EuP Preparatory Study Lot 11

Motors (sub-study)

Minutes Second Stakeholder Meeting

Venue: ZVEI, Stresemannallee 19, 60596 Frankfurt, Germany

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Participants:

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These minutes record the main issues and outcomes discussed at this second stakeholder meeting. The details of this meeting were posted on the study web-site in advance of this meeting, and an e-mail sent to all registered stakeholders to alert them to these web-site updates. The discussion and questions raised were based on the contents of the second report also posted on this web-site in advance of the meeting.
http://www.ecomotors.org/files/Motorsreport2_Nov-06.pdf

Between the first and second formal stakeholder meetings, Anibal De Almeida also attended the VEM Workshop Electrical Drives for Industrial Applications, held on September 12-13, Wernigerode, Germany, in which he made an invited presentation on the EuP Motor study. During this meeting additional technical input to the study was received.

Key Decisions and Actions

Definition of Products

Based on the preliminary discussion held in the first Stakeholders Meeting, Brussels, 29th June, a more detailed discussion was carried out on the final definition of product categories, to take into account the conditions stated in the EuP Directive, particularly sales data and energy use. There is consensual agreement on the vast dominance and relevance of 3-phase induction motors. The EU motor market was presented based on data from relevant market studies and from CEMEP. From these sources and from other studies carried out both in the EU and in other parts of the world, is clear that the market is largely dominated by three-phase induction motors, which also consume the vast majority of the electricity consumption in the power range under consideration in this study.

However, the other small minority motor types will be also analysed in line with the MEEUP methodology, as far as they provide the same function, in terms of applications, market trends, energy use, and ecodesign analysis. Technologies which show energy efficiency advantages will be investigated in more detail.

DC motors, both of the conventional type with brushes (motor design invented 150 years ago), and new brushless motors (also called electronically commutated motors) were discussed. Existing statistics do not discriminate among brushed and brushless DC Motors. The former type has a fast shrinking market share due to serious reliability and maintenance problems, only being used in applications with a very small number of operating hours. The application of brushed DC Motors is highly fragmented over a large variety of customized old design applications. As a result of their obsolete nature, IEEE test standards no long support this type of motor. By contrast, brushless motors are becoming increasingly dominant, although they have not yet reached the status of a general purpose standardized product. Although it is clear that the brushed DC motor only has a small and declining market share, it will also be analysed in order to demonstrate its eco-impact.

Brushless Permanent Magnet DC Motors (or EC Motors) have high efficiency, high torque/weight ratio, overcome the reliability limitations of conventional DC motors, cost has been decreasing and may become a key player particularly in the low power range. The reliability is excellent with lifetimes up to 100.000 hours Because of their large savings potential these motors deserve to be analysed in detail in particular in the chapter dedicated to the best next available technologies.

Action: Stakeholders, including manufacturers

Provide Bill of materials for a 1.1 and 11 kW brushless DC motor, including electronic controller, prices and efficiency.
Provide Bill of materials for a 1.1 and 11 kW brushed DC motor, including electronic controller, prices and efficiency.

Universal motors (uses a commutator and brushes, having similar construction to a DC series wound motor) represent around 4% of integral horsepower market revenues, are mainly used in household/garden appliances (main appliances are regulated for the overall performance) and portable power tools. The application of universal motors is also highly fragmented over a large variety of customized applications. Universal motors can operate directly from the 230 V AC supply and rotate a very high speed (up to 30.000 RPM), leading to a large power density. Universal motors are still being used in because of their relatively large power to weight ratio, their speed can be controlled very simply, leading to low initial cost of the apparatus in which they are incorporated. They have low efficiency, short lifetime, being used in applications with a small number of operating hours (typically well below 100 hours per year). The study will show whether they represent sufficiently significant environmental impact to include/exclude them in/from the scope of the study based on the art.15 of the EuP directive. This argument was presented without raising disagreement.

However, because of the large numbers of universal motors still being made in the lower power range of this study (universal motors never exceed a few kW), an ecodesign analysis will be carried out on a typical application with a 1000 W motor to verify the level of their eco-impact.

Action: Stakeholders, including manufacturers

Provide Bill of materials for a 1 kW universal motor, prices and efficiency curve.

Synchronous motors represent only 5% of the volume of motor revenues (even much less in terms of sales volume), their use being confined to higher power ratings (typically above 500 kW), due to slightly higher efficiency and power factor control capability. They are typically used in specialized customized applications in which very precise speed control is required. Because of above reasons, they do not seem be in the scope of the EuP directive. These arguments will be further substantiated in the report in order to confirm whether they will be included/excluded into the scope of the study. This was presented without raising disagreement.

Single phase motors represent a small share of the AC motors market (around 3%), are more expensive and less efficient than equivalent 3 phase motors and they are mainly used in appliances in residential applications (regulated by other measures) and with maximum power of a few kW. The main reason for the use of single phase induction motors in the low power range is the lack of 3-phase supply, which occurs mostly in the residential sector. These motors typically have a small number of operating hours per year and their energy use is, accordingly, very reduced. The application of single-phase motors is also highly fragmented over a large variety of customized design applications (small machine tools, pumps, fans and compressors), with a very wide range of applications of operating hours.
A key issue appears to be the identification of applications of single-phase motors, in the power range under consideration, in which a large number of general purpose motors are used with a large number of operating hours. For such type of applications an ecodesign analysis will be carried out on 1.1 kW motor. A relevant issue is the comparison with other motors (e.g. a 3-phase induction motor or a brushless DC motor) with a similar power.

