

Fast Learning Curves – LED Lighting’s Rapid Reduction in Price

Michael Scholand, CLASP Europe

August 2016

LED light bulbs originally entered lighting markets around the world at high prices about 5 to 6 years ago, but like all solid-state technologies, they have experienced a very significant reduction in price. This pressure on prices is undoubtedly a source of concern for lighting manufacturers, but it is also a tremendous opportunity for consumers and businesses alike, fuelling rapid market uptake derived from shorter payback periods and improved affordability. This memo explores a few publicly available price forecasts and then drills down on specific directional LED lamp pricing in five large European countries.

In order to get a feel for the LED price trends in the market, we looked at three publicly available sources of information on LED pricing – all of which showed a downward trend over the last six years. These trends are all based on an LED equivalent bulb to a 60W incandescent lamp (approximately 800 lumens of light), and we kept the pricing in nominal values (i.e., not adjusting for inflation). The table below provides a snapshot of these three LED lamp price trends. The LBNL and LED Insider reports are both based on on-going market research and collection of pricing information to calculate an average selling price. The US DOE report offers an estimate that was developed through an extensive industry-consultative process, and provides both historic and forecasted relative costs for LED lamps.

Table 1. Select sources of price trend information on non-directional household lamps

Title of Report / Paper	Source, Link	Estimates
“The evolving price of household LED lamps: Recent trends and historical comparisons for the US market” ¹	LBNL, 2014; Click here	2011 to 2014
Trade magazine (global), focusing on the LED business; most recent data available online ²	LED Insider; click here	2010 to 2016
“Solid-State Lighting R&D Plan, June 2016” ³	US DOE, 2016; Click here	2013 to 2020

In Figure 1, the three non-directional, 800 lumen light output lamp prices are plotted, having converted all the prices to Euros using historic currency exchange data from the European Central

¹ “The evolving price of household LED lamps: Recent trends and historical comparisons for the US market” by Brian F. Gerke, Allison T. Ngo, Andrea L. Alstone, and Kibret S. Fisseha; Energy Analysis and Environmental Impacts Department; Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720; Paper LBNL#6854E; November 2014; [click here](#)

² A trade journal that conducts market surveys and publishes some data on their results. The data shown for LED Inside, a division of Trend Force Corporation is all from the public domain on their website: [click here](#)

³ Solid-State Lighting R&D Plan, Solid-State Lighting Program, Building Technologies Office, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, DOE/EE-1418; June 2016; [click here](#)

Bank. The US DOE estimates were indexed to the global average selling price reported by LED Insider for June 2013. In general, a very steep reduction in pricing was observed between June 2011 and December 2013 by both the LBNL web research and the LED Inside market analysts. DOE's estimate between June 2013 and the last LED Inside data in June 2016 matches nearly perfectly, and then continues on to 2020. It should be noted that the LED Inside and US DOE forecasts do not incorporate promotions and subsidies that may be offered by electric utilities or other agencies, whereas the LBNL web pricing would capture that (perhaps this is the reason for the lower prices observed by LBNL).

