# Ten Tips to Save Energy and Money with Electric Motors

Tips for efficient motor use are:-

**1. Measure**

The phrase, 'If you can't measure it, you can't manage' remains a true statement for electric motors. To make the biggest impact you must have a clear understanding of which motors and processes are consuming the most energy in your plant. This will allow you to target your efforts and gain the quickest Return on Investment.

**2. Understand Energy Use**

Electric motors are energy conversion devices, they convert electrical energy in to rotational energy and some heat.

It is important to understand the difference between motor speed (rotational speed) and motor load (opposing force [torque]). The energy consumption of a motor is related to both speed and load. A slow motor with a full load will consume more energy than a fast motor with no load.

All motor driven loads are a combination of one or more of the following forces, and the type of load will determine the best energy saving strategy to be employed.

| Force | Typical Application | Energy Saving Strategy |
|---|---|---|
| Friction | Sanders, Grinders, Mixing | Reduce Operating Time |
| Gravity | Cranes, Displacement Pumps, Conveyors | Improve System Efficiency |
| Inertia | Flywheels, Rolling Mills, Centrifuges | Intelligent Motor Control |
| Drag | Fans, Centrifugal Pumps | Reduce Speed |

**3. Fixed Speed v Variable Speed**

Consider which applications are already variable speed, those that must remain fixed speed and those where the speed could be reduced.

Be careful though, reducing speed on some applications will not reduce energy consumption. For example, halving the speed of a conveyor system will just mean the conveyor will take twice as long to move the same amount of material.

Also, many applications such as grinders, mixers, rolling mills etc only work correctly at full motor speed. Running these at a reduce speed may damage the equipment or affect the finished product.

**4. Turn it Off**

It sounds simple, but the most effective way to save energy is to switch the motor off when it's not needed. Often the reason for not doing this is the perceived risk of additional wear and tear at motor start up. This is especially true for motors started Direct On Line or with Star Delta starters.

Using a Soft Starter will reduce the wear and tear at every start, and a correctly specified and installed soft start will reduce the strain on mechanical and electrical systems by as much as 70%.

**5. Efficient System Design**

There is little point installing the latest high efficiency motors and equipment, if the entire system is fundamentally inefficient.

Study how the system works and identify when and where the motor is doing work unnecessarily. For example, many older pumping systems have been designed to run continuously and use overflow/return pipework. Very often the use of sensors, levels detector, PLC's and Soft Starters can be combined to create a system that starts and stops automatically to meet demand.

In larger pump installations, a cascade system can be created using Soft Starters and a single Variable Speed Drive to create a cost effective system with an infinitely variable output. The aim is to create a system where the motor only operates when it is required, and if the motor needs to start/stop many times an hour, a Soft Starter can be used to reduce wear.

**6. Slow Down**

In the simplest terms, at the same load, a slow motor does less work than a fast motor. So you can only save energy in applications where you need less work done.

Variable Speed Drives save energy by allowing the motor to do less work. They are very effective in reducing speed and saving energy in applications where the main opposing force is drag, so this is especially true in HVAC, fan and centrifugal pump applications. Due to the physics of drag, a small reduction in motor speed will result in a larger reduction in the work done and the energy consumed. However, reducing motor speed in applications where the main opposing force is gravity or inertia will not save any energy. Also, be aware that Variable Speed Drives waste between 3-5% of energy, so ensure the potential savings are greater than the potential losses.

**7. Use Energy Saving Motor Controls**

All motors, even IE3/NEMA Premium Efficiency Motors are most efficient at near full load, as motor load fall below 50%, efficiency begins to reduce. This effect exists because the motor will always use a certain amount of energy to create the magnetic fields needed to rotate the motor irrespective of load.

In applications where the motor load is variable or the motor runs at light loads for long periods, Intelligent Energy Saving Motor Controllers should be used.

In these applications Energy Saving Motor Controllers constantly match the amount of energy supplied to the motor to the load. The motor still always runs at full speed, but during the lightly load periods, energy savings of 20% or more can be achieved.

Energy Saving Motor Controllers can be used in any application, but best results are seen with intermittent loads such as hydraulic power packs, pump jacks and inertial loads such as rolling mills.

**8. Size Motors Correctly**

At full load all motors, even old motors, are surprisingly efficient. But as the load reduces, motor efficiency quickly falls away – even on the latest high efficiency motors. Therefore a high efficiency motor is only truly efficient when it is being used near full load conditions.

It is good engineering practice to slightly oversize a motor for a particular application, this will extend motor life and provide some extra capacity when it is required, and if a motor is oversized larger than required the motor should be re-examined.

Rather than replacing expensive motors, Energy Saving Motor Controllers are very effective in saving energy in oversized motors.

**9. Use High Efficiency Motors**

The latest IE3/NEMA Premium Efficiency motors are more efficient, but the efficiency gains are marginal. Only in a very few cases where the motor is very old and running 24/7, will it make financial sense to replace a perfectly functioning motor with a new motor.

However upgrading the motor as it reaches the end of its service life, or when the motor fails, should be considered as best practice. Motor rewinds should only be considered when the motor cannot be replaced due to specific technical reasons or lack of availability of suitable replacements.

Also, be aware that the design and higher copper content of IE3/NEMA Premium Efficiency motors means that the inrush currents and peak torque on start can be considerably higher. In some cases it may be necessary to upgrade the motor starting control gear. In these cases consider installing a Soft Start to limit the inrush current and also to extend the life of the motor.

**10. Reduce Wear & Tear**

After energy costs, down time is the next single biggest cost to any plant operator.

A large amount of wear occurs when an electric motor is started; the high initial currents and forces put great strain on the mechanical and electrical systems. To reduce the damaging effects, Soft Starters should be used in all fixed speed applications and this then will extend motor life.

Soft starting can also be achieved by using Variable Speed Drives, but this is less efficient and far more costly.

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