	50.2	49.0	46.2	47.4
16	Dual Path w/DCV	43.5	43.2	43.1	42.9	43.3	43.4	43.2	43.3	43.5	43.4
17	Base DX w/Free Reheat	46.4	51.1	51.8	56.2	48.2	48.0	50.2	49.0	46.2	47.4

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
11	Dual Path	4.6	9.4	10.0	14.5	6.4	6.2	8.4	7.2	4.4	5.6
12	Dual Path w/Enthalpy Wheel	12.6	12.7	12.7	13.9	12.5	12.6	12.5	13.9	12.4	14.2
13	Dual Path w/AAHX	7.9	12.6	13.3	17.8	9.7	9.5	11.7	10.5	7.7	8.9
14	Dual Path w/Desiccant	27.8	32.5	33.1	37.6	29.5	29.3	31.5	30.3	27.6	28.7
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	4.6	9.4	10.0	14.5	6.4	6.2	8.4	7.2	4.4	5.6
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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School-9 Month-South

2004 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2399	1638	1126	977	754	516	540	266	252	0
01	Base DX	2383	1637	1115	971	761	506	550	285	259	0
02	DX w/Improved Dehumid.	2450	1688	1179	1032	801	540	600	323	293	0
03	Base DX w/Lower Airflow	2427	1684	1170	1023	804	533	591	323	297	0
04	Base DX w/AAHX	1723	1409	945	869	672	433	482	265	209	0
05	Base DX w/Subcool Reheat	2222	1518	1001	780	680	440	454	228	213	0
06	Base DX w/o Lat. Coil Degrad.	1965	1182	753	452	426	280	329	80	84	0
07	Base DX w/Bypass Damper	2295	1572	1054	869	724	463	499	260	228	0
08	Base DX w/Desiccant	34	121	1	0	0	0	0	0	0	0
09	Base DX w/Enthalpy Wheel	665	686	552	483	363	294	256	52	33	0
10	Base DX w/OA Precool	2367	1585	1110	944	732	520	575	259	217	0
11	Dual Path	1724	1077	686	489	444	315	349	104	91	0
12	Dual Path w/Enthalpy Wheel	513	367	152	9	23	19	6	0	0	0
13	Dual Path w/AAHX	805	529	262	46	127	101	84	24	19	0
14	Dual Path w/Desiccant	0	0	0	0	0	0	0	0	0	0
15	Base DX w/DCV	2006	1363	999	947	689	458	572	269	234	0
16	Dual Path w/DCV	859	656	481	211	228	139	171	11	15	0
17	Base DX w/Free Reheat	39	30	14	0	0	0	2	4	0	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	8	9	9	10	9	11	11	14	12	10
01	Base DX	8	9	9	10	9	11	11	15	12	10
02	DX w/Improved Dehumid.	8	10	10	10	10	12	12	15	13	11
03	Base DX w/Lower Airflow	8	9	9	10	9	11	11	14	12	10
04	Base DX w/AAHX	10	11	11	12	11	13	12	17	13	11
05	Base DX w/Subcool Reheat	9	10	10	11	10	12	11	15	12	10
06	Base DX w/o Lat. Coil Degrad.	9	10	10	11	10	12	12	16	13	11
07	Base DX w/Bypass Damper	8	10	10	10	9	12	11	15	12	10
08	Base DX w/Desiccant	20	17	16	15	14	15	14	18	13	12
09	Base DX w/Enthalpy Wheel	6	7	7	7	7	8	7	11	8	9
10	Base DX w/OA Precool	9	11	10	11	10	13	12	16	13	11
11	Dual Path	12	12	11	11	12	14	14	18	15	13
12	Dual Path w/Enthalpy Wheel	9	9	8	8	9	9	9	13	10	10
13	Dual Path w/AAHX	13	13	12	12	13	15	15	19	16	14
14	Dual Path w/Desiccant	20	17	16	15	14	15	14	19	14	13
15	Base DX w/DCV	8	9	8	9	8	9	9	12	9	8
16	Dual Path w/DCV	11	11	10	10	11	12	12	16	13	11
17	Base DX w/Free Reheat	10	12	11	12	10	13	12	16	13	10

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
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School-9 Month-South

2004 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.31	0.36	0.36	0.37	0.34	0.48	0.40	0.58	0.47	0.33
01	Base DX	0.31	0.36	0.36	0.37	0.34	0.48	0.40	0.58	0.46	0.33
02	DX w/Improved Dehumid.	0.28	0.31	0.32	0.32	0.31	0.45	0.38	0.52	0.44	0.31
03	Base DX w/Lower Airflow	0.28	0.32	0.33	0.33	0.31	0.46	0.38	0.53	0.44	0.31
04	Base DX w/AAHX	0.38	0.42	0.42	0.43	0.37	0.51	0.43	0.64	0.50	0.35
05	Base DX w/Subcool Reheat	0.34	0.39	0.39	0.40	0.35	0.50	0.41	0.61	0.48	0.34
06	Base DX w/o Lat. Coil Degrad.	0.32	0.37	0.38	0.39	0.35	0.49	0.41	0.59	0.47	0.33
07	Base DX w/Bypass Damper	0.32	0.36	0.37	0.37	0.34	0.48	0.40	0.58	0.47	0.33
08	Base DX w/Desiccant	1.01	0.70	0.67	0.59	0.54	0.52	0.43	0.60	0.39	0.31
09	Base DX w/Enthalpy Wheel	0.23	0.25	0.25	0.26	0.23	0.26	0.20	0.38	0.24	0.27
10	Base DX w/OA Precool	0.34	0.39	0.39	0.39	0.36	0.51	0.42	0.63	0.49	0.35
11	Dual Path	0.30	0.32	0.32	0.31	0.31	0.46	0.38	0.52	0.44	0.30
12	Dual Path w/Enthalpy Wheel	0.23	0.24	0.24	0.24	0.22	0.24	0.19	0.35	0.22	0.25
13	Dual Path w/AAHX	0.36	0.37	0.37	0.35	0.34	0.48	0.40	0.55	0.46	0.31
14	Dual Path w/Desiccant	0.94	0.63	0.59	0.51	0.47	0.46	0.37	0.51	0.33	0.28
15	Base DX w/DCV	0.27	0.29	0.28	0.30	0.24	0.30	0.25	0.41	0.29	0.21
16	Dual Path w/DCV	0.26	0.25	0.24	0.24	0.22	0.27	0.22	0.35	0.26	0.18
17	Base DX w/Free Reheat	0.46	0.50	0.47	0.48	0.40	0.53	0.45	0.64	0.50	0.33

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	13	14	14	15	13	15	16	15	17	13
01	Base DX	13	14	14	14	12	15	16	15	17	13
02	DX w/Improved Dehumid.	11	12	12	12	11	13	14	14	15	12
03	Base DX w/Lower Airflow	11	13	13	13	11	14	15	14	16	12
04	Base DX w/AAHX	16	17	16	17	14	17	18	17	18	15
05	Base DX w/Subcool Reheat	14	15	15	16	13	16	17	16	17	14
06	Base DX w/o Lat. Coil Degrad.	13	15	15	15	13	15	16	15	17	13
07	Base DX w/Bypass Damper	13	14	14	15	13	15	16	15	17	13
08	Base DX w/Desiccant	30	26	23	22	18	17	18	15	15	13
09	Base DX w/Enthalpy Wheel	9	10	10	10	9	9	9	10	9	11
10	Base DX w/OA Precool	14	15	15	15	14	16	17	16	18	14
11	Dual Path	12	12	12	12	11	13	14	14	16	12
12	Dual Path w/Enthalpy Wheel	9	9	9	9	9	8	8	9	9	10
13	Dual Path w/AAHX	15	14	14	14	13	15	16	14	17	12
14	Dual Path w/Desiccant	28	23	20	19	16	14	15	13	12	11
15	Base DX w/DCV	11	12	11	12	10	11	12	10	11	10
16	Dual Path w/DCV	11	10	10	9	9	9	10	9	10	8
17	Base DX w/Free Reheat	19	20	18	19	15	17	19	17	18	13

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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School-9 Month-South

2004 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System										
00	Conventional DX	1.8	2.2	2.2	2.5	2.0	2.1	2.2	2.1	2.0	2.2
01	Base DX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
02	DX w/Improved Dehumid.	1.9	2.4	2.4	2.7	2.2	2.3	2.4	2.3	2.2	2.4
03	Base DX w/Lower Airflow	2.0	2.5	2.5	2.8	2.3	2.4	2.5	2.4	2.3	2.4
04	Base DX w/AAHX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.2	2.3
05	Base DX w/Subcool Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
06	Base DX w/o Lat. Coil Degrad.	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
07	Base DX w/Bypass Damper	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
08	Base DX w/Desiccant	1.8	2.2	2.2	2.5	2.1	2.1	2.2	2.2	2.0	2.2
09	Base DX w/Enthalpy Wheel	1.1	1.3	1.3	1.4	1.3	1.3	1.3	1.4	1.3	1.5
10	Base DX w/OA Precool	1.8	2.2	2.2	2.5	2.1	2.1	2.2	2.2	2.0	2.2
11	Dual Path	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
12	Dual Path w/Enthalpy Wheel	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
13	Dual Path w/AAHX	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
14	Dual Path w/Desiccant	1.8	2.2	2.3	2.5	2.1	2.2	2.3	2.2	2.1	2.2
15	Base DX w/DCV	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
16	Dual Path w/DCV	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
17	Base DX w/Free Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System										
00	Conventional DX	3	4	4	4	4	4	5	6	5	5
01	Base DX	4	4	4	5	4	5	5	6	5	5
02	DX w/Improved Dehumid.	4	5	5	6	5	6	6	8	6	6
03	Base DX w/Lower Airflow	4	5	4	5	4	5	5	7	5	5
04	Base DX w/AAHX	4	5	5	6	5	6	6	8	6	6
05	Base DX w/Subcool Reheat	4	5	4	5	4	5	5	7	5	5
06	Base DX w/o Lat. Coil Degrad.	4	5	5	5	5	5	6	7	6	6
07	Base DX w/Bypass Damper	4	5	4	5	5	5	6	7	6	6
08	Base DX w/Desiccant	6	7	6	7	6	7	8	10	8	8
09	Base DX w/Enthalpy Wheel	3	4	3	4	4	4	4	6	5	5
10	Base DX w/OA Precool	4	5	5	5	5	5	6	7	6	6
11	Dual Path	7	7	7	7	7	8	8	11	9	8
12	Dual Path w/Enthalpy Wheel	5	5	5	5	5	6	6	8	7	6
13	Dual Path w/AAHX	8	8	7	7	8	8	9	11	10	9
14	Dual Path w/Desiccant	7	8	7	8	8	8	9	11	9	9
15	Base DX w/DCV	4	5	4	5	4	5	5	7	5	5
16	Dual Path w/DCV	8	7	7	7	8	8	9	11	9	9
17	Base DX w/Free Reheat	4	5	4	5	4	5	5	7	5	5

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

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School-9 Month-South

2004 Standard

Net Sensible DX Cooling Capacity*
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
01	Base DX	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
02	DX w/Improved Dehumid.	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
03	Base DX w/Lower Airflow	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
04	Base DX w/AAHX	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
05	Base DX w/Subcool Reheat	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
06	Base DX w/o Lat. Coil Degrad.	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
07	Base DX w/Bypass Damper	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
08	Base DX w/Desiccant	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
09	Base DX w/Enthalpy Wheel	0.7	0.8	0.8	0.9	0.8	0.9	0.9	0.9	0.9	1.0
10	Base DX w/OA Precool	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
11	Dual Path	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
12	Dual Path w/Enthalpy Wheel	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
13	Dual Path w/AAHX	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
14	Dual Path w/Desiccant	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
15	Base DX w/DCV	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
16	Dual Path w/DCV	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
17	Base DX w/Free Reheat	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
00	Conventional DX	2022	1617	1502	1429	1298	1227	1267	1096	1127	1012
01	Base DX	2023	1608	1494	1418	1281	1210	1250	1075	1108	989
02	DX w/Improved Dehumid.	1779	1346	1231	1148	1021	956	993	823	857	745
03	Base DX w/Lower Airflow	1826	1404	1294	1211	1078	1014	1050	878	913	798
04	Base DX w/AAHX	2532	1996	1851	1745	1585	1501	1548	1334	1376	1234
05	Base DX w/Subcool Reheat	2270	1802	1670	1586	1424	1345	1394	1194	1230	1091
06	Base DX w/o Lat. Coil Degrad.	2128	1701	1580	1514	1360	1265	1314	1117	1153	1007
07	Base DX w/Bypass Damper	2082	1645	1524	1443	1299	1224	1268	1082	1118	990
08	Base DX w/Desiccant	2044	1707	1633	1560	1557	1466	1476	1350	1389	1269
09	Base DX w/Enthalpy Wheel	1439	1130	1064	980	1038	986	959	906	947	893
10	Base DX w/OA Precool	2266	1761	1638	1537	1459	1373	1400	1232	1275	1140
11	Dual Path	1983	1358	1230	1078	1083	983	987	826	903	719
12	Dual Path w/Enthalpy Wheel	1476	1069	999	886	971	885	871	776	843	708
13	Dual Path w/AAHX	2419	1648	1491	1306	1292	1165	1177	964	1058	825
14	Dual Path w/Desiccant	1689	1434	1361	1314	1245	1158	1185	1042	1064	966
15	Base DX w/DCV	1773	1467	1393	1338	1265	1196	1222	1069	1093	1015
16	Dual Path w/DCV	1726	1222	1131	1002	1063	966	960	817	889	741
17	Base DX w/Free Reheat	3112	2393	2094	1941	1713	1526	1603	1282	1325	1004

