



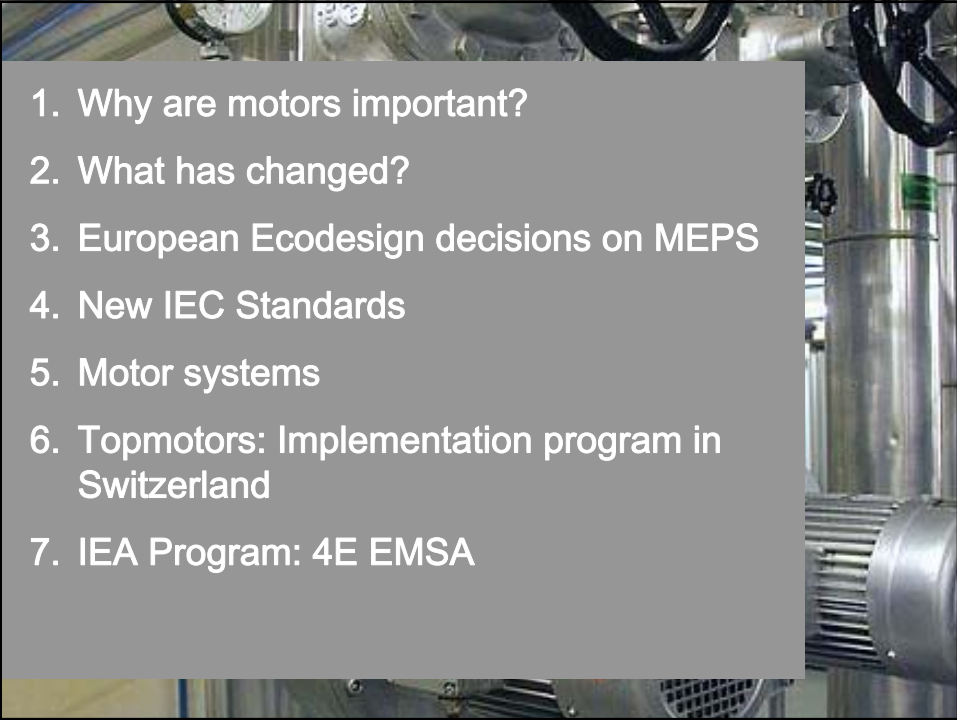
Efficient Electric Motor Systems

International Developments

Vienna, 2 March 2010

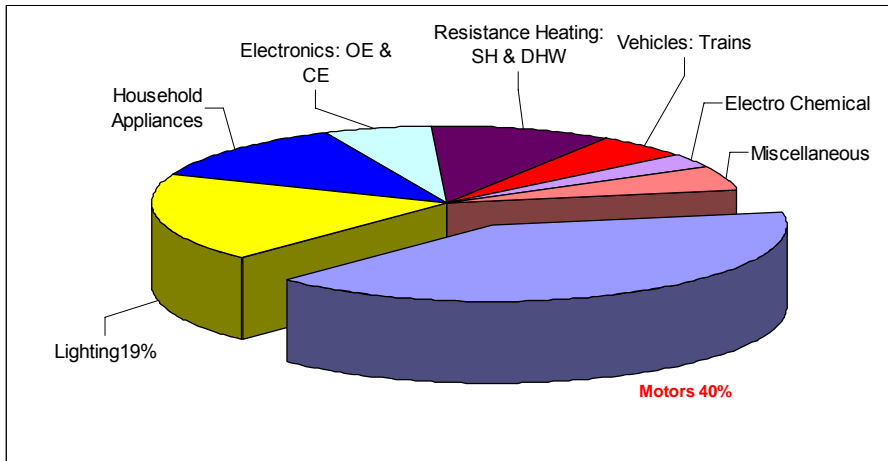
Conrad U. Brunner, Zurich Switzerland

- IEA Efficient Electrical End-Use Equipment 4E www.motorsystems.org
Operating Agent: Electric Motor Systems Annex EMSA
- IEC TC2/WG 28 and WG31 www.iec.ch
- Motor Summits in Zurich Switzerland www.motorsummit.ch
- Topmotors: Implementation in Switzerland www.topmotors.ch

