

Annex: Electric Motor Systems

MS Project Paper (V3)

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Abstract

The Motor Systems Annex in IEA 4E tries to bundle best technical practice and policy know how in order to stimulate market transformation towards energy efficiency in the field of electric motor systems applications in industry, infrastructure and large building. So far 5 countries (Australia, Austria, Denmark, Switzerland and the UK) have agreed to collaborate. Several other countries have voiced interest and will hopefully join soon. The goal is to increase energy efficiency by 20% to 30% in the electricity consumption of motor systems - which are responsible for 40% of global demand - and thus reduce greenhouse gas emissions.

The project deals with pumps, fans, compressor and traction equipment and is organized to start with 6 Tasks (plus 2 additional Tasks to be started later):

- A Implementation Support & Outreach
- B Technical guide for motor systems
- C Testing centers
- D Instruments for coherent motor policy (to be started on a later date)
- E Training and capacity building
- F Energy management in industry
- G New motor technologies
- H Total motor systems integration (to be started on a later date)

In kind and cash contributions are shared by all participants with a minimum flat fee to pay for the general costs (Operating Agent and Task A).

MS will start from 1 November 2008 and last until the end of 2011. The total proposed budget as of now is 0.666 Mio € for 3 years (cash and in kind). The next MS meeting will be held on 24 November 2008 in Zurich Switzerland.

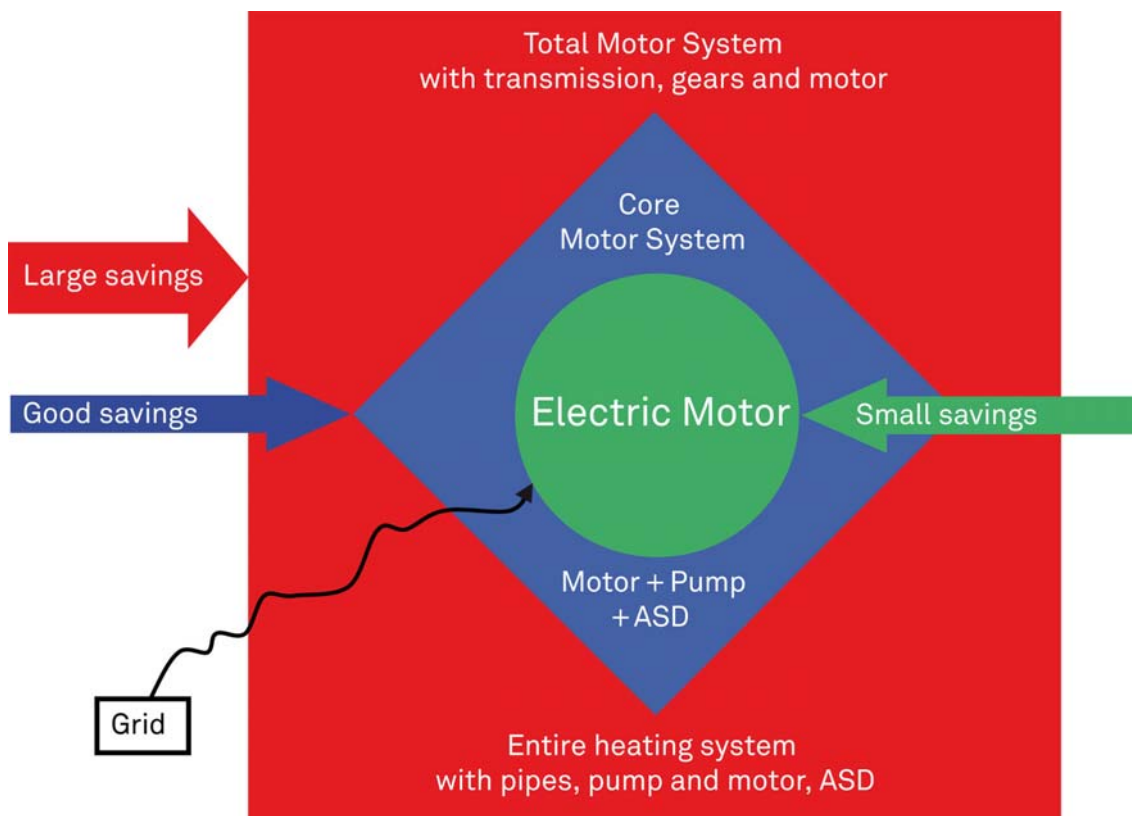
Goal and Scope

The goal of this IEA 4E Motor Systems Annex (MS) is to propagate energy efficiency in electric motor systems of advanced technology and engineering by coordinated policy and market mechanisms. The reduction of electricity demand will reduce global CO₂ emissions. Motor systems are responsible for 40% of global electricity demand. Energy efficiency improvements of 20% to 30% on average have been proven by industrial efficiency programs.

The range of electric motor systems to be treated in the MS is clearly defined. Major focus are the 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 produced worldwide in large quantities and are used globally in industry, building technology and infrastructure systems. The majority of the motors are AC, 2-, 4- and 6-pole and with 200 V to 1000 V. It will also include new emerging motor technologies with higher efficiencies and motor controls.

The electric motor and its core motor system (pump, fan, compressor, et cetera including the auxiliary components adjustable speed drive ASD, gear, transmission belt, etc.) will be treated in this Annex; they will be approached in the Tasks as separate work items (see Graph 1). The complete motor system (the entire heating, cooling, ventilation system in a building, etc.) with pipes, ducts, et cetera which has the largest energy savings can not be considered within the scope of the MS because of its complexity.

Graph 1 Definitions



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

Smaller motors ($\ll 1$ kW), often single phase, used in household appliances to drive washing machines and electronic equipment etc. will not be treated here because their standards, labels and Minimum Energy Performance Standards MEPS can be looked at in the context of the entire piece of equipment. Larger motors, typically run on middle or high voltage, are not considered in this Annex because they are custom made for specific purposes. It has been estimated that the mid range of electric motors (0.5 - 500 kW) treated here in MS, is responsible for the largest share of electricity demand of all electric motors.

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

Electric motors are mass-produced in standard types and sizes and are sold primarily to Original Equipment manufacturers OEM's and wholesalers. Only large industrial users buy motors directly from manufacturers. Also the respective core motor systems like pumps, fans and compressors are mass-produced but in less standardized categories.