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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School-9 Month-South

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*

[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System S01 Net Cap==>	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
00	Conventional DX	1.1	1.1	1.1	0.9	0.9	1.0	1.0	0.8	0.9	0.7
01	Base DX	1.1	1.1	1.2	1.0	0.9	1.1	1.1	0.8	0.9	0.7
02	DX w/Improved Dehumid.	1.1	1.1	1.1	0.9	0.9	1.0	1.0	0.8	0.9	0.7
03	Base DX w/Lower Airflow	1.1	1.1	1.2	1.0	0.9	1.1	1.1	0.8	0.9	0.7
04	Base DX w/AAHX	1.3	1.3	1.4	1.2	1.2	1.4	1.4	1.0	1.2	0.9
05	Base DX w/Subcool Reheat	1.2	1.2	1.4	1.1	1.1	1.3	1.3	1.0	1.0	0.8
06	Base DX w/o Lat. Coil Degrad.	1.2	1.1	1.2	1.0	1.0	1.1	1.1	0.8	1.0	0.7
07	Base DX w/Bypass Damper	1.2	1.1	1.3	1.0	1.0	1.1	1.1	0.9	1.0	0.7
08	Base DX w/Desiccant	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.7
09	Base DX w/Enthalpy Wheel	0.8	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.7	0.6
10	Base DX w/OA Precool	1.2	1.1	1.2	1.0	1.0	1.1	1.1	0.8	0.9	0.7
11	Dual Path	1.2	1.1	1.2	1.0	0.9	1.0	1.0	0.8	0.9	0.7
12	Dual Path w/Enthalpy Wheel	0.8	0.6	0.7	0.6	0.6	0.6	0.6	0.5	0.6	0.6
13	Dual Path w/AAHX	1.4	1.2	1.4	1.1	1.1	1.3	1.2	0.9	1.1	0.9
14	Dual Path w/Desiccant	0.8	0.8	0.9	0.8	0.7	0.7	0.8	0.6	0.7	0.7
15	Base DX w/DCV	1.0	0.9	1.0	0.8	0.8	0.9	0.9	0.7	0.8	0.7
16	Dual Path w/DCV	1.1	0.9	1.0	0.8	0.8	0.9	0.9	0.6	0.8	0.6
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	0.7

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System S01 Net Cap==>	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
00	Conventional DX	261	932	1146	965	1661	2747	2825	3136	4229	2505
01	Base DX	265	939	1156	975	1672	2762	2840	3157	4246	2525
02	DX w/Improved Dehumid.	296	1013	1247	1064	1775	2901	2971	3332	4425	2707
03	Base DX w/Lower Airflow	290	997	1227	1044	1753	2871	2944	3294	4389	2668
04	Base DX w/AAHX	236	874	1071	892	1572	2626	2712	2991	4074	2354
05	Base DX w/Subcool Reheat	252	910	1121	941	1631	2703	2784	3088	4174	2453
06	Base DX w/o Lat. Coil Degrad.	260	934	1152	973	1670	2760	2838	3156	4244	2524
07	Base DX w/Bypass Damper	264	939	1156	975	1672	2762	2840	3157	4246	2525
08	Base DX w/Desiccant	9718	5782	4503	3463	3530	2780	2809	2415	2410	1701
09	Base DX w/Enthalpy Wheel	274	606	764	693	885	935	857	1410	1327	1894
10	Base DX w/OA Precool	273	954	1178	996	1699	2795	2867	3199	4291	2570
11	Dual Path	274	1012	1256	1099	1763	2896	2983	3337	4400	2718
12	Dual Path w/Enthalpy Wheel	255	591	749	692	870	930	848	1419	1319	1943
13	Dual Path w/AAHX	258	981	1220	1066	1721	2841	2936	3271	4327	2651
14	Dual Path w/Desiccant	9427	5431	4165	3126	3229	2621	2609	2405	2382	1848
15	Base DX w/DCV	186	374	419	339	606	957	1057	1155	1635	884
16	Dual Path w/DCV	193	427	485	420	669	1058	1171	1292	1764	1018
17	Base DX w/Free Reheat	250	921	1149	971	1670	2760	2838	3156	4244	2525

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School-9 Month-South

2004 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.8	2.2	2.2	2.5	2.0	2.1	2.2	2.1	2.0	2.2
01	Base DX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
02	DX w/Improved Dehumid.	1.9	2.4	2.4	2.7	2.2	2.3	2.4	2.3	2.2	2.4
03	Base DX w/Lower Airflow	2.0	2.5	2.5	2.8	2.3	2.4	2.5	2.4	2.3	2.4
04	Base DX w/AAHX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.2	2.3
05	Base DX w/Subcool Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
06	Base DX w/o Lat. Coil Degrad.	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
07	Base DX w/Bypass Damper	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
08	Base DX w/Desiccant	1.8	2.2	2.2	2.5	2.1	2.1	2.2	2.2	2.0	2.2
09	Base DX w/Enthalpy Wheel	1.1	1.3	1.3	1.4	1.3	1.3	1.3	1.4	1.3	1.5
10	Base DX w/OA Precool	1.1	1.6	1.6	1.9	1.4	1.5	1.6	1.6	1.4	1.6
11	Dual Path	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
12	Dual Path w/Enthalpy Wheel	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
13	Dual Path w/AAHX	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
14	Dual Path w/Desiccant	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
15	Base DX w/DCV	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
16	Dual Path w/DCV	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
17	Base DX w/Free Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	0.9	1.3	1.4	1.6	1.2	1.2	1.3	1.3	1.1	1.3
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

School-12 Month-South

2004 Standard

Occupied Hours when RH>65%

[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2373	1739	1192	959	793	547	592	278	247	0
01	Base DX	2369	1719	1185	912	789	523	586	279	252	0
02	DX w/Improved Dehumid.	2429	1769	1239	989	823	558	621	304	269	0
03	Base DX w/Lower Airflow	2412	1737	1230	960	823	553	611	308	274	0
04	Base DX w/AAHX	1449	1219	815	656	551	374	394	226	160	0
05	Base DX w/Subcool Reheat	2206	1563	1082	708	695	429	471	231	202	0
06	Base DX w/o Lat. Coil Degrad.	2005	1196	871	351	370	217	306	101	86	0
07	Base DX w/Bypass Damper	2300	1619	1126	776	730	470	507	250	214	0
08	Base DX w/Desiccant	16	23	2	0	0	0	0	0	0	0
09	Base DX w/Enthalpy Wheel	315	228	198	84	78	73	62	2	13	0
10	Base DX w/OA Precool	2363	1693	1211	1063	789	559	636	301	207	0
11	Dual Path	1639	904	623	205	247	168	160	79	65	0
12	Dual Path w/Enthalpy Wheel	239	166	139	68	52	67	44	1	10	0
13	Dual Path w/AAHX	586	325	186	58	91	89	40	35	26	0
14	Dual Path w/Desiccant	3	1	0	0	0	0	0	0	0	0
15	Base DX w/DCV	2037	1426	1007	817	601	390	507	170	111	0
16	Dual Path w/DCV	591	281	213	94	116	88	93	10	26	0
17	Base DX w/Free Reheat	200	113	39	5	10	17	2	13	0	0

Life Cycle Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	8	10	10	10	9	12	11	15	12	10
01	Base DX	8	10	10	11	10	12	11	16	12	10
02	DX w/Improved Dehumid.	9	10	10	11	10	13	12	16	13	11
03	Base DX w/Lower Airflow	8	10	10	10	9	12	11	15	12	10
04	Base DX w/AAHX	10	12	12	13	11	14	13	18	14	12
05	Base DX w/Subcool Reheat	9	11	11	11	10	13	12	17	13	11
06	Base DX w/o Lat. Coil Degrad.	9	11	11	11	10	13	12	17	13	11
07	Base DX w/Bypass Damper	9	11	10	11	10	13	12	16	13	11
08	Base DX w/Desiccant	22	18	17	16	16	16	15	20	15	13
09	Base DX w/Enthalpy Wheel	7	7	7	8	7	8	8	12	9	9
10	Base DX w/OA Precool	9	11	11	12	11	13	13	17	14	12
11	Dual Path	12	12	12	12	12	15	14	19	16	13
12	Dual Path w/Enthalpy Wheel	9	9	9	9	9	10	9	14	10	10
13	Dual Path w/AAHX	13	14	13	13	13	16	15	20	17	14
14	Dual Path w/Desiccant	22	18	17	16	16	16	16	20	15	14
15	Base DX w/DCV	8	9	9	10	8	9	9	13	10	9
16	Dual Path w/DCV	11	11	11	11	11	12	12	17	14	12
17	Base DX w/Free Reheat	11	13	12	13	11	13	13	17	13	11

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

School-12 Month-South

2004 Standard

Annual HVAC Energy Cost

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.33	0.40	0.41	0.42	0.37	0.52	0.44	0.66	0.51	0.37
01	Base DX	0.33	0.40	0.40	0.42	0.37	0.52	0.44	0.65	0.51	0.37
02	DX w/Improved Dehumid.	0.30	0.35	0.36	0.36	0.34	0.49	0.41	0.58	0.48	0.34
03	Base DX w/Lower Airflow	0.30	0.36	0.37	0.38	0.35	0.50	0.42	0.60	0.49	0.35
04	Base DX w/AAHX	0.41	0.47	0.47	0.49	0.41	0.56	0.48	0.73	0.55	0.40
05	Base DX w/Subcool Reheat	0.37	0.44	0.44	0.46	0.39	0.54	0.46	0.69	0.53	0.38
06	Base DX w/o Lat. Coil Degrad.	0.35	0.42	0.42	0.44	0.38	0.53	0.45	0.67	0.52	0.37
07	Base DX w/Bypass Damper	0.34	0.41	0.41	0.42	0.37	0.52	0.44	0.66	0.51	0.37
08	Base DX w/Desiccant	1.14	0.80	0.77	0.66	0.63	0.62	0.52	0.71	0.46	0.35
09	Base DX w/Enthalpy Wheel	0.24	0.27	0.28	0.28	0.26	0.29	0.23	0.44	0.28	0.31
10	Base DX w/OA Precool	0.37	0.43	0.43	0.44	0.40	0.56	0.46	0.71	0.54	0.40
11	Dual Path	0.33	0.36	0.36	0.35	0.35	0.50	0.42	0.59	0.49	0.34
12	Dual Path w/Enthalpy Wheel	0.24	0.26	0.26	0.26	0.24	0.27	0.21	0.40	0.26	0.28
13	Dual Path w/AAHX	0.40	0.42	0.41	0.41	0.38	0.53	0.44	0.63	0.51	0.35
14	Dual Path w/Desiccant	1.06	0.73	0.70	0.58	0.55	0.55	0.45	0.60	0.40	0.32
15	Base DX w/DCV	0.28	0.32	0.31	0.34	0.27	0.32	0.28	0.47	0.32	0.24
16	Dual Path w/DCV	0.27	0.28	0.27	0.27	0.24	0.29	0.25	0.40	0.29	0.21
17	Base DX w/Free Reheat	0.49	0.55	0.52	0.54	0.44	0.58	0.50	0.73	0.55	0.37

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy

[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	14	16	16	16	14	16	18	17	19	15
01	Base DX	14	16	16	16	14	16	18	17	18	15
02	DX w/Improved Dehumid.	12	14	14	14	12	15	16	15	17	13
03	Base DX w/Lower Airflow	12	14	14	15	13	15	16	16	17	14
04	Base DX w/AAHX	17	19	18	19	16	18	20	19	20	16
05	Base DX w/Subcool Reheat	15	17	17	18	15	17	19	18	19	15
06	Base DX w/o Lat. Coil Degrad.	14	17	16	17	15	17	18	17	19	15
07	Base DX w/Bypass Damper	14	16	16	17	14	16	18	17	19	15
08	Base DX w/Desiccant	34	30	26	25	21	19	21	18	17	15
09	Base DX w/Enthalpy Wheel	10	11	11	11	10	10	10	11	11	12
10	Base DX w/OA Precool	15	17	17	17	15	18	19	18	20	16
11	Dual Path	14	14	14	14	13	15	16	15	17	13
12	Dual Path w/Enthalpy Wheel	10	10	10	10	10	9	10	10	10	11
13	Dual Path w/AAHX	16	16	16	16	14	16	18	16	18	14
14	Dual Path w/Desiccant	31	27	23	22	18	16	18	16	15	13
15	Base DX w/DCV	12	13	13	14	11	12	13	12	12	11
16	Dual Path w/DCV	11	11	11	11	10	10	11	10	11	9
17	Base DX w/Free Reheat	20	22	21	21	17	19	21	19	20	15

** Source Energy = Gas Energy + Electric Energy/31.3%*

Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

MI = Miami FL
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School-12 Month-South

