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Campaign to Protect
Rural England
Standing up for your countryside

Night Blight:

Mapping England's light pollution and dark skies



Night Blight: Mapping England's light pollution and dark skies

“All generations and cultures have looked up and wondered at the stars. But sadly this part of our shared environment has been degraded. Unless they live in remote rural areas, young people may grow up without ever seeing a truly dark starry sky – and that’s a real deprivation.”

Lord Martin Rees, Astronomer Royal

Contents

Summary	2
Introduction	4
How the maps were created	6
What the maps show:	8
Across Great Britain	8
Light pollution from the Strategic Road Network	8
A picture of the English regions	8
What's the story in the counties?	9
How districts influence lighting in a local area	11
National Parks and Areas of Outstanding Natural Beauty – holding guard against light pollution	13
National Character Areas – light and landscape character	14
Conclusion and recommendations	15



Semerwater, North Yorkshire

Summary

We can now present the most accurate ever picture of how much light is spilling up into Britain's night skies.

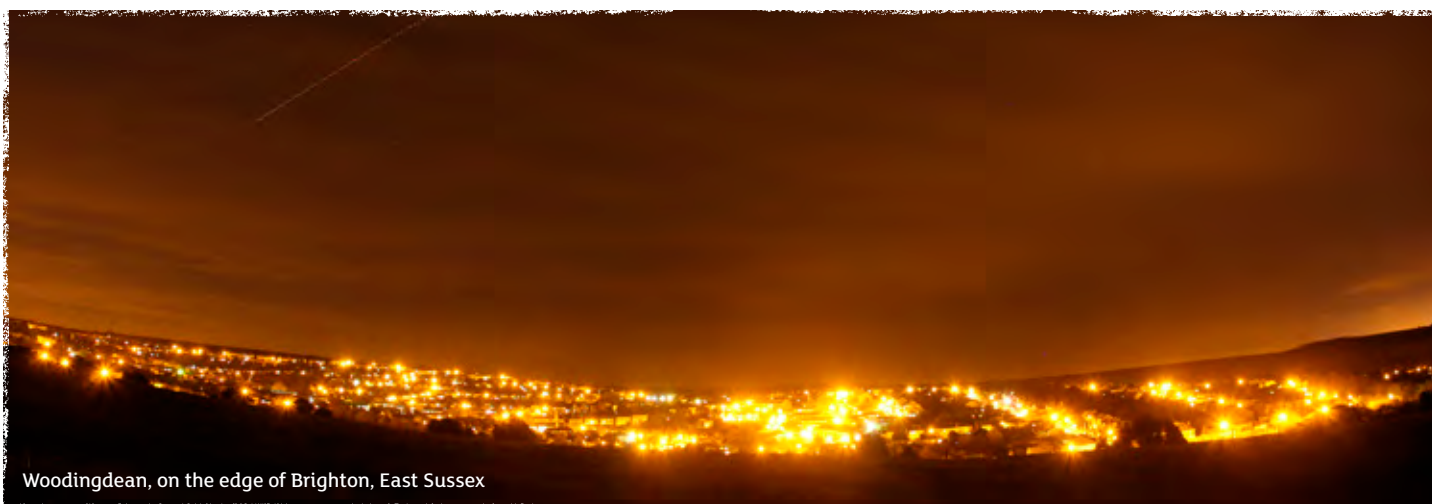
The Campaign to Protect Rural England (CPRE) has long fought for the protection and improvement of dark skies, and against the spread of unnecessary artificial light. Having last published a major mapping project on light pollution and dark skies in 2003 (based on data from 1993 and 2000), CPRE commissioned LUC to create new maps of Great Britain's light pollution and dark skies.¹ Using data captured by a satellite at 1.30 am throughout September 2015, the latest technology has been used to give an accurate picture of how much light is spilling up into the night sky and show where urgent action is needed. We also sought to find where the darkest skies are so that they can be protected and improved.

Detailed interactive maps have been created for England showing districts, counties, National Parks and Areas of Outstanding Natural Beauty (AONBs) and, at a wider scale, National Character Areas. Besides these, there are high-level maps available for Scotland and Wales, so that we can now present the most accurate ever picture of how much light is spilling up into Britain's night sky.

The key findings from our analysis of the mapping are:

- Only 22% of England has pristine night skies, which we consider as completely free of light pollution. When the two darkest categories are combined, almost half of England has what most of us regard as dark skies. Yet light pollution continues to spread into the countryside from towns and cities, damaging the character of rural areas.

- Almost half (47%) of the very darkest skies in England have no national protection.² The other half (53%) of our darkest skies are in National Parks and Areas of Outstanding Natural Beauty, demonstrating the vital role these places play in protecting and enhancing our experience of the countryside.
- There is significant light pollution from motorways and trunk roads.
- There is substantial light pollution from some business districts such as the City of London, and facilities such as Leicester football stadium, that are not in use at 1.30 am.
- The South West (67%) and North East (65%) regions of England have the highest proportion of their area in the two darkest categories. The brightest region is London.
- Based on average light levels across the county, Herefordshire is England's darkest county, yet Northumberland has the highest proportion of pristine dark skies at 72% to Herefordshire's 60%. Both counties are taking steps to improve street lighting and reduce light pollution. The brightest counties based on average light levels are West and South Yorkshire, followed by Berkshire and Cheshire.



Woodingdean, on the edge of Brighton, East Sussex

¹ Due to improvements in the technology used and accuracy of the maps, this new data is not directly comparable with our earlier maps. This report presents the evidence from this new data and our analysis of it. It does not contain comparisons with previous data.

² This figure is for the darkest category only, colour band 1.



Only 22% of England has pristine night skies



Northumberland has the highest proportion of pristine dark skies at 72%

Based on what these maps show, CPRE recommends:

Government

- should **ensure that local authorities are implementing Government policy to control light pollution**, as set out in the National Planning Policy Framework and associated guidance. In the absence of resources for the relevant departments (Defra and DCLG³) to pursue rigorous monitoring, we call on Ministers to issue a clear statement that local authorities should take action to control light pollution and protect dark skies in their areas.

Local authorities

- should **develop policies to control light pollution in local plans which will ensure that existing dark skies are protected, and that new developments do not increase local light pollution**.⁴ Our maps can be used as evidence to inform decisions on local planning applications.
- local highway authorities should **identify areas with severe light pollution and target action to reduce it**, such as investing in dimming technology, running part-night lighting schemes (in consultation with the local community) or replacing street lighting with less light polluting types. Our maps can also be used to identify existing dark skies that need to be protected and enhanced, such as the large tracts of dark skies in Herefordshire, Devon and Yorkshire.

- local highway authorities should **develop a Street Lighting Policy**, which could include Environmental Lighting Zones to ensure that appropriate lighting is used in each area.