Basically there are three different motor markets to be dealt with:

- Replacement of existing motor systems: replacement can happen as discretionary retrofit together with a potential upgrading of the motor and/or the system vs. replacement upon planned or sudden failure.
- Replacement is also to be considered vs. repair (rewinding), which often reduces the motor efficiency.
- New installations in expanding or new industrial facilities.

In all these three cases specific evaluations and decision-making has to be made. Different energy efficiency potential, different actors and cost benefit for the three markets have to be considered. In many installations old inefficient equipment is used way beyond its technical and economical life cycle and later sold and reused.

Technical matters (testing standards, energy efficiency classes, marking schemes & labels, etc.), information programs (training, capacity building, etc.) and policy issues (necessary regulation, market mechanisms, incentives, MEPS, implementation, enforcement, etc.) will be treated.

Ongoing international and important national activities in this field shall be tied into this IEA 4E MS Annex. Existing experience within IEA (DSM program, etc.) will be connected to the Motor Systems Annex.

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

- Spreading good/best practice,
- New improved technology,
- Learning from positive policy experiences.

Procedures

The MS has been developed in several stages. Switzerland has proposed an initial version of a project paper that was circulated to all interested parties by late 2007. In March 2008 a Draft 3 was distributed: In a kick-off meeting on 10 June 2008 in Zurich the Tasks were discussed and the Task leaders were nominated. Subsequently the Task leaders provided a draft description of their Task including a preliminary budget which was circulated in July and in September 2008.

The cost estimate is based on the Task descriptions and deliverables. The financing was decided to be on a flat fee base for the general cost plus a fee for participating in every additional task. In kind work was to be attributed following the Task leaders decision.

The present MS Project Paper (Version 3) is a fairly mature plan for the work to be started 1 November 2008. It is ready to be presented to the IEA IA 4E ExCo at its meeting on 23/24 October 2008 in Washington DC USA for approval.

If approved it will form the base for work in the first 3 project years from 2009 to 2011. An extension for 2 more years thereafter has been discussed but not formally decided yet. The MS project will have to be updated regularly and decided for the next period.

Next step will be to develop detail work plans and start with the work of the individual tasks. Next MS meeting is on 24 November 2008 in Zurich Switzerland (side event to Motor Summit 2008).

Tasks and Budget

The MS will start with the active participation of 5 countries (Australia, Austria, Denmark, Switzerland and UK) soon to be followed by 2 more countries (Japan and South Africa) in 2010. It is expected to have several other countries that have voiced interest to join MS later on (Brazil, Canada, France, Korea, and Netherlands).

The MS will start with 6 Tasks from A to G. Overall MS coordination will be the duty of the Operating Agent as coordinator, manager and liaison the IEA 4E ExCo. Every Task identifies its scope and states its milestones and individual deliverables at the end.

Task A is the basic implementation and external communication for the outreach to be accomplished under this 4E MS.

Task D Instruments for Coherent Motor Policy has been delayed at the start of MS. Task H Total Motor Systems Integration has not been clearly defined yet.

Table 1 Task Participants and Leaders

Tasks	Countries	Australia	Austria	Denmark	Japan	South Africa	Switzerland	UK
		OA	Operating Agent	Participant in Task	Participant in Task	Participant in Task	Participant in Task	Participant in Task
A	Implementation Support & Outreach	Participant in Task	Participant in Task	Participant in Task	Participant in Task	Participant in Task	Task Leader	Participant in Task
B	Technical Guide for Motor Systems		Participant in Task	Task Leader	Participant in Task	Participant in Task	Participant in Task	
C	Testing Centers	Task Leader		Participant in Task		Participant in Task	Participant in Task	
D	Instruments for Coherent Motor Policy	* Possible Task Leader						
E	Training & Capacity Building		Participant in Task	Task Leader		Participant in Task		
F	Energy Management in Industry	Participant in Task		Participant in Task	* Possible Task Leader	* Possible Task Leader		
G	New Motor Technologies	Participant in Task		Participant in Task	Participant in Task	Participant in Task	Participant in Task	Task Leader
H	Total Motor Systems Integration							Task Leader

The designated Task leaders are:

- A Conrad U. Brunner (Switzerland)
- B Hans Andersen (Denmark)
- C Sarah Hatch (Australia)
- D Sarah Hatch (Australia) (to be started on a later date)
- E Hans Andersen (Denmark)
- F (to be determined)
- G Charles Gaisford (UK)
- H Charles Gaisford (UK) (to be started on a later date)

The proposed operating Agent is Conrad U. Brunner.

The results from the above matrix (Table 1) for total cost (56% is cash and 44% is in kind) of Task work and funding expectations for 3 years (2009 - 2011) are reflected below in Table 2 (in 1000 Euro €). The funding is based on a flat fee per country of 10 k€ per annum to pay for the cost of all MS general items (namely Task A and OA) plus a minimum fee for each Task (cash and in kind) in which each country participates.

Not all countries have been able to secure and confirm the necessary funds so far. Confirmed contributions in cash and in kind from 5 countries are as of 2 October 2008 two thirds of the proposed total budgets.

Table 2 Budget of 2009 - 2011

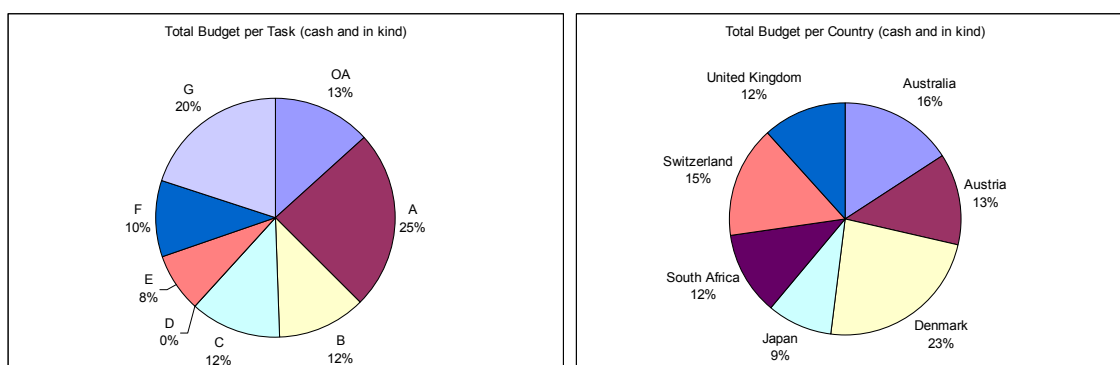
Countries (1'000 €)	Member 4E	Participating MS	OA	A	B	C	D	E	F	G	Total
Australia	x	x	12,0	25,2	0,0	31,0	0,0	0,0	18,0	19,0	105,2
Austria	x	x	12,0	25,2	13,0	0,0	0,0	16,5	9,0	9,0	84,7
Denmark	x	x	12,0	25,2	32,0	20,0	0,0	27,5	18,0	22,0	156,7
Japan		(x)	8,0	18,0	10,0	0,0	0,0	0,0	12,0	11,5	59,5
South Africa		(x)	8,0	18,0	10,0	9,0	0,0	10,0	12,0	11,5	78,5
Switzerland	x	x	24,0	25,2	15,0	20,0	0,0	0,0	0,0	19,0	103,2
United Kingdom		x	12,0	25,2	0,0	0,0	0,0	0,0	0,0	41,0	78,2
Total Budget (1000 €)			88,0	162,0	80,0	80,0	0,0	54,0	69,0	133,0	666,0
			13,2%	24,3%	12,0%	12,0%	0,0%	8,1%	10,4%	20,0%	100,0%

