

FREQUENTLY ASKED QUESTIONS

General

1. Who are the qualified personnel to endorse my measurement and verification (M&V) plan and report?

Refer to the table below on the qualified personnel required to endorse all M&V plans and reports:

Equipment/System*	Qualified personnel (For M&V plan and report endorsement)
Motor Split-unit air conditioner Lighting	No endorsement needed if supported by energy performance test report from accredited lab For lighting, if measurement is required, Licensed Electrical Worker (LEW) & SCEM can endorse plan & report
Chilled water system Compressed air system Boiler system	Third party qualified persons (PE(Mechanical/Electrical/Chemical) / QuESS / SCEM)
All other equipment / systems	Third party qualified persons (PE(Mechanical/Electrical/Chemical) / QuESS)

Pertaining to chilled water system

2. **My company, an owner/operator of an industrial facility, intends to replace our existing old chillers with more energy efficient ones. Besides the criteria listed on the E2singapore website, what else do we need to take note of in submitting our PG application?**

Companies are encouraged to take a holistic approach and achieve system level energy efficiency improvements rather than carry out one for one replacement of existing equipment.

For chilled water systems (comprising chillers, chilled water pumps, condenser water pumps and cooling towers), the weighted-average system performance shall be better than the values tabulated below.

Chiller capacity (ton)	Expected system efficiency (kW/ton)
≤150	0.8
150 < capacity ≤ 300	0.7
>300	0.65

In the project proposal, companies must provide a typical cooling load profile (from permanent monitoring system or a 2-week energy audit) and a breakdown of the system performance by components (*e.g. chillers: 0.8kW/ton, chilled water pumps: 0.15kW/ton, condenser water pumps: 0.10kW/ton, cooling towers: 0.10kW/ton*)

3. **How are the energy savings computed?**

The projected annual energy savings should be computed using the following formula:-

$(\text{Average cooling load})_{\text{projected}} \times (\text{Performance}_{\text{current}} - \text{Performance}_{\text{targeted}}) \times (\text{annual operating hours})$

where

- average cooling load is in refrigeration tons
- system performance is in kW/ton

4. **How shall we measure the energy savings from the upgrading of the chilled water system?**

The general measurement and verification requirements can be found at:- http://www.e2singapore.gov.sg/Incentives/Energy_Efficiency_Fund.aspx

The system performance at component level shall be measured and verified before and after the implementation of the project. The system performance measurement error shall be within ±5%.

For baseline measurement, the minimum measurement duration shall be two weeks. The M&V Plan including method to measure, verify, and compute energy savings, as well as the baseline data must be submitted and approved by NEA/EDB before the existing equipment are removed. Operation of equipment is encouraged to be scheduled so that all equipment can be measured for a holistic assessment of the system. The following variables shall be measured and logged concurrently at 1-minute interval:

- Chilled-water: supply temperature (°C), return temperature (°C) and flow rate (L/s);
- Condenser water: supply temperature (°C), return temperature (°C) and flow rate (L/s);
- Electrical power inputs for all chillers (kW);
- Electrical power inputs (kW) and frequencies (Hz) from variable speed drives, for all pumps and cooling tower fans; and
- Weather station for ambient dry-bulb temperature and relative humidity for large chiller systems (>500 tons);

Measurement System (includes sensor and data acquisition system)	Required Uncertainty
Temperature	±0.03°C
Flow	±2%
Power	±1%

For the post-implementation measurement, a minimum of two months of operational data shall be submitted to NEA/EDB. A permanent monitoring system shall be installed for the upgraded/new chilled water system. Measuring instruments for the new chilled water system(s) shall be installed to monitor the following variables at 1-minute interval:

- Chilled-water return temperature (°C), for chilled-water header and individual new high efficiency chillers;
- Chilled-water supply temperature (°C), for chilled-water header and individual new high efficiency chillers;
- Entering condenser water temperature (°C), for condenser water header and individual new high efficiency chillers;
- Leaving condenser water temperature (°C), for condenser water header and individual new high efficiency chillers;
- Chilled-water flow rate (L/s), for chilled-water header and individual new high efficiency chillers;
- Condenser water flow rate (L/s), for condenser water header and individual new high efficiency chillers;
- Electrical power inputs (kW) from external power meters, for all chillers;
- Electrical power inputs (kW) and frequencies (Hz) respectively from variable speed drives, for all pumps and cooling tower fans; and
- Any other instruments required for optimisation of central chilled-water plant.

For large chiller systems, catering to loads above 500 tons, it is also recommended that the company install instrument to measure outdoor ambient dry-bulb air temperature (°C) and outdoor ambient relative humidity (%) (converted to wet-bulb temperature, displayed and trended) at two 2 separate locations spaced along the length of the cooling towers to indicate the wet bulb temperature in the vicinity of the cooling towers.

