



Trinity College Dublin

Coláiste na Tríonóide, Baile Átha Cliath

The University of Dublin



Lighting & Light Pollution in Mayo



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Mayo Dark Skies



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Introduction



- I am an astrophysicist working in TCD and co-founder of Dark Sky Ireland, member of the International Dark Sky Association
- Background in Physics/Astrophysics, also interest in outdoors
- Since 2009 have been researching the topic of light pollution and been involved in EU COST Action “Loss of Night Network”, have international colleagues from a range of disciplines (many facets to light at night!)
- Have undertaken SEAI sponsored research and attended ILP External Lighting course, currently working with Irish ILP branch
- Helped towards setting up of Kerry DSR & Mayo DSP

Light to space

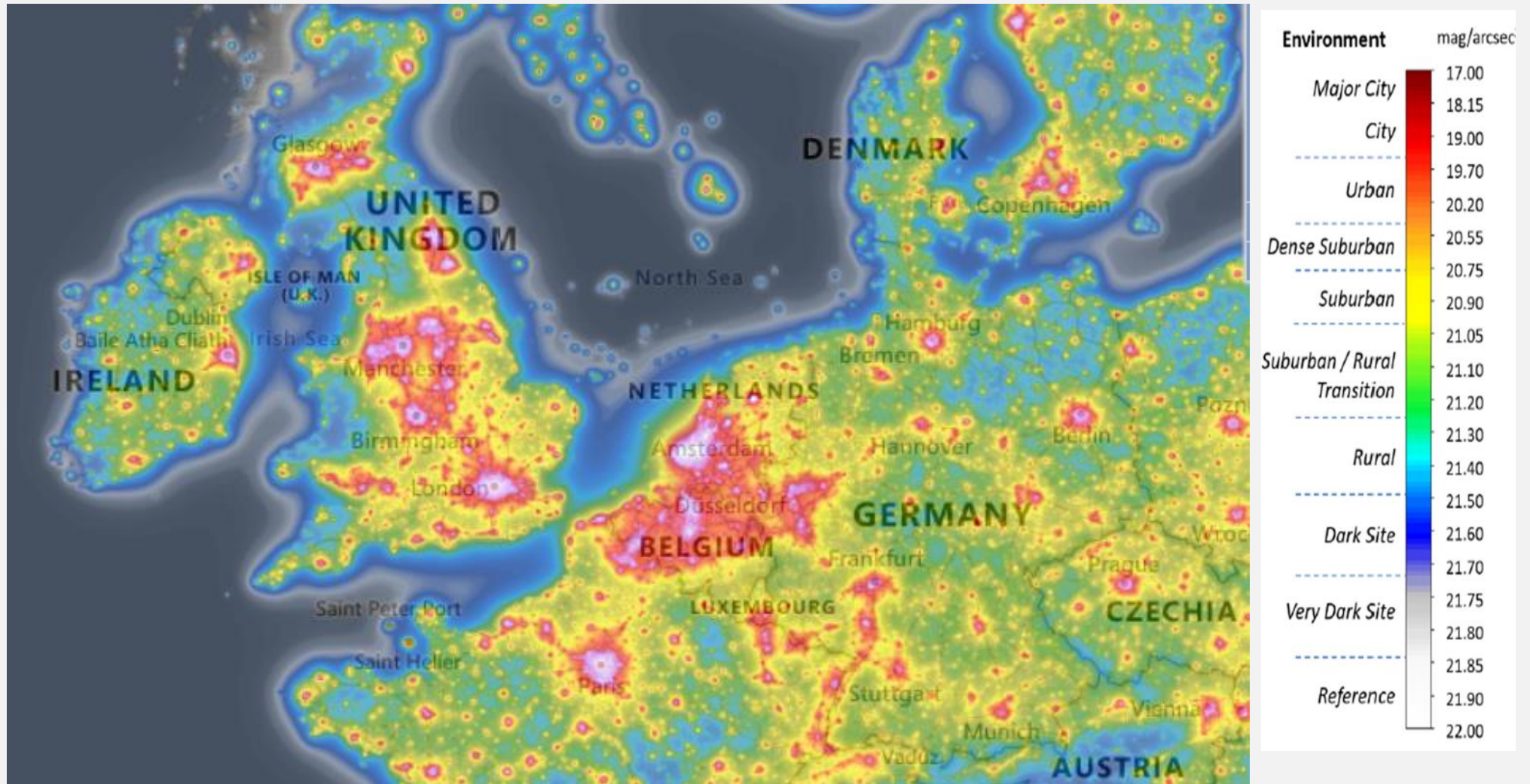


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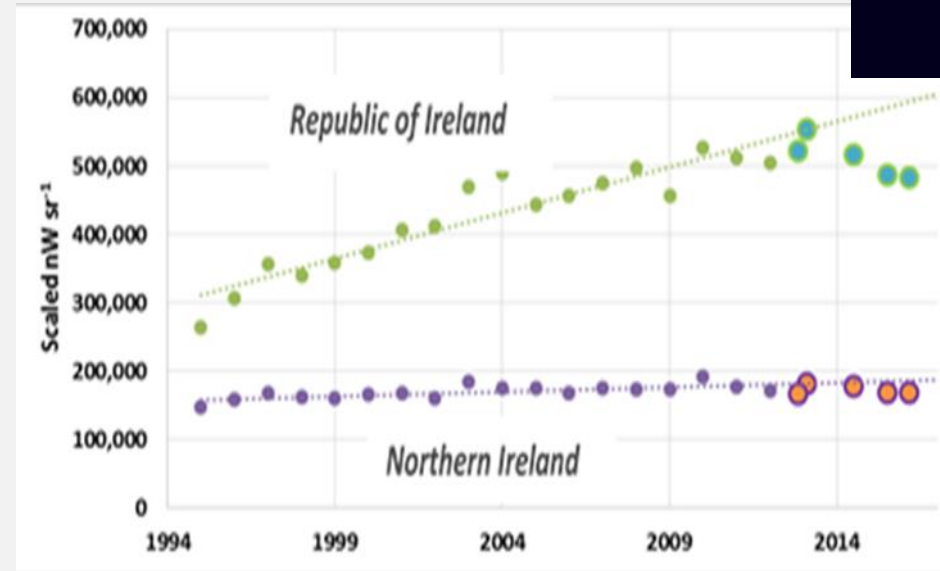
Light levels in Europe



Growth in Irish light emission



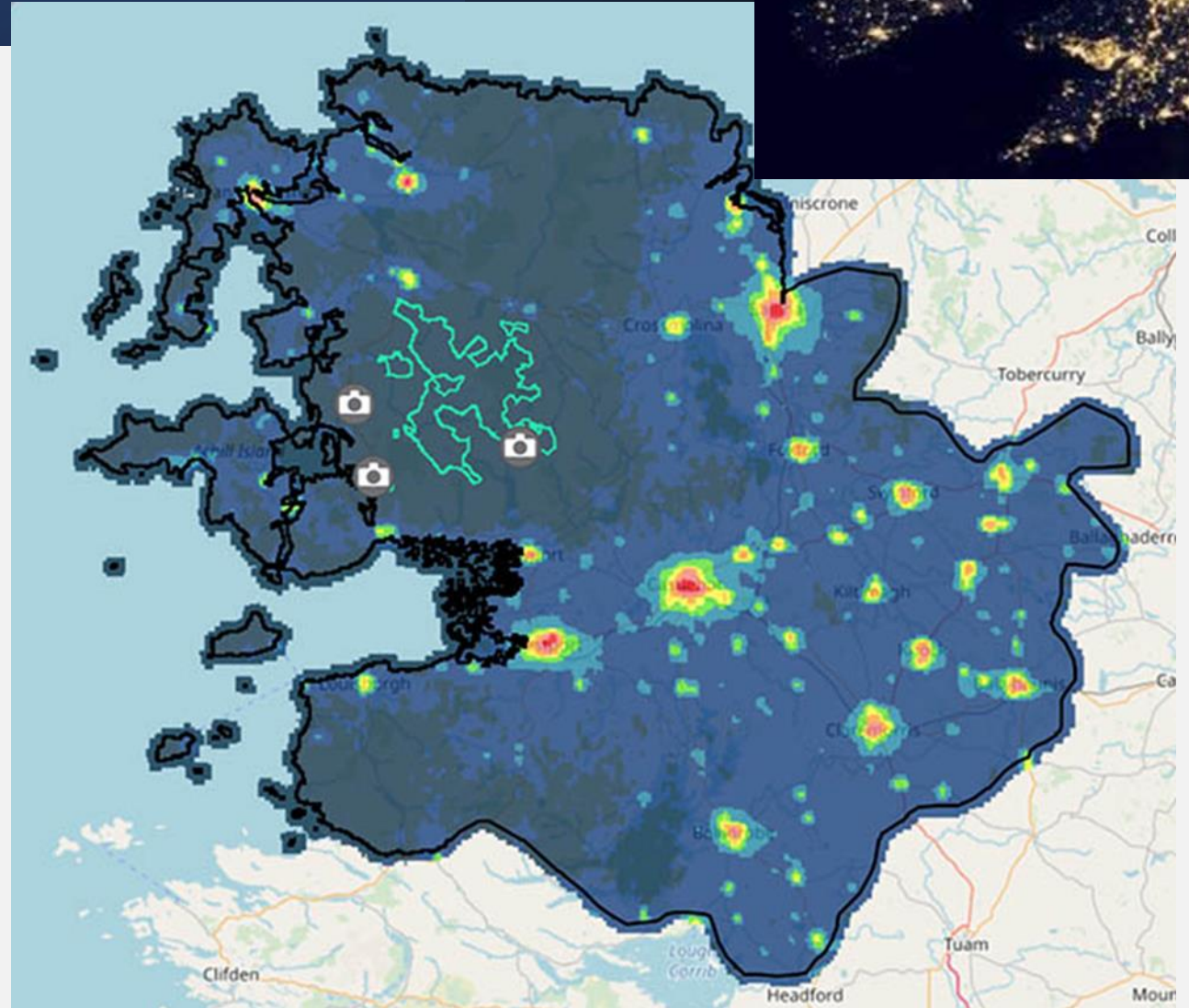
- Republic's light higher than that from N. Ireland
- Light emitted to space from the Republic increased at **10 times** northern rate
- Levelling off may be partially due to introduction of LEDs



