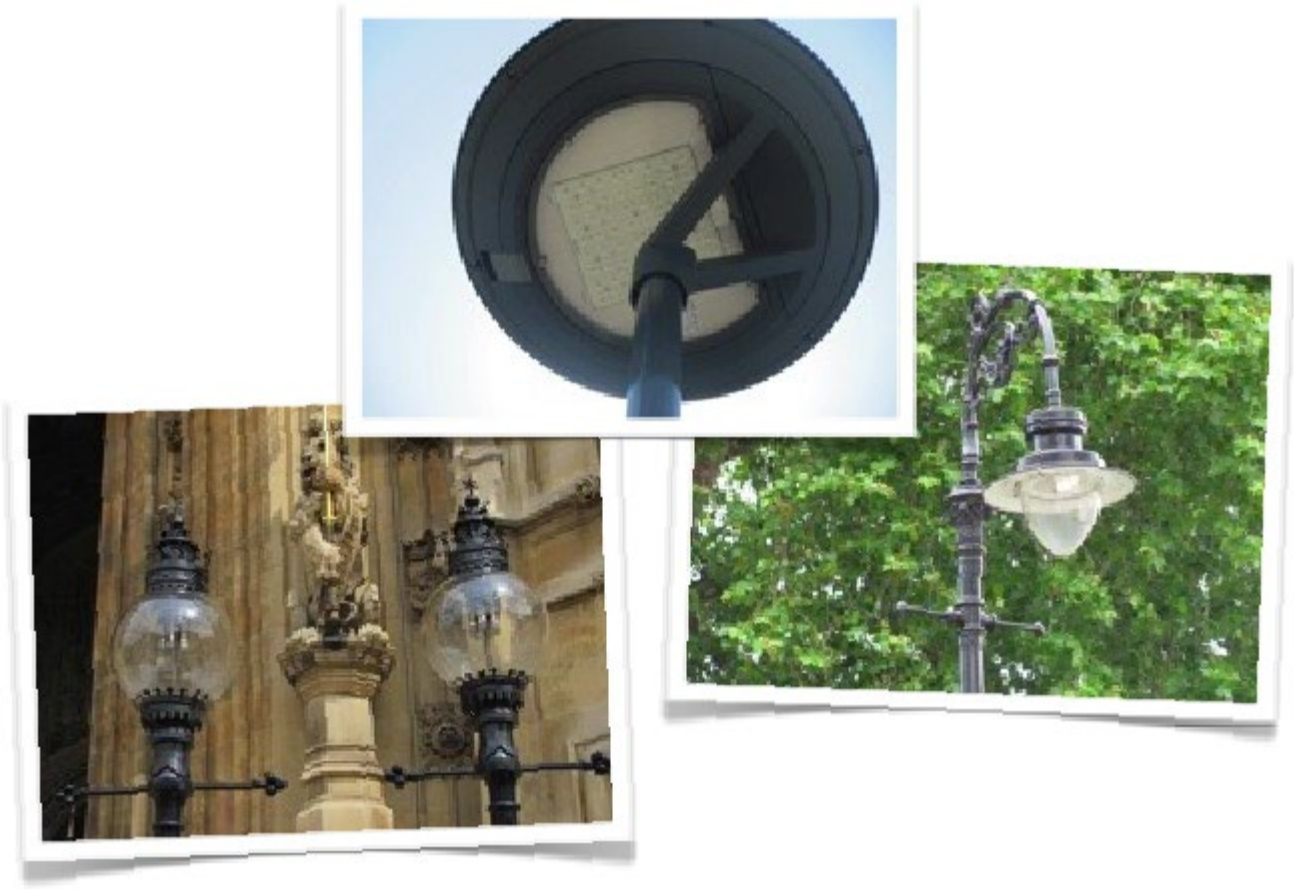
STREETLIGHT REDUCTION PROGRAMS



McArthur Fellowship 2011

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Executive Summary

The most significant efficiency gains to be made from street lighting can be achieved by turning them off or not providing them in the first place!