Graph 2: Budget development 2009 - 2011 (cash and in kind)

Countries	Member 4E	Participating MS	Cash-Budget per year and total				In-Kind Budget per year and total			
			2009 in 1'000 €	2010 in 1'000 €	2011 in 1'000 €	Cash in 1'000 €	2009 in 1'000 €	2010 in 1'000 €	2011 in 1'000 €	In-Kind in 1'000 €
year										
Australia	x	x	28,5	23,5	15,0	67,0	18,2	11,4	8,6	38,2
Austria	x	x	12,5	12,5	12,5	37,5	15,2	16,4	15,6	47,2
Denmark	x	x	26,0	26,0	17,5	69,5	32,2	21,4	33,6	87,2
Japan		(x)	0,0	19,5	16,0	35,5	0,0	11,4	12,6	24,0
South Africa		(x)	0,0	26,0	17,5	43,5	0,0	19,4	15,6	35,0
Switzerland	x	x	25,5	25,5	17,0	68,0	13,2	12,4	9,6	35,2
United Kingdom		x	22,0	15,5	15,5	53,0	9,2	7,4	8,6	25,2
Total Budget (1'000 €)			114,5	148,5	111,0	374,0	88,0	99,8	104,2	292,0

Total Cash and In-Kind Budget per year and total			
2009 in 1'000 €	2010 in 1'000 €	2011 in 1'000 €	Total in 1'000 €
46,7	34,9	23,6	105,2
27,7	28,9	28,1	84,7
58,2	47,4	51,1	156,7
0,0	30,9	28,6	59,5
0,0	45,4	33,1	78,5
38,7	37,9	26,6	103,2
31,2	22,9	24,1	78,2
202,5	248,3	215,2	666,0

Graph 3: Total budget per Tasks and per participating country



General Remarks & Rules

Cost estimates	Currency	All estimates in 1000 Euro (€)
	Base	Based on task description by task leaders and editing by OA
	In Kind	In kind work is estimated at 600 € (average mix) per day
	Travel cost	Travel cost are estimated individually by Task leaders and are considered in kind
	Coordination	Budgets in Task description will be coordinated, once general budget is approved
	Details	All tasks will need a detail work plan to be approved by the MS that forms the base for contracting.
Financing	Time line	Budget is based on 2009/10/11 (3 years). For 2012/13 (2 additional years) a preliminary budget is available that can be decided later.
	Participating countries	Start 2009 with 5 participating countries. 2010 2 additional countries are considered to share burden.
	General	All MS members share the general cost (OA and A) plus minimum of participation in at least one task
	In Kind	Countries pay in kind for time and travel cost to attend meetings and to deliver relevant national research material, market studies, etc. It also includes task work paid for directly in each country. Each task leader shall negotiate and confirm expected in kind budgets with each participating country.
	OA	Shared by all members, Switzerland with larger participation (2007 to 2011), no in kind work
	Task A	Equally shared by all members (cash and in kind), includes cost for general MS meetings
	Task B - G	Generally shared by all actively participating members, except task leader has provided budget with larger cash and/or in kind contribution (to be reviewed), task D not active yet.
Task H	No budget and task description available so far	
Exchange rate 2 Oct 2008	€ / US \$	1,41
	€ / UK £	0,79
	€ / CHF	1,58
	€ / AUD	1,77

List of All Task Descriptions

See following tables A to G (no Task D and H).



Task Description

General Information

Task

OA Operating Agent

Task leader Switzerland	Name: Conrad U. Brunner	Institution, Country: A+B International Gessnerallee 38a CH 8001-Zurich Switzerland
	Email: cub@cub.ch	
Participating Countries	All present members of IEA 4E MS Annex: <ul style="list-style-type: none"> ■ Australia ■ Austria ■ Denmark ■ Switzerland ■ UK Potential future members (potential date for active participation): <ul style="list-style-type: none"> ■ Japan (2010) ■ South Africa (2010) 	

Timeline

Timeline (start, end)	2008 Prepa- ration	2009 Start	2010	2011	2012	2013 End	Total
Milestones	Agreed Plan	Annual Report 1	Annual Report 2	Annual Report 3	Annual Report 4	Final Report	

Description	
Scope / General Description	<p>The Operating Agent of the IEA IA 4E Motor Systems Annex is responsible for the coordination of the Annex with its Tasks:</p> <p>Administration:</p> <ul style="list-style-type: none"> ■ Work plan ■ Timeline ■ Financial planning: costs and funding ■ Financial accounting: sponsors and recipients ■ Reporting to 4E ExCo ■ Organization of 2 annual meetings of all Tasks <p>Content:</p> <ul style="list-style-type: none"> ■ Coordination, guidance and support for Tasks A to H ■ Supervision of Tasks fulfilling their timelines and deliverables ■ Planning of Task development and future Tasks <p>The OA budget includes:</p> <ul style="list-style-type: none"> ■ Work of OA as MS coordinator, with necessary technical and administrative assistants (all fees including taxes) [58%] ■ Reporting to ExCo and coordination with other 4E Annexes and 4E OA [14%] ■ Expenses for OA travel (2 annual internal MS meetings) [5%], ■ Expenses for 2 annual internal 2-day MS Task meetings and video-conferences (conference rooms, travel cost for experts, et cetera) [23%]