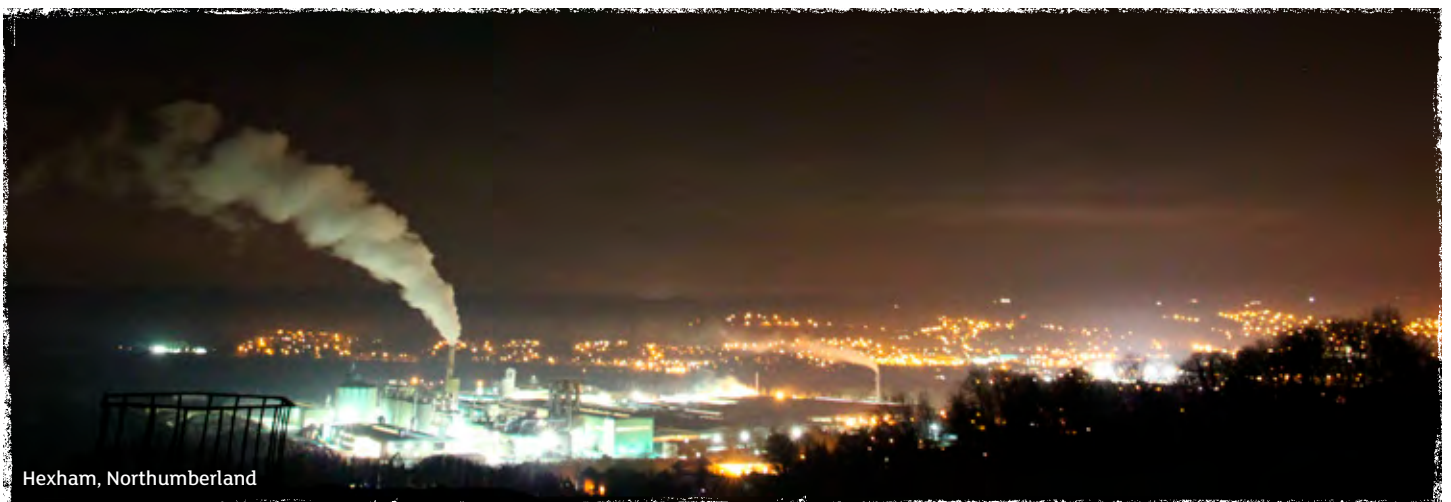
Highways England

- should **use the maps to identify sections of motorways and trunk roads that need urgent attention to reduce light pollution**. Any new lighting should be well designed and be the minimum required to meet its purpose.
- should use the opportunity of the review of the Design Manual for Roads and Bridges to **specify ambitious performance-based standards for lighting** that minimise light pollution.

Businesses and large facility owners

- should **review their existing lighting and ensure new developments do not cause light pollution**. Dimming and switching off lights would also save money. Larger facilities that create light pollution can be identified on the maps.

A complete list of recommendations is on page 15.



Hexham, Northumberland

³ Department for Environment, Food and Rural Affairs and Department for Communities and Local Government.

⁴ Examples of effective policies can be found in CPRE (2014) *Shedding Light: a survey of local authority approaches to lighting in England* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/3608-shedding-light>

Introduction

Our view of the stars – a source of infinite amazement for scientists, casual observers and the millions of us that seek out rural places to rest and recuperate – is obscured by light pollution.

It's a sad fact that many children will grow up never seeing the Milky Way, our own galaxy, because of the impact of artificial light. CPRE has campaigned against light pollution for many years. We believe that darkness at night is one of the key characteristics of rural areas and is an important feature that differentiates them from urban areas. But light can spread for miles from the source; blurring the distinction between town and country.

Light pollution is a generic term referring to artificial light that shines where it is neither wanted nor needed. In broad terms, there are three types of light pollution:

- **skyglow** – the pink or orange glow we see for miles around towns and cities, spreading deep into the countryside, caused by a scattering of artificial light by airborne dust and water droplets
- **glare** – the uncomfortable brightness of a light source
- **light intrusion** – light spilling beyond the boundary of the property on which a light is located, sometimes shining through windows and curtains

Apart from the impact on people's experience of the countryside, there is an increasing awareness of the effect that light pollution can have on wildlife, by interrupting natural rhythms including migration, reproduction and feeding patterns.⁵ A 2010 survey by CPRE found that light pollution can cause a great deal of distress to humans too, including disrupted sleep, and in some cases has driven people to move house.⁶ Studies suggest that exposure to light at night can disrupt the body's production of melatonin, a brain hormone best known for its daily role in resetting the body's biological clock.⁷

Light spilling up into the night sky is also a waste of money and energy: local councils were estimated to spend £613 million on street lighting in 2014-15⁸ – and the lights can account for between 15-30% of a council's carbon emissions. Advances in lighting technology mean that upward light pollution can be minimised without compromising road safety or increasing crime.⁹ Advice is available on good design and installation of lighting to reduce light pollution from various sources. These are listed on our website: nightblight.cpre.org.uk.



Salcombe skyglow

⁵ Royal Commission on Environmental Pollution (2009) *Artificial Light in the Environment* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228832/9780108508547.pdf

⁶ CPRE (2010) *Lighting Nuisance survey* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/1974-lighting-nuisance-survey-2009-10-report>

⁷ British Astronomical Association's Commission for Dark Skies *Blinded by the Light? A handbook on light pollution* Chapter 4 'Light pollution and human health' Steven W Lockley Ph.D. <http://www.britastro.org/dark-skies/pdfs/HANDBOOKTEXT.pdf>

⁸ Department for Communities and Local Government 'Local authority revenue expenditure and financing England: 2014 to 2015 budget' https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/365581/RA_Budget_2014-15_Statistical_Release.pdf

⁹ London School of Hygiene & Tropical Medicine (2015) *The effect of reduced street lighting on road casualties and crime in England and Wales: controlled interrupted time series analysis* <http://jech.bmj.com/content/early/2015/07/08/jech-2015-206012.full.pdf+html>

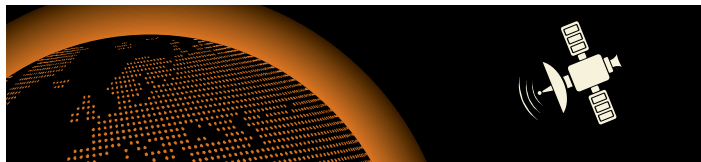
“Light spilling up into the night sky is a waste of money and energy: local councils were estimated to spend £613 million on street lighting in 2014-15 – and the lights can account for between 15-30% of a council’s carbon emissions”

Lighting at the
University of Sussex

How the maps were created

We have used satellite data to create the most detailed maps ever of Britain’s night skies.

Satellite data and the colour bands



Technology has developed since the publication of our previous *Night Blight!* maps of 1993 and 2000.¹⁰ As a result these new maps are much more detailed, but not comparable with the older ones.

The new maps are based on data gathered by the National Oceanographic and Atmospheric Administration (NOAA) in America, using the Suomi NPP weather satellite. One of the instruments on board the satellite is the Visible Infrared Imaging Radiometer Suite (VIIRS) which captures visible and infrared imagery to monitor and measure processes on Earth, including the amount of light spilling up into the night sky, which is captured by a day/night band sensor. Our maps do not show what the view of the night sky would be from the ground; this is commonly monitored using a Sky Quality Meter.¹¹ But the higher the levels of light pollution in an area, the more people’s view of the night sky will be obscured.

CPRE worked with LUC who selected the clearest, most cloud-free dataset on which to base our maps. Our mapping used data gathered in September 2015, and is made up of a composite of nightly images taken that month as the satellite passes over the UK at 1.30 am. Data has been plotted geographically and clipped to Great Britain’s boundary using a Geographical Information System (GIS).