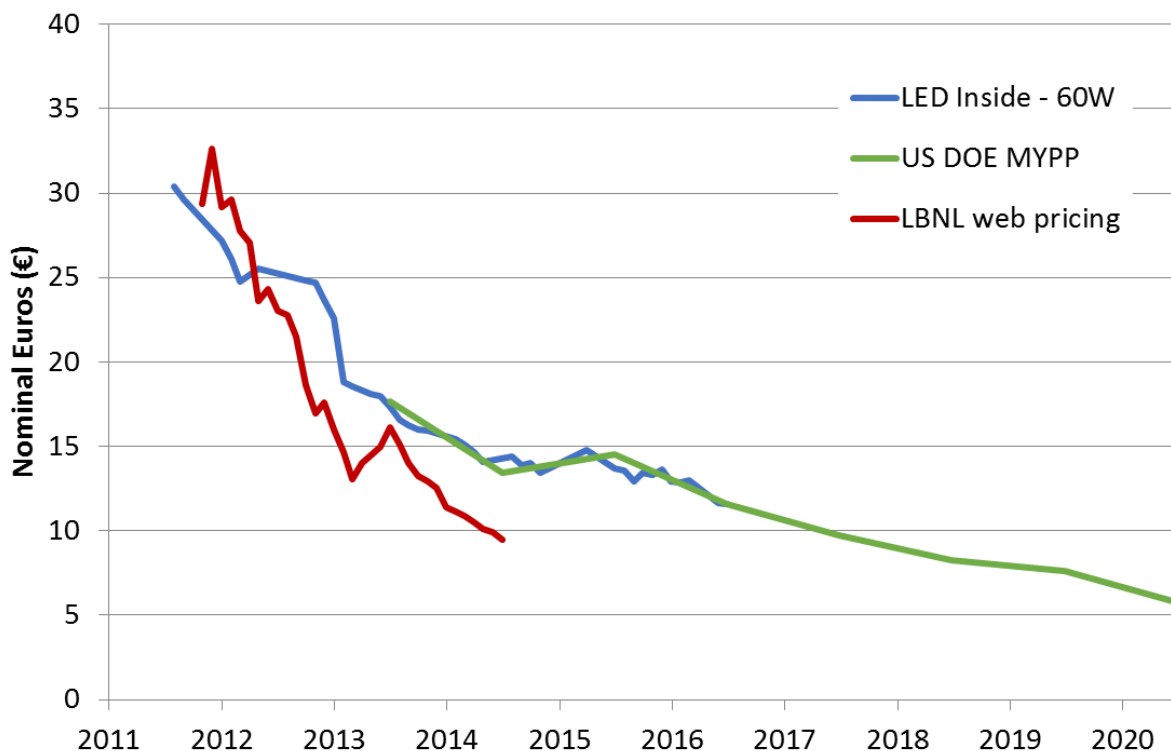


Figure 1. Combined plot of three trends for 60-Watt equivalent LED replacement lamps

CLASP then proceeded to conduct research on the European directional lamp market, by focusing on LED lamp prices at major lighting sales websites in France, German, Italy, Spain and the United Kingdom. CLASP obtained historic retail prices of mainstream directional LED bulbs sold between 2011 and 2016 and normalised the light output of these directional lamps to 250 lumens, which is approximately equivalent to a 35W halogen spot light. This normalisation ensures that the price comparison remains fair. Only models from major manufacturers, including Philips and Osram, were chosen to ensure a mainstream, quality sample of lamps. Similar to Figure 1, the prices shown were not adjusted for inflation (i.e., they are presented as 'nominal' Euros) – simply showing the prices as they were presented on the archived website pages (see Appendix for links to the pages). This website archive research found the following:

- France – a 90% decline in LED directional lamp prices over the last 6 years

- Germany – an 80% decline in LED directional lamp prices over the last 5 years
- Italy – 80% decline in LED directional lamp prices over the last 4 years
- Spain – 85% decline in LED directional lamp prices over the last 5 years
- United Kingdom – 85% decline in LED directional lamp prices over the last 6 years

In general, the trend found very significant reductions in pricing, particularly between 2011 and 2014. These trends mirrored those observed by LBNL, LED Insider and US DOE, as shown in Figures 2 through 6. Please note that this comparison is not precisely the same due to the fact that the data in Figure 1 is based on a 60-watt equivalent LED retrofit lamp and the European national data is based on a 35-watt equivalent LED retrofit spot light, however the trends were quite similar. All prices shown in these graphs are in nominal Euros, meaning they have not been adjusted for inflation.

Figure 2 shows the French directional lamp prices superimposed over the global trends for non-directional lamps, and curve-fitted with a polynomial trend line. The steepness of the French data tracks that of LBNL, although appears to be about year later. The general trend is for a steep decline between 2012 and 2015 with a gradual slowing of the trend in 2015 and 2016.

