LISTEN.
THINK.
SOLVE.®

Energy Saving Solutions Using Variable Frequency Drives

Keystone E
April 20 – 01:00 PM
April 21 – 09:00 AM

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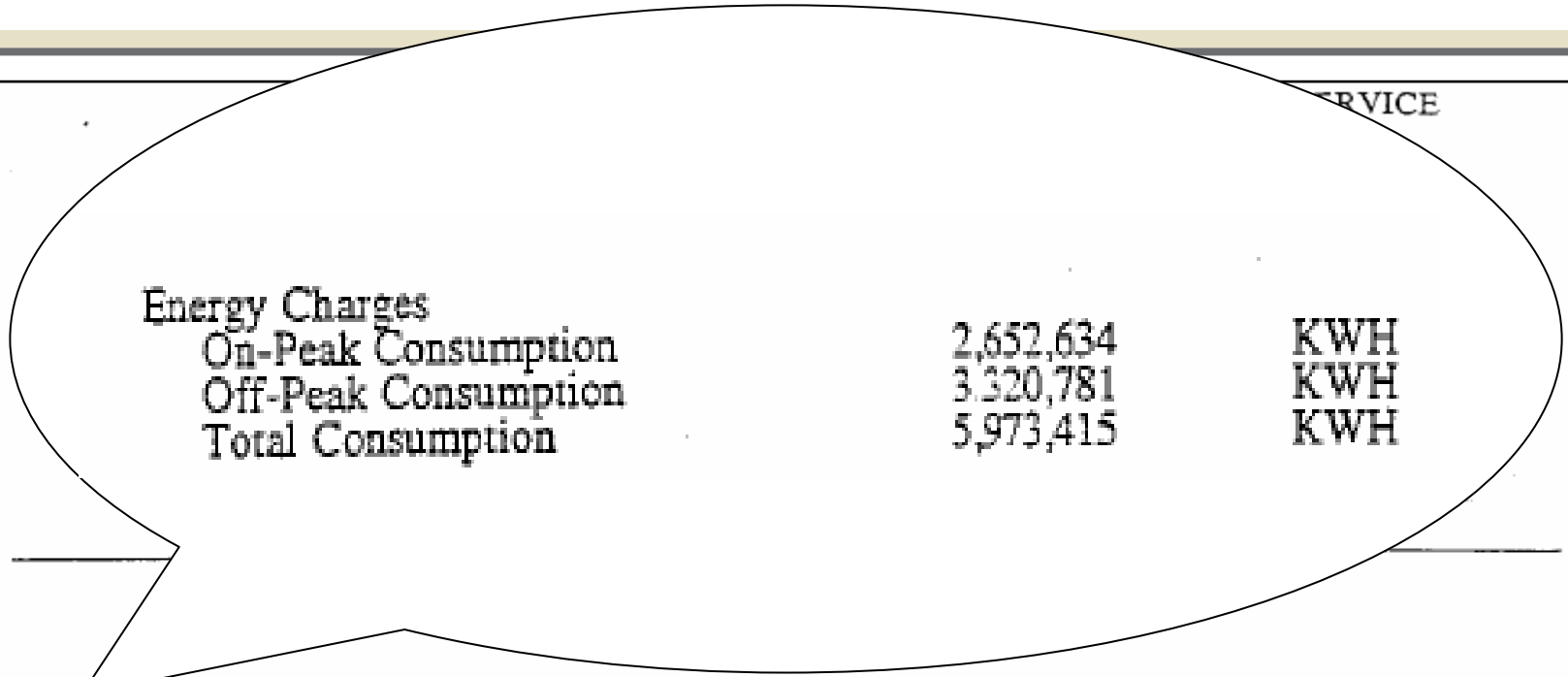
Schaedler Yesco
EXPO 2010
ALLEN-BRADLEY • ROCKWELL SOFTWARE
Rockwell Automation

Energy Efficiency: What's all the fuss about?

