

Efficiency matters.



Motor Summit 2010 in Zurich

Global Electric Motor Market Study - a first trial

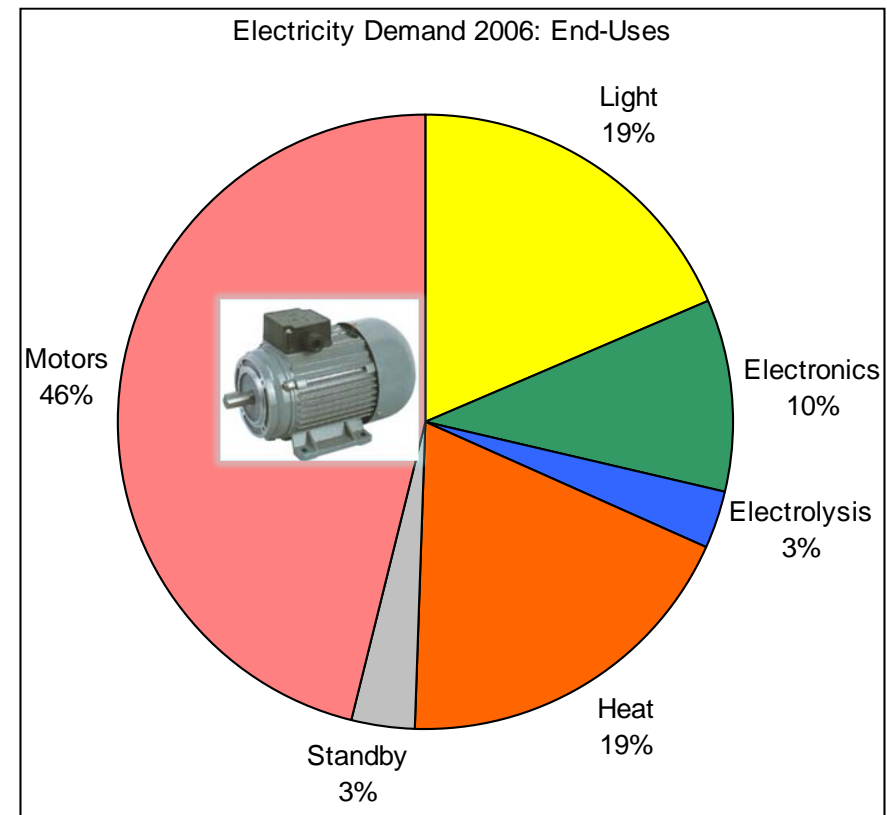
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Introduction

- About 45% of the global electricity demand by electric motors (EM) systems
- Main applications: compressors, pumps, fans and mechanical movement
- Global market studies basically inexistent



Source: A+B International 2009

Scope

- Study examines EM market of 12 most relevant economies (incl. EU-27 as a country group)
- Goal:
 - Characterization of the global market
 - Estimation of electricity demand by EM
 - Market penetration of high efficient EM
- EM under examination: 0.75 – 375 kW, mainly asynchronous AC poly-phase motors

Approach

- Bottom-up model for each country, variables were:
 - # of sold motors,
 - # of motors in the stock,
 - life span,
 - running hours,
 - load factor and
 - motor efficiency
- If possible, all variable differentiated by motor size class
- Diffusion of the sales and stock regarding high efficiency motors estimated by a stock model

Sources

- Sales data from national or regional manufacturers associations
(e.g. CEMEP, CNIS, NEMA, JEMA, etc.)
- National authorities
(statistical offices and customs as Eurostat, U.S Census Bureau, Rosstat, etc.)
- Research and information papers and reports
(e.g. SAVE II project, ACEEE, etc.) on behalf ministries and research funds (e.g. US DOE, European Commission, etc.)
- Independent commercial market studies
(e.g. Frost & Sullivan)