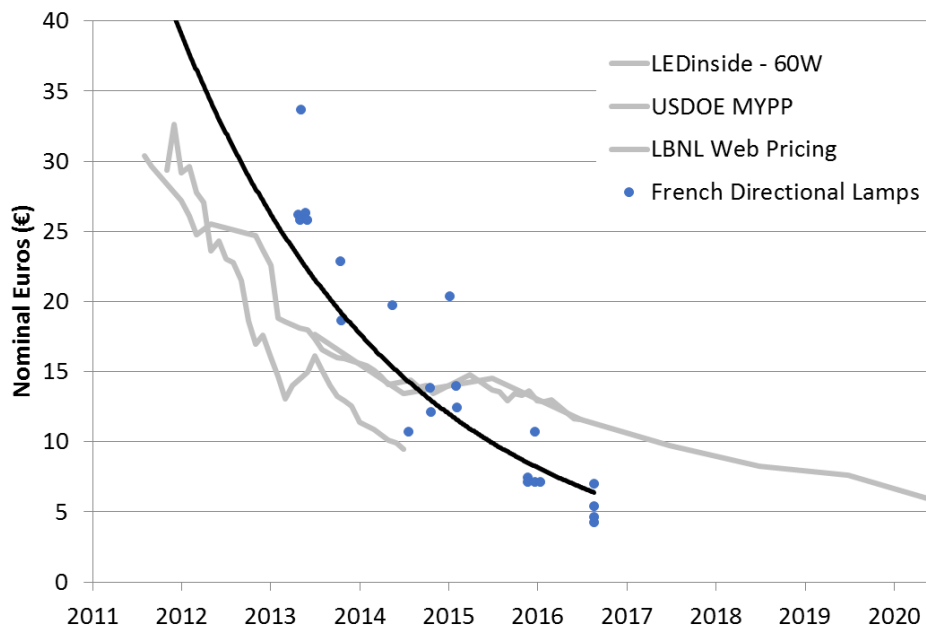


Figure 2. Nominal prices of French LED lamp prices compared with the global trend

Figure 3 shows the German directional lamp prices superimposed over the global trends for non-directional lamps, and curve-fitted with a polynomial trend line. The trend in the German data appears to track the LBNL web pricing data quite closely, and flattens out, in parallel with the US DOE and LED Inside data in 2015-2016.

