Benchmarking a Product Market to Determine an Energy Baseline for Change

Steve Coyne

en.lighten

Topics

1. Introduction
2. Scoping the lighting product & key metrics
3. Benchmarking product performance
4. Determining usage patterns (application and time)
5. Towards an energy baseline

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 the lighting product & key metrics

Identifying the product scope

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

  (eg general household omni-directional lamps)

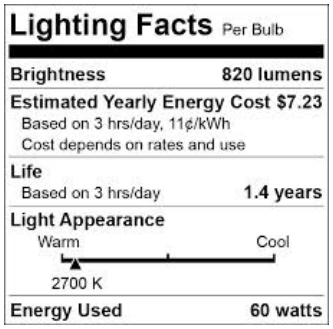
  - Lamp technology (eg incandescent, halogen, CFL, LED…)
  - Distribution (eg Omni-directional, directional)
  - Light output, Wattage
  - Shape, physical size, cap
  - etc

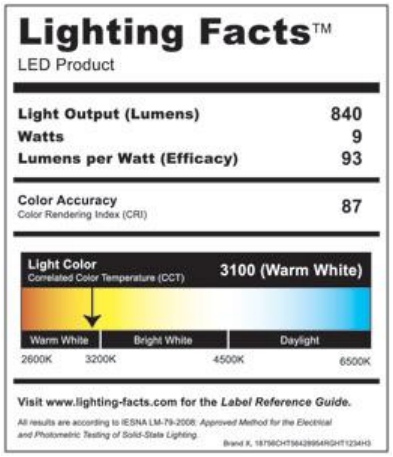
Note any detracting features

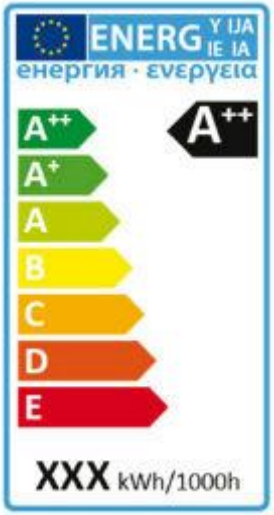
- Are there any features of a technology which could limit range of applications or acceptance?
  - Equivalency & interchangeability
  - Health hazards
    - UV, blue light, flicker …
  - Operational aspects
    - Start time, dimmability …
  - End of life
    - Hazardous waste, recyclability, waste …

The Metrics: What information is required?

- Comparative Labels
  - Typically a limited number of parameters







lites.asia

Australian Aid

en.lighten

UNEP

The Metrics: What information is required?

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

The Metrics: What information is required?

- Performance standards
  - Higher Efficiency Performance Standards (HEPS)
    - Similar to endorsement labels
  - Mandatory Minimum Energy Performance Standards (MEPS)
    - Significantly greater number of metrics than for voluntary programs such as HEPS and labels
    - Extensive parameter list needs to be considered to safeguard features associated with the provision of lighting that are perceived as critical to the consumer & government.
    - Analysis for MEPS will require data for life-cycle costs, technology feasibility and consumer affordability & cost/benefit.
- This may ultimately influence the type of program proposed.

The Metrics: What may be required?

- Light output
- Light distribution
- Efficacy
- Lifetime
- Lumen maintenance
- Start-up & run-up time
- Electrical
  - Power Factor
  - Total Harmonic Distortion
- UV
- Blue light
- Flicker
- Colour
  - CRI
  - CCT
  - Uniformity
  - Consistency
- Price

3. Benchmarking product 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

Technical Data

Data

As determined earlier:

(as an example)