Work Plan & Goals (including details of milestones)	<ol style="list-style-type: none"> 1. Preliminary phase. IEA IA and MS Annex (2007 and 2008) Definition, preliminary program, preliminary participants, kick-off event, first public event. Annual report 1 (including performance records and financial statements). 2. First phase: Program build-up (2009) Make MS and its Tasks coherent and active. Annual report 2. 3. Second phase: Expansion (2010 - 2011) Expand country and Task membership, participation and funding. Revise list of active Tasks. Update Task description. Annual reports 3 and 4. 4. Third phase: Consolidation (2012 - 2013) Focus on integration of MS findings and implementation with key stakeholders and in target countries. Annual report 5 and Final Report.
Deliverables	<ol style="list-style-type: none"> 1. Annual reports 1 to 5, including reporting to 4E ExCo. 2. Final report 2013

Coordination	
External institutional contacts	Organizations and programs: IEA 4E ExCo, other IEA 4E Annexes, other IEA IA (Industry, DSM, etc.)
Coordination with ongoing / planned activities	

Approved version	1
Date	3.10.2008

Task Description

General Information

Task

A Implementation Support & Outreach

Task leader Switzerland	Name: Conrad U. Brunner	Institution, Country: A+B International Gessnerallee 38a CH 8001-Zurich Switzerland
	Email: cub@cub.ch	
Participating Countries	All present members of IEA 4E MS Annex: <ul style="list-style-type: none"> ■ Australia ■ Austria ■ Denmark ■ Switzerland ■ UK Potential future members (potential date for active participation): <ul style="list-style-type: none"> ■ Japan (2010) ■ South Africa (2010) 	

Timeline

Timeline (start, end)	2009	2010	2011	2012	2013	Total
	Start				End	
Milestones	EEMODS'09 Nantes France	MS'10 Asia-Pacific	EEMODS'11 Europe	MS'12 America	EEMODS'13 Australia	

Description	
Scope / General Description	<p>Task A is the general information and communication platform:</p> <ul style="list-style-type: none"> ■ internally for MS Annex member countries ■ externally for associated industry, motor users, other countries and stake holders. <p>The means of communications are internal workshops and video-conferences, public seminars and regional conferences, web site with regular electronic newsletters (www.motorsystems.org) and the distribution of printed material.</p> <p>The goal is the build-up of a global efficient motor-systems-network in order to target key stake holders in industry, government and academia. Information and results from all 4E MS Tasks will be exchanged also between existing motor systems projects, energy efficiency programs and respective governmental and non-governmental organizations.</p> <p>A motor-market database for all participant countries and other countries will be built up. This includes sales data of efficient motor systems (IE3/IE2, VFD, etc.). The annual monitoring results will be published regularly and are used to identify target countries and to monitor MS project development.</p> <p>A central motor systems document archive will be built based on results from all MS Tasks. It includes relevant international and national standards and policy documents, research study results and best practice reports.</p> <p>The Task A budget includes:</p> <ul style="list-style-type: none"> ■ Work of Task leader with necessary technical and administrative assistants (all fees including taxes) [39%] ■ Work for coordination of motor data-base with MS participants and other countries [16%] ■ Expenses for MS 1 public meeting annually (conference rooms, food, video-conferences, travel expenses for invited experts/speakers, etc.) [20%] ■ Work and expenses for communication (print publications, electronic newsletter, web, et cetera.) [25%]
Work Plan & Goals (including details of milestones)	<p>First Phase: Program build-up (2009)</p> <ol style="list-style-type: none"> 1. Make MS and its Tasks coherent and active. Build-up internal and international communication network. 2. Second phase: Expansion (2010 - 2011) Expand membership, participation and funding. Revise list of active Tasks. Contact target countries and stake holders. 3. Third phase: Consolidation (2012 - 2013) Focus on implementation of MS findings with key stakeholders and in target countries.
Deliverables	<ul style="list-style-type: none"> ■ Annual public workshops as side event at international motor conference: MS (08 in Zurich), EEMODS (09 in France), from then on alternating between Asia-Pacific, America and Europe. ■ Expand list of participating organizations and persons in global efficient-motor-systems-network. ■ Build-up Motor system web site with document archive and market data review. ■ Build solid volume of web-visitors and -hits. ■ Provide fact sheets of 4E MS. ■ Forward 2 to 4 electronic newsletters per year.
In kind work	<p>Member countries of the MS Annex will be required to dedicate in kind work to Task A and make cash contributions according to</p>

	<p>an agreed financial scheme.</p> <ul style="list-style-type: none"> ■ National resources: National research results and reports on best practice experiences and policy should be shared and made available to other MS participants. ■ Available data on national market studies on motor and motor systems production, import/export, share of IE3 and IE2 shall be provided to the MS. Intellectual property has to be honored and copyright has to be mentioned. ■ Qualified staff: Capable of attending international meetings (online and twice a year in person), necessary capacity for work available, work time and travel cost. Necessary infrastructure: video and phone conferences, et cetera. ■ In kind work applies only to work specifically dedicated to the MS within its scope and the deliverables of the respective Tasks. It must be additional work otherwise not undertaken.
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Coordination	
External institutional contacts	Organizations and programs: CLASP, APEC-ESIS, APP, Motor-Challenge Europe, EuP, ITFSP, Unido, UNDP, UNEP, EERE, ACEEE, eceee, ECOS,
Coordination with ongoing / planned activities	Stakeholder industry organizations: NEMA, JEMA, CEMEP, ICA

Approved version	1
Date	3.10.2008



Task Description

General Information

Task

B

Technical Guide & Tools

Task leader Denmark	Name Hans Andersen	Institution, Country Danish Technological Institute, Denmark
	Email: Hans.Andersen@teknologisk.dk	
Participating Countries	<ul style="list-style-type: none"> ■ Austria ■ Denmark ■ Japan ■ South Africa ■ Switzerland 	

Timeline

Timeline (start, end)	2009	2010	2011	2012	2013	Total
Milestones - Startup - Handbook – facts - Handbook – engineer - Guide – tools	Start-up WS Management whole C	HB- facts - η -levels - labeling - LCC-scheme	HB-eng - sizing - starting issues - control, motor & transmission - maintenance	G-tools - over-view of tools in action - user guide and demonstration		