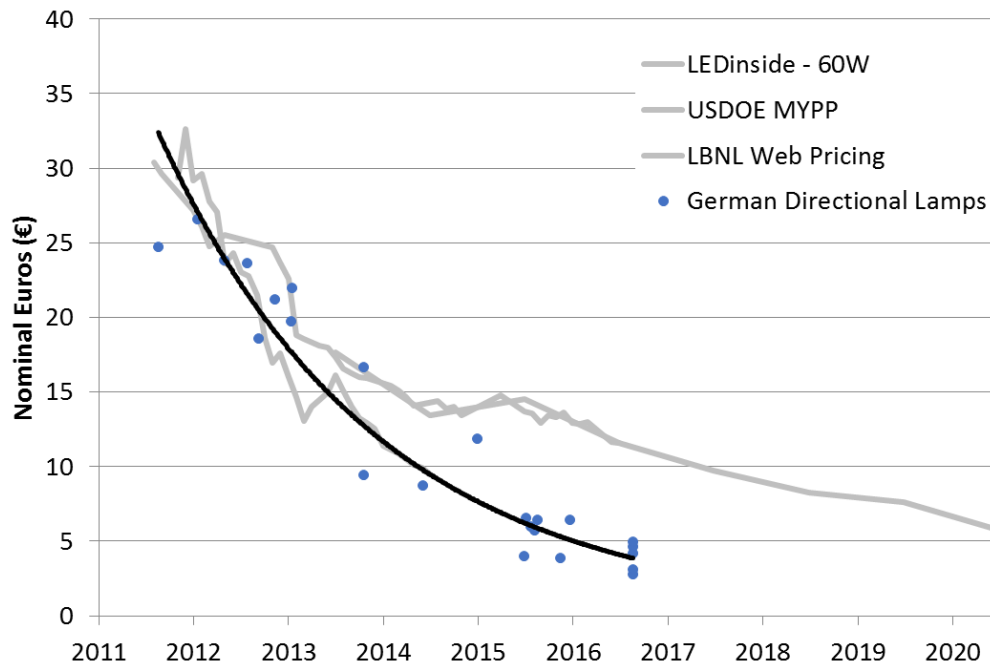


Figure 3. Nominal prices of German LED lamp prices compared with the global trend

Figure 4 shows the Italian directional lamp prices superimposed over the global trends for non-directional lamps, and curve-fitted with a polynomial trend line. The trend in the Italian data is very similar to the French and German datasets, tracking the steepness of the LBNL web pricing data closely, and then gradually flattening out (but still trending downward) in 2015-2016.

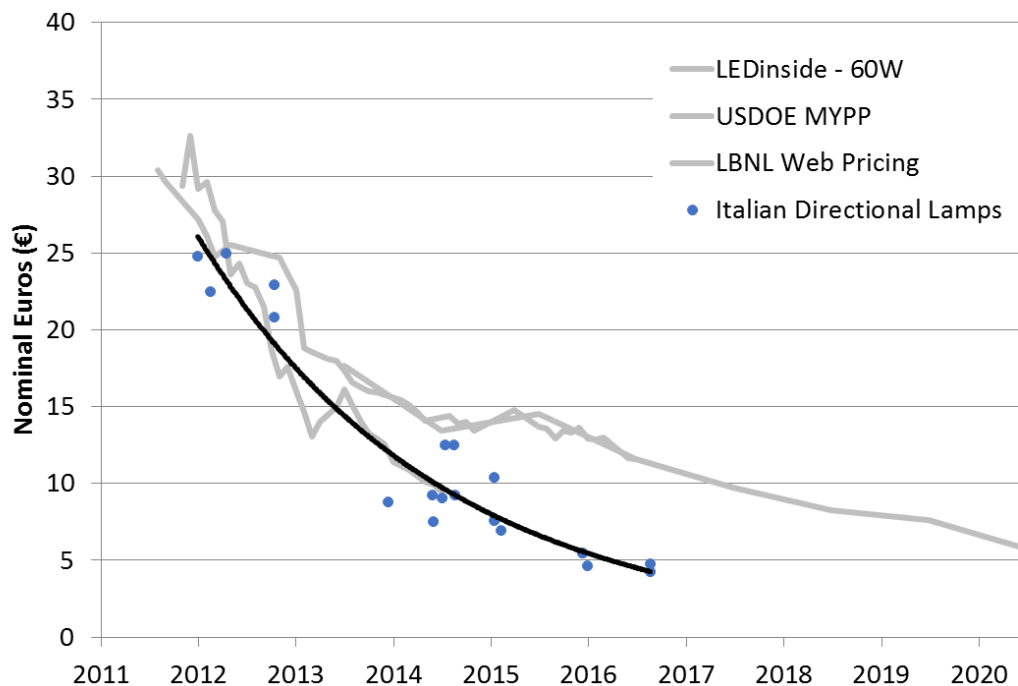


Figure 4. Nominal prices of Italian LED lamp prices compared with the global trend

Figure 5 shows the Spanish directional lamp prices superimposed over the global trends for non-directional lamps, and curve-fitted with a polynomial trend line. The trend in the Spanish data is very similar to the German, tracking the steepness of the LBNL web pricing data closely, and then gradually flattening out (but still trending steeply downward).

