Steve Ruddell

General Manager

ABB Drives & Motors

Motor Summit 2007
Zurich Switzerland

Towards more efficient electric motors and systems

The importance of energy efficiency in Industry

Industry globally consumes over 40% of the planet's energy production.

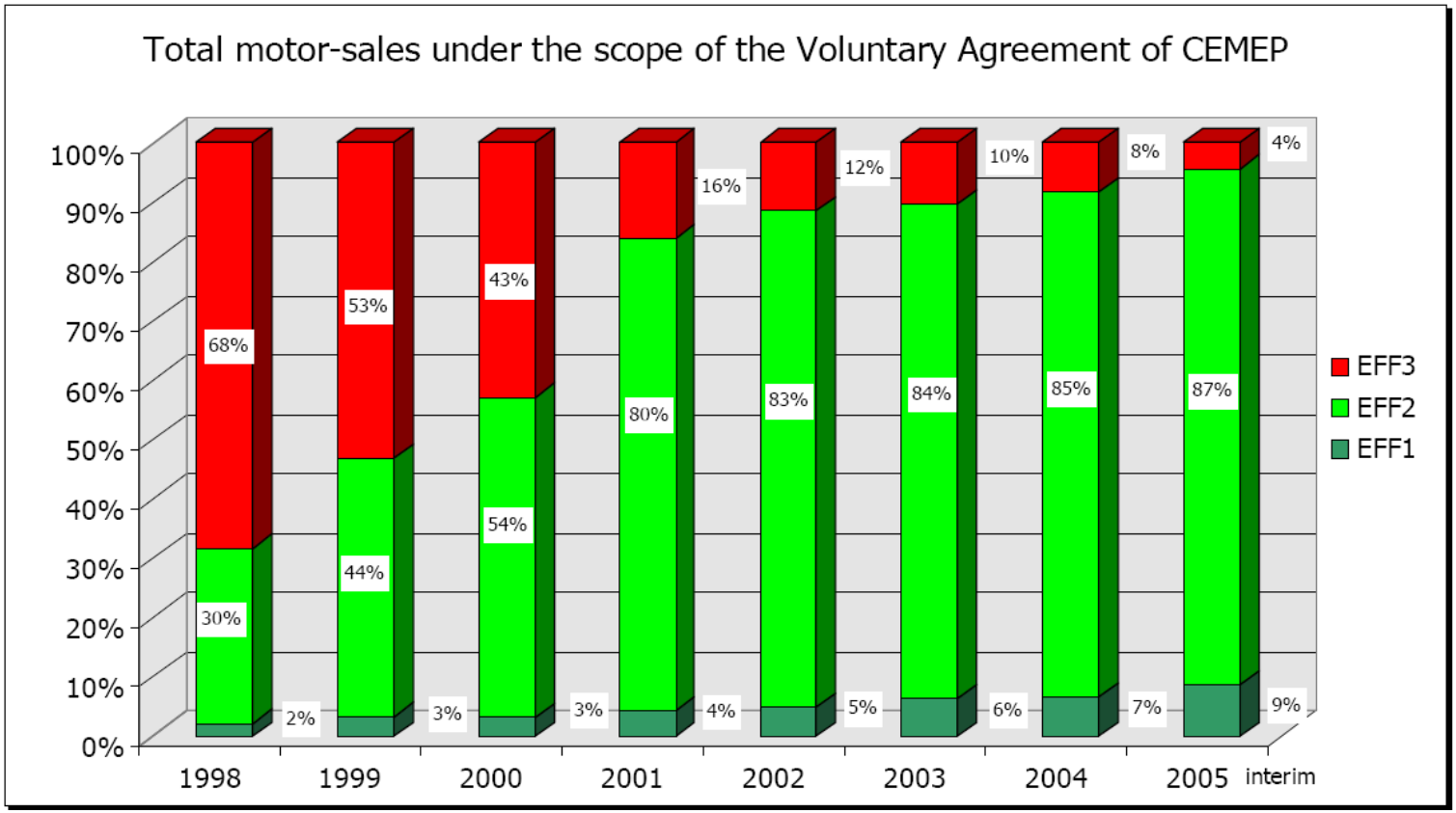
65% of all global industrial electricity is consumed by the electric motors that drive plant and equipment.

An electric motor running continuously will consume it's capital cost in electricity within 30 days irrespective of power rating.