- 
- A background image showing industrial machinery, including pipes, valves, and a large electric motor, in a factory or plant setting.
1. Why are motors important?
 2. What has changed?
 3. European Ecodesign decisions on MEPS
 4. New IEC Standards
 5. Motor systems
 6. Topmotors: Implementation program in Switzerland
 7. IEA Program: 4E EMSA

Global Electricity Consumption

3

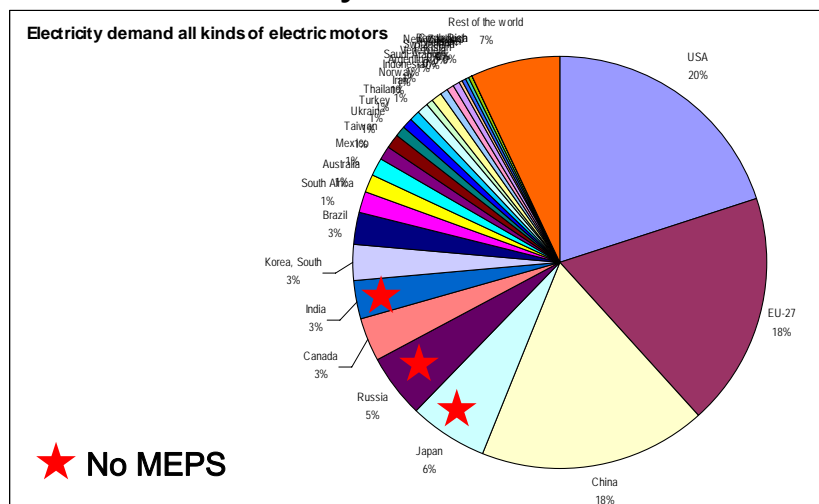


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Global Electricity Use for Motors

4



★ No MEPS

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Source: IEA-Draft CUB 2009



Motor Applications & Production

5

Application

- Pump
- Fan
- Compressor
- Transport Person and Goods
- Industrial Handling and Processing
- Vehicles

Production

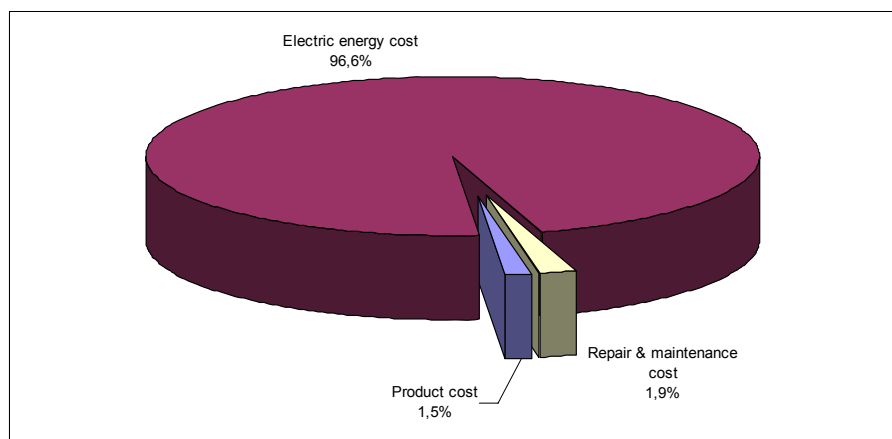
- Motor Different Types and Size
- Electronic Part Variable Frequency Drive
- Mechanical Parts Gear, Brake, Transmission, Clutch
- System Integrated Packed System
 OEM Machines for Industry

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Life Cycle Cost

6

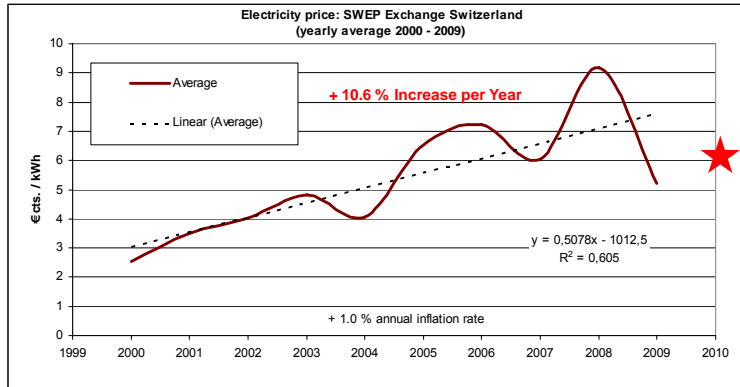


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Electricity Price

7



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4E



Very old motor stock

What has changed?