2004 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.8	2.2	2.2	2.5	2.0	2.1	2.2	2.1	2.0	2.2
01	Base DX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
02	DX w/Improved Dehumid.	1.9	2.4	2.4	2.7	2.2	2.3	2.4	2.3	2.2	2.4
03	Base DX w/Lower Airflow	2.0	2.5	2.5	2.8	2.3	2.4	2.5	2.4	2.3	2.4
04	Base DX w/AAHX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.2	2.3
05	Base DX w/Subcool Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
06	Base DX w/o Lat. Coil Degrad.	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
07	Base DX w/Bypass Damper	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
08	Base DX w/Desiccant	1.8	2.2	2.2	2.5	2.1	2.1	2.2	2.2	2.0	2.2
09	Base DX w/Enthalpy Wheel	1.1	1.3	1.3	1.4	1.3	1.3	1.3	1.4	1.3	1.5
10	Base DX w/OA Precool	1.8	2.2	2.2	2.5	2.1	2.1	2.2	2.2	2.0	2.2
11	Dual Path	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
12	Dual Path w/Enthalpy Wheel	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
13	Dual Path w/AAHX	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
14	Dual Path w/Desiccant	1.8	2.2	2.3	2.5	2.1	2.2	2.3	2.2	2.1	2.2
15	Base DX w/DCV	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
16	Dual Path w/DCV	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
17	Base DX w/Free Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	3	4	4	4	4	4	5	6	5	5
01	Base DX	4	4	4	5	4	5	5	6	5	5
02	DX w/Improved Dehumid.	4	5	5	6	5	6	6	8	6	6
03	Base DX w/Lower Airflow	4	5	4	5	4	5	5	7	5	5
04	Base DX w/AAHX	4	5	5	6	5	6	6	8	6	6
05	Base DX w/Subcool Reheat	4	5	4	5	4	5	5	7	5	5
06	Base DX w/o Lat. Coil Degrad.	4	5	5	5	5	5	6	7	6	6
07	Base DX w/Bypass Damper	4	5	4	5	5	5	6	7	6	6
08	Base DX w/Desiccant	6	7	6	7	6	7	8	10	8	8
09	Base DX w/Enthalpy Wheel	3	4	3	4	4	4	4	6	5	5
10	Base DX w/OA Precool	4	5	5	5	5	5	6	7	6	6
11	Dual Path	7	7	7	7	7	8	8	11	9	8
12	Dual Path w/Enthalpy Wheel	5	5	5	5	5	6	6	8	7	6
13	Dual Path w/AAHX	8	8	7	7	8	8	9	11	10	9
14	Dual Path w/Desiccant	7	8	7	8	8	8	9	11	9	9
15	Base DX w/DCV	4	5	4	5	4	5	5	7	5	5
16	Dual Path w/DCV	8	7	7	7	8	8	9	11	9	9
17	Base DX w/Free Reheat	4	5	4	5	4	5	5	7	5	5

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA

ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

School-12 Month-South

2004 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
01	Base DX	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
02	DX w/Improved Dehumid.	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
03	Base DX w/Lower Airflow	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
04	Base DX w/AAHX	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
05	Base DX w/Subcool Reheat	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
06	Base DX w/o Lat. Coil Degrad.	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
07	Base DX w/Bypass Damper	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
08	Base DX w/Desiccant	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
09	Base DX w/Enthalpy Wheel	0.7	0.8	0.8	0.9	0.8	0.9	0.9	0.9	0.9	1.0
10	Base DX w/OA Precool	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
11	Dual Path	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
12	Dual Path w/Enthalpy Wheel	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
13	Dual Path w/AAHX	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
14	Dual Path w/Desiccant	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
15	Base DX w/DCV	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5
16	Dual Path w/DCV	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
17	Base DX w/Free Reheat	1.2	1.5	1.6	1.7	1.4	1.5	1.5	1.5	1.4	1.5

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
00	Conventional DX	2203	1820	1695	1636	1469	1372	1459	1261	1290	1139
01	Base DX	2199	1809	1686	1630	1453	1355	1443	1241	1272	1116
02	DX w/Improved Dehumid.	1932	1523	1399	1330	1168	1074	1160	965	996	849
03	Base DX w/Lower Airflow	1979	1585	1466	1406	1233	1138	1226	1028	1059	908
04	Base DX w/AAHX	2751	2252	2095	2008	1801	1680	1786	1542	1578	1388
05	Base DX w/Subcool Reheat	2472	2027	1886	1827	1615	1506	1610	1378	1414	1230
06	Base DX w/o Lat. Coil Degrad.	2321	1919	1782	1738	1543	1424	1524	1293	1327	1142
07	Base DX w/Bypass Damper	2261	1852	1722	1664	1475	1372	1467	1253	1286	1118
08	Base DX w/Desiccant	2202	1877	1797	1726	1717	1619	1653	1519	1558	1416
09	Base DX w/Enthalpy Wheel	1511	1225	1156	1084	1148	1090	1082	1034	1076	1005
10	Base DX w/OA Precool	2457	1973	1839	1745	1648	1536	1610	1412	1455	1283
11	Dual Path	2167	1551	1410	1269	1248	1116	1175	977	1059	825
12	Dual Path w/Enthalpy Wheel	1550	1156	1081	977	1071	976	983	888	958	803
13	Dual Path w/AAHX	2654	1887	1706	1542	1495	1325	1406	1149	1245	951
14	Dual Path w/Desiccant	1799	1566	1490	1450	1376	1283	1337	1188	1210	1088
15	Base DX w/DCV	1874	1603	1528	1494	1401	1318	1375	1221	1242	1140
16	Dual Path w/DCV	1818	1336	1240	1123	1176	1065	1091	944	1018	847
17	Base DX w/Free Reheat	3335	2659	2349	2215	1946	1730	1877	1491	1535	1138

**All systems are normalized by the same tons in a given city to provide common comparison point.*

MI = Miami FL
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CH = Chicago IL
PO = Portland OR

School-12 Month-South

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*
[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
00	Conventional DX	1.1	1.1	1.1	1.0	1.0	1.0	1.2	1.0	1.1	0.8
01	Base DX	1.2	1.1	1.2	1.0	1.0	1.1	1.3	1.0	1.1	0.8
02	DX w/Improved Dehumid.	1.2	1.1	1.1	1.0	1.0	1.0	1.2	0.9	1.1	0.8
03	Base DX w/Lower Airflow	1.2	1.1	1.2	1.0	1.0	1.0	1.2	1.0	1.1	0.8
04	Base DX w/AAHX	1.3	1.3	1.4	1.3	1.3	1.3	1.4	1.3	1.3	1.0
05	Base DX w/Subcool Reheat	1.3	1.3	1.4	1.2	1.2	1.2	1.4	1.1	1.2	0.9
06	Base DX w/o Lat. Coil Degrad.	1.2	1.1	1.3	1.1	1.1	1.1	1.3	1.0	1.1	0.9
07	Base DX w/Bypass Damper	1.2	1.1	1.3	1.1	1.1	1.1	1.3	1.0	1.1	0.8
08	Base DX w/Desiccant	1.0	0.9	0.9	0.8	0.9	0.9	1.0	0.8	0.9	0.7
09	Base DX w/Enthalpy Wheel	0.8	0.7	0.7	0.6	0.7	0.7	0.8	0.7	0.7	0.6
10	Base DX w/OA Precool	1.2	1.1	1.2	1.0	1.1	1.1	1.2	1.0	1.2	0.8
11	Dual Path	1.3	1.1	1.2	1.0	1.1	1.1	1.3	1.0	1.2	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.6	0.7	0.6	0.7	0.7	0.7	0.6	0.7	0.6
13	Dual Path w/AAHX	1.5	1.3	1.4	1.1	1.3	1.2	1.4	1.2	1.3	1.0
14	Dual Path w/Desiccant	0.9	0.8	0.9	0.8	0.8	0.8	0.9	0.7	0.8	0.7
15	Base DX w/DCV	1.0	0.9	1.0	0.9	0.9	0.9	1.1	0.9	0.9	0.8
16	Dual Path w/DCV	1.1	0.9	1.1	0.8	0.9	0.9	1.1	0.8	1.0	0.7
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	0.8

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*
[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
00	Conventional DX	278	1003	1221	1038	1771	2925	3001	3436	4524	2786
01	Base DX	282	1011	1232	1048	1784	2940	3017	3456	4541	2808
02	DX w/Improved Dehumid.	316	1089	1328	1140	1894	3085	3158	3637	4726	3000
03	Base DX w/Lower Airflow	309	1072	1306	1120	1870	3055	3128	3599	4688	2958
04	Base DX w/AAHX	251	940	1142	962	1676	2797	2881	3285	4362	2627
05	Base DX w/Subcool Reheat	268	979	1194	1012	1738	2879	2957	3385	4466	2732
06	Base DX w/o Lat. Coil Degrad.	277	1005	1227	1045	1780	2938	3015	3455	4539	2806
07	Base DX w/Bypass Damper	281	1011	1231	1048	1784	2940	3016	3456	4541	2808
08	Base DX w/Desiccant	11094	6845	5410	4041	4286	3490	3600	3116	3097	1996
09	Base DX w/Enthalpy Wheel	294	677	835	759	995	1078	1017	1693	1602	2171
10	Base DX w/OA Precool	291	1026	1255	1070	1811	2975	3047	3499	4586	2854
11	Dual Path	292	1088	1337	1177	1881	3081	3171	3643	4700	3013
12	Dual Path w/Enthalpy Wheel	273	663	820	758	978	1073	1008	1702	1595	2226
13	Dual Path w/AAHX	274	1056	1300	1143	1836	3024	3119	3573	4623	2941
14	Dual Path w/Desiccant	10868	6571	5155	3717	3964	3295	3348	3039	3012	2132
15	Base DX w/DCV	197	408	457	376	648	1029	1111	1311	1793	1034
16	Dual Path w/DCV	204	466	527	460	716	1132	1230	1463	1931	1181
17	Base DX w/Free Reheat	266	993	1223	1044	1779	2937	3014	3455	4538	2808

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School-12 Month-South

2004 Standard

Net Total DX Cooling Capacity - Primary System
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1.8	2.2	2.2	2.5	2.0	2.1	2.2	2.1	2.0	2.2
01	Base DX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
02	DX w/Improved Dehumid.	1.9	2.4	2.4	2.7	2.2	2.3	2.4	2.3	2.2	2.4
03	Base DX w/Lower Airflow	2.0	2.5	2.5	2.8	2.3	2.4	2.5	2.4	2.3	2.4
04	Base DX w/AAHX	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.2	2.3
05	Base DX w/Subcool Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
06	Base DX w/o Lat. Coil Degrad.	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
07	Base DX w/Bypass Damper	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
08	Base DX w/Desiccant	1.8	2.2	2.2	2.5	2.1	2.1	2.2	2.2	2.0	2.2
09	Base DX w/Enthalpy Wheel	1.1	1.3	1.3	1.4	1.3	1.3	1.3	1.4	1.3	1.5
10	Base DX w/OA Precool	1.1	1.6	1.6	1.9	1.4	1.5	1.6	1.6	1.4	1.6
11	Dual Path	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
12	Dual Path w/Enthalpy Wheel	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
13	Dual Path w/AAHX	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
14	Dual Path w/Desiccant	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
15	Base DX w/DCV	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3
16	Dual Path w/DCV	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
17	Base DX w/Free Reheat	1.9	2.3	2.4	2.6	2.2	2.2	2.3	2.3	2.1	2.3

Net Total DX Cooling Capacity - Secondary System
[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	0.9	1.3	1.4	1.6	1.2	1.2	1.3	1.3	1.1	1.3
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Motel-South

2004 Standard

Occupied Hours when RH>65%
[Annual Hrs]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	7051	5369	4019	3542	3047	2409	2492	1739	1516	3
01	Base DX	7091	5406	4077	3579	3083	2451	2529	1767	1577	4
02	DX w/Improved Dehumid.	7165	5499	4169	3624	3126	2479	2576	1801	1639	4
03	Base DX w/Lower Airflow	7172	5505	4179	3634	3134	2485	2582	1800	1655	4
04	Base DX w/AAHX	5319	4321	3039	2174	2157	1695	1664	1222	839	1
05	Base DX w/Subcool Reheat	7048	5369	3987	3555	3067	2430	2519	1766	1574	3
06	Base DX w/o Lat. Coil Degrad.	4880	2886	1573	409	342	338	377	208	143	0
07	Base DX w/Bypass Damper	7074	5388	4034	3562	3075	2439	2523	1767	1574	3
08	Base DX w/Desiccant	1861	1211	620	162	22	7	208	0	13	0
09	Base DX w/Enthalpy Wheel	7004	5121	3975	3577	3166	2441	2554	1851	1624	16
10	Base DX w/OA Precool	6753	5046	3579	3203	2671	1955	2097	1358	1028	0
11	Dual Path	1146	634	252	64	0	0	7	29	9	0
12	Dual Path w/Enthalpy Wheel	1104	516	130	33	0	0	49	22	0	0
13	Dual Path w/AAHX	728	558	225	60	0	0	3	26	0	0
14	Dual Path w/Desiccant	2	18	0	0	0	0	0	0	0	0
15	Base DX w/DCV	7381	5558	4270	3698	3207	2559	2650	1862	1771	11
16	Dual Path w/DCV	1010	597	213	62	0	0	2	14	1	0
17	Base DX w/Free Reheat	555	635	301	80	17	0	38	55	11	0

