Design 101 for Energy Managers

An Overview of MEPR design options for your supermarket, and how they impact your energy budget.

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HVAC

Desiccants

VFD's

Ventilation strategies

Heat reclaim

Electrical Design

Lighting

Power Distribution

Demand Response

Sub-metering / load profiles

208V vs. 480V

Refrigeration

Conventional DX HFC

Secondary MT

CO_2

Distributed

ECM motors

Plumbing

Hot Water Heat Reclaim

Vacuum Condensate Systems

Fixtures

Recirculation Systems

Water Treatment

- **Supermarkets use 5 times more energy than Commercial Buildings**

- **Refrigerated Cases 50 % Energy Used**

- **75 % of the Case Load Infiltration**

Table 3 Relative Refrigeration Requirements with Varying Store Ambient Conditions

Refrigerator Model	70°F db					78°F db		
	Relative Humidity, %					Relative Humidity, %		
	30	40	55	60	70	50	55	65
Multideck dairy	0.90	0.95	1.00	1.08[a]	1.18[b]	0.99	1.08[a]	1.18[b]
Multideck low-temperature	0.90	0.95	1.00	1.08[a]	1.18[b]	0.99	1.08[a]	1.18[b]
Single-deck low-temperature	0.90	0.95	1.00	1.08[a]	1.15	0.99	1.05	1.15
Single-deck red meat	0.90	0.95	1.00	1.08[a]	1.15	0.99	1.05	1.15
Multideck red meat	0.90	0.95	1.00	1.08[a]	1.18[b]	0.99	1.08[a]	1.18[b]
Low-temperature reach-in	0.90	0.95	1.00	1.05[a]	1.10	0.99	1.05[a]	1.10

Note: Package warm-up may be more than indicated. Standard flood lamps are clear PAR 38 and R-40 types.

[a]More frequent defrosts required.

[b]More frequent defrosts required plus internal condensation (not recommended).

