IEA Implementing Agreement

Energy Efficient Electrical End-Use Equipment

Annex 4: Electric Motors

Zürich, 25. June 2007, (CUB:c:\daten\iea ia\iea ia motors draft 1.doc)

Draft 2

Conrad U. Brunner, A+B International, Zurich Switzerland
cub@ABinternational.ch

1 Background

On 9 March 2007 a definition workshop was held at IEA in Paris to discuss the idea of a new IA. Standby Power, Lighting and Benchmarking were given as Annexes, motors and other equipment were mentioned as possible (see Chairman Richard Bradley's summary). On 9 July 2007 IEA has invited for a first meeting of a future IEA IA to define the Annexes and their scope.

Electric motors and systems in building technology and industry driving pumps, fans and compressors, etc. have been identified in an IEA "Industrial Electric Motor Systems Efficiency" workshop on motors on 15/16 May 2006 in Paris. The results showed that motors and systems use some 40% of electricity worldwide (60% to 70% of the electricity in the industrial and 30 to 40% in the service sector). It has been demonstrated by a large number of projects around the world that motor systems have an average efficiency potential of between 20% and 30%, with 10% to 80% in individual cases).

Major measures for improvement include:

1. Proper motor and equipment sizing according to the required load
2. Use of electronic frequency inverters (adjustable speed drives) to adapt the motor to the necessary partial load
3. Use of high efficiency electric motors that run cooler and more stable for an extended period of time
4. Secure no unnecessary losses in pipes, ducts, leaks.

Although motors are traded globally market barriers for efficient motors exist due to varying grid frequency (60Hz and 50Hz), not aligned testing standards and different marking schemes. Mandatory minimum energy performance standards are considered (after ample experience in USA, Canada, Australia, New Zealand, etc.) to be the most effective political instrument to move the motor market up to high efficient motors and systems.

In June 2006 at a side event of EEDAL'06 in London the international motor harmonization project SEEEM was launched (www.seeem.org). The European Union has decided on an Ecodesign directive for energy using projects in 2005 where electric motors, pumps and fans are targeted in Lot 11 for legislation in 2008 (www.ecomotors.org). Intermediate reports from Anibal de Almeida show that Premium motors have the least life cycle cost compared to Eff1 and Eff2. The IEC has launched two new standards for harmonized motor efficiency testing and energy efficiency classification ready to be implemented by 2008. The ITFSP has made a motor task among its topics (www.itfsp.org). The CLASP initiative has collected policy data (labels, MEPS, etc.) in various countries for motors, pumps, etc. (www.clasponline.org).

Today 10 countries with 47% of global electricity demand have motor MEPS enacted. 14 new countries (mainly in Asia and Europe) are targeted for a next round until 2012 to reach circa 80% of global electricity demand.

Table: Global electricity consumption for industrial electric motors
Sources: IEA WEO 2006 and A+B International (2007)

	Unit	Value
Electricity production global (2006)	PWh/a	18.6
Electricity production from fossil energy	PWh/a (%)	12.4 (67%)
Electricity for industrial motors (not included household appliances, consumer electronics, office equipment, vehicles)	PWh/a (%)	7.4 (40%)
Capacity for electric motors (peak)	TWe	1.6 to 2.3
Motor electricity, greenhouse gas emissions	G t CO2/a	4.3
Motor system energy efficiency improvement potential (average within life cycle 10..20 years)	min max	20% 30%
Electricity savings potential (industry and buildings)	PWh/a min max	 1.5 2.2
Greenhouse gas emission reductions potential	G t CO2/a min max	 0.9 1.4
Average electricity price (industrial end-users)	Euro/kWh	0.05
Electricity cost savings potential (industrial end-users)	Billion Euro/a min max	 75 110

2 Scope

The range of electric motors to be treated in this Annex should be clearly defined.