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

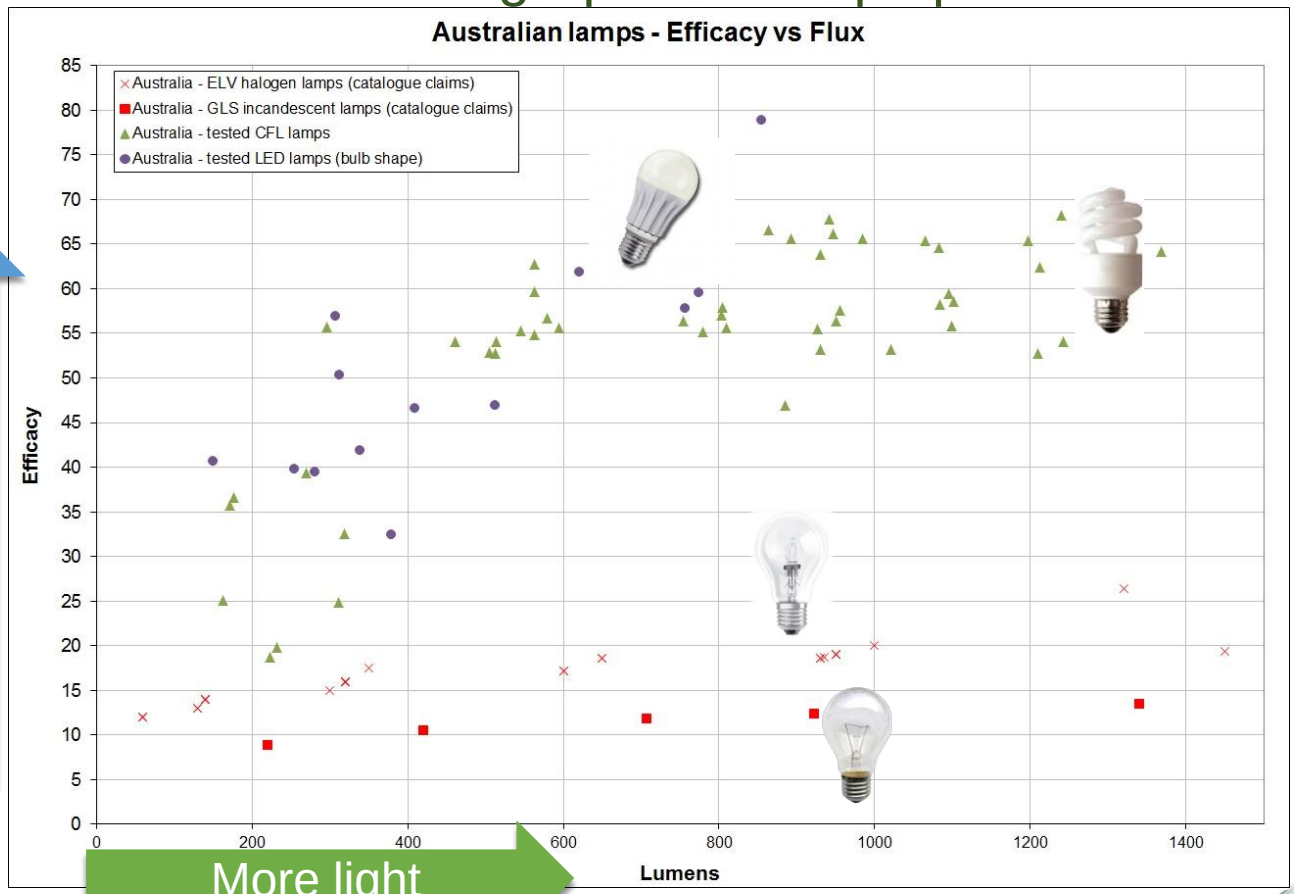
Source

- Product packaging
- Manufacturer catalogues/websites
- Consumer advocacy groups
- Commissioned independent testing
- Non branded test data from test laboratories

lites.asia Australian Aid en.lighten UNEP

Results of data gathering (claims & test data)