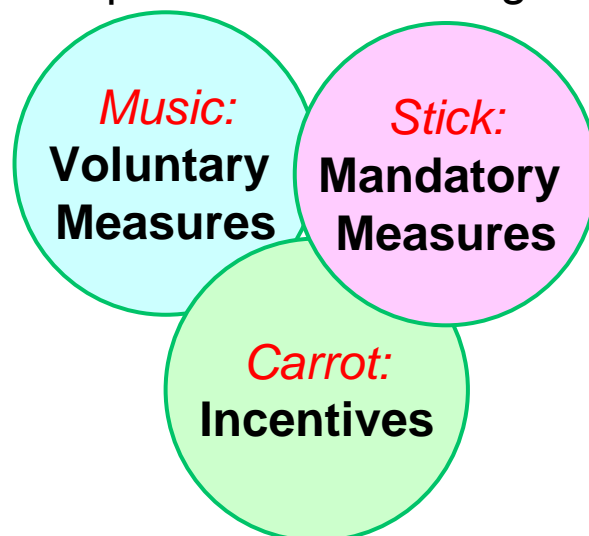
9

- New technology available:
 - VFD (Variable Frequency Drive)
 - PM (Permanent Magnet)
 - SR (Switched Reluctance)
- Electricity more expensive
- CO₂ problem and price
- Price of raw materials: copper, steel, aluminium, rare earth
- Slow global economy delays new investment in industry
- 39 countries now with mandatory standards MEPS:
70% of world electricity use
- Global standards now are harmonized
 - Testing IEC 60034-2-1 (2007)
 - Efficiency classes IEC 60034-30 (2008)
 - Guide for selection and application IEC 60034-31 (2010)



How to Speed Market Change ?

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European Ecodesign Decisions

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22 July 2009 (Nr. 640/641)

	Size	Date 1	Date 2	Date 3
Electric Motors 2 - 6 poles, Continuous Duty	0.75 – 375 kW (mech)	June 2011 IE2	Jan 2015 ≥ 7.5 kW IE3 or IE2 + VFD	Jan 2017 All sizes IE3 or IE2 + VFD
Circulator Pumps	1 – 2500 W (hydr)	Jan 2013 EEI ≤ 0.27	Jan 2015 EEI ≤ 0.23	

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European Ecodesign Decisions

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22 July 2009 (Nr. 640/641)

	Exclusions			
Electric Motors <ul style="list-style-type: none"> ■ 2 - 6 poles, ■ Continuous Duty 	Motors in liquids,	Motors integrated and not separable from gear, pump, fan, compressor	Brake motors	<ul style="list-style-type: none"> • >1000 m a sea • ambient > 40°C • Max operating temp > 400 °C
Circulator Pumps <ul style="list-style-type: none"> ■ glandless ■ standalone 	Drinking water pumps	Integrated into heating products		

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Global Standards

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Efficiency Levels	Efficiency Classes	Testing Standard	Performance Standard
	IEC 60034-30	IEC 60034-2-1 incl. stray load losses 2007	Mandatory MEPS
Premium Efficiency	IE3	Low Uncertainty	USA 2011 Europe* 2015 (≥ 7.5 kW), 2017
High Efficiency	IE2	Medium Uncertainty	USA
			Canada
			Mexico
			Australia
			New Zealand
			Korea
Standard Efficiency	IE1	Medium Uncertainty	Brazil
			China 2011
			Switzerland 2011
			Europe 2011
			China
Below Standard			Brazil
			Costa Rica
			Israel
			Taiwan
			Switzerland

bold means in effect
*) IE3 or IE2+VSD

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Motor Sales: the World is Changing

