

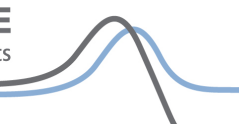
BNSTL02: Street & Traffic Lighting Government Standards Evidence Base 2009: Reference Scenario

Version 1.1

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis forms part of the Evidence Base created by Defra's Market Transformation Programme.

1 Introduction

- The Reference Scenario is a projection of what is likely to happen to energy consumption of each product if no new policies are implemented. All agreed and formally signed-off policies are included in the Reference Scenario.
- [Note that in this round of Government Standards, any ErP measures which were passed at Regulatory Committee in 2008 are included in the Reference scenario, although at the time of writing not all of these measures had been published in the Official Journal of the European Union].
- This GSBN covers lamps, ballasts and luminaires used for street & traffic lighting.
- Street lighting refers to all public street lighting and signage. Lamps used for street lighting are CFLs (for signage), High-Pressure Mercury, Metal Halide, High-Pressure Sodium (HPS) and Low-Pressure Sodium (LPS).
- Traffic lighting refers to traffic signals. General Lighting Service (GLS) – mostly tungsten halogen - and Light Emitting Diodes (LEDs) lamps are used for traffic signals.



2 Scenario outputs

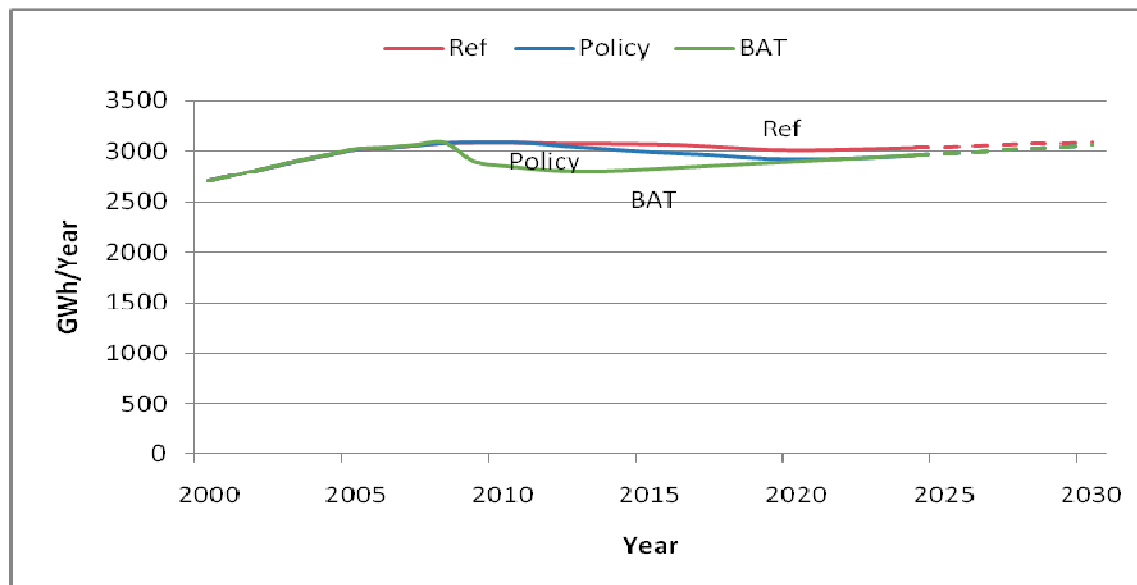


Figure 1: Street & Traffic lighting energy consumption, 3 scenarios

Table 1 Summary energy¹ and CO₂² data (Street Lighting)

Energy Consumption (GWh)	2009	2020	2030
CFL	60	60	70
High pressure mercury	20	0	0
Metal Halide	110	380	640
High pressure sodium	1840	2070	2240
Low pressure sodium	860	470	110
TOTAL	2890	2980	3060

¹ E

Energy consumption figures for the non-domestic sector in the 'Product policy analysis and projections 2010' document were scaled down to match DECC projections for overall energy demand (www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx).

MTP data represents the best currently available information based on a bottom-up modelling approach. MTP's data is the basis for detailed energy calculations in the 'Product policy analysis and projections 2010'. However, DECC projections indicate that overall energy demand in the non-domestic sector is lower than projected by MTP's detailed models. MTP has assumed that the differences between the DECC overall projections and its detailed bottom-up projections are due to incomplete data on the following inputs for some of its non-domestic products:

- existing product stock;
- existing product efficiency;
- product usage.