Description	
Scope / General Description	<p>A state of the art reference guide addressed for three kinds of target groups:</p> <ol style="list-style-type: none"> 1. Machinery-builders 2. End-users & consultants in general 3. Manufacturers of electrical motors & VSDs <p>The guide will outline legislation topics all over the world and emphasize minimum requirements for being represented in markets all over the world.</p> <p>Furthermore the guide will secure proper design of motor-systems adjusted to the accurate need. Topics such as type of motor, size of motor, type of control system, type of transmission and best primary machinery (fan, compressor & pump) will all be analyzed and underlined by practical examples.</p> <p>Related – very important for end-user – issues such as maintenance and possibility for later upgrading of the system will also be discussed and underlined by practical examples.</p> <p>Several tools related to the issues described above are already developed all over the world. After a screening, those who still are in function will be presented in a short description, a user's manual and again underlined by a practical example.</p>
Work Plan & Goals (including details of milestones)	<p>2009</p> <p>A 2-days startup meeting in Copenhagen will be arranged. At this meeting the Task-leader will outline three different work-packages:</p> <ul style="list-style-type: none"> - Handbook only including facts (world-map for CLASP etc.) - Handbook in engineering and end-user guidance - Handbook in calculation tools <p>The Task-leader will participate in all three work-packages and each of the four other contribution countries is supposed to participate in at least one package.</p> <p>In the second half of 2009 there will be 1-day meetings arranged for each work-package. Video-conference will be necessary for some of the participants.</p> <p>2010</p> <p>Again the whole group will be gathered in a 2 day-meeting. Day one is for discussing the first final draft of the Handbook including facts according to MEPS, standards etc.</p> <p>This handbook has to be a very thin one due to the fact that it must be re-written every third year. At least the dynamic part of the book has to be very thin.</p> <p>The second day is for discussing the work in the two remaining packages.</p> <p>2011</p> <p>Finishing the Handbook in engineering</p> <p>2012</p> <p>Finishing the Handbook in Calculation-tools</p>
Deliverables	<p>2009</p> <p>Minutes from start-up workshop – WS1 Minutes from work-package meetings – 3 meetings</p>

	<p>Draft of Handbook including facts (CLASP etc.)</p> <p>2010 Minutes for status works-shop – WS2 Minutes from work-package meetings – 2 meetings Final of Handbook including facts (CLASP etc.) Draft of Handbook in engineering and guidance</p> <p>2011 Minutes for status works-shop – WS3 Minutes from work-package meetings – 1 meeting Final of Handbook in engineering and guidance Draft of Handbook in calculation-tools</p> <p>2012 Minutes for closing works-shop – WS4 Final of Handbook in calculation-tools</p>
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Coordination	
External institutional contacts	
Coordination with ongoing / planned activities	IEC guides IEC 60034-31 (Planning), IEC 60034-20-2 (VFD); MEPS-guide NEMA/IEC: Boteler/Doppelbauer/de Almeida, et al. FAQ: Doppelbauer et al. (2008)

Approved version	1
Date	3.10.2008



Task Description

Task

C Testing Centers

Task leader Australia	Name Sarah Hatch	Institution, Country Department of the Environment, Water, Heritage and the Arts, Australia
	Email: <i>sarah.hatch@environment.gov.au</i>	
Participating Countries	<ul style="list-style-type: none"> ■ Australia ■ Denmark ■ South Africa ■ Switzerland 	

Timeline

Timeline (start, end)	2009	2010	2011	2012	2013	Total
	Start	End				
Milestones	MS1 MS2 MS3 MS4	Mar 09 Dec 09	Dec 10			

<p>Scope / General Description</p>	<p>The aim of this work is to raise the quality of testing of motors worldwide. This will be achieved by facilitating a dialogue between a selection of test labs in order to share best practice in the use of the new IEC 60034-2-1 procedures.</p> <p>This will also represent a useful forum for developing conventions on any unresolved points of detail on procedures, should any become apparent.</p> <p>This network of laboratories will be encouraged to share the results of this work with other laboratories in each geographical region.</p> <p>It is hoped that this exchange of ideas will still take place.</p> <p>This work is important in order that both suppliers and purchasers can be confident of the claimed performance of motors on the market.</p>
<p>Work Plan & Goals (including details of milestones)</p>	<p>MS1 Identification of Participating Test Centers Identification of key independent and industry testing centers in each geographical region. The following regions are suggested at this stage:</p> <ul style="list-style-type: none"> - Americas (USA, Canada, South America) - Asia-Pacific (China, Japan, Korea, Australia etc) - Europe <p>This activity includes gaining agreement from these test centers to participate in the work. Indicatively there shall be at least three (hopefully 4 to 6) test centers from each region.</p> <p>MS2 First international meeting on Testing procedures Arrange and facilitate a first meeting of representatives from these test laboratories. To make this more attractive to test labs, this would probably be arranged as part of an existing meeting, e.g. EEMODS. A progress report will be produced.</p> <p>MS3 Second international meeting on Testing procedures This would follow on from the first meeting, at a time chosen according to the need. While budget is shown for a physical meeting, it might be possible for this to take the form of a telephone-/videoconference instead. A progress report will be produced.</p> <p><i>In addition, further meetings would be arranged on an annual basis by the group, but without the in depth support of this annex. This is to see whether the group has the motivation to function on an ongoing basis – and if not, to see what type of support is needed.</i></p> <p>MS4 Final Report Report summarizing the achievements of this Testing procedure workgroup.</p>
<p>Deliverables</p>	<ul style="list-style-type: none"> - Two meetings and associated documentation including full minutes and progress reports - Report summarizing the achievements of this Testing procedure workgroup.

Coordination with ongoing / planned activities	It is expected that the results of the APP Round Robin motor testing will be made available to the annex. This Sub Task may also wish to provide information to the APP Round Robin motor testing project. It is necessary to have the IEC Round Robin motor testing report available in 2009.
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Approved version	1
Date	3.10.2008



Task Description

General Information

Task

D Coherent Motor Policy

Task leader Australia & Austria	Name Sarah Hatch Konstantin Kulterer	Institution, Country Australian Government Austrian Energy Agency
	Email: sarah.hatch@environment.gov.au Ph +61 2 6274 1199 www.energyrating.gov.au konstantin.kulterer@energyagency.at T: +43 (0)1 586 15 24 - 114	
Participating Countries	■ start delayed	

Timeline

Timeline (start, end)	2009 Start	2010	2011 End	2012	2013	Total
Milestones		01/draft report	07/Final report			

NOTES Travel is an estimated amount for attendance at key meetings, e.g. ACEEE Summer Study to help with research for reference materials. Budget based on 5d admin overhead for each country, 5 * 15 d for production of case studies, 5d for production of summary document, and 11.5 days additional for Task leaders for coordinating the study.