- Create benchmark graphs of lamps performances



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

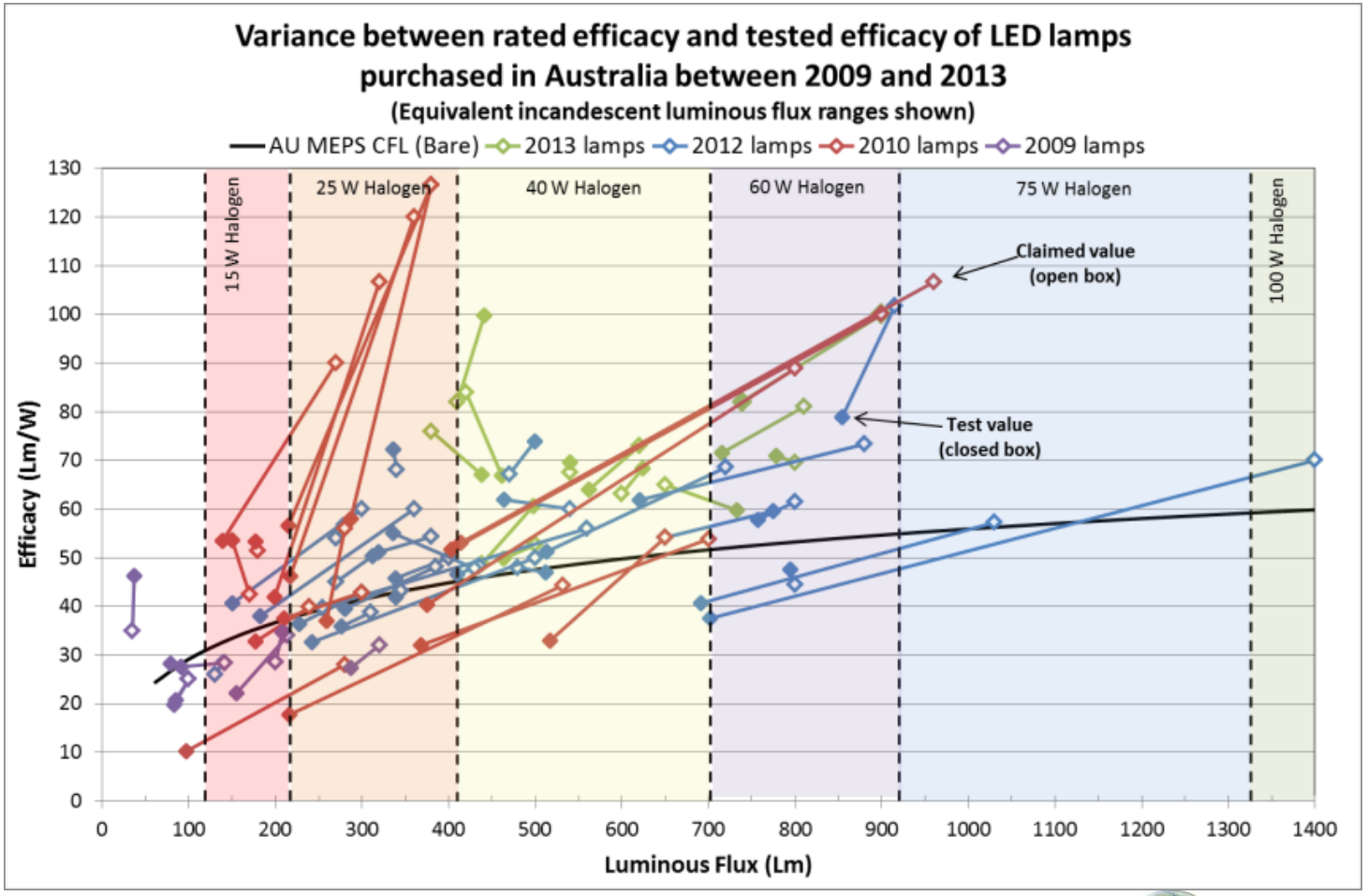
lites.asia

Australian Aid

en.lighten

UNEP

Calibrate claimed performance data by testing



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

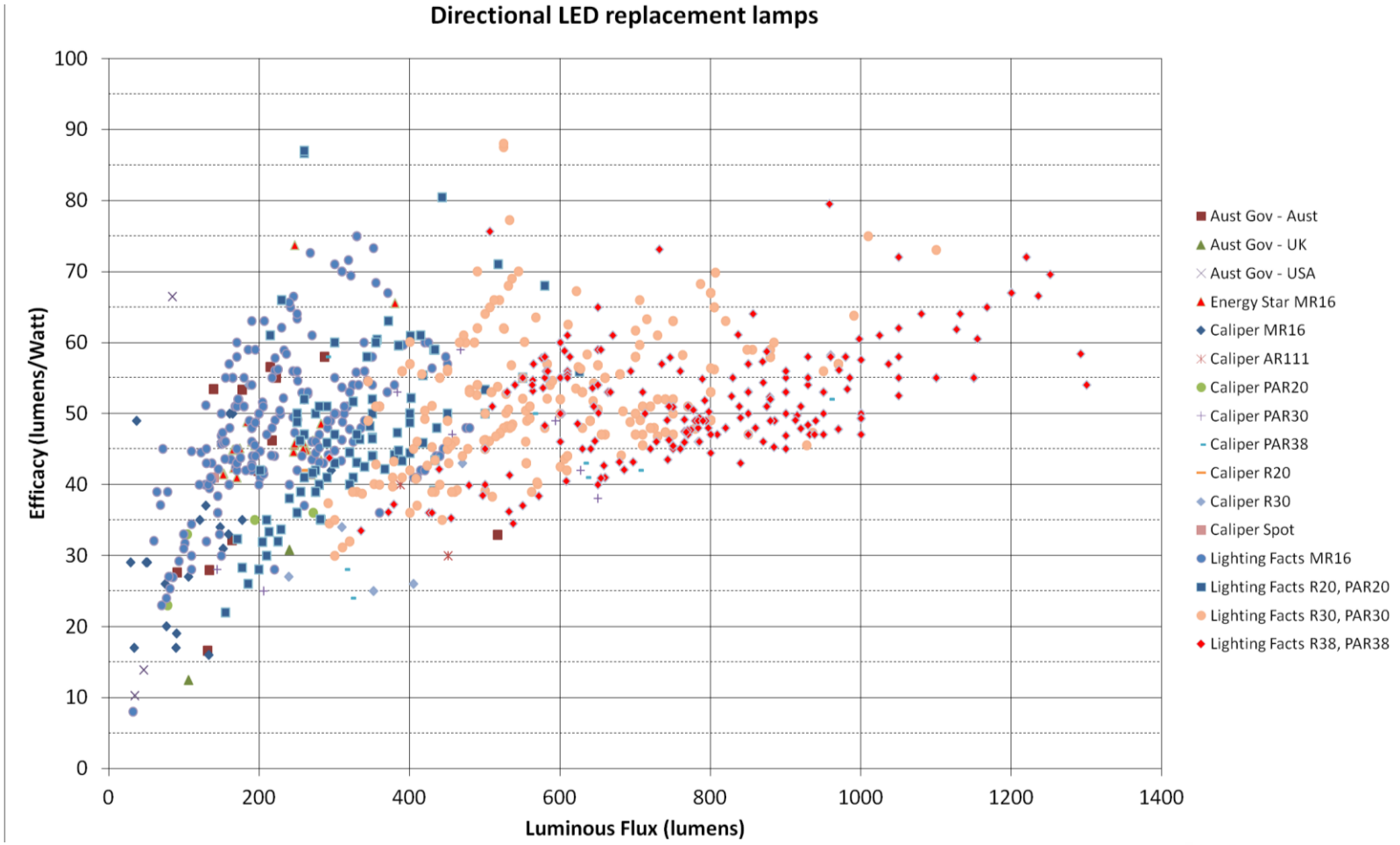
lites.asia

Australian Aid

en.lighten

UNEP

Or only use test data



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

lites.asia

Australian Aid

en.lighten

UNEP

4. Determining usage patterns (application and time)

Usage Data: 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 Data: 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 from Questionnaire Survey

- Provide data acquisition opportunity from a large sample population
- Relatively inexpensive
- Limited veracity of results due to possibly:
  1. Misunderstanding (or ambiguous) questions
  2. Unable to correctly identify question choices (eg kitchen light has incandescent or halogen lamps)
  3. Not knowing the information requested (eg average hours of use of kitchen lights)

