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| **Submission for the Creation of a New Activity or Amendment of an Existing Activity under the ESI Scheme** |
| **Applicant details** |
| Date of submission | 28/11/2015 |
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| **Summary of proposal**Please provide evidence, data or references to justify all claims made.The suggested elements of a response are provided in italics. The text in italics may be deleted in the submission. |
| **Category of proposed activity** | High efficiency EC fan upgrades in HVAC. PBA methodology. |
| **Confidentiality statementMUST BE COMPLETED**In lodging a submission, parties acknowledge the Department's right to engage consultants and contractors to assist in the assessment process, and to disclose information (that might otherwise be identified as confidential by a party) to such persons for those purposes. | There are no confidential parts to this submission.  |
| **Briefly describe new or amended activity**Maximum 100 words. | New activity: BPA – Small scale methodReplacing existing indoor fan systems in HVAC systems with high efficiency direct drive electronically commutated (EC) fans. Minimum efficiency fan motor efficiency grade level of new fan to meet Emission Reduction Fund (ERF) levels or above. Fan input power (none speed controlled) in the HVAC system is measured over a 1h period before the change over. The fan is then replaced with one or multiple EC fans. The fan speed is adjusted to match the performance of the original fan and input power is then measured over a 1h period.  |
| **Estimate the average annual energy savings for an average installation of that activity** | The existing fan system, usually consisting of a double inlet forward curved centrifugal blower with belt drive and standard 4pole motor, is removed from the HVAC system. Next a replacement EC fan system is installed. The system can consist of either a single motorized fan with housing to replicate the existing fan system (drop in replacement) or it can consist of multiple motorized fans installed in a housing or fan array. Once installed the fan speed of the new EC fan(s) is commissioned to match the fan performance (air flow and static pressure) of the old fan.HVAC fan upgrades take place mostly in commercial buildings, for example air handling units, fan coil units, packaged air conditioning units (roof top). Typical projects will include one to five fan replacements, for example small stores, pubs, clubs. Larger projects include upgrades in mid tier commercial office buildings, large retail and industrial sites. Reward:The electrical savings of the fan multiplied by operating hours per day. Operating hours can be taken from the BCA, however the activity should acknowledge if an application is a 24h/7 operation, for example computer room air conditioning units (CRAC) in data centres. Proof/exampleComputerCool Pty Ltd undertook 619 EC fan upgrades using 862 EC fans and achieved an average saving of 45.8% or 1.3kW (32.2kWh per day) per unit. (see appendix (1) for details)Typical examples for EC fan upgrades in HVAC are in appendix (2) Wakefield house and (3) Diamond light. Fan savings 50% and 55%. Example using the ComputerCool data: HVAC upgrade for 6000$ generates electricity savings of 16kWh/day (12 h operation) or saves approx. 60to CO2 in 10years. At AUD20 per certificate – the VEECs for such an upgrade would be worth AUD 1,200.  |
| **Demonstrate that the activity is likely to be additional to business as usual (BAU)** | ROI in applications where HVAC equipment is not operated continuously is very often more than 4years. For example average figures of the ComputerCool logs at 19ct per kWh – ROI is 2.7years at 24h operation. Considering typical office hours the HVAC systems is unlikely to operate for more than 9 to 10h per day. Using the ComputerCool data, the ROI more than doubles. Most businesses see the acceptable threshold for undertaking an upgrade at 3years. Abatements help to bring the activity close to or under the 3year threshold and therefore make it more attractive. SME s that only operate a small number of air conditioning systems are currently not upgrading HVAC equipment. SME usually have no budget for energy reduction activities and no reduction targets in place unlike large corporates. Currently there is no methodology under the VEEC or ERF scheme in place that can financially support SMEs with the upgrade of HVAC system without the administrative cost for the implementation outweighing the benefit. Larger corporate end users, like for example retail stores or large offices, will use other methodologies to claim abatements. They have the necessary reporting structure, often existing sub-metering in place to do this. The performance of the HVAC equipment does not change when the fan system us upgraded with EC fans, therefore it is unlikely that the upgrade will change the behaviour of the user. However, EC fans offer the possibility to be speed controlled very easily and EC fans can be integrated in a high level interface monitoring and control system. This will encourage an upgrade to the control strategy and implementation of speed control as this can be done very cost effective. This work would be additional to the activity of the fan replacement and would not be considered in the PBA abatement calculation.  |