Source: 2010 ASHRAE Handbook 15.4

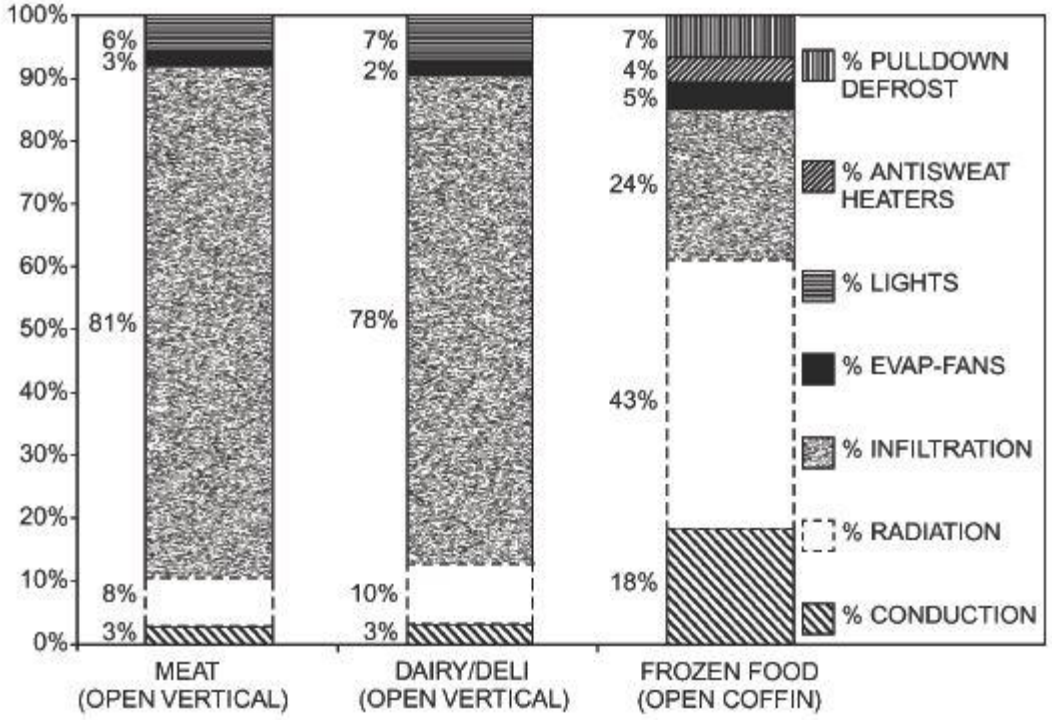
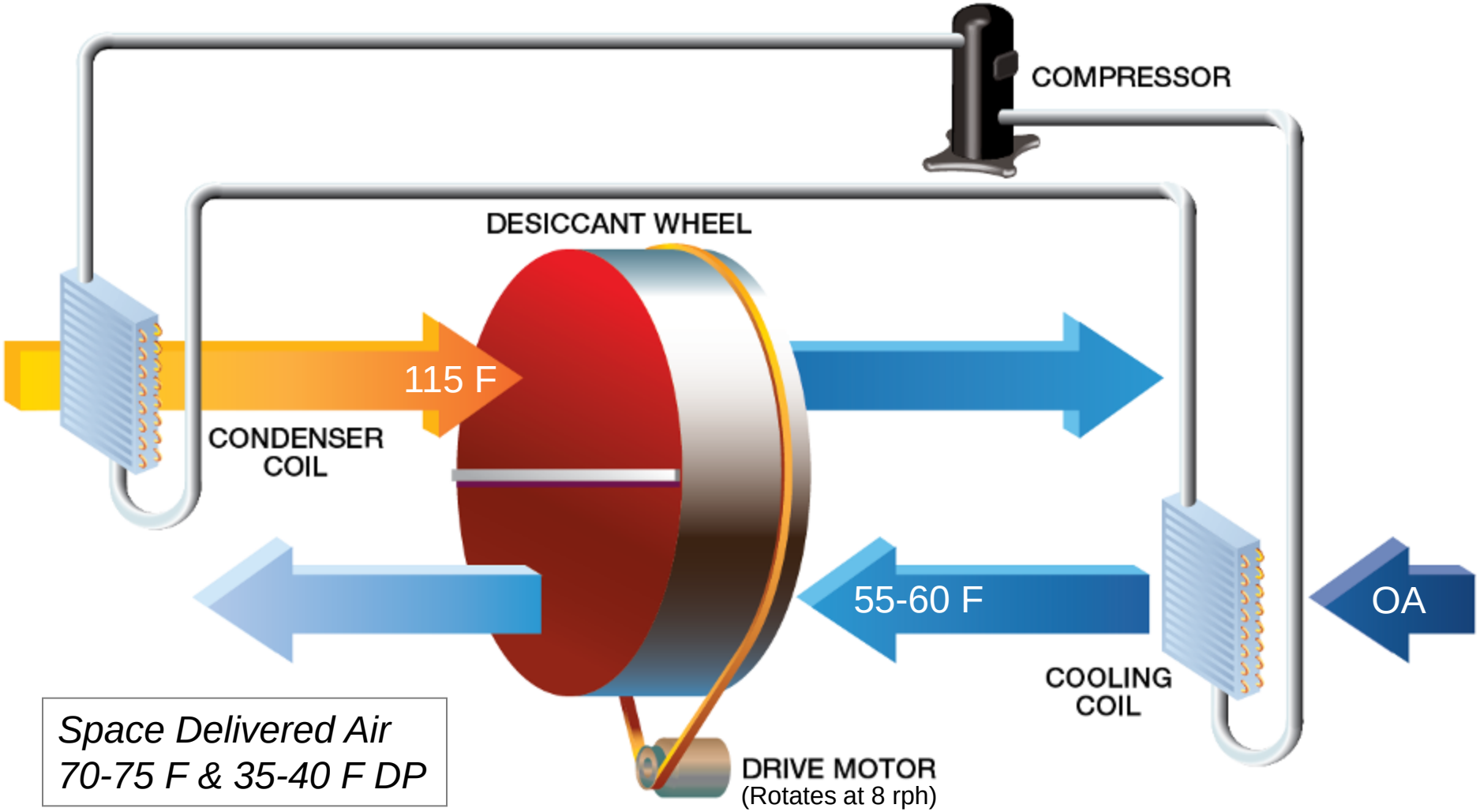


Fig. 9 Components of Refrigeration Load for Several Display Refrigerator Designs at 75°F db and 55% rh