The data has been split into nine categories to distinguish between different light levels. Colours have been assigned to each category ranging from dark blues (darker) to dark reds

Figure 1. How the maps have been split into colour bandings to show levels of brightness

Categories	Brightness values (in nw/cm ² /sr) ¹²
Colour band 1 (Darkest)	<0.25
Colour band 2	0.25-0.5
Colour band 3	0.5-1
Colour band 4	1-2
Colour band 5	2-4
Colour band 6	4-8
Colour band 7	8-16
Colour band 8	16-32
Colour band 9 (Brightest)	>32

(brighter) as shown in Figure 1. The maps are divided into pixels, 400 metres x 400 metres, to show the amount of light shining up into the night sky from that area. This is measured by the satellite in nanowatts, which is then used to create a measure of night-time brightness.

Further detail on the data source, units of measurement and how the data has been processed can be found in the LUC report.

Creating a national map

The nine colour bands were applied to a national map of Great Britain (Figure 2 opposite), which clearly identifies the main concentrations of night time lights, creating light pollution that spills up into the sky.

The highest levels of light pollution are around towns and cities, with the highest densities around London, Leeds, Manchester, Liverpool, Birmingham and Newcastle. Heavily lit transport infrastructure, such as major roads, ports and airports, also show up clearly on the map. The national map also shows that there are many areas that have very little light pollution, where people can expect to see a truly dark night sky.

The interactive map

We have created an interactive map of Britain’s light pollution and dark skies (Figure 3). Our map is underlaid by Open Street Map, which gives an increasing level of detail the further you zoom in. There are a variety of layers that can be switched on, including the English regions, counties, districts, and, at a larger scale, National Character Areas.¹³ The map also shows National Parks and Areas of Outstanding Natural Beauty in England and Wales, alongside the National Parks and equivalents to AONBs – National Scenic Areas in Scotland. People can also search for a location by postcode and generate a printable map. The detailed mapping can be accessed via our dedicated website: nightblight.cpre.org.uk.

Figure 3. The interactive mapping website



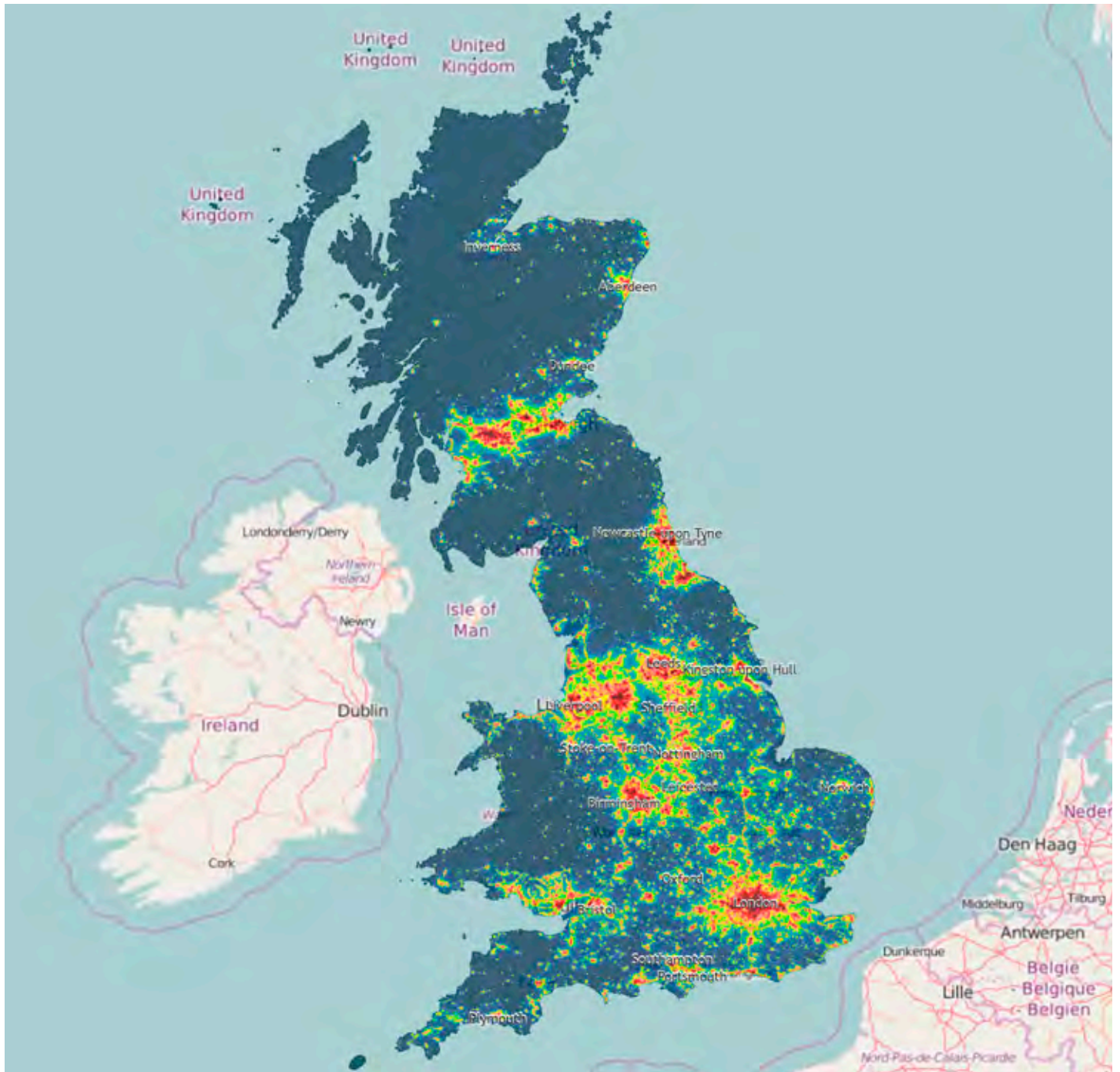
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The nine colour bands were applied to a national map of Great Britain, which clearly identifies the main concentrations of night time lights, creating light pollution that spills up into the sky

“

The highest levels of light pollution are around towns and cities, with the highest densities around London, Leeds, Manchester, Liverpool, Birmingham and Newcastle

Figure 2. National map of light pollution and dark skies



¹⁰ CPRE (2003) *Night Blight!* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/1986->

¹¹ https://en.wikipedia.org/wiki/Sky_Quality_Meter

¹² The brightness values are measured in nanowatts/cm²/steradian (nw/cm²/sr). In simple terms, this calculates how the satellite instruments measure the light on the ground, taking account of the distance between the two. See LUC report for more details.

¹³ England's National Character Area profiles provide both a strong evidence base to underpin local planning policy and a summary of opportunities for the future management of an area.

What the maps show

Find out where England’s darkest skies are and which areas have the most light pollution.

Across Great Britain

We wanted to find out how light pollution varied around Great Britain and where the largest tracts of dark skies remain. The results show that only 21.7% of England has pristine night skies, completely free from light pollution (Figure 4). This compares with almost 57% of Wales and 77% of Scotland. When the two darkest categories are combined, 49% of England can be considered dark, compared with almost 75% in Wales and 87.5% in Scotland. There are noticeably higher levels of light pollution in England in all the categories, compared with Wales and Scotland. The amount of the most severe light pollution is five times higher in England than in Scotland and six times higher than in Wales.

The different levels of light pollution are linked to the varying population densities of the three countries; where there are higher population densities, there are higher levels of light pollution. For example, the Welsh Valleys are clearly shown by the fingers of light pollution spreading north from Newport, Cardiff, Bridgend and Swansea. In Scotland, the main populated areas stretching from Edinburgh to Glasgow show almost unbroken levels of light pollution, creeping out from the cities and towns to blur any distinction between urban and rural areas.

