SUSTAINABLE STREET LIGHTING INITIATIVES

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Abstract

Street lighting is a key service the Local Government provides to its community. However; the ability to influence how this service is provided, at what service level, and at what cost as been significantly removed from the control of Local Government.

With the emergence of LED luminaires and other associated street lighting technologies and infrastructure, as well as industry reform, the next five years will determine if Local Government influences the industry in a way that ensures a sustainable financial and environmental outcome for our communities.

Key Words

Streetlighting, Lighting, LED, Energy, Electricity

Introduction

In which Asset Class does Australia rank in the lowest performance in the developed world?
Which Asset does Council pay the capital, finance, and depreciation costs in cash yet have little to no say in its selection, or even own the asset?
Which Asset does Council pay to maintain yet not determine the Service Level?
Which Asset does the Council have little to no understanding of the true costs yet pays the bill to an organization (sometimes a private organization) without question or market testing every month?
The answer to all of these questions is Street Lighting.

Street Lighting Context

There are approximately 2.4 million street lighting lamps in operation throughout Australia consuming approximately 1460 Million kW/h of electricity annually at a cost of approximately $215M. This cost exceeds $430 Million when asset provision and maintenance costs are added.

In addition, approximately 1,575,000 tonne of CO_2 gases are produced (approximately 50% of emissions generated by Local Government), the equivalent of approximately 750,000 passenger vehicles.

The vast majority (94%) of street lighting is owned and operated by Energy Distribution Businesses (EDB's). Currently 67% of these are state owned while the remaining 33% are privately owned. Of the currently state owned EDB's, New South Wales which represents approximately almost 40% is likely to change ownership* in the near future with a privatization agenda being the key item in the recent State Election. This privatization seems to be the direction of the Street Lighting Industry in Australia with States seeking funds and efficiency gains.

Relevant Legislation and Regulation

The legislation surrounding street lighting is quite subjective.

The Local Government Act requires that Councils provide services and facilities that benefit its area, ratepayers, residents and visitors. The Act also requires that Council provides infrastructure for its community that protects the community from any hazard.

The Lighting Standard (AS/NZS 1158) is a voluntary standard separated in two main categories:

P_{CAT} for residential streets and public open spaces

V_{CAT} for main vehicular roads

The vast majority of residential streets offer very low levels of lighting which can really only be described as “way finding” lighting. Many areas, especially fringe urban or rural areas do not comply with even these minimal standards.

Street Lighting Price Regulation is undertaken by the Australian Energy Regulator (AER) in most States and Territories of Australia, and the Energy Regulation Authority (ERA) in Western Australia, however this tends to focus on energy use of lamp types rather than the tariffs applied for asset charges and maintenance where the role becomes more focused on mediation between Councils and Street Lighting Providers.

Technology Advances

The first electric streetlight was installed in Australia in Tamworth NSW in 1888.

The vast majority of streetlights are High Intensity Discharge (HID) Lamps which create an arc in an arc tube containing different gases which when “excited” produce light.

The first of these lamps lasted 75 hours and produced between 2-7 lumens per watt.

The common types of lamps today far exceed this early performance as per Table 1.

The strong preference for white light, along with the timing of the introduction of different lamp type technologies has seen Mercury Vapour become the most prevalent lamp type in Australia. Mercury Vapour lamps are especially popular in residential streets (P_{CAT}), while High Pressure Sodium are most common on main roads (V_{CAT}).

LED lighting is a rapidly developing technology which has far less physical and technical restraints than HID lighting and its performance characteristics have recently equaled or surpassed common lamp types. LEDs currently have an efficacy of 100 lumens per watt and a life expectancy of 12-20 years. This performance is expected to continue to improve over time.