Energy bills alone count for between 12.2% and 20% of total operating costs and have risen by 27% in the last 6 months.*

* RWE Npower survey published in Utility Weekly16th March 2007

The reality of energy efficiency improvements



FACT The uptake of EFF1 motors is disappointingly slow in Europe

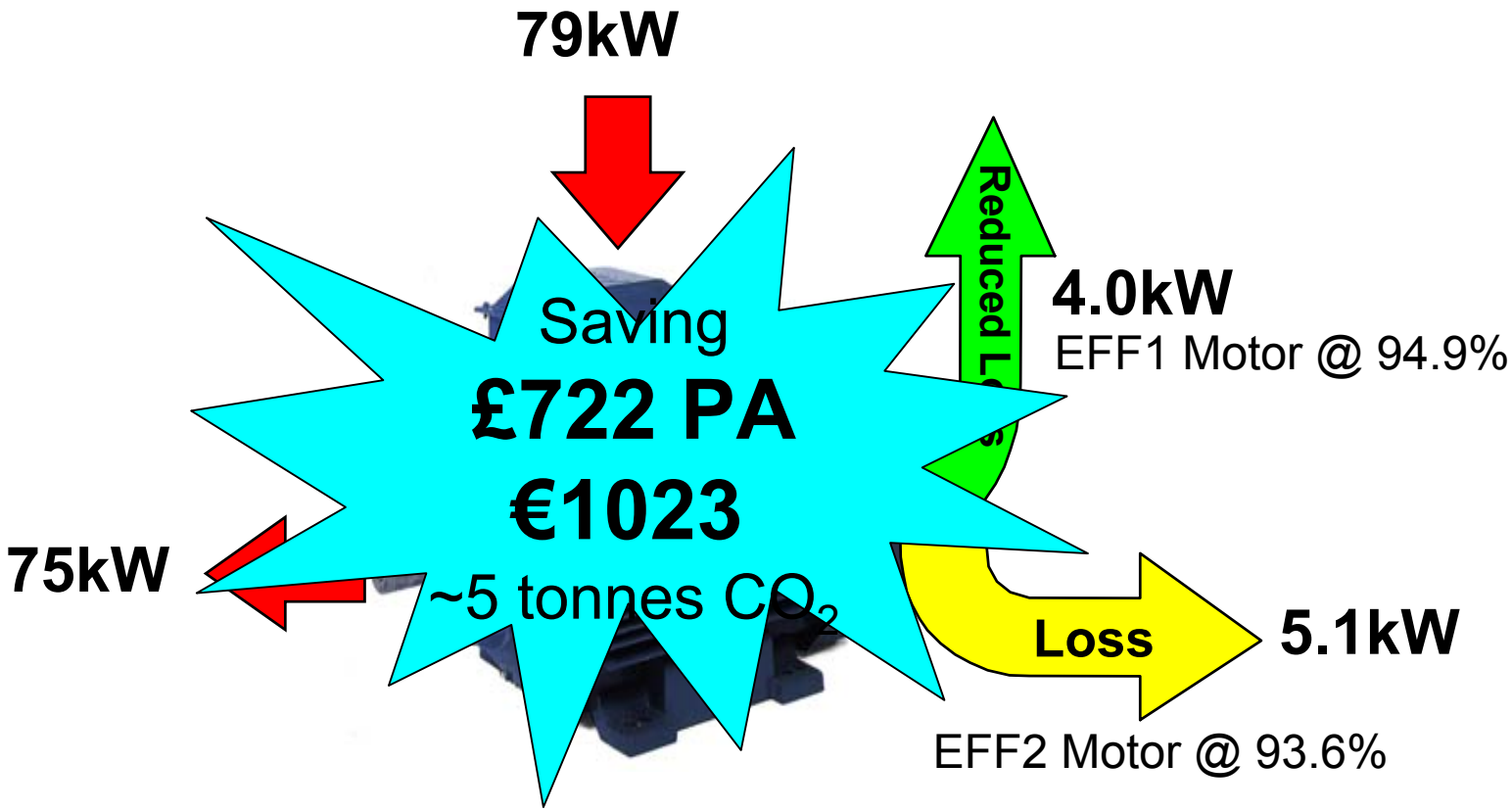
The commercial reality of being energy efficient

- 60+% of all motors are sold to OEM's and are embedded into the original equipment – many are "buried" within the equipment and out of sight.

- OEM's are driven by cost of purchase in order to remain competitive and not cost of ownership.
  - 30% of all motors sold in Europe are still in the EFF3 class coming mainly from non-signatory manufacturers (according to the Institution of Engineering and Technology.)