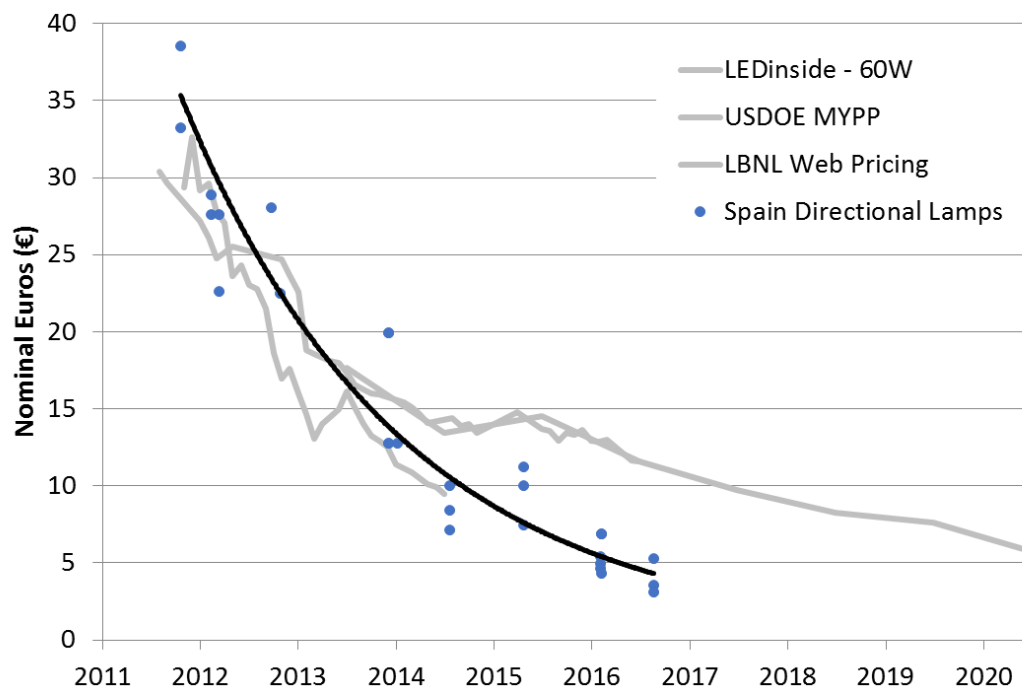


Figure 5. Nominal prices of Spanish LED lamp prices compared with the global trend

Figure 6 shows the United Kingdom directional lamp prices superimposed over the global trends for non-directional lamps, and curve-fitted with a polynomial trend line. These data were converted from Pounds Sterling to Euros using historic exchange rates published by the European Central Bank. The trend in the UK data is very similar to the other European countries, tracking the steepness of the LBNL web pricing data closely, and then gradually flattening out.