| **List the key variables that should be considered to ensure the activity best represents the delivered energy savings** | Fan input power varies with the fan load and installation conditions. No two installations are identical. Therefore data from a nameplate or rated data from a data sheet is not sufficient. Air performance and electrical input power needs to be measured. The performance of the EC fan system needs to be adjusted (change speed) to match the performance of the original fan system. In fix fan speed HVAC applications, the fan power does not vary with ambient temperature or temperature settings. In a system where fans are operated at two or 3 fans speeds, it is suggested to use the lowest speed step to measure and calculate savings in electrical input power; however the replacement fan system needs to be capable to cover the full performance range (minimum to maximum air flow) of the replaced fan. No other part of the HVAC system is allowed to change prior to the air and input power measurement to calculate the abatements. For example sealing of ducts or building envelope, modification of registers, dampers or grilles. Removal or addition of zones. Introduction of demand control (speed control). These additional activities need to be implemented afterwards. |
| **List all existing product standards which support the claims for energy savings or related matters** | AS/NZS ISO 12759:2010 fan standard defines fan systems and efficiencies. The standard differentiates between bare shafted fans and driven fans. This proposal is always referring to driven fans as defined in the standard. Test standard for fans ISO5801:2008 – defines how performance and efficiencies are tested in lab environment.Emissions Reduction Fund (ERF) introduced minimum efficiency levels for driven fan systems based on the ISO12759 and the test standard ISO5801 1. Replacement fans need to comply with the ERF levels. The fan manufacturer needs to confirm this in writing
2. Replacement fans need to be EC fans (electronically commutated motors with permanent magnet rotor)
3. Input power (kW) and input current (A) to the existing fan system and the upgrades system need to be measured using identical equipment
4. Proof needs to be provided that the replacement fan is matching the performance (air flow) of the replaced fan system. To proof that performance is equal, at least 2 out of the following 4 performance criteria need to match. a) air flow (+/-5%) using flow hood, pieto tube or anemometer methods. For example sum of air flows from all registers, duct air velocity, return air grille, heat exchanger.b) static pressure across the fan (+/- 10%)

c) average air velocity through the coil (+/- 5%)d) temperature difference coil air on and air off temperature (+/- 3%)  |
| **Ensuring savings are valid** | All work must be documented including photographic evidence of the product that was removed as well as the upgrade product. The fan systems and nameplate data. One independent reference is suggested to verify the performance measurement results of both the existing and the upgrades fan system. Two possible sources for an independent verification are available: 1. Where available this information can be supported by the original equipment manufacturer’s information of the same or similar equipment. For example performance charts of HVAC equipment or air flow measurements of the existing fan system. Performance tests need to be according to ISO5801 or equivalent standards.
2. Commissioning data of the existing HVAC system with details about air flow, input power and current draw if the company that undertook those measurements is not the same company as the company that is performing the upgrade work.
3. Removed fan system is tested in an air test rig in line with ISO5801
4. Independent M&V company verifies the results

A, B, C or D are then compared to the measured results to verify the plausibility. Deviations are expected but the measured performance should be comparable.Performance information is forwarded to the AP for verification. The AP needs to audit the contractor if any doubt arises. A minimum proportion of installation, for example one out of 20, should be verified by an independent M&V company. These checks need to be random and paid for by the AP. |
| **Protecting health and safety** | All work is performed by fully licenced mechanical contractor, usually plumbing and electrical contractors. OH&S requirements will vary with clients and for some locations there are special permits and qualifications required. For example for work in hospitals or work in large shopping centres. The contractors have to comply with these individual requirements. Compliance is the responsibility of the contractor.  |
| **Other benefits and issues** | Small AHU and packaged air conditioning units can be found on thousands of buildings in VIC alone. We estimate an upgrade market of more than 5000 HVAC units per year with an average cost of AUD 6,000 per unit. A contractor would spend an average of 9h per upgrade; therefore this work would employ 22 installers.More than 50% of the total cost of an upgrade is cost for the actual installation in form of labour. Therefore a majority of the total generated sales of 30MioAUD flows back into the VIC economy. The speed controllability of the new installed EC fans systems will encourage the implementation of demand control and hence increase the electricity savings even more. Further beneficiaries: increase industry knowledge and training in the use of high efficient fans in HVAC equipment. The same technology is used in new Air conditioning systems and vastly different compared to the original systems. Similar methodologies do exist under the ESC scheme in NSW, however, the major difference is that the methodology needs to be simple and inexpensive enough so that it is worthwhile doing for small upgrade jobs.  |