- Republic's light output / capita higher, though number of public lighting in NI is 64% of that of the Republic => *strong commercial component*
- Public lighting important component of local authority budget

Night sky in Mayo

- Image at right show the emission to space, i.e. how Mayo would look as seen from the Space Station
- The image is displayed in false colour with red urban areas much brighter than their surroundings



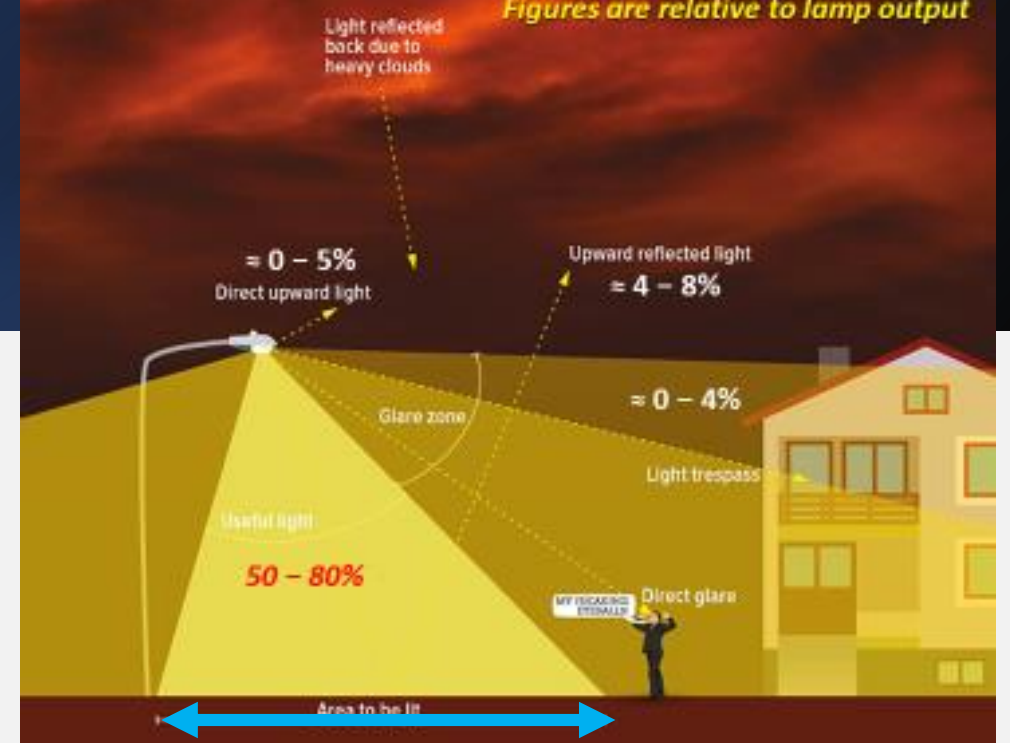
Sky brightness



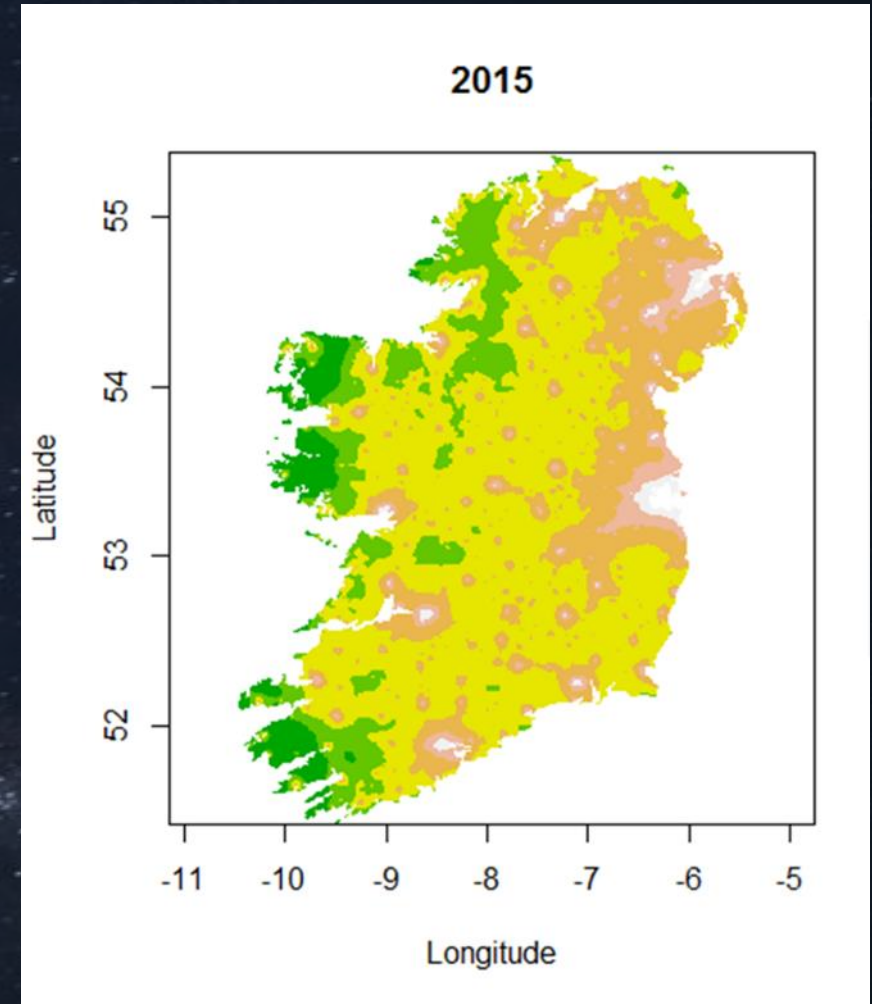
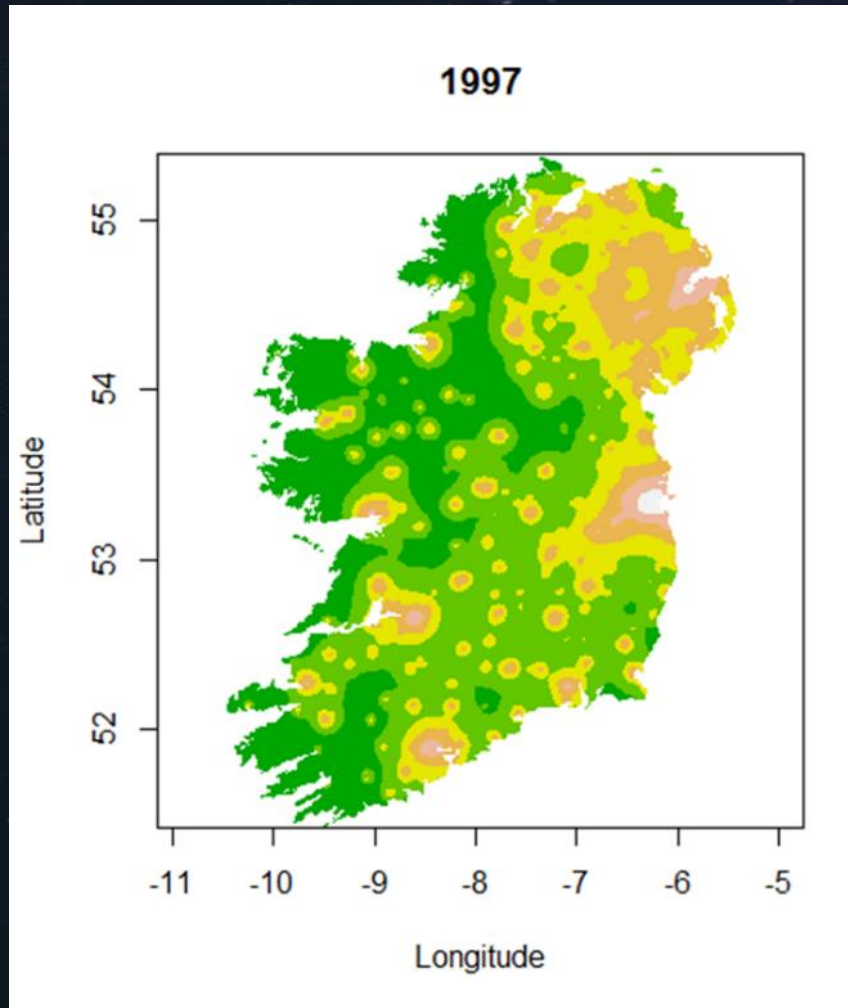
Photo Credit: Ray Butler

