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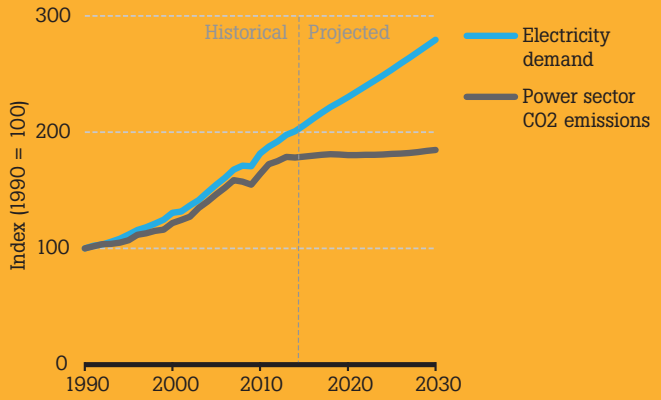
Energy efficiency and electrical motors

Reduce operational cost while cutting emissions



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THE ENERGY CHALLENGE

The energy we use comes at a price. A price which is not only paid in hard currency, but also in environmental costs.

Greenhouse gases are a major contributor to climate change, and energy production accounts for two-thirds of global greenhouse-gas emissions.*

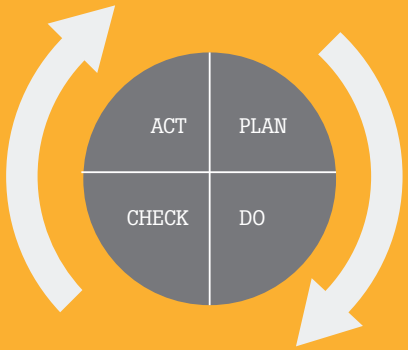
Electricity demand is expected to increase by more than 40 % in 2030.* Although emissions are expected to remain flat*, this is way too high to fulfil the climate pledges made by over 150 countries at the COP21 conference held in Paris 2015.

Because new technologies emerge slowly, experts claim that the agreed greenhouse-gas emissions for this century will already be reached soon after 2030.

The International Energy Agency (IEA) has formulated a “Bridge Strategy” to avoid this early peak in GHG emissions.

A major part of this strategy is improving the energy efficiency in industry.

* Source: IEA, 2015



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ENERGY EFFICIENCY AND ISO 50001

To improve energy efficiency in industry, the International Organization for Standardization has developed the voluntary ISO 50001 energy management standard. This is similar to the ISO 9001 quality management standard.

It is based on the proven PLAN–DO–CHECK–ACT cycle to improve industrial energy efficiency in a structural way.

ISO 50001 energy management in a nutshell:

Plan: Conduct energy reviews, establish baselines and energy performance indicators, set objectives and targets, make action plans.

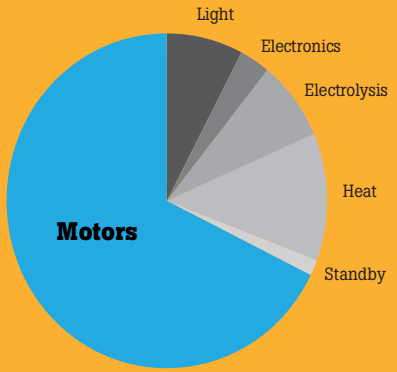
Do: Implement energy management plans.

Check: Monitor and measure processes against energy policy and objectives. Report results.

Act: Take actions to continually improve energy performance.

Benefits: Save money on energy.

Avoid large carbon emission penalties.
Keep climate change under control.



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ELECTRIC MOTORS

Electricity is a major industrial energy source, and electric motors consume two thirds of it worldwide*. Electric motors are therefore high on the list of energy saving opportunities.

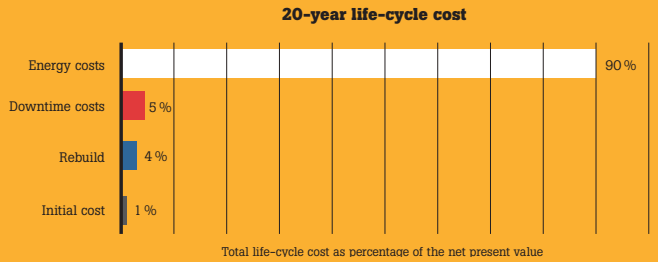
Old, inefficient motor systems may be around for many years. New systems, though efficient on paper, may not be running under optimal conditions and waste energy.