From sales to (running) stock

- International trade of both motors and OEMs heavily affects
 - Domestic production of motors,
 - sales and
 - installed numbers of motors
- For most countries no data on stock available. Stock approximated by sales data
- Stock keeping of EM for fast replacement

Motor sales

Sales data EM in various countries in thousand units

(* sales data differentiated by size classes available)

*Table not disclosed due to copyright reasons
See forthcoming IEA information paper for more details*

Trade data for United States, EU-25 and China in different Units

	Year	Production	Export	Import	Demand	Source
U.S. (million \$)	2003	1'243	729	1'402	1'915	U.S. Census Bureau, 2004
EU-25 (1000 units)	2007	14'069	2'197	3'016	14'888	Eurostat, 2008
China (%)	~2004	100%	29%	5%	76%	Ryan et al., 2005

Motor Stock

EM Stock in the twelve most relevant countries

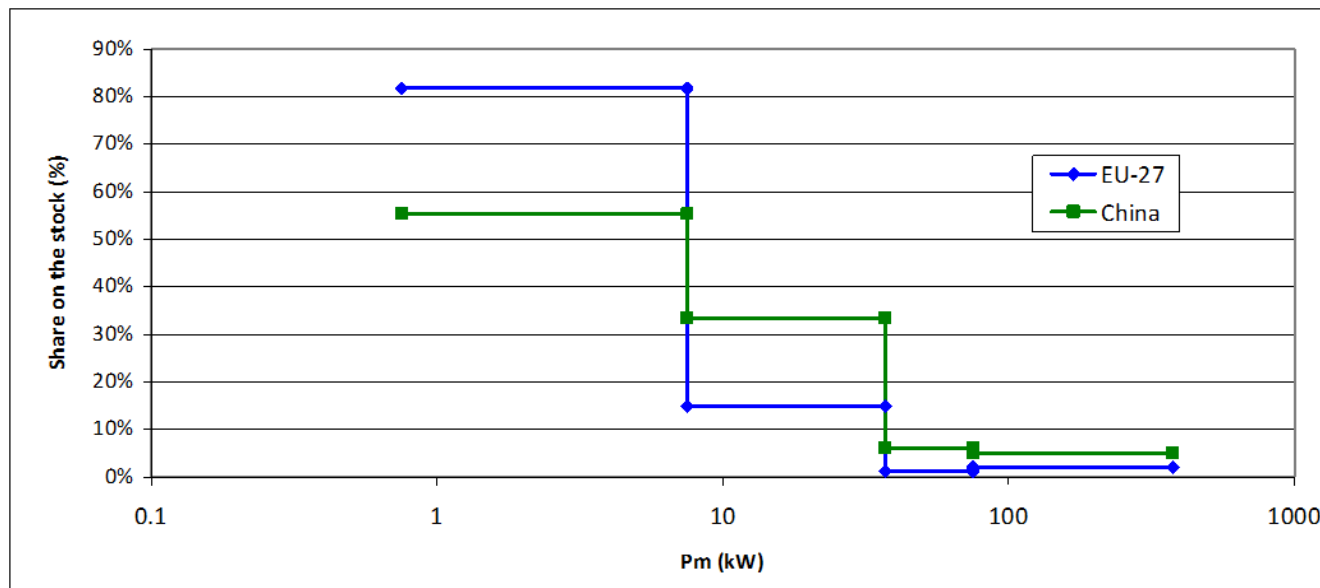
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Source: TEP Energy and various others

Motor Size Classes

- In most statistics, sales data differentiated by size classes
- Small EM dominate the sales in units
- Share of different size classes on sales/stock differ highly among countries

Share of size classes on the stock in units in China and EU-27



Size classes:
0.75-7.5 kW,
7.5-37 kW,
37-75 kW and
75-375 kW

Sources: Zhao Yuejin
2005, several
sources for EU-27

Motor Life Span

- Small EM have generally shorter life spans than large EM
- Crucial variable if deriving stock from sales