- An EFF1 motor costs on average 25% more than an EFF2 motor.
  - The fact that motors running in excess of 4000 hours per annum will recover this premium in a matter of months is ignored by the OEM.

Basics: EFF2 Motors v EFF1 Motors



Electricity cost of £0.075/kWhr / Running 8760 hours per annum / 4 pole motor efficiencies

Energy savings potential of motor driven systems

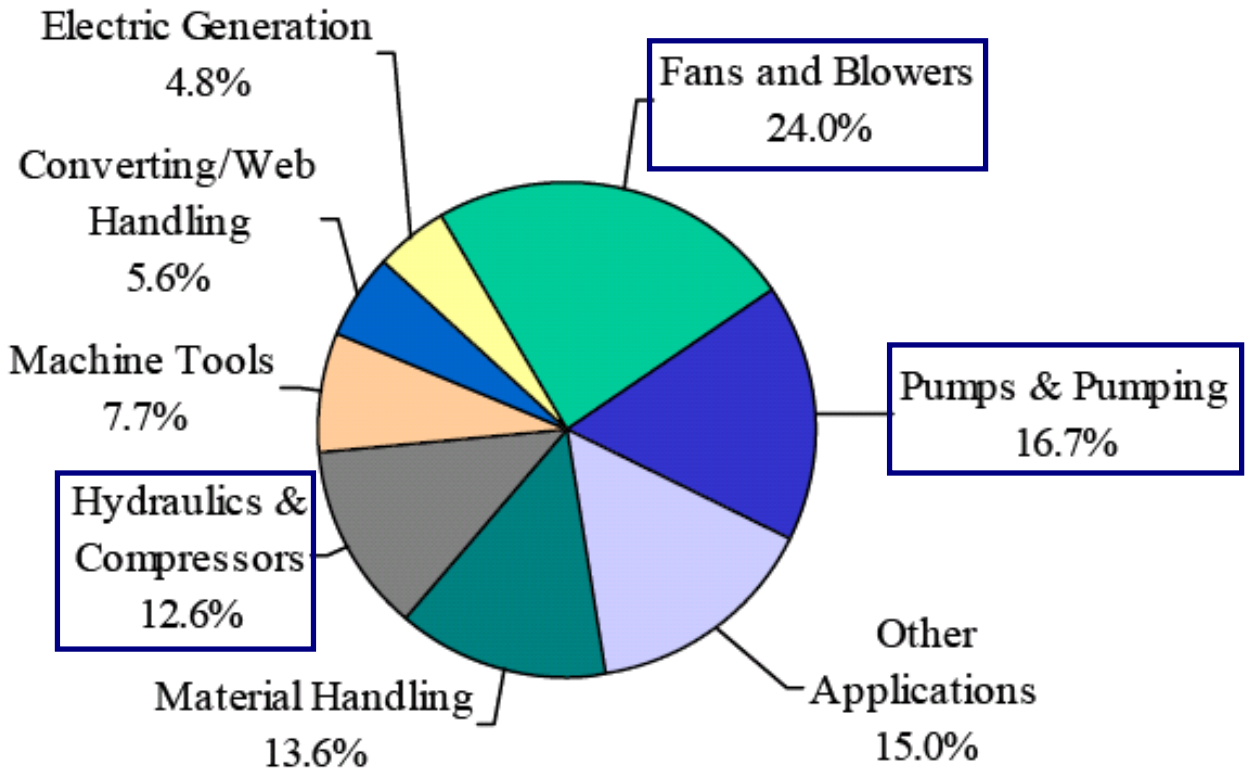
- The highest potential savings of electricity is to be found in the application of pumps, fans and compressors; i.e. variable torque loads.

- CEMEP estimate that energy savings of between 30 and 60% can be achieved through total system optimization in the following areas:

Measure	Total savings potential
Use of energy saving motors	10%
Use of variable speed drives	30%
Improving the application of the motor driven system	60%

