MASSEY UNIVERSITY

The Unintended Effects of Road Lighting

Transport and Environment Knowledge Hub Webinar
3 December 2020

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The Intended Effects of Road Lighting

The science of street lights: what makes people feel safe at night

September 29, 2018 12.33am AEST

New LED lighting on state highways will improve safety and reduce road crime

Damian George · 10:32, Mar 14 2018

DELWYN DICKEY/STUFF

News

Driver calls for better lighting on motorways after horror crash

The Unintended Effects of Road Lighting

BUSINESS

NZTA's introduction of blue LED lights raises number of concerns

ENVIRONMENT

LED street lighting harmful for urban wildlife - Dr Therésa Jones

From **Nine To Noon**, 9:37 am on 10 September 2018 Share this

The harmful effects of blue light on wildl… ities.

Northland LED streetlight retrofitting moratorium call

Tuesday, 3 December 2019, 10:49 am
Article: Susan Botting - Local Democracy Reporter

A Whangarei doctor is calling for a moratorium on Northland's $6.2 million dollar …olution'.

The 'mad' world of energy-efficient street lights

GEOFF VAUSE - 14:17, Nov 30 2017

…r of Whangarei's Northland Environmental Health …istrict councils should put a moratorium in place on …lights with bright blue white LED lighting.

stuff ≡ national

Effects of LED streetlights on autistic son led Damien McNamara on dark sky campaign

Alex Geary - 05:00, Nov 03 2019

≡ NOTED CURRENTLY CULTURE MONEY HEALTH LIFE

How exposure to LED lights harms animals as well as humans

By Peter Griffin | Dec 5, 2018

Otago Daily Times

News | Sport | Life & Style | Entertainment | Business | Regions

Westland petrels dazed by LED street lamps

124 17

Spectrum

Incandescent

- Heated Filament
- Colour of light depends on temperature of filament

https://commons.wikimedia.org/wiki/File:Tungsten_filament_in_an_incandescent_light.JPG