Sky brightness

- We can observe light sources directly, but light also scatters off objects & the atmosphere to generate “sky domes” over towns and diffuse light in the countryside
- Extra light dillutes fainter natural sky



Irish light pollution increase

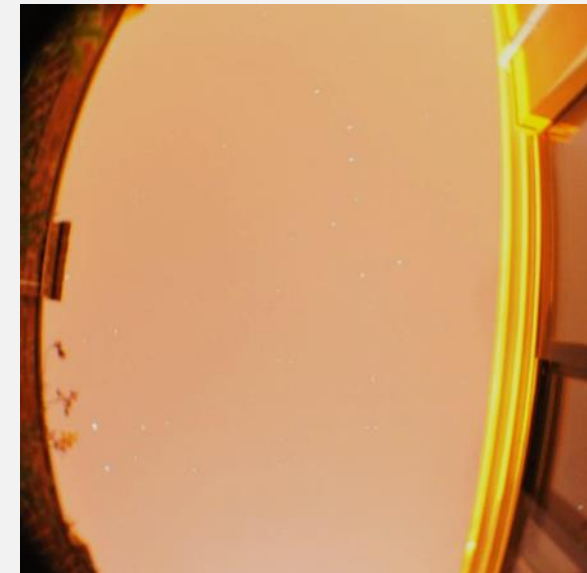
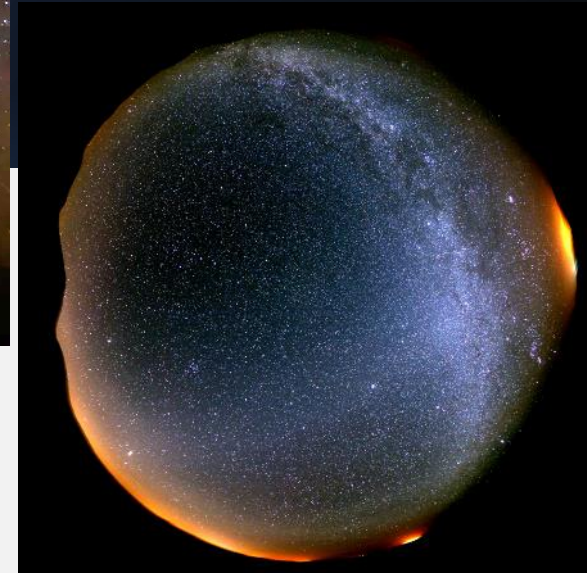


- Increase in light level due to growth: in rural areas many “one-off” houses

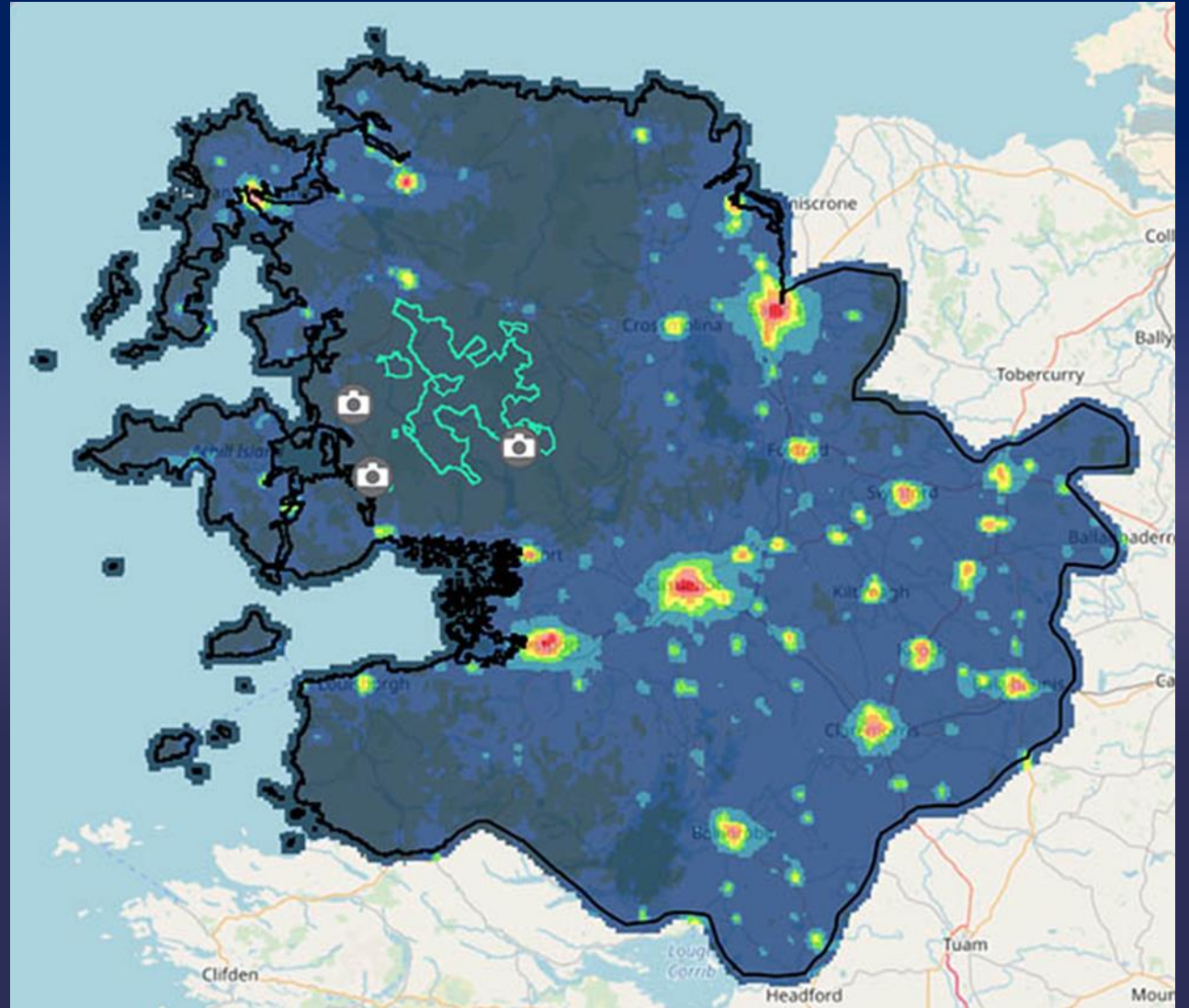
Light impact

- Light travels into wider environment
- Nearly 100% of the Irish population sees degraded skies in some form, polluted towards the zenith
- 84% of pop can not see natural skies, with Milky Way no longer visible, which occurs over 40% of the country
- Over half a million people (11%) live in areas where their eyes cannot get dark-adapted and hence depend on their colour vision at night & no lunar cycle
- 18.5% of the population use colour vision at night