Light pollution from the Strategic Road Network

Responsibility for lighting in England is split between different bodies. Highways England is responsible for lighting on motorways and trunk roads (the Strategic Road Network), while local highway authorities, typically county councils outside urban areas, are responsible for the majority of street lighting in towns and cities (see ‘What’s the story in the counties’ for more detail on this).

Highways England are installing more efficient lighting and switching off lights on some parts of the Strategic Road Network. However, a significant challenge remains: light pollution from motorways and trunk roads shows prominently on the national map. For example, the M25 is clearly visible around London (aside from an unlit section in Kent). In Surrey, the majority of the M25 is causing upward light pollution that falls within the three brightest categories, with the most severe light pollution caused by a motorway service station. In Hertfordshire, the M25, M1 and the A1(M) appear to contribute to the light pollution spilling up into the night sky, with light levels increased at large junctions. The A1(M) is prominent in Bedfordshire and Cambridgeshire; and a large section of the M62 that crosses open countryside between Manchester and Leeds also shows high levels of upward light pollution.

There is much that can be done by Highways England, such as adopting more ambitious design standards and setting targets in the Road Investment Strategy 2 (covering 2021 onwards) to reduce light pollution further.

A picture of the English regions

We analysed the nine English regions to investigate the distribution of light pollution and dark skies. The average (mean) brightness value for each of the regions is worked out by the average brightness values of all of the 400m x 400m squares in the region and suggests that the South West is, on average, the darkest region, followed by the East of England, East Midlands and the South East. London has the highest level of light pollution and is 24 times brighter than the darkest region of the South West. It is also eight times brighter than the next brightest region – the North West. (Figure 5)

Looking at the percentage of a region covered by the darkest two bands, 67% of the South West is darkest,

Figure 4. Light levels in England, Wales and Scotland

Categories	England	Wales	Scotland	GB
Colour band 1 (Darkest)	21.7%	56.9%	76.8%	46.2%
Colour band 2	27.3%	18.0%	10.7%	20.1%
Colour band 3	19.1%	9.3%	4.6%	12.6%
Colour band 4	11.0%	5.8%	2.8%	7.3%
Colour band 5	6.8%	3.8%	1.7%	4.6%
Colour band 6	5.0%	2.9%	1.2%	3.3%
Colour band 7	4.3%	2.1%	1.0%	2.8%
Colour band 8	3.2%	1.0%	0.9%	2.1%
Colour band 9 (Brightest)	1.6%	0.2%	0.3%	1.0%



When the two darkest categories are combined, 49% of England can be considered dark, compared with almost 75% in Wales and 87.5% in Scotland



London is the brightest region, with no truly dark skies. The darkest location within London is found in Bromley



followed by the North East at 65%, then the North West and Yorkshire & Humber at 49%. Unsurprisingly, London is the brightest region, with no truly dark skies (in the two darkest categories) and only 13 400 x 400m squares within the third darkest category. The darkest location within London is found in Bromley where the largest zone of colour band 4 (green) is found in the southern part of the borough. The next brightest regions are the South East, although the region still has 39% of the night sky in the darkest two bands, closely followed by the East Midlands on 35%.

What's the story in the counties?

There are a variety of sources of light pollution; one of the main culprits is street lighting, which is largely managed by county councils, unitary authorities and city councils.¹⁴ An increasing number are investigating whether they can save money and energy by making adjustments to the street lighting in their areas. In 2014, a CPRE survey, *Shedding Light*,¹⁵ investigated why councils were motivated to dim streetlights or run part-night¹⁶ or switch-off schemes. We found that the biggest incentive for reducing street lighting was to save energy and money, with the reduction in light pollution often coincidental.

So how did the 41 English counties¹⁷ fare when ranked from darkest to brightest? When counties were ranked on the basis of the average brightness of the pixels within their boundary, the top five, from darkest to brightest, are shown in Figure 6.

But when considering which counties have the highest percentage of pristine night skies, free of light pollution, it results in a different top five:

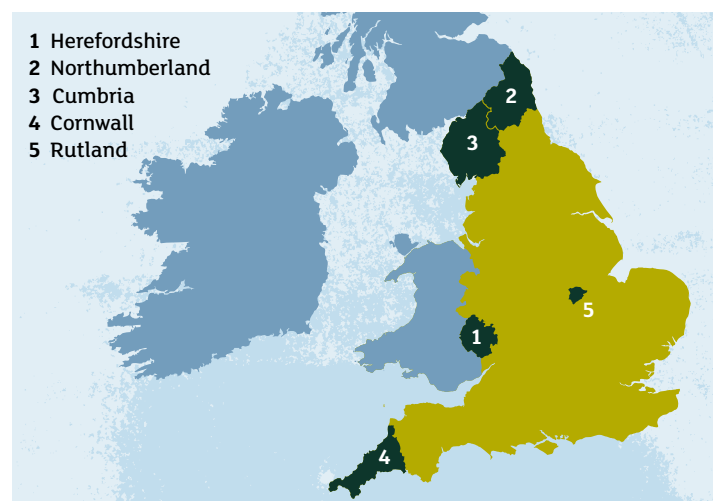
1. Northumberland comes out top with 72% of its skies in the darkest category (87% when combining the two darkest bands).
2. In Cumbria, 62% of the night skies are in the darkest category, and when combined with the next darkest, 85% of the county has dark skies.
3. Herefordshire has the third highest amount of pristine night skies, with 60% in the darkest category; and 88% when combined with the next darkest category.
4. The next darkest county is Devon, which has 56% of its night skies in the darkest colour band, and 82% in the two darkest categories.
5. North Yorkshire is the fifth darkest county with 42% of night skies in the darkest category and 70% when considering the two darkest categories.

CPRE's research has found that the top five counties with the highest amount of pristine dark skies are in the process of making changes to the street lighting in their counties. One example is in Northumberland.

Figure 5. Darkest to brightest regions, on average

Region	Rank of average brightness value (mean)	Average brightness value (linked to colour band)
South West	1	1.25
East of England	2	2.01
East Midlands	3	2.35
South East	4	2.75
Yorkshire and the Humber	5	3.16
North East	6	3.22
West Midlands	7	3.26
North West	8	3.86
London	9	30.53

Figure 6. Top five darkest counties, based on average light levels



¹⁴ Although some lighting in a county can be owned and maintained by districts, boroughs, town and parish councils.

¹⁵ CPRE (2014) *Shedding Light: a survey of local authority approaches to lighting in England* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/3608-shedding-light>

¹⁶ Part-night lighting is usually switched off between midnight and 5 am.

¹⁷ We have analysed counties using 41 of the former Ceremonial County boundaries, which includes many of the newer unitary authority areas. Seven of these have been excluded from this analysis (Bristol, Merseyside, Greater Manchester, West Midlands, Tyne & Wear, Greater London, City of London) and the areas are considered in the district analysis.

