Drivepower Dollars and Sense

Which of these categories consumes the most primary energy in the United States?

- A • Vehicular drive systems (cars, trucks, and trains).
- B • Electrical motors (such as induction, synchronous, and dc motors).
- C • Electrical lighting systems (such as incandescent or fluorescent lights).
- D • The Space shuttle.

The answer is **B • Electrical motors**. Over half of the electricity produced in the United States in 1986 (2574 billion kW-Hr). More than forty per-cent of this energy could be saved by complete applications of cost-effective drive system efficiency improvements. On a national scale this would:

- Save 25 to 50 billion dollars per year.
- Save 100 to 300 billion dollars due to delayed construction of new power plants.

What does this mean to you?

An industrial motor running for more than 4000 hours per year typically uses ten times its capital cost in electrical energy. This is equivalent to a \$100,000 house using \$1,000,000 in utilities. At such a rate of consumption, each small improvement in efficiency is important. If suggested improvements, such as those in **Energy Efficient Drivepower - An Overview**, were implemented, the total cost savings could be substantial. At an average Cost of Energy Saved of 0.5 cents per kilowatt-hour (kW-h), fifteen year lifetime, five per-cent annual real discount rate, and an electrical energy cost of 5 cents per kW-h, you could be paying 4.5 cents for every kilowatt-hour saved over the fifteen year period. If you had used 1,000,000 kilowatt-hours of electrical energy in 1986 (equivalent to running five 25-HP motors continuously for a year), your potential savings could have been:

Savings at least $28\% \times 1,000,000 \text{ kW-h} \times 0.045 \text{ ¢/kW-h}$,
but less than $60\% \times 1,000,000 \text{ kW-h} \times 0.045 \text{ ¢/kW-h}$,

or between \$ 12,600 and \$ 27,000.

Over the 15 year period, this would mean \$189,000 to \$405,000 saved. This does not include reductions in your electric utility bill due to lower electrical demand and better power factor.

Where are the energy saving opportunities in your facility?

There are many areas where energy could be and probably is being used inefficiently in your facility. But to capture the full savings, one needs a systems approach - a focus on the entire system. A drivepower system is made of all of the components from the electrical supply to the driven load. This includes components such as the wire, electronic drive and control packages, motors, shaft couplers, belts, chains, gear drives, and bearings. Power quality should also be

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POTENTIAL ENERGY SAVINGS

Figure 1
Break Down of Potential Energy Savings in the United States (Billion Kilowatt-Hours).

PERCENTAGE IMPROVEMENT

Figure 2.
Potential Percentage of Improvement in Energy Savings for Drivepower Systems.

examined. An analysis should examine each part of the drivepower system to determine how its efficiency can be improved and how this improvement will affect the rest of the system. The analysis should also include the potential savings in the utility's distribution and generation systems. The results of this analysis are presented in Figures 1 and 2. Figure 1 shows a

breakdown of the areas analyzed where energy could be saved. Upper and lower limits for potential savings are identified for each area. In Figure 2, the potential savings of Figure 1 are grouped and described as a percentage.

How could this energy be saved?

As Figure 2 demonstrates, there is the potential to save electrical energy in five major areas. Some energy saving items cost little or nothing to implement while others require the purchase of a major piece of electronic equipment or the replacement of components in the existing drivepower system. The following is a summary of some of the energy saving methods (percentages are not additive):

1. Proper Motor Application Nationwide, sixteen to twenty-four per-cent of the electrical energy produced for use by motors can be saved through proper motor selection, sizing, and maintenance. This is the result of:

- Selecting energy efficient motors.
- Matching a motors torque characteristics to the load.
- Sizing the motor for maximum efficiency.
- Using only high quality lubricants which match the application.
- NOT over- or under-lubricating motors.
- Using only the highest quality rewinding techniques to repair motors.
- Replacing or rewinding all motors with aluminum (rotor) windings.
- Using only high quality materials, such as copper for the windings.

2. Electrical Supply Improvements Poor power quality reduces electric motor efficiency. Power quality improvements could account for electrical energy savings of from four to twenty-one per-cent in the United States. Poor power quality can come from the utility, other consumers supplied by the utility, and poor quality electrical equipment or improper use of electrical equipment within your facility. Power quality can be improved by:

- Upgrading the power delivered by your utility to your facility.
- Purchasing and using better quality electrical equipment within your facility.
- Properly isolating electrical equipment which degrades power quality.
- Supplying nameplate voltages to motors.
- Ensuring correct phase balance.
- Monitoring the electrical supply for power quality problems.
- Reducing or eliminating sources of harmonics.
- Installing electrical equipment properly.

3. Better Motor Controls Improved controls offer the single largest opportunity for savings in drivepower systems. Nationally, an estimated forty-one to forty-five per-cent of the energy lost in a drivepower system is due to nonexistent or improper control of the shaft speed of the load. A typical example is the use of a throttling valve to regulate the flow on a fixed speed pump or fan system. If the throttling value is removed and a variable speed drive is used, a significant improvement in system efficiency is obtained. Motor controls include:

- Variable speed electronic and mechanical drives.
- Fast controllers to turbomachinery.
- Power factor controllers in low-duty-factor applications.
- Controls which shut off motors when not in use.
- Feedback control systems.

Improvements in motor efficiency can also come from:

- Proper selection of gear ratios and sheave sizes for constant speed applications.
- Properly applying and setting feedback control systems.

4. Reduced Drivetrain Losses The drivetrain accounts for eight percent of the losses in a drivepower system. This energy can be saved by:

- Properly aligning belt drives.
- Properly tensioning belts.
- Properly lubricating the chain in chain drives.
- Converting V-belts to synchronous belts.
- Converting roller chains to silent chains.
- Using direct driven loads instead of gear, belt, or chain drives.
- Using high quality bearings in all parts of the drivetrain.
- Applying proper lubricants in appropriate amounts.

5. Indirect Savings Many of the improvements suggested above lead to indirect savings of 12 to 18% of the electrical energy delivered to drivepower systems. For example, if a system is more efficient, less energy is converted to heat. Thus, in an air conditioned environment, less energy is required for cooling. Indirect savings are the result of:

- Reducing the energy required for heating, ventilating, and air conditioning (HVAC) systems.
- Reducing the energy lost in the utilities electrical distribution systems.
- Reducing downtime due to better quality bearings (fewer bearing failures).
- Reducing motor rewinds due to cooler operation of the motor.
- Reducing maintenance due to the proper selection and application of lubricants.

What should I do next?

The references listed in this booklet will provide you with additional reading material to guide you in selecting the areas in your facility with the greatest potential for improvement. If energy consultants are used, thoroughly check into their background. Only use consultants who examine the entire drivepower system, not just the application of adjustable speed drives and energy efficient motors. They should also examine the energy savings potential in your electric lighting systems to minimize your total energy consumption.

For more information, contact:

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