Life Cycle Cost*
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	2	3	3	3	3	3	3	5	4	3
01	Base DX	2	3	3	3	3	3	3	5	4	3
02	DX w/Improved Dehumid.	2	3	3	3	3	4	3	5	4	3
03	Base DX w/Lower Airflow	2	3	3	3	3	3	3	5	4	3
04	Base DX w/AAHX	3	3	3	4	3	4	4	6	4	4
05	Base DX w/Subcool Reheat	3	3	3	3	3	4	3	5	4	3
06	Base DX w/o Lat. Coil Degrad.	3	4	3	4	3	4	4	6	5	4
07	Base DX w/Bypass Damper	3	3	3	3	3	4	3	5	4	3
08	Base DX w/Desiccant	6	5	4	4	4	4	4	6	4	3
09	Base DX w/Enthalpy Wheel	2	2	2	3	2	3	2	4	3	3
10	Base DX w/OA Precool	3	3	3	3	3	4	4	5	4	3
11	Dual Path	5	5	5	5	5	6	5	8	6	5
12	Dual Path w/Enthalpy Wheel	5	5	4	5	4	5	4	7	5	4
13	Dual Path w/AAHX	6	6	5	5	5	6	6	8	6	5
14	Dual Path w/Desiccant	8	6	6	6	6	6	5	8	6	5
15	Base DX w/DCV	2	3	3	3	3	3	3	5	4	3
16	Dual Path w/DCV	5	5	5	5	5	6	5	8	6	5
17	Base DX w/Free Reheat	4	4	4	4	3	4	4	6	4	3

** Installed Equipment Cost plus 15-yr HVAC Electric and Gas Cost in 1000s of 2004 dollars*

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Motel-South

2004 Standard

Annual HVAC Energy Cost
[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.12	0.14	0.14	0.15	0.13	0.17	0.15	0.24	0.18	0.13
01	Base DX	0.12	0.13	0.14	0.15	0.13	0.17	0.15	0.23	0.18	0.13
02	DX w/Improved Dehumid.	0.10	0.12	0.12	0.13	0.12	0.16	0.13	0.20	0.16	0.12
03	Base DX w/Lower Airflow	0.11	0.12	0.12	0.13	0.12	0.16	0.14	0.21	0.16	0.12
04	Base DX w/AAHX	0.15	0.17	0.16	0.18	0.15	0.19	0.16	0.27	0.19	0.14
05	Base DX w/Subcool Reheat	0.13	0.15	0.15	0.16	0.14	0.18	0.15	0.25	0.18	0.14
06	Base DX w/o Lat. Coil Degrad.	0.14	0.15	0.15	0.16	0.14	0.18	0.16	0.25	0.18	0.13
07	Base DX w/Bypass Damper	0.12	0.14	0.14	0.15	0.13	0.17	0.15	0.23	0.18	0.13
08	Base DX w/Desiccant	0.33	0.25	0.24	0.22	0.21	0.21	0.18	0.26	0.17	0.13
09	Base DX w/Enthalpy Wheel	0.10	0.11	0.11	0.12	0.10	0.12	0.10	0.19	0.12	0.11
10	Base DX w/OA Precool	0.13	0.15	0.15	0.15	0.14	0.18	0.15	0.25	0.18	0.14
11	Dual Path	0.22	0.22	0.21	0.22	0.19	0.23	0.19	0.33	0.23	0.16
12	Dual Path w/Enthalpy Wheel	0.19	0.19	0.18	0.19	0.16	0.17	0.14	0.27	0.17	0.14
13	Dual Path w/AAHX	0.23	0.23	0.22	0.23	0.20	0.24	0.20	0.34	0.23	0.17
14	Dual Path w/Desiccant	0.38	0.29	0.27	0.25	0.23	0.23	0.19	0.31	0.19	0.15
15	Base DX w/DCV	0.12	0.13	0.13	0.14	0.12	0.16	0.13	0.22	0.16	0.12
16	Dual Path w/DCV	0.22	0.22	0.21	0.21	0.19	0.21	0.18	0.31	0.21	0.15
17	Base DX w/Free Reheat	0.21	0.21	0.20	0.21	0.17	0.21	0.18	0.29	0.20	0.14

** Annual HVAC Energy Cost in 1000s of 2004 dollars using state average energy prices*

Annual HVAC Source Energy
[MWh]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	5.0	5.4	5.4	5.8	5.1	5.8	6.4	6.1	6.6	5.6
01	Base DX	5.0	5.3	5.4	5.8	5.1	5.7	6.3	6.0	6.5	5.6
02	DX w/Improved Dehumid.	4.3	4.6	4.6	4.9	4.4	5.0	5.5	5.3	5.9	4.8
03	Base DX w/Lower Airflow	4.4	4.8	4.8	5.1	4.5	5.2	5.7	5.4	6.0	5.0
04	Base DX w/AAHX	6.4	6.6	6.5	7.0	6.1	6.6	7.3	6.8	7.3	6.4
05	Base DX w/Subcool Reheat	5.5	5.8	5.8	6.2	5.4	6.1	6.7	6.3	6.8	5.9
06	Base DX w/o Lat. Coil Degrad.	5.7	6.0	6.0	6.5	5.6	6.1	6.8	6.3	6.8	5.7
07	Base DX w/Bypass Damper	5.0	5.4	5.4	5.8	5.1	5.7	6.3	6.0	6.5	5.6
08	Base DX w/Desiccant	10.2	9.3	8.4	8.3	7.4	6.9	7.4	6.7	6.4	5.8
09	Base DX w/Enthalpy Wheel	4.3	4.4	4.4	4.8	4.3	4.3	4.7	4.7	4.7	5.0
10	Base DX w/OA Precool	5.4	5.8	5.8	6.1	5.5	6.1	6.7	6.3	6.9	5.9
11	Dual Path	9.3	8.9	8.6	8.8	8.3	8.4	8.9	8.2	8.8	7.3
12	Dual Path w/Enthalpy Wheel	7.8	7.5	7.4	7.5	7.1	6.9	7.2	6.8	6.8	6.6
13	Dual Path w/AAHX	9.8	9.3	9.0	9.2	8.7	8.7	9.3	8.5	9.1	7.5
14	Dual Path w/Desiccant	12.7	11.2	10.1	9.7	9.0	8.2	8.7	7.8	7.6	6.7
15	Base DX w/DCV	4.8	5.1	5.2	5.6	4.9	5.4	5.9	5.6	6.0	5.3
16	Dual Path w/DCV	9.1	8.7	8.4	8.6	8.1	8.1	8.6	7.8	8.3	7.0
17	Base DX w/Free Reheat	8.6	8.4	8.0	8.4	7.1	7.3	8.2	7.4	7.6	6.0

** Source Energy = Gas Energy + Electric Energy/31.3%*
Electricity delivery efficiency of 31.3% from DOE 2004 Buildings Energy Databook, p. 6-4

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PO = Portland OR

Motel-South

2004 Standard

Net Total DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.5
01	Base DX	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
02	DX w/Improved Dehumid.	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
03	Base DX w/Lower Airflow	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.6
04	Base DX w/AAHX	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
05	Base DX w/Subcool Reheat	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
06	Base DX w/o Lat. Coil Degrad.	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
07	Base DX w/Bypass Damper	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
08	Base DX w/Desiccant	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5
09	Base DX w/Enthalpy Wheel	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
10	Base DX w/OA Precool	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
11	Dual Path	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
14	Dual Path w/Desiccant	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
15	Base DX w/DCV	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
16	Dual Path w/DCV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
17	Base DX w/Free Reheat	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

Installed Equipment Cost*

[1000 $2004]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	1	1	1	1	1	1	1	1	1	1
01	Base DX	1	1	1	1	1	1	1	1	1	1
02	DX w/Improved Dehumid.	1	1	1	1	1	1	1	2	1	2
03	Base DX w/Lower Airflow	1	1	1	1	1	1	1	2	1	1
04	Base DX w/AAHX	1	1	1	1	1	1	1	2	1	2
05	Base DX w/Subcool Reheat	1	1	1	1	1	1	1	2	1	1
06	Base DX w/o Lat. Coil Degrad.	1	1	1	1	1	2	2	2	2	2
07	Base DX w/Bypass Damper	1	1	1	1	1	1	1	2	1	1
08	Base DX w/Desiccant	1	1	1	1	1	1	1	2	1	2
09	Base DX w/Enthalpy Wheel	1	1	1	1	1	1	1	1	1	1
10	Base DX w/OA Precool	1	1	1	1	1	1	1	2	1	2
11	Dual Path	2	2	2	2	2	2	3	3	3	3
12	Dual Path w/Enthalpy Wheel	2	2	2	2	2	2	2	3	3	2
13	Dual Path w/AAHX	2	2	2	2	2	3	3	3	3	3
14	Dual Path w/Desiccant	2	2	2	2	2	2	3	3	3	3
15	Base DX w/DCV	1	1	1	1	1	1	1	2	1	1
16	Dual Path w/DCV	2	2	2	2	2	3	3	3	3	3
17	Base DX w/Free Reheat	1	1	1	1	1	1	1	2	1	1

** Installed Equipment Cost in 1000s of 2004 dollars (Representative costs only, get current quotes.)*

MI = Miami FL
HO = Houston TX
SH = Shreveport LA
FW = Fort Worth TX
AT = Atlanta GA
ST = Washington DC
SL = St. Louis MO
NY = New York NY
CH = Chicago IL
PO = Portland OR

Motel-South

2004 Standard

Net Sensible DX Cooling Capacity*

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System**										
00	Conventional DX	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
01	Base DX	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
02	DX w/Improved Dehumid.	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
03	Base DX w/Lower Airflow	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
04	Base DX w/AAHX	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
05	Base DX w/Subcool Reheat	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
06	Base DX w/o Lat. Coil Degrad.	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
07	Base DX w/Bypass Damper	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
08	Base DX w/Desiccant	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
09	Base DX w/Enthalpy Wheel	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3
10	Base DX w/OA Precool	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
11	Dual Path	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
12	Dual Path w/Enthalpy Wheel	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
13	Dual Path w/AAHX	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
14	Dual Path w/Desiccant	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
15	Base DX w/DCV	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
16	Dual Path w/DCV	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
17	Base DX w/Free Reheat	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4

** Capacity of Primary plus Secondary systems where applicable (Case 10-14 & 16)*

HVAC Electric Energy per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
00	Conventional DX	3865	3276	3048	3024	2764	2535	2666	2310	2316	2156
01	Base DX	3804	3216	2996	2977	2713	2485	2618	2263	2273	2114
02	DX w/Improved Dehumid.	3274	2691	2471	2431	2190	1972	2098	1753	1764	1615
03	Base DX w/Lower Airflow	3359	2788	2577	2547	2297	2078	2206	1864	1876	1725
04	Base DX w/AAHX	4897	4114	3809	3777	3434	3129	3298	2836	2849	2621
05	Base DX w/Subcool Reheat	4183	3542	3302	3277	2979	2737	2882	2496	2506	2332
06	Base DX w/o Lat. Coil Degrad.	4378	3672	3400	3415	3075	2745	2919	2466	2460	2198
07	Base DX w/Bypass Damper	3864	3261	3035	3008	2736	2502	2638	2274	2284	2121
08	Base DX w/Desiccant	3810	3355	3204	3180	3076	2832	2900	2590	2599	2402
09	Base DX w/Enthalpy Wheel	3272	2748	2591	2542	2491	2300	2349	2115	2138	2024
10	Base DX w/OA Precool	4144	3493	3251	3190	2979	2713	2831	2454	2466	2263
11	Dual Path	7202	5755	5273	4912	5081	4388	4393	3812	3933	3204
12	Dual Path w/Enthalpy Wheel	6074	4985	4651	4335	4603	4060	4007	3592	3716	3110
13	Dual Path w/AAHX	7598	6024	5530	5185	5350	4596	4621	4003	4117	3363
14	Dual Path w/Desiccant	6163	5065	4726	4390	4678	4122	4066	3629	3761	3141
15	Base DX w/DCV	3693	3152	2957	2946	2719	2495	2613	2265	2272	2134
16	Dual Path w/DCV	7080	5683	5226	4877	5059	4384	4382	3801	3923	3226
17	Base DX w/Free Reheat	6615	5287	4695	4580	4084	3509	3773	3077	2966	2351

**All systems are normalized by the same tons in a given city to provide common comparison point.*

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Motel-South

2004 Standard

HVAC Electric Demand per Base DX S01 Net Total Capacity*

[Annual Peak kW/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
00	Conventional DX	1.0	1.0	1.1	1.0	0.9	1.0	1.1	0.8	0.8	0.8
01	Base DX	1.1	1.0	1.2	1.0	0.9	1.0	1.1	0.8	0.8	0.8
02	DX w/Improved Dehumid.	1.0	1.0	1.1	0.9	0.8	0.9	1.0	0.7	0.8	0.7
03	Base DX w/Lower Airflow	1.1	1.0	1.2	1.0	0.9	1.0	1.1	0.7	0.8	0.8
04	Base DX w/AAHX	1.3	1.3	1.4	1.2	1.1	1.3	1.4	1.0	1.1	1.0
05	Base DX w/Subcool Reheat	1.2	1.2	1.4	1.1	1.0	1.2	1.3	0.9	1.0	0.9
06	Base DX w/o Lat. Coil Degrad.	1.1	1.1	1.2	1.1	1.0	1.1	1.2	0.9	0.9	0.9
07	Base DX w/Bypass Damper	1.1	1.1	1.2	1.1	0.9	1.0	1.1	0.8	0.9	0.9
08	Base DX w/Desiccant	1.0	0.9	1.0	0.9	0.9	0.8	0.9	0.7	0.8	0.7
09	Base DX w/Enthalpy Wheel	0.9	0.9	1.0	0.9	0.9	0.8	0.9	0.7	0.8	0.8
10	Base DX w/OA Precool	1.1	1.1	1.2	1.0	0.9	1.0	1.1	0.8	0.9	0.8
11	Dual Path	1.5	1.3	1.5	1.2	1.3	1.3	1.3	1.1	1.1	1.0
12	Dual Path w/Enthalpy Wheel	1.2	1.1	1.2	1.1	1.1	1.0	1.0	0.8	1.0	0.9
13	Dual Path w/AAHX	1.5	1.4	1.6	1.3	1.3	1.3	1.4	1.1	1.2	1.1
14	Dual Path w/Desiccant	1.2	1.1	1.2	1.1	1.1	1.0	1.1	0.9	1.0	0.9
15	Base DX w/DCV	1.0	1.0	1.1	1.0	0.9	0.9	1.0	0.7	0.8	0.8
16	Dual Path w/DCV	1.4	1.3	1.4	1.2	1.2	1.2	1.3	1.0	1.1	1.0
17	Base DX w/Free Reheat	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.0