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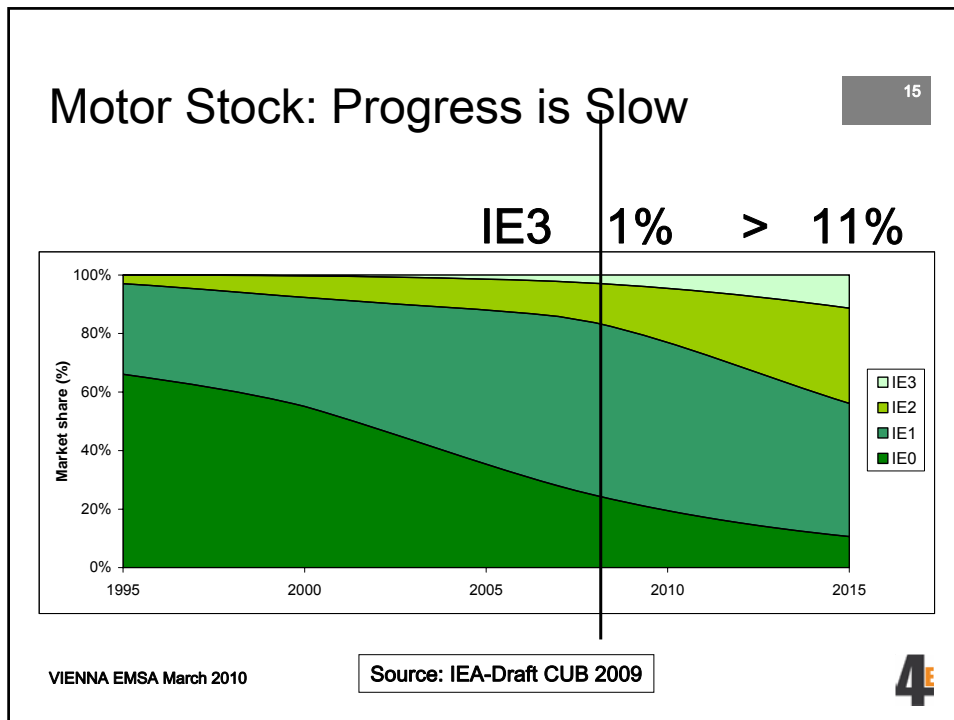
IE3 3% > 23%



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Source: IEA-Draft CUB 2009





Harmonized Standards: IEC

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- IEC 60034-2-1:2007 TESTING
- IEC 609034-30:2008 EFFICIENCY CLASSES
- IEC 60034-31: GUIDE for the Selection and Application

UPCOMING

- IEC 60034-2-2: Large motors
- IEC 60034-2-3: Converter-fed motors

PROJECTS

- Round Robin Test: Report 2010
- Revision of IEC 60034-2-1: ► Input/Output
- PM motors: Testing & Classification

 IEC 60034-30 17
Edition 1.0 2008-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Rotating electrical machines –
Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)

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IEC Energy Efficiency Classes 18

IEC 60034-30 (Published 21 October 2008)

■ Premium Efficiency	IE3	-	NEMA Premium
■ High Efficiency	IE2	Eff 1	EPAct
■ Standard Efficiency	IE1	Eff 2	-
■ Below Standard Efficiency	-	Eff 3	-

Rating Plate new ! Testing method new !