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

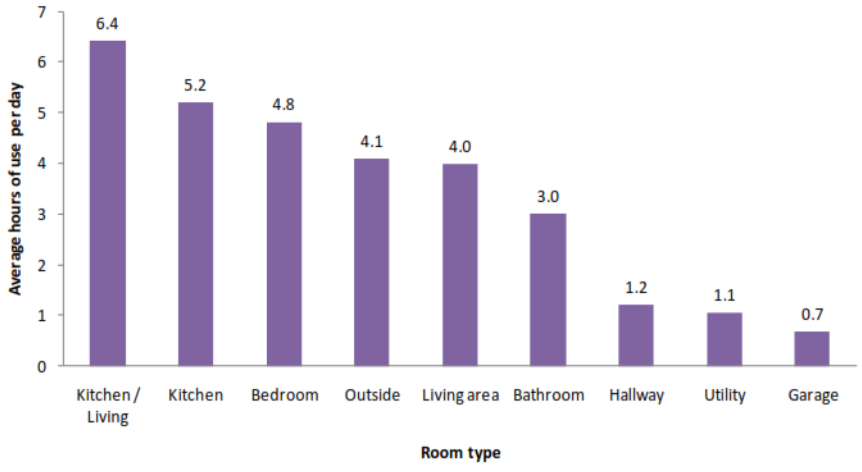


Figure 1 – Average hours of use per weekday (by room type) [n = 147 houses[1]].

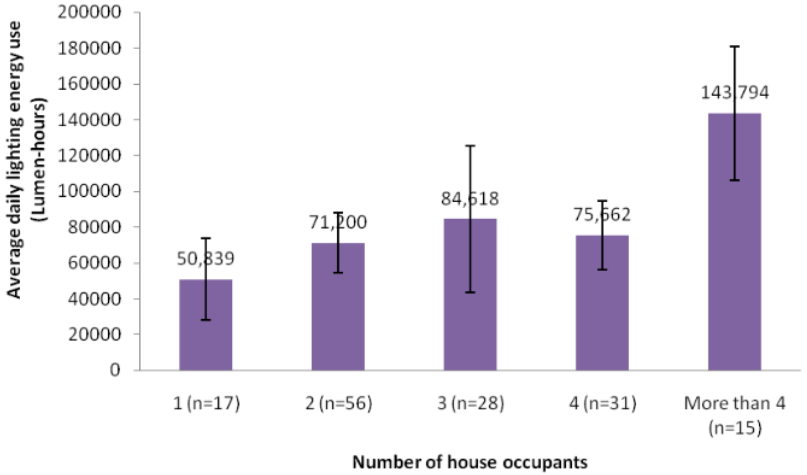


Figure 8 – Household lighting energy consumption by number of occupants (in lumen-hours[3]).

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

lites.asia Australian Aid en.lighten UNEP

Data from Physical Audits

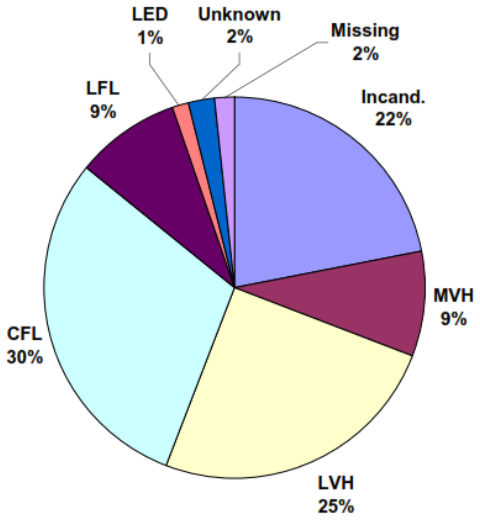
- Provide data acquisition opportunity from a small sample population
- Relatively expensive
- High veracity of results due to auditor's availability to:
  1. Clarify questions
  2. Personally identify correct question choices (eg kitchen light has halogen lamps)
  3. Explore by querying household habits to reasonably estimate information requested (eg average hours of use of kitchen lights)

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)