**All systems are normalized by the same tons in a given city to provide common comparison point.*

Heating+Regen Gas per Base DX S01 Net Total Capacity*

[Annual kWh/ton]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	**System S01 Net Cap==>**	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
00	Conventional DX	195	1395	1659	1512	2295	3550	3733	4120	5556	2868
01	Base DX	199	1408	1674	1527	2313	3573	3757	4152	5589	2900
02	DX w/Improved Dehumid.	228	1526	1818	1676	2483	3802	3973	4454	5905	3209
03	Base DX w/Lower Airflow	222	1500	1786	1644	2446	3754	3925	4389	5836	3142
04	Base DX w/AAHX	168	1299	1542	1391	2154	3359	3555	3870	5292	2615
05	Base DX w/Subcool Reheat	189	1362	1618	1470	2245	3482	3671	4031	5464	2779
06	Base DX w/o Lat. Coil Degrad.	183	1394	1667	1519	2307	3567	3753	4150	5586	2896
07	Base DX w/Bypass Damper	199	1408	1674	1527	2313	3573	3757	4152	5589	2900
08	Base DX w/Desiccant	13212	9608	7438	5847	6230	4815	5003	4523	4347	2383
09	Base DX w/Enthalpy Wheel	201	915	1019	1011	1266	1388	1528	2246	2339	2117
10	Base DX w/OA Precool	198	1419	1692	1543	2333	3600	3781	4188	5627	2933
11	Dual Path	82	1021	1254	1167	1778	2949	3222	3449	4757	2336
12	Dual Path w/Enthalpy Wheel	75	504	574	589	731	847	1002	1523	1526	1509
13	Dual Path w/AAHX	75	995	1226	1140	1745	2910	3185	3403	4703	2290
14	Dual Path w/Desiccant	11966	8202	6011	4658	4498	3451	3741	3299	2991	1585
15	Base DX w/DCV	171	1160	1378	1253	1907	2909	3087	3394	4600	2312
16	Dual Path w/DCV	63	805	990	925	1413	2336	2588	2745	3815	1787
17	Base DX w/Free Reheat	163	1383	1664	1521	2309	3570	3755	4151	5586	2899

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Motel-South

2004 Standard

Net Total DX Cooling Capacity - Primary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System										
00	Conventional DX	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.5
01	Base DX	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
02	DX w/Improved Dehumid.	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
03	Base DX w/Lower Airflow	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.6
04	Base DX w/AAHX	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
05	Base DX w/Subcool Reheat	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
06	Base DX w/o Lat. Coil Degrad.	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
07	Base DX w/Bypass Damper	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
08	Base DX w/Desiccant	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5
09	Base DX w/Enthalpy Wheel	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5
10	Base DX w/OA Precool	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.5
11	Dual Path	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
12	Dual Path w/Enthalpy Wheel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13	Dual Path w/AAHX	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
14	Dual Path w/Desiccant	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
15	Base DX w/DCV	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
16	Dual Path w/DCV	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
17	Base DX w/Free Reheat	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6

Net Total DX Cooling Capacity - Secondary System

[tons]

	Location ==>	MI	HO	SH	FW	AT	ST	SL	NY	CH	PO
Case	System										
00	Conventional DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
01	Base DX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
02	DX w/Improved Dehumid.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
03	Base DX w/Lower Airflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
04	Base DX w/AAHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
05	Base DX w/Subcool Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
06	Base DX w/o Lat. Coil Degrad.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
07	Base DX w/Bypass Damper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08	Base DX w/Desiccant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09	Base DX w/Enthalpy Wheel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Base DX w/OA Precool	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11	Dual Path	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
12	Dual Path w/Enthalpy Wheel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
13	Dual Path w/AAHX	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
14	Dual Path w/Desiccant	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
15	Base DX w/DCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	Dual Path w/DCV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
17	Base DX w/Free Reheat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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APPENDIX C

SYSTEM PERFORMANCE DATA AND CHARTS

ASHRAE 1254-RP
A/C Unit Performance Curves
Case 0 - Conventional DX Unit
Carrier 48HJ008 7-1/2 Tons at 3000 CFM
Data taken from page 147 of Carrier Manual 48h,t-2pd.pdf

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English Units

	EWB	ODB (F)	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kBtu)	EIR w/OD Fan	EIR Normalized		EIR w/o OD Fan	EIR Normalized		Cool Cap Normalized
ARI	67	95	6.61	0.65	7.26	92.9	0.267	1		0.243	1		1
	62	75	5.06	0.65	5.71	90.7	0.21	0.81		0.190	0.784		0.976
	67	75	5.11	0.65	5.76	99.6	0.20	0.74		0.175	0.721		1.072
	72	75	5.16	0.65	5.81	107.3	0.18	0.69		0.164	0.676		1.155
	62	85	5.77	0.65	6.42	87.5	0.25	0.94		0.225	0.927		0.942
	67	85	5.82	0.65	6.47	96.5	0.23	0.86		0.206	0.848		1.039
	72	85	5.89	0.65	6.54	105.1	0.21	0.80		0.191	0.788		1.131
	62	95	6.53	0.65	7.18	83.5	0.29	1.10		0.267	1.099		0.899
	67	95	6.61	0.65	7.26	92.9	0.27	1.00		0.243	1.000		1.000
	72	95	6.69	0.65	7.34	101.6	0.25	0.92		0.225	0.925		1.094
	62	105	7.36	0.65	8.01	79.6	0.34	1.29		0.316	1.300		0.857
	67	105	7.48	0.65	8.13	88.8	0.31	1.17		0.287	1.184		0.956
	72	105	7.55	0.65	8.2	97.6	0.29	1.08		0.264	1.087		1.051
	62	115	8.27	0.65	8.92	75.4	0.40	1.51		0.374	1.542		0.812
	67	115	8.37	0.65	9.02	84.5	0.36	1.37		0.338	1.392		0.910
	72	115	8.46	0.65	9.11	93.2	0.33	1.25		0.310	1.276		1.003
	62	125	9.24	0.65	9.89	71.9	0.47	1.76		0.439	1.806		0.774
	67	125	9.34	0.65	9.99	80	0.43	1.60		0.398	1.641		0.861
	72	125	9.43	0.65	10.08	88.3	0.39	1.46		0.364	1.501		0.950

Metric Units for E-Plus

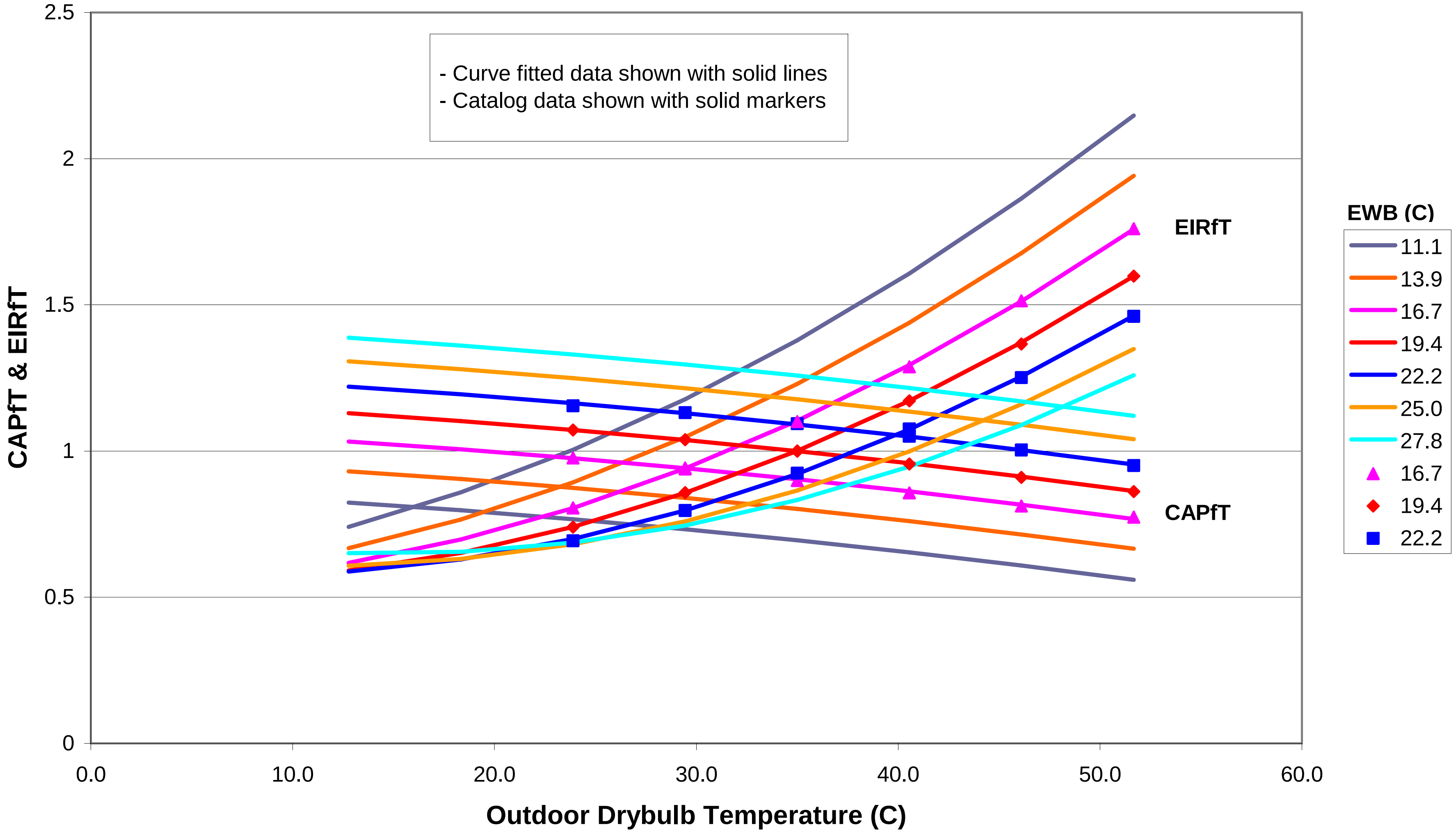
	EWB (C)	EWB**2	ODB (C)	ODB**2	ODB*EWB	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kW)	EIR w/OD Fan	EIR Normalized	Excel Calculated EIR	% Diff		Cool Cap Normalized	Excel Calculated CAP	% Diff
ARI	19.4		35.0			6.61	0.65	7.26	27.219455	0.267	1				1		
	16.7	277.8	23.9	570.7	398.1	5.06	0.65	5.71	26.57	0.215	0.806	0.805	-0.09%		0.976	0.975	-0.09%
	19.4	378.1	23.9	570.7	464.5	5.11	0.65	5.76	29.18	0.197	0.740	0.740	0.03%		1.072	1.072	-0.01%
	22.2	493.8	23.9	570.7	530.9	5.16	0.65	5.81	31.44	0.185	0.693	0.699	0.88%		1.155	1.163	0.72%
	16.7	277.8	29.4	867.0	490.7	5.77	0.65	6.42	25.64	0.250	0.939	0.940	0.14%		0.942	0.941	-0.06%
	19.4	378.1	29.4	867.0	572.5	5.82	0.65	6.47	28.27	0.229	0.858	0.857	-0.17%		1.039	1.038	-0.10%
	22.2	493.8	29.4	867.0	654.3	5.89	0.65	6.54	30.79	0.212	0.796	0.796	-0.01%		1.131	1.129	-0.21%
	16.7	277.8	35.0	1225.0	583.3	6.53	0.65	7.18	24.47	0.293	1.100	1.103	0.26%		0.899	0.903	0.51%
	19.4	378.1	35.0	1225.0	680.6	6.61	0.65	7.26	27.22	0.267	1.000	1.000	0.05%		1.000	1.000	-0.02%
	22.2	493.8	35.0	1225.0	777.8	6.69	0.65	7.34	29.77	0.247	0.924	0.921	-0.36%		1.094	1.091	-0.25%
	16.7	277.8	40.6	1644.8	675.9	7.36	0.65	8.01	23.32	0.343	1.288	1.294	0.48%		0.857	0.862	0.57%
	19.4	378.1	40.6	1644.8	788.6	7.48	0.65	8.13	26.02	0.312	1.172	1.172	0.05%		0.956	0.958	0.23%
	22.2	493.8	40.6	1644.8	901.2	7.55	0.65	8.2	28.60	0.287	1.075	1.074	-0.12%		1.051	1.049	-0.14%
	16.7	277.8	46.1	2126.2	768.5	8.27	0.65	8.92	22.09	0.404	1.514	1.512	-0.11%		0.812	0.816	0.58%
	19.4	378.1	46.1	2126.2	896.6	8.37	0.65	9.02	24.76	0.364	1.366	1.371	0.41%		0.910	0.913	0.33%
	22.2	493.8	46.1	2126.2	1024.7	8.46	0.65	9.11	27.31	0.334	1.251	1.254	0.26%		1.003	1.004	0.04%
	16.7	277.8	51.7	2669.4	861.1	9.24	0.65	9.89	21.07	0.469	1.760	1.758	-0.11%		0.774	0.767	-0.87%
	19.4	378.1	51.7	2669.4	1004.6	9.34	0.65	9.99	23.44	0.426	1.598	1.599	0.04%		0.861	0.863	0.26%
	22.2	493.8	51.7	2669.4	1148.1	9.43	0.65	10.08	25.87	0.390	1.461	1.462	0.09%		0.950	0.954	0.40%

