



3. Motor Systems Energy Assessment

**Hugh Falkner,
Anibal T. De Almeida**

Contents

- Why Motor Systems Energy Assessments?
- Plant level energy use
- Start of the **energy assessment** (audit)
- Looking for ... Motor Upgrades
- Looking for ... Switching off opportunities
- Looking for ... VSD opportunities
- Detailed System Optimisation **energy assessment** (audit)
– the bigger picture

Why Motor Systems Energy Assessments?

- If you have large pump, fan or compressed air systems where there may be energy savings, then consider a specialist Opportunities Assessment. (Consider the UNIDO specialist opportunities assessment).
- But if there are not the skills available, then just identifying what savings you can, and suggesting a Specialist audit where useful, is just fine.
- And because it needs less instrumentation, its quicker.
- *If your Motor Systems Energy Assessment is successful, then you may win budget for these later more detailed opportunity assessments.*

Motor System Energy Assessments in perspective

- How much time would you be prepared to spend chasing a kWh?
- If you only have 2-3 days on site, where will you focus your efforts?
- Look for the biggest and easiest opportunities –Fan SO and Pump SO comes later. This first assessment should give the financial justification to do a more detailed opportunities assessment where useful.
- ISO50001 talks about “Significant Energy Using Equipment.”
- We are not searching for perfection, rather some easy savings. This may mean that some or possibly the biggest opportunities are missed. But at least we have something.

Why Motor System Energy Assessments are Important

- ◆ 70% of industrial electric load is produced by motor systems
- ◆ Opportunities to reduce energy use include:
 - ◆ Old control technologies (throttles, dampers, ...)
 - ◆ Changing operating conditions
 - ◆ Varying production needs
- ◆ Although system efficiency can be 70% or higher, it often falls below 50% and as low as 15%-20%

Ask the big questions

- What is the system trying to achieve?
- What are the settings – who says?
- Is it the best way of doing it?

What are you aiming to achieve?

- Motor upgrades?
 - Switch off options?
 - VSD opportunities?
 - System optimisation?
-
- Identify systems that could do with more in depth investigation – FSO or PSO

Where to look first

- Big equipment
- Older equipment
- Long down times
- Varying loads
- Support equipment
- Problem equipment

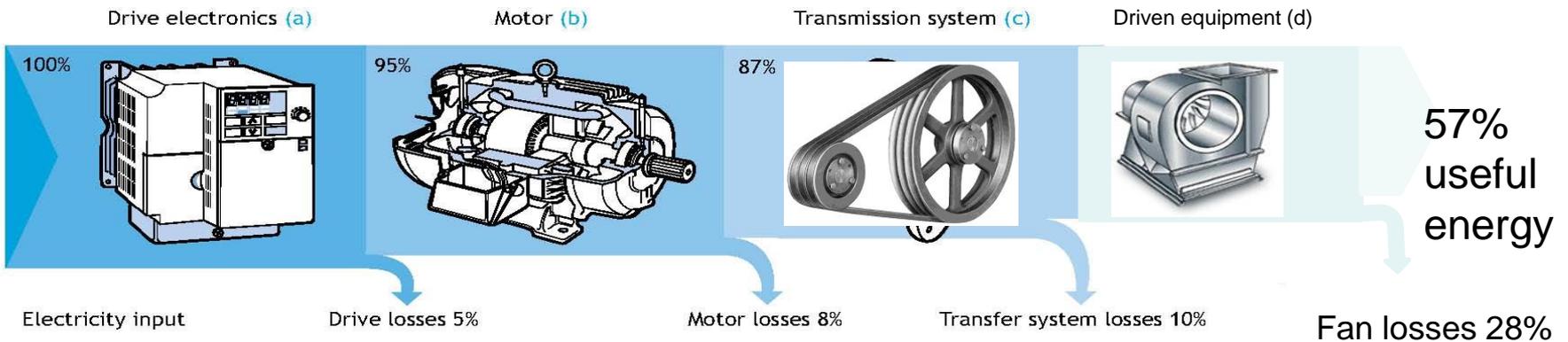
Where not to look

Every plant is different, but you will probably find that these are not very lucrative areas for saving:

- *Process equipment (Value of throughput too high and plant already fine tuned for the process)*
- *Critical processes (Risk of unexpected problems unacceptable)*
- *Small equipment (Energy use too small to justify detailed investigation or implementation)*
- *Equipment scheduled for replacement (Financial payback unattractive)*

Start at the load and work backwards – don't optimise a poor system

Example: Power chain for a fan unit



Energy losses occur at each stage



Which equipment to target?

Work with facility to identify key motor systems that will be reviewed

What's the energy cost?

Obtain energy use and cost data to determine unit costs

Pick the Top 20 Motor Systems

- Ideally end up with a list of 10-20 motor systems to look at.
- Allow 30-60 mins per system.

How Detailed should your recommendations be?

- Your main objective is to identify and give an outline financial justification for energy saving opportunities.
- Distinguish those jobs that can be designed and implemented in house, and those that require outside assistance.
- The Motor Systems Energy Assessment sets the scene for a more detailed technical design and investment programme.

Pre-assessment checks

- Check all pre-visit information
- Check everyone still available
- Check attitudes – *does everyone want you there, who is showing you around?*
- Check motivations – *what are their problems, what is going to make them invest?*

List priority equipment

- Its only loose, but it is a talking point, and will enable you to plan your time.
- Allow for time in walking around the site.
- Check accessibility – safety, keys

Existing data

- Plant data – allow for wear, undocumented changes, actual operating conditions
- Instruments – are they believable?
- Energy use - what exactly is it measuring?
- Maintenance history / shedule

- Can waste a lot of time, but may just contain a gem. Trying to answer the above questions can yield a lot of information!

First – Listen!

Listen to:

- Maintenance staff
- Plant operators
- Production manager
- Quality control

Key Opportunities

- Motor upgrade
- Proper sizing
- Switch off
- Transmissions
- Variable Speed Drives (VSDs)

Looking for.....

- Motor Upgrade Opportunities – or are we?
- Is it worth your time assessing each motor individually?
- Would a Motor Management Policy be more cost appropriate?
- Switching it off opportunities

Switch Off – Running when not needed

- Tea breaks
- Out of hours
- Review switch on/off times
- Timeswitches / BMS controls
- Tool changes
- Between batches

How to switch off

- Education
- Timers
- Thermostats
- Interlocks
- Load sensors

Frequency of Switching

- Strict limits – worse for large motors and large inertia loads
- Chiefly thermal considerations
- Motor manufactures provide a table with the maximum number of starts per hour, as a function of the motor power and load inertia.

Variable Speed Drives Opportunities

- This is the big opportunity if the load speed requirements change time.
- You need to understand the speed/ torque load requirements variation in time in order to identify the need for a VSD.

Case study : Savings opportunities with VSD

Existing pumping system:

Motor runs at 2900rpm

Electrical power absorbed: 22kW

Pressure: 4 bar

Opportunity to reduce flow rate by 15%

- New speed (rpm): $2900 \times 0.85 = 2465$ rpm
- New pressure (bar): $4 \times (0.85)^2 = 4 \times 0.72 = 2.9$ Bar
- New power (kW): $22 \times (0.85)^3 = 22 \times 0.614 = 13.5$ kW

Discount saving by 5% to account for additional losses due to VSD

- Savings potential = $((22\text{kW} - 13.5\text{kW}) \times 95\%) = \mathbf{8.075\text{kW}}$
- Conclude: 15% flow (speed) reduction = 37% power reduction