- Rapidly rising energy costs
- Finite supplies of fossil fuels
- Slow growth of alternate energy supplies
- Greenhouse gas & carbon emissions linked to world climate changes
- Exponential growth in energy demand worldwide
- Government incentives for increasing energy efficiency
- 3 phase AC motors (and the work that they perform) represent a significant portion of the world's total energy consumption
- Increasing socioeconomic volatility

Sample Energy Bill



RVICE

Energy Charges			136,700 45
On-Peak Consumption	2,652,634	KWH	
Off-Peak Consumption	3,320,781	KWH	
Total Consumption	5,973,415	KWH	
On Peak Demand Charges			82,806 95
Firm Billed On Peak KW Of 11,327.9 On 05/01/97 1:45 PM			
Firm Reactive Power Of 3,189.80 @ Time Of On Peak KW			
Firm Power Factor Of 96.7			
Customer Demand Charges			6,978 44
Customer Demand Of 12,031.8 On 05/01/97 1:45 PM x $0.58000			
Current Month's Maximum Demand Of 12,031.8 On 05/01/97 1:45 PM			
Facilities Charges			475.00
Amount Subject To Tax	226,960 84		
State Tax @ 5.0 %			11,348 04
County and Stadium Tax @ 0.60 %			1,361.77
Total Current Charges			$239,670.65

Energy Savings no-brainer: Motor Efficiency

Motors transform energy into work. Energy = $$. The more efficient a motor is, the less energy ($$) is wasted to perform the required work.

Use High efficiency motors!!

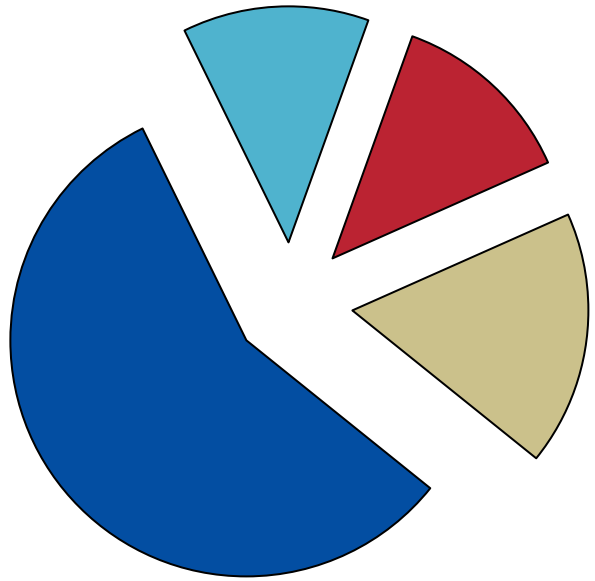
http://www.ab.com/drives/motors/kwsavings.html

Spiraling Energy Costs

- In the United States, Manufacturers spend more than $33 billion annually on electricity.
- Motor systems , in the US industrial sector, consume 63% of the total energy, more than half of which run pumps & fans

  (*source "US Industrial motor systems market opportunities assessment" Dec 1998 by DOE*)
- Pumps account for 20% of electrical demand worldwide

Life Cycle Costs Of an Industrial Pump



Source: Office of Industrial Technologies, Energy Efficiency and Renewable Energy, U.S. Department of Energy