Coefficients for E-Plus performance curves

	Col F	Col E	Col D	Col C	Col B	Const	Adj a
	f	e	d	c	b	a	
EIR	-0.00123243	0.00044872	0.020958251	0.001510777	-0.048378819	0.924476805	0.9254768
CAP	-4.9823E-06	-6.0618E-05	-0.00283346	-0.000337137	0.047045056	0.388282246	0.3892822

	CAP	EIR
a	0.389282246	0.925476805
b	0.047045056	-0.048378819
c	-0.000337137	0.001510777
d	-0.002833461	0.020958251
e	-6.06182E-05	0.00044872
f	-4.98232E-06	-0.001232429

Case 0 - Carrier 48HJ008 7.5 Tons 3000 CFM
Performance Map - Catalog vs. Curve Fit



ASHRAE 1254-RP
A/C Unit Performance Curves
Case 1 - Base DX Unit
Carrier 48HJ009 8-1/2 Tons at 3000 CFM
Data taken from page 147 of Carrier Manual 48h,t-2pd.pdf

Rated COP 3.5595838

English Units

	EWB	ODB (F)	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kBtu)	EIR w/OD Fan	EIR Normalized	EIR w/o OD Fan	EIR Normalized	Cool Cap Normalized
ARI	67	95	7.68	0.65	8.33	101.2	0.281	1	0.259	1	1
	62	75	5.81	0.65	6.46	98.7	0.223	0.795	0.201	0.776	0.975
	67	75	5.88	0.65	6.53	109.1	0.204	0.727	0.184	0.710	1.078
	72	75	5.95	0.65	6.6	123.1	0.183	0.651	0.165	0.637	1.216
	62	85	6.67	0.65	7.32	94.8	0.264	0.938	0.240	0.927	0.937
	67	85	6.74	0.65	7.39	105.4	0.239	0.852	0.218	0.843	1.042
	72	85	6.83	0.65	7.48	119.7	0.213	0.759	0.195	0.752	1.183
	62	95	7.59	0.65	8.24	90.6	0.310	1.105	0.286	1.104	0.895
	67	95	7.68	0.65	8.33	101.2	0.281	1.000	0.259	1.000	1.000
	72	95	7.76	0.65	8.41	115	0.250	0.888	0.230	0.889	1.136
	62	105	8.61	0.65	9.26	85.9	0.368	1.310	0.342	1.321	0.849
	67	105	8.7	0.65	9.35	96.7	0.330	1.175	0.307	1.186	0.956
	72	105	8.8	0.65	9.45	110.5	0.292	1.039	0.272	1.049	1.092
	62	115	9.72	0.65	10.37	81.5	0.434	1.546	0.407	1.572	0.805
	67	115	9.79	0.65	10.44	91.8	0.388	1.382	0.364	1.405	0.907
	72	115	9.86	0.65	10.51	104.7	0.343	1.220	0.321	1.241	1.035
	62	125	10.81	0.65	11.46	76	0.515	1.832	0.485	1.874	0.751
	67	125	10.96	0.65	11.61	86.8	0.457	1.625	0.431	1.664	0.858
	72	125	11.08	0.65	11.73	100	0.400	1.425	0.378	1.460	0.988

Metric Units for E-Plus

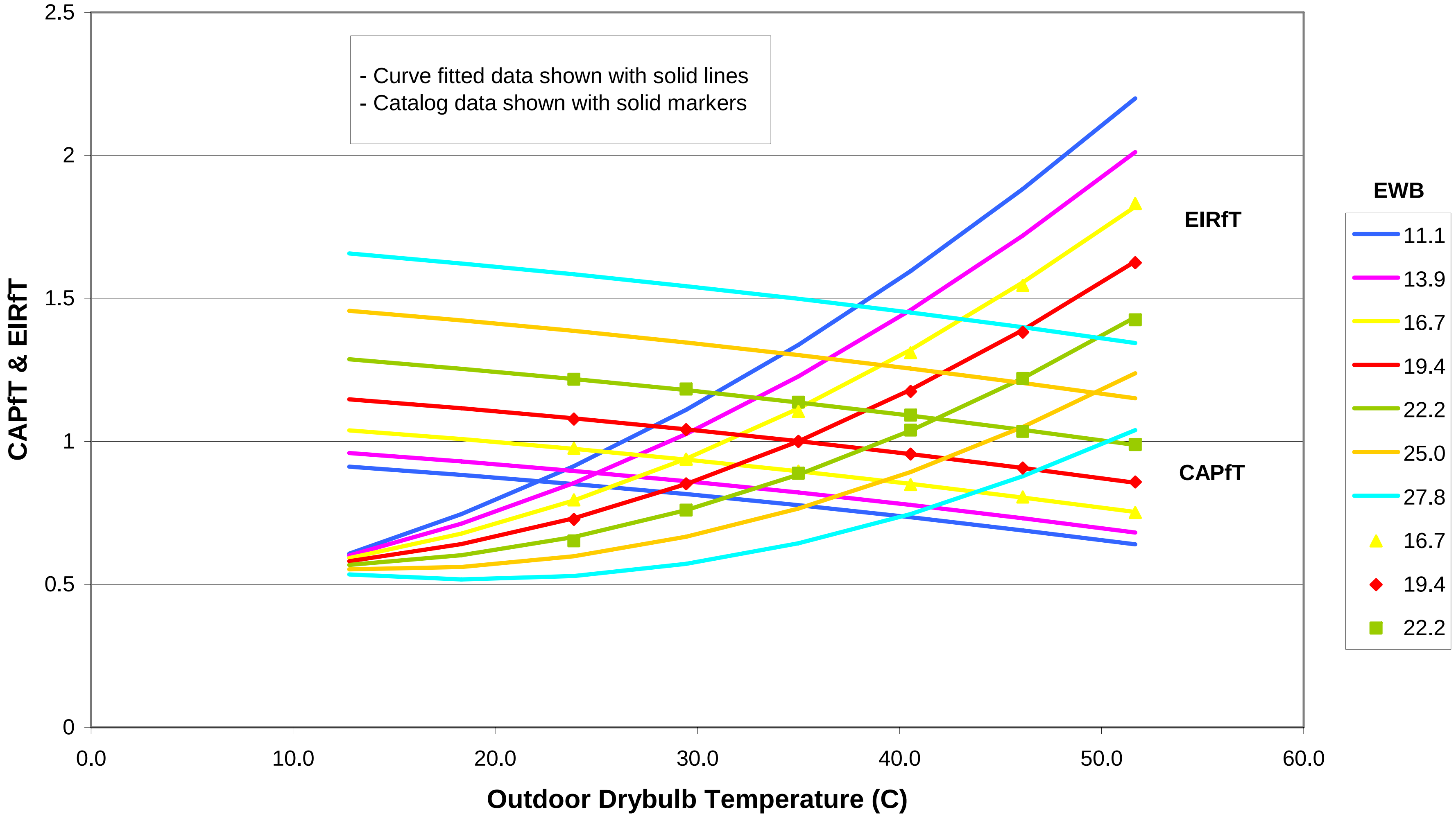
	EWB (C)	EWB**2	ODB (C)	ODB**2	ODB*EWB	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kW)	EIR w/OD Fan	EIR Normalized	Excel Calculated EIR	% Diff	Cool Cap Normalized	Excel Calculated CAP	% Diff
ARI	19.4		35.0			7.68	0.65	8.33	29.65133314	0.281	1			1		
	16.7	277.8	23.9	570.7	398.1	5.81	0.65	6.46	28.92	0.223	0.795	0.793	-0.23%	0.975	0.974	-0.18%
	19.4	378.1	23.9	570.7	464.5	5.88	0.65	6.53	31.97	0.204	0.727	0.730	0.45%	1.078	1.081	0.23%
	22.2	493.8	23.9	570.7	530.9	5.95	0.65	6.6	36.07	0.183	0.651	0.666	2.18%	1.216	1.218	0.13%
	16.7	277.8	29.4	867.0	490.7	6.67	0.65	7.32	27.78	0.264	0.938	0.939	0.09%	0.937	0.936	-0.06%
	19.4	378.1	29.4	867.0	572.5	6.74	0.65	7.39	30.88	0.239	0.852	0.850	-0.19%	1.042	1.042	0.07%
	22.2	493.8	29.4	867.0	654.3	6.83	0.65	7.48	35.07	0.213	0.759	0.759	0.03%	1.183	1.179	-0.35%
	16.7	277.8	35.0	1225.0	583.3	7.59	0.65	8.24	26.55	0.310	1.105	1.115	0.87%	0.895	0.895	0.01%
	19.4	378.1	35.0	1225.0	680.6	7.68	0.65	8.33	29.65	0.281	1.000	1.000	-0.01%	1.000	1.000	0.05%
	22.2	493.8	35.0	1225.0	777.8	7.76	0.65	8.41	33.69	0.250	0.888	0.883	-0.58%	1.136	1.136	-0.03%
	16.7	277.8	40.6	1644.8	675.9	8.61	0.65	9.26	25.17	0.368	1.310	1.320	0.80%	0.849	0.851	0.28%
	19.4	378.1	40.6	1644.8	788.6	8.7	0.65	9.35	28.33	0.330	1.175	1.180	0.42%	0.956	0.955	-0.03%
	22.2	493.8	40.6	1644.8	901.2	8.8	0.65	9.45	32.38	0.292	1.039	1.037	-0.18%	1.092	1.090	-0.19%
	16.7	277.8	46.1	2126.2	768.5	9.72	0.65	10.37	23.88	0.434	1.546	1.556	0.63%	0.805	0.804	-0.22%
	19.4	378.1	46.1	2126.2	896.6	9.79	0.65	10.44	26.90	0.388	1.382	1.389	0.55%	0.907	0.907	-0.04%
	22.2	493.8	46.1	2126.2	1024.7	9.86	0.65	10.51	30.68	0.343	1.220	1.221	0.10%	1.035	1.040	0.55%
	16.7	277.8	51.7	2669.4	861.1	10.81	0.65	11.46	22.27	0.515	1.832	1.821	-0.59%	0.751	0.753	0.21%
	19.4	378.1	51.7	2669.4	1004.6	10.96	0.65	11.61	25.43	0.457	1.625	1.629	0.23%	0.858	0.855	-0.35%
	22.2	493.8	51.7	2669.4	1148.1	11.08	0.65	11.73	29.30	0.400	1.425	1.434	0.66%	0.988	0.987	-0.08%

Coefficients for E-Plus performance curves

	Col F	Col E	Col D	Col C	Col B	Const	Adj a
	f	e	d	c	b	a	
EIR	-0.00167709	0.00048511	0.028298025	-0.000134077	0.022281508	0.171059889	0.1740599
CAP	-6.3117E-05	-5.5265E-05	-0.00272643	0.001974308	-0.031261829	1.067939449	1.0679394

	CAP	EIR
a	1.067939449	0.174059889
b	-0.031261829	0.022281508
c	0.001974308	-0.000134077
d	-0.002726426	0.028298025
e	-5.52654E-05	0.000485106
f	-6.31169E-05	-0.001677095

Case 1 - Carrier 48HJ009 8.5 Tons 3000 CFM
Performance Map - Catalog vs. Curve Fit



- Curve fitted data shown with solid lines
- Catalog data shown with solid markers

