Benchmarking: A Valuable Market-Based Practice in the MVE Toolkit

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1. Introduction: Establishing a technical and economic basis for standards and labels

- Need to develop a national baseline for targeted lighting products.
- This will assist with:
  - Calculating how much energy is typically consumed
  - Determining appropriate technology alternatives
    - Effective and efficient replacement options
  - Determining the potential energy savings
  - Evaluation of the effectiveness of any programs implemented.

Engagement with stakeholders

Engaging early with representative body stakeholders will assist with quality and extent of data gathered. Include:

- Customs
- Government agencies
- Retailer and wholesaler associations
- Lighting industry associations
- Housing/building associations
- Consumer associations

2. Scoping: Identifying the product scope

- Need to define the products that the proposed benchmarking will include?

  (eg general household omni-directional lamps)

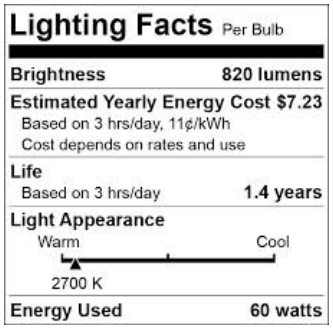
  - Lamp technology (eg incandescent, halogen, CFL, LED…)
  - Distribution (eg Omni-directional, directional)
  - Light output, Wattage
  - Shape, physical size, cap
  - etc

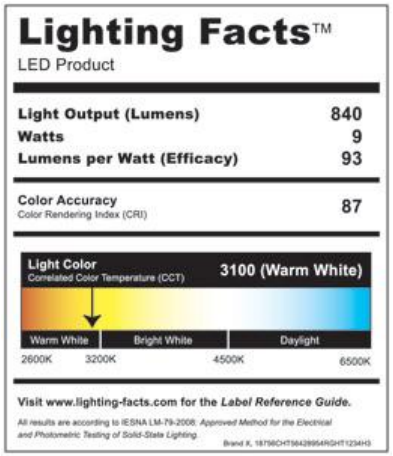
Note any detracting features

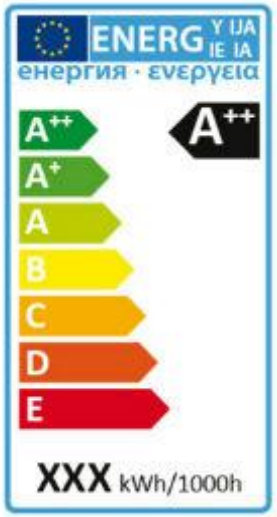
- Are there any features of alternative technologies which could limit range of applications or acceptance?
  - Equivalency & interchangeability
  - Health hazards
    - UV, blue light, flicker …
  - Operational aspects
    - Start time, dimmability …
  - End of life
    - Hazardous waste, recyclability, waste …

The Metrics: What information is required?

- Comparative Labels
  - Typically a limited number of parameters







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The Metrics: What information is required?

- Endorsement Labels
  - Generally include key parameters associated with higher quality lighting

3. Benchmarking performance: The Data

- Market data
  - What products are available and popular in the market?
- Technical data
  - What are the performance characteristics of available products?

Market Data

Data

- Annual sales volumes
- Typical sales prices
- Local production volumes
- Import and export volumes

Source

- Retailer/wholesaler associations
- Local manufacturers/suppliers
- Lighting industry association
- Customs
- Credit card entities
- Market research companies
- Webbots (?)

Technical Data

Data

As determined earlier:

(as an example)