The main focus of this report is not about energy efficient street lighting although the concept does feature heavily. The report is about challenging the need for the amount of publicly funded lighting provided in our society and also challenging the mindset of those who are dictating that need.

You will note that I talk about the provision of street lighting not the demand or expectation. I do this as I believe the public has been moulded to simply accept what is provided.

Let us start by asking ourselves some very important yet basic questions...

· Why are we scared of the dark?
· Why do we light roads when cars have headlights?
· Why do we light residential streets at 2am when nobody is using them?
· Why do we think 'security lighting' deters criminals or makes us safer?

Challenging questions?
Not really, just an indication of they way we have been moulded to accept what is provided for us. As an example, there is no expectation for the provision of lights on our rural roads yet in most towns you could quite safely drive around without turning on your car headlights???

If we are honest in answering these questions a couple of things become apparent. We have all become comfortable with the concept of turning night into day and the providers of this equipment, having a pecuniary interest, are only too willing to facilitate our needs.
We can come up with all sorts of justifications for this addiction we have but is it really a demonstrated need or just the continual evolution of an engineering masterpiece that remains unchallenged?

It is my hope that this report and its recommendations will bring into question current contracts in place, regulations enforced, design principles employed and even unsubstantiated perceptions and safety concerns in our communities.

Background

I get extremely agitated and yell at my kids when I come home and it seems like every light in the house is switched on. I go around after them switching off lights, whinging and moaning about the rising cost of electricity, the impact on the environment, blah blah blah.
YET...
I live in a street where the lights stay on all night even though nobody is 'out there'.
I work in a power generation facility where there were no light switches installed as the company didn't have to 'pay' for power.
I drive a car with magnificent state-of-the-art headlamps. Most of the time I cannot even tell if they are switched on or not when driving in town because it is so well lit.
I expect the walkway through my local park to be fully illuminated at all times incase I decide I might wander through there one night.

Why do we have such a different outlook when it comes to domestic verses public lighting?
Is it because we pay the bills for usage in our homes or businesses?
WELL...
We are paying for public lighting also and paying more dearly than any of us are aware.

Much work has been done on investigating energy efficient lighting in Australia. In the domestic market we have even regulated to outlaw incandescent lamps.
But what of public, main road and residential street lighting?
Surely this is an issue that somebody else is responsible for!

Let's look at some data and then determine why we should be concerned!

- Worldwide, the ratio of streetlights to people is approximately 1:10. This is true for Australia also with close to 2.3 million publicly funded lights in operation.
- Over two thirds of these are on residential streets and are illuminated all night and every night.
- Although there is much improved technology available, new installations are still being encouraged with inefficient, expensive and environmentally destructive lamps.
- Street lighting contributes more than half of Local Council's greenhouse emissions and the ratepayers are left to foot the bill.
- The impact of providing this 'service' in Australia exceeds 1.5 million tonnes of greenhouse gas emissions and the financial burden for Baw Baw Shire alone is nearly half a million dollars per year. We only have just over 40,000 residents.

No question, the provision of street lighting in it's current form is unsustainable.
So let's go back to basics and ask the fundamental question, 'Why are we providing it?'
Street lighting has evolved from the days of horse and cart. We used gas lanterns to mark the track after dark and provide some guidance. Much the same way we still use marker buoys for shipping lanes today.
With the continued development of the electric light, came the recognition of the potential to actually illuminate the track allowing for better ease of passage.
We know the rest... horse and cart evolved into motor vehicles, street lighting technology progressed to what we have today.
But there is some things that have been overlooked on the way. Just simple things like cars have headlights yet we continue to light up the black bit in the middle of the road. Lighting has been used as a cheap and effective way to pacify peoples fear of the unknown and the unseen.
It wasn't all without some planning or purpose though. In the early days of power generation, a constant nighttime demand was required for 'base load' consumption. Off peak hot water services and street lighting were promoted to meet that need. The generators and the lighting grid were publicly owned assets complementing each other with a side benefit of providing what was seen to be a required service to the community.
As we know these assets have now long been privatized and advances in technology have allowed generators to become more flexible in their output.
Unfortunately what hasn't followed is a review of street lighting requirements under this new operating regime. The public is still funding the use of street lighting but has little or no say in its provision.
Designers of new sub-divisions and road engineers will say we need to comply with the Australian Standards AS1158.
This is simply incorrect.
These standards are an advisory guide only but they are being promoted as the minimum requirement by our electricity distribution businesses.
I am not for one moment suggesting we should turn off all of our current street lighting but how long can we afford to continue with business as usual?
Is it our risk aversion and anti-litigation behaviors driving this culture?
Is it public expectation has been built up over the years and we are frightened to challenge this?