Major focus should be poly-phase electric motors between 0.5 and 500 kW that carry the bulk of the load to drive pumps, fans, compressors and mechanical drives. These machines are mainly used in industry, building technology and infrastructure. The motor and its core system (like the pump, fan, compressor, ASD, gear, belt, etc.) should be treated but not the complete system (the entire heating/cooling/ventilation system in a building, etc.)

Within that major range of motors the specific types and makes of electric motors should be left open because new motor technologies (permanent magnet, etc.) will be a major driver for enhanced energy efficiency. Also the auxiliary components (adjustable speed drives, voltage balance systems, etc.) should be included.

Smaller motors, often single phase, used in household appliances to drive washing machines, electronic equipment etc. should not be treated here because they can be looked at in the system context of the entire piece of equipment.

Electric motors in vehicles (trains, cars, airplanes, etc.) should not be looked at either because they are usually tailor-made for specific purposes with different frequencies, etc.

Technical matters (testing standards, energy efficiency classes, marking schemes & labels, etc.) and policy issues (necessary regulation, market mechanisms, incentives, etc.) should be treated.

3 Tasks

3.1 Data base

A global data base should be built up starting from existing IEA database. Subsequent surveys in key countries should be made to ensure a data volume whereupon a global motor efficiency strategy can be founded.

- Market and energy data (stock and annual sales with energy classes)
- Industry benchmarks (kWh per product)
- Policy data (monitoring system)
- Standards and labels (CLASP)
- Testing centres (accredited)

3.2 Technical issues

A reference system on technical issues should be built up, including:

- Aligned testing standard
- Energy efficiency classes
- Harmonized marking systems and labels
- New motor technologies (permanent magnet)
- Adjustable speed drives
- Tools for engineers
- Round robin test to qualify testing labs

3.3 Policy instruments

A reference system on successful policy instruments applied in different countries should be built up, including:

- Policy options and necessary steps
- Mandatory regulation (MEPS) domestic/imports
- Voluntary implementation (labels)
- Enforcement & compliance (certification, spot checking, sanctions)
- Public procurement

3.4 Incentives

A reference system on successful incentive measures applied in different countries should be built up, including:

- Financial incentives (loans, tax rebates, CDM, bonus/malus, etc.)

Information exchange (BAT)
Capacity building

3.5 Implementation support

Implementation of motor MEPS and subsequent policies has to be defined and countries and organizations need help to do it:

Manufacturers
OEM's
Rewinders
Distributors
End-users (large industries/smal users SME)
Developing countries

4 Time line

2007 Build basic organization, arrange for formal IE start with IEA rules,
Agree on time-line, operating agent, budget and funding,
Invite new member countries,
Define work packages.

2008 Assign work packages to task groups,
Launch data-base project,
Cooperate with AP6, EuP, ITSFP, SEEEM, MCP, IEC
Stake holder meeting in Paris: NEMA, CEMEP, JEMA, BEE, CNIS, AGO, etc.
Provide annual report (web based information on line)

2009 Organize stake holder meeting at EEMODS'09 in Nantes France

5 Organization

The IEA IA Motor annex should be staffed from technical and policy experts from the key regions of motor producers and motor users, namely Asia (China, India, Japan), Europe (EU and Russia, Switzerland), Australia/New Zealand, North America (USA/Canada), Middle/South America (Mexico, Brazil) and Africa (South Africa). It should focus on the 14 most critical economies for future implementation (see Annex).

The organization can be built around existing international projects and know how groups (SEEEM, CLASP, EuP, etc.).

6 Funds

The available funding from participating countries will have to be shared in the number of annexes. The motor annex will need a three year start-up budget in the order of magnitude of 1.5 to 3 million Euros depending on defined tasks and available resources and funding.