- Lumen output
- Wattage
- Efficacy
- Lifetime
- Colour qualities

Source

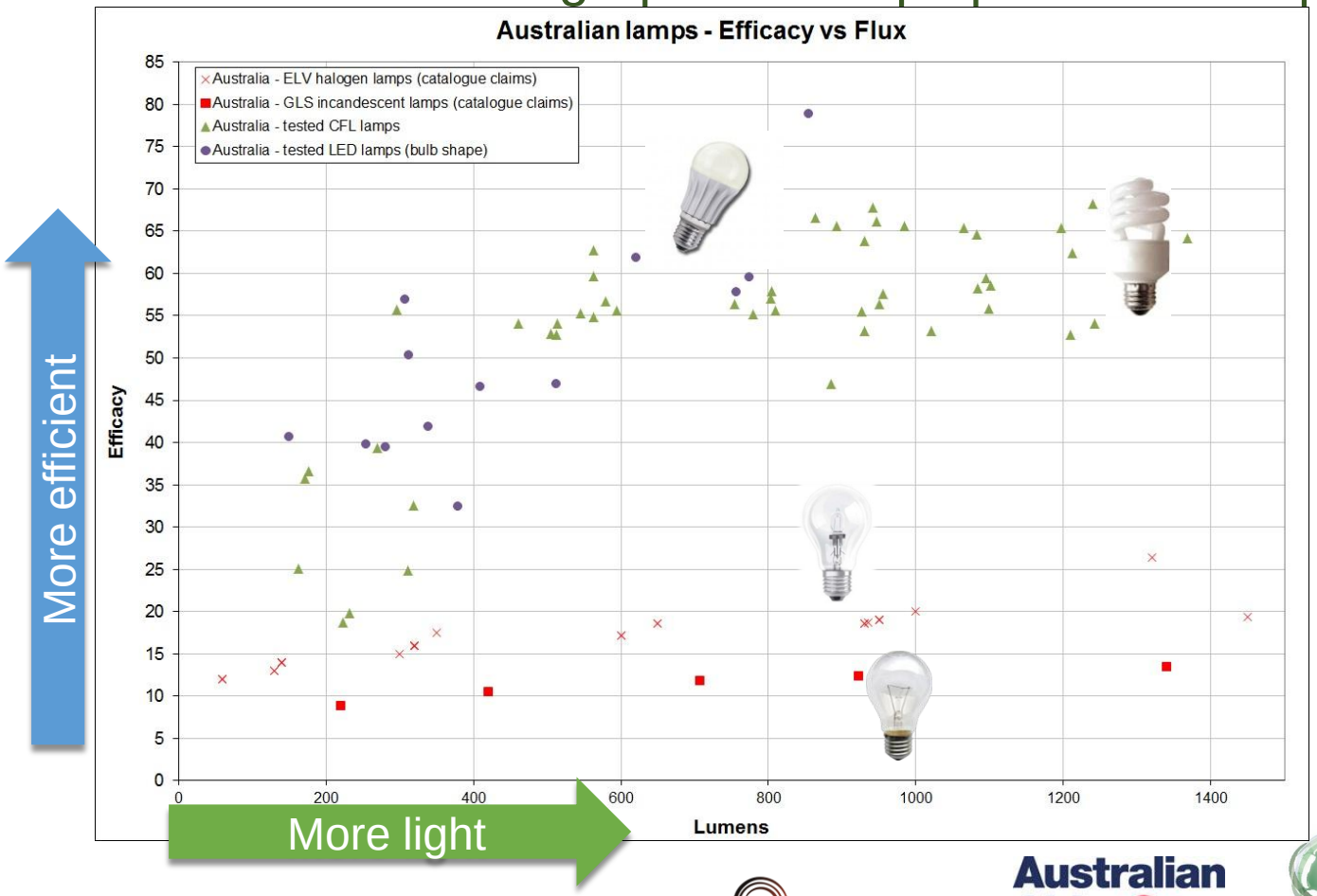
- Product packaging
- Manufacturer catalogues/websites

(calibrate against independent test data)

- Consumer advocacy groups
- Commissioned independent testing
- Non branded test data from test laboratories

Results of data gathering (claims & test data)

- Create benchmark graphs of lamps performance parameters



Source: Appliance & Energy Efficiency Branch, Department of Industry, Australia

4. Usage Patterns: Where and how are these products used?

Data

- Installed lamp stock
- Housing stock

And by Sector (eg household)

- Lamp technology mix
- Daily hours of use
- Time of use
- Dimming levels
- Switching frequency

Source

- Anecdotal estimates
- Housing/building industry associations
- Prior research reports
- New surveys by questionnaire
- New physical audits

Behavioural: What are desirable features of the products?

Data

- Rate of technology upgrade
- Lamp selection process at point of sale
- Barriers to particular lamp technologies
- Supply chain attitudes to energy efficiency

Source

- Historical retail sales data
- Prior research reports
- New surveys by questionnaire

How to gather data: Survey, audit or monitoring

- Need to understand benefits and limitations of each method.
- Need to match sample population to correct demographic mix (eg age groups, affluence, location).