Incandescent

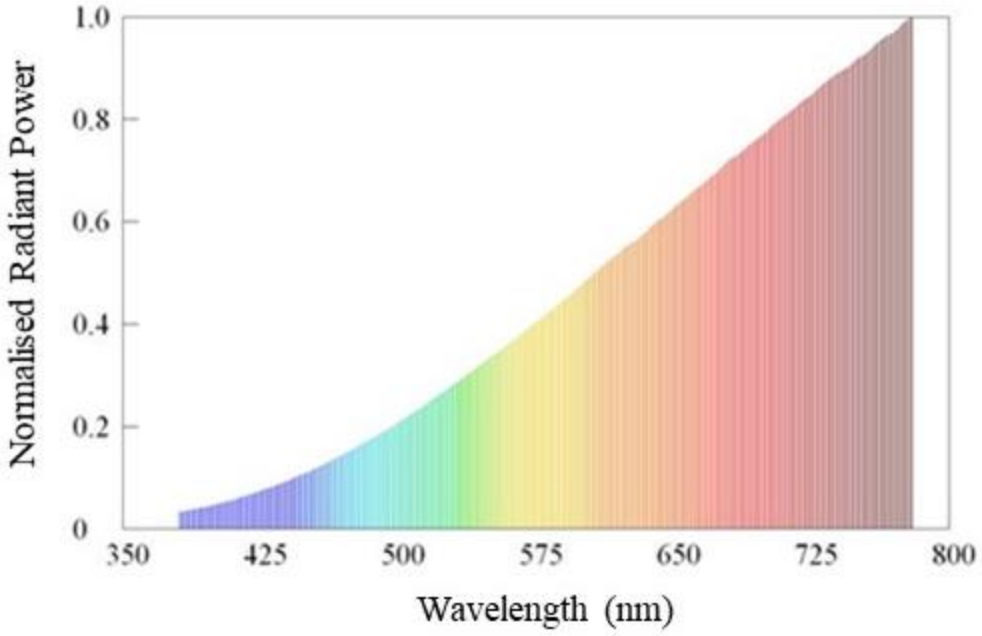


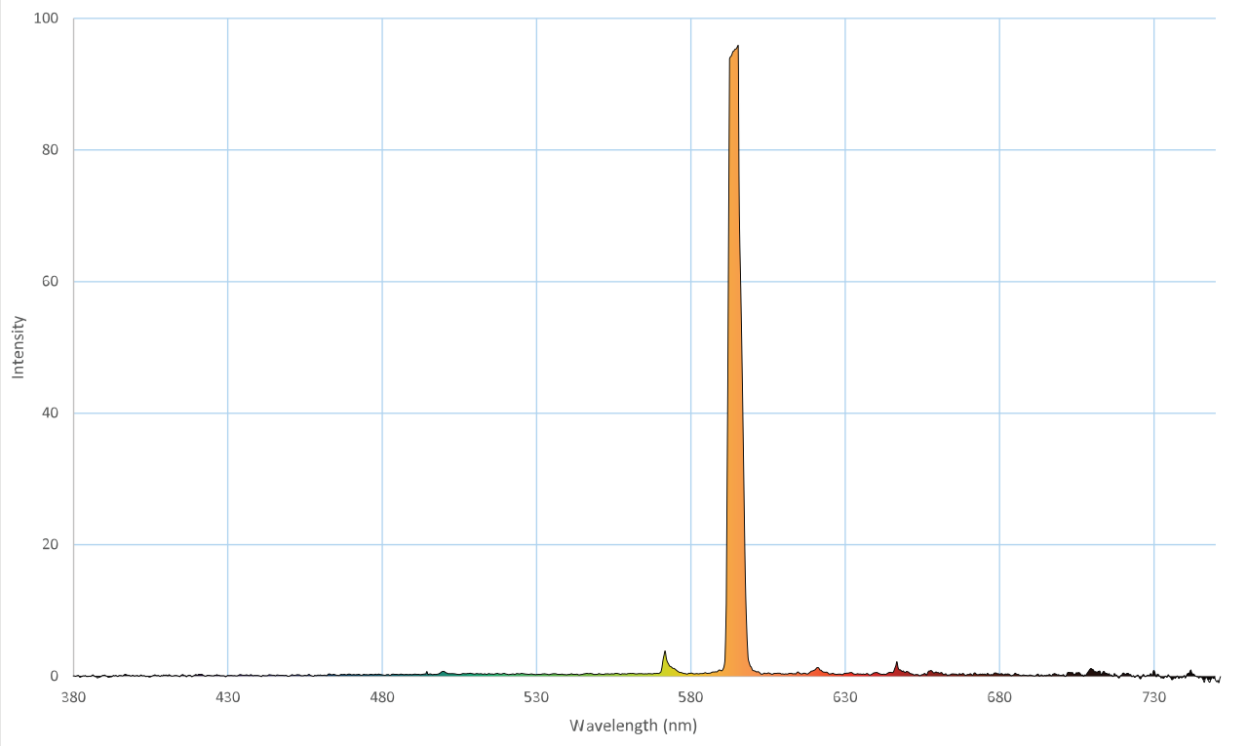
Image by S Mander

Low Pressure Sodium

- Gas Discharge
- Uses sodium
- Yellow colour

https://pt.wikipedia.org/wiki/Ficheiro:LPS_Lamp_35W_running.jpg

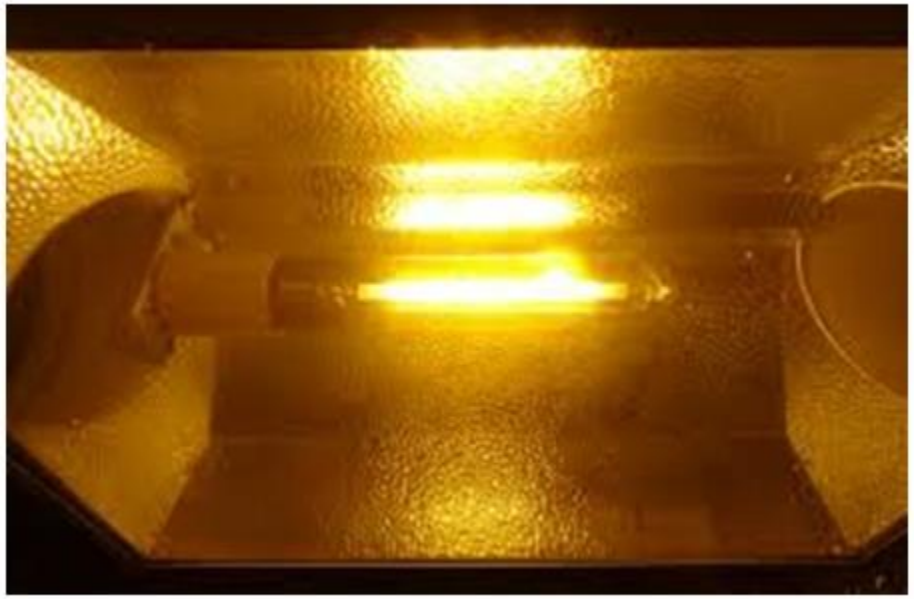
Low Pressure Sodium



https://en.wikipedia.org/wiki/Sodium-vapor_lamp#/media/File:Low-pressure_sodium_lamp_spectrum.svg

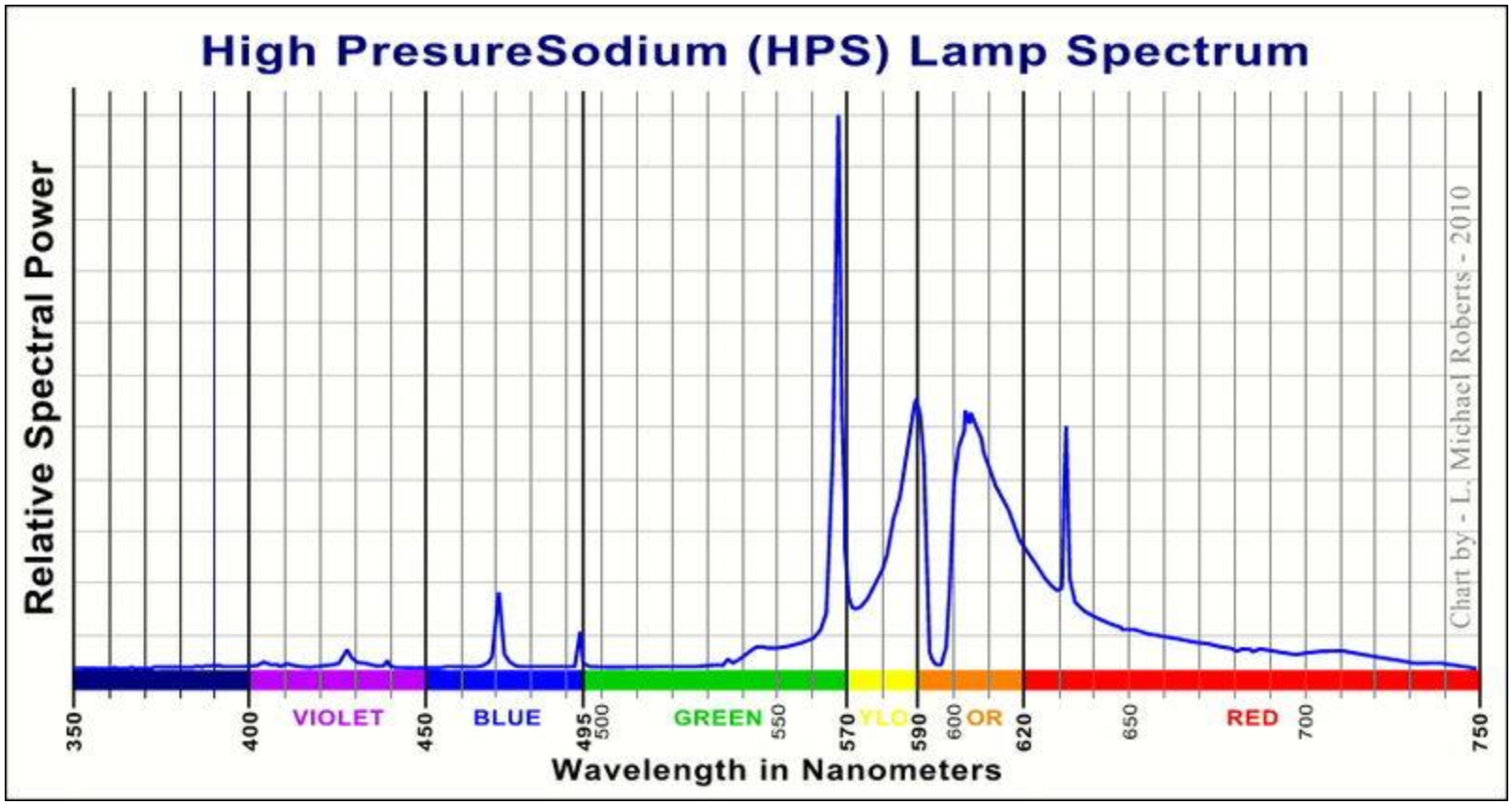
High Pressure Sodium

- Gas Discharge
- Uses sodium
- Yellow-white colour



https://commons.wikimedia.org/wiki/File:HPS_(High_Pressure_Sodium)_grow_light_bulb.jpg

High Pressure Sodium



https://commons.wikimedia.org/wiki/File:High_Pressure_Sodium_Lamp_Spectrum.jpg

Light Emitting Diode (LED)

- Uses electronics to make light
- Phosphor coating is used to convert blue light to white

https://commons.wikimedia.org/wiki/File:LED_streetlamp_in_Tallinn_002.JPG

Light Emitting Diode (LED)

