The Dark Side of Light at Night

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Presentation Objectives

1. What is light pollution (ALAN)?
2. What are the consequences of light pollution?
3. Human Health effects
4. Current Legislation
5. AS4282 Obtrusive Lighting
6. Recommendations
What is light pollution?

- >80% of the world and >99% of the US and European populations live under light polluted skies (Falchi et al. 2016)
- Australia least light polluted of the G20 countries
- Artificial lighting is increasing by 6% each year

“an excess of non-natural light at night”

Fabio Falchi et al. Sci Adv 2016;2:e1600377
Artificial Light at Night = ALAN
Consequences of ALAN

1. Loss of the night sky
2. Energy waste
3. Ecological impacts
4. Nuisance light trespass
5. Glare
6. Human health
1. Loss of the night sky

Humans have always had a fascination with the stars

The stars have inspired:
- Scientific discoveries
- Art
- Literature
- Astronomy
- Navigation
- Exploration
- Philosophy
2. Energy waste

Perth city at night

Hong Kong

In the USA;
- 30% of all outdoor lighting is wasted
- costing $3.3 billion
- Release 21 million tons of CO$_2$ each year
3. Ecological effects

Light pollution causes changes in;
• habitat use,
• foraging behavior, and/or
• orientation behaviors.
4. Nuisance light trespass

Sources of nuisance light include;

- Residential neighbours
- Commercial facilities
- Industrial facilities
- Sporting facilities
- Electronic billboards
- Streetlights
5. Glare
6. Human health effects of ALAN

Research emerging since 1990 that implicates exposure to artificial light at night in;

• Sleeplessness
• breast and prostate cancers,
• obesity,
• Diabetes
• heart disease, and
• Depression
Recognizing there other causes of poor sleep quality, including:

- Stress, anxiety and depression
- Sleep apnoea
- Alcohol, smoking, other legal and illegal drugs
- Restless leg syndrome
- Illness or injuries
- Shift work
- Lack of exercise
- Obesity

However the cause and effect may become circular – e.g. depression causes lack of sleep which increases the feelings of depression.
How does exposure to light at night affect humans?

- Retinal cells in the eye, called melanopsin, regulate the circadian rhythm (Blenky et al 2003)
- BLUE light is the most important wavelength in setting the rhythm (Lockley et al 2003).

![Bright white LED spectrum](image)
6. Human health effects

How does the human circadian cycle work?

- **Melatonin** (the sleepy hormone) is released when the sun goes down and is suppressed when the sun comes up.
- **Cortisol** (a stress hormone increases blood pressure) peaks in the morning and is suppressed at night.
6. Human health effects

- Light exposure at night stops melatonin production, maintains the elevated cortisol levels.
- Increased cortisol causes blood pressure to go up.
- High blood pressure can lead to heart disease, kidney failure, sleep apnoea, diabetes, and obesity etc.
6. Human health effects - LEDs

LED lights are particularly concerning:

• LEDs increase visible sky glow, glare impacts (50+ years), reduces night vision

• LEDs are enriched in blue wavelengths which;
  • strongly suppress melatonin, disrupting the circadian cycle, and
  • damages the retinal cells, particularly in the eyes of children
“Community Guidance to Reduce the Harmful Human and Environmental Effects of High Intensity Street Lighting”
American Medical Association, June 2016

Concluded that high-intensity LED street lights emit a large amount of blue light which:

- creates worse night-time glare than conventional lighting
- adversely suppresses melatonin during night.
- have five times greater impact on circadian sleep rhythms than conventional street lamps
- Impacts on human health.
The recently released world atlas of artificial night sky brightness concluded that

• the recent moves to change street lighting over to bright white LEDs could result in a 3 fold increase in light pollution globally, and

• light pollution needs to be addressed immediately to prevent public health issues, as well as energy waste, financial cost and ecological consequences
Reducing ALAN

Recommendations for reducing light pollution;
- Target light to the task,
- Switch off/dim lights when not in use,
- Reduce light intensity,
- Select bulbs with a colour temperature of 3000K or less
- Use lights with blue light blocking coatings on the inside of LED and compact fluorescent bulbs.
- Use Smart Lighting technology.
Reducing ALAN

- Avoid bulbs rich in blue light

- Select fully shielded/cutoff light fixtures
ALAN regulations

• International
  International Dark Sky Association (IDA),
  – Guidelines for LED lighting systems
  – Example Outdoor Lighting Ordinances for policy makers, and

• National
  – No Commonwealth regulations on ALAN
  – AS4282 used as a default National Standard
  – Environmental Law recognize nuisance light

• State;
  – All States default to AS4282,
  – ACT and Qld also refer to their Environmental Protection Acts

• Local councils
  – Typically default to AS4282
“AS4282 Control of the Obtrusive Effects of Outdoor Lighting”

• Currently under revision (1997), expected in 2017
• Addresses lighting for new construction in commercial areas only
• **Does not** address residential area nuisance lighting
• **Does not** apply to advertising signs, lighting systems that are cyclic or flashing or floodlighting of buildings and external signs
• Written by, and for, lighting engineers **not** for planners, regulators or the general public
**Australian Standard AS 4282 review**

"AS4282 Control of the Obtrusive Effects of Outdoor Lighting"

- In practice lights are modelled, not measured *in situ*, to test for compliance
- Sets luminance and illuminance limits for lights that are inconsistent with each other and are *unacceptably high* for residential areas.
- **Guidelines** for control and management of light trespass are inadequate, lack strength and are typically not strictly enforced,
- **Costs** ~$200!!!!
- LEDS are not specifically addressed

*I believe the new standard needs to recognise and address the emerging health impacts of exposure to artificial light at night.*
Recommendations for regulators addressing nuisance lighting complaints;

• Provide feedback on the revised AS4282 when it is released for public comment

• Prepare your own user friendly nuisance lighting ordinance, free and publicly available

• Educate local residents about the safety, security and medical risks arising from excessive uncontrolled lighting
Recommendations for regulators addressing nuisance lighting complaints;

• Work with Main Roads, Health, Building and Planning to better manage ALAN

• Lobby for State legislation to control excessive and unnecessary lighting

• Investigate Smart Lighting technology

Or potentially face the risk of future mass class action suits from residents claiming health impacts from exposure to ALAN
QUESTIONS?