Both direct and diffuse light affects both humans and the natural environment

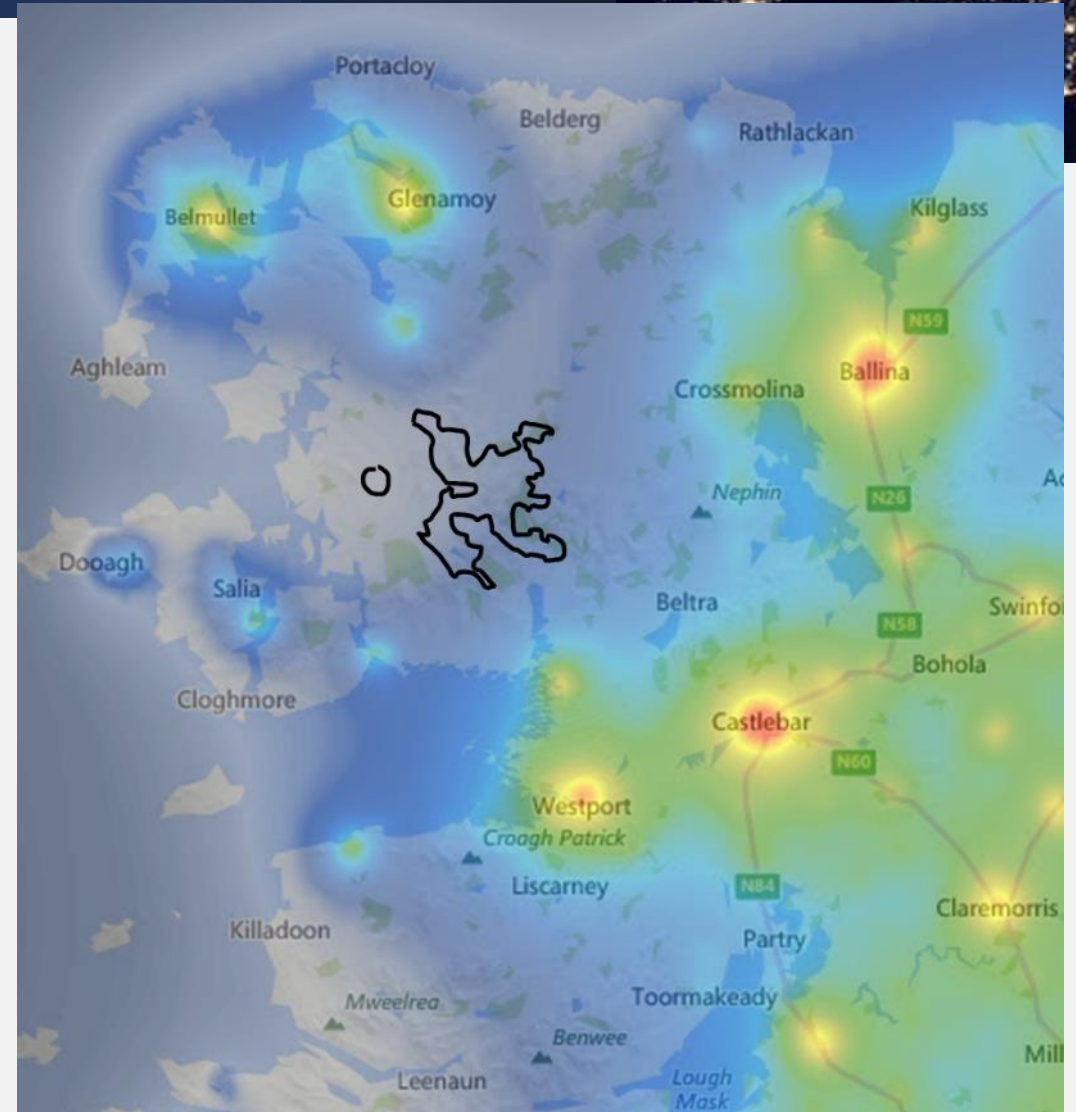


Night sky in Mayo



Night sky in Mayo

- Image at right show the emission to space, i.e. how Mayo would look as seen from the Space Station
- The image is displayed in false colour with red urban areas much brighter than their surroundings
- Light pollution is spreading across the county (residential, commercial & public)
- Approx 30% energy wasted in poor design/fitting
- All public lighting (17,000 lamps) are on dusk to dawn "on" time 4150 hours p.a.
- Rebound effect – increased energy efficiency leads to additional energy use (i.e. more lights)

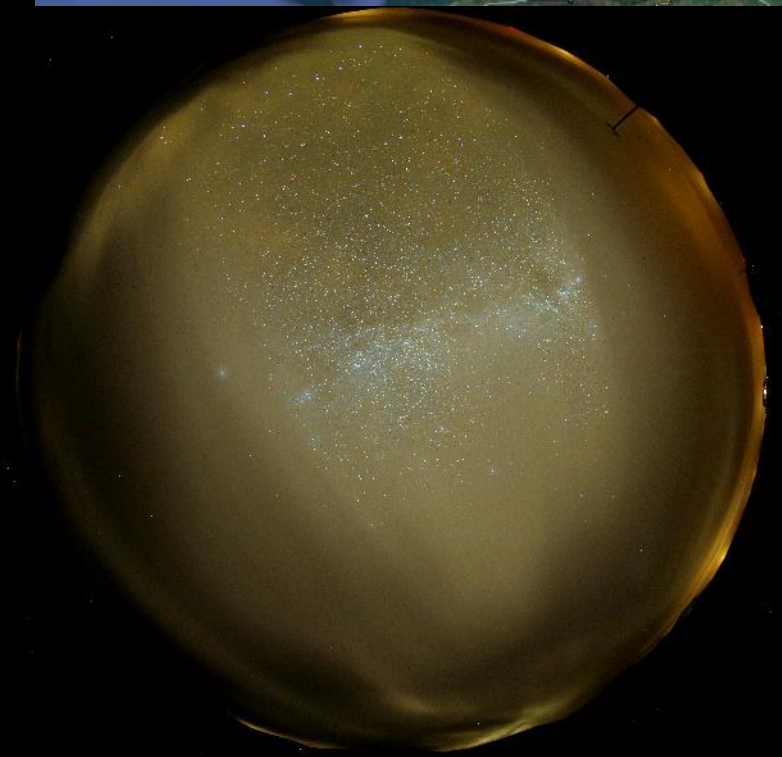
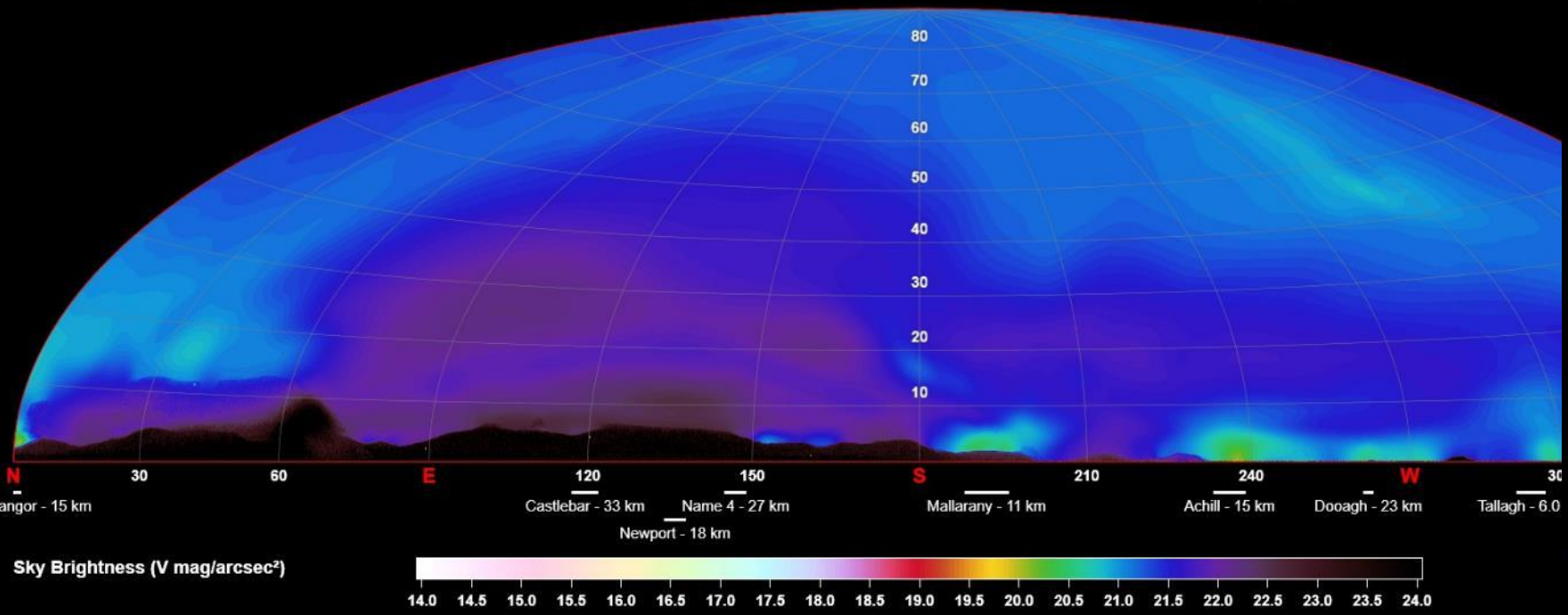