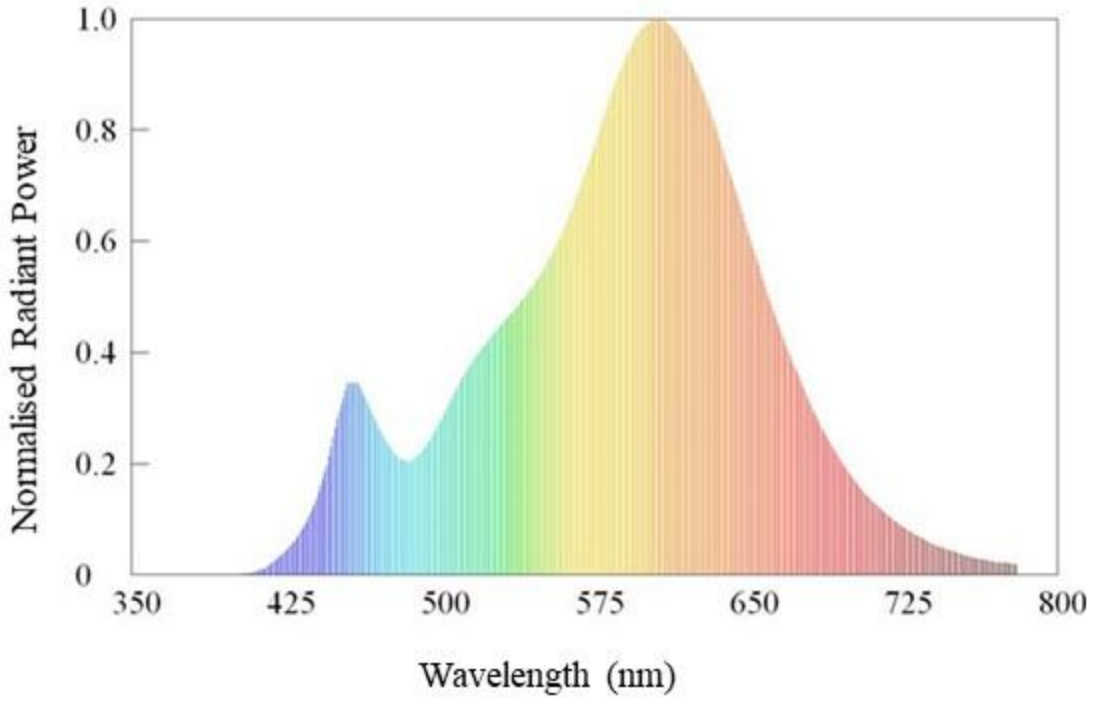


Image by S Mander

Human Response

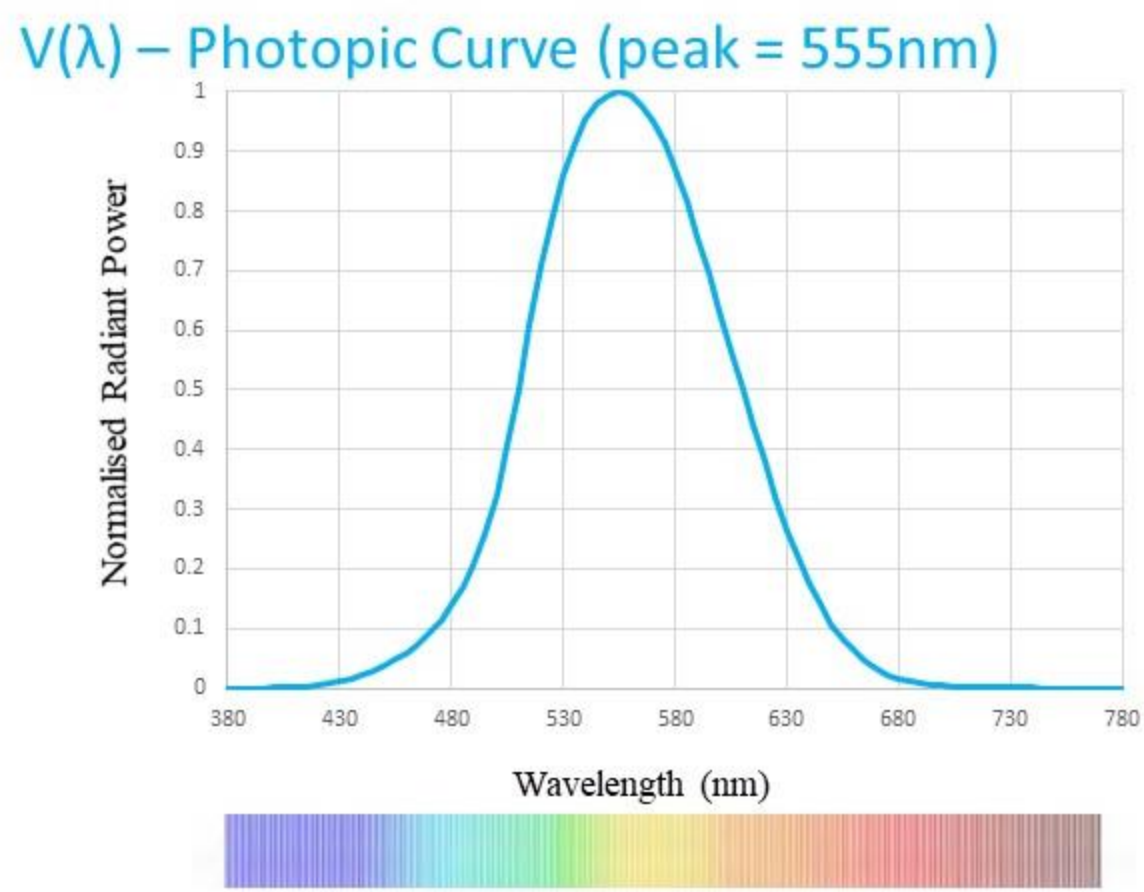


Image by S Mander

Human Response

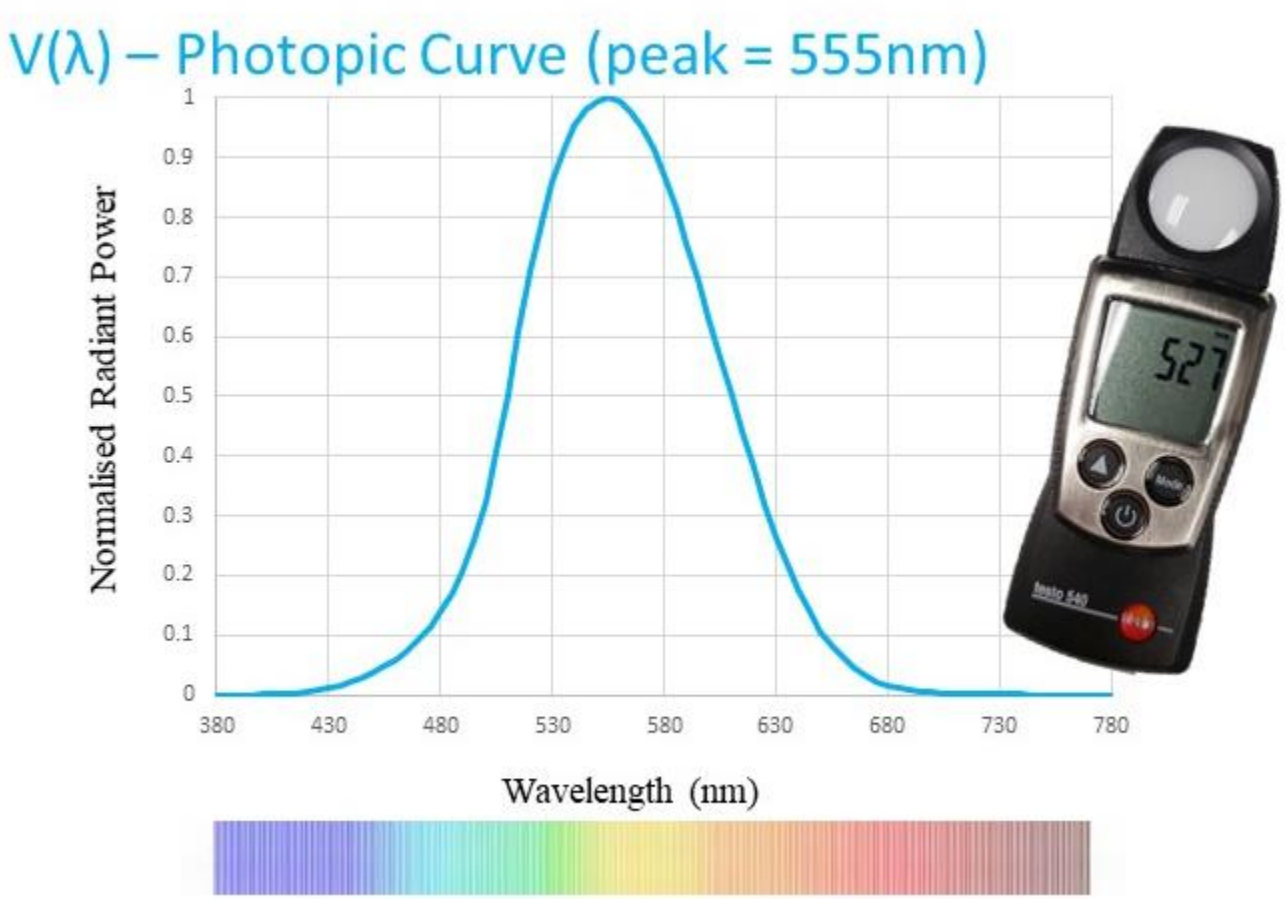