The energy consumption figures in these GSBNs have **not** been scaled down, in order to enable constructive stakeholder comment on the MTP input data, and therefore differ from the ones presented in 'Product policy analysis and projections 2010'.

² For CO₂ factors, please see MTP Briefing Note BNXS01 [Carbon Dioxide Emission Factors for UK Energy Use](#)

Version: 1.1

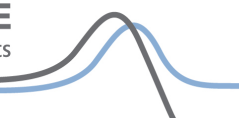
First created: 08/07/09

Updated: 21/06/10

Last reviewed: 21/06/10

MARKET TRANSFORMATION PROGRAMME

Developing evidence for Government and business on energy using products



CO ₂ Emissions (MtCO ₂)			
CFL	0.02	0.03	0.03
High pressure mercury	0.01	0.00	0.00
Metal Halide	0.05	0.17	0.28
High pressure sodium	0.79	0.89	0.96
Low pressure sodium	0.37	0.20	0.05
TOTAL	1.24	1.28	1.32

Table 2 Summary energy and CO₂ data (Traffic Lighting)

Energy Consumption (GWh)	2009	2020	2030
GLS	180	0	0
LED	20	30	30
TOTAL	200	30	30
CO ₂ Emissions (MtCO ₂)			
GLS	0.08	0.00	0.00
LED	0.01	0.01	0.01
TOTAL	0.09	0.01	0.01

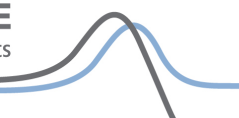
3 Current policy & measures

Table 3 Current policies & measures, Reference Scenario

Policy name	Period in force	Description	Impact
Energy Using Products (ErP) Directive on Tertiary Lighting	2009-2017	Agreed in 2008 and in force from March 2009. In March 2012 the least efficient high pressure sodium and metal halide lamps of low colour rendering are removed from the market, and luminaire requirements are established. In March 2015, high-pressure mercury lamps are removed from the market. In March 2017 the majority of metal halide lamps will have to reach efficacies equivalent to current ceramic versions.	100% of high-pressure mercury lamps sold become high-pressure sodium lamps by 2015. 100% of HPS standard lamps sold become HPS 'plus' lamps by 2012. 100% of metal halide lamps sold become equivalent in efficacy to ceramic metal halide lamps by 2017. These are assumed to be 12% more efficient than standard versions.
Highways Agency Sustainable Development	2009 onwards	The Highways Agency (HA) are responsible for 5% of street lighting and are currently	Relating to HA stock only: 20% of HPS lamps are removed by

MARKET TRANSFORMATION PROGRAMME

Developing evidence for Government and business on energy using products



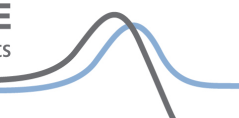
Policy name	Period in force	Description	Impact
Policy		conducting a cost-benefit analysis on their stock. Lamps are due to be removed when the CBA does not support replacing old schemes.	2013. 20% of LPS lamps are removed by 2013. 100% of new HPS installations are comprised of the 12% more efficient HPS 'plus' type of lamp going forward. 50% of lamps are dimmed to 50% of their light output for half the lit time.
County Surveyors' Society (CSS) 'Invest to Save' Guidance	2009 onwards	This guidance discusses the removal of street lighting and investment in dimming technologies by Local Authorities. Modest savings have been ascribed.	30% of the higher efficacy lighting is dimmed to 50% of their light output for half the lit time. This equates to a 4.5% energy saving. This saving is applied to new installations from 2009.
Policies contributing towards trends in the Reference scenario			
<ul style="list-style-type: none"> - Highways Agency specification for the design of street lighting - LIGHTCO₂RE calculator 		The impacts of these measures have not been quantified in the Reference Scenario, though it is understood that they are likely to contribute to the observed energy consumption pattern.	