Asset Audit Case Study

Asset audits were undertaken in two separate Local Government Areas; Unley City Council, and Campbelltown City Council. These audits visually surveyed 100 per cent of luminaires within the audit area identifying:

- Location
- Pole Type
- Luminaire type
- Approximate Age of Luminaire
- Condition of Luminaire
- Lamp Type
- Lamp Height
- Other site relevant details

In total, across the two Local Government Areas, approximately 11,000 street lights were surveyed.

Approximately 65% of lamps were Mercury Vapour (MV), with next most predominant lamp type being High Pressure Sodium (HPS) at 26%.

Table 1:

Lamp Type	Light Colour	Lumens / Watt	Life Expectancy
High Pressure Sodium	Yellow	<150	13 Years
Metal Hallide	White	100	4-7 Years
Mercury Vapour	White	60	3-5 Years
Compact Fluorescent	White	100	3-5 Years
Low Pressure Sodium	Orange	200	3-5 Years

Approximately 81% of Council luminaires were estimated to be over 15 years old. Approximately 90% of Luminaires were located in P_{CAT} areas.

Findings of Review

The review of Street Lighting was primarily aimed at both the cost and performance of the provision of the service by the Street Lighting provider.

The cost of street lighting is approximately $150 per lamp contributed to by two reasonably equal components:

- Tariff (asset charge); and
- Electricity

While there are several Tariff types pending the specific obligation of the Council or the Street Lighting Provider (SLP), the Tariff is made up of:

- Maintenance Cost;
- Capital Cost;
- Depreciation Cost; and
- Overhead Cost

Regulation requires that maintenance costs reflect the actual costs, however the ability for an individual Council to have vision over, or audit these costs is near impossible.

Likewise, the Capital and Depreciation costs are assigned across a Regulated Asset Base. However, this term is reasonably misleading as the value of the individual assets in this asset base is somewhat self-determined and then pooled across the entire SLP distribution area. There is no actual direct correlation between the physical assets within a Local Government Area and the tariffs paid by that Local Government for the street lighting assets provided.

The Review identified specific tariff related costs where significant cost reductions could be achieved, including:

- Government financing of Asset Base (i.e. lower cost for capital)
- Non-cross subsidization of Asset Base (i.e. Council pays directly for its own assets)
- Installation of LED (i.e. low maintenance) Luminaires
- Using Private ownership to benefit from Asset Depreciation (ie. Tax shield)

The above factors were identified as having the potential to reduce Tariff costs by 74%.

In addition, Council ownership / control of the street lighting assets could also lead to further savings or commercialization opportunities as street light infrastructure progresses to become a multi-functional piece of infrastructure and / or digital technology hub.

The Review further identified specific measures related to energy costs where significant cost reductions could be achieved, including:

- LED Luminaire Energy Efficiency (ie. improved efficacy - lumens / watt)
- LED Optical Controls (ie. increased spacing of luminaires)
- LED Energy Controls (ie. ability to control lighting levels)

The above factors were identified as having the potential to reduce Electricity costs by up to 72%.

In addition to these electrical cost savings, a similar carbon reduction was achievable. As street lighting contributes approximately 50% of the carbon emissions generated by Local Government, this reduction is significant.

The performance of street lighting was reviewed against the following general criteria:

- Maintenance; and
- Lighting Levels

Through discussions with multiple stakeholders (including the Street Lighting Provider) it was determined that Maintenance was minimal at best, and there was no

Service Level Agreement in place between the Council and the SLP.

There was no pro-active or routine maintenance undertaken to ensure optimum operational performance of the assets, and the visual inspection audit identified that the vast majority of assets were operating below expected levels.

Critical maintenance (i.e. an outage) was performed in an untimely manner and only initiated by a community reporting mechanism.

Lighting Levels in the community could be categorized clearly between the main roads and residential roads, as is typical across Australia, with light levels significantly higher on main roads.

Residential roads which theoretically complied in general with P_{CAT} Standards often suffered from reduced performance in the field due to both the poor maintenance of luminaires and impedance by trees. It is important to recognize that P_{CAT} Lighting Standards were actually post determined from what had been deployed in the field, and even though theoretical compliance sounds appeasing, the light levels in these streets are poor in comparison to urban areas in other developed nations.