ASHRAE 1254-RP

A/C Unit Performance Curves

Case 2 - Base DX Unit with Improved Dehumidification

Carrier 48HJ012 10 Tons at 3000 CFM

Data taken from page 148 of Carrier Manual 48h,t-2pd.pdf

Rated COP 3.6049727

English Units

	EWB	ODB	Compr	OD Fan	Total	Cool Cap	EIR	EIR		EIR	EIR		Cool Cap
		(F)	(kW)	(kW)	(kW)	(kBtu)	w/OD Fan	Normalized		w/o OD Fan	Normalized		Normalized
ARI	67	95	9.16	0.65	9.81	120.7	0.277	1		0.259	1		1
	62	75	7.12	0.65	7.77	115	0.231	0.831		0.211	0.816		0.953
	67	75	7.21	0.65	7.86	129.4	0.207	0.747		0.190	0.734		1.072
	72	75	7.35	0.65	8	140.3	0.195	0.702		0.179	0.690		1.162
	62	85	8.02	0.65	8.67	110	0.269	0.970		0.249	0.961		0.911
	67	85	8.13	0.65	8.78	125.3	0.239	0.862		0.221	0.855		1.038
	72	85	8.29	0.65	8.94	137.7	0.222	0.799		0.205	0.793		1.141
	62	95	8.98	0.65	9.63	103	0.319	1.150		0.298	1.149		0.853
	67	95	9.16	0.65	9.81	120.7	0.277	1.000		0.259	1.000		1.000
	72	95	9.33	0.65	9.98	133.8	0.255	0.918		0.238	0.919		1.109
	62	105	10	0.65	10.65	96.5	0.377	1.358		0.354	1.365		0.800
	67	105	10.28	0.65	10.93	115.4	0.323	1.165		0.304	1.174		0.956
	72	105	10.46	0.65	11.11	128.7	0.295	1.062		0.277	1.071		1.066
	62	115	11.2	0.65	11.85	90.8	0.445	1.606		0.421	1.625		0.752
	67	115	11.47	0.65	12.12	109.1	0.379	1.367		0.359	1.385		0.904
	72	115	11.66	0.65	12.31	123.2	0.341	1.229		0.323	1.247		1.021
	62	125	12.5	0.65	13.15	86.2	0.521	1.877		0.495	1.911		0.714
	67	125	12.77	0.65	13.42	101.8	0.450	1.622		0.428	1.653		0.843
	72	125	12.99	0.65	13.64	117.5	0.396	1.428		0.377	1.457		0.973

Metric Units for E-Plus

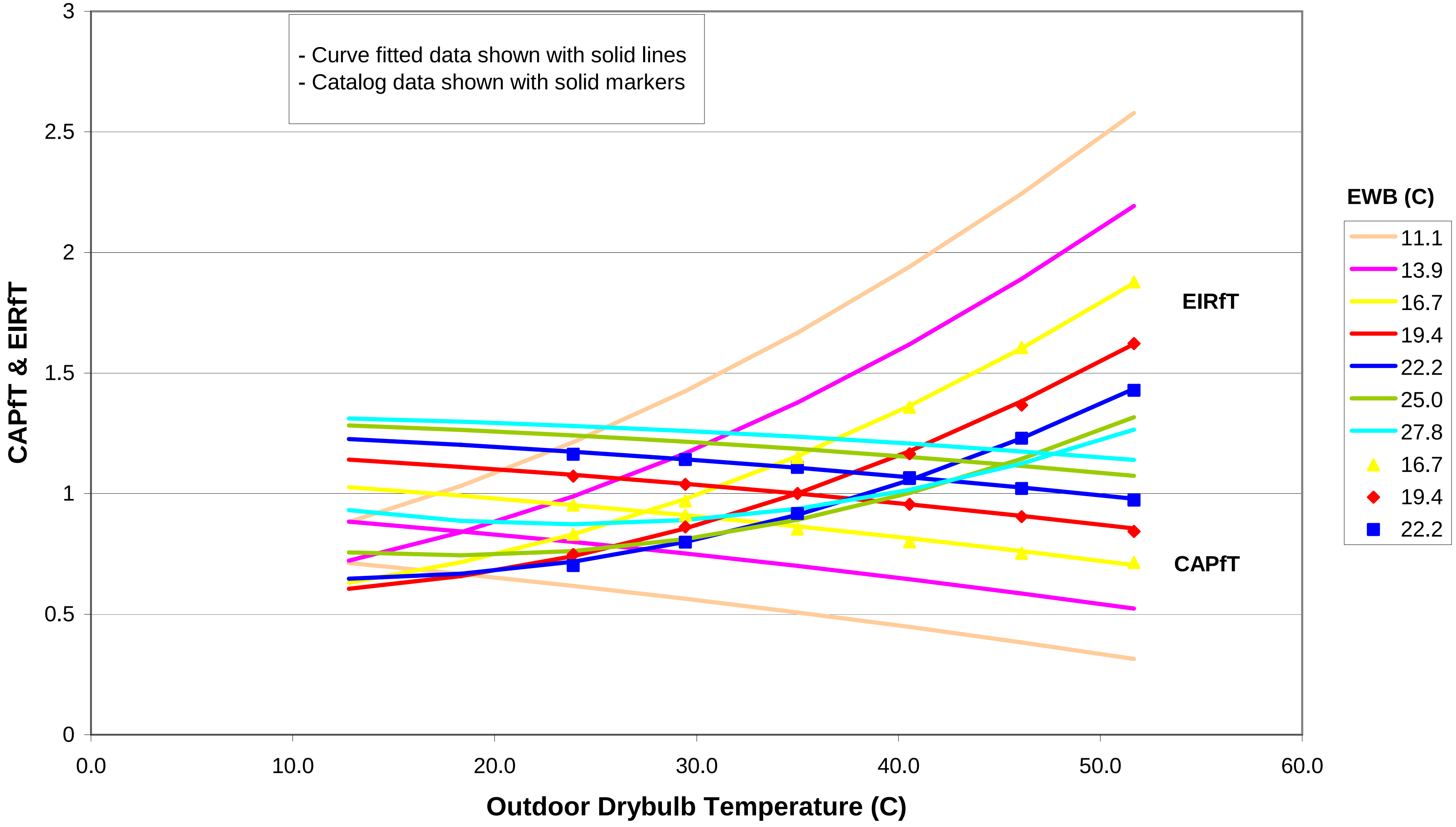
	EWB	EWB**2	ODB	ODB**2	ODB*EWB	Compr	OD Fan	Total	Cool Cap	EIR	EIR	Excel Calculated	% Diff			Cool Cap	Excel Calculated	% Diff
	(C)		(C)			(kW)	(kW)	(kW)	(kW)	w/OD Fan	Normalized	EIR				Normalized	CAP	
ARI	19.4		35.0			9.16	0.65	9.81	35.36478	0.277	1					1		
	16.7	277.8	23.9	570.7	398.1	7.12	0.65	7.77	33.69	0.231	0.831	0.831	-0.01%			0.953	0.953	0.01%
	19.4	378.1	23.9	570.7	464.5	7.21	0.65	7.86	37.91	0.207	0.747	0.741	-0.85%			1.072	1.078	0.53%
	22.2	493.8	23.9	570.7	530.9	7.35	0.65	8	41.11	0.195	0.702	0.718	2.33%			1.162	1.174	1.00%
	16.7	277.8	29.4	867.0	490.7	8.02	0.65	8.67	32.23	0.269	0.970	0.978	0.83%			0.911	0.910	-0.10%
	19.4	378.1	29.4	867.0	572.5	8.13	0.65	8.78	36.71	0.239	0.862	0.855	-0.81%			1.038	1.041	0.25%
	22.2	493.8	29.4	867.0	654.3	8.29	0.65	8.94	40.35	0.222	0.799	0.800	0.10%			1.141	1.142	0.14%
	16.7	277.8	35.0	1225.0	583.3	8.98	0.65	9.63	30.18	0.319	1.150	1.155	0.44%			0.853	0.864	1.29%
	19.4	378.1	35.0	1225.0	680.6	9.16	0.65	9.81	35.36	0.277	1.000	1.000	0.02%			1.000	1.000	0.01%
	22.2	493.8	35.0	1225.0	777.8	9.33	0.65	9.98	39.20	0.255	0.918	0.912	-0.61%			1.109	1.107	-0.13%
	16.7	277.8	40.6	1644.8	675.9	10	0.65	10.65	28.27	0.377	1.358	1.364	0.43%			0.800	0.815	1.89%
	19.4	378.1	40.6	1644.8	788.6	10.28	0.65	10.93	33.81	0.323	1.165	1.176	0.92%			0.956	0.956	-0.04%
	22.2	493.8	40.6	1644.8	901.2	10.46	0.65	11.11	37.71	0.295	1.062	1.056	-0.62%			1.066	1.068	0.17%
	16.7	277.8	46.1	2126.2	768.5	11.2	0.65	11.85	26.60	0.445	1.606	1.603	-0.18%			0.752	0.761	1.18%
	19.4	378.1	46.1	2126.2	896.6	11.47	0.65	12.12	31.97	0.379	1.367	1.383	1.17%			0.904	0.908	0.41%
	22.2	493.8	46.1	2126.2	1024.7	11.66	0.65	12.31	36.10	0.341	1.229	1.230	0.03%			1.021	1.025	0.46%
	16.7	277.8	51.7	2669.4	861.1	12.5	0.65	13.15	25.26	0.521	1.877	1.873	-0.21%			0.714	0.704	-1.43%
	19.4	378.1	51.7	2669.4	1004.6	12.77	0.65	13.42	29.83	0.450	1.622	1.620	-0.10%			0.843	0.856	1.47%
	22.2	493.8	51.7	2669.4	1148.1	12.99	0.65	13.64	34.43	0.396	1.428	1.435	0.46%			0.973	0.979	0.57%

Coefficients for E-Plus performance curves

	Col F	Col E	Col D	Col C	Col B	Const	Adj a
	f	e	d	c	b	a	
EIR	-0.00210511	0.00049969	0.034834074	0.004347743	-0.139175357	1.661909799	1.6639098
CAP	0.000348964	-5.9918E-05	-0.01024879	-0.001852196	0.103511185	-0.121750947	-0.117751

	CAP	EIR
a	-0.117750947	1.663909799
b	0.103511185	-0.139175357
c	-0.001852196	0.004347743
d	-0.010248787	0.034834074
e	-5.99183E-05	0.000499691
f	0.000348964	-0.00210511

Case 2 - Carrier 48HJ012 10 Tons 3000 CFM
Performance Map - Catalog vs. Curve Fit



ASHRAE 1254-RP
A/C Unit Performance Curves
Case 3 - Base DX Unit with Lower Airflow
Carrier 48HJ009 8-1/2 Tons at 2550 CFM
Data taken from page 147 of Carrier Manual 48h,t-2pd.pdf

Rated COP 3.4614078

English Units

	EWB	ODB (F)	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kBtu)	EIR w/OD Fan	EIR Normalized		EIR w/o OD Fan	EIR Normalized		Cool Cap Normalized
ARI	67	95	7.62	0.65	8.27	97.7	0.289	1		0.266	1		1
	62	75	5.77	0.65	6.42	94.8	0.231	0.800		0.208	0.780		0.970
	67	75	5.84	0.65	6.49	105.7	0.210	0.725		0.189	0.708		1.082
	72	75	5.92	0.65	6.57	119.5	0.188	0.650		0.169	0.635		1.223
	62	85	6.61	0.65	7.26	90.6	0.273	0.947		0.249	0.935		0.927
	67	85	6.69	0.65	7.34	101.9	0.246	0.851		0.224	0.842		1.043
	72	85	6.77	0.65	7.42	115.5	0.219	0.759		0.200	0.752		1.182
	62	95	7.52	0.65	8.17	86.6	0.322	1.115		0.296	1.113		0.886
	67	95	7.62	0.65	8.27	97.7	0.289	1.000		0.266	1.000		1.000
	72	95	7.71	0.65	8.36	111.3	0.256	0.887		0.236	0.888		1.139
	62	105	8.54	0.65	9.19	82.5	0.380	1.316		0.353	1.327		0.844
	67	105	8.64	0.65	9.29	93.5	0.339	1.174		0.315	1.185		0.957
	72	105	8.75	0.65	9.4	107.2	0.299	1.036		0.279	1.047		1.097
	62	115	9.64	0.65	10.29	78	0.450	1.559		0.422	1.585		0.798
	67	115	9.73	0.65	10.38	89.2	0.397	1.375		0.372	1.399		0.913
	72	115	9.8	0.65	10.45	101.9	0.350	1.212		0.328	1.233		1.043
	62	125	10.7	0.65	11.35	73.1	0.530	1.834		0.500	1.877		0.748
	67	125	10.9	0.65	11.55	84.3	0.468	1.619		0.441	1.658		0.863
	72	125	11.03	0.65	11.68	97.3	0.410	1.418		0.387	1.453		0.996