Or is it simply all too hard and somebody else's problem?

Let's take a look at what's happening around the world

England

CAMBRIDGE

The decision to visit Cambridge England was made for several reasons. Cambridgeshire County Council came highly recommended due to the fact that they were highly advanced in the process of letting a contract for the upgrade and ongoing maintenance of their entire street lighting infrastructure.
Cambridge City also has many similarities to Baw Baw Shire.
By way of explanation, the County Council is similar to our State Government and the City similar to our Municipal Council. The County has responsibility for lighting on all roads and highways while the City controls public buildings, car parks, etc.

A meeting was pre-arranged to discuss two separate topics on our visit to Cambridge and was attended by representatives of the County, the City and the successful private company awarded the contract on behalf of the County.

1. Public private partnership for the management, operations, renewal and upgrade of the Cambridgeshire County Council's public lighting, and
2. Cambridge City car park LED lighting conversion project

The projects in brief...

1. Cambridgeshire project

* 56,000 lights
* Lack of investment and maintenance has driven the need to renew.
* A goal to reduce carbon emissions.
* Power costs are increasing and public lighting accounts for 15% of energy usage for the entire organisation. Approx 1.5 million pounds per annum.
* An opportunity through National Government for Private Finance Initiative (PFI)
* A tender was let for a 25 year management and operations contract for the County's public lighting which also included renewal of all fittings throughout the first 5 years
* All lights will be converted to 35 watt sodium vapor from mercury vapor
* Power costs will be reduced by half to 750k pounds
* There will be a removal of 10 % of lights that are deemed as not required
* Initially lights will be dimmed by 20% after 10pm and another 20% after midnight
* All lights will be managed from a central system for added flexibility, ease of monitoring and reporting purposes.

2. Cambridge car park LED project

* council own this car park and receive significant revenue annually from it
* a brief was developed to replace all lighting in the underground sections (3 floors)
* the brief included options for retrofit of existing fittings or total replacement but specified LED technology
* 200 lights to be replaced - currently 150 watt metal halide
* Estimated 2.5 year cost recovery

Slovenia

SLOVENSKE KONJICE

Why Slovenia?
Europe is at the forefront of LED street lighting technology and this small town in this tiny country is the home of a manufacturing company called Grah Automotive.
Among other things, Grah design and produce LED tail light components for some of the worlds most high profile motor vehicle manufacturers. They have also branched out into street lighting and in conjunction with the local municipality have replaced over half of all the public lighting with new LED fittings.
The trip to Konjice provided several opportunities.
I met with the owner of Grah Automotive and toured the manufacturing facility.
I met with the Mayor of the municipality and learnt about the challenges faced in dealing with the community.

And I was able to witness new and old technology side by side.

GRAH AUTOMOTIVE

*Robert Grah explained the business plan of his company and outlined his vision for the future of LED technology worldwide.
*He explained his belief that the market had been tainted by cheap, sub-standard and outdated LED technology from China and the industry must now re-launch with the latest developments.
*LED street lighting is ready to go and already being used
*Many thousands of fittings installed worldwide but yet to make inroads into the Australian market.
*Grah do not recommend the retrofitting of existing fixtures with LED inserts as all components may not be compatible. There can be issues also with heat dispersion and therefore these fittings can be difficult to warrantee.
*Current gains of up to 90% in efficiency can be achieved by converting to LED now. The technology will improve further but with nowhere near this type of potential win. Any delay in converting to LED, justified by waiting for further efficiency improvements, is flawed in theory due to the elevated costs of continuing with existing.
*Streetlights can be enhanced with additional uses by fitting things like WiFi transmitters, security cameras, traffic counters, parking toll collection, etc.
*Dimming of LED achieves almost the complete equivalent savings in relation to the percentage dimmed and also extends the life expectancy of the fitting.
*Grah LED's are guaranteed for a minimum of 60,000 hours (approx 15 years when operating during all night time hours) and will last even longer if dimmed.