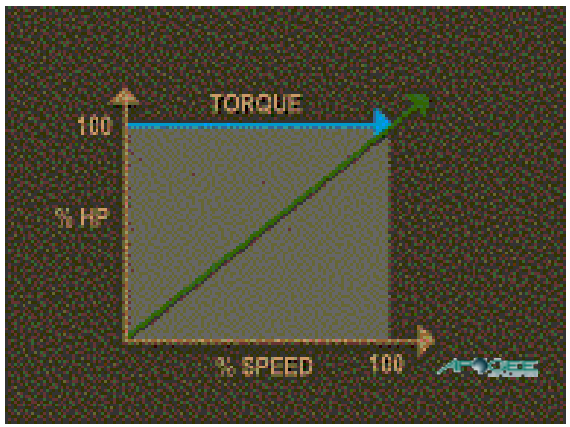
Hydraulic Institute

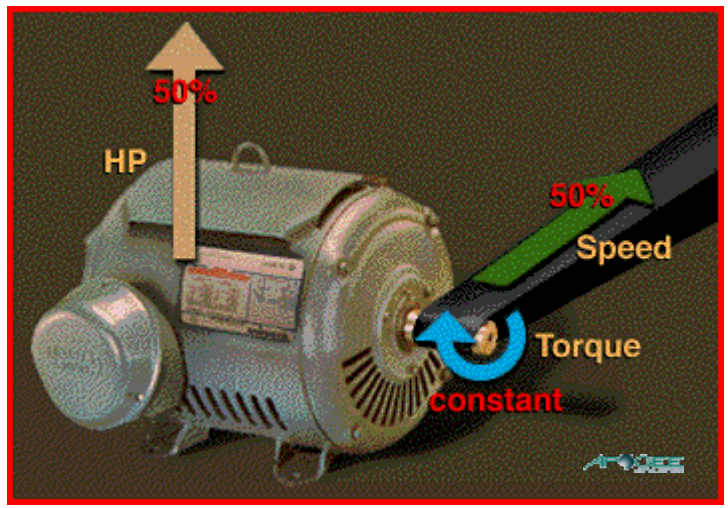
Europump

Energy Savings by using VFD's: How?

Constant Torque Applications vs. Variable Torque Applications

Constant torque loads require the same amount of torque at low speeds as they do at high speeds. Torque remains constant throughout the speed range, and the horsepower increases and decreases in direct proportion to the speed.





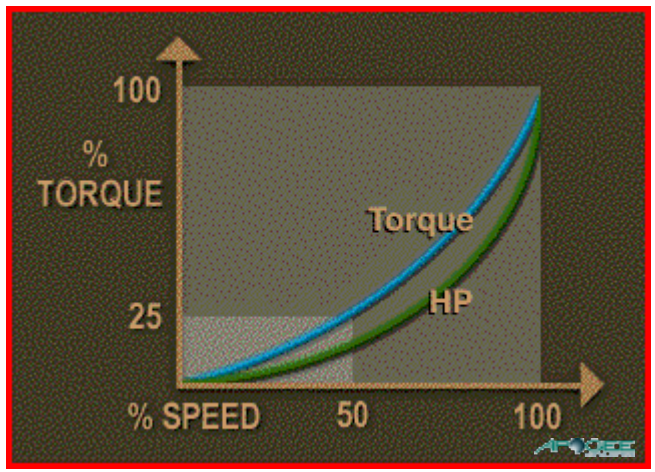
- PD & REC. Pumps & Compressors
- Conveyors

Energy Savings by using VFD's: How?

Constant Torque Applications vs. Variable Torque Applications

Variable Torque loads require much lower torque at low speeds than at high speeds. The torque required varies as the square of the speed, and the horsepower required varies as the cube of the speed. Variable torque loads include most centrifugal and axial pumps, fans and blowers and many mixers and agitators.

- Centrifugal Fans & Pumps
- Axial Blowers
- Some Mixers & agitators



Speed	Torque	HP
100%	100%	100%
80%	64%	51%
50%	25%	12.5%

Energy Savings by using VFD's: How?

Laws of affinity (abridged version)

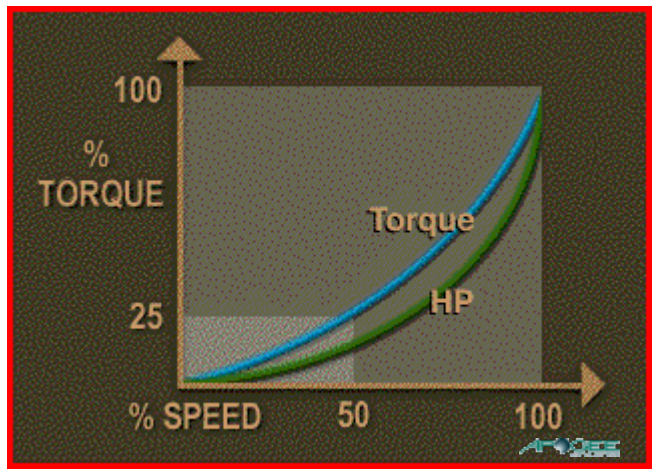
Centrifugal Fans & Pumps:

-- Flow is proportional to speed --

-- Power is a function of the cube of speed --

As an example, when the speed of a centrifugal fan or pump is reduced to 50% (or one half), the flow through the fan or pump is also reduced to 50% BUT, the horsepower is reduced to the cube of the speed (.5 x .5 x .5) which is .125 or 12.5% of that required to drive the load at full speed.