Data Collection Method	Population	Cost	Data Veracity
Questionnaire Survey	Large	Inexpensive	Limited
Physical Audits	Small	Expensive	High
Monitoring	Very small	Very expensive	Very high

- Combination of methods very cost effective way of maximising quality and extent of data. (calibration)

Examples of Survey results:

Table 60: Average House Summary – Usage Characteristics

Average Per House*	Incandescent	Mains Voltage Halogen	Low Voltage Halogen	Compact Fluorescent	Linear Fluorescent	LED	Unknown
Frequent Long	10% (1.0)	19% (0.8)	26% (3.3)	32% (5.0)	15% (0.6)	29% (0.2)	14% (0.1)
Frequent Short	23% (2.4)	16% (0.7)	29% (3.7)	25% (4.0)	22% (0.8)	39% (0.3)	25% (0.2)
Occasionally	20% (2.1)	29% (1.3)	16% (2.1)	21% (3.3)	34% (1.3)	6% (0.0)	24% (0.2)
Rare	47% (4.7)	37% (1.6)	29% (3.6)	22% (3.6)	30% (1.1)	26% (0.2)	37% (0.3)

** For houses where usage questions were asked – N = 87*

Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/2010-ResidentialLighting-Report-FINAL.pdf

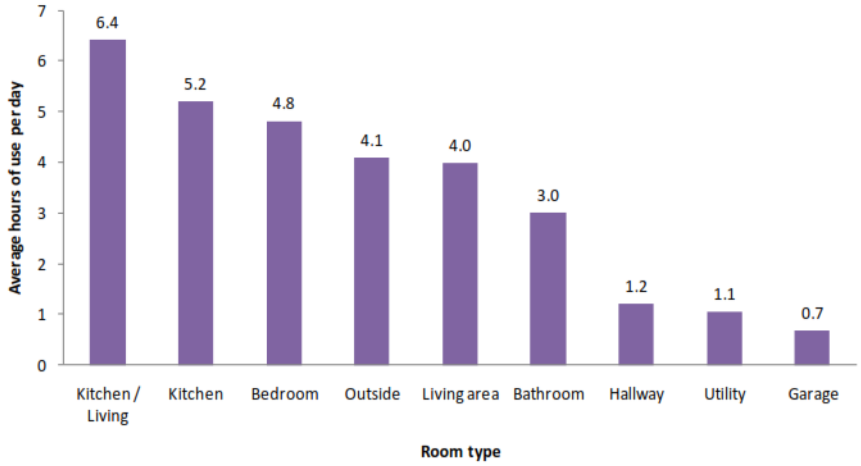


Figure 1 – Average hours of use per weekday (by room type) [n = 147 houses[1]].

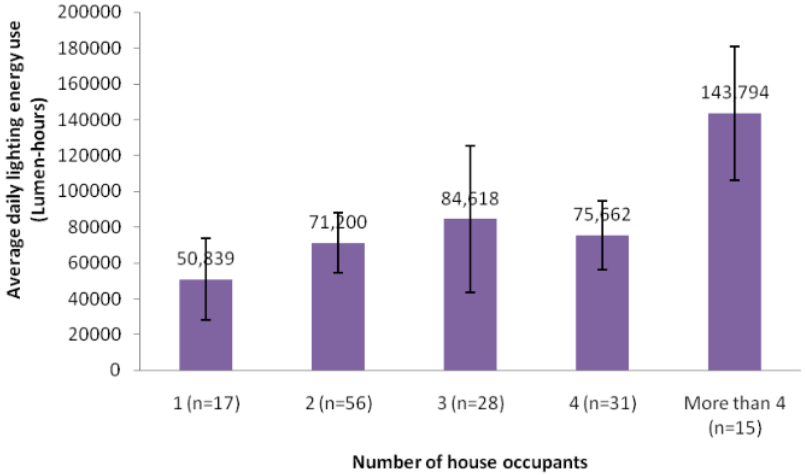


Figure 8 – Household lighting energy consumption by number of occupants (in lumen-hours[3]).