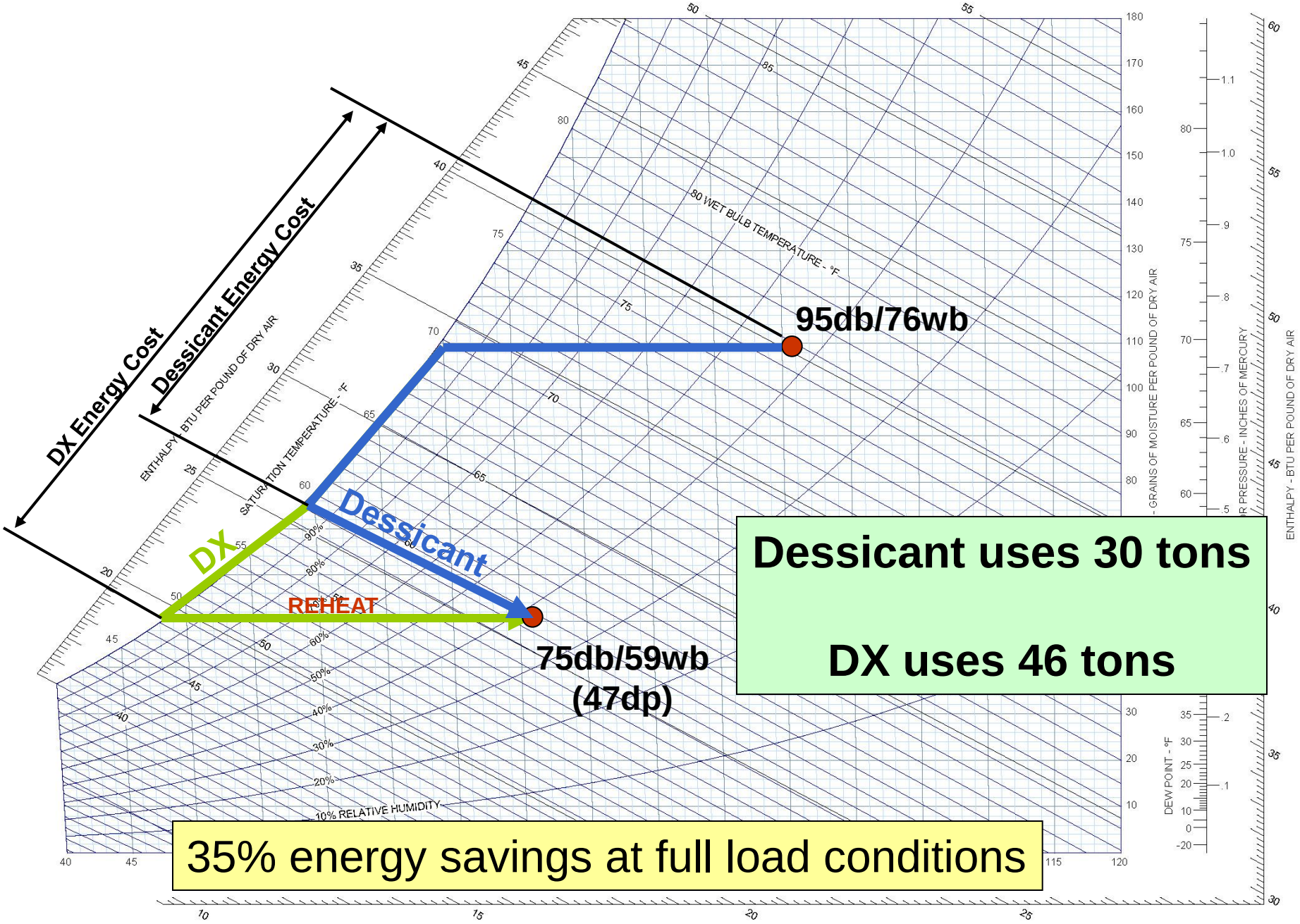
Source: 2010 ASHRAE Handbook 15.5

Desiccant Wheel Concept
Condenser Heat Regenerative



Space Delivered Air
70-75 F & 35-40 F DP

Performance @ 6000 cfm - full load conditions

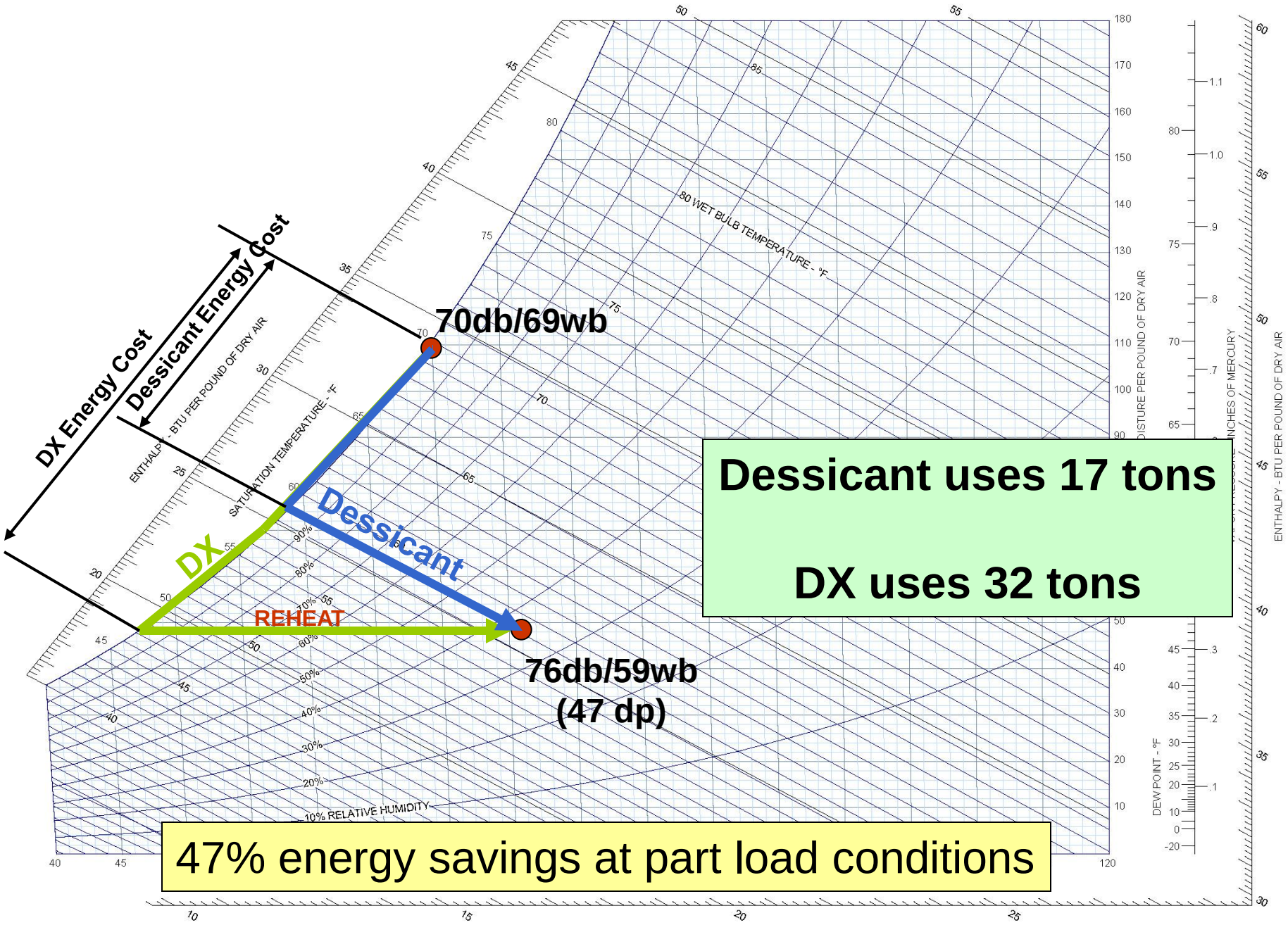


Dessicant uses 30 tons

DX uses 46 tons

35% energy savings at full load conditions

Performance @ 6000 cfm - part load conditions



VFDs

- Fan / Pump Laws:

BHP2 / BHP1 = (CFM2 / CFM1)^3

Reduce CFM 10% = 27% horsepower reduction

VFDs

2003 CEC Advanced Variable Air Volume System Guide

57% Fan Energy savings for a 50,000 sq.ft. office building with a VAV system versus constant volume.

Exhaust Ventilation Control

- Exhaust and make-up airflow rates are adjusted in relation to the cooking load – Reduction up to 50%
- Sensors in the exhaust collar/hood – meets the requirements of IMC 507.2.1.1

Water Treatment

Fouling Factor	Fouling Thickness (in)	Fouling Thickness (mm)	% inc. energy consumption ***
0.00025	1/32	0.079375	3.10%
0.0005	1/16	0.15875	6.20%
0.001	1/8	0.3175	12.40%
0.002	1/4	0.635	24.80%

*** FIGURES FROM ASHRAE® 2000 HANDBOOK; HVAC SYSTEMS & EQUIPMENT

Fouling Thickness (in)	Fouling Thickness (mm)	% inc. energy consumption *
1/32	0.78	8.5
1/16	1.56	12.4
1/8	3.12	25
1/4	6.24	40

Non-chemical Technologies for Scale and Hardness Control”, US Dept of Energy, DOE/EE-1062, Jan 1998

Secondary Systems

Each 1^0F increase in chilled water temp, system efficiency increases 2 – 4 %.

Each 1^0F decrease in condenser water temp, system efficiency increases 1 – 2 %.

ECM Motors

Single Phase Power

W = V x A x Power Factor

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