MAESCO

(Pertubuhan Syarikat Syarikat Perkhidmatan Tenaga Malaysia)

Malaysia Association of Energy Service Companies

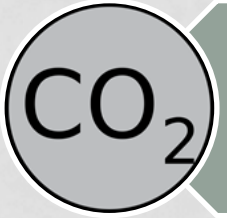
INDUSTRY EXPERIENCE OF ESCOS

GOING GREEN?

Solar PV? Yes and No but its better than nothing

Planting Trees? – Questionable as actual CO2 absorbed is not quantifiable

Rain Water Harvesting? – remember our dry spells? 3 months of dry weather means we cannot take average annual rainfall…..



Every kWh Saved is equal to approximately 0.7 kg of CO2! – True Green is sometimes not visible!

ESCO BUSINESS HISTORY IN MALAYSIA

- 1992 – UTM inked the 1st EPC contract with Institute Sultan Iskandar and Supersymmetry Pte. Ltd
- 10 year contract to enhance the performance of the AHU while eliminating RH issues and converting T8 lamps to T5 Lamps

Universiti Teknologi Malaysia

MAIN RESULTS:

a) Saving of 318.00 kW or **39%**
b) Lighting intensity Watt/m^2 reduced from 24.7 to 7.5 - reduction of 70%
c) kWh per annum /area (kWh/m^2) from 169 to 99 - reduction of 58%
d) Improvement in comfort condition of the library
e) Savings worth RM 340,000 per annum

The electronic ballast was selected based on this criteria:

1. Total Harmonic Distortion (THD) of less than 20% or 10% depending on the model of the ballast.
2. Power factor > 95%
3. Lamp current Crest Factor less than 1.7
4. Minimum starting temperature of –20^{0}F to 50^{0}F
5. Minimum detectable flicker – high frequency

The retrofit works undertaken to improve the efficiency were:

- Replaced old oversized motor with new Super-E type
- Replace old fan and motor pulleys with optimally designed size
- Alignment of pulleys to reduce transmission losses
- Electrical connection to motor and necessary adjustment of over load relay setting.
- Control and Monitoring

Total Savings Calculation for Phase I, II and III

Power (kW) Savings

The total savings from Phase 1, Phase II and Phase III > Total Savings = [5] + [8]+ [11] + [13] kW = **318** kW [15]

With the cost of electricity at:-

kWh Cost = 0.19 RM/kWh [16]

Peak kW Cost = 17.30 RM/kW/month [17]

calculation of savings per month can be expressed as follows:-

Savings = kWh savings + Max. demand savings = (318 kW x N x 0.19 RM/kWh) + (318 x 17.3 RM/kW) [18]

where N is the number of operating hours per month.

To calculate average savings per month, we will use 20 weekdays @ 15.5 working hours, 4 Saturdays @ 9 working hours, and 4 Sundays @ 8 working hours, which makes:-

N = (20 x 15.5) + (4 x 9) + (4 x 8) = **378** hours per month [19]

Average monthly kWh savings and max. demand savings, therefore : ***kWh Savings = RM 22,839.50 per month***
Max. demand Savings = RM 5501.57 per month

Total Monthly Savings : RM 28,341.07

Annual Savings = RM 340,092.84 [20]

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NEW FRONTIER

- Shared Savings Contract with Reducing Share over the 10 year period
- Super Accurate monitoring of AHU temperatures, energy use by chillers
- Contractual agreement with agreed M&V
- Ahead of its time – 24 years ago!

OTHER EPCS

- E-Eye Sdn. Bhd and Telekom Malaysia
  - Exchange Building
  - 10 Year contract fixed scale
  - Chiller Plant efficiency improvement
- Factor Four Technology and Telekom Malaysia
  - 2 Exchange Building
  - 10 year sliding scale contract with higher savings for TM as the contract approached it end
  - Chiller Plant efficiency improvement

Both EPCs relied on agreed M&V and Accurate Transparent Monitoring

TELEKOM MALAYSIA WITH FACTOR FOUR TECHNOLOGY

Case Study : Telekom Malaysia

Completed : 2005/2006

BEFORE RETROFIT – 591 kW

- Air Cooled Chillers replaced by higher efficiency water cooled
- New chillers sized correctly after audit.
- Additional pumps in operation to counter flow to AHUs.
- Total Chilled Water Pumping Energy = 60 kW
- Total Plant Energy Consumption = 1300 amps
- Ave CHWS Temp June 2003 = 9 to 10 Deg C - created issues in terms of RH and temperature

