Shop Tech Talk July 2009

Premium Efficient Electric Motors–Benefits , Rebates and the Law

There are 3 components to understanding what we need to know concerning the changes happening in the electric motor world.

1. The impact of the 2007 Energy Independence and Security Act (EISA) that will become effective after December 19, 2010
2. The impact of the proposed (passed by US House, not yet come up before the US Senate) almost certain American Clean Energy Leadership Act of 2009 (ACELA), which has a Motor Efficiency Rebate Program.
3. How much can you save by using Premium Efficient motors ?

First, the 2007 Energy Independence and Security Act (EISA)

Effective December 19,2010 this law will require that general purpose motors from 1-200 HP sold in the USA will have to meet or exceed Nema Premium motor efficiency levels as per Nema MG-1 Table 12-12 Other motors not previously affected are now subject to this law. The previous lower motor efficiency standard were set by EPACT'92 and EPACT'05 and they are now superceded by the higher efficiency standards of the new 2007 Energy Independence and Security Act.

A summary of EISA requirements follows:

Description	Efficiency*
1-200HP, T frame, 2/4/6-Pole, 230 or 460V, 3-Ph, 60 Hz, open	NEMA MG1 Table 12-12
1-200HP, T frame, 2/4/6-Pole, 230 or 460V, 3-Ph, 60 Hz, enclosed	NEMA MG1 Table 12-12
1-200HP, T frame, 2/4/6-Pole, 230 or 460V, 3-Ph, 60 Hz, explosion proof	NEMA MG1 Table 12-12
201-500 HP, 2/4/6-Pole, <600V, open or enclosed	NEMA MG1 Table 12-11
U frame	NEMA MG1 Table 12-11
Design C	NEMA MG1 Table 12-11
Close-coupled pump	NEMA MG1 Table 12-11
Fire Pump motors	NEMA MG1 Table 12-11
Footless motors	NEMA MG1 Table 12-11
Vertical Solid Shaft, normal thrust	NEMA MG1 Table 12-11
8-Pole (900 RPM @ 60 Hz)	NEMA MG1 Table 12-11
Multi-speed (based on highest HP & associated pole/RPM)	NEMA MG1 Table 12-11
3-Ph, 60 Hz, with voltages less than 600 but not 230 or 460	NEMA MG1 Table 12-11
Intermittent duty	NEMA MG1 Table 12-11
3-Ph, 50 Hz, all voltages	Not subject to EISA
60/50 Hz rated motors subject to EISA if operated at 60 Hz	
TEBC and DPFV not subject to EISA	

*NEMA Table 12-12 refers to NEMA Premium; Table 12-11 generally refers to EPACT levels.

Table 52
FULL-LOAD EFFICIENCIES FOR 60 Hz NEMA PREMIUM® EFFICIENCY ELECTRIC MOTORS RATED 600 VOLTS OR LESS (RANDOM WOUND) [MG 1 Table 12-12]

	2 POLE		4 POLE		6 POLE	
HP	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
			OPEN MOTORS			
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2	85.5	82.5	86.5	84.0	87.5	85.5
3	85.5	82.5	89.5	84.0	88.5	86.5
5	86.5	84.0	89.5	84.0	89.5	87.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	95.8	95.0	95.8	95.0
450	95.8	95.0	96.2	95.4	96.2	95.4
500	95.8	95.0	96.2	95.4	96.2	95.4
			Enclosed Motors			
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2	85.5	82.5	86.5	84.0	88.5	86.5
3	86.5	84.0	89.5	87.5	89.5	87.5
5	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

Table 51
FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS [MG 1 Table 12-11]EPACT