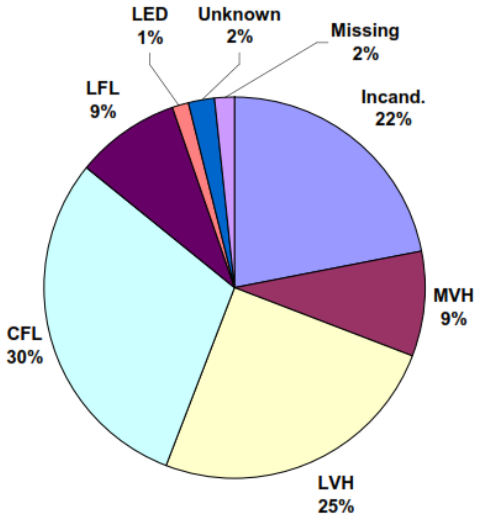
Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/Lighting-Survey-Pilot_FINAL.pdf

Examples of Audit results:

Table 6: Average House Summary - Lamp Number and Watts by Technology

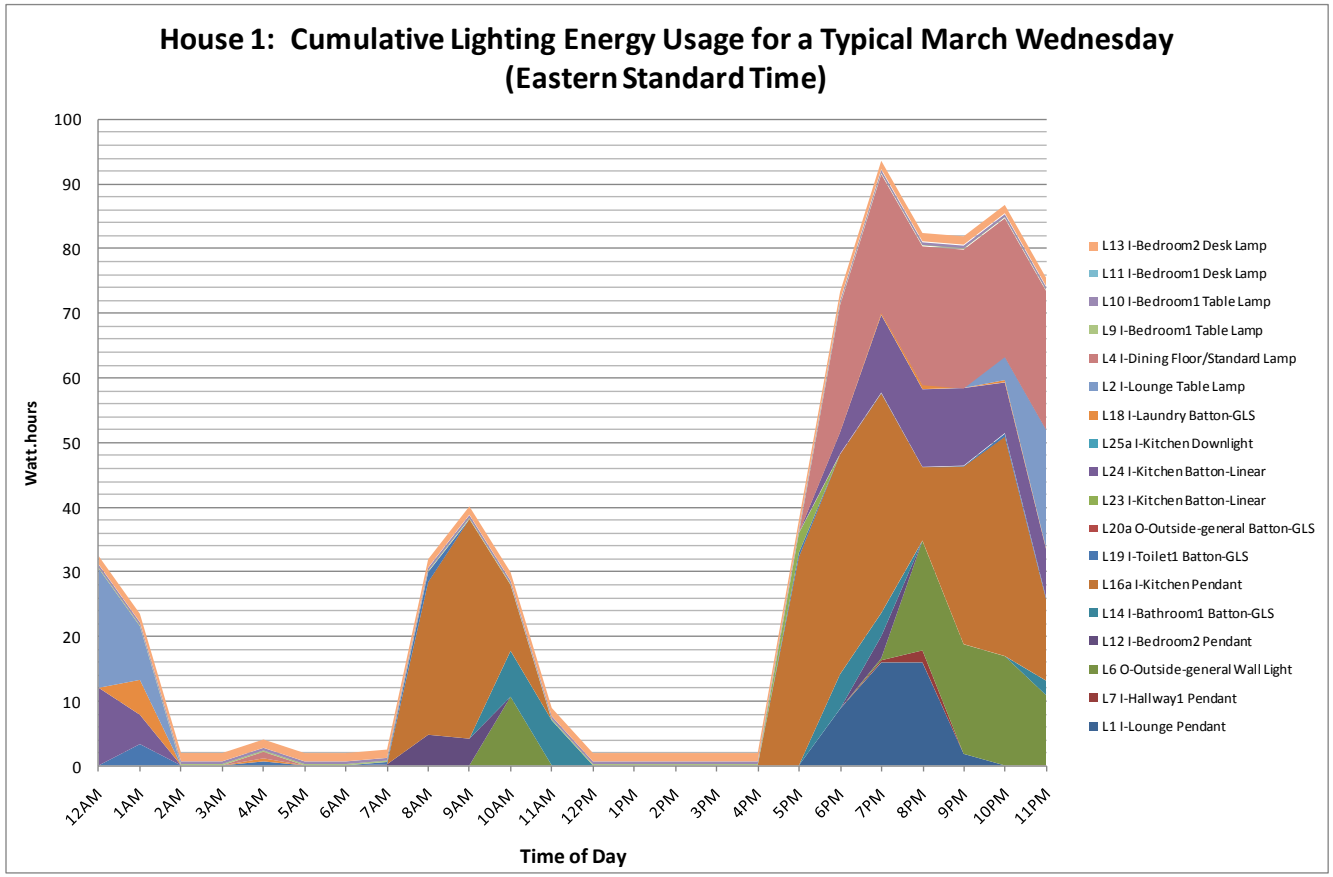
Average Per House	Incandescent*	Mains Voltage Halogen	Low Voltage Halogen	Compact Fluorescent	Linear Fluorescent	LED
Number of Lamps	10.5	4.3	11.9	14.4	4.2	0.7
Number Share	22.0%	8.9%	24.8%	30.1%	8.9%	1.4%
Watts Total	755	294	558	195	142	4
Watts Share	37.6%	14.6%	27.8%	9.7%	7.0%	0.2%
Watts per Lamp	72.7	74.5	44.0	13.6	33.3	5.1