Speed/CFM/GPM	Power ($$)
100%	100%
90 %	73 %
80 %	51 %
70 %	34 %
60 %	22 %
50 %	12 %
40 %	6 %



Energy Savings by using VFD's: WOW !!

Fan & Pump Power consumption as a function of Flow (speed)

FLOW	KW	Cost/hr	Cost/2k Hrs	△Cost/2k hrs
50000 CFM (100%)	149 (200 HP)	$ 14.90	$29,800	
45000 CFM (90%)	109 (146 HP)	$10.90	$21,800	$ 8,000
40000 CFM (80%)	76 (102 HP)	$ 7.60	$15,200	$14,600
35000 CFM (70%)	51 (69 HP)	$ 5.10	$ 10,200	$ 19,600
30000 CFM (60%)	32 (43 HP)	$ 3.20	$ 6,400	$ 23,400
25000 CFM (50%)	19 (25 HP)	$ 1.88	$ 3,760	$ 26,040
20000 CFM (40%)	10 (13 HP)	$ .96	$ 1,920	$ 27,880

- 200 HP (149 KW) AC motor running a centrifugal fan rated at 50000 CFM
- Cost per kilowatt hour is $0.10 (no demand, no taxes or other fees)
- HP * .746Kw * $0.10 * 2000 hours

Energy Savings Calculations- An Example

A 25 HP fan needs to supply air 10 hours a day for 300 days a year.

The cost of running the fan at full speed, for the entire year would be

25HP x 0.746 kW/HP x 3000 hrs x 0.12 kW/hr = $ 6714.00

Assuming that the fan does not have to run at full speed all the time:
25% of the time at 100% speed;50% of time at 80% speed;25% of time at 60% speed.

The cost of running the fan with a variable frequency drive would be:

25 HP x 0.746 kW/hp x 750 hrs x 0.12/kWhr x $(1.00)^3$ = $ 1678.50

25 HP x 0.746 kW/hp x 1500 hrs x 0.12/kWhr x $(0.80)^3$ = $ 1718.78

25 HP x 0.746 kW/hp x 750 hrs x 0.12/kWhr x $(0.60)^3$ = $ 362.56

Total = $ 3759.84

Potential Annual savings would be $ 6714.00 – $ 3759.84 = $ 2954.16

What's the return? How long to payback?

- Energy Savings Calculators for fan & pump applications provide estimated times to payback based on user supplied data
- Allow for project planning & justification
- Calculators work on well documented & reliable formulas and methods