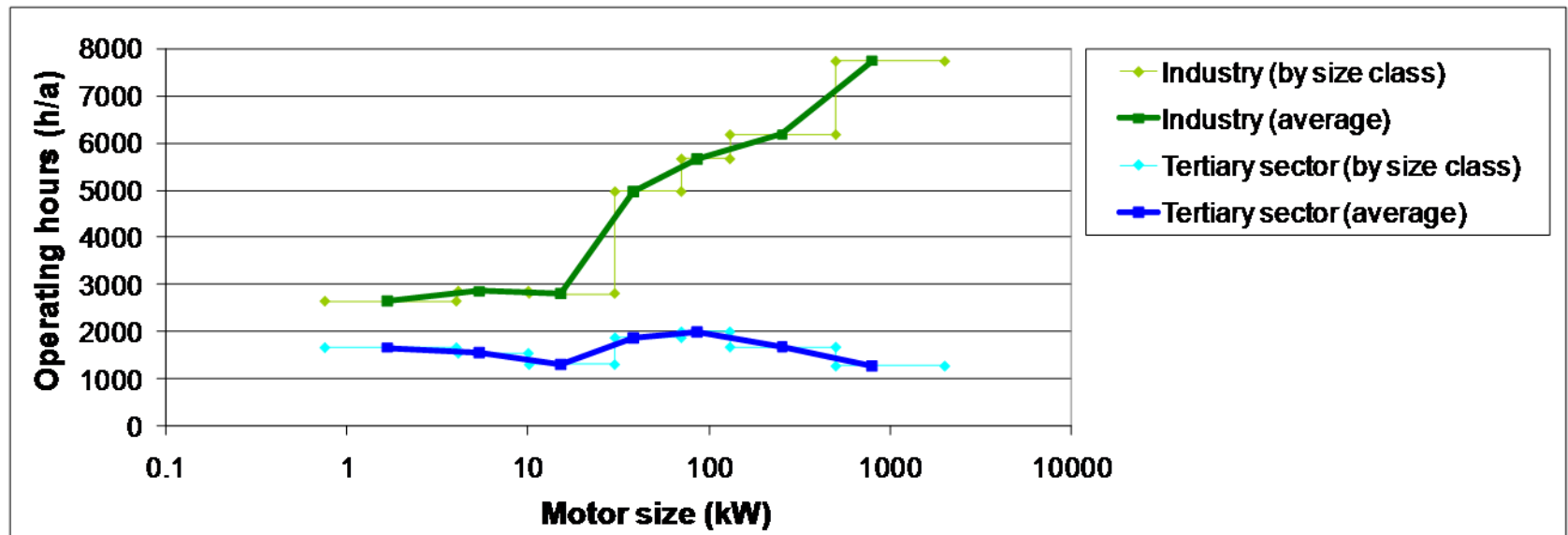
Average life span (including repairs) by two studies

De Almeida, 2008		Schueler, Leistner, and Douglass, 1994	
Size class	Average life (years)	Size class	Average life (years)
1.0–7.5 kW	12	0.75–3.75 kW / 1–5 hp	17
7.5–75 kW	15	3.75–15 kW / 5–20 hp	19
75–250 kW	20	15–37.5 kW / 20–50 hp	22
		37.5–93 kW / 50–125 hp	29
		> 93 kW / > 125 hp	29

Operating Hours

- Number of hours (per year) during which EM is in operation
- Differ by size classes and sector

Annual operating hours in the industrial and tertiary sector by motor size for EU-15