3.1 Policy timeline

- The following policy timeline identifies when policies come into effect, including future revisions that are formally signed off:

Policy name	Current specific ation in force	2009	2010	2011	2012	2013	2014	2015	2017	2018-2020
Energy Using Products (ErP) Directive on Tertiary Lighting	2009	Comes into force	Stage 1 requirements in force		Stage 2 requirements in force (excluding Table 9 ³) ⁴			Stage 2 Table 9 requirements in place	Stage 3 requirements in place	
Highways	2009	Measure adopted								

³ P.21, Implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council



Policy name	Current specific ation in force	2009	2010	2011	2012	2013	2014	2015	2017	2018-2020
Agency Sustainable Development Policy										
CSS 'Invest to Save' Guidance	2009	Recommended guidance								

4 Efficiency

4.1 Summary

- The base efficiency metric used in the Government standards is lamp luminous efficacy measured in lumens per watt. This is a measure of the amount of light emitted by the lamp (in lumens) for the amount of electrical power consumed (rated wattage in watts). The sales-weighted average efficacy of the total new lamp sales is presented.
- For simplicity the efficiency of the ballast (lamp control gear) is not accounted for in this metric although it has been fully accounted for in the model as a whole.
- The efficiency metrics quoted below correspond to values that are relevant to the average wattage of each lamp type. Lamp efficiency is dependant on wattage, so efficiency of lamps of lower than average wattage will be lower than the figures quoted, and for lamps of higher than average wattage, efficiency will be higher.
- The highest efficiency category for street lighting (>130 lm/w) represents low-pressure sodium lighting which is being replaced on grounds other than simple lamp efficacy e.g. aesthetic preferences and security considerations.

Table 4 Street Lighting Efficiency Metrics

	Lumens/Watt					
	Average	CFL	High Pressure Mercury	Metal Halide	High Pressure Sodium	Low Pressure Sodium
2007	105.2	80.9	49.0	70.0	92.8	140.0
2010	102.3	80.9	49.0	72.6	93.2	140.0
2020	98.5	80.9	49.0	95.6	95.9	140.0
2030	93.1	80.9	49.0	95.6	97.9	140.0

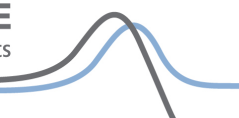


Table 5 Average efficiency metric based on distribution of sales

	Percentage of sales in each classification (Street Lighting)					
	Average lumens/watt	≤60 lm/w	60 < lm/w ≤75	75 < lm/w ≤100	100 < lm/w ≤130	>130 lm/w:
2009	103.5	0.4%	10%	56%	0%	33%
2010	102.3	0.3%	12%	56%	1%	31%
2011	101.3	0.2%	13%	57%	1%	29%
2012	100.7	0.2%	13%	56%	3%	28%
2013	100.0	0.2%	13%	57%	4%	26%
2014	99.3	0.2%	13%	57%	4%	25%
2015	98.6	0.2%	14%	58%	5%	23%
2016	98.0	0.2%	14%	59%	5%	21%
2017	100.3	0.2%	2%	72%	6%	20%
2018	99.7	0.2%	2%	73%	6%	18%
2019	99.1	0.2%	2%	74%	7%	17%
2020	98.5	0.2%	2%	75%	7%	15%
2021	97.9	0.2%	2%	76%	8%	14%
2022	97.3	0.2%	2%	77%	8%	12%
2023	96.7	0.2%	2%	78%	8%	11%
2024	96.2	0.2%	2%	79%	9%	10%
2025	95.6	0.2%	2%	80%	9%	8%
2026	95.1	0.2%	2%	81%	10%	7%
2027	94.6	0.2%	2%	82%	10%	5%
2028	94.1	0.2%	2%	83%	11%	4%
2029	93.5	0.2%	2%	84%	11%	3%
2030	93.1	0.2%	2%	85%	11%	2%

MARKET TRANSFORMATION PROGRAMME

Developing evidence for Government and business on energy using products

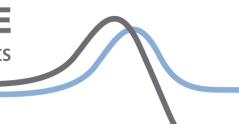
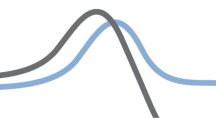


Table 6 Traffic Lighting Efficiency Metrics

	Lumens/Watt		
	Average	GLS	LED
2007	18.5	18.1	48.0
2010	28.6	18.1	97.0
2020	162.0	18.1	162.0
2030	162.0	NA	162.0