Description	
Scope / General Description	<p>Reference guides of successful programs and policies for implementing motor systems efficiency all over the world. The aims of this Task are to:</p> <ol style="list-style-type: none"> 1. share information on what is needed to make each type of program successful, including pitfalls to be avoided. 2. understand what mix of policies and programs are needed to achieve particular goals. <p>Regions covered will include: US, Australia, Japan, Europe, furthermore: Canada, New Zealand, South Africa, South America, China, and India.</p> <p>Policy Instruments with focus on motor systems efficiency included could be for example: MEPS (legal or voluntary), labels, energy management-schemes and audit programs, rebate programs, training and education programs, financial incentives (taxes, funding schemes, credits...), white certificates, public awareness programs, projects of energy service companies, co operations such as energy agencies with production or service companies, information platforms. Coordination necessary with Technical Guide Task B</p>
Work Plan & Goals (including details of milestones)	<p>01/2010</p> <p>First Draft of Policy Instruments:</p> <ul style="list-style-type: none"> - Listing of possible programs/policies to be evaluated. - Selection of 10 -15 case studies to be prepared in the first part of the project. - Preparation of first selected cases studies, allocation of work will be done according to the projects hours (e.g. AUS: 3-5, AUT: 3-5, JAP: 2) <p>Aspects to be considered include enforcement, compliance, calculation methods, evaluation of the success (e.g. energy savings) of the programs (sources: web, articles, conference proceedings, interviews, public statistics, financial considerations)</p> <p>7/2011</p> <p>Final Draft of Policy Instruments: Most important experiences with policy instruments for motor systems will be described (scope, stakeholders, kind of measure, evaluation of success) Including the main lessons learned for implementing policy instruments on different levels (local, regional, national, continental and global), definition of necessary steps, stakeholder-integration, and criteria for success.</p> <p>Summary Handbook A short (c.3-8 page) document aimed at non-technical policymakers summarizing the findings of the Task.</p>
Deliverables	<p>First Draft of Policy Instruments reference guide and summary "handbook".</p> <p>Final Version of Policy Instruments and summary "handbook".</p>

Coordination	
External institutional contacts	<p>Energy System and Components provider (Austria, Germany), Ministries Austria MEPS Guide Boteler/Doppelbauer/DeAlmeida, 2008</p>
Coordination with ongoing / planned activities	<p>Ecodesign EuP Consultation Forum Lot 11 (www.ecomotors.org) European Energy Using Consultation Forum</p>

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Task Description

General Information

Task

E

Training and Capacity Building

Task leader Denmark	Name Hans Andersen Henning Gudmand-Høyer	Institution, Country Danish Technological Institute Danish Standards Denmark
	Email: Hans.andersen@teknologisk.dk HG@ds.dk	
Participating Countries	<ul style="list-style-type: none"> ■ Austria, ■ Denmark ■ South Africa 	

Timeline

Timeline (start, end)	2009	2010	2011	2012	2013	Total
Milestones	Establish MS-Annex boards: - politicians - machinery builders - end-users & consultants - manufacturers	Discussion in boards activities from Task A-H	Training Course 1 - politicians & manufacturers	Training Course 2 - Machinery-builders and End-users	Assembly total package	

Description	
Scope / General Description	<p>It is necessary to ensure adequate institutional, human and financial resources on a national level. The training of industrial engineers and planners as well as dissemination among policy makers, end-users, technical advisors.</p> <p>This Task will produce a total package of dissemination and training material. The development will take place side by side with the development of the other specific Task in the Motor Systems Annex. Coordination necessary with Task B Technical Guide.</p> <p>In Denmark there is a heavy tradition in training and discussion of these issues. Therefore it's easy to establish discussion-boards in the different mentioned target groups.</p> <p>These groups will carry out a first draft of material. This material secondly will be tested in the other participating countries in at least one of the four prioritized target-groups:</p> <ul style="list-style-type: none"> - Politicians - Machinery builders - End-users & technical advisors - Manufacturers (motors, transmission, VSDs etc.) <p>As an example Denmark will incorporate some of the activities which are going on according to standardization activities in general:</p> <p><i>DS – Danish Standardization - will in collaboration with our national committee S-502 Rotating Machines (linked to IEC and CENELEC), make sure that relevant views and comments are communicated between the project 4E relevant people, and the Danish national committee. This will secure that the Danish industry and authority will get maximum benefit of the Danish participation in the project.</i></p> <p><i>In addition DS will be able to communicate the status and progress to the Danish public via our homepage and newsletter.</i></p> <p><i>Both Tasks will take place through out the project period.</i></p>
Work Plan & Goals (including details of milestones)	<p>2009 (second half) Planning outlining of the MS-annex to target-groups 1 day Seminar for the 4 target-boards in Denmark</p> <p>2010 Presentation/discussion of element from all MS-annex Tasks in the Danish target-groups & at least one additional country.</p> <p>2011 Public / International / training course in Denmark addressed to politicians and manufacturers.</p> <p>2012 Public / International / training course in Denmark addressed to Machinery-builders and End-users.</p> <p>2013 Assembly of total dissemination and training package</p>
Deliverables	<p>2010 Agendas from works-shops Presentation from work-shops Minutes form work-shops</p> <p>2011 & 2012 Programs form training-courses Description of necessary trainings-staff Presentations from training courses Tools from training courses</p> <p>2013 Total package ready for www-download</p>

Coordination

External institutional contacts

Coordination with ongoing / planned activities

Approved version	1
Date	3.10.2008



Task Description

General Information

Task

F Energy Management in Industry

Task leader (to be decided)	Name Draft by: Frank Hartkamp	Institution, Country SenterNovem Netherlands
	Email: f.hartkamp@senternovem.nl	
Participating Countries	<ul style="list-style-type: none"> ■ Australia ■ Denmark ■ Japan ■ South Africa 	

Timeline

Timeline (start, end)	2009 Start	2010	2011	2012	2013 End	Total
Milestones	Position Paper	Linking List Energy Manage- ment	Linking List En- ergy Services	Linking List En- ergy Audit and Bench- mark	Fact sheets & Task evalua- tion, review	