IE3 93.4% **Low uncertainty**

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New Look

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IE3 93.4%

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Electric Motors: Scope

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Included

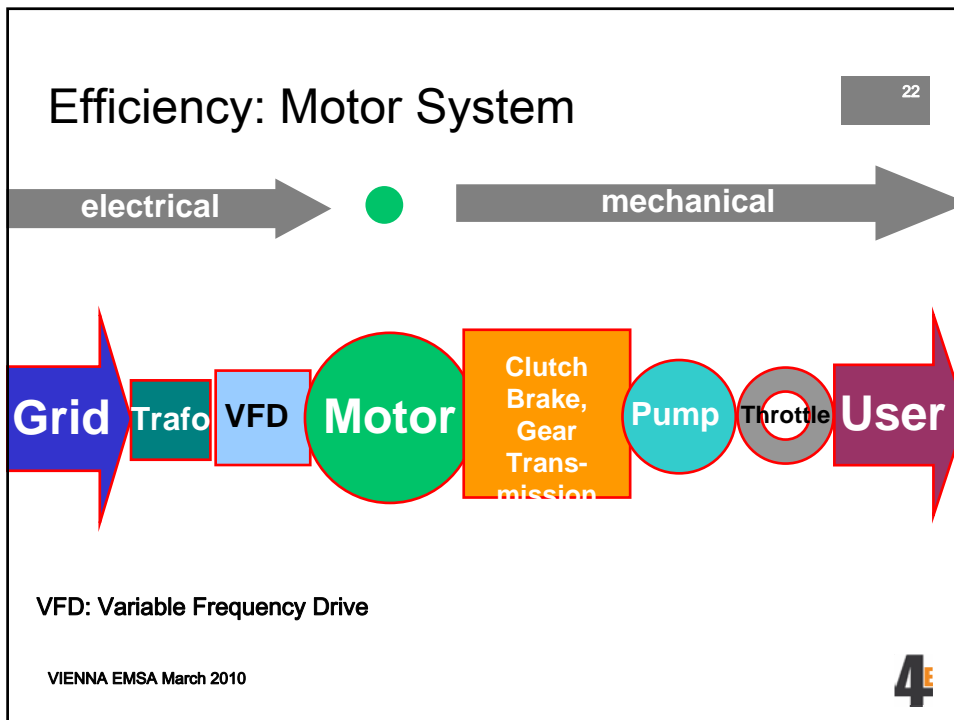
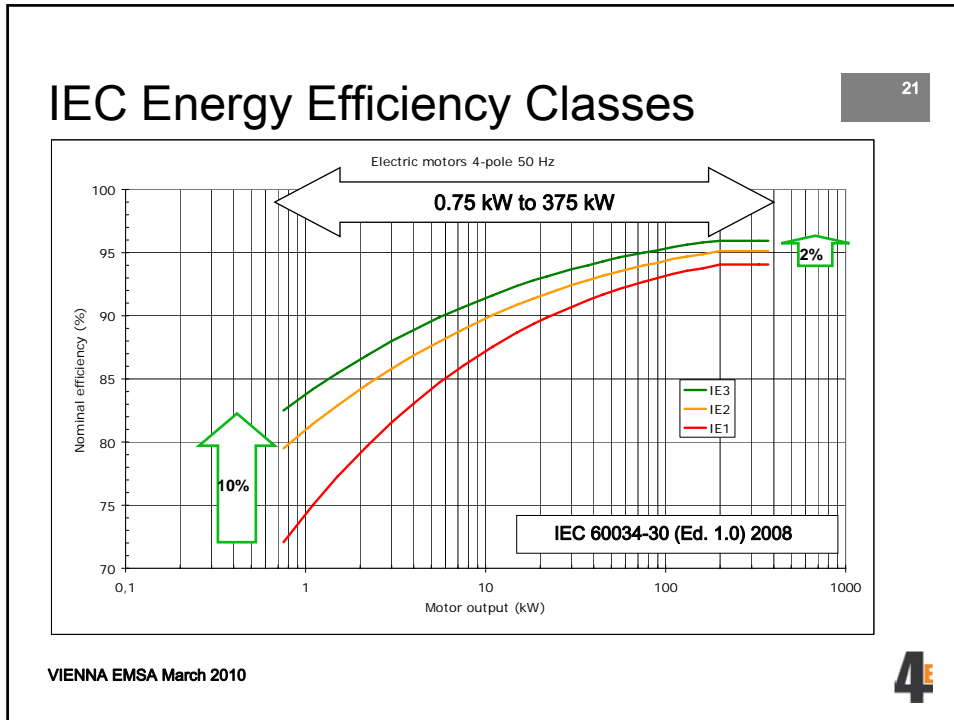
- 0.75 kW – 375 kW
- 2-, 4-, 6-Poles
- 3-phases
- < 1000 Volt (also multi Volt)
- 50 Hz and 60 Hz (also dual frequency)
- General purpose vs. special purpose

Not included

- Fully integrated in pump, fan, etc.
- Solely for converter operation

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Scope of EMSA: 0.5 ... 500 kW

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The diagram illustrates the scope of EMSA through five nested levels of energy efficiency, represented by concentric shapes:

- Grid** (outermost, white box): The source of electricity.
- Entire heating system with pipes, pump and motor, ASD** (red square): The complete system including transmission and gears.
- Motor + Pump + ASD** (blue diamond): The core motor system.
- Core Motor System** (green circle): The electric motor itself.
- Total Motor System with transmission, gears and motor** (innermost, red square): The motor and its immediate drive components.

Arrows indicate the potential for savings at each level:

- Large savings** (red arrow) between the Grid and the Entire heating system.
- Good savings** (blue arrow) between the Entire heating system and the Motor + Pump + ASD.
- Small savings** (green arrow) between the Motor + Pump + ASD and the Core Motor System.