	2 POLE		4 POLE		6 POLE		8 POLE	
HP	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
OPEN MOTORS								
1	—	—	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	84.0	81.5	75.5	72.0
2	84.0	81.5	84.0	81.5	85.5	82.5	85.5	82.5
3	84.0	81.5	86.5	84.0	86.5	84.0	86.5	84.0
5	85.5	82.5	87.5	85.5	87.5	85.5	87.5	85.5
7.5	87.5	85.5	88.5	86.5	88.5	86.5	88.5	86.5
10	88.5	86.5	89.5	87.5	90.2	88.5	89.5	87.5
15	89.5	87.5	91.0	89.5	90.2	88.5	89.5	87.5
20	90.2	88.5	91.0	89.5	91.0	89.5	90.2	88.5
25	91.0	89.5	91.7	90.2	91.7	90.2	90.2	88.5
30	91.0	89.5	92.4	91.0	92.4	91.0	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	92.4	91.0
75	93.0	91.7	94.1	93.0	93.6	92.4	93.6	92.4
100	93.0	91.7	94.1	93.0	94.1	93.0	93.6	92.4
125	93.6	92.4	94.5	93.6	94.1	93.0	93.6	92.4
150	93.6	92.4	95.0	94.1	94.5	93.6	93.6	92.4
200	94.5	93.6	95.0	94.1	94.5	93.6	93.6	92.4
250	94.5	93.6	95.4	94.3	95.4	94.5	94.5	93.6
300	95.0	94.1	95.4	94.5	95.4	94.5	—	—
350	95.0	94.1	95.4	94.5	95.4	94.5	—	—
400	95.4	94.5	95.4	94.5	—	—	—	—
450	95.8	95.0	95.8	95.0	—	—	—	—
500	95.8	95.0	95.8	95.0	—	—	—	—
Enclosed Motors								
1	75.5	72.0	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	85.5	82.5	77.0	74.0
2	84.0	81.5	84.0	81.5	86.5	84.0	82.5	80.0
3	85.5	82.5	87.5	85.5	87.5	85.5	84.0	81.5
5	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91.0	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91.0	89.5	90.2	88.5	89.5	87.5
25	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
30	91.0	89.5	92.4	91.0	91.7	90.2	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93.0	91.7	94.1	93.0	93.6	92.4	93.0	91.7
100	93.6	92.4	94.5	93.6	94.1	93.0	93.0	91.7
125	94.5	93.6	94.5	93.6	94.1	93.0	93.6	92.4
150	94.5	93.6	95.0	94.1	95.0	94.1	93.6	92.4
200	95.0	94.1	95.0	94.1	95.0	94.1	94.1	93.0
250	95.4	94.5	95.0	94.1	95.0	94.1	94.5	93.6
300	95.4	94.5	95.4	94.5	95.0	94.1	—	—
350	95.4	94.5	95.4	94.5	95.0	94.1	—	—
450	95.4	94.5	95.4	94.5	—	—	—	—
500	95.4	94.5	95.8	95.0	—	—	—	—

Second, the American Clean Energy Leadership Act of 2009 (ACELA)

ACELA is a counterpart Bill to the American Clean Energy and Security Act of 2009 (ACES),the combined energy and climate bill that is currently making its way through Congress.
ACELA has added a motor efficiency rebate program (*Section 229*) to it that was passed recently by the House.
"This section would direct DOE to establish, by January 1, 2010, a program to provide rebates for the purchase and installation of new electric industrial motors that meet certain energy efficiency standards. To qualify for the rebates, entities must produce evidence that they are purchasing the new motors in order to replace older motors that meets certain specifications (to be established by DOE within 90 days of the enactment of the section), and that the older motor has been removed from service and been properly disposed of.
The amount of the rebate would be the product of $25.00 and the nameplate horsepower of the new motor. Under the program, the distributors of the new electric motor would also receive a rebate for each new motor sold, equal to the product of $5.00 and the nameplate horsepower of the new motor.
This section would authorize to be appropriated the following sums:

* ***$80 million for fiscal year 2010;***
* ***$75 million for fiscal year 2011;***
* ***$70 million for fiscal year 2012;***
* ***$65 million for fiscal year 2013; and***
* ***$60 million for fiscal year 2014***

Example
Replacing 75HP motor: 25 x 75 HP + 5 x 75 HP = $1875 + $375 = $2250 total rebate dollars

To take advantage of these " Crush for Credit " rebates I would recommend that any plant wanting to upgrade or simply purchase new Premium Efficient motors do all the necessary survey work as soon as possible so that they will be ready to purchase these new motors as soon as this program comes into effect ie Jan 10, 2010

If the Senate approves this bill and $80 million is appropriated for the first year 2010 you can see that with 50 states sharing this amount the money could go quickly.

Why is the Government doing this?