MUNICIPALITY SLOVENSKE KONJICE

*Reception with Mayor Mr. Miran Gorinsek including press conference to explain Australia's interest in visiting their municipality.
*Discussion around increasing costs and the need to harness this.
*The public expect high levels of lighting, hence the need for increased efficiency.
*Initial concern with selecting 'unproven' technology dissipated very quickly as the rollout of new fittings gained momentum.
*Sl. Konjice has a population of around 5000 and have already updated approx half of their lighting to LED (800-1000 pieces)
*Experienced a day and night time tour to compare new and old technology in various streets.

Spain

BARCELONA / SAN FOST

I was invited to Spain to witness the contract in place for the provision of public lighting services common in most parts of Europe. Citelum is name of the company that has been awarded this contract for parts of Barcelona and nearby San Fost.

BARCELONA

·Met with company executives including Director General Citelum Iberica, Juan Pons Gutierrez-Armesto in their offices.
·A presentation was delivered outlining the contracts in place and the operations of the business worldwide.

·Citelum manage in excess of 2,200,000 lighting points and have a presence in over 100 countries.
·They have been awarded a contract to maintain one zone of Barcelona's lighting grid which includes some architecturally significant fittings in the historic downtown portion of the city.
·Toured the works depot. Met with the operations staff and viewed the detailed reports prepared regularly for the City officials. Received a demonstration of the software used to produce these documents.
·Toured the city (day and night) to view the lighting infrastructure Citelum are responsible for.

SAN FOST DE CAMPSENTELLES

·Smaller city located approximately 20km from outskirts of Barcelona.
·Citelum has been awarded contract for public lighting including renewal of fittings with energy efficient types.
·Installed an 8000m2 Solar Photovoltaic array linked with a smart public lighting system. Up to 750kw of power is fed into the grid during daylight hours accumulating credits which are in turn redeemed to power the lighting grid at night.
·Met with the Mayor of San Fost Mrs Montserrat Sanmarti who explained how the environmental significance of this proposal was one of the major factors in this contract being let.
·Under the contract, the lights remain the property of the City however all risk is assumed by Citelum. Any energy reductions provide an incentive for Citelum as they are responsible to pay the power charges. The contract is open to new technology that provides a win to both parties.
·A pay-in tariff of up to five times the general rate was negotiated for the solar power.
·The City had identified major drivers being increasing costs, high emissions and power consumption, many complaints and obsolete infrastructure. The City had a lack of funds to be able to address these issues.
·Since the contract has been awarded complaints have reduced significantly, service levels have improved, additional lights have been added (with no further cost to City), carbon footprint has reduced and standards regarding 'light-spill' are being met.

FRANCE

AGDE ARCHIPEL DE VIE

Agde is a coastal municipality in the south of France. The normal population of approximately 22,000 swells to over 200,000 during the summer vacation time. There is about 10,400 public lighting points which means that the majority of the time a ratio of 1 light to every 2 residents exists.

·Met with Mayor Mr Gilles D'ettore who explained how the previous lighting regime was unsustainable.
·Toured the City to look at new equipment that had been fitted and some of the significant structures to be lit.
·In 2007 a Public Private Partnership was entered into for the provision of lighting services for the municipality. This was the first such arrangement that had been struck in France.