Key Drivers to Improved Performance

It was determined that there were five significant contributors which affected either cost or performance. Those contributors are as identified below:

- Asset Cost (affected by asset owner, asset type, and asset age)
- Power Cost (affected by asset type and unit rate)
- Maintenance Cost (affected by asset type, asset age, and asset owner)
- Lighting Level (affected by asset age, asset type, and asset number)
- Service Level (affected by asset owner, asset age, and asset type)

The above list also identifies the determining factors of the significant contributors. By reviewing the common drivers it becomes apparent which drivers must be focused upon in order to reduce cost and improve performance. These key drivers are:

- Asset Type – predominantly lamp type;
- Asset Age, and;
- Asset Ownership

Barriers to Change

The benefits of switching to LED luminaire technology are abundantly clear, however to date there has been an insignificant take-up of this proven technology. The barriers to this change are:

- Misaligned Interest
- Capital Cost
- Technology Confidence
- Resource
- Product Approval

A significant barrier to change is the Misalignment of Interests. The Street Lighting Provider is also the Energy Distribution Business (EDB). Undertaking a major asset renewal program which has the potential to reduce energy consumption (ie distribution) by approximately 70% is contradictory in purpose to that of the EDB. This misaligned interest is lessened to a degree when the EDB is State owned rather than privately owned, as you would expect that the common community interests of State and Local Government would prevail. It is important to note that if a State is about to privatize its EDB(s) then it is critical for Local Government to ensure that Street Lighting Services and Assets are dealt with appropriately prior to this shift.

The Capital Cost of replacing luminaires can be a significant hurdle, with not only the product cost but also the installation and residual asset costs to be considered. These costs however can be significantly reduced. The purchase price of a quality LED luminaire has significantly reduced in recent years and will continue to do so (however not at such a fast pace). Installation costs can be significantly reduced through obtaining economies of scale through bulk replacement

programs. Residual costs can be reduced or negated through asset replacement programs which replace older assets first, through negotiation with the SLP, or through retaining the existing assets on the Regulated Asset Base (i.e. paying them out over time). The total Capital Cost is currently estimated at approximately $500 per street light.

Confidence in LED Technology has been a concern with respect to both the future maintenance costs of a new technology, and determining when to adopt a fast evolving and improving technology given that too early an adoption will lead to a missed opportunity. With respect to maintenance, there have now been significant bulk replacement programs and testing internationally to have extreme confidence in the low maintenance credentials of a quality LED product. With respect to concerns over early adoption, most quality LED luminaires allow for easy replacement of LED modules allowing future upgrading. The capability and characteristics of LED luminaires now outperform all types of other lamps. Further delay in adoption and implementation is unjustified.

Local Government in general is lacking in resource. This resource deficit is compounded in street lighting expertise in all but the largest Councils. Where municipal Councils once led the street lighting industry, this expertise has largely migrated to EDB's and private industry over the previous fifty years with the structural reform within the electrical generation and distribution industry. It is important that a Council obtains the required expertise prior to any bulk replacement program through either consultants or partnering with a street lighting organization.

As the current Lighting Standard does not cater for LED luminaires there has been some reluctance to adoption, and reluctance obtaining product approval. The existing Lighting Standard is currently being updated to allow LED technology and will be released shortly. Irrespective, the benefits of LED technology are large enough for many Councils to have commenced bulk replacement programs based on a performance and risk assessment approach. There has also been concern that straight replacement of LED on existing poles will be deemed an upgrade and imply that Lighting Standards must be complied with. Where this previously was a potential risk (even though residential street standards are a guide) the capability of the LED luminaires are such that Lighting Standards can be achieved by current products on existing pole spacing. EDB's and Product suppliers have been the active parties in obtaining Product approvals and ratings to allow installation on unmetered networks, however Councils should consider the installation of private streetlight networks, especially in areas of (re)development (e.g. main street upgrades etc.) which will allow for improved savings through metering, lighting controls, and improved spacing.