Metric Units for E-Plus

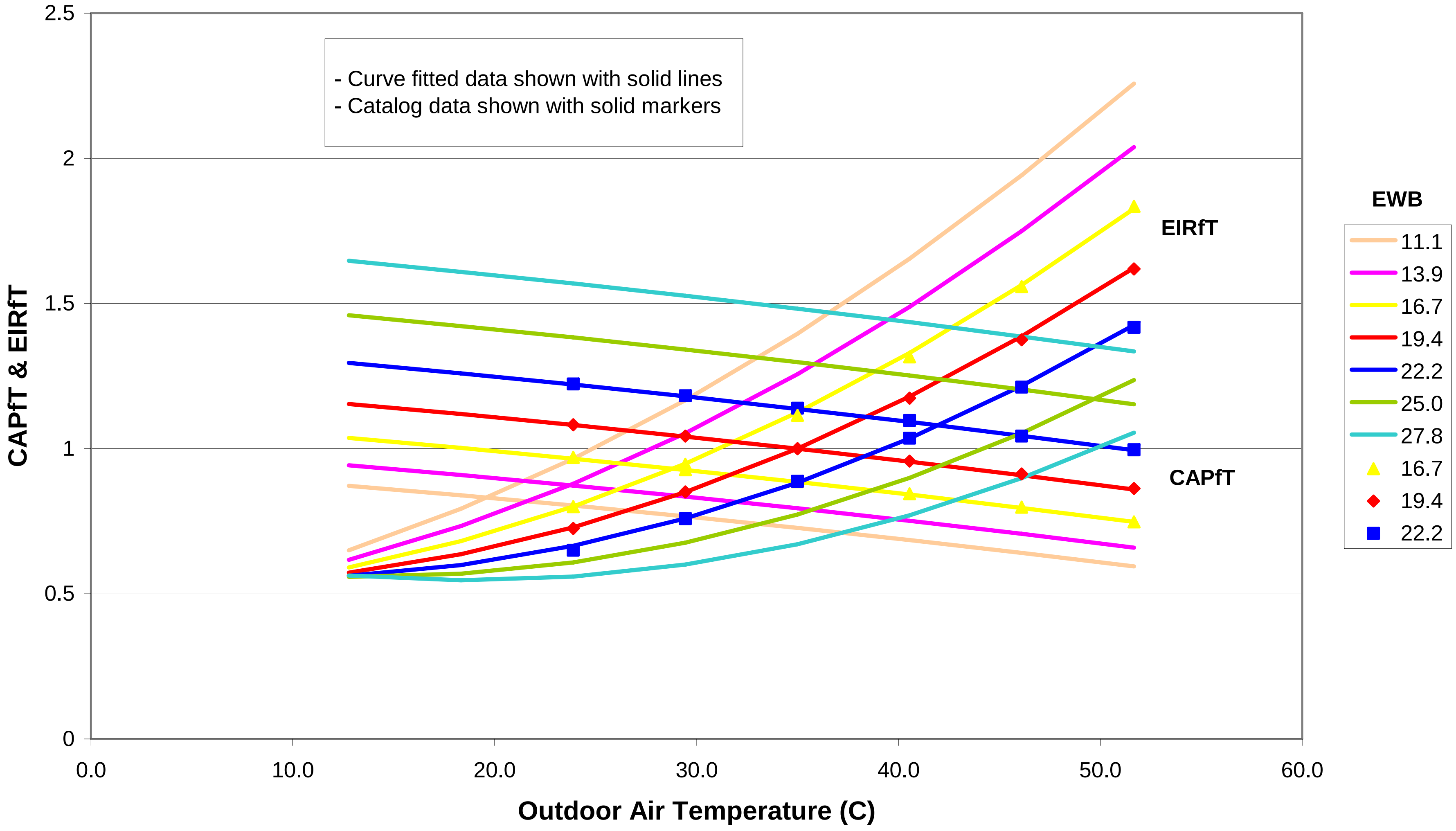
	EWB (C)	EWB**2	ODB (C)	ODB**2	ODB*EWB	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kW)	EIR w/OD Fan	EIR Normalized	Excel Calculated EIR	% Diff			Cool Cap Normalized	Excel Calculated CAP	% Diff
ARI	19.4		35.0			7.62	0.65	8.27	28.62584	0.289	1					1		
	16.7	277.8	23.9	570.7	398.1	5.77	0.65	6.42	27.78	0.231	0.800	0.800	0.04%			0.970	0.966	-0.48%
	19.4	378.1	23.9	570.7	464.5	5.84	0.65	6.49	30.97	0.210	0.725	0.729	0.50%			1.082	1.081	-0.04%
	22.2	493.8	23.9	570.7	530.9	5.92	0.65	6.57	35.01	0.188	0.650	0.665	2.39%			1.223	1.221	-0.20%
	16.7	277.8	29.4	867.0	490.7	6.61	0.65	7.26	26.55	0.273	0.947	0.948	0.15%			0.927	0.927	-0.07%
	19.4	378.1	29.4	867.0	572.5	6.69	0.65	7.34	29.86	0.246	0.851	0.850	-0.09%			1.043	1.042	-0.13%
	22.2	493.8	29.4	867.0	654.3	6.77	0.65	7.42	33.84	0.219	0.759	0.760	0.10%			1.182	1.180	-0.18%
	16.7	277.8	35.0	1225.0	583.3	7.52	0.65	8.17	25.37	0.322	1.115	1.125	0.91%			0.886	0.885	-0.12%
	19.4	378.1	35.0	1225.0	680.6	7.62	0.65	8.27	28.63	0.289	1.000	1.000	0.02%			1.000	1.000	-0.05%
	22.2	493.8	35.0	1225.0	777.8	7.71	0.65	8.36	32.61	0.256	0.887	0.883	-0.48%			1.139	1.137	-0.18%
	16.7	277.8	40.6	1644.8	675.9	8.54	0.65	9.19	24.17	0.380	1.316	1.330	1.06%			0.844	0.842	-0.32%
	19.4	378.1	40.6	1644.8	788.6	8.64	0.65	9.29	27.40	0.339	1.174	1.179	0.44%			0.957	0.955	-0.20%
	22.2	493.8	40.6	1644.8	901.2	8.75	0.65	9.4	31.41	0.299	1.036	1.035	-0.06%			1.097	1.092	-0.49%
	16.7	277.8	46.1	2126.2	768.5	9.64	0.65	10.29	22.85	0.450	1.559	1.564	0.35%			0.798	0.796	-0.31%
	19.4	378.1	46.1	2126.2	896.6	9.73	0.65	10.38	26.14	0.397	1.375	1.386	0.85%			0.913	0.908	-0.50%
	22.2	493.8	46.1	2126.2	1024.7	9.8	0.65	10.45	29.86	0.350	1.212	1.216	0.39%			1.043	1.044	0.13%
	16.7	277.8	51.7	2669.4	861.1	10.7	0.65	11.35	21.42	0.530	1.834	1.827	-0.40%			0.748	0.748	-0.07%
	19.4	378.1	51.7	2669.4	1004.6	10.9	0.65	11.55	24.70	0.468	1.619	1.623	0.26%			0.863	0.859	-0.39%
	22.2	493.8	51.7	2669.4	1148.1	11.03	0.65	11.68	28.51	0.410	1.418	1.426	0.56%			0.996	0.995	-0.13%

Coefficients for E-Plus performance curves

	Col F	Col E	Col D	Col C	Col B	Const	Adj a
	f	e	d	c	b	a	
EIR	-0.00172068	0.00046636	0.030397201	0.000480022	-0.001923191	0.387891266	0.3918913
CAP	-5.2113E-05	-3.7111E-05	-0.00417693	0.001514432	-0.011756982	0.884688876	0.8826889

	CAP	EIR
a	0.882688876	0.391891266
b	-0.011756982	-0.001923191
c	0.001514432	0.000480022
d	-0.004176926	0.030397201
e	-3.71107E-05	0.000466358
f	-5.21129E-05	-0.001720684

Case 3 - Carrier 48HJ009 8.5 Tons 2550 CFM
Performance Map - Catalog vs. Curve Fit



ASHRAE 1254-RP
A/C Unit Performance Curves
Case 5 - DX System with Subcooling Reheat Coil
Carrier 48HJ009 8-1/2 Tons at 3000 CFM with MoistureMiser
Data taken from page 151 of Carrier Manual 48h,t-2pd.pdf

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English Units

	EWB	ODB (F)	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kBtu)	EIR w/OD Fan	EIR Normalized		EIR w/o OD Fan	EIR Normalized		Cool Cap Normalized
ARI	67	95	7.75	0.65	8.4	94.8	0.302	1		0.279	1		1
	62	75	5.95	0.65	6.6	96.4	0.234	0.773		0.211	0.755		1.017
	67	75	6.05	0.65	6.7	106.4	0.215	0.711		0.194	0.696		1.122
	72	75	6.18	0.65	6.83	115.2	0.202	0.669		0.183	0.656		1.215
	62	85	6.75	0.65	7.4	91	0.278	0.918		0.253	0.907		0.960
	67	85	6.9	0.65	7.55	100.6	0.256	0.847		0.234	0.839		1.061
	72	85	6.97	0.65	7.62	110	0.236	0.782		0.216	0.775		1.160
	62	95	7.56	0.65	8.21	85.5	0.328	1.084		0.302	1.082		0.902
	67	95	7.75	0.65	8.4	94.8	0.302	1.000		0.279	1.000		1.000
	72	95	7.75	0.65	8.4	104.7	0.274	0.905		0.253	0.905		1.104
	62	105	8.58	0.65	9.23	78.6	0.401	1.325		0.373	1.335		0.829
	67	105	8.76	0.65	9.41	87.6	0.367	1.212		0.341	1.223		0.924
	72	105	8.8	0.65	9.45	97.3	0.331	1.096		0.309	1.106		1.026
	62	115	9.61	0.65	10.26	71.7	0.488	1.615		0.457	1.639		0.756
	67	115	9.77	0.65	10.42	80.5	0.442	1.461		0.414	1.485		0.849
	72	115	9.86	0.65	10.51	89.8	0.399	1.321		0.375	1.343		0.947
	62	125	10.64	0.65	11.29	64.8	0.595	1.966		0.560	2.009		0.684
	67	125	10.78	0.65	11.43	73.3	0.532	1.760		0.502	1.799		0.773
	72	125	10.91	0.65	11.56	82.4	0.479	1.583		0.452	1.620		0.869

Metric Units for E-Plus

	EWB (C)	EWB**2	ODB (C)	ODB**2	ODB*EWB	Compr (kW)	OD Fan (kW)	Total (kW)	Cool Cap (kW)	EIR w/OD Fan	EIR Normalized	Excel Calculated EIR	% Diff			Cool Cap Normalized	Excel Calculated CAP	% Diff
ARI	19.4		35.0			7.75	0.65	8.4	27.77615	0.302	1					1		
	16.7	277.8	23.9	570.7	398.1	5.95	0.65	6.6	28.24	0.234	0.773	0.766	-0.86%			1.017	1.021	0.38%
	19.4	378.1	23.9	570.7	464.5	6.05	0.65	6.7	31.17	0.215	0.711	0.720	1.27%			1.122	1.121	-0.09%
	22.2	493.8	23.9	570.7	530.9	6.18	0.65	6.83	33.75	0.202	0.669	0.683	2.02%			1.215	1.224	0.69%
	16.7	277.8	29.4	867.0	490.7	6.75	0.65	7.4	26.66	0.278	0.918	0.911	-0.79%			0.960	0.964	0.47%
	19.4	378.1	29.4	867.0	572.5	6.9	0.65	7.55	29.48	0.256	0.847	0.837	-1.21%			1.061	1.064	0.22%
	22.2	493.8	29.4	867.0	654.3	6.97	0.65	7.62	32.23	0.236	0.782	0.772	-1.22%			1.160	1.164	0.35%
	16.7	277.8	35.0	1225.0	583.3	7.56	0.65	8.21	25.05	0.328	1.084	1.101	1.62%			0.902	0.902	0.05%
	19.4	378.1	35.0	1225.0	680.6	7.75	0.65	8.4	27.78	0.302	1.000	1.000	-0.01%			1.000	1.000	0.01%
	22.2	493.8	35.0	1225.0	777.8	7.75	0.65	8.4	30.68	0.274	0.905	0.908	0.28%			1.104	1.100	-0.44%
	16.7	277.8	40.6	1644.8	675.9	8.58	0.65	9.23	23.03	0.401	1.325	1.338	0.96%			0.829	0.835	0.67%
	19.4	378.1	40.6	1644.8	788.6	8.76	0.65	9.41	25.67	0.367	1.212	1.209	-0.25%			0.924	0.931	0.75%
	22.2	493.8	40.6	1644.8	901.2	8.8	0.65	9.45	28.51	0.331	1.096	1.090	-0.57%			1.026	1.029	0.27%
	16.7	277.8	46.1	2126.2	768.5	9.61	0.65	10.26	21.01	0.488	1.615	1.621	0.37%			0.756	0.761	0.65%
	19.4	378.1	46.1	2126.2	896.6	9.77	0.65	10.42	23.59	0.442	1.461	1.465	0.27%			0.849	0.856	0.83%
	22.2	493.8	46.1	2126.2	1024.7	9.86	0.65	10.51	26.31	0.399	1.321	1.318	-0.23%			0.947	0.953	0.60%
	16.7	277.8	51.7	2669.4	861.1	10.64	0.65	11.29	18.99	0.595	1.966	1.950	-0.83%			0.684	0.682	-0.19%
	19.4	378.1	51.7	2669.4	1004.6	10.78	0.65	11.43	21.48	0.532	1.760	1.766	0.37%			0.773	0.776	0.34%
	22.2	493.8	51.7	2669.4	1148.1	10.91	0.65	11.56	24.14	0.479	1.583	1.592	0.55%			0.869	0.871	0.22%

Coefficients for E-Plus performance curves

	Col F	Col E	Col D	Col C	Col B	Const	Adj a
	f	e	d	c	b	a	
EIR	-0.00177975	0.00074729	0.015824043	0.000604235	0.004015641	0.434347586	0.4353476
CAP	-8.9837E-05	-9.175E-05	-0.00375859	0.000113924	0.034216637	0.593779741	0.5967797

	CAP	EIR
a	0.596779741	0.435347586
b	0.034216637	0.004015641
c	0.000113924	0.000604235
d	-0.00375859	0.015824043
e	-9.17495E-05	0.000747287
f	-8.98373E-05	-0.001779745

Case 5 - Carrier 48HJ009 8.5 Tons 3000 CFM
with MoistureMiser
Performance Map - Catalog vs. Curve Fit