AFTER RETROFIT – 164 kW

AVERAGE ENERGY USAGE TODAY:

- 400 RT Chiller =140 kW (Max 215 kW)
- CHW Pump = 8.1 kW (Max 8.9 kW)
- CW Pump = 7.5 kW (Max 9.2 kW)
- Cooling Towers = 9 kW (Max 19 kW)
- Ave Ch Plant kW for March 2006 = 160 kW (Max 180 kW)
- Ave CHWS Temp March 2006 = 7.5 Deg C - improved chws quality

Measured Chiller Plant Efficiency :

BEFORE : 2.0 kW/ton!

AFTER : 0.60 kW/ton!

10 Year EPC Contract between Factor Four Technology and Telekom Malaysia

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EPC CONSTRAINTS

- Contracts are 10 years
- Risk for both parties increases as duration is long – A Decade!
- M&V has to work for 10 years
- Maintenance of system is usually the ESCO's responsibility
  - Failure of equipment is the ESCO's risk!
- People come and Go
- Changes in Building use is possible
- Transfer of Equipment requires asset management

WHAT'S ARE THE BARRIERS??

- Financing?
  - Bank will not and possibly never finance an EPC
    - Returns are not constant
    - Returns require client ESCO relationship to be strong and healthy
    - Business can change strategy
  - Bank need to make money
    - 6% to 8% interest reduces ESCOs profits and increases its risk
- Selfish? (Let's be honest ☺)
  - Owners want to have it all and ESCOs want to have escape clauses
    - ESCOs invest but Owners want to have larger share
  - ESCOs don't want to take up the maintenance and want to sell the project at the end of the contract without considering the client is going to be straddled with possibly old and obsolete equipment
  - ESCO want's safety nets that irks or shifts the client towards the defensive

ENGINEERING & M&V are NOT BARRIERS- It can be addressed

THE KEY ELEMENT FOR EPC SUCCESS

KEY FACTS – AND IT'S THE TRUTH!

- Savings cannot be measured because its no longer there!
- We cannot measure savings…..but
- We can measure energy use before and after
  - Before is the baseline
  - After is present use of energy

Baseline - present energy use (+-adjustments) = *SAVINGS*

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WHAT IS M&V?

"Measurement & Verification (M&V) is the process ofusing measurements to reliably determine actual saving created within an individual facility by an energymanagement program."

Ref: IPMVP Vol I, 2010, Chapter 9

The key challenge in selling and buying EE is that energy savings can only be projected through engineering design.....

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M&V

- Provides a method which can be considered rigorous, repeatable and disciplined
- Gives the element of certainty to the energy efficiency design and implementation

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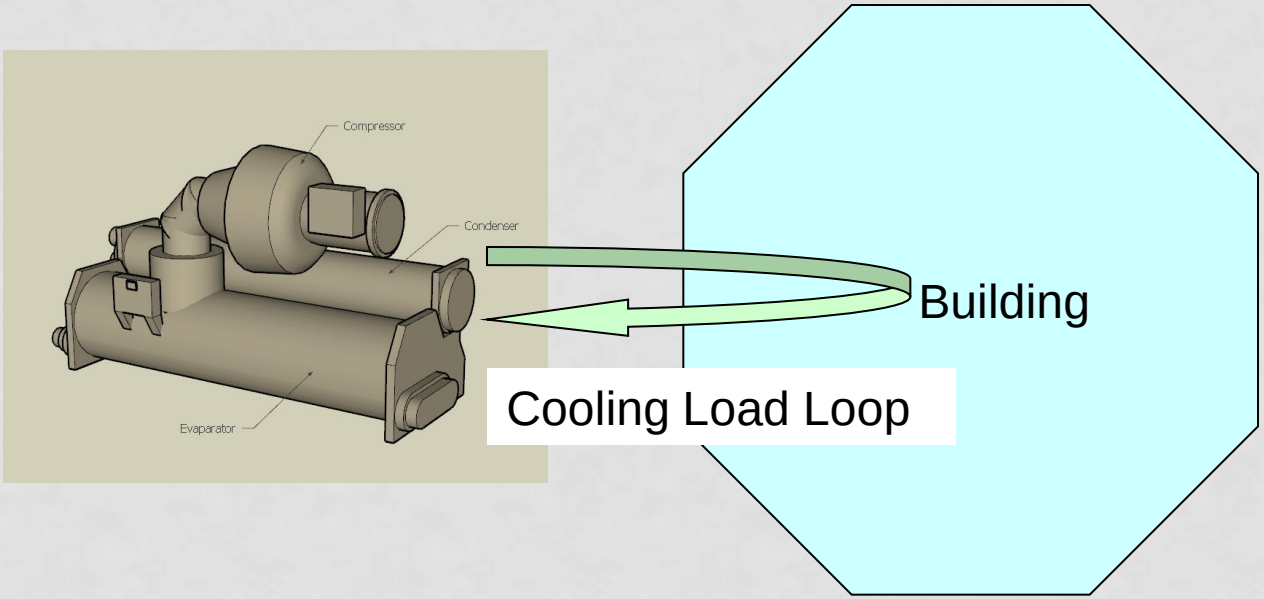
AN EXAMPLE OF ESTABLISHING BOUNDARY FOR EPC