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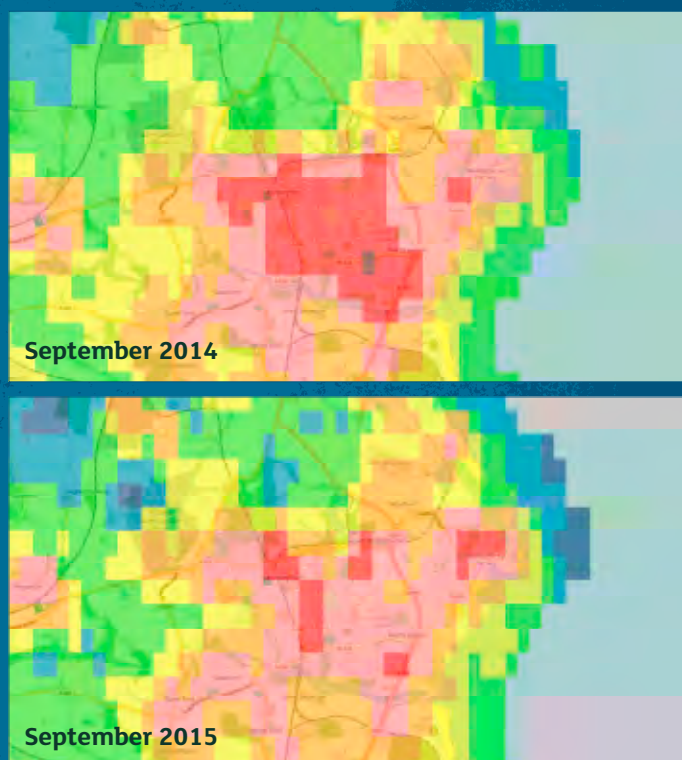
In addition to the carbon and money savings, ‘sky glow’ or light pollution will be significantly reduced, allowing for better viewing of the stars and the moon in the night sky

Case study: Northumberland County Council

In early 2015, Northumberland County Council began an ambitious £25 million project to modernise all the street lights in the county over the next three years. Around 29,000 lights will be replaced with Light Emitting Diode (LED) technology, with nearly 17,000 lampposts being replaced. The council are hoping to cut energy consumption by street lighting by more than 60%, which will lead to savings of £300,000 per year and reduce the carbon footprint of the street lighting stock by more than 5,000 tonnes of carbon dioxide. The programme to renew the street lighting started in the town of Ashington.

We looked back to satellite data from September 2014 to see how upward light pollution looked in the town, compared with September 2015 once the new lighting had been installed. The images were taken by the same satellite passing over at 1.30 am.¹⁸

The satellite images show a clear change in the distribution of light around Ashington since the street lights were changed to LED. In 2014, a large amount of the upward light pollution from the town fell in the second brightest category (red) but this appears to have changed by September 2015. There are also more blue (darker) pixels in September 2015, showing areas with less light pollution spilling up into the night sky.



Herefordshire County Council, which has the third highest amount of the darkest skies in England, started a street light improvement programme in 2008 following concerns over electricity costs, light pollution and the need to reduce carbon emissions. In early 2016, the project to replace the majority of the 12,000 council-owned lights with LEDs was completed, with around 9,000 street lights included in a dimming programme. The project has cost £7 million and will save an estimated £16 million in energy and maintenance costs over 20 years.

In Devon, the fourth darkest county, the council is introducing part-night lighting across the county. The county council is responsible for over 72,000 street lights, costing an estimated £3.4 million in electricity in 2011 and producing nearly 20,000 tonnes of carbon dioxide every

year. That accounts for around 30% of the county council's annual emissions of almost 62,000 tonnes of carbon dioxide. In residential areas, the times some street lights are on will be changed from all night to lighting between dusk and about 12.30 am, and again from about 5.30 am until dawn. An information leaflet by Devon County Council to residents about the scheme states, among other benefits, that: ‘In addition to the carbon and money savings, “sky glow” or light pollution will be significantly reduced, allowing for better viewing of the stars and the moon in the night sky.’

Some counties, such as Norfolk, the eighth darkest county, take a strategic approach by implementing an Environmental Lighting Zones policy. This means that the county is divided into zones where there are strict requirements for the type of exterior lighting used in an area.¹⁹

¹⁸ As the images are influenced by the number of cloud free nights that have been used to create the monthly composites, it is not possible to get two images that are captured under exactly the same climatic conditions. It is therefore reasonable to assume that the data may be influenced by this.

¹⁹ Environmental Lighting Zones are described in the Institute of Lighting Professionals (2012) *Guidance notes for the reduction of obtrusive light* <https://www.theilp.org.uk/documents/obtrusive-light/>



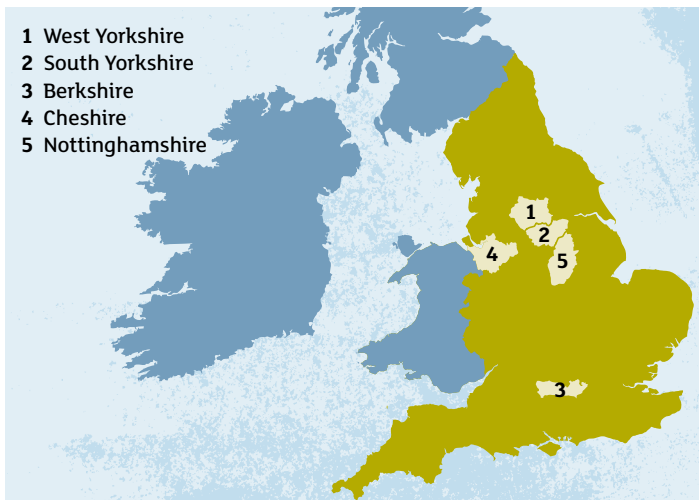
By encouraging good design, planning policies and decisions should limit the impact of light pollution on local amenity, intrinsically dark landscapes and nature conservation

Even though many county councils²⁰ are investing in schemes to renew the street lighting in their area, our satellite data reveals that in some cases this has not had a significant impact on reducing light pollution spilling up into the night sky. This may be due to lighting design that does not prevent light pollution – for example, lanterns which allow light to spill upwards. Increasingly, highway lighting is being outsourced by local authorities within long-term Private Finance Initiative contracts. It is critical these include targets to reduce light pollution, particularly in sensitive areas. The five brightest counties on average are shown in Figure 7.

Many councils are investing in changes to their street lighting. In the brightest county, West Yorkshire, Calderdale district council will be renewing its street lighting which should help reduce the upward light pollution in the area. A four-year project to replace 11,000 lighting columns and 19,000 ‘lanterns’ will begin in 2017.