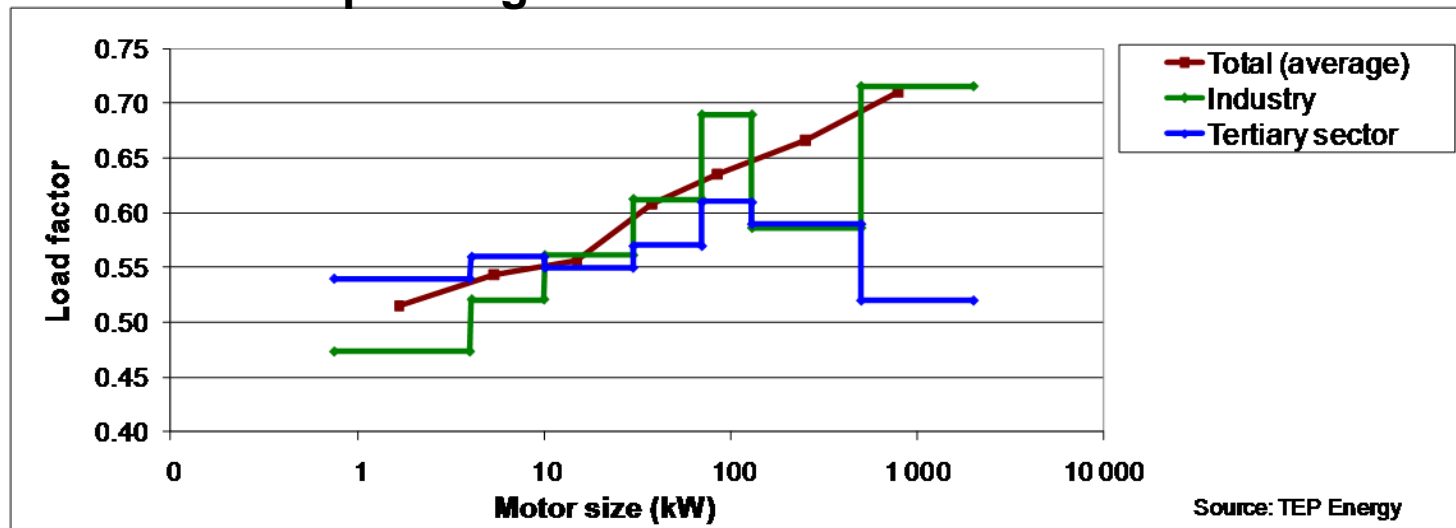


Source: SAVE II 2000, TEP estimates

Load Factor

- Fraction of installed rated capacity a motor is actually running (average over a year)
- Full load hours obtained by multiplying operating hours with average load factor

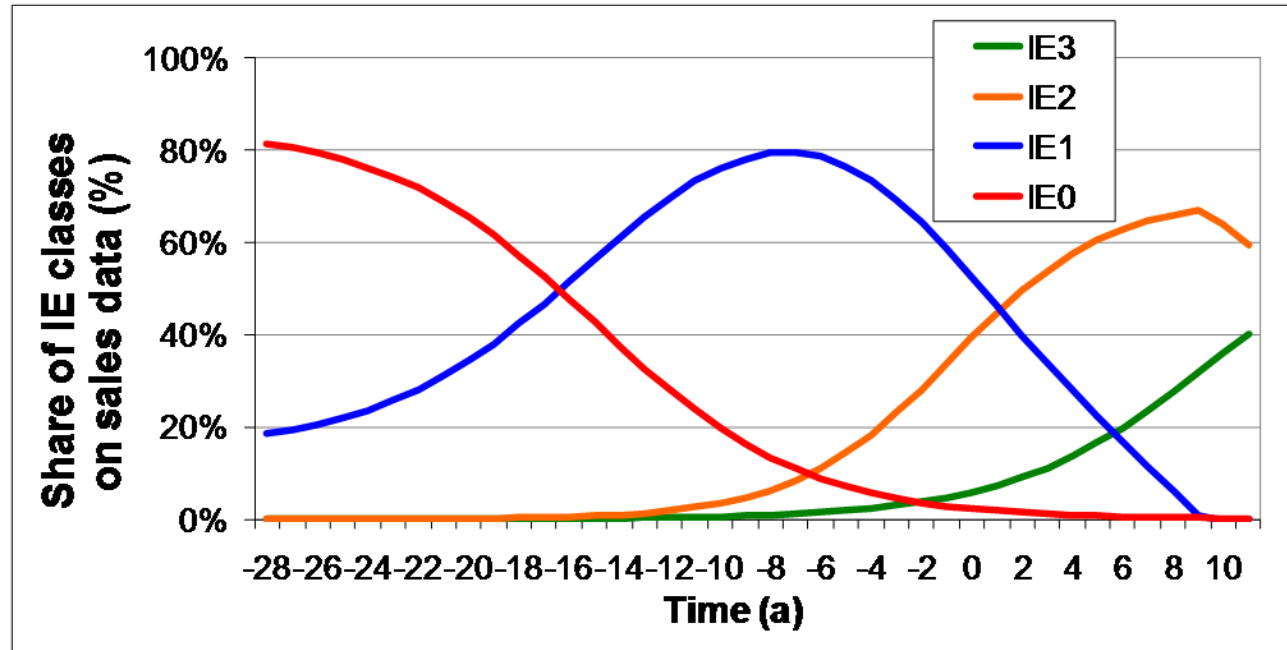
Load factor depending on the motor size and sector