Motor market by applications

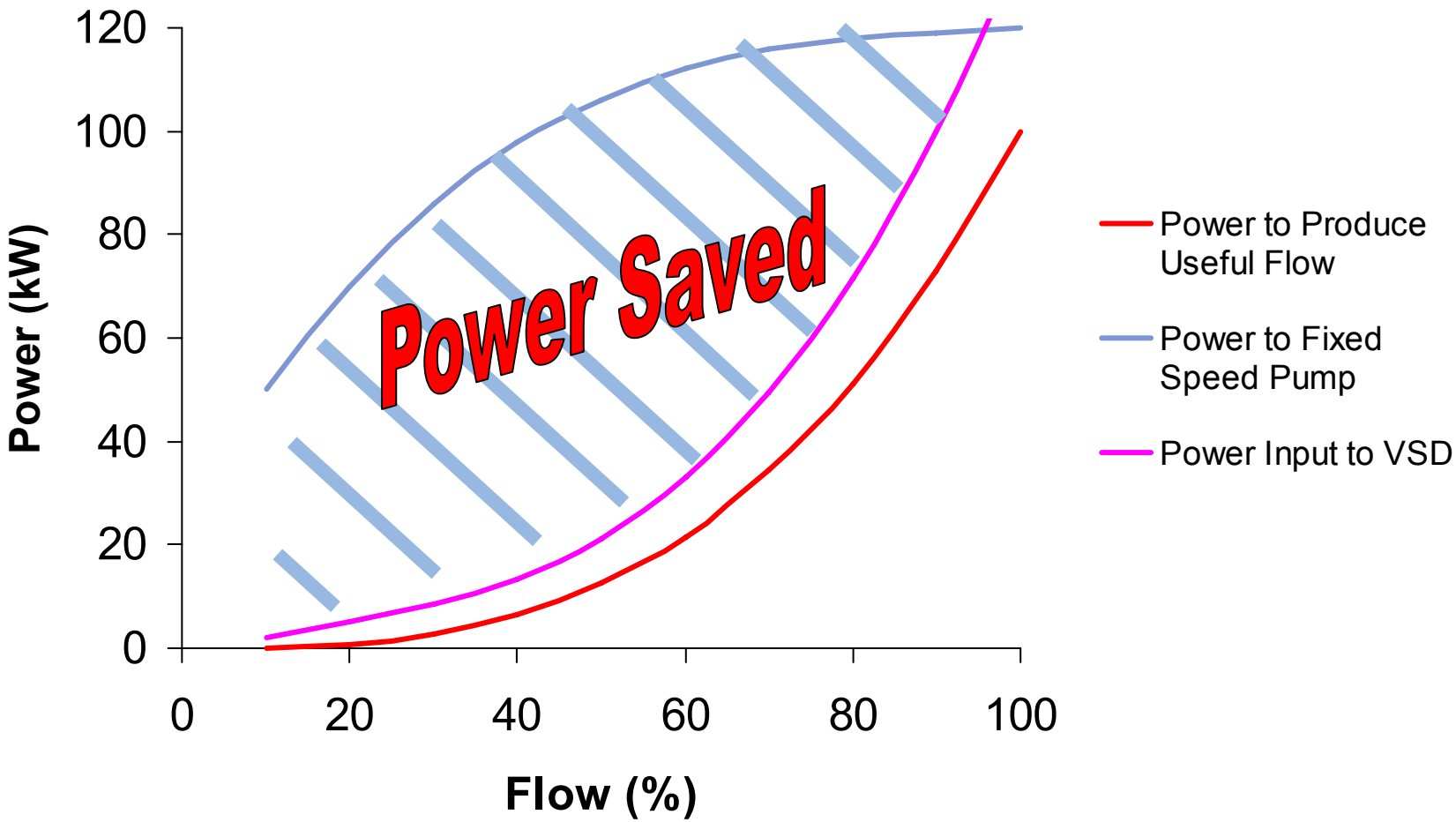
Europe Middle East & Africa market survey



~ 50% of market = variable torque applications

Source: IMS Research 2003

Centrifugal Pumps – Fixed Speed v Variable Speed



Energy consumption by frame sizes

Motors on a typical plant

Output kW / (Frame Size*)	Installed base %	Energy used %
0.75 - 4 / (80 -112)	58.8	4.8
>4.0 - 15 / (132 - 160)	26.4	10.4
>15 - 37 / (180 - 225)	9.1	12.7
>37 - 75 / (225 - 280)	2.9	12.7
>75 - 160 / (280 - 315)	1.8	14.5
>160 - 355 / (315 - 355)	0.7	15.8
>355 - 700 / (355 - 400)	0.2	13.4
>700 / (450+)	0.1	15.7

*** 4 pole ratings**

Source: United States Industrial Motor Systems Market Opportunities Assessment, December 1998