Description	
Scope / General Description	<p>This Task focuses on proper motor system management from an energy perspective and how this should be included in the various standardizations on industrial energy issues, now being worked on from CEN/CENELEC and ISO.</p> <p>At the European level standards are being formulated for: (1) energy management, (2) energy audit, (3) benchmarking and (4) energy efficiency services. (1) is also starting on ISO level, probably the others will follow in due time.</p> <p>How to implement proper motor system management should be 'crystal clear' in these related standards.</p> <p>Output of the Task will be:</p> <ul style="list-style-type: none"> - awareness raising - linking documents for these standards and how to implement actions for motor system energy use optimization. For instance in the guidelines of the standard on energy management, no examples are put in how to choose for the accurate efficiency class of the motor, or how to identify and solve compressed air leakage; and: additional to the standard for energy audit an overall description of how to conduct the audit part on motor systems is needed. - fact sheets to communicate results
Work Plan & Goals (including details of milestones)	<ul style="list-style-type: none"> ■ 2009: workshops and position paper. This phase will start up the work from 2010: input will be needed from partners and others what (examples and descriptions) to include. ■ 2010 – 2012: linking documents, to generate input for various standard processes ■ 2012-2013 fact sheets
Deliverables	<p>2010: Position paper and minutes of workshops</p> <p>2010: Linking document for energy management</p> <p>2011: Linking document for energy services</p> <p>2012: Linking document for energy audit</p> <p>2012: Linking document for energy benchmarking</p> <p>2013: 4 fact sheets and 1 project evaluation/review</p>

Coordination	
External institutional contacts	ISO Standard development group
Coordination with ongoing / planned activities	

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Task Description

General Information

Task

G

New Motor Technologies

Task leader United Kingdom	Name Charles Gaisford	Institution, Country Sustainable Products & Materials Program, DEFRA, UK
	Email: Charles.Gaisford@WSPGroup.com	
Participating Countries	<ul style="list-style-type: none"> ■ Australia ■ Denmark ■ Japan ■ South Africa, ■ Switzerland ■ UK <i>Future countries: Canada, USA</i>	

Timeline

Timeline (start, end)	2009	2010	2011	2012	2013	Total
Sub Task 1	Jan---Apr					
Sub Task 2	Jan---Dec					
Sub Task 3		Jan-----	-----	-----Dec		
Sub Task 4	Jan-----	-----	-----	-----Dec		

Description

Scope / General Description	<p>Scope: Initially stand alone, series produced electric motors used in commercial and industrial applications; in cases where motors require an electronic controller (converter) in order to function then the electronic controller is also included Electric Motors with a rated input (PN) of 0.75kW through 375 kW, with a rated voltage UN up to 1000V and designed for continuous duty (S1). Motors designed for 'special purpose' applications such as explosive atmospheres are excluded'. Motors with fixed speed outputs and motors with variable speed outputs, e.g. converter (variable speed drive) fed motors are included. Examples types include ac induction motors, permanent magnet motors and switched reluctance motors. The scope will be refined further as the work is progressed.</p> <p>The methods of application and use of these electric motors is initially outside of the scope of this work. It is intended that their use will be addressed in another future Task within the annex.</p> <p>Background</p> <p>Comparisons across motor technologies: The efficiency of current best-in-class AC induction motors is relatively high, ranging from about 83% for small motors (1.1 kW) to over 95% for large motors (110 kW); future efficiency gains for this type of motor are not anticipated to be significant. Other motor technologies (OMTs), such as those employing permanent magnets or</p>
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	<p>switched reluctance motors, offer potential for increased efficiency improvements, especially in the smaller motor size ranges.</p> <p>As OMTs gain acceptance, they will be competing for market share and there will be demand for equal comparisons between the technologies. Developing such comparisons is not straightforward and several issues need to be considered, including:</p> <ol style="list-style-type: none"> 1) Overall efficiency: When considering existing technologies, the efficiency of OMTs (including the electronic controller) is comparable with or exceeds the efficiency of best-in-class AC induction motors at or near full load, and OMTs are considerably more efficient under part-load conditions. 2) Fixed speed applications vs. variable speed applications: <ol style="list-style-type: none"> a) Line-connected AC induction motors can deliver only a nominal output torque (power) at a fixed speed, whilst many OMTs deliver output torque (power) across a wide speed range, thereby exceeding the capabilities of line-connected AC induction motors. There may be a cost premium for OMTs due to the electronic controller. b) An AC induction motor may also be controlled by an electronic controller (variable speed drive) to deliver similar functionality to that of OMTs, and at a comparable cost. <p>It is therefore possible to conclude the following:</p> <ul style="list-style-type: none"> • In fixed speed applications and when efficiency requirements dominate, OMTs will compete directly with AC induction motors at the top end of the market. • In applications where variable speed control is required, OMTs will compete with AC induction motors fitted with electronic controllers. <p>Labeling schemes and related energy conservation measures should therefore be designed to deliver an equal comparison of these technologies in the scenarios described.</p> <p>Testing Methods There has been some debate within industry as to how the performance of an electronic motor controller may be measured in terms of efficiency and there is consensus that this varies considerably, which is in part due to the electrical input stage of the controller and the electrical harmonics this may cause. Further research is required in order to establish the optimum measurement methods for efficiency determination.</p> <p>The electronic controller and motor comprise a "Power Drive System", it is more accurate to access the performance of this system than the individual components, and to measure the overall losses. Experience from industry suggests the comparative losses at full load are less significant than the losses at part load which can vary by up to 50%. Consequently any categorization system should consider a "basket" of duty points.</p> <p>Test standards A standard intended to address measurement of variable speed motors is being developed, namely IEC60034-2-3 'Specific test methods for determining losses and efficiency of converter fed AC machines', this standard is however still in the early stages of drafting and is only scheduled for completion in 2012; in addition it only addresses the performance of the motor and does not take account of the electronic controller.</p> <p>It is intended that Task 1 will lead to the development of methods and standards that will enable equal comparisons between different electric motor technologies.</p>
<p>Work Plan & Goals (including details of milestones)</p>	<p>Sub Task 1: Analysis of existing test standards <i>Start date:</i> Jan 2009 <i>Duration:</i> 3 months <i>Cost / Effort required:</i> Euro 8k based on 11 to 14 days effort <i>Objective:</i> To determine the coverage of efficiency test standards for the products in question <i>Deliverable:</i> Report</p> <p>Actions:</p> <ol style="list-style-type: none"> 1) Research current established motor technologies available on the market and establish their relative levels of uptake (e.g. ac induction, permanent magnet, switched reluctance motors) 2) Research emerging / future motor technologies and establish likely uptake – by size, proportion and by application type. 3) Identify test methods (globally) in existence for all of these products, note type of performance measured (e.g. full load at fixed speed, or part load at part speed) and existing performance rating systems (e.g. labeling schemes) 4) Conduct gap analysis on the test standards identifying: <ol style="list-style-type: none"> a. Which motor technologies do not have sufficient test methods to rate their performance (including their electronic controllers) and,