Lighting retrofit reduces direct kWh BUT also reduces heat gain inside the building – i.e. lower kW means less heat.

This can also be translated into savings in the cooling load.

Where to set the Boundary? It depends on the M&V and Savings target – if cooling load savings is to be claimed, the energy used by the HVAC system must be measured – not just kWh but cooling load

M&V PROTOCOLS

- IPMVP (most widely used)
- US DOE FEMP M&V Guide for US government buildings
- ASHRAE Guideline 14: Measurement of Energy and Demand Savings (2002)
- California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals.
- Australian Best Practice Guide – built on IPMVP
- Benchmarks, certificats et tests regionaux (France)

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THE WAY FORWARD

SMASHING BARRIERS

THE WAY FORWARD

- An Arrangement that addresses the barriers!
  - HYBRID EPC: This EPC takes the best of both worlds
    - Financing becomes possible – it's an engineering project with fixed payments
    - Client and ESCO reduces time based risk – contracts can be less than 3 years
    - Both Parties enjoy returns sooner – Client gets to enjoy the full savings immediately and ESCO recovers investment much sooner.
  - PERFORMANCE CONSULTING
    - Client links consultant
    - Consultant avoids higher financial risk
    - Client gets a guarantee on performance but probably a lower rate compared to the Hybrid Solution

EPC 2016 – A FRESH APPROACH

- A Consulting EPC
  - Technology Park Malaysia and ISI Ventures Sdn. Bhd
  - Chiller Plant Retrofit
  - ISIV as the Design Consultant and Project Supervisors guaranteed the savings
- Hybrid EPC
  - Star Media Hub (SMH) and Energy IR Sdn.Bhd.
  - EPC but short term contract
  - Guarantee linked to staggered payments

ENHANCED SERVICE DELIVERY

It can only materialize if:

Prior to Contract:

- Engaged with client on Engineering Concepts and needs
  - Both parties must have the skilled set!
- Determining the barriers and finding ways to overcome it collectively

During Pre-Retrofit (after contract)

- Auditing with accurate data - reduces uncertainty with agreed boundaries pre-set prior to the contract
- Transparent information sharing

Post Retrofit

Enhance Service Delivery Smashes Barriers!

AN EXAMPLE

SMASHING BARRIERS

SUCCESS STORY OF HYBRID EPC

The **Star Media Hub (SMH)** Energy Efficiency committee was keen to enhance their program into top gear. They had already captured the low hanging fruits, installed Solar PV and knew the ACMV and Compressed Air System was the Main SEUs they needed to optimize.

How to approach this while ensuring SMH reduces its risk? Decision Had to Be Made!

Hire a consultant and hope for the design is optimal??

OR

Hire an ESCO to provide a performance guarantee

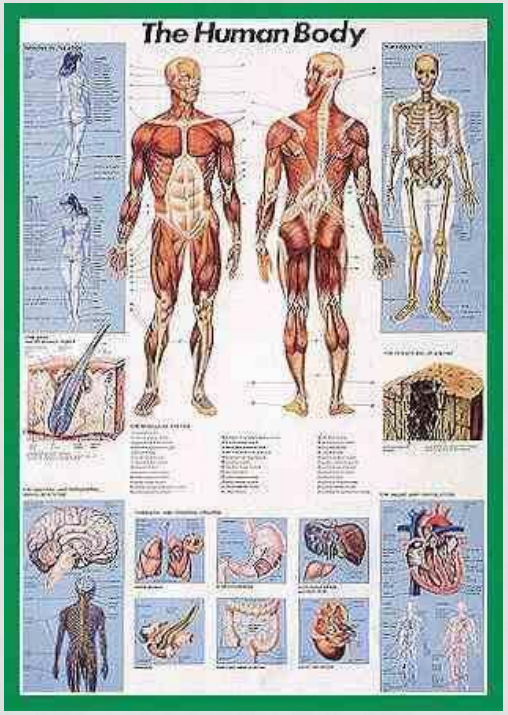
Knowing System Performance with an Audit Report
Quality of the Audit Report – Accuracy, reliable and engineering sense
Optimizing the System through optimal efficiency and optimal cost