Fan Energy Savings Tool.LNK

Pump Energy Savings Tool.LNK

http://www.ab.com/drives/

HVAC Specific Solution: FanMaster

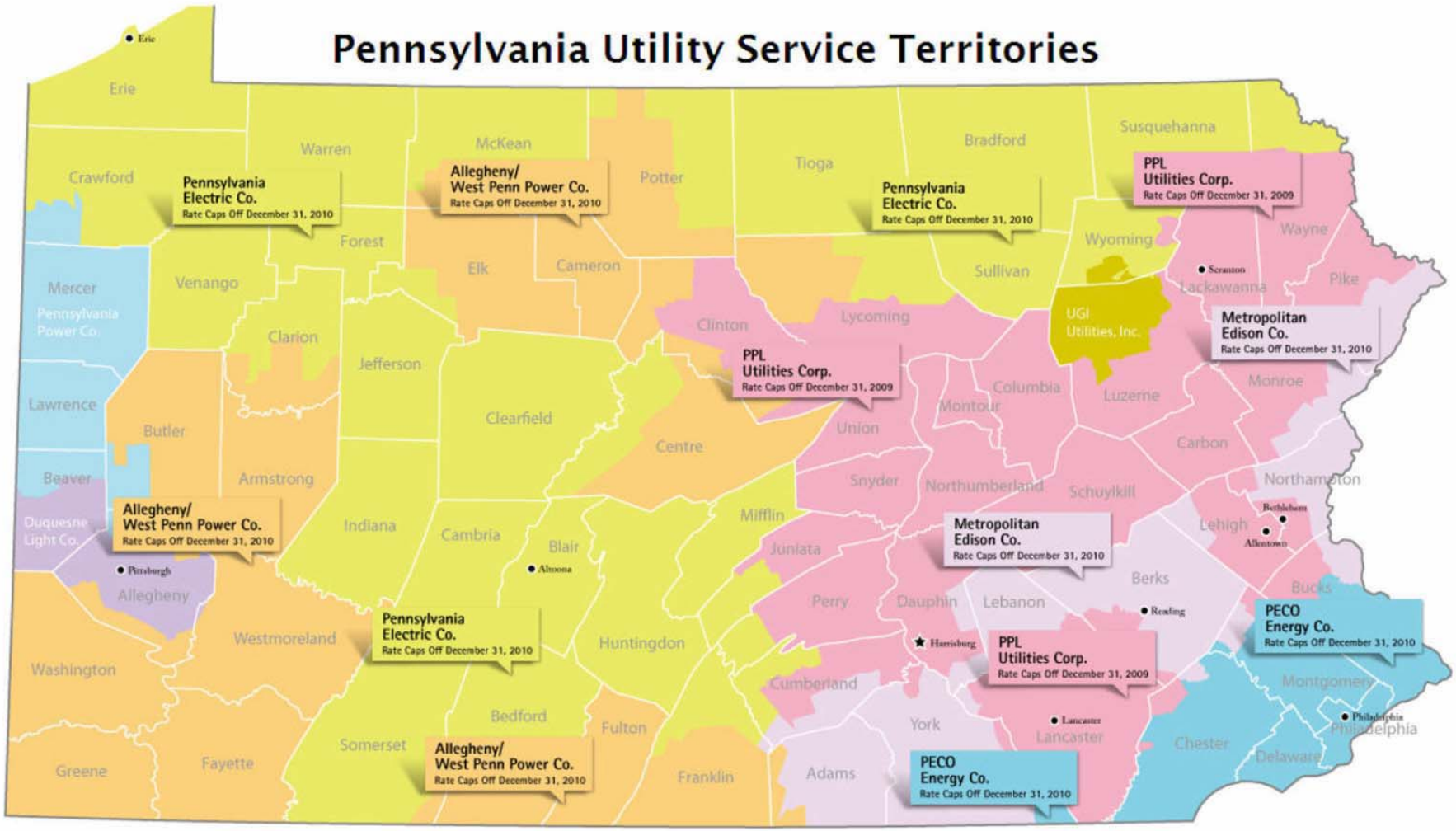
Constant Volume Air Handling Upgrade Package

The PowerFlex® FanMaster™ is a data acquisition and control system that is integrated with existing constant volume, mixed air, single path constant volume air handling units (AHU). This system utilizes air temperature and quality transmitters, a damper blade position indicator, a fan current transducer and a PLC with custom-configured application software. This monitors the AHU supply, mixed air temperature, fan motor current and controls the fan motor speed in order to calculate and save energy.

FanMaster Energy Saving Calculator_1.2.xls

The Allen-Bradley FanMaster™ energy saving package converts a constant volume air handler to variable air flow without changes to your existing mechanical and controls systems.

PA Electric Utilities



Utility Rebates and Incentives

PA Utility Rebates as part of Pa Act 129 may well offer a substantial funding source in the form of incentives and rebates, making a VFD retrofit opportunity too advantageous to pass up.

SYD _ EDC Rebate Websites 030310.pdf