Night sky from Letterkeen



Ballycroy NP

SQC Sky Quality Camera 4.11.2011



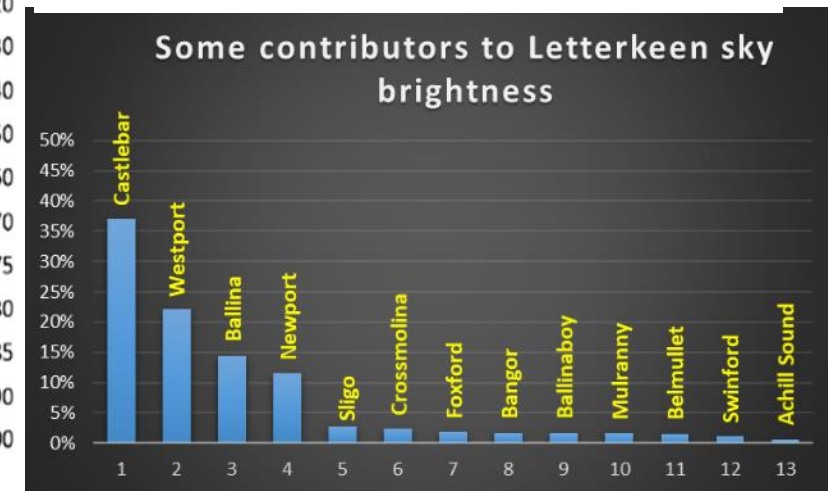
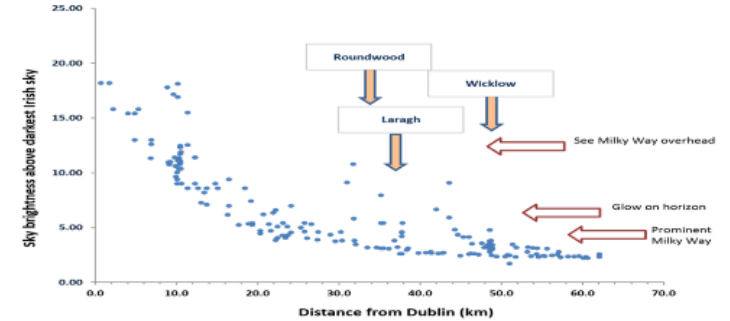
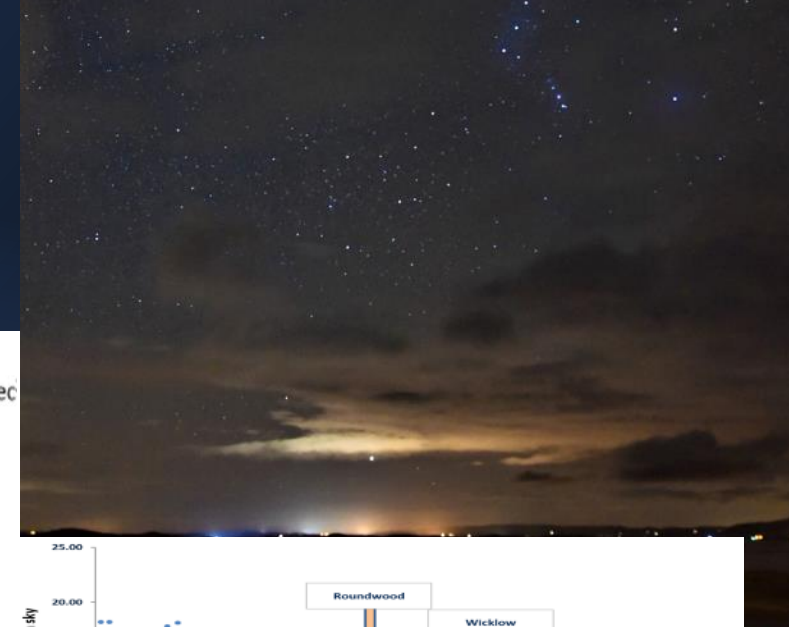
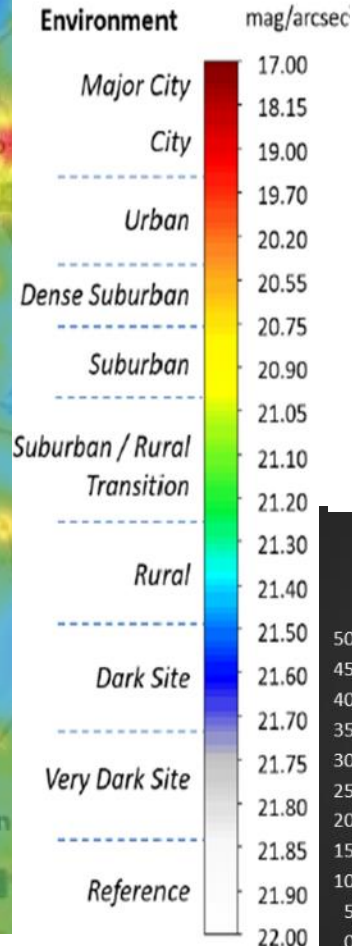
Night sky in Mulranny

- Image at right show the light from Westport and environs as seen from Mulranny, approx. 20 km away
- A range of light sources can be seen creating “light domes”, but also radiating upwards to space