Systematically and regularly checking the efficiency of your electric motors can give the baselines and energy performance indicators required by ISO 50001. You can also save energy, and reduce expensive maintenance and repair costs. And you minimize process interruptions.

Three major factors influencing motor efficiency are:

- MOTOR EFFICIENCY CLASS
- MOTOR LOADING
- MOTOR DERATING

* Source: IEA, 2009



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MOTOR EFFICIENCY CLASS

Most electric motors have an efficiency number on their nameplate. This number shows how well the motor should convert electrical into mechanical energy.

Motors come in different efficiency classes depending on their construction. The higher the class, the better the efficiency, and the less energy needed for the job

Different regions have different names for these efficiency classes. Two widely used classification systems are:

IEC: IE1/IE2/IE3/IE4
NEMA: Standard/High/Premium/Super Premium

Replacing a lower class motor with a higher efficiency class type requires an investment. But as initial capital costs are only about 1 % of total costs over a 20 year motor lifespan (energy amounts to 90 %)*, it pays to invest in energy efficient motors.

* Source: Toshiba

MOTOR LOADING

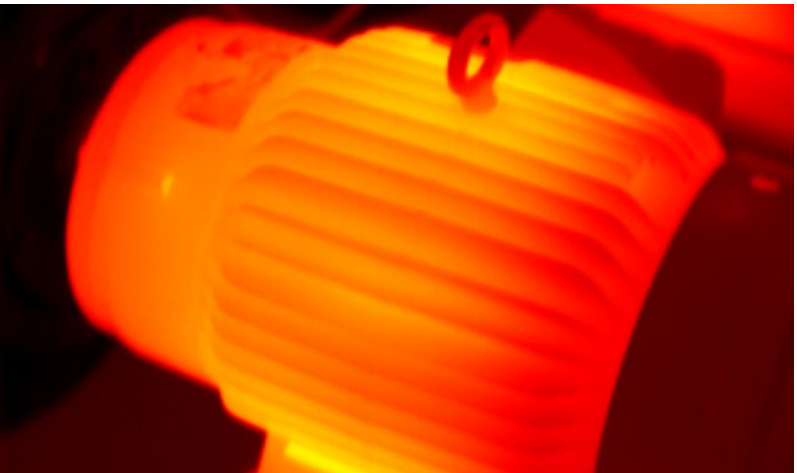
Motor loading means how well the specified motor capacity and the mechanical load are matched.

There are three basic load situations:

OVERLOAD
The motor is too small for the task at hand. The motor overheats, will have a reduced lifespan, and may fail regularly. It will lose energy in the form of heat resulting in low energy efficiency.

UNDERLOAD
The motor is too big for the task at hand. It will run at a fraction of its specified power and draw excessive and ineffective electrical current. As this current does not supply useful energy, efficiency is low. Utilities may demand penalties for this excessive and ineffective current.

NOMINAL LOAD
The motor capacity and the mechanical load are well matched. The motor runs at its nominal specified power, using the energy to do the job as efficiently as possible. This is the preferred load situation.



MOTOR DERATING

Motor derating means the motor has to be used at below its specified power due to poor quality of the electrical supply. Derating lowers the energy efficiency of the motor. Ignoring the derating can cause early failures and reduced lifetimes.

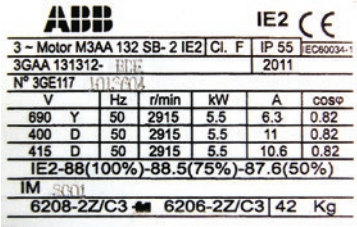
There are four major reasons for derating:

VOLTAGE UNBALANCE
The three phases of the voltage supply do not have equal values. This causes mechanical strain and loss of efficiency in the motor

VOLTAGE HARMONICS
Other frequencies besides the fundamental 50/60Hz are present in the voltage supply. This causes reverse torques and heat losses in the motor, which lowers motor efficiency.

OVER / UNDER VOLTAGE
The voltage supply is either too high or too low compared to the specified motor voltage. Both situations lower the motor efficiency.