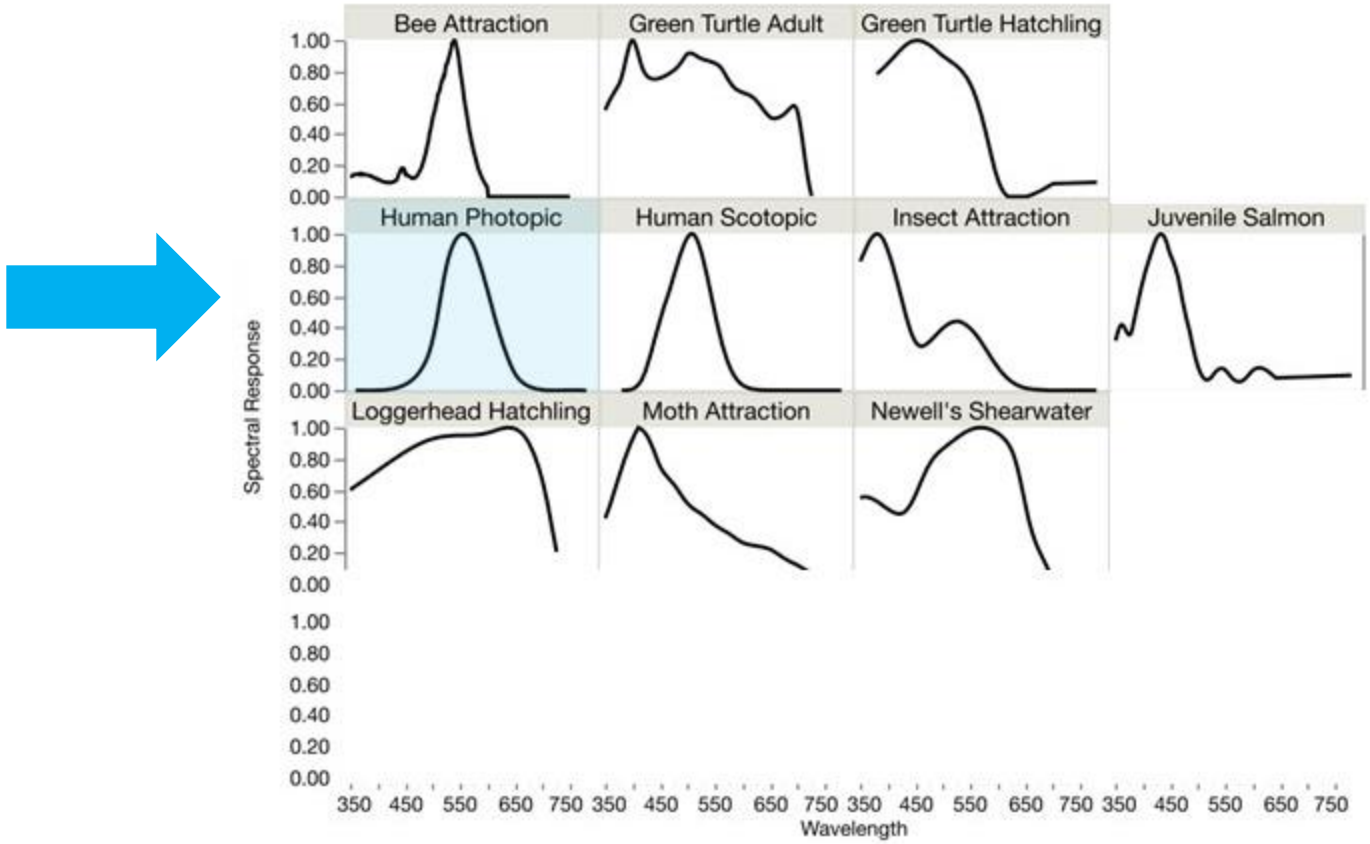


Image by S Mander

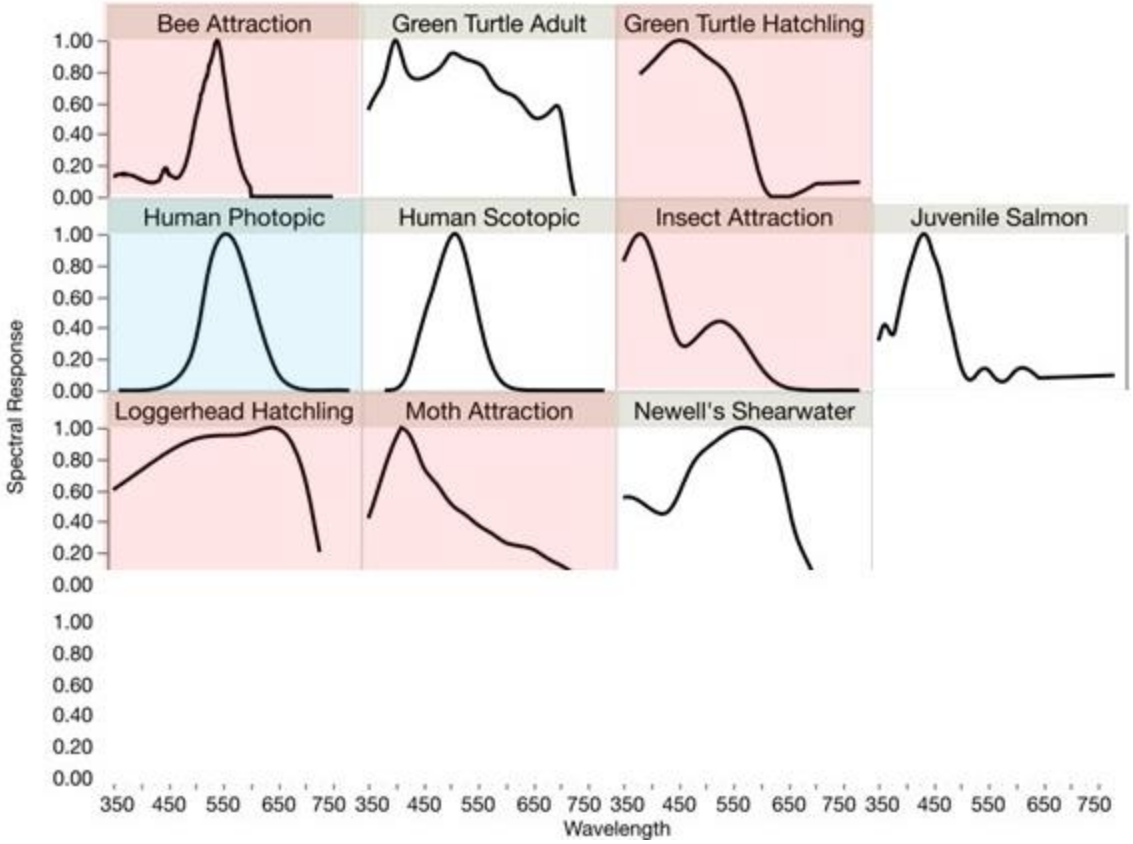
Wildlife Response



Longcore et al., 2018 [refer references page for full details]