Energy consumption by frame sizes

Motors on a typical plant

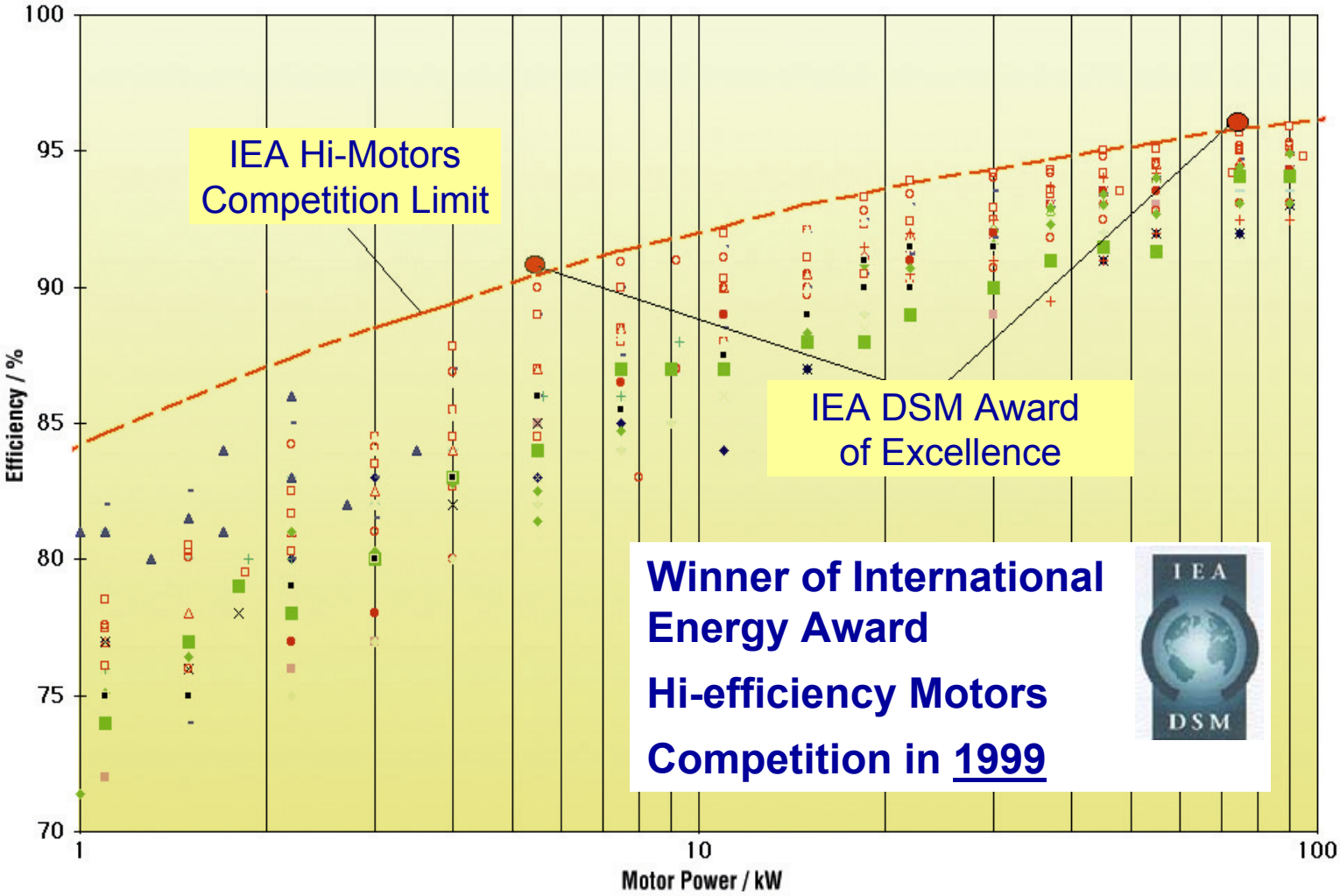
Output kW / (Frame Size*)	Installed base %	Energy used %
0.75 - 4 / (80 -112)	58.8	4.8
>4.0 - 15 / (132 - 160)	26.4	10.4
>15 - 37 / (180 - 225)		
>37 - 75 / (225 - 280)		
>75 - 160 / (280 - 315)		
>160 - 355 / (315 - 355)		
>355 - 700 / (355 - 400)	0.2	13.4
>700 / (450+)	0.1	15.7

Priority 1
95% of energy in 41% of the installed base

* 4 pole ratings

Source: United States Industrial Motor Systems Market Opportunities Assessment, December 1998