A photograph of industrial machinery with a large electric motor is shown on the right side of the diagram.

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Variable Load

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TODAY

- Fixed Speed Motor + Throttle

TOMORROW

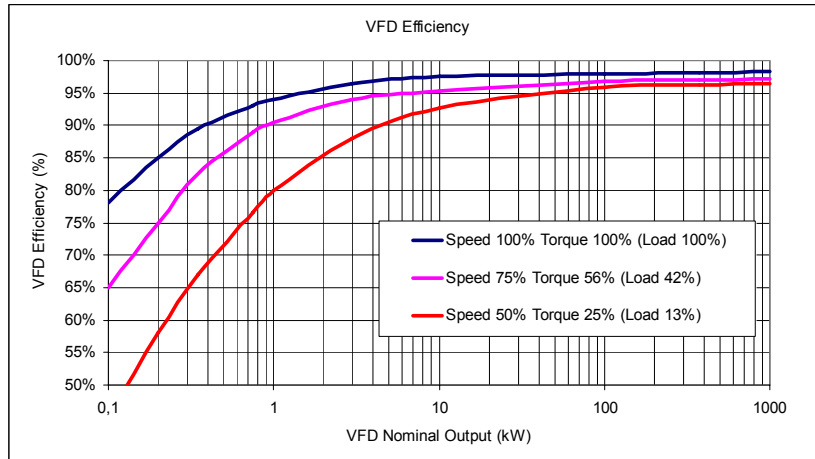
- Variable Frequency Drive + Induction Motor
- Variable Frequency Drive + PM or SR Motor

VFD LOSSES (0.75 kW ... 375 kW)

- Nominal 100% load operation: 2% ... 5%
- Partial Load 13%: 5% ... 25%

New: High Efficient VFD

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Source: EEMODS'09: Angers, Brunner, De Almeida, Doppelbauer



2009: IE3
Premium Efficiency



Topmotors



- Effizienzpotenzial 10% bis 30%
- Neue Technologien:
 - Premium Effizienz Motoren
 - Permanent Magnet Motoren
 - Variable Drehzahl Frequenzumformer
 - Besseres Engineering: Dimensionierung
- Neue Tools für Motor-Check: ILI und Sotea
- Maschinenbauer sind gefordert
- Europa ist gegenüber USA im Rückstand

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Topmotors in Switzerland

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- Pilotstudien in 11 Industrien
- Website www.topmotors.ch
- 15 Merkblätter
- Ausbildungskurse
- 2 Tools: ILI und SOTEA
- Partnerschaft mit Herstellern, Anwendern & Verbänden

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Motor-Check Tools

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SOTEA

Software Tool zur
Potenzialabschätzung

Fachlicher Dialog mit Betriebsleitung

Input:

Gesamtverbrauch Elektrizität
Betriebskenndaten: Schichten, Alter

Output:

Motorenverbrauch, Ersatzpotenzial,
Payback

ILI

Intelligente Motorenliste

Liste aller (wichtiger) elektrischer
Motoren

Input: Alter, Leistung, Funktion,
Betriebsstunden, FU

Output:

Drei Dringlichkeitsklassen

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IEA 4E



Efficient Electrical End-Use Equipment

- Standby
- Set-top Boxes
- Lighting
- Mapping & Benchmarking
- Electric Motor Systems EMSA

Executive Committee:

- Chair: Hans-Paul Siderius
- Vice Chair: Shane Holt
- Operating Agent: Mark Ellis
- Austrian representative: Michael Hübner



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EMSA Goal



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- Promote high efficient electric motors systems
- In industrial and developing countries
- Dissemination of best practice on technical and economical experience
- Lessons learned for coherent motor policy
- Minimum energy performance standards & labels


In order to:

- Energy efficiency improvement
- Lower emission of greenhouse gases


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EMSA Tasks


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A	Implementation Support & Outreach
B	Technical Guide for Motor Systems
C	Testing Centers
D	Instruments for Coherent Motor Policy
E	Training & Capacity Building
F	Energy Management in Industry
G	New Motor Technologies
H	Total Motor Systems Integration