The Provider Perspective

To expand on the issue of Misalignment between EDB's and the introduction of LED technology the issue should be viewed from their perspective.

An Australia wide replacement of existing street lights with LED luminaires would have a capital cost of approximately $1.2B. This capital would need to be sourced and the assets placed on the balance sheet. It is appreciated that these assets would become part of the Regulated Asset Base and the EDB would be capable of recovering costs through tariffs, however the EDB's jointly have a Regulated Asset Base of approximately $850M. In an environment where Local Government is pressuring for reduced tariff costs, increasing the Regulated Asset Base by 140%, where the only means of recovery is increased tariffs it is likely that the EDB's would sustain a substantial share of this asset write-down.

In addition to a potential asset write down of up to $850M, the EDB's generate revenue through the distribution of electricity. The transition to LED technology could ultimately reduce electricity usage and therefore distribution by 70%. This reduction applied nationally would result in a revenue reduction of approximately $85M annually. A Net Present Value of the transition to LED street

lighting may be in order of a $1.8B loss for the EDB's.

Although it could be considered that such a reduction in power usage would ultimately have an beneficial impact on generation and distribution infrastructure, it should be noted that the majority of street lighting usage is in off-peak periods, whereas the generation and distribution infrastructure is built to deal with peak loads.

It is clear why there has been significant resistance by the EDB's for transition to LED street lighting.

Conclusion

Local Government is required to provide street lighting to its community; however, Local Government has largely lost control of how this service is performed and the costs associated.

The majority of street lighting providers are somewhat conflicted in their provision of this service to Local Government and the communities that they serve. The transition to LED street lighting could result in significant up front and ongoing reductions in profitability to EDB's.

LED technology is a disruptive technology, as in it makes the existing technology redundant. The financial and environmental benefits available to Local Government through the adoption of LED technology are significant and should no longer be viewed with caution or trepidation. The barriers to adoption must be overcome.

Local Government is well placed to drive this change but must aim to reform the industry to regain ownership and control of the assets that provide this service to their communities. This can be achieved through negotiation or direct action and implementation.

Local Government should obtain the expertise to undertake this reform through employment, advisory services, or partnering with private industry.

New South Wales faces a once in a lifetime opportunity to achieve this reform with the impending privatization of the electricity distribution network. Other States and Territories may have similar opportunities, but will more than likely need to take more direct action.

Ultimately the benefits to the community are significant and allow for financial and environmental sustainability. How the initial burden is shared between the stakeholders will depend on who has the loudest voice, who is the most educated, and who utilizes the skills of diplomacy and negotiation. Local Government is coming from a position of weakness in this discussion and must quickly apply resources to ensure that burden isn't carried solely by their communities.

Acknowledgements

Mr Paul Di Iulio

Author Biography & Photograph

Scott Williams

Scott is the Director of COMPLETE Urban Pty Ltd.

Scott has over 20 years' experience in community assets and infrastructure and how they are delivered around the world. As the founder of COMPLETE he has dedicated his career to assisting Local Government in achieving sustainable outcomes through innovative solutions.

Scott specializes in the principles of Public Private Partnerships, Alliancing, and Contract Development. He has worked collaboratively with industry leaders on award winning projects in London, Doha, Abu Dhabi, Auckland, and throughout Asia and Australia.

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John was appointed as General Manager Assets & Environment of the City of Unley in mid 2012. John's current role covers all areas of infrastructure, asset management and environment.

Prior to this appointment, John has had experience at a senior level in a range of private and public sector organisations.

He has a civil engineering degree, as well as a Masters in Business Administration.

John has a strong background in organisational change, process improvement, service improvement, asset management and organisational efficiency, particularly linking organisation strategy to service delivery.

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