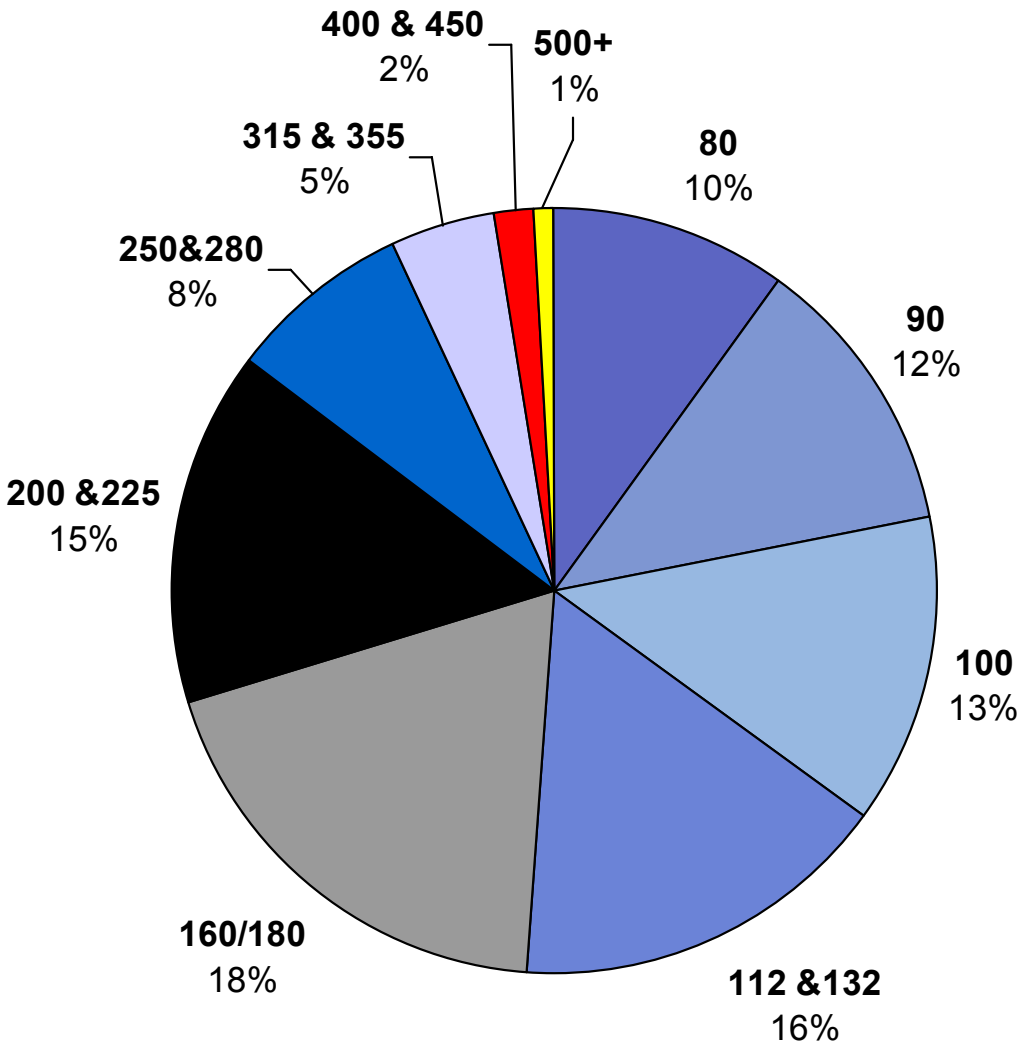
Motor manufacturers can do better!



The red line shows the mandatory limit of Motiva IEA Hi-Motors Competition. The dots (△□◇— etc.) in the graph are efficiency values of major motor manufacturers' motors available on the market. These values are taken from the EURODEEM database .