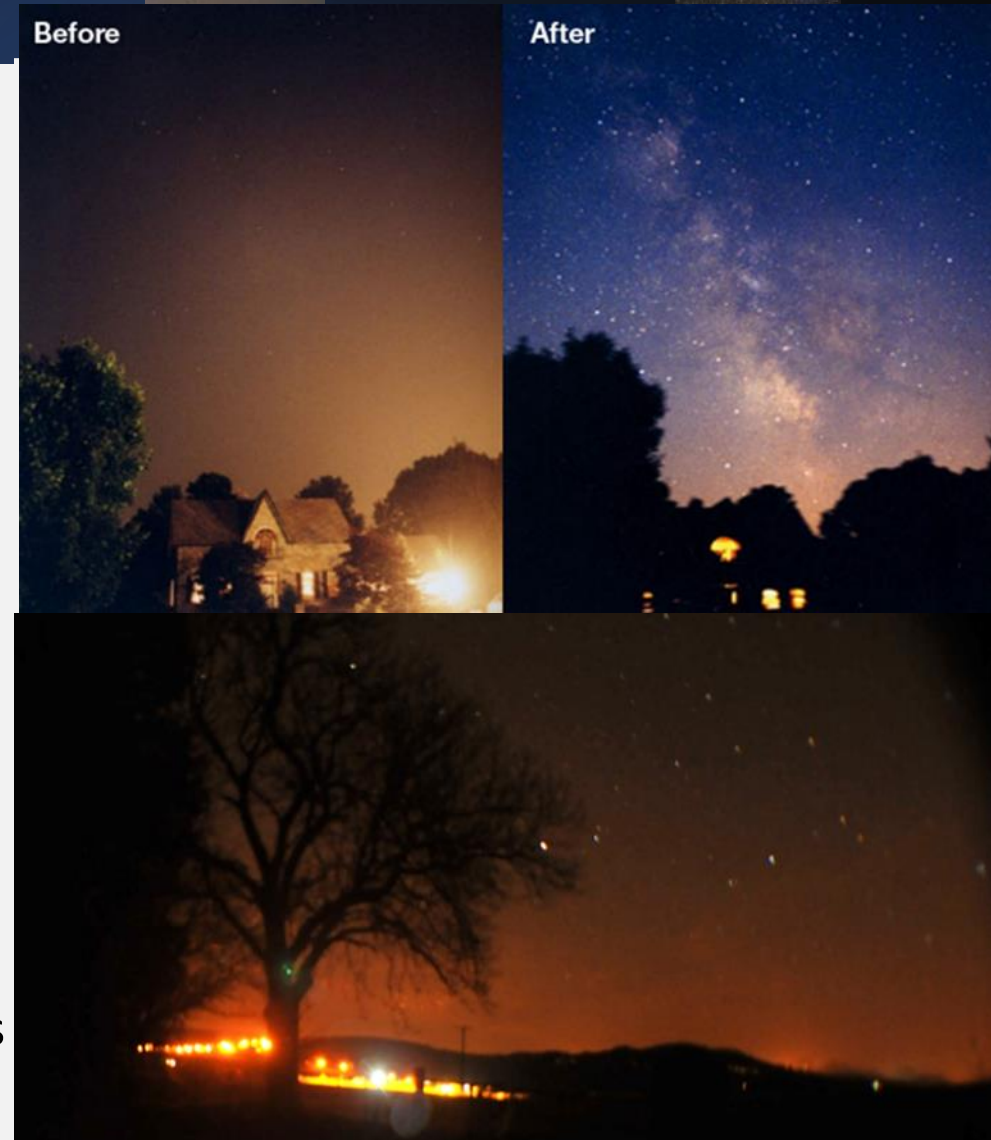
Sky brightness

- Using known light sources we can model how bright the sky will appear from any location
- Influence of Castlebar 23km away is apparent, but there are very dark areas which can be developed as DS areas
- Have confirmed with my own measurements



Sky brightness

- Rural areas affected disproportionately – local light sources proportionally bigger effect
- Resulting increase in Irish land area affected by light –
 - **≈35% of area**
 - **over 60% of population**
- Light spreads into conservation areas
- Many more faint stars than bright ones, hence proportionally larger loss of sky quality
- Losing natural environment
 - **“half the park is after dark”**
- Blue light detrimental to environment & dark sky areas





Unintended consequences:
Influence on nature

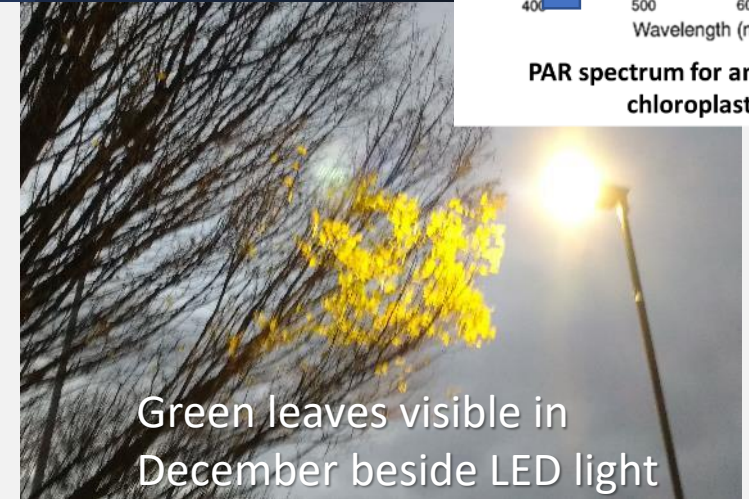
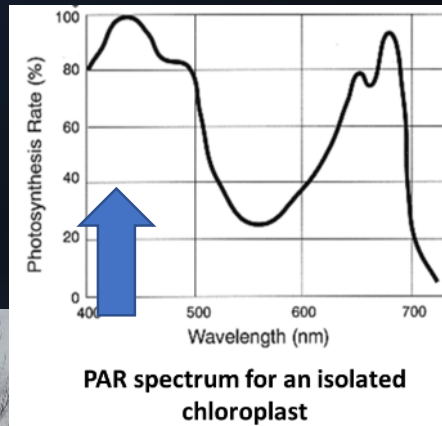


Plants & insects

- Light can also affect trees, inducing earlier bud burst and delaying leaf fall, causing stress to the tree
- Prolonged light exposure has been shown to affect plant species growing near the light due to blue spike in LED spectrum lining up with peak in blue absorption



- Effect of light on moths important as moths are pollinators and prey insects for, e.g. bats
- Research released last week shows effect of light on morphology – smaller eyes in insects living in brighter environment



Lamp on left has a warm white spectrum and few insects while lamp on the right has a much bluer spectrum (CCT of 5000K or so) and many insects.

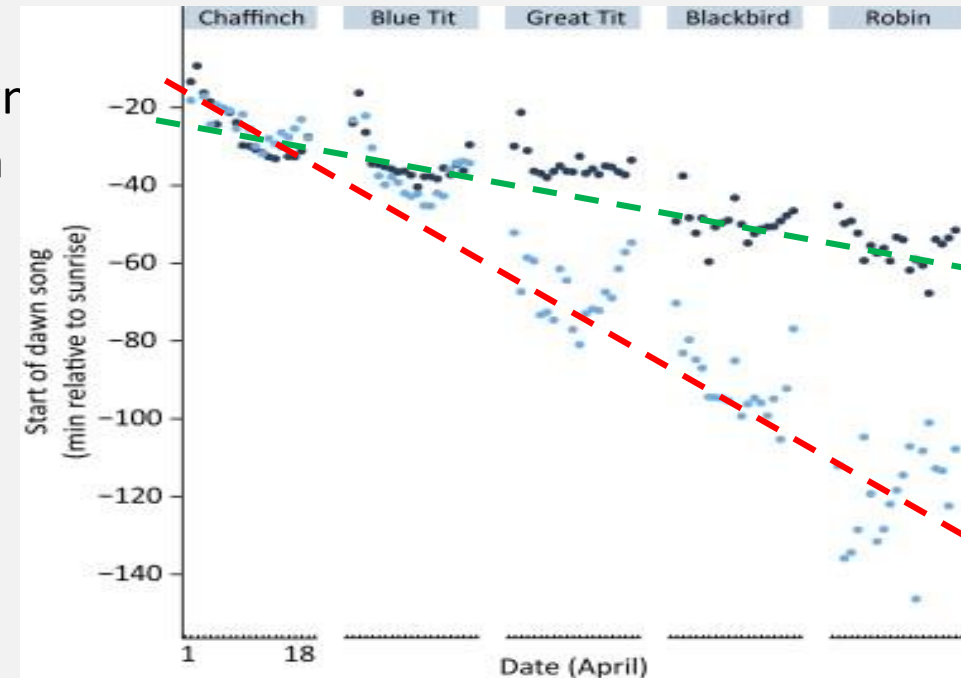
Effect on bats

- Well-known effect of light on bats
- Larger species aware of predation by owls and avoid lit areas
- Smaller species may be attracted to light & gain by access to insects - affects competition & biodiversity
- Important aspect which may be overlooked is that light can act as a barrier to passage of bats, e.g. along hedgerows – can create choke points limiting access from roost to foraging areas
 - Important in terms of rural road & greenway lighting as well as lighting over water courses



Effect on birds

- One effect of lighting is to change the timing of the dawn chorus, though the magnitude of this effect depends on the species →
- Other effects include alteration of sexual maturity, changes in the number of chicks raised etc.
- Nesting swallows are affected by direct light on roosts
- Other examples of impacts include Shearwaters whose chicks become disorientated by coastal light
- Migrating birds can also be affected as most travel by night and use light cues



Connecting to the natural world

- Humans have evolved to cope with natural light cycles – the range from full sunlight to weak moonlight is about 1,000,000 to 1
- Light disconnects us from natural environment which can reduce stress
- Night-time outings provide strong connection with people sharing the experience
- Provides different point of view/ sense of wonder! (for all ages!)
- Precautionary principle / good stewardship of planet

Carved stones and
Milky Way at Knowth
by Ken Wilson



Star party at Knowth (Ken Wilson)



June 1889 – not much artificial
light in Saint-Rémy-de-Provence

Lighting

Bad lighting

- Tourmakeady bridge shows an example of unnecessary (and disused) lighting on a bridge
- Remember that the most energy we can save is by not having lights on, also the cost of installation, maintenance etc.