·The PPP purpose was to design, finance, construct, operate and maintain the public lighting infrastructure. The municipality was no longer able to upkeep the existing public expectation.
·An additional requirement was to provide permanent Architectural Lighting for the City of Agde. This lighting has adopted LED technology.
·An 18 year agreement was entered into involving 4 partners.
·Interestingly no consideration was given to 'de-lamping' during the off tourist season. The public would not accept this was the reason given.
·Same issues of aging infrastructure, increasing costs, etc. were the drivers for the upgrade
·Promotion of a 'New night life identity' also a key consideration.
·Capital investment by contractors and energy consumption paid by City.
·Different color temperature of lighting provided for vehicles as opposed to pedestrians.

UNITED STATES

SANTA ROSA CALIFORNIA

California has a reputation for environmental leadership in America however the lighting reduction program adopted by the City of Santa Rosa was driven primarily by financial pressures on the budget. The greenhouse emissions per person for the state of California are about half of that of the rest of America

·Met with the Chief of Public Works for the City of Santa Rosa, Mr Rick Moshier and his Senior Electrician.
·Santa Rosa has a population of 165,000 with 550 miles of road network and 16,000 lights
·Streetlight reduction program proposed to reduce operating budget expenditure.

·Legal advice was sort prior to commencement of any plans and then the support of the Police Department was canvassed for the idea. According to Rick this is an imperative step as it was the downfall of several schemes attempted elsewhere.

·The major driver as stated was financial and the ultimatum was to reduce costs or terminate the services of one road 'patch' crew (4 people).

·A report was drafted for Council detailing the plan to switch off approximately 1/3 of all lights, place a further 1/3 on timers so that they are off between midnight and 5am and replace the remaining lights with improved efficiency fittings.

·The report indicated that, if adopted, Council's $800,000 expenditure on public lighting could be halved.

·The proposal was approved by Council, with the conscious decision that it was a necessary measure to reduce operating expenditure. No public consultation was sort but a communications plan was developed cognizant of the perceptions and needs of the community. The belief was that it would have been delayed or not occurred if community input was sort.

·Some basic rules were established to help determine which lights were to be targeted. These were... Maintain provision of lighting at all intersections. Where intersections were greater than 100m apart, a mid-block light was provided on a timer. If intersections are greater than 200m apart, a light will be left on.

·A clear message was sent to the community that street lighting is not provided for private house or business security. That is an individual responsibility.

·Rick assumed overall responsibility for dealing with complaints and addressed each individually. Overall there was approximately 6 complaints per 100 lights turned off and after examination, he had the delegated authority to decide if it should be switched back on or not.

·Council received a $400k grant which was used to purchase timers, some new fittings and to pay wages for a full time staff member to administer the program.

·Induction Lighting technology was used to increase efficiency despite some known issues. Difficulty with dimming, mercury content disposal at end of life and high initial cost are some of the problems but it was decided that LED was not sufficiently proven.

AUSTRALIA

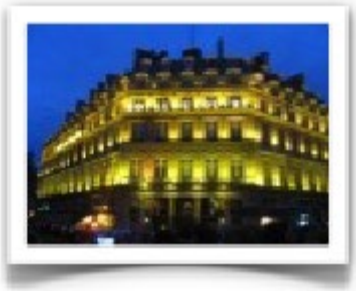
BAW BAW SHIRE

·Population just over 40,000.
·Second fastest growing rural shire in Victoria
·Geographic size over 4000km2.
·2000km of road networks
·4000 lights costing approximately $450,000 per annum
·Lighting infrastructure is owned by the electricity distribution business
·No energy efficient lighting installed
·We just continue to roll out the same

LEARNINGS

Lighting Provision

Worldwide the standard appears to be 1 public streetlight per 10 people in most developed countries. As the planet's human population continues to grow and demands on natural resources increase, to continue with this practice is highly unsustainable. European standards appear to be greater as far as quantity of illumination required but counter that by demanding higher efficiency in the types of fittings that are used.