Europe Middle East Africa Market Survey

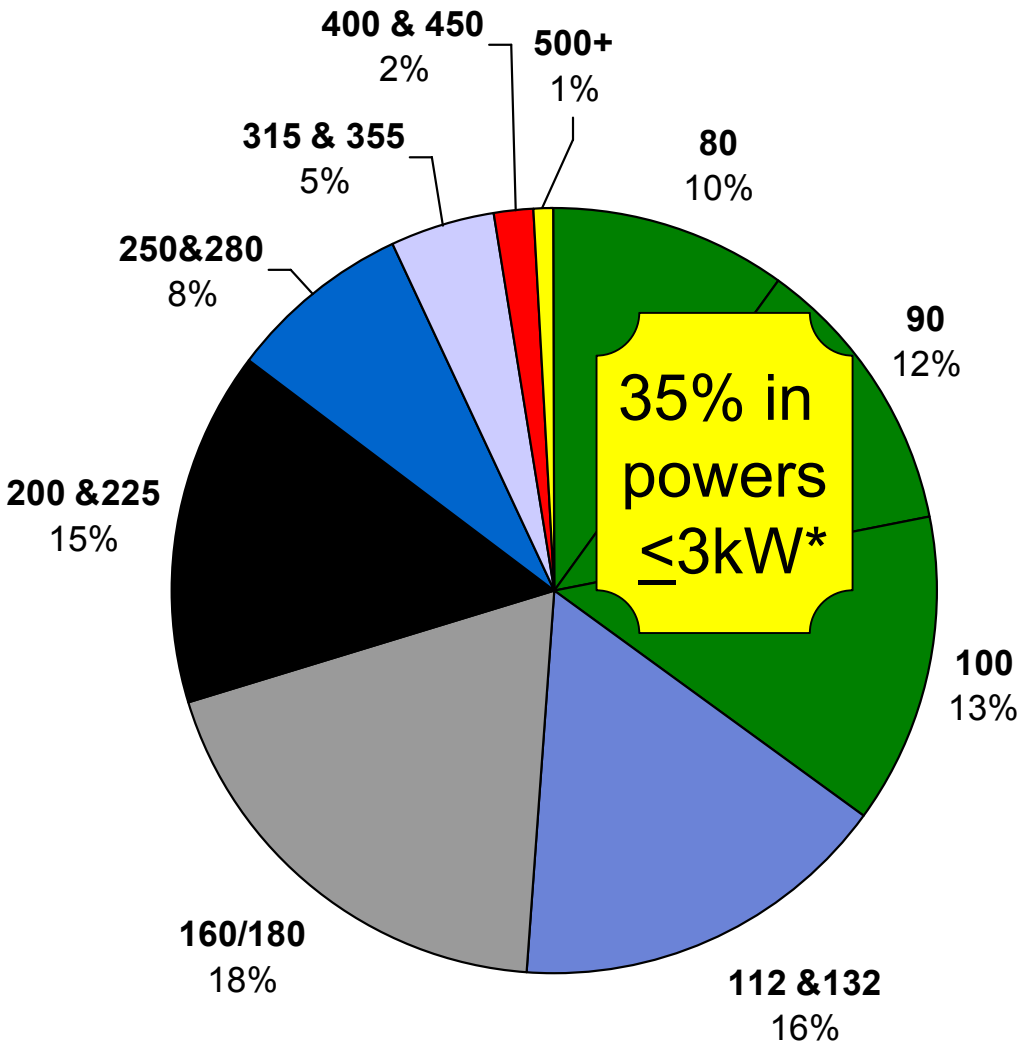
Market by IEC Frame Sizes as % of Revenues