Because electric motor systems account for 23% of all electricity consumed in the U.S. and 70% of all electrical energy in the manufacturing sector. The energy required to operate electric motors spewed a staggering 26 billion metric tons of CO_2 emissions into the atmosphere in 2004… expected to grow another 65% by 2030.

While on the subject of rebates I would also like to inform you of the rebates currently being offered by Progress Energy Company

Table 6-4
Prescriptive Motors Qualifying Efficiencies / Incentives

NEMA Premium-Efficiency Motors – Minimum Qualifying Efficiencies							
Horse Power	3600 RPM		1800 RPM		1200 RPM		Incentive per Motor
	Open	Closed	Open	Closed	Open	Closed	
1	77.0%	77.0%	85.5%	85.5%	82.5%	82.5%	$10
1.5	84.0%	84.0%	86.5%	86.5%	86.5%	87.5%	$15
2	85.5%	85.5%	86.5%	86.5%	87.5%	88.5%	$20
3	85.5%	86.5%	89.5%	89.5%	88.5%	89.5%	$25
5	86.5%	88.5%	89.5%	89.5%	89.5%	89.5%	$30
7.5	88.5%	89.5%	91.0%	91.7%	90.2%	91.0%	$40
10	89.5%	90.2%	91.7%	91.7%	91.0%	91.0%	$50
15	90.2%	91.0%	93.0%	92.4%	91.7%	91.7%	$55
20	91.0%	91.0%	93.0%	93.0%	92.4%	91.7%	$65
25	91.7%	91.7%	93.6%	93.6%	93.0%	93.0%	$75
30	91.7%	91.7%	94.1%	93.6%	93.6%	93.0%	$85
40	92.4%	92.4%	94.1%	94.1%	94.1%	94.1%	$110
50	93.0%	93.0%	94.5%	94.5%	94.1%	94.1%	$140
60	93.6%	93.6%	95.0%	95.0%	94.5%	94.5%	$165
75	93.6%	93.6%	95.0%	95.4%	94.5%	94.5%	$210
100	93.6%	94.1%	95.4%	95.4%	95.0%	95.0%	$260
125	94.1%	95.0%	95.4%	95.4%	95.0%	95.0%	$275
150	94.1%	95.0%	95.8%	95.8%	95.4%	95.8%	$325
200	95.0%	95.4%	95.8%	96.2%	95.4%	95.8%	$450

We would be glad to discuss with you these possibilities whenever you are ready to purchase any new Premium Efficiency electric motors.

And third, 'How much can you save'

On the next few pages I have put 6 pages of information that clearly explain in simple terms the calculations necessary to know how much money you can save by upgrading to premium efficiency motors. This information is taken from the Department of Energy "Energy Efficient Motor Selection Handbook"

Also for those of you who would prefer a computer software type solution I would like to recommend the Baldor Energy Savings Tool V 3.0 which can be downloaded free of charge at

http://www.baldor.com/support/software_download.asp?type=BE$T%20Energy%20Savings%20Tool

Chapter 3
How Much Can You Save?

The amount of money you can save by purchasing an energy-efficient motor instead of a standard motor depends on motor size, annual hours of use, load factor, efficiency improvement, and the serving utility's charges for electrical demand and energy consumed

Three pieces of information are required to evaluate the economic feasibility of procuring an energy-efficient motor instead of a standard motor. First, obtain a copy of your utility's rate schedule. Then determine load factor or percentage of full rated output. Finally, determine the number of motor operating hours at rated load With this information you can determine your annual energy and cost savings.

Understanding Your Utility's Rate Schedule

The cost of electricity for a commercial or industrial facility is typically composed of four components:

1. **Basic or Hookup Charge.** A fixed amount per billing period that is independent of the quantity of electricity used This charge covers the cost of reading the meter and servicing your account.

2. **Energy Charges.** A fixed rate ($/kWh) or rates, times the electrical consumption (kWh) for the billing period. Energy charges are frequently seasonally differentiated and may also vary with respect to the quantity of electricity consumed. Utility tariffs may feature declining block or inverted rate schedules. With a declining block rate schedule, illustrated in Table 10, energy unit prices decrease as consumption increases.

3. **Demand Charge.** A fixed rate ($/kW) times the billable demand (kW) for the billing period. Demand charges are often based upon the highest power draw for any 15-minute time increment within the billing period. Some utilities feature ratcheted demand charges where the applicable monthly demand charge is the highest value incurred during the preceding year.