Wildlife Response

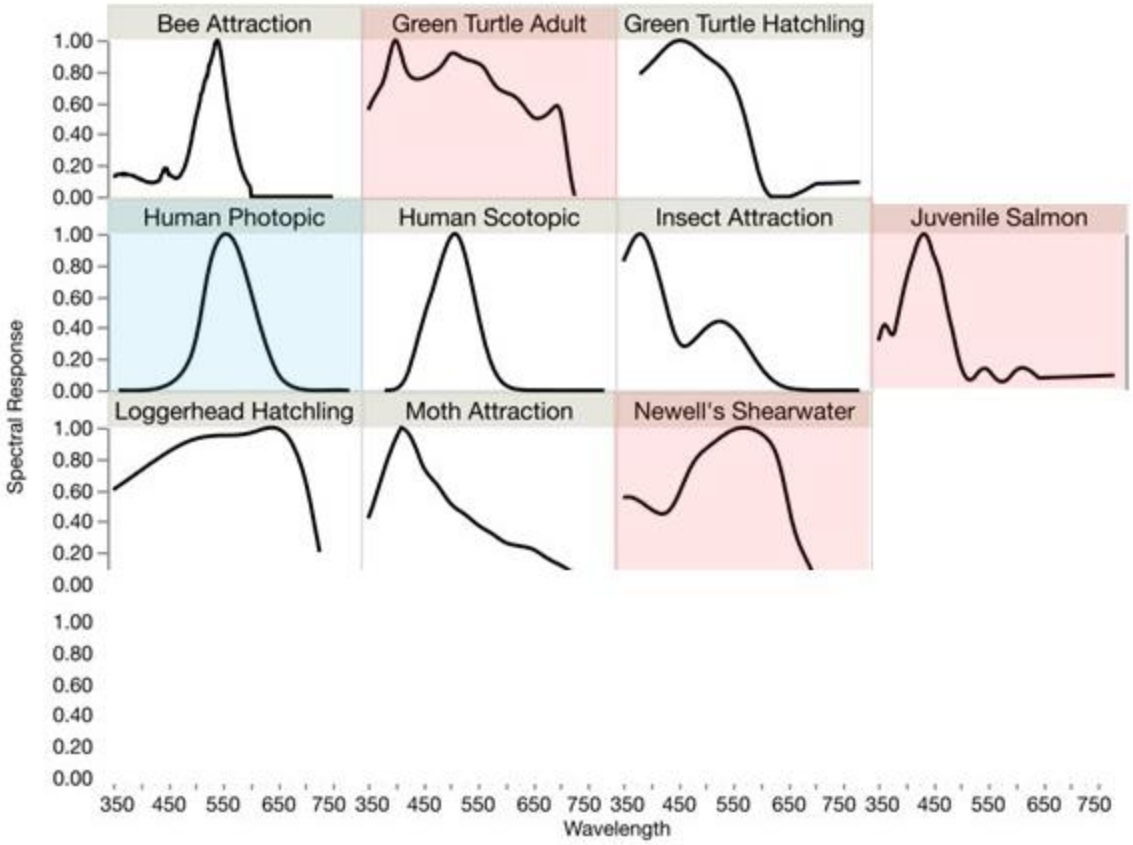
Behavioural Response



Longcore et al., 2018 [refer references page for full details]