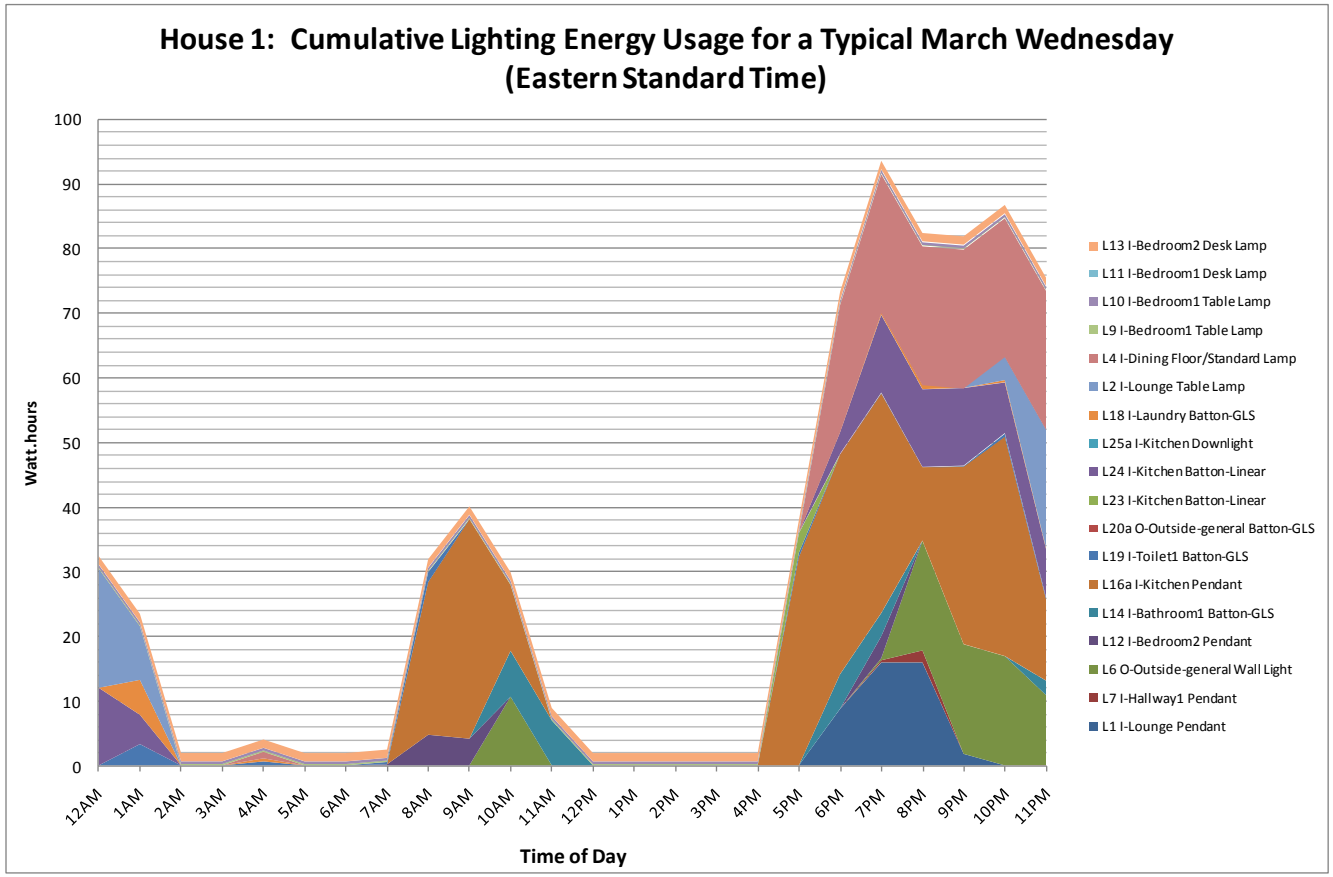
Source: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/2010-ResidentialLighting-Report-FINAL.pdf

lites.asia Australian Aid en.lighten UNEP

Data from Monitoring

- Provide data acquisition opportunity from a **very** small sample population
- **Very** expensive
- **Very** high veracity of results due to actual monitoring of parameters such as:
  1. Actual time of use
  2. Switching frequency

Examples of Monitoring results:



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

lites.asia Australian Aid en.lighten UNEP

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

Data gathering by survey, audit & monitoring

- Combination of methods can be very cost effective way of maximising quality and extent of data obtained.
- An audit with monitoring can be used to calibrate data from a survey questionnaire on estimated hours of use and switching etc
- A physical audit can be used to calibrate data from a questionnaire on lamp technology identification errors

5. Towards an energy baseline

Ancillary Data

- **What is impact of electricity costs/emissions and economy?**

Data

- Electricity prices (current & forecast)
- Electricity generation fuel mix
- Local lighting industry economics & employment

Source

- Electricity sector
- Government energy & trade agencies
- Lighting industry association

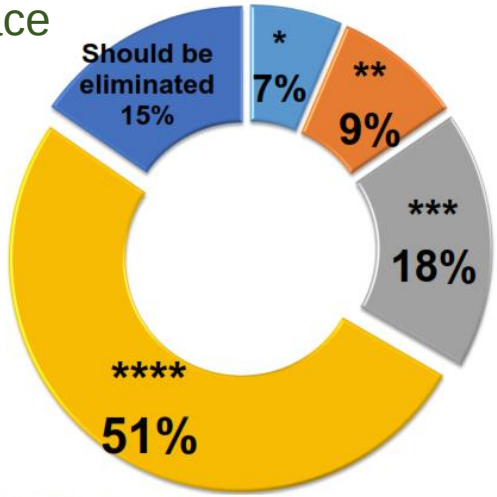
lites.asia Australian Aid en.lighten UNEP

Results of Data Gathering: Predictive

- 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

lites.asia

Australian Aid

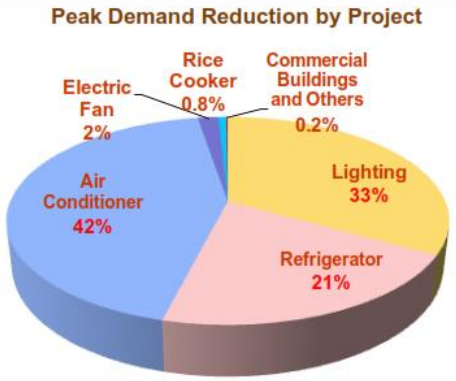
en.lighten

UNEP

Results of Data Gathering: Reflective

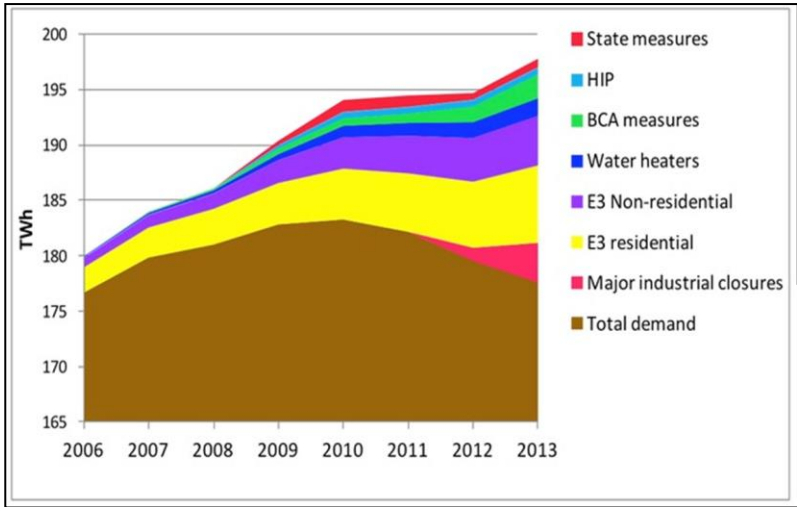
Impact of The Philippines regulations on demand side Management

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

lites.asia

Australian Aid

en.lighten

UNEP

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

Question and Answer Period

Thank you!

Join us for the next webinar on
Legislative Frameworks to be held the during the last week of July

enlighten@unep.org

www.enlighten-initiative.org

info@lites.asia

www.lites.asia

lites.asia Australian Aid en.lighten UNEP