Doncaster district council in South Yorkshire, the second brightest county, has invested in a street light replacement programme which involves dimming lights in residential areas and Sheffield, Barnsley and Rotherham councils are also investing in LED technology. It should be noted that although many councils are investing in LED lighting, which will reduce upward light pollution, careful consideration must be given to the type of LED installed. There is public and scientific concern about the higher temperature blue rich lighting which has unknown impacts on human health and ecology.²¹

Figure 7. Top five brightest counties, based on average light levels

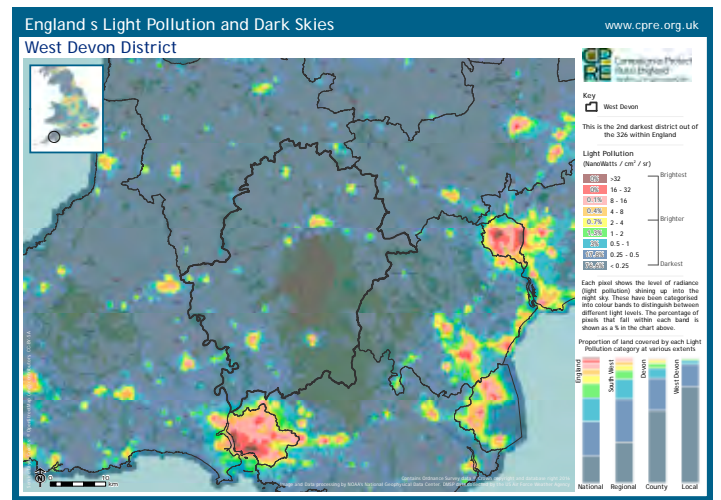


How districts influence lighting in local areas

District councils can have a significant impact on lighting levels in an area, as they are usually the local planning authority. There is national planning policy to control light pollution, which advises councils that: ‘By encouraging good design, planning policies and decisions should limit the impact of light pollution on local amenity, intrinsically dark landscapes and nature conservation.’²² Many councils have a lighting policy that aims to reduce the lighting impact of new development, or changes to the lighting of existing ones. A CPRE survey found that although there are some councils who are proactively working to limit any new light pollution, there are many councils who do not.²³ This can also be the case in borough councils, which may manage both planning and street lighting in the borough.



Figure 8. A sample district map



²⁰ Along with the unitary authorities.

²¹ Find out more about LED lighting in the International Dark-Sky Association guidance: <http://darksky.org/lighting/led-practical-guide/>

²² Read CPRE's analysis of the National Planning Policy Framework paragraph 125 and guidance: www.cpre.org.uk/local-group-resources/campaigning/planning/item/3045-planning-campaign-briefing-7-light-pollution

²³ CPRE (2014) *Shedding Light: a survey of local authority approaches to lighting in England* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/3608-shedding-light>



Our maps have shown that 19 of the 20 brightest districts, based on average light levels across the area, are London Boroughs

We investigated the satellite data to see, on average, how the 326 districts (including unitary, London and metropolitan boroughs) were doing.

- The Isles of Scilly, off the Cornish coast, is the darkest of the district areas with 91% of its night skies falling in the darkest category, with very little light pollution elsewhere.
- The next darkest district is West Devon, with 77% of its night skies completely free of light pollution (in the darkest category). The district council has a lighting policy in its local plan to ensure that any development does not cause light pollution.
- Eden district, in Cumbria, is the third darkest with 76% in the darkest category. The district also has a local plan policy which should help Eden district remain one of the darkest districts in England.

The top 20 darkest districts, on average, fall in the darkest three categories. Ten of the darkest districts are in the South West, the darkest region in England (see Figure 9). So which districts have a real problem with light pollution?

Our maps have shown that 19 of the 20 brightest districts, based on average light levels across the area, are London boroughs (see Figure 10). This is due to the density of lighting in relatively small boroughs compared to larger districts elsewhere in the country. The brightest pixel in London is near Wembley Stadium in the London Borough of Brent.

Figure 10. Top 10 brightest London boroughs with average brightness values (mean)

1 City of London 127.78	5 Islington 68.72	8 Hammersmith and Fulham 56.78
2 Tower Hamlets 82.07	6 Newham 58.14	9 Southwark 56.19
3 City of Westminster 73.35	7 Lambeth 57.72	10 Brent 55.97
4 Hackney 68.72		

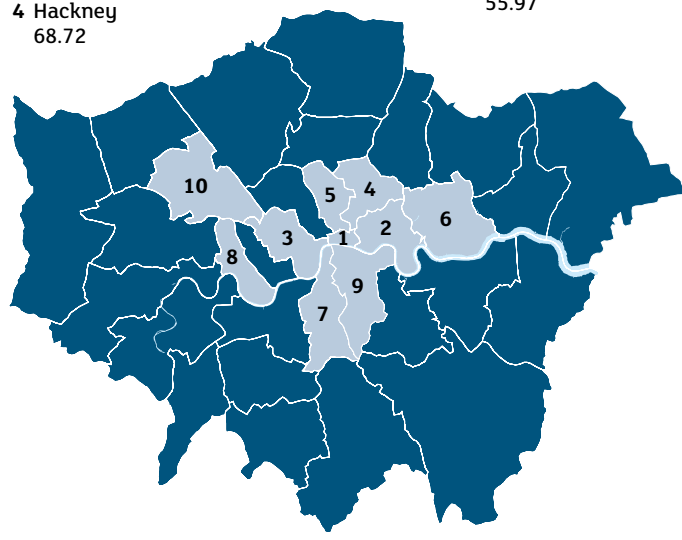


Figure 9. The top 20 darkest districts

District	County	Region	Rank of average brightness value (mean)	Average brightness value – linked to colour band
Isles of Scilly	Cornwall	South West	1	0.14
West Devon	Devon	South West	2	0.28
Eden	Cumbria	North West	3	0.31
Ryedale	North Yorkshire	Yorkshire and the Humber	4	0.31
Torridge	Devon	South West	5	0.33
Richmondshire	North Yorkshire	Yorkshire and the Humber	6	0.42
West Somerset	Somerset	South West	7	0.43
South Lakeland	Cumbria	North West	8	0.43
Craven	North Yorkshire	Yorkshire and the Humber	9	0.43
Mid Devon	Devon	South West	10	0.44
West Dorset	Dorset	South West	11	0.51
Herefordshire	Herefordshire	West Midlands	12	0.51
Cotswold	Gloucestershire	South West	13	0.56
South Hams	Devon	South West	14	0.57
North Norfolk	Norfolk	East of England	15	0.58
North Dorset	Dorset	South West	16	0.58
Northumberland	Northumberland	North East	17	0.61
Hambleton	North Yorkshire	Yorkshire and the Humber	18	0.62
North Devon	Devon	South West	19	0.62
Wealden District	East Sussex	South East	20	0.64



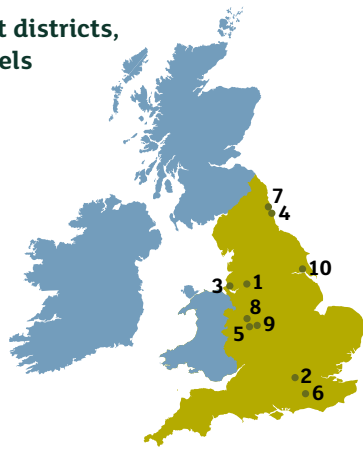
53% of our pristine dark skies are in National Parks and AONBs



47% of our finest dark skies have no protection

Figure 11. Top 10 brightest districts, based on average light levels

- 1 Manchester
- 2 Slough, Berkshire
- 3 Liverpool
- 4 Sunderland
- 5 Sandwell, West Midlands
- 6 Crawley, West Sussex
- 7 South Tyneside
- 8 Wolverhampton
- 9 Birmingham
- 10 Kingston upon Hull



Many of these districts are either planning or under way with street light replacement programmes (see Figure 11). For example, Slough, Reading and Wokingham borough councils recently won a £27 million grant from the Department for Transport 'Challenge Fund' to replace street lighting in their areas with LEDs, which will be controlled with dimming technology. The severe light pollution levels around Crawley are largely caused by Gatwick Airport.