	<p>b. Which test methods could be used to give an equal comparison across technologies?</p> <p>5) Identify gaps and associated opportunities to develop test methods and performance comparisons between the motor technologies, most notably between fixed speed ac motors and variable speed controlled motors.</p> <p>Sub Task 2: Product performance testing & measurement <i>Start date: Jan 2009</i> <i>Duration: 12 months</i> <i>Cost / Effort required: Euro estimate 70k (based on 3 months of laboratory research time)</i> <i>Objective: To evaluate test methods and product configurations that will lead to optimum efficiency test standards for the products in question</i> <i>Deliverable: Report plus recommendations to underpin standards development</i></p> <p><i>National contributions: (note the work in this Task will be carried out by a research organization so cash only contributions recommended).</i></p> <p>Actions: Conduct a research project examining the spread of efficiency performance across a sample of electric motors with their electronic controls (initially motors in the size range 0.75 kW through 37 kW) Establish the following:</p> <ol style="list-style-type: none"> 1) The spread of efficiencies across as range of motor and controllers with different input stages (e.g. 6 pole uncontrolled rectifiers, with and without input filters, and active input stages), and sizes. Test different speed and loading scenarios. The sample should include ac induction motors, switched reluctance motors and permanent magnet motors. 2) The most optimum / representative controller configuration (with motor) for efficiency performance measurement. 3) The most optimum (repeatable) test method for efficiency performance measurement. <p>It is envisaged that industry will be invited to participate in the exercise, supplying the machines for testing (motors and controllers) and contributing to discussions (series of workshops) on determining the optimum test configurations. <i>Note it is anticipated that the results will be presented in a format that will not allow the performance of individual manufacturer's products to be identified.</i></p> <p>Sub Task 3: Facilitating standards development <i>Start date: Jan 2010</i> <i>Duration: 36 months</i> <i>Cost / Effort required: Euro 45k over 3 years. Based on 17 to 22 days effort plus Euro 2K expenses per year.</i> <i>Objective: To facilitate development of existing standards and to initiate development of measures such as a labeling scheme for variable speed motors.</i> <i>Deliverable: Technical services</i></p> <p>Using the outputs from Task 2:</p> <ol style="list-style-type: none"> 1) (2010 - 2011) Supply data and a representative to attend and contribute to the further development of IEC 60034-2-3, pressing for the inclusion of the electronic controllers into the test procedure. 2) (2010 - 2012) Facilitate a forum to develop and agree standard methods of comparison between the significant different motor technologies (e.g. how to compare between fixed speed motors & variable speed motors). Outputs from this could lead to an IEC or equivalent standard being developed, E.g. a labeling scheme for variable speed motors that is parallel to the new labeling scheme IEC 60034-30. <p>Sub Task 4: Co-ordination & facilitation of the sub Task <i>Start date: Jan 2009</i> <i>Duration: 48 months</i> <i>Cost / Effort required: Euro 32k over 4 years. Based on 11 to 12 days effort plus Euro 1K expenses per year.</i> <i>Objective: To facilitate projects and co-ordinate activities associated with sub Tasks 1 – 3. Arrange contracts, stakeholder engagement, publish results.</i> <i>Deliverable: Coordination of Sub Task 1 - 3</i></p> <p>Notes: Objectives include a) to remain technology type independent wherever possible b) To identify ways to compare between fixed speed products and variable speed products.</p>
Deliverables	<ol style="list-style-type: none"> 1) Report presenting: <ol style="list-style-type: none"> a) Classification of motor technologies with associated test methods and performance classification systems

	<ul style="list-style-type: none"> b) List of emerging motor technologies and methods to measure performance and classification c) List of gaps and opportunities for to develop performance test and classification methods between the motor technologies. <p>2) Laboratory report describing:</p> <ul style="list-style-type: none"> a) Test results of a sample of VSDs with motors operating at various duties. b) Comparison of various test methods c) Recommendations for most optimum controller and motor configuration for test purposes d) Results and recommendations for most repeatable efficiency measurement test methodology <p>3)</p> <ul style="list-style-type: none"> a) Technical support services and facilitation to development of IEC test standard. b) Recommendations on how to conduct comparisons between variable speed and fixed speed motors. c) Initiate development of labeling scheme for variable speed motors.
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Note: Budget implications have to be clarified as to distribution of large first year over 2 to 3 years. Financing has to be clarified. In kind work of participants might need to be converted in cash contributions.

Coordination	
<p>External institutional contacts</p> <p>Coordination with ongoing / planned activities</p>	<p>Contact : Charles Gaisford Email: Charles.Gaisford@WSPGroup.com Tel : +44 (0)075 0022 7169</p> <p>The IEC are currently developing</p> <ul style="list-style-type: none"> ■ A guide IEC 60034-20 "Guide for the performance and testing of brushless permanent magnet servo motors" (CD 23.11.2007, Paul Watson chair) ■ a standard, <i>IEC 60034-2-3 'Specific test methods for determining losses and efficiency of converter fed AC machines'</i>. This standard is still in the early stages of drafting and only due for publication in 2012. <p>It is intended that the outputs of TASK I could be used to inform and accelerate the development of this standard.</p> <p>University of Nottingham, UK who have extensive experience in, and testing facilities (including calorimeters) for electric motors and their electronic controls are possible candidates to consider for carrying out the research work.</p> <p>Trade associations to engage include: CEMEP (Europe) NEMA (USA) GAMBICA (UK)</p> <p><i>Other organizations will be considered as they are proposed, this could include:</i> <i>Other Academic institutions</i> <i>Other national trade associations</i> <i>Canadian Standards Association</i></p>

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