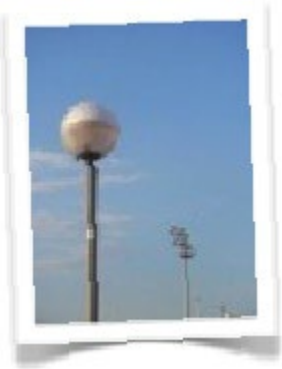
Colour Temperature

Although most lamps emit 'white' light, this can vary from a cosy warm to a cold colour. This colour is conventionally stated in a scale of degrees Kelvin with temperatures over 5000 called cool colours (blueish white), while lower colour temperatures are called warm colors (yellowish white through red). The temperature is an important factor in determining the type of lamp to be installed especially in public areas like city squares. In a cold environment, people are more likely to be attracted to these areas if a yellow light is used as it gives a perception of warmth.

Mesopic Vision

The human eye processes vision very differently between daytime light levels (photopic vision) and night without any artificial lighting (scotopic vision). Mesopic vision is the combination of both photopic and scotopic vision in low but not quite dark lighting situations. The traditional method of measuring light assumes photopic vision and is often a poor predictor of how a person sees at night. This realisation can have very significant impacts on the amount of lighting points required and in the case of Cambridgeshire, provided justification to remove up to 10% of their lights when they entered into a new maintenance contract.

Technology



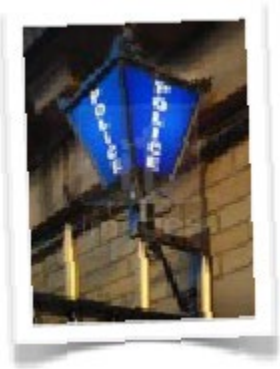
High pressure sodium vapor and mercury vapor are the most common lamps in use for public lighting. In recent times a push has been made toward fluorescent lighting due to it's increased efficiency. More recently again the industry is pushing to LED and Induction Lighting. Potential savings in efficiency of up to 90% can be gained by adopting this latest technology. Speaking very generally, England and the USA similar to Australia, appear to be taking a conservative approach rather than embracing the latest trends in Europe. Significant regulations regarding efficiency gains, light pollution and end of life lamp disposal are seeing the LED taking the lead in lighting scheme upgrades across Europe. While we are getting excited about the ability for compact fluorescent to deliver efficiency improvements in Australian Public Lighting, the legislators in Europe are preparing to ban them as early as 2012 due to the mercury content in the lamps.

Other technology advances include the increasing use of dimming as a way to decrease consumption. Of the lighting types mentioned above, LED is the only one that achieves the full equivalent benefit from dimming as it is the only one that does not incur losses in 'control gear'.

Maintenance is also a large factor for consideration. LED and Induction both have similar life expectancies of up to 20 years lamp life and therefore virtually negate the need for any maintenance program and only require consideration around renewal. All the other types require regular lamp changing (approx 5 yearly for sodiums and 4 yearly for mercury) adding to labour resources, waste management and heavy metal recovery issues.

In regards to new installations significant savings are achievable due to reduced cabling size for better efficiency lighting. Copper is another of our finite resources that is under increasing demand and accordingly has sky-rocketed in price. Less power consumption in lamps allows decreased supply cable size at installation.

Regulation, Standards & Public Consultation



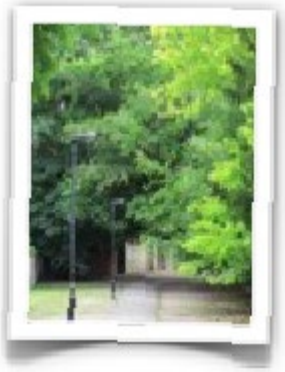
Prior to embarking on any reduction program, I learnt that it is imperative to engage the law enforcement authorities in the local area. Failure to get the police on board has resulted in the collapse of several schemes in the US and has required the municipality to reinstate lights that had been de-lamped.

Public lighting designers, road engineers and developers also need to be flexible and open to new concepts.

It is important to note that the Australian Standards for the provision of Public Lighting AS 1158 are not mandated but are purely an advisory guide. Unfortunately, for unknown reasons, we make developers and our service providers employ these guidelines as minimum requirements. We need to shift our thinking from business as usual to questioning the relevance of what we are providing.