National Parks and Areas of Outstanding Natural Beauty – holding guard against light pollution

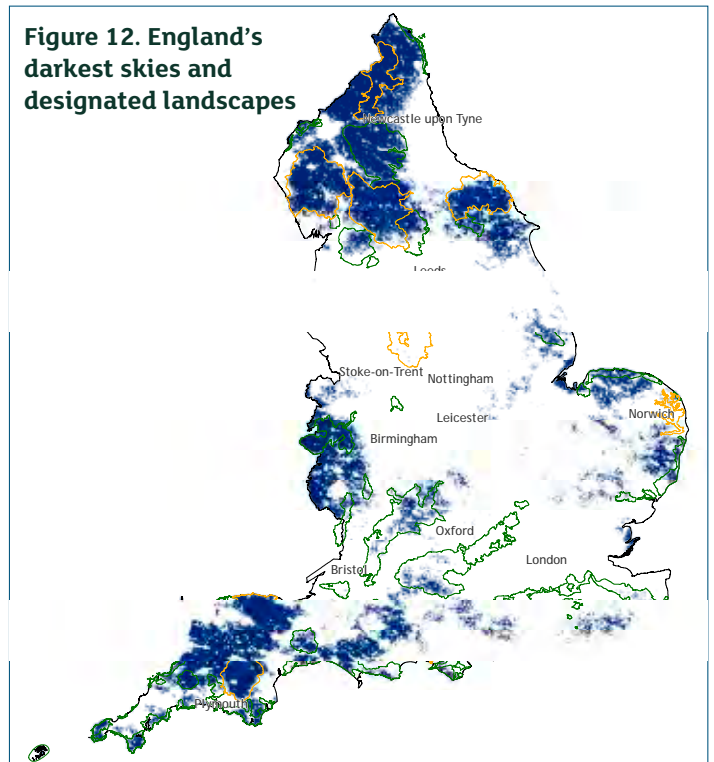
Our mapping found that 53% of England's pristine dark skies, free of light pollution, are in National Parks and Areas of Outstanding Natural Beauty (Figure 12). 59% of National Parks have the darkest skies possible, along with 40% of AONBs. This shows that designated landscapes cover much of England's darkest skies and suggests that the designation is helping to protect these dark skies. Many are making the most of their dark skies to draw new visitors into their areas, known as 'astrotourism', which provides a year-round attraction for people to view a truly dark starry sky. Some National Parks and AONBs are working towards Dark Sky status, which is awarded by the International Dark-Sky Association. There are two main types of designation: Dark Sky Park and Dark Sky Reserve – based on a core area, and three other types which are less commonly pursued in England.²⁴

There are ten National Parks in England which protect 27% of the darkest skies in the country. National Park Authorities are the planning authority for these areas, which means they can work to ensure that any major new development does not cause light pollution.

The darkest National Park is Northumberland²⁵ with 96% of the area having pristine night skies and very little light pollution elsewhere. In 2013, Northumberland National Park and Kielder Water & Forest Park were awarded Dark Sky status and became the 'Northumberland International Dark Sky Park', which at 1,483 square kilometres is Europe's largest area of protected night sky. The National Park is developing lighting guidance to ensure that there is no new light pollution created in the area that could hinder the view of the dark skies and tranquil landscapes below. Northumberland National Park has also developed a Lighting Master Plan to ensure that no light pollution is caused by new developments.

Exmoor National Park is the second darkest in England, having 92% pristine dark skies and minimal light pollution. This park became an International Dark Sky Reserve in 2011, the first in Europe. The core area covers some 83 square kilometres and is surrounded by a buffer area of 98 square kilometres of mainly farmed landscape, which includes a number of small settlements. The park has also developed a strong lighting policy in its draft local plan that will ensure that no light pollution affects the Dark Sky Reserve.²⁶

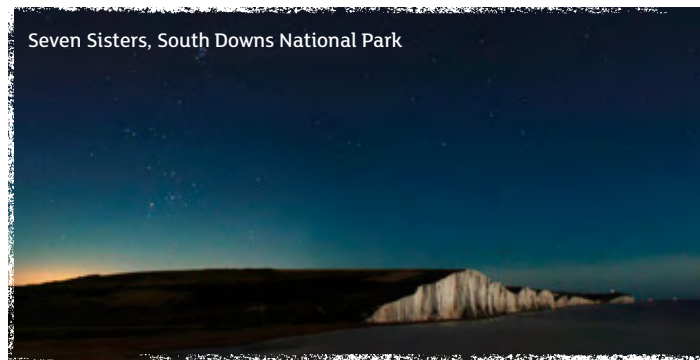
Figure 12. England's darkest skies and designated landscapes



²⁴ Find out more about Dark Sky designations: <http://darksky.org/idsp/>

²⁵ Northumberland is also the most tranquil county according to CPRE.

²⁶ The policy can be viewed in Exmoor National Park's 2014-15 report to the International Dark-Sky Association: http://www.exmoor-nationalpark.gov.uk/_data/assets/pdf_file/0004/638500/IDSA-Dark-Sky-Places-Annual-Report-October-2014-2015.pdf



The third darkest National Park is the Yorkshire Dales, which has 79% night skies falling in the darkest category. There is little light pollution within the park and the area has two Dark Sky Discovery sites²⁷: designated as such because they provide the best places for stargazing, being away from the worst of any local light pollution, providing good sightlines of the sky and have good public access.

The South Downs National Park was awarded Dark Sky Reserve status in May 2016; our maps show the Park has 14% pristine night skies, with 57%, the majority, in the next darkest category. There is little severe light pollution, making the area unusual in the highly populated South East. Gaining Dark Sky status will help protect these remarkably dark skies in the long term.

There are 34 Areas of Outstanding Natural Beauty in England which protect 26% of our darkest skies. Planning policies and decisions are taken by the various local authorities within the AONB area, although several AONBs are running projects to help protect and promote the value of dark skies. For example, there are many Dark Sky Discovery sites in AONBs and some are working towards International Dark Sky status. The Isles of Scilly AONB is the darkest, as it was when considered as a district. The next darkest AONB is the North Pennines with 86% pristine night skies and very little light pollution; Shropshire Hills AONB similarly has 86% of skies in this category.

On average, Cannock Chase AONB is the brightest, although 47% falls in the third darkest category and there is no severe light pollution; the majority of the light spills out from the towns of Cannock, Rugeley and Stafford into the AONB. This shows that the AONB is an oasis of darkness for people to enjoy compared to the surrounding towns. The Chichester Harbour AONB is the next but one brightest, with 53% in the third darkest category and light pollution from



surrounding towns. There is also a high level of light pollution spilling up into the night sky and surrounding landscape by Madestein UK, a greenhouse complex. The Suffolk Coast and Heaths AONB has the brightest pixels in all of the AONBs, associated with RAF Woodbridge and Felixstowe port on the edge of the AONB, both severe sources of light pollution that have a significant effect on the AONB. Despite this, the AONB has 33% of its night skies in the darkest category.

National Parks and AONBs have a vital role in the protection of dark landscapes and the skies above them, yet 47% of England's darkest skies are outside protected areas and may not be covered by local planning policies to protect against light pollution. There are large swathes of the very darkest skies outside these designated areas in Devon, heading into East Cornwall and in Herefordshire. CPRE Herefordshire wants to see a large area of the county designated as a 'Marches AONB'; such a designation should help protect much of the dark skies in the county. There is also a significant area of unprotected dark skies to the south of the North York Moors National Park, an area that the local CPRE group would like to see designated as a Yorkshire Wolds AONB.