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EMSA Task Leader


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Tasks	Countries	Australia	Austria	Denmark	Netherlands	South Africa *)	Switzerland	UK	Contact (Task Leader)	
		OP	Operating Agent							
A	Implementation Support & Outreach	Participant	Participant	Participant	Participant	Participant	Participant	Participant	Conrad U. Brunner	CH
B	Technical Guide for Motor Systems		Participant	Task leader		Participant	Participant		Sandie B. Nielsen	DK
C	Testing Centers	Task leader		Participant		Participant	Participant		Sarah Hatch	AU
D	Instruments for Coherent Motor Policy	Participant	Task leader				Participant		Konstantin Kulterer, Marcus Hofmann	AT
E	Training & Capacity Building		Participant	Task leader	Participant	Participant			Sandie B. Nielsen	DK
F	Energy Management in Industry	Participant		Participant	Task leader	Participant			Rob de Klerck	NL
G	New Motor Technologies	Participant		Participant	Participant	Participant	Participant	Participant	Charles Gaisford	UK
H	Total Motor Systems Integration	Participant		Participant	Participant	Participant	Participant	Participant		Start later

Participant in Task

Task leader

*) to be confirmed

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- EMSA Archive
- Search



4E Electric Motor Systems
EMSA

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4E - Electric Motor Systems Annex EMSA

Electric motor systems use 40% of global electricity. They are used in industry, infrastructure and large buildings to drive pumps, fans, compressors, tractor systems and industrial handling & processing. With using best practice energy efficiency can be improved by 20% to 30% on average. Most improvements have a pay back time of 1 to below 3 years. This means a big potential impact on reduction of global greenhouse gas emissions.

In order to gain fast and efficient access to the large potential of energy efficiency improvements of motor systems the 4E Electric Motor Systems Annex EMSA is organized in tasks that will each contribute to a coordinated effort towards rapid transformation of global markets by:

- Spreading good practice,
- New improved technologies,
- Positive policy experiences.

EMSA is treated in 8 Tasks from A to H. The overall coordination in the Suite of the Operating Agent as coordinator and manager. Every Task identifies its scope and states its individual deliverables at the end.

Task A is the basic implementation work, external communication and outreach to be done under EMSA. The decision on selecting the following Tasks B to H, detailing and modifying the Tasks and eventually adding other new Tasks will be taken jointly by the participants and the respective Task leaders.

- A. Implementation support & outreach
- B. Technical guide for motor systems
- C. Testing centers
- D. Instruments for coherent motor policy
- E. Training & capacity building
- F. Energy management in industry
- G. New motor technologies
- H. Total motor systems integration (start later)

Download the EMSA Fact Sheet here.

News

- Motor Summit 2010 - program and registration
- 29 Jul 10 - Motor Systems
- Motor Summit 2010 announced
- 21 Oct 09 - Motor Systems
- EMSA goes EEMODE 2009
- 1 Feb 09 - Motor Systems
- EMSA Testing Centres Workshop at EXPOD 09
- 27 Aug 07 - Motor Systems

















www.motorsystems.org

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Participants in EMSA

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Australia 	Austria 	Denmark 	Netherlands 
Switzerland 	UK 	South Africa 	
Brazil 	Canada* 	China P.R.* 	France 
India* 	Japan* 	Korea S.* 	Sweden 
USA* 			*) Asian Pacific Partnership APP

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Participating Countries EMSA

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- Australia, Austria, Denmark, Netherlands, UK, Switzerland, South Africa (from 2010)*: *active*
- Brazil*, Canada, China*, Finland, France, India*, Japan, Korea S., Sweden, USA: *interested*
- ICA**: *interested to support Annex*

*) Non IEA Members

***) International Copper Association

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Conclusions

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1. Electric Motors are responsible for 40% electricity use
2. Efficiency potential of 10% to 30% is not tapped
3. MEPS are moving new motor sales toward IE3
4. Improvements need focus on Motor Systems
5. Tools for Motor-Check are readily available
6. Life cycle cost is the key planning instrument
7. Down sizing saves cost for better systems
8. Variable frequency drives need careful design

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Thank You for Your Attention

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Contact Information

- www.motorsystems.org (English)
- www.topmotors.ch (Deutsch et Français)

- See you all at the Motor Summit 2010
27 – 28 October 2010 in Zurich
www.motorsummit.ch

- Conrad U. Brunner
 - Operating Agent for IEA 4E
Electric Motor Systems Annex
 - Gessnerallee 38a
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