

Energy Savings by means of Energy Efficient Electric Motors

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1. Introduction

In the future, the cost of energy will increase due to environmental problems and limited resources. The electric motors consume a significant amount of electricity in the industrial and in the tertiary sectors of the European Union. Because of its simplicity and robustness the three-phase squirrel-cage induction motor is the prime mover of the modern industry. The electric-motor manufacturers are seeking methods for improving the motor efficiencies, which resulted in a new generation of electric motors that are known as energy-efficient motors.

Europe has a great dependence on energy; therefore it is an important goal the promotion of energy efficient motors to be applied in the industry.

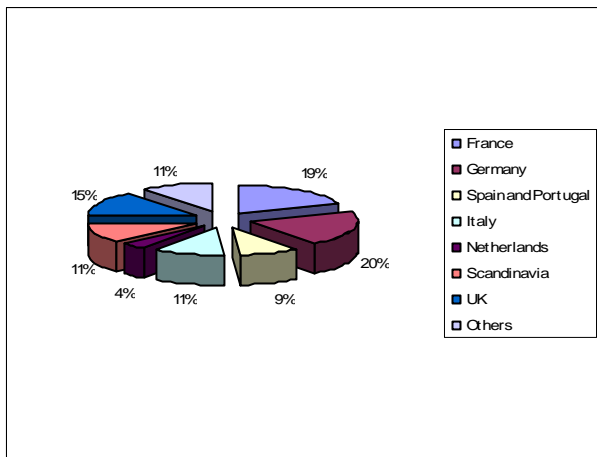


Figure 1.1 – Share of Electricity Consumption in European Union Countries. It is based on 2010 Consumption Forecast [1]

2. Energy Efficient Motor (EEM)

A. Definition

An EEM produces the same shaft output power, but uses less input power than a standard efficiency motor.

Standard motor generally competes on price, not efficiency. On the contrary, EEM competes on efficiency, not price.

There are a lot of terms in order to name this kind of motors, for example “energy efficient”, “efficiency premium” or “energy saving”. In order to clarify this situation, CEMEP (the European Committee of Manufacturers of Electrical Machines and Power Electronics) and the European Commission have devised motor efficiency classification labels – Eff1, Eff2 y Eff3 – to make it much easier for purchasers to identify energy efficient motors on the market.

B. Constructive description

EEM is manufactured using the same frame as a standard motor, but they have some differences:

- Higher quality and thinner steel laminations in the stator.
- More copper in the windings.
- Optimized air gap between the rotor and the stator.
- Reduced fan losses.
- Closer machining tolerances.
- A greater length.
- High quality aluminium used in rotor frame.

C. Advantages when implementing Energy Efficient Motor

- Environmental benefits: reduction CO₂ equivalent emissions.
- Increasing of productivity.
- Less maintenance due to improve motor design.
- They usually have high power factors what means that their total current is lower. This leads to saving in power supply, cables and power factor correction.
- Increased lifetime of their bearings and windings.

D. Economical Evaluation

Generally, energy efficient motors cost an average 15 to 30 percent more than standard motors, but it depends on the specific motor manufacturers and market competition. It is often possible to obtain a lower price premium when purchasing a large quantity of energy efficient motors. The price premium per horsepower is lower for the large motor ratings.

The next figure shows the different prices between an energy efficient motor and a standard motor.

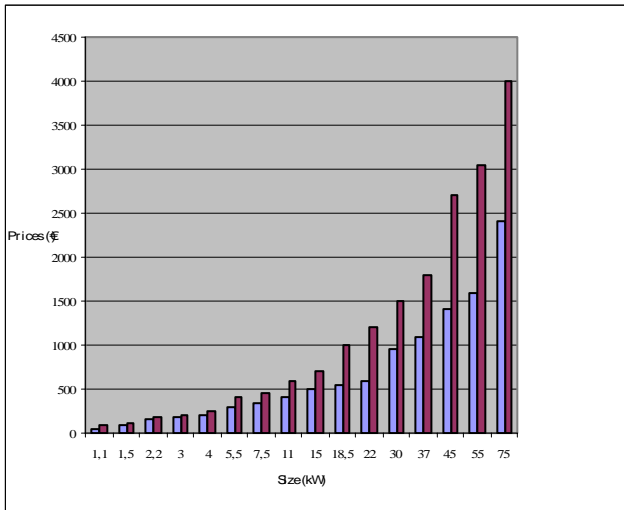


Figure 2.1 – Average sales-weighted prices in the EU [5].

3. Practical Cases

The software EURODEEM International is going to be used in order to develop different practical cases.

A. Case n° 1: A new purchase of energy efficient motor

A new energy efficient motor (Eff1) is going to be bought and it is compared with a motor Eff2. Their size and speed are 55 kW and 1500 rpm, respectively. It assumes a 75% load.

	Eff2	Eff1
Efficiency (%)	93.2	94.6
Differential cost (€)	-	1071
Energy use (kWh/year)	265533	261540
Energy cost (€/year)	13277	13077
Demand charge (€/year)	2655	2615
Energy Savings		
Energy (kWh/year)	-	3993
Demand (kW)	-	0.7
Energy savings (€/year)	-	200
Demand savings (€/year)	-	40
Total saving (€/year)	-	240
Simple payback (years)	-	4,47

B. Case n° 2: Rewinding

A rewind standard motor (Eff3) of size of 75 kW and speed of 3000 rpm is going to be compared by an energy efficient motor of the same size and the same speed. They are operating 75% load.

	Eff3	Eff1
Efficiency (%)	90.4	94.8

Differential cost (€)	-	2103
Energy use (kWh/year)	373423	356148
Energy cost (€/year)	18671	17807
Demand charge (€/year)	3734	3561
Energy Savings		
Energy (kWh/year)	-	17275
Demand (kW)	-	2.9
Energy savings (€/year)	-	864
Demand savings (€/year)	-	173
Total saving (€/year)	-	1036
Simple payback (years)	-	2.02

4. Conclusions

The analysis presented shows that energy efficient motors are an opportunity for improving the efficiency of motor systems, leading to large cost-effective energy savings, improving of the industrial economic efficiency and reducing the environmental impacts.

In spite of their advantages, these motors find barriers in the market that stop their penetration a large scale. These barriers are being overcome thanks to different strategies such as education, training, financial incentives, labelling and others.

With practical cases, it can be noticed that EEM is more efficient than standard motor and rewind motor. Also, energy savings can be achieved and the extra cost of their purchase can be regained in five years or less.

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