Table 7 Average efficiency metric based on distribution of sales

	Percentage of sales in each classification (Traffic Lighting)			
	Average lumens/watt	≤50 lm/w	100 < lm/w ≤130	>130 lm/w:
2009	24.7	89%	11%	0%
2010	28.6	87%	13%	0%
2011	35.1	81%	0%	19%
2012	38.9	78%	0%	22%
2013	38.6	80%	0%	20%
2014	44.2	77%	0%	23%
2015	52.3	72%	0%	28%
2016	64.2	64%	0%	36%
2017	81.7	53%	0%	47%
2018	105.8	39%	0%	61%
2019	138.6	16%	0%	84%
2020	-			
2030	162.0	0%	0%	100%



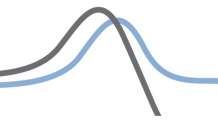
4.2 Data sources – efficiency

Table 8 Efficiency data sources (Street Lighting)

Year	Lamp Type	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
1960-2030	All	Various manufacturers catalogues	Various years	Various. e.g. Philips, SLI-Sylvania (Thorn), GE, Osram	Lumen and rated wattage values are published for each lamp type. These are used to produce efficiency data from stock and average wattage data.	High confidence in efficiency data. Lower confidence in exact product mix year on year.
1960-2001	All	ASLEC Survey, 2001	2001	Association of Street Lighting Electrical contractors	Lamp wattage spread given in survey. Survey results covered about one third of all street lighting installations in UK.	High
2002-2009	All	Expert judgment	2001	MTP Technical Expert	Lamp efficacy and wattage mix remains unchanged until affected by ErP Tertiary measure. There	Low – no evidence for sales of more efficient lamps

MARKET TRANSFORMATION PROGRAMME

Developing evidence for Government and business on energy using products



Year	Lamp Type	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
					is no available evidence to justify a change.	
2010 - 2017	HPS, metal halide	ErP Implementing Measure for Tertiary Lighting	2009	European Commission	Lamp efficacies change as per timetable given above.	High – exact timing for each lamp uncertain but end result confidence is high
2006-2030	HPS in new installations	Expert judgment	2005	MTP Technical Expert	Discussion with scheme designers suggested that HPS installations replacing LPS ones could have same average wattage.	Low – based on private communications
2006-2030	Metal halide	Expert judgment and PD CEN/TR 13201-1:2004 'Road lighting: selection of lighting classes'.	2005	MTP Technical Expert	Report suggests that white light schemes can be one class lower lux level so 58W average watts LPS are replaced with 56.4W ceramic metal halide lamps.	Low – actual practice adopted by lighting designers not known

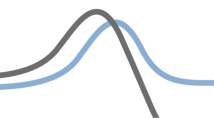
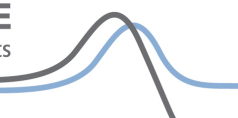


Table 9 Efficiency data sources (Traffic Lighting)

Year	Lamp Type	Reference	Reference date	Author	Justification	Confidence in sources (High/Low)
1960-2001	GLS	ASLEC Survey, 2001	2001	Association of Street Lighting Electrical contractors	Lamp wattage spread given in survey. Survey results covered about one third of all street lighting installations in UK.	High
2002-2020	GLS	Technical expert opinion	2001	MTP Technical Expert	Lamp efficacy and wattage mix remains unchanged. No available evidence to justify a change.	Low – no evidence for sales of more efficient lamps
2004-2030	LED	Expert assumption and SSL DOE Roadmap projections of LED efficiency	2008	Navigant Consulting et al for USDOE	Efficiency assumption is best available estimate based on numerous experts in field. Equivalent wattage based on replacing current GLS (halogen lamps) with LED.	Low - this is a rapidly evolving technology and estimates of efficiency improvements change frequently



4.3 Methodology & key assumptions – efficiency

4.3.1 Historic data

Table 10 Interpolation & background calculations – efficiency

Year	Lamp Type	Methodology & assumptions
1960 - 2008	All	Efficiency of all historic lamp types assumed to be the same as that seen in Aslec survey 2001.
2005-2008	High Pressure Sodium	Expert judgment that same average wattage can be applied to new high-pressure sodium schemes replacing low pressure sodium is based on the fact that although HPS lamps are ~ 30% less efficient, the luminaires that use them can be much more optically efficient than LPS ones, allowing no increase in wattage for 'standard' version. HPS 'Plus' version is 12% lower wattage.
2005-2008	Metal Halide	Expert judgment on metal halide lamps replacing LPS: Average lumen output of LPS lamp is 5280 Lm. PD CEN/TR 13201-1:2004 allows approximately 33% reduction in lumens with white light or ~3500 Lm. 45W 'cosmo white' gives 4300 lumen and is lowest wattage 'white' light available so wattage of this lamp used for 'ceramic' version; 'standard' version is assumed to be 12% higher wattage.