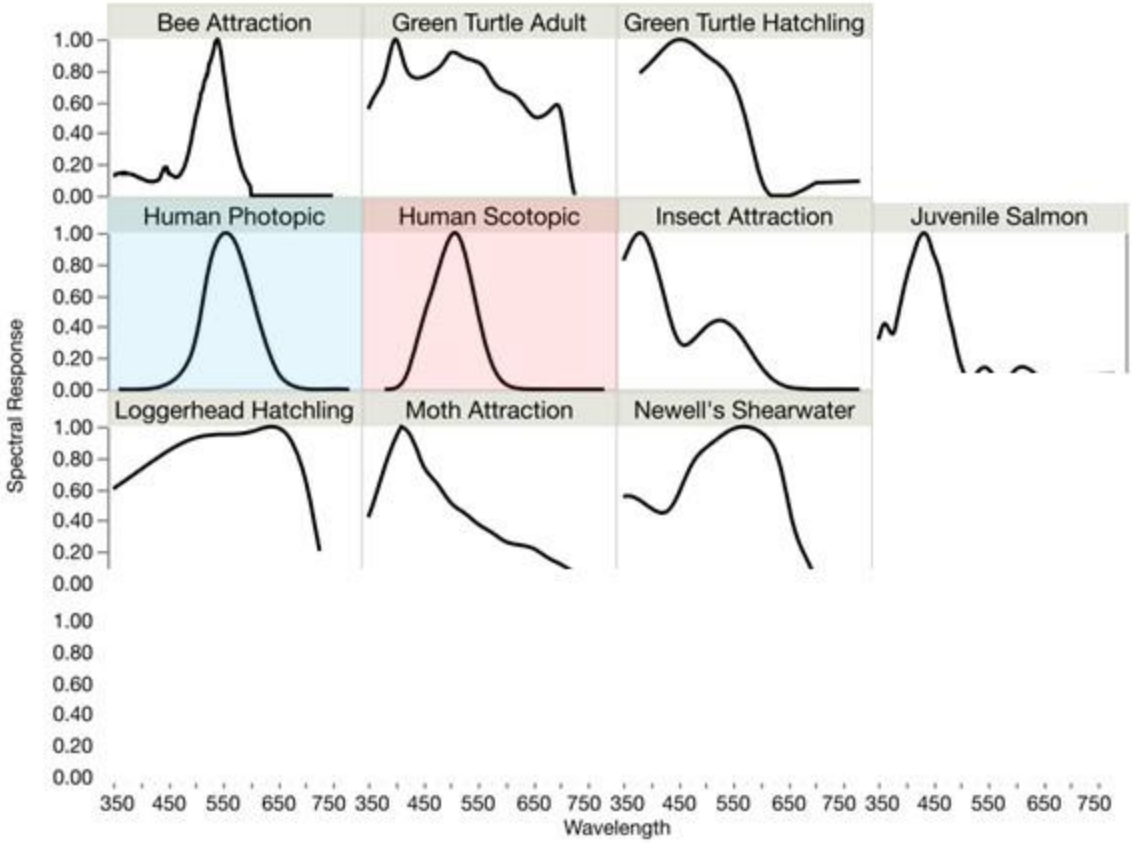
Wildlife Response

Visual Sensitivity



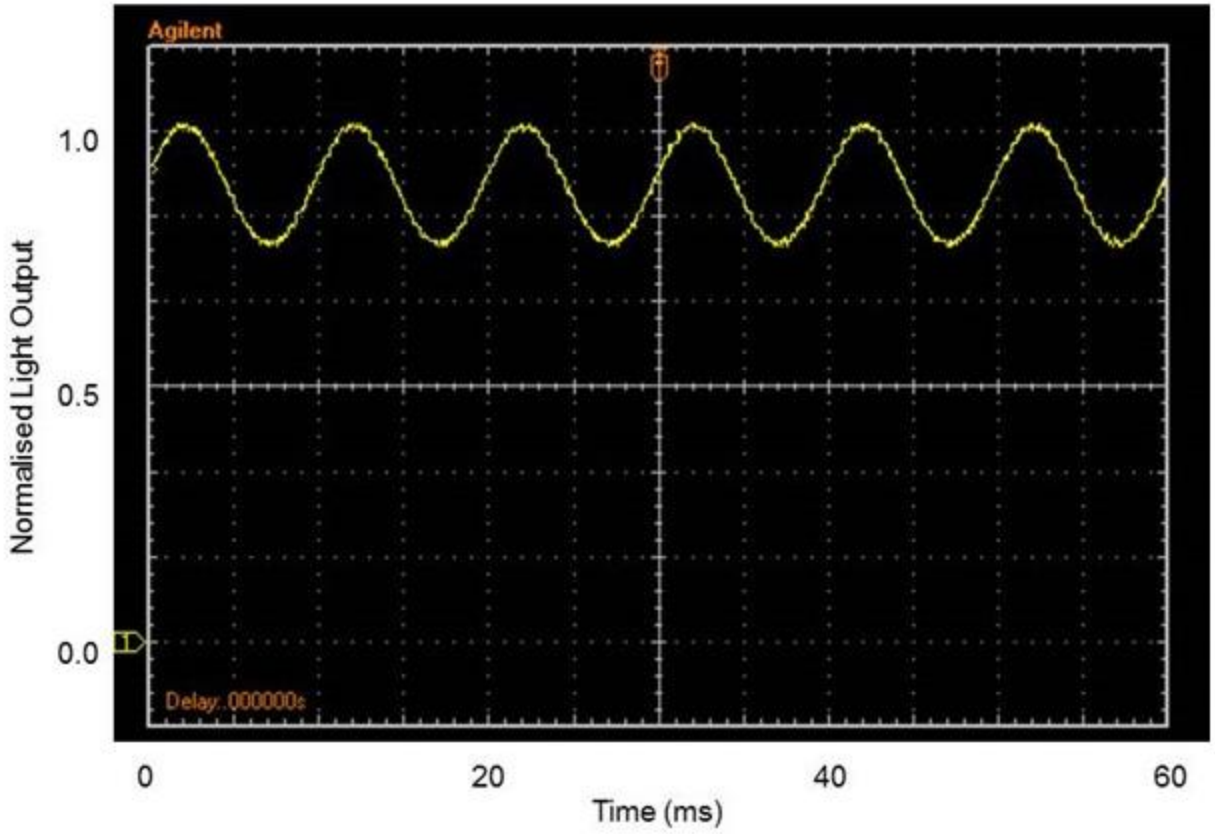
Human Response

Human Scotopic Response (low light levels)