HIGH TEMPERATURE
High motor temperature has a negative effect on motor performance.



CHECKING MOTOR EFFICIENCY

Checking motor efficiency needs a two-step approach: first look at the motor nameplate and then use a practical motor efficiency measurement tool.

MOTOR NAMEPLATE
The motor nameplate may reveal the motor efficiency class and the specified efficiency.

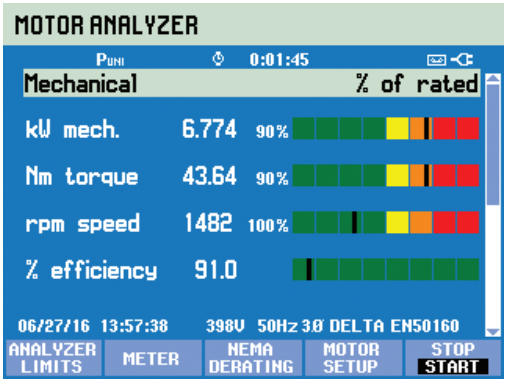
This data is determined under laboratory conditions, but the actual motor efficiency may be hugely different in real operational conditions.

MOTOR EFFICIENCY TOOL
A motor efficiency tool measures the actual efficiency with which the motor turns electrical into mechanical energy.

The tool also measures the factors which influence efficiency. This enables corrective actions if the efficiency is below the targets set according to ISO 50001.

A practical tool only needs electrical connections to the motor and can be used without interrupting the running motor process.

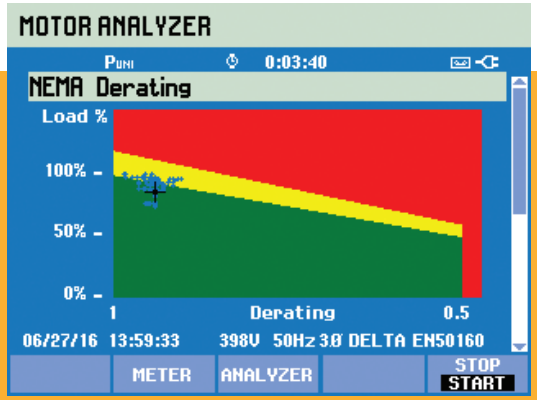
The Fluke 438-II Motor Analyzer fulfils these requirements and offers many additional functions for motor efficiency analysis.



MOTOR EFFICIENCY SCREEN

The left page shows the motor efficiency screen of the Fluke 438-II Motor Analyzer function.

The actual motor efficiency can be read directly and is recorded over time.



MOTOR DERATING SCREEN

The actual motor load and derating according to NEMA MG1-2014 can be read from the derating screen.

The derating screen shows if the motor is being used efficiently and within its operational limits to maximize motor lifetimes.

ENERGY EFFICIENCY SUMMARY

Industrial energy efficiency must be improved to avoid reaching agreed greenhouse-gas emission limits too soon.

ISO50001 provides a management system for structural energy savings in industry.

Electrical energy is a major industrial energy source. Electric motors consume two thirds of this source.

Electric motors are often less efficient than their specifications suggest.

By checking motor efficiency and optimizing operational conditions, significant energy savings can be realized with limited investment.

Saving money on energy bills and carbon penalties and also helps to keep climate change under control.

IT PAYS TO BE ENERGY EFFICIENT

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Found this interesting?
Ask your Fluke representative for a demo.

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Fluke Corporation
P.O. Box 9090
Everett, WA USA 98206
Web: www.fluke.com

Fluke Europe B.V.
P.O. Box 1186
5602 BD Eindhoven
The Netherlands
Web: www.fluke.com

For more information call:
In the U.S.A. (800) 443-5853
or Fax (425) 446-5116
In Europe/M-East/Africa +31 (0)40 2 675 200
or Fax +31 (0)40 2 675 222
In Canada (905) 890-7600
or Fax (905) 890-6866
From other countries +1 (425) 446-5500
or Fax +1 (425) 446-5116

Fluke (UK) Ltd.
52 Hurricane Way
Norwich
Norfolk
NR6 6 JB
United Kingdom

Tel.: +44 (0)20 7942 0700
Fax: +44 (0)20 7942 0701
E-mail: industrial@uk.fluke.nl
Web: www.fluke.com

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