4. **Power Factor Penalty or Reactive Power Charge.** A penalty is frequently levied if power factor falls below an established value (typically 90 or 95 percent). A low power factor indicates that a facility is consuming a proportionally larger share of reactive power. While reactive power (VAR) does not produce work and is stored and discharged in the inductive and capacitive elements of the circuit, distribution system or I^2R losses occur. The utility requires compensation for these losses.

Table 10
Utility Rate Schedule Showing Seasonal Pricing and Declining Block Rates

Monthly Rate:

Basic Charge:	$4.55 for single-phase or $19.00 for three-phase service.
Demand Charge:	No charge for the first 50 kW of billing demand. $5.35 per kW for all over 50 kW of billing demand.

Energy Charge:

October - March	April - September
5.2156	4.9672 cents per kWh for the first 20,000 kWh
4.1820	3.9829 cents per kWh for the next 155,000 kWh
2.9695	2.8281 cents per kWh for all over 175,000 kWh

Determining Load Factor

Secondly, determine the load factor or average percentage of full-rated output for your motor. To calculate the load factor, compare the power draw (obtained through watt meter or voltage, amperage, and power factor measurements) with the nameplate rating of the motor. For a three-phase system, wattage draw equals the product of power factor and volts times amps times 1.732.

Determining Operating Hours

Lastly, determine the number of motor operating hours at rated load. Electrical energy savings are directly proportional to the number of hours a motor is in use. All things being equal, a high-efficiency motor operated 8,000 hours per year will conserve four times the quantity of energy of an equivalent motor that is used 2,000 hours per year.

Determining Annual Energy Savings

Before you can determine the annual dollar savings, you need to estimate the annual energy savings.

Energy-efficient motors require fewer input kilowatts to provide the same output as a standard-efficiency motor. The difference in efficiency between the high-efficiency motor and a comparable standard motor determines the demand or kilowatt savings. For two similar motors operating at the same load, but having different efficiencies, the following equation is used to calculate the kW reduction.[2,10]

Equation 1

$$kW_{saved} = hp \times L \times 0.746 \times \left(\frac{100}{E_{std}} - \frac{100}{E_{HE}}\right)$$

where:

- hp = *Motor nameplate rating*
- L = *Load factor or percentage of full operating load*
- E_{std} = *Standard motor efficiency under actual load conditions*
- E_{HE} = *Energy-efficient motor efficiency under actual load conditions*

The kW savings are the demand savings. The annual energy savings are calculated as follows:[2]

Equation 2

$$kWh_{savings} = kW_{saved} \times \text{Annual Operating Hours}$$

You can now use the demand savings and annual energy savings with utility rate schedule information to estimate your annual reduction in operating costs. Be sure to apply the appropriate seasonal and declining block energy charges.

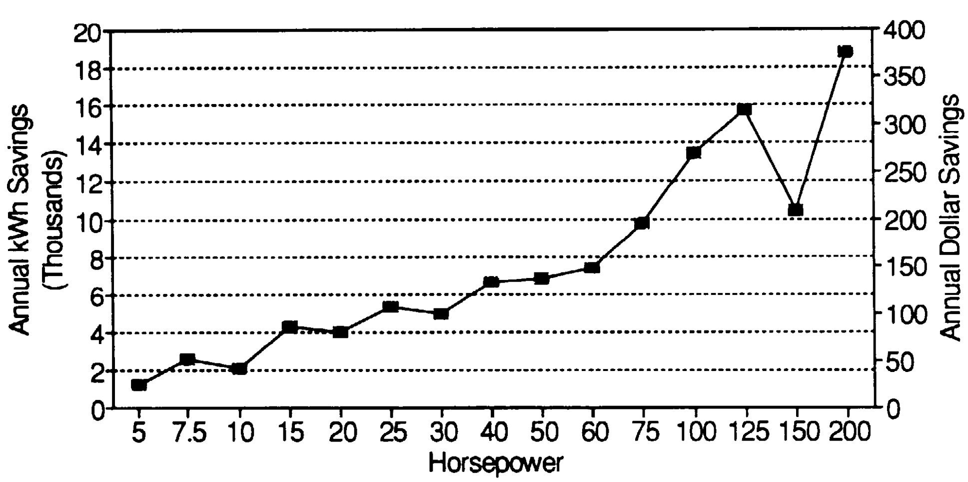
The total annual cost savings is equal to:

Equation 3

$$\text{Total savings} = (kW_{saved} \times 12 \times \text{monthly demand charge}) + (kWh_{savings} \times \text{energy charge})$$

The above equations apply to motors operating at a specified constant load. For varying loads, you can apply the energy savings equation to each portion of the cycle where the load is relatively constant for an appreciable period of time. The total energy savings is then the sum of the savings for each load period. Determine the demand savings at the peak load point. The equations are not applicable to motors operating with pulsating loads or for loads that cycle at rapidly repeating intervals!'

Figure 5
Annual Energy Savings Versus Motor Size
for TEFC, 1800 RPM, 8000 Hrs Annual Use



Savings also depend on motor size and the gain in efficiency between a new high-efficiency motor and a new or existing standard efficiency unit. Energy-efficient motor savings, based upon an average energy charge of $0.04/kWh, are shown in Figure 5. The performance gain for the energy-efficient motor is based on the difference between the average nominal full-load efficiencies for all energy-efficient motors on the market as compared to the average efficiency for all standard-efficiency units.

Motor Purchase Prices

Motor dealers rarely sell motors at the manufacturer's full list price. Even a customer walking in "off the street" would be offered a list price discount. Motor prices continuously vary, and rather than reprint catalogs and brochures, manufacturers advertise high list prices and authorize their dealers to provide discounts. Several major manufacturers tend to use the same list prices, given in Table 3, for both their lines of standard and energy-efficient motors. Each motor manufacturer, however, has a unique discounting policy, which typically varies with respect to dealer sales volume.

The discounting practice of one motor manufacturer is given in Table 11. The dealer's wholesale price is the list price times the appropriate multiplier for the dealer's sales volume. The dealer makes it's profit through "marking up" the manufacturer's discounted list price. Typical dealer markups range from 10 to 25 percent and depend on dealership practices and the size of the purchase order or number of motors a customer buys. There is no difference in the discount for energy-efficient and standard motors. Thus, you can buy a standard or energy-efficient motor for 55 to 85 percent of the manufacturers stated list price. Be sure to get quotes from vendors and use discounted motor prices or price premiums when determining the cost effectiveness of energy-efficient motor investments.

Table 11
Typical Motor Wholesale Pricing Practices

Annual Dealer Sales Volume	List Price Multiplier (%)
0 - $35,000/year	70
$35,001-100,000/year	57
$100,000/year or more	50

Assessing Economic Feasibility

Because of better design and use of higher quality materials, energy-efficient motors cost 15 to 30 percent more than their standard efficiency counterparts. In many cases, however, this price premium is quickly recovered through energy cost savings. To determine the economic feasibility of installing energy-efficient motors, assess the total annual energy savings in relation to the price premium.

Common methods of assessing the economic feasibility of investment alternatives include:

- Simple payback
- Life cycle costing methodologies
  - Net Present Value (NPV)
  - Benefit to Cost Ratio
  - Internal Rate of Return (ROR)

Most industrial plant managers require that investments be recovered through energy savings within 1 to 3 years based on a simple payback analysis. The simple payback is defined as the period of time required for the savings from an investment to equal the initial or incremental cost of the investment. For initial motor purchases or the replacement of burned-out and unrewindable motors, the simple payback period for the extra investment associated with an energy-efficient motor purchase is the ratio of the price premium less any available utility rebate, to the value of the total annual electrical savings.

Equation 4

$$\text{Simple payback years} = \frac{\text{Price premium - utility rebate}}{\text{Total annual cost savings}}$$

For replacements of operational motors, the simple payback is the ratio of the full cost of purchasing and installing a new energy-efficient motor relative to the total annual electrical savings.

Equation 5

$$\text{Simple payback years} = \frac{\text{New motor cost + installation charge - utility rebate}}{\text{Total annual cost savings}}$$

Example:
The following analysis for a 75 hp TEFC motor operating at 75 percent of full rated load illustrates how to determine the cost effectiveness of obtaining an energy-efficient versus a standard-efficiency motor for the initial purchase case.