- Glare from bad lighting may also negate the benefits of the light: compare the two images below showing a potential intruder who is present in both images →






Bad lighting

- The lamp to the right of the path was installed to protect students at night, but the placement can also serve to mask potential offenders (arrowed at right)
- Increased light does not always lead to improved safety (think Dublin's O'Connell St, for instance) and safety at night may be correlated with similar issues during the day
- In this case, reduced contrast and better light placement would be more beneficial

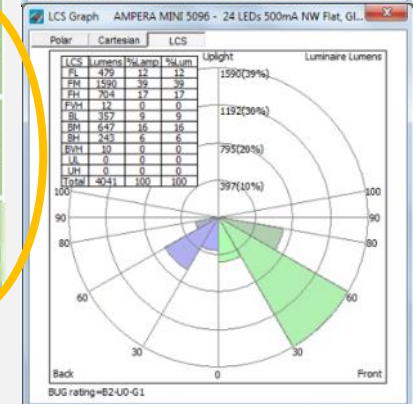
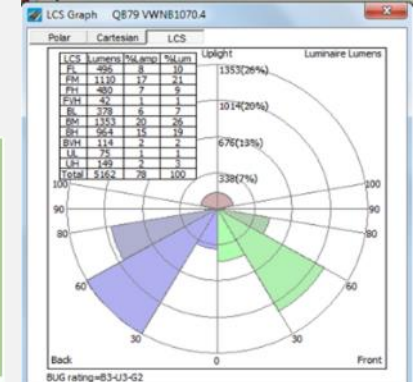
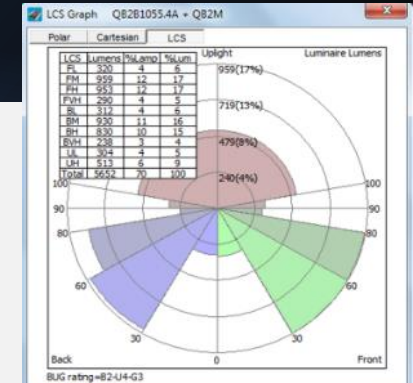


Streetlighting control

- LPS and HPS still represent the bulk of the lighting
- Total proportion of upward light can be similar for HPS and LED as ground reflection is more important than for LPS case
- LED emission generally has a stronger blue component. Theoretical results of relevance are shown below:

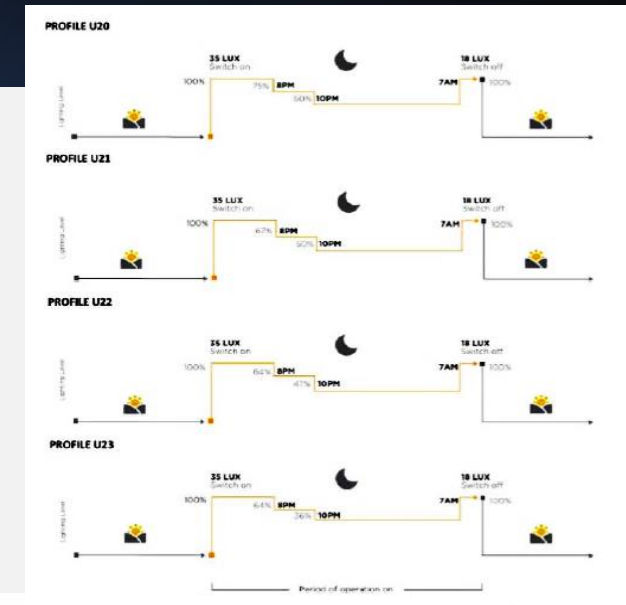
Type	Lamp lumens	Direct uplight (ULR)	Reflected uplight (10% refl)	TOTAL upwards relative to lamp	"skyglow" high angle light (80° - 90°)	Direct uplight (ULR)	Reflected uplight (10% refl)	TOTAL upward lumens to environment	"skyglow" high angle light (80° - 90°)
LPS 55W 	8,100	10.0%	4.7%	14.8%	22.0%	817	381	1,199	1,783
HPS 70W 	6,600	3.4%	6.2%	9.6%	22.0%	224	409	634	1,444
LED 37W 	5,270	0.0%	9.5%	9.5%	23.0%	0	501	501	0

- *Need to limit high angle light (Highways England weighting scheme)*



Lighting Plans

- LED lighting permits the choice of colour & use of controls not possible with older technologies
- Due to DSI discussions with the national Road Management Office (RMO) some flexibility in terms of colour temperature and trimming/dimming profiles (including multiple dimming steps) is possible for local authorities
- Lighting curfews also permissible for sensitive areas such as parks & dark sky areas
- Colour temperatures as low as 2700K are now permitted in special cases and Mayo CC has approved their use in the case of Newport, retrofitting existing LED lanterns



3-81.8 Colour Temperature Selection

Table 2 provides the general recommendations for the correlated colour temperature (CCT) for new retrofit LED lanterns.

The final colour temperature of LED Lanterns shall be submitted to the *Project Manager* during the design stage for acceptance.

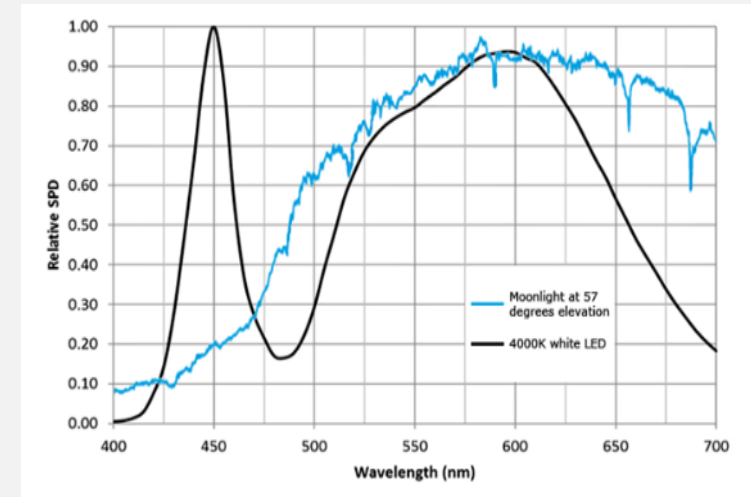
Table 2: Colour Temperature Selection

Location	Colour Temperature
National Road Network	As per the TII- DN-LHT-03038 document
Dark Sky areas, National parks, within 2.5km radius of bat roost locations.	It shall be considered scheme by scheme basis. However, it is recommended to be 2,700K in accordance with ILP Guidance Note 08/18 "Bats and artificial lighting"
Other areas	Warm colour appearance in accordance with BS 5489- 1:2013 unless otherwise stated by the <i>Project Manager</i> .

Streetlight colour

- Initially LED installations in Mayo had a CCT of 4000K (“neutral white”), these were mainly fitted to TII national roads.
- Since then, approx. 20% of installed LEDs have a CCT of 3000K (“warm white”) which has been the recommended value in recent years.

* source, Conal Sexton, MayoCC



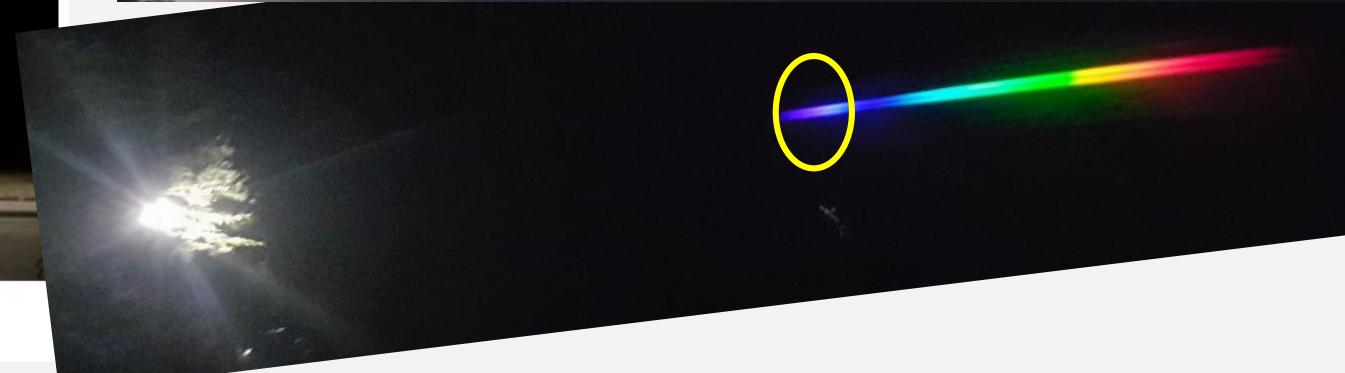
Existing 2200 Kelvin HPS



3000 Kelvin



4000 Kelvin



Appearance & colour accuracy

- Besides 3000K CCT lighting even lower temperature lanterns are available when required using PC Amber (phosphor-coated blue LED) or amber LEDs with no blue emission
- Although this light may appear broadly similar to older sodium lighting, because of the continuum spectrum colour reproduction is much better
- Even quite low CCT LED lamps generate a sufficient range of wavelengths to permit human (and digital) colour vision to discriminate between colours. This colour image shows a coloured hat containing a range of colours as imaged by a digital camera beneath an amber light of 2200K
- Additionally, some manufacturers have designed lighting that alters depending on the time of the day, becoming warmer towards the evening to reduce environmental impact at twilight and beyond



Conclusions

What is needed?