National Character Areas – light and landscape character

Darkness at night or the presence of light pollution will affect the character of a landscape, whether urban or rural, and also affect people's experience of a landscape. The variety of landscapes in England is reflected in the 159 National Character Areas (NCAs) identified by Natural England. The NCA profiles²⁸ have been updated to describe in detail the special characteristics of an area, including key facts and data, and summarise opportunities for the future management of an area. The NCA profiles provide valuable contextual evidence, including the growing body of data on light pollution and references to dark skies that need to be protected. For example, the Cheviots NCA in Northumberland notes that a key characteristic of the area is its tranquillity: 'Wild, open moorlands, few settlements or roads and dark night skies are responsible for this NCA being perceived as one of the most undisturbed areas in England.'

To complement the NCA profiles, we have created detailed maps for each NCA, to help identify opportunities to reduce light pollution and protect dark skies at a larger scale. As may be expected, the darkest and brightest NCAs coincide with the darkest counties, National Parks and AONBs. Detailed information about the darkest and brightest NCAs can be found in the LUC report, which is available from: nightblight.cpre.org.uk.

²⁷ Find out more about the Dark Sky Discovery project: <http://www.darkskydiscovery.org.uk/>

²⁸ View the NCA profiles: <https://www.gov.uk/government/publications/national-character-area-profiles-data-for-local-decision-making>

Conclusion

Our new maps provide a detailed picture of how light pollution is dispersed around the country. The mapping identifies our darkest skies – the places that need to be protected for the benefit of current and future generations.

The satellite data was captured at 1.30 am – illustrating how much wasted money and energy is burning up into the night sky when most people are asleep.

It is vital that local authorities adopt policies to control light pollution. Our evidence suggests that few are implementing national planning guidance – but where they do it is effective and that where they have invested in new lighting technology this has reduced the amount of light spilling up into the night sky.^{29 30} The darkest counties have all made changes to street lighting in their areas, resulting in less upward light pollution. Government must do more to ensure that local authorities are doing all they can to control light pollution.

Despite recent efforts to improve lighting on motorways and trunk roads, there is still action needed by Highways

England to reduce the amount of light pollution that is evident around its network. The technology is available to have well designed lighting where and when it is needed, which will save Highways England money, reduce energy consumption and reduce light pollution too.

England's National Parks and AONBs are the guardians of 53% of the darkest skies we have, and their continued vigilance will help protect our darkest places for years to come. Yet CPRE is concerned that there are few long-term safeguards to protect the remaining 47% of our pristine night skies from new sources of light pollution. This is where local authorities have a vital role to play in developing and implementing policies to protect existing dark skies.

Based on the findings of this research and mapping, CPRE makes the following recommendations for action:

Recommendations

Government

- should **ensure that local authorities are implementing Government policy to control light pollution**, as set out in the National Planning Policy Framework and associated guidance. In the absence of resources for the relevant departments (Defra and DCLG³¹) to pursue rigorous monitoring, we call on Ministers to issue a clear statement that local authorities should take action to control light pollution and protect dark skies in their areas.

Local authorities

- should **develop policies to control light pollution in local plans which will ensure that existing dark skies are protected, and that new developments do not increase local light pollution**.³² Our maps can be used as evidence to inform decisions on local planning applications.
- local highway authorities should **identify areas with severe light pollution and target action to reduce it**, such as investing in dimming technology, running part-night

lighting schemes (in consultation with the local community) or replacing street lighting with less light polluting types. Our maps can also be used to identify existing dark skies that need to be protected and enhanced, such as the large tracts of dark skies in Herefordshire, Devon and Yorkshire.

- local highway authorities should **develop a Street Lighting Policy**, which could include Environmental Lighting Zones to ensure that appropriate lighting is used in each area.

Highways England

- should **use the maps to identify sections of motorways and trunk roads that need urgent attention to reduce light pollution**. Any new lighting should be well designed and be the minimum required to meet its purpose.
- should use the opportunity of the review of the Design Manual for Roads and Bridges to **specify ambitious performance-based standards for lighting** that minimise light pollution.

(Continued over)

²⁹ CPRE (2014) *Shedding Light: a survey of local authority approaches to lighting in England* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/3608-shedding-light>

³⁰ There is often controversy about the use of LED lighting and we urge councils to give careful consideration to the type they use, due to the potential effects of higher temperature blue rich lighting on people and wildlife. Read more in the International Dark-Sky Association guidance: <http://darksky.org/lighting/led-practical-guide/>

³¹ Department for Environment, Food and Rural Affairs and Department for Communities and Local Government.

³² Examples of effective policies can be found in CPRE (2014) *Shedding Light: a survey of local authority approaches to lighting in England* <http://www.cpre.org.uk/resources/countryside/dark-skies/item/3608-shedding-light>

Recommendations

(continued)

National Park Authorities and Areas of Outstanding Natural Beauty

- should continue exemplary work to curb light pollution in their areas, including by having **strong policies in Management Plans and local plans to control light pollution**;
- should **use the maps as evidence to support applications for Dark Sky place status and to inform National Park Authority decisions about planning applications, and in the AONBs to inform responses to applications**. The maps can also be used by local authorities to develop effective policies to control light pollution both within National Parks and AONBs and in areas around them.

Landscape specialists

- should **use the maps to inform Environmental Impact Assessments**, as a baseline to measure the potential impact of new developments and land use. The maps could help inform appropriate mitigation, for example as part of the Landscape and Visual Impact Assessment. They could also be used to inform landscape and seascape character assessments.
- the maps could also be **used in settings studies** where the experience of an asset is dependent on the quality of its surrounding dark night skies. The maps can provide evidence to support this and to show how change/development may affect this experience.

Businesses and large facility owners

- should **review their existing lighting and ensure new developments have well designed lighting schemes that do not cause light pollution**. Dimming and switching off lights would also save money. Larger facilities that create light pollution can be identified on the maps.

Developers

- should **ensure new developments have well designed lighting schemes** that do not cause light pollution.

Parish councils and community groups

- can **use the maps as evidence to inform neighbourhood plans and to shape local decisions about lighting**, such as street lights owned by parish councils.

Schools

- can **use the maps as an educational resource to teach students about light pollution and the value of dark skies**; a lesson plan is available from CPRE for Key Stage 1 and 2 children.

If you are concerned about local light pollution

- you can look up your local area on our interactive map and use this as evidence to help you shape future developments in your area, so that they either have well-designed lighting schemes or are refused permission if they would cause light pollution in existing dark places.
- you can also use the maps to lobby your local council about light pollution, for example if a particular light source is a problem, and raise the issue with your local MP.
- the maps will also help you find your nearest dark skies, to escape from nearby light pollution and experience a truly dark starry night sky!



Supporters

CPRE has worked with several organisations on this project; it would not have been possible without their support.



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CPRE fights for a better future for England's unique, essential and precious countryside. From giving parish councils expert advice on planning issues to influencing national and European policies, we work to protect and enhance the countryside.

Our objectives

We campaign for a sustainable future for the English countryside, a vital but undervalued environmental, economic and social asset to the nation. We highlight threats and promote positive solutions. Our in-depth research supports active campaigning, and we seek to influence public opinion and decision-makers at every level.

Our values

- We believe that a beautiful, tranquil, diverse and productive countryside is fundamental to people's quality of life, wherever they live
- We believe the countryside should be valued for its own sake
- We believe the planning system should protect and enhance the countryside in the public interest



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