Kilowatts saved:

$$kW_{saved} = hp \times Load \times 0.746 \times \left(\frac{100}{E_{std}} - \frac{100}{E_{HE}}\right)$$

$$= 75 \times .75 \times 0.746 \times \left(\frac{100}{91.6} - \frac{100}{94.1}\right)$$

$$= 1.21$$

Where E_{std} and E_{HE} are the efficiencies of the standard motor and the alternative energy-efficient unit.

This is the amount of energy conserved by the energy-efficient motor during each hour of use. Annual energy savings are obtained by multiplying by the number of operating hours at the indicated load.

Energy saved:

$$kWh_{savings} = \text{Hours of operation} \times kW_{saved}$$

$$= 8{,}000 \text{ hours} \times 1.21$$

$$= 9{,}680 \text{ kWh/year}$$

Annual cost savings:

Total cost savings =

$$(kW_{saved} \times 12 \times \text{Monthly demand charge}) + (kWh_{savings} \times \text{Energy charge})$$

$$= 1.21 \times 12 \times \$5.35/kw + 9{,}680 \times \$0.03/kWh$$

$$= \$368$$

In this example, installing an energy-efficient motor reduces your utility billing by $368 per year. The simple payback for the incremental cost associated with a energy-efficient motor purchase is the ratio of the discounted list price premium (from Table 3) or incremental cost to the total annual cost savings. A list price discount of 75 percent is used in this analysis.

Cost Effectiveness

$$\text{Simple pay back} = \frac{\text{List Price premium} \times \text{Discount factor}}{\text{Total annual cost savings}}$$

$$= \frac{\$747 \times 0.75}{\$368} = 1.5 \text{ years}$$

Thus, the additional investment required to buy this energy-efficient motor would be recovered within 1.5 years. Energy-efficient motors can rapidly "pay for themselves" through reduced energy consumption. After this initial payback period, the annual savings will continue to be reflected in lower operating costs and will add to your firm's profits.[2]

Recommendations for Motor Purchasers

As a motor purchaser you should be familiar with and use consistent sets of nomenclature. You should also refer to standard testing procedures. Be sure to:[10]

- Insist that all guaranteed quotations are made on the same basis (i.e., nominal or guaranteed minimum efficiency).
- Prepare specifications that identify the test standard to be used to determine motor performance.
- Recognize the variance in manufacturing and testing accuracy and establish a tolerance range for acceptable performance.
- Comparison shop.
- Obtain an energy-efficient motor with a nominal efficiency within 1.5 percent of the maximum value available within an enclosure, speed, and size class.

Energy consumption and dollar savings estimates should be based upon a comparison of nominal efficiencies as determined by IEEE 112 - Method B for motors operating under appropriate loading conditions. Note that the NEMA marking standard only refers to efficiency values stamped on the motor nameplate. In contrast, manufacturers' catalogues contain values derived from dynamometer test data. When available, use catalog information to determine annual energy and dollar savings.

Making the Right Choice

Comparison shop when purchasing a motor, just as you would when buying other goods and services. Other things being equal, seek to maximize efficiency while minimizing the purchase price. Frequently, substantial efficiency gains can be obtained without paying a higher price. Figure 6 illustrates the list price versus full-load efficiency for currently marketed 10 hp/ 1800 RPM standard and energy-efficient motors. It is readily

Figure 6
List Price versus Efficiency for Standard and Energy-Efficient Motors
10 HP, 1800 RPM, TEFC