Source: IMS Research 2003

Europe Middle East Africa Market Survey

Market by IEC Frame Sizes as % of Revenues

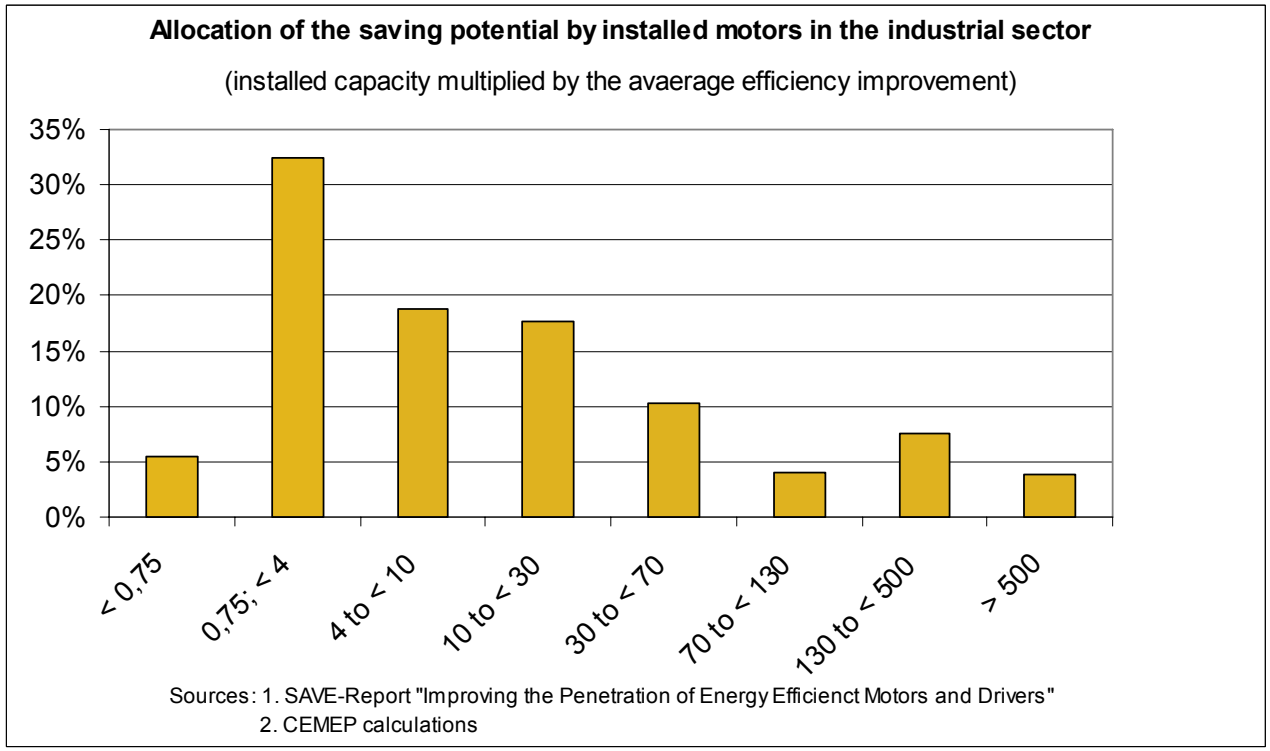


* 4 pole ratings

Source: IMS Research 2003

Priority 2: Small motors (i.e. ≤100 frame size / ≤3kW)

- Small motors account for approx. 5% of total motor load on a typical plant (greater in other areas) but are a huge installed base.
- Greatest potential energy improvements can be achieved in this power rating:



Priority 2: Small motors (i.e. ≤100 frame size / ≤3kW)

- Small motors account for approx. 5% of total motor load on a typical plant (greater in other areas) but are a huge installed base.
- Greatest potential energy improvements can be achieved in this power rating.
- 35% of the total market is in “small” motors (i.e. ≤100 frame size / ≤3kW) and this is a range where it is difficult for manufacturers to increase to EFF1 levels because:
  - Improving efficiency requires an increase in slot area.
  - This generally leads to a larger diameter motors.
  - This is typically a very costly measure (e.g. new tooling, etc…)
- Demand is not there from the market for EFF1 motors in these frame sizes.Due to low demand manufacturers are not getting the volume effect to enable price reductions.
- Prices differentials between EFF1 & EFF2 motors in these frames are typically much greater than in larger frame sizes

Proposal for new efficiency classification scheme

- CEMEP working with IEC on proposed new standard for efficiency classifications – Committee Draft IEC 60034-30 Ed1
- Objective is to globally harmonise energy efficiency classes:
  - Many different energy efficiency standards for cage induction motors are currently in use (NEMA, EPACT, CEMEP, COPANT, AS/NZS, JIS, GB, …) with new classes currently being developed.
  - It becomes increasingly difficult for manufacturers to design motors for a global market and for customers to understand differences and similarities of standards in different countries.
- Ratings covered: 0.75 kW – 370 kW (i.e. ~95% of market)
- New classes:
  - 3-Star (Premium) – New (~1-3 point improvement on EFF1 levels)
  - 2-Star (High) - equivalent to current EFF1
  - 1-Star (Improved) - equivalent to current EFF2

The way forward…

- At the Spring European Council meeting (Brussels 8/9 March 2007), EU Heads of Government agreed a binding target to reduce Europe's greenhouse gas emissions by at least 20% by 2020 (compared to 1990 levels)

- The use of high efficiency motors and variable speed drives can play a vital role in helping deliver these targets.

- We must all play our part in making energy efficiency a reality:
  - End Users – Specify EFF1 motors and insist OEM's fit them.
  - OEM's – Sell the long term benefits of fitting EFF1 motors; make it a differentiator.
  - EU / Local Government – Incentivise the use of EFF1 motors through tax breaks & grants and/or legislate as in the case of EPAct in North America.
  - CEMEP – Introduce new classification scheme with new category above current EFF1 level and encourage phase out of current EFF2 level.
  - Manufacturers – Stop making EFF3 motors!
    Continue to push the efficiency boundary above EFF1 current levels.

Power and productivity
for a better world™