4.3.2 Future analysis

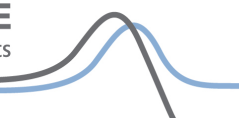
Table 11 Extrapolation & background calculations – efficiency

Year	Lamp Type	Methodology & assumptions
2009-2030	All	Same efficiency assumed until ErP forces a change.
2010-2020	High Pressure Sodium	It has been assumed that all HPS lamps sold will be 'plus' types from 2010 but only new installations will benefit from efficiency savings; old installations will have more light but same wattage. 3% per annum switch to 'plus' lamp savings assumed for old HPS stock; all new HPS replacing LPS can be 'plus' from 2010. Note: some new installations may have used 'plus' lamps between 2000 and 2010 but no assumptions surrounding this have been made due to lack of reliable information.
2009-2017	Metal Halide	It has been assumed that all metal halide lamps sold will be of equivalent efficacy to 'ceramic' types from 2017 onwards and that the benefits of these lamps will encourage 5% per annum of installations to switch to the higher efficacy lamps between 2009 and 2016.

4.4 Data issues – efficiency

Table 12 Data issues – efficiency

Issue/risk	Approach taken/rationale
Some lamps may have been higher efficacy versions, for example high pressure sodium 'plus' types, prior to ErP intervention, but the benefit has not been modelled.	MTP has no information on the relative sales of standard and 'enhanced' versions of the lamps and has no evidence on which to base any split.
Evidence for the number of metal halide installations is small.	Growth of this new category is based on a very small survey of local authorities so there is low confidence



in the data.

4.5 Confidence level – efficiency

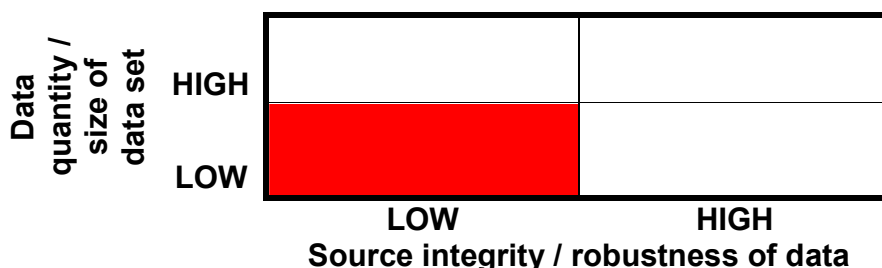


Figure 2 Confidence indicator for efficiency data

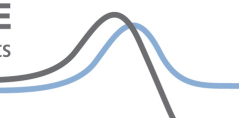
- Product mix and average wattage which determine the efficiency of the overall stock are based on one large survey and one very small supplementary survey. No assumptions have been made about more efficient scheme designs beyond those mentioned in Table 6 above.

5 Other issues

- Some historic lighting schemes may have been giving lighting levels significantly below those recommended in PD CEN/TR 13201-1:2004 'Road lighting: selection of lighting classes'. Such schemes may require a higher average wattage than used previously but it has been assumed that such schemes will be balanced out by schemes in which efficiency savings can be made through better design.

Related MTP information

- Briefing Note BNCL12: Light-emitting Diodes - Innovation Briefing Note
- BNSTL01: Street & Traffic Lighting Government Standards Evidence Base 2009: Key Inputs
- BNSTL03: Street & Traffic Lighting Government Standards Evidence Base 2009: Policy Scenario
- BNSTL04: Street & Traffic Lighting Government Standards Evidence Base 2009: Best Available Technology Scenario
- BNSTL KO01: Street & Traffic Lighting Government Standards Evidence Base 2009: Key Outputs



Changes from Version 1.0

- Reformatting of data in Tables 1 and 2
- Reference to 2009 consultation document replaced with final document 'Product policy analysis and projections 2010'.
- Minor changes to GSN template.

Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email info@mtprog.com quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

For further information on related issues visit <http://efficient-products.defra.gov.uk>