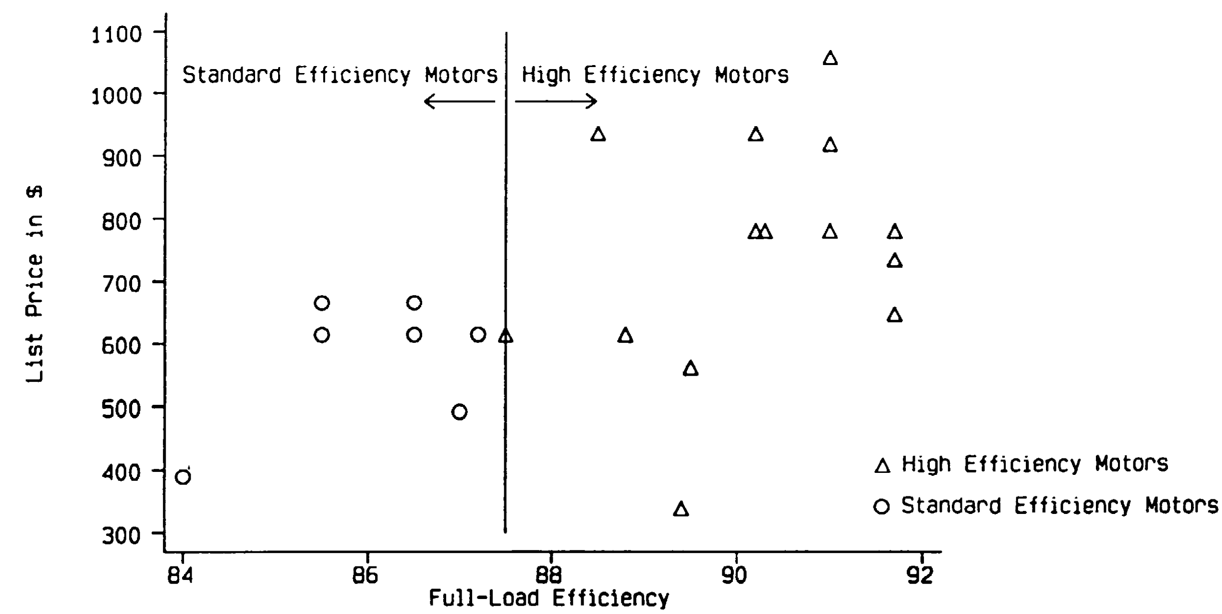


Figure 7
Value of 1 Percent Efficiency Gain by Motor Size
3/4 Load, 8,000 Hours, $0.04/kWh