Another thing that needs to be questioned is our acceptance of responsibility. I offer an example of a conversation that I had regarding the use of individual photo electric cells on every fitting. If the PE cell becomes faulty, it fails into the on position energising the lamp until someone notices and organises for it to be replaced. Because the light is powered by an unmetered supply, Council only gets charged based on a calculation of the nighttime running hours. This was seen to be a win as we were in a sense getting the power for nothing! No consideration to the fact that it was wasteful to run when not required.

A conversation with the public on the issue of lighting reduction is going to be very difficult. The perception of lighting and public safety being intertwined is indeed worrisome and in my opinion unsubstantiated. I believe this is the result of using an engineering solution to address a social issue. This is somehow made more acceptable to us given we all share a deep down concern for the dark or of more relevance 'what we can't see'.



Some very robust and consistent rules need to be established providing the justification for decreasing the levels of publicly provided lighting available and improving the efficiency of existing. We need good arguments but more importantly we need to believe those arguments and develop a sense of urgency in delivery.

RECOMMENDATIONS

1. Approve an LED street light for use in Victoria.

The current list of approved street lamps available does not include any LED fittings. This recommendation is the highest priority so as to allow for the greatest efficiency gains and minimal maintenance to be achieved in any changeover program. The major argument to prevent this from happening continues to be that the technology is unproven. This is incorrect. LED's are widely used in the European market and provide much better light output per consumption than any of the alternatives. Warranties are being offered up to 10 years by manufacturers and I find it ironic that the Electricity Distribution Businesses sit on the approvals committee for new street lights in Victoria when they have possibly the most to lose from any improvement in technology.

2. Prohibit the new installation of Mercury Vapour lamps.

Mercury vapour is the least efficient of the common lamps used in street lighting today and the most prevalent (up to 70%). It also has significant issues around lamp disposal at the end of life. Any renewal should require less consuming fittings rather than replacement of the same. Installing mercury vapour in any new subdivision should simply not be allowed and can be included as a condition on any new planning application that is submitted for approval.

3. Develop a Baw Baw Shire plan to partially de-lamp residential streets as a role model to other Councils.

We may be small in comparison to the population of our City counterparts but we have the ability to trial a reduction program and provide real data on the success or otherwise of such a scheme. I would like to develop a detailed plan based on the criteria developed in Santa Rosa, California to...

- identify mid-block street lamps in residential areas that can be de-lamped and ones that can be fitted with a simple timing device to reduce the operating hours.
- negotiate a reduced tariff with SP Ausnet for these decreased operating hours.
- cap and fix the current budget spend on lighting by Council so that incentive is provided to increase efficiency. Any savings (from timed or removed lights) will be used to change over outdated fittings to more efficient technology.

4. Investigate the feasibility of an investment plan to upgrade to energy efficient street lights.

I believe there is an opportunity to create an incentive to raise the capital required to changeover street lights to energy efficient fittings. 4 years would seem like a feasible pay-back period for an efficient streetlight (maybe less for LED). If an investor or company was prepared to provide the capital up front for the purchase and changeover of the fitting, and Council was prepared to return the savings for say 8 years, it could be a profitable venture for both parties. The investor would receive good guaranteed return on investment and Council would benefit from the long term savings in finances, maintenance and importantly greenhouse emissions. Individual ratepayers may even 'adopt-a-light' under a scheme like this.

5. Challenge the conventional thinking around the provision of streetlights.

It is a little known public fact that the State Government charges Councils for lighting provided on VicRoads roads although they have no input into the amount or type of fittings installed. Councils pay the full cost of providing lighting on residential streets and in public areas. They are then required to pay a portion of the costs for State roads.

Why are we lighting roads anyway?
If it is for the safety of pedestrians, turn the poles around 180 degrees and light the footpath!
If it is to make cars more visible, mandate bright colors or side illumination of vehicles. Why not slow them down?
If it is a social issue and there are concerns for safety, change the culture, don't adopt an engineering solution that makes everyone feel better because 'at least we are doing something'.

Councils used to own the lighting infrastructure. The majority now belongs to private enterprise. However we are expected to fund this obsession on behalf of our ratepayers.

There should be no such thing as a minimum lighting standard!