Measuring Flicker

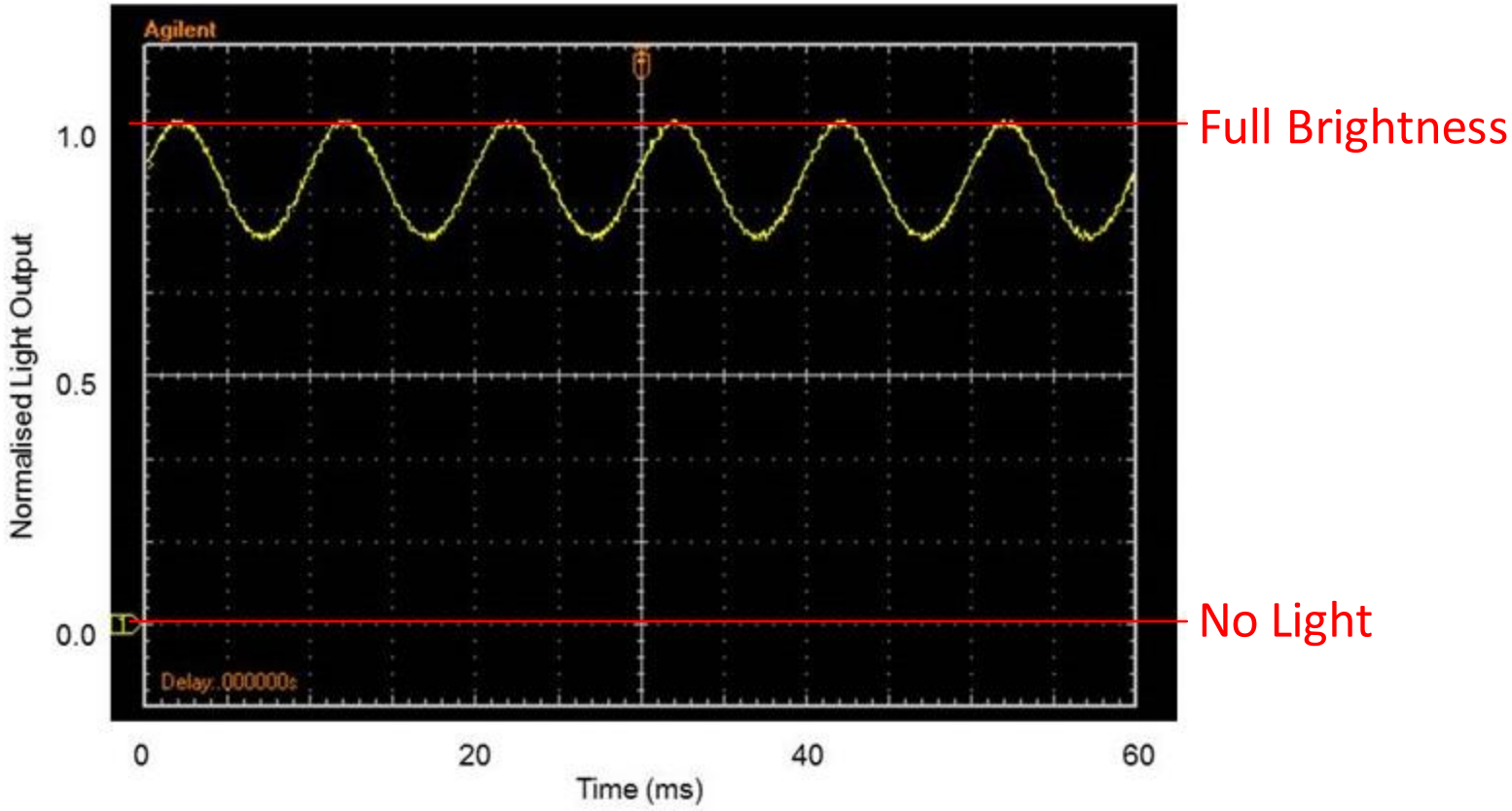
Flicker



Incandescent

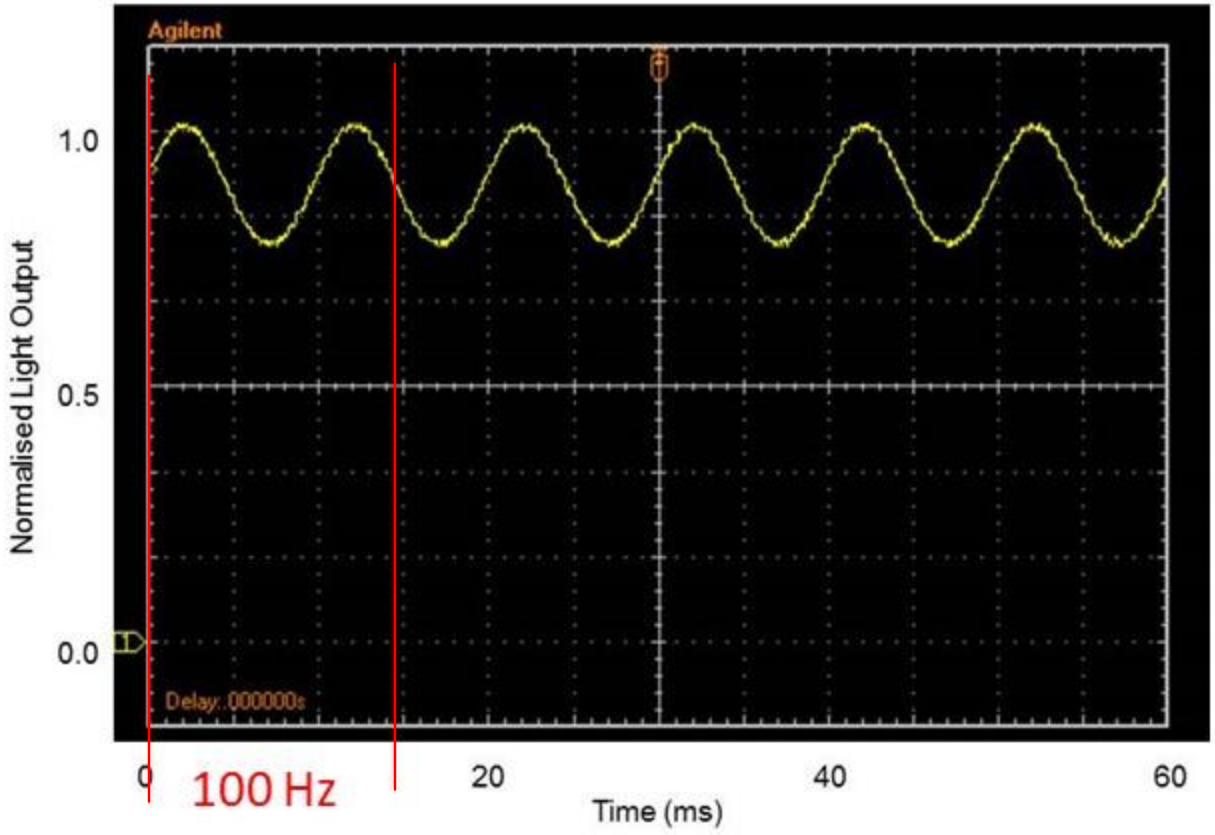
Image by S Mander

Flicker



Incandescent

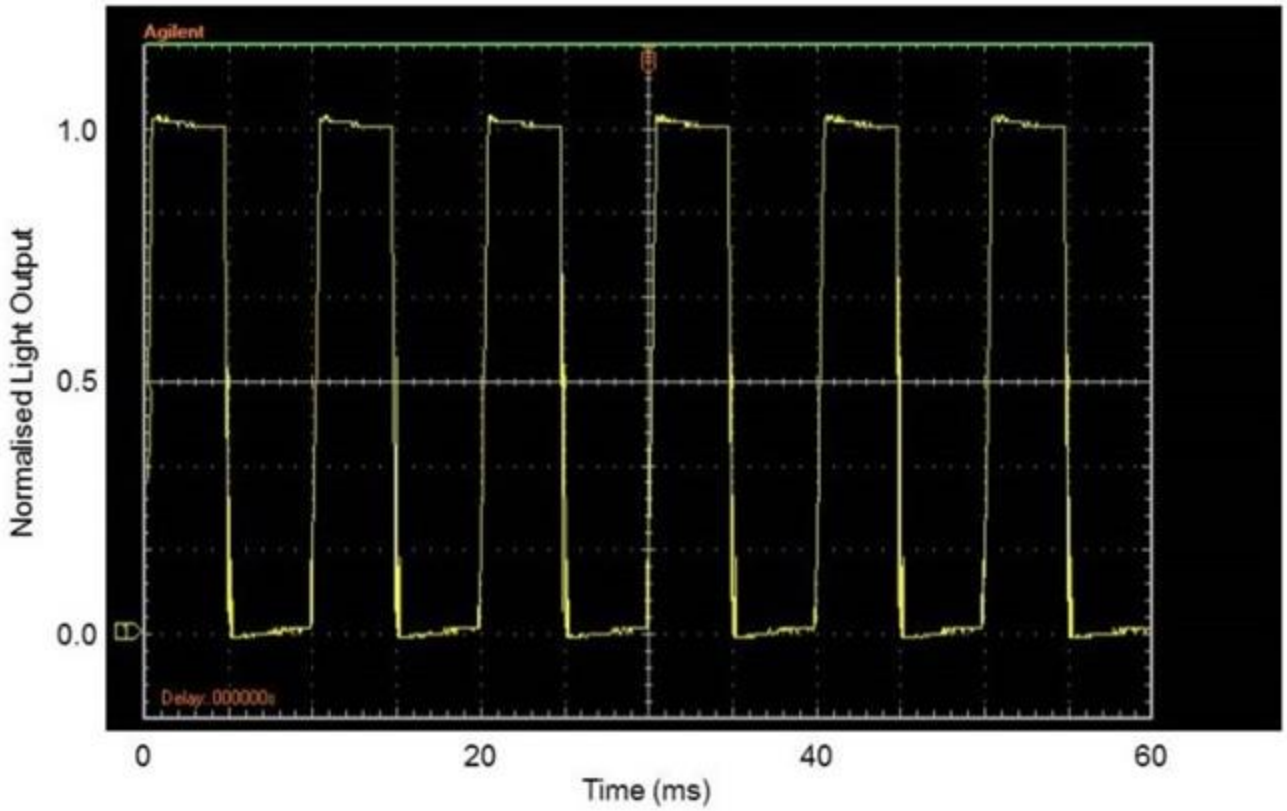
Flicker



Incandescent

Image by S Mander

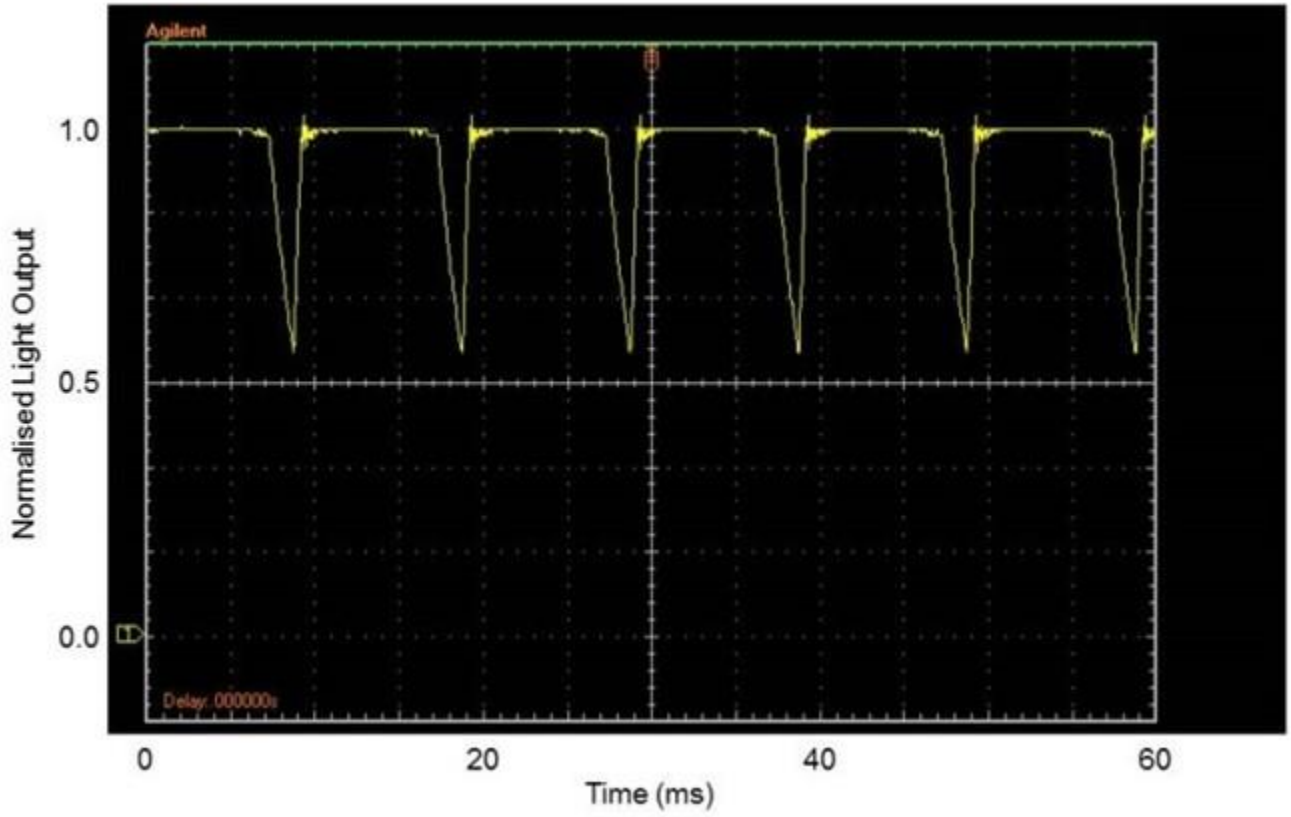
Flicker



LED Type 1

Image by S Mander

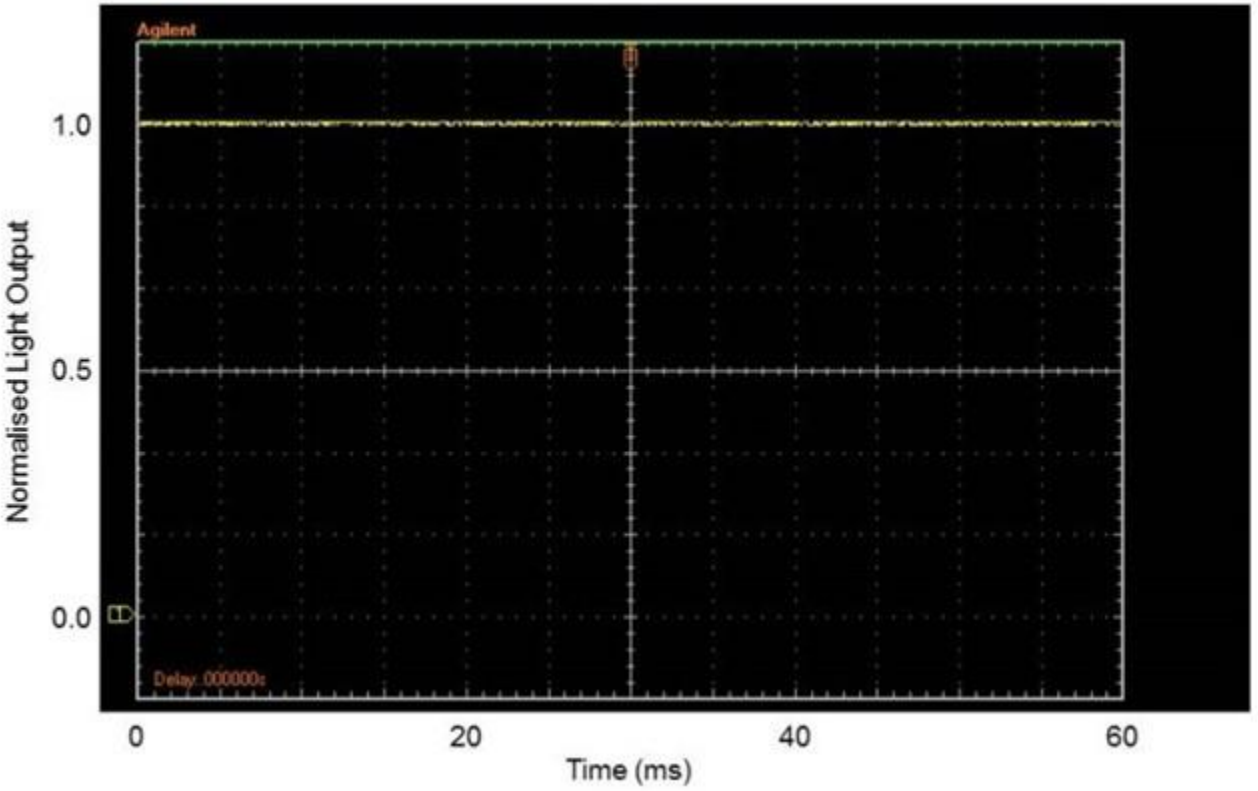
Flicker



LED Type 2

Image by S Mander

Flicker



LED Type 4

Image by S Mander

CFF – Human Response

- Critical Fusion Frequency: The point at which the eye fuses a series of discrete images into what appears to be a constant image.

- Human CFF varies from around 60 Hz to 100 Hz.

CFF - Wildlife Response

- The critical fusion frequency for wildlife varies.
  - Brown rat 25 Hz
  - Salmon 72 Hz
  - Emperor moth 75 Hz
  - Honeybee 240 Hz
  - Blow-fly 240 Hz

Inger et al., 2014 [refer references page for full details]

Mitigation Techniques

- Spectrum
- Flicker
- Intensity
- Timing
- Optics
- Height
- Installation

Measurement

- Careful design and monitoring is needed.

- The unintended effects of road lighting need to be measured in ways that are:
  - Cheap
  - Smart
  - Easy to use
  - Repeatable

References

Inger, R., Bennie, J., Davies, T. W., & Gaston, K. J. (2014). Potential biological and ecological effects of flickering artificial light. *PLoS ONE, 9*(5), Article e98631. https://doi.org/10.1371/journal.pone.0098631

Longcore, T., Rodríguez, A., Witherington, B., Penniman, J. F., Herf, L., & Herf, M. (2018). Rapid assessment of lamp spectrum to quantify ecological effects of light at night. *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology, 329*(8-9), 511-521. https://doi.org/10.1002/jez.2184