A reduction in light emissions through integrated **county-wide policy on light pollution**

Light pollution can be reduced through a number of simple measures:

- *Directional lighting (Shielding)*
- *Reduction in colour temperature (blue light emissions),*
- *Adjust timing*
- *Quantity of light used*

"Light what is necessary, for the time necessary, with the least amount of light necessary"



Growing support on Dark Sky policy

Our Rural Future Policy – Dept Rural & Community Development - Working Group est. for 2022
Strategic Policy on Dark Skies

EU Green Public Procurement for Lighting employs principle of “As Low As Reasonably Achievable” to reduce light pollution

EU’s Biodiversity Strategy for 2030, the EU adopted text calling member states to tackle light pollution at source

UK Medical Officer’s 2017 Report re LED updates
“If retrofits purely on the basis of energy efficiency and cost, it is possible to end up with installations that may not be fit for purpose.”

Photo Sept 2019 Lough Feagh Newport town light pollution
(blue rich light scatter especially significant in cloudy conditions)



Why Mayo should have LP Policy:

- Positive for **climate action**, **biodiversity** and aligning with many **UN SDGs**
- **Financial** savings
- Opportunity to coincide policy with remaining **LED retrofits**
- Future proofs **Mayo International Dark Sky Park**, and planned Observatory / Planetarium
- **Reputational** enhancement for county and a model for **best practice** nationwide
- Supports Newport's goal for **1st Dark Sky Friendly** town.



How do we make changes?



Alternative lighting approaches

- For sensitive areas where lighting is required, reduction in the light falling on hedgerows and surroundings might be achieved by limited bollard lighting, which also keeps light out of the sightline, permitting better visibility

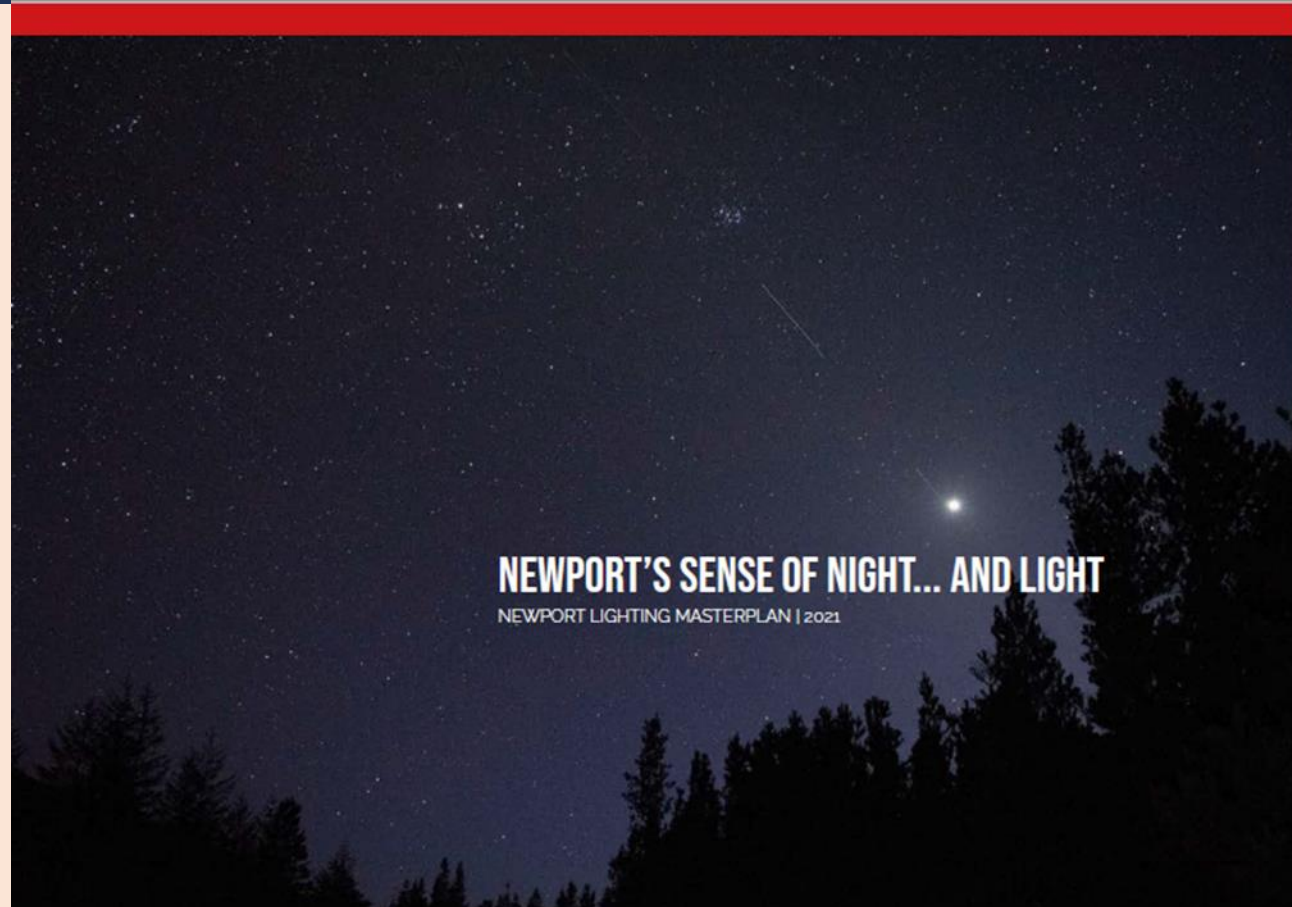


Good lighting is subtle yet effective....



Newport Lighting Master Plan

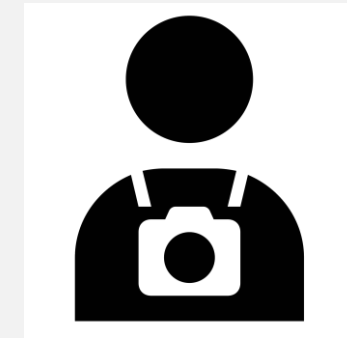
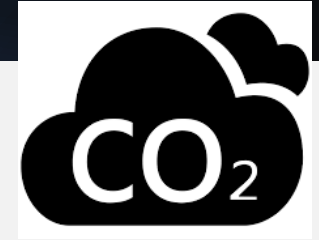
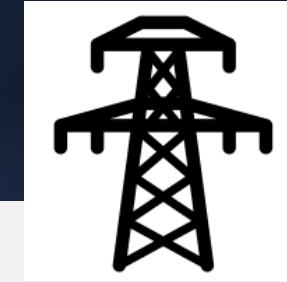
- Lighting Master Plan sponsored by Heritage Ireland



<http://www.mayodarkskypark.ie/what-s-on/mdsp-admin/newport-lighting-master-plan>

Benefits

- Save money, energy, carbon
 - *It costs to provide light*
- Reduce another potential environmental stressor
- Connects us to the wider world
- Potential health benefits
- Tourism potential
 - *80% Irish CS respondents interested in Dark Sky events*
- Cultural, health & historical connection
 - *Half the park is after dark*



This is a form of pollution that can be halted at the speed of light...

Consultation

Public Consultation on a National Strategy on Outdoor Recreation

Night hiking is the latest exercise trend we love and here's where you can do it

By Claire Concannon - 19/07/2020



*A parting
thought from
David
Attenborough:*

*"No one will protect what they
don't care about; and no one
will care about what they have
never experienced"*

Mayo vista - © Brian Wilson