THE DESIRED CONTRACT DETAILS

The Approach

- Engage an ESCO that provides a guarantee
- Avoid long term contract but still ensure the ESCO obligation is extended
- Use actual measurements in a fixed boundary
  - Reduces uncertainties
  - Avoids pitfalls of other users increasing or reducing their energy demand

SMASHING BARRIERS! ENGINEERING CONCEPTS IT?



Chillers, Cooling Towers – our skin

Knowledge - Brain

Pumps – Heart

Accurate Measurements – Eyes

AHUs, Ventilation – Lungs

Sensors, Controls – Nerves

Pipes, Ducting – Veins

The Team Understood what a System Meant!

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SMASHING BARRIERS: THE SOLUTION THAT MATCHES THE NEEDS OF BOTH PARTIES!

Hybrid EPC

- Short Term : 18 months
- Performance guarantee with actual measurements used as verification
- System kW/ton used as the measurement index
- Heat Balance with high accuracy sensors to further reduce uncertainty
- SMH enjoys savings and ESCO gets paid sooner
  - Increased earnings for SMH
  - Reduced duration reduces risk for ESCO

SMASHING BARRIERS: THE OUTCOME

- ESCO balance only paid in 3 month intervals after proven savings
- Contract Value is higher than standard run of the mill replacement BUT
- SMH gets guaranteed savings
- SMH does not pay large sum to start off project
- SMH only pays when there is savings
- ESCO enjoys higher returns than normal contract

ESCO and SMH invested proportionately

THE PROJECT DETAILS

200 RT chiller is replaced by a 389 RT chiller however, the 2 existing 200 RT units are retained as standby if the new chiller experiences failure during operation.

Air Cooled Chiller load was shifted to new water cooled chiller – improved overall efficiency

Energy Savings up to RM 850,000 a month for RM 2.3 million investment

MEASUREMENTS – THE LOST SCIENCE.

No accurate and efficient engineering decision can be made without measurements!	Results from Accurate Measurements:
• Chiller Water Flow • Chilled and Condenser Water Delta T • Chiller kW	• Chiller Efficiency • Pumping Rate check – highrate / lowrate • Possible improvements

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THE CHILLER AUDIT – THE DETAILS

- Complies to Building and Construction Authority (BCA Singapore) CODE ON PERIODIC ENERGY AUDIT OF BUILDING COOLING SYSTEM and ASHRAE Standards which emphasises on:
  - Accurate sensors and heat balance checks is required
  - Thermistor accuracy - (±0.03 to ±0.05 Deg C)
  - True RMS Power meters
  - Correct installation of flowmeters

HEAT BALANCE is a method advocated by AHRI 550/590 to determine the performance of a chiller. Accuracy of temperature sensors (±0.03 Deg C) and correct flow measurements will reduce error to ±5 to 6%.

Without measuring condenser and chilled water flow, there is no guarantee that the tonnage calculation, i.e. the performance of the chiller will be known correctly.

Cooling Tons = ΔT x Flow , therefore (e% -e%)x e%

THE NEXT STEP

- The Design and Retrofit
- Continuous Monitoring
- Accurate Data and Monthly Reporting
- Constant engagement with the SMH Energy Team and ESCO

CONCLUSION

THE ESCO CHALLENGE

- ESCOs need to update the method of M&V
- kWh alone is not sufficient to justify savings
  - kWh only tells consumption
    - Is it efficient?
    - What drives it?
- ESCOs need to enhance their reporting method
- Not just Data! Accurate Data is critical in ESCO business

THE CLIENT CHALLENGE

- Expand knowledge
- View operations as a system
- Understand that EPC is teamwork
  - Profit and Risk needs to be shared
  - It cannot be one-sided
  - It requires agreed set of measurement – the goal post cannot change!
- ESCOs are Taking a Calculated Engineering Risk.
  - Savings has to be shared accordingly for financial justification