Average House – Technology Share (number of lights)



Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/2010-ResidentialLighting-Report-FINAL.pdf

Examples of Monitoring results:



Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/Lighting/2010-06-remp-coyne.pdf

Examples of Monitoring results:

House 3							No. days	54
Light	**Room**	**Lamp Tech**	**No of lamps**	**Lamp W**	**W.hrs**	**hrs**	**W.hrs (per day)**	**hrs / day**
L27	I-Hallway2	Compact fluorescent - integral ballast	1	18.0	5,867	326	109	6.0
L12A	I-Kitchen	Compact fluorescent - integral ballast	3	9.0	8,618	319	160	5.9
L26	I-Lounge	Compact fluorescent - integral ballast	1	10.4	2,320	224	43	4.1
L11B	I-Kitchen	Linear fluorescent	2	36.0	15,199	211	281	3.9
L16	I-Dining	Incandescent - mains voltage	1	75.1	15,669	209	290	3.9
L46	I-Bedroom4	Compact fluorescent - integral ballast	1	7.3	1,426	195	26	3.6
L21	I-Lounge	Compact fluorescent - integral ballast	1	13.8	2,317	168	43	3.1
L34	I-Bedroom3	Incandescent - mains voltage	1	39.8	6,198	156	115	2.9
L22A	I-Lounge	Compact fluorescent - integral ballast	2	13.0	2,722	105	50	1.9
L40	I-Bathroom2	Incandescent - mains voltage	1	60.0	6,002	100	111	1.9
L25	I-Lounge	Compact fluorescent - integral ballast	1	10.4	898	87	17	1.6
L10A	I-Bathroom1	Halogen - low voltage	4	50.0	12,711	64	235	1.2
L7C	I-Hallway1	Halogen - low voltage	6	50.0	18,768	63	348	1.2
L24A	I-Lounge	Compact fluorescent - integral ballast	4	13.0	3,078	59	57	1.1
L35	I-Hallway3	Incandescent - mains voltage	1	100.0	4,956	50	92	0.9
L45A	I-Bedroom4	Halogen - low voltage	8	50.0	17,010	43	315	0.8
L38A	I-Laundry	Linear fluorescent	3	36.0	1,656	15	31	0.3
L23A	I-Lounge	Halogen - low voltage	4	50.0	2,006	10	37	0.2
L6	I-Study	Incandescent - mains voltage	1	39.3	0	0	0	0.0
		Totals	**46**	**681**	**127,421**	**2,401**	**2,360**	**44**

Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/Lighting/2010-06-remp-coyne.pdf

5. The Benchmark: Energy baseline needs ancillary data

- **What is impact of electricity costs/emissions**
- **(What will the impact on the local economy be?)**

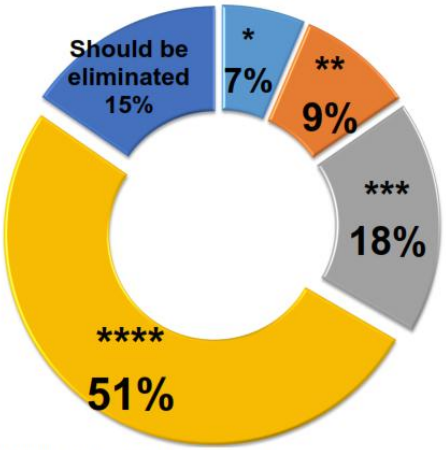
Data	Source
Electricity prices (current & forecast)	Electricity sector
Electricity generation fuel mix	Government energy & trade agencies
Local lighting industry economics & employment	Lighting industry association

Results of Benchmarking: Predictive use

- Creating a Stock Model then assists predictive analysis

Utopia	Summary
Energy Savings (TWh)	**8.83**
residential	4.83
professional	3.02
outdoor	0.98
CO2 Savings (Mt CO2)	**6.77**
residential	3.70
professional	2.32
outdoor	0.75
Financial Savings (Million US$)	**617.82**
residential	282.61
professional	253.04
outdoor	82.17
Payback Period (years)	**0.77**
residential	0.99
professional	0.28
outdoor	0.48
Hg Emission Reductions (kg of Hg)	**408.47**
CFL	-5.68
FL	8.20
Electricity	405.94
SO2 Emission Reduction (kg of SO2)	**24467357**
NOx Emission Reduction (kg of NOx)	**13248539**