Source: SAVE II 2000, TEP estimates

Diffusion of Efficiency

- Sales data for high efficiency motors (IE2 & IE3) vary highly among countries
- Leading countries are Canada and United States
- EU-27 lagging about 8 to 10 years behind, China about 5 to 6 years



Country or country group	Lag compared to the reference t=0
Canada and US	+2 to 0 years
Mexico	-2 years
Australia, NZ	-3 to -4 years
China, South Korea	-5 to -6 years
Taiwan, Brazil	-7 to -8 years
EU	-8 to -10 years
Other countries with no MEPS or VA	-12 to -15 years

Bottom-up Results and Comparison with top-down and literature

*Table not disclosed due to copyright reasons
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- Total: quite well, some major deviations in some countries

Forecast of MEPS and market shares

- MEPS implementing year for motors in the three largest motor using economies

Motor MEPS	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
USA	IE2													IE3						
Europe EU-27														IE2				IE3*		IE3**
China P.R.					IE0				IE1					IE2						

*) > 7.5 kW or IE2+ VFD

**) all sizes or IE2+ VFD

- Sales by efficiency classes (global)

*Table not disclosed due to copyright reasons
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Comparison of sales and stock shares

- Sales by efficiency classes (global)

*Table non-disclosed due copy right reasons
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- Stock by efficiency classes (global)

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Recommendations for improvements of the bottom-up model

- Size class distribution data is available (this kind of data is almost a prerequisite).
- Stock model data is available at least for one year, not too far back in the past (less than 10 years).
- Additional information on operating hours, load factors etc. is available from surveys.
- Sales data are available for several years.
- A stock model, fed with sales data ideally several years, can be “anchored” to stock data of at least one year or to top-down estimates.
- Data on international trade of both motors and OEMs is available.
- The top-down approach can be refined by differentiating share of motor electricity demand by sub-sectors and by country or country group (developing state, climate).

Recommendations for Policy Makers

- Energy saving potential is tremendous
- Policy instruments for EM have to follow a long term perspective in order to cope with the low turnover rate
- Policy instruments should include requirements for the motor driven **system** as a whole as well as for the application of variable speed drives
- **IEA information paper:**
Brunner C., Jakob M., Jochem E., Meyer M., Waide, P. (not yet published). **Energy Efficiency Policy Opportunities for Industrial Electric Motor Driven Systems (working title)**. Prepared for: The International Energy Agency (IEA). By: Navigant Consulting, A+B International, Switzerland, TEP Energy, Zurich Switzerland and IREES (former BSR Sustainability), Karlsruhe Germany

Efficiency matters.



Thank you very much for your attention!

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