With the exception* of the uncertainty of the measurement system listed in the table below, SS591:2013 Code of Practice for Long Term Measurement of Central Chilled Water System Energy Efficiency shall be adhered to.

Measurement System (includes sensor and data acquisition system)	Required Uncertainty
Temperature*	±0.03°C
Flow	±1%
Power*	±1%

Please check with NEA/EDB on the suitability of instrument and sensors before ordering.

Measurement of flow rate

For the installation of flow meters, companies shall modify pipe works where necessary in order that there are sufficient straight pipe lengths for the proper measurement of flow rates.

Pertaining to lighting

5. My company, an owner/operator of an industrial facility, intends to upgrade our existing lighting fixtures with more efficient ones. Which areas do we need to pay attention to?

To ascertain that the lighting replacement does not compromise the illuminance level, a simulation of the illuminance level with the new light fixtures compared to the existing light fixtures shall be performed. The simulation results shall be submitted as part of the project proposal. Please refer to SS531:2008 Code of practice for lighting of work places for the recommended illuminance levels.

The technical specifications of the proposed lighting (including information such as lumen output, efficacy, colour rendering index, design power consumption etc.) shall be submitted together with the project proposal.

The efficacy (based on the technical specifications) of new LED lamps shall be at least 100 lumens/watt (lm/W) to qualify for the grant.

6. How are the annual energy savings computed?

The projected annual energy savings shall be computed using the following formula:-

Numbers of lighting fixtures x (power per fixture_{current} – power per fixture_{proposed}) x annual operating hours

7. How are the energy savings from the lighting replacement measured and verified?

The general measurement and verification requirements can be found at:- http://www.e2singapore.gov.sg/Incentives/Energy_Efficiency_Fund.aspx

Companies shall measure and verify the power consumption and lux level of both the existing and proposed lighting fixtures. The power meter shall sample the power consumption of the fixtures at one-minute intervals for a period of at least 30 minutes. If the power consumption is not constant, sampling shall be done over a longer period, which shall be approved by NEA/EDB.

Permanent metering is not necessary.

Pertaining to motors

8. My company, an owner/operator of an industrial facility, intends to upgrade our existing motors with more efficient ones. Besides the criteria listed on the E2singapore website, what else do we need to take note of in submitting our PG application?

Only IE3/4 three phase induction motor models are eligible for the grant. The motors shall be installed at the industrial facility.

The company (grant applicant) should request the motor supplier to submit a type test report certified by an accredited test laboratory to NEA for verification. The type test report shall minimally contain the following information:

- Brand of motor
- Model number
- Rated power/power rating (kW)
- Voltage (V)
- Speed (rpm)
- Frequency (Hz)
- Full load efficiency (including IE rating and part load efficiency if possible)

The test reports shall be provided by one of the following categories of testing laboratories:

- a) Testing laboratories that are accredited to ISO/IEC 17025:2005 by the Singapore Accreditation Council (SAC) to carry out the tests in accordance with IEC60034:2014 (Method 2-1-1B) or IEEE 112-2004 (Method B); or
- b) Testing laboratories in countries other than Singapore that are accredited ISO/IEC 17025:2005 by their local accreditation bodies, which have signed a Mutual Recognition Arrangement (MRA) with the SAC, to carry out the tests in accordance with IEC60034:2014 (Method 2-1-1B) or IEEE 112-2004 (Method B).

The list of SAC accredited testing laboratories and MRA partners is available at <https://www.sac-accreditation.gov.sg/Pages/Homepage.aspx>.

The list of pre-qualified IE3 motors is provided in the table below.

S/N	Brand	Model	Rated Power
1	SEW-Eurodrive	DRN80M4	0.75 kW

9. How are the annual energy savings computed?

Assuming that the motor load remains unchanged, the annual energy savings shall be computed using the following formula:

Number of motors x (electrical input power per motor_{current} – electrical input power per motor_{proposed}) x annual operating hours

where the electrical input power per motor at full load shall be calculated using the following formula:

$$\frac{\text{Rated power of motor}}{\text{Efficiency of motor}}$$

10. How are the energy savings from the motor replacement measured and verified?

On-site measurement and verification are not required.

NEA and EDB officers will conduct site visits to verify the rated power and efficiency of the motors before and after the replacement.

Pertaining to split-unit air conditioners

11. I am purchasing energy-efficient air-conditioners (based on tick rating) for my industrial facility. Do we need to carry out post-retrofit measurement and verification?

The scheme supports the purchase of air-conditioners for use in your industrial facility, where the air-conditioner must have a tick rating of 4 or 5 ticks under NEA's Mandatory Energy Labelling Scheme. You may check if the product you are purchasing is eligible from [this link](#). Post-retrofit measurement and verification is not necessary.