Action: Stakeholders, including manufacturers
Identification of applications of single-phase motors, in the power range under consideration, in which a large number of general purpose motors are used with a large number of operating hours.
Provide Bill of materials for a 1.1 kW single-phase motor, prices and efficiency curve.

3-Phase Induction motors represent 87% of the AC integral motor market revenues, have relatively low cost, they are very robust and have long lifetime.

Because of the standard power sizes and because of the ongoing IEC efficiency classification standard the power range general purpose induction motors (0.75-200 kW) will be considered in this study. The proposed **scope of the study will cover:**

- 3 phase A.C. squirrel cage induction motors in accordance to EN 60034-1
- Power range 0.75 to 200 kW (Limits of IEC Classification Standard)
- Rated frequency: 50Hz
- Rated voltage up to 1000 V
- Degree of protection: IP 54 or IP 55
- Cooling: TEFC "Totally Enclosed, Fan Cooled"
- Single-speed
- Continuous running duty, S1
- General purpose Induction motors (both foot, face and flange mounted)
- No special motors (e.g. explosion protection type “e”, “d”)

Recent progress on efficiency testing standards was presented and discussed. Recent developments **of IEC 60034-2 (CDV Ed.4/2, 2006), which allows** three different test methods to obtain the motor efficiency and provide a level playing field for efficiency comparisons is a very welcome development. This revised standard can provide the basis for future motor efficiency policies.

Environmental standards

Relevant environmental standards were also discussed. The **WEEE Directive (Directive 2002/96/EC)** specifically states that large-scale stationary industrial electrical and electronic tools do not have to conform with this directive. This seems to imply that industrial motors are not covered. Additionally, because of its large scrap value, motors are recycled at the end of their lifetime.
This argument was presented without raising disagreement.

RoHS Directive (Directive 2002/95/EC)
This directive covers electric and electronic equipment as defined in the WEEE Directive, and therefore it seems to imply that industrial motors are not covered. Even so it was stated that motor manufacturers are taking measures in the direction of this directive, such as avoiding the use of lead based solder. In some situations, in which security and safety are a prime concern, manufacturers, may have to use small amounts hazardous materials.

Motor prices

Motor prices early this decade showed a tendency to decrease, but recent increase in the price of raw materials may reverse that trend. EFF1 prices are typically 20-30% above EFF2 motors price. The motor market is characterized by large discounts, and therefore there is a large uncertainty in the motor prices.

Action: Stakeholders, including manufacturers
For analysis in the study which are the typical prices (cost for the consumer) for 1.1 kW, 11 kW and 110 kW motors?
-EFF2
-EFF1

-Equiv of NEMA Premium

Bill-of-Materials (BoMs)

Bill-of-Materials (BoMs) - CEMEP has collected data from manufacturers and produced BoMs for the key materials for the following different motors:
-EFF1 and EFF2 in the power range of 1.1 kW, 11 kW and 110 kW to cover the considered power range

Action: Stakeholders, including manufacturers
Is it desirable to have a further definition of the BOMs, regarding the materials listed below? In the positive case it may be be useful to have an approximate breakdown on their material composition, in order to use this data in the model.

- Other steel
- Insulation materials
- Impregnation resin
- Packaging

Production Phase

- **Bill of Materials (consideration of spare parts of usage phase)**

The VhK EcoReport assumes 1% of the total weight as spare parts. This is thought highly inadequate, as the situation regarding motor repair is more complex . After discussion it was considered that on average a motor was repaired two times, although the number of repairs is strongly dependent upon the power level (e.g. motors below 5 kW are not typically repaired in the EU).

Action: Stakeholders, including manufacturers
For replacement windings and bearings does 2 times the weight of the windings and bearings seem appropriate to be considered in the medium and large power levels?
Primary scrap production during sheet metal manufacturing - is the default value in the VHK model of 25% appropriate?

Product specific inputs
Some of the default assumptions in the model deserve validation by relevant stakeholders

Action: Stakeholders, including manufacturers
Are the following default values appropriate?

- Landfill (fraction of products not recovered) – default 5%
- Plastics
  - Re-used/Closed loop recycling – default 1%
  - Material Recycling – default 10%
  - Thermal Recycling (non hazardous incineration optimised for energy recovery) – default 90%
- Metals recycling percentage 95%

Best Next Available Technologies (BNAT)

There was a discussion on Best Next Available Technologies**,** which have not yet reached the status of general purpose product.
The following technologies appear to fit in the BNAT scope:
-BLDC Motors (previously addressed)
-SR Motors

Integrated VSD Motors are already an off-the-shelf general purpose product and their analysis was suggested because of their low but growing penetration. Their use is mainly advantageous on variable load applications.

Action: Stakeholders, including manufacturers

- Which power ranges to consider for each the technologies above mentioned? Which market niches appear as the most promising, and which are typical operating conditions in those applications?
- Are there any other technologies deserving to be considered as BNAT?
- Provide Bill of materials for a 1.1 kW and 11 kW Switched Reluctance motor, including electronic controller, prices and efficiency.
- Provide Bill of materials for a 1.1 kW and 11 kW Integrated VSD motor, including electronic controller, prices and efficiency.

Anibal T. De Almeida, December 12, 2006