Annex

The status of 2008 for energy efficiency classes, testing standards and MEPS is shown in the following graph:

Efficiency Levels	Efficiency Classes	Testing Standard	Performance Standard
	IEC 60034-30	IEC 60034-2-1	Mandatory
	Global 2008	incl. stray load losses 2008	Policy goal
Super Premium efficiency	IE4		
Premium efficiency	IE3		USA 2011
High efficiency	IE2		USA Canada Mexico Australia New Zealand Korea 2008 Brazil 2009 China 2011 Europe 2011?
Standard	IE1		China Brazil Costa Rica Israel Taiwan

Countries with MEPS as of today have 47% of global electricity, 44% of global energy and 34% of global population.

MEPS	Year	1-phase induction motor	3-phase induction motor	Pump	Fan	Room AC	Central AC	Chillers	Heat pumps	Compres-sors	population	primary energy	electricity produc-tion
Australia	2000		1			1	1		1		**20**	**118**	**239**
Brazil	1999		1								**186**	**200**	**387**
Canada	1998		1			1	1		1		**33**	**311**	**576**
Chile	?	1	1								*16*	*26*	*51*
China	2006		1		1	1	1	1		1	**1'310**	**1'626**	**2'237**
Costa Rica			1			1					**4**		
Israel			1	1	1	1					**7**		
Malaysia											*25*	*60*	*91*
Mexico	2002	1	1	1		1	1				**107**	**144**	**222**
New Zealand											**4**	**18**	**43**
Philippines		1				1					*89*	*25*	*56*
Taiwan			1			1		1			**23**	**98**	**218**
Thailand	?		1			1					65	81	126
USA	1997		1			1	1		1		**298**	**2'324**	**4'148**
Vietnam	?		1			1					*83*	*50*	*40*
Total	**15**	**3**	**10**	**2**	**2**	**9**	**4**	**2**	**2**	**1**	**2'270**	**5'081**	**8'434**
											33,6%	**43,6%**	**47,0%**
											Mio	MToe	TWh

To reach some two thirds of global population, with 80% of GDP, and electricity in a MEPS motor strategy, the following 14 new countries (7 of them in Asia and 5 in Europe) should be added to the list. Target countries for the next round of MEPS should be among the large and developing economies (marked in red):

		Population		GDP		Electricity		
		Mio	% cumul	Mio US $	% cumul	TWh/a	% cumul	
1	**China**	1'322	20,0%	2229	5,0%	2475	13,6%	MEPS
2	**India**	1'130	37,1%	785	6,8%	679	17,3%	
3	**United States of America**	301	41,7%	12455	34,9%	4239	40,7%	MEPS
4	**Indonesia**	235	45,3%	287	35,5%	123	41,3%	
5	**Brazil**	190	48,1%	794	37,3%	405	43,6%	MEPS
6	**Pakistan**	165	50,6%	111	37,5%	96	44,1%	
7	**Bangladesh**	150	52,9%	60	37,7%	23	44,2%	
8	**Russia**	141	55,0%	581	39,0%	952	49,5%	
9	**Japan**	127	57,0%	4506	49,1%	1134	55,7%	
10	**Mexico**	109	58,6%	768	50,9%	233	57,0%	MEPS
11	**Germany**	82	59,9%	2782	57,1%	619	60,4%	
12	**Thailand**	65	60,9%	176	57,5%	575	63,5%	
13	**France**	64	61,8%	2193	62,5%	399	65,7%	
14	**United Kingdom**	61	62,7%	2193	67,4%	399	67,9%	
15	**Italy**	58	63,6%	1723	71,3%	302	69,6%	
16	**Korea, South**	49	64,4%	788	73,1%	395	71,8%	2008
17	**South Africa**	44	65,0%	240	73,6%	245	73,1%	
18	**Spain**	40	65,6%	1124	76,1%	292	74,7%	
19	**Australia**	20	66,0%	701	77,7%	243	76,0%	MEPS
20	**Canada**	33	**66,5%**	1115	**80,2%**	594	**79,3%**	MEPS
	Total	**4'388**		**35'610**		**14'422**		