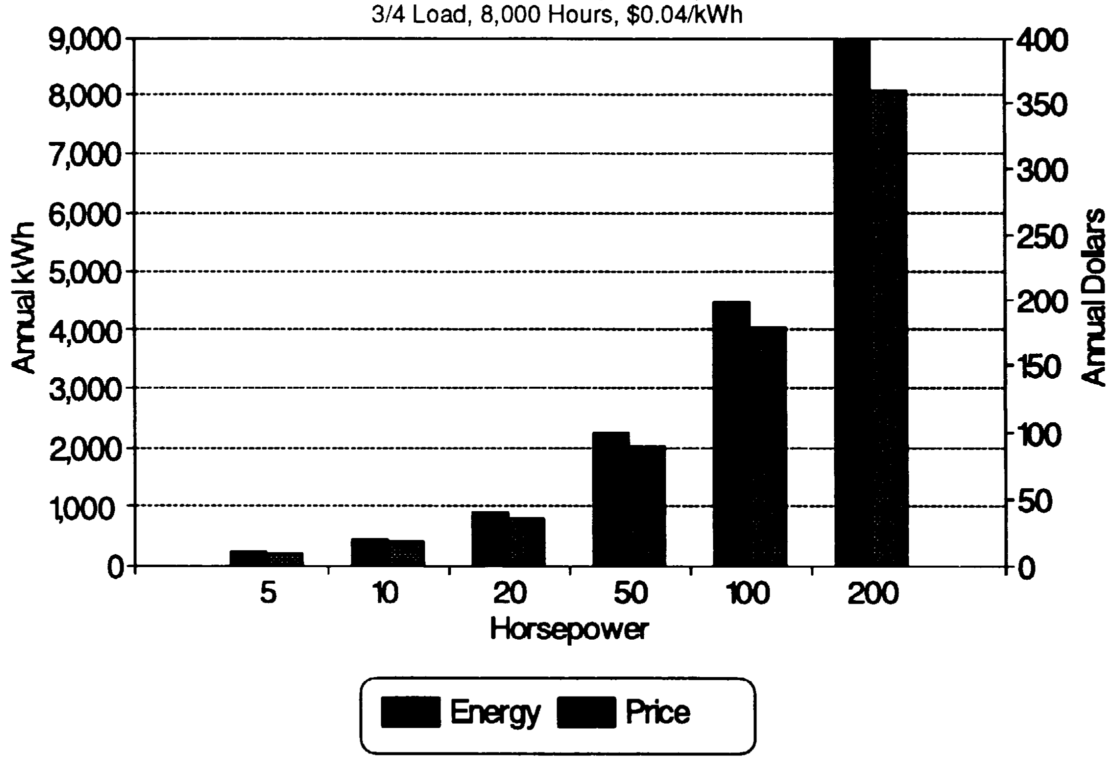
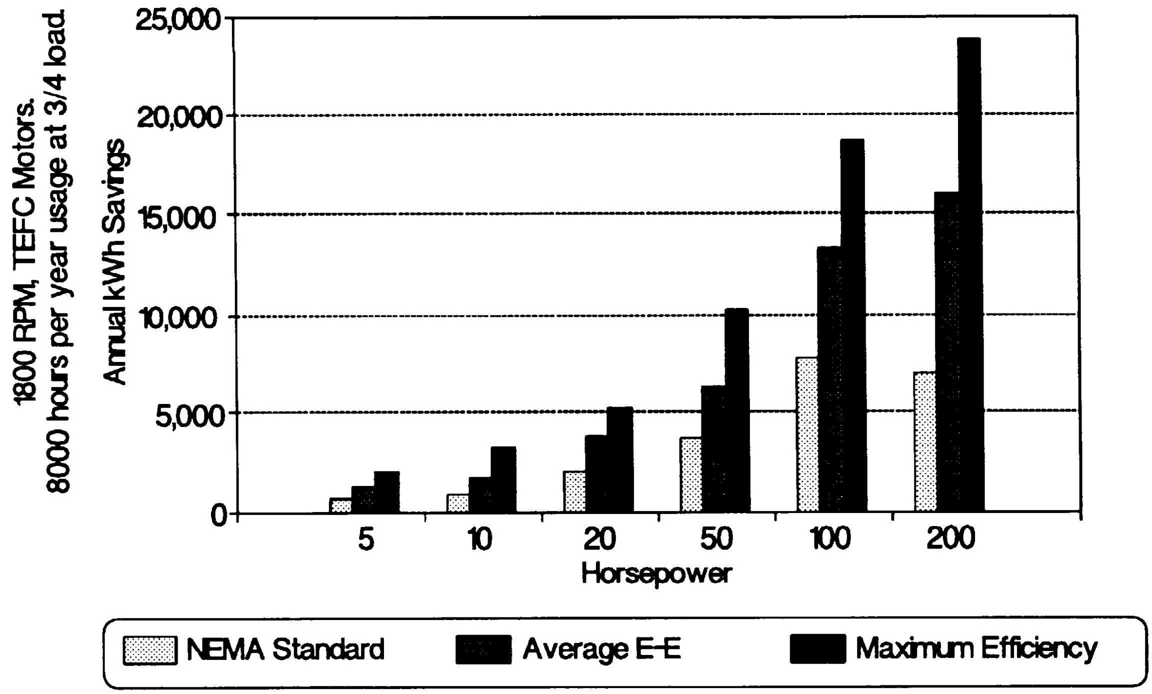


Figure 8
Energy Savings by Using Energy-Efficient Over Standard Motors



Note: Figure 8 illustrates the annual energy savings available through selection of an energy-efficient TEFC motor that just satisfies the NEMA minimum energy-efficient motor standards; for a motor that exhibits average high-efficiency performance; and for a motor with superior performance for a given speed, enclosure, and size class. The base case is the purchase of a "typical" standard-efficiency motor. Base case and average energy-efficient motor efficiencies are taken from Table 3.

apparent that you can obtain an efficiency improvement of as much as 6 points without paying any price penalty.

With the right information, you can quickly identify a motor that produces substantial energy and cost savings for little or no extra investment. The value of a 1-point efficiency improvement is shown with respect to motor horsepower in Figure 7. At an electricity price of $.04/kWh, a single point of efficiency gain for a 50 hp motor can result in an annual savings of approximately 2,600 kWh, worth $104.

Because so many motors exceed the minimum NEMA energy-efficiency standards, it is not enough to simply specify a "high-efficiency" motor. Be certain to purchase a true "premium-efficiency" motor, an energy-efficient motor with the highest available efficiency characteristics.

The value associated with "making the right choice" is graphically characterized by the minimum/maximum savings analysis illustrated in Figure 8. You can often **triple** the available savings by choosing a motor with the top performance in its class instead of a motor that barely satisfies NEMA minimum energy-efficiency standards.