- Predicted impact of Indonesia's regulations on the number of CFL products in the market place



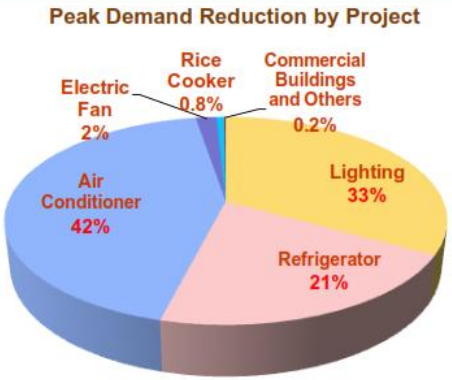
Source: Palaloi, CFL Survey in Indonesia Market 2011, BPPT

http://www.lites.asia/files/otherfiles/0000/0285/Kuala_Lumpur_lites.asia_meeting_1.8_Country_Update_Indonesia.pdf

Results of Benchmarking: Reflective use

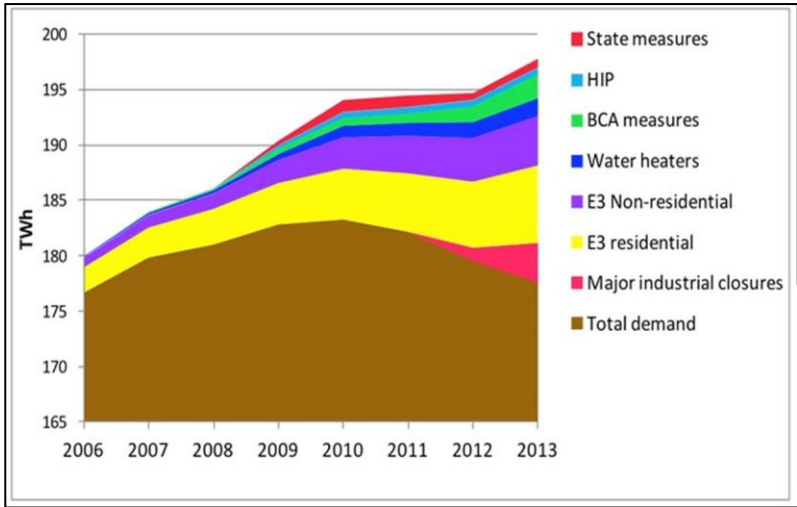
Impact of The Philippines regulations on demand side Management

Engineering Estimate of DSM Program Impacts by EGAT



Achieved to date (as of Mar 2014)			
Program	MW	GWh	CO_2 (Ton)
Lighting	**1,087.1**	**6,046.9**	**3,608,932**
- Fluorescent Tube (T8)	401.5	1,957.5	1,446,682
- Fluorescent T5 Program	174.5	792.1	425,076
- FTL (T5)	129.1	585.6	313,966
- ElecTronic Ballast T5	45.4	206.5	111,110
- CFL(before labeling)	10.0	57.2	42,295
- CFL(labeling 2008)	482.9	3,130.5	1,621,383
- Low-Loss Ballast	18.2	91.3	60,230
- HPSV Street Light	-	17.2	12,723
- LED Street lighting (EGAT)	-	1.1	543

Source: http://www.lites.asia/files/otherfiles/0000/0302/Kuala_Lumpur_lites.asia_meeting_1.10_Country_Update_Philippines.pdf



The effect of Australia's major energy efficiency policies and programs on electricity demand.

Source: http://theconversation.com/why-is-electricity-consumption-decreasing-in-australia-20998

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Conclusion

Obtaining quality data at the beginning of any program helps to:

- Understand the issues
- Justify decisions
- Critically assess the outcomes.

Additional Resources:

- Achieving the Global Transition to Energy Efficient Lighting Toolkit, UNEP en.lighten
  - http://learning.enlighten-initiative.org/toolkit.aspx
- Energy Efficiency Labels and Standards: A Guidebook for Appliances, Equipment and Lighting, CLASP
  - http://clasponline.org/en/Resources/Resources/StandardsLabelsGuidebook.aspx