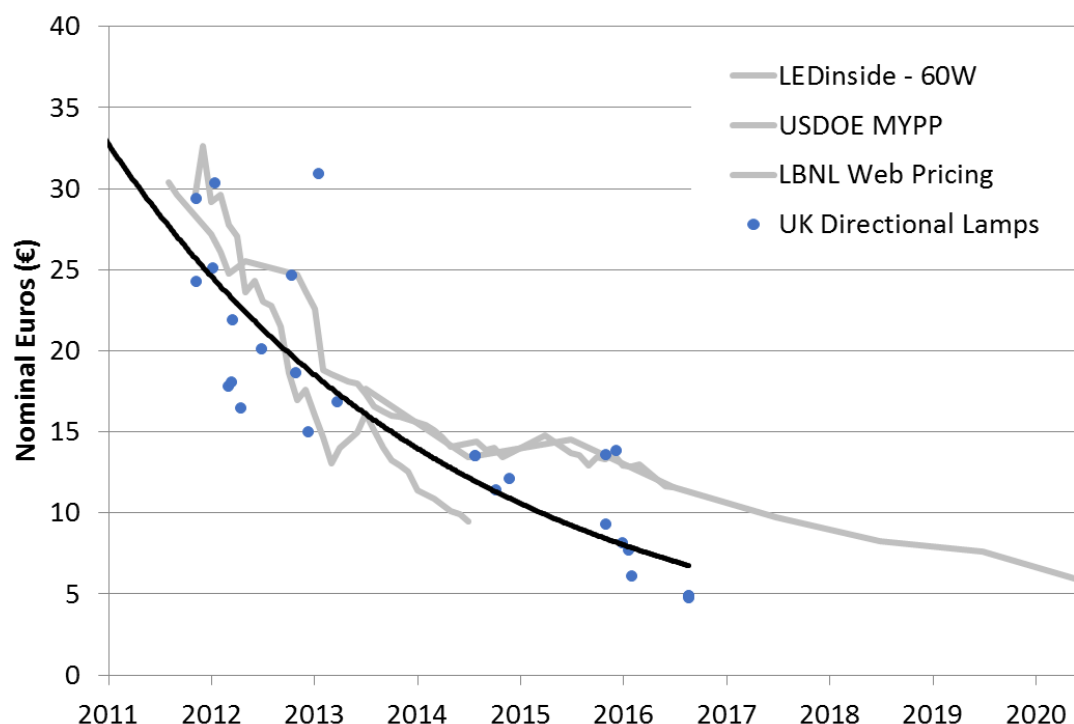


Figure 6. Nominal prices of UK LED lamp prices compared with the global trend

Overall, the European data on directional lamps is in line with the global average selling prices of non-directional lamps for the sources identified. While the price per lumen was not the same (that is, global data was based on a 60-watt equivalent non-directional lamp and the European data was 35-watt equivalent directional lamp), there tended to be good alignment on a cost basis in 2011 through 2014. The European pricing tended to track the LBNL web crawling dataset most closely, which seems reasonable as the European pricing is also a web pricing survey, although much more limited than LBNL's work. However, the European data has exhibited further downward trends that tended not to align with the LED Inside and US DOE MYPP projections in 2014-2016. Thus, it may appear consumers in Europe are being offered high quality lamps⁴ at affordable prices. Perhaps this effect is in response to the European market for directional LED lamps being accelerated by the Ecodesign regulation.

⁴ In order to ensure quality models in this assessment, the CLASP data collected for Europe only included lamps offered by Philips and OSRAM.

Attachments - Individual European Country Profiles

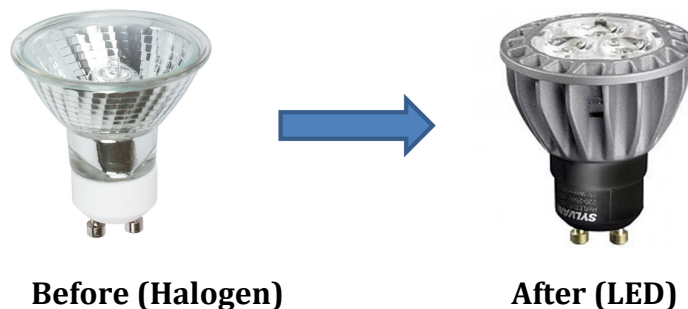
- France
- Germany
- Italy
- Spain
- United Kingdom

Spot retail price analysis found a 90% decline in LED lamp prices over the last 6 years in France

*Michael Scholand, CLASP Europe
24 August 2016*

European Policy Context

The price of directional LED lamps in France has dropped by 90% over the last six years. Consumers are experiencing payback periods of just a few months followed by years and years of savings. In 2012, an Ecodesign measure was adopted to help steer markets toward high quality, high efficiency lighting products across Europe. Now, starting on 1 September 2016, manufacturers and importers across Europe will stop placing mains-voltage (230V) directional halogen lamps (also called “spot lights”) on the European market. This measure removes the least efficient (D-class) directional lamps from the market, in favour of B-class and better options. There are no C-class directional lamps. This Ecodesign measure is yet another example of how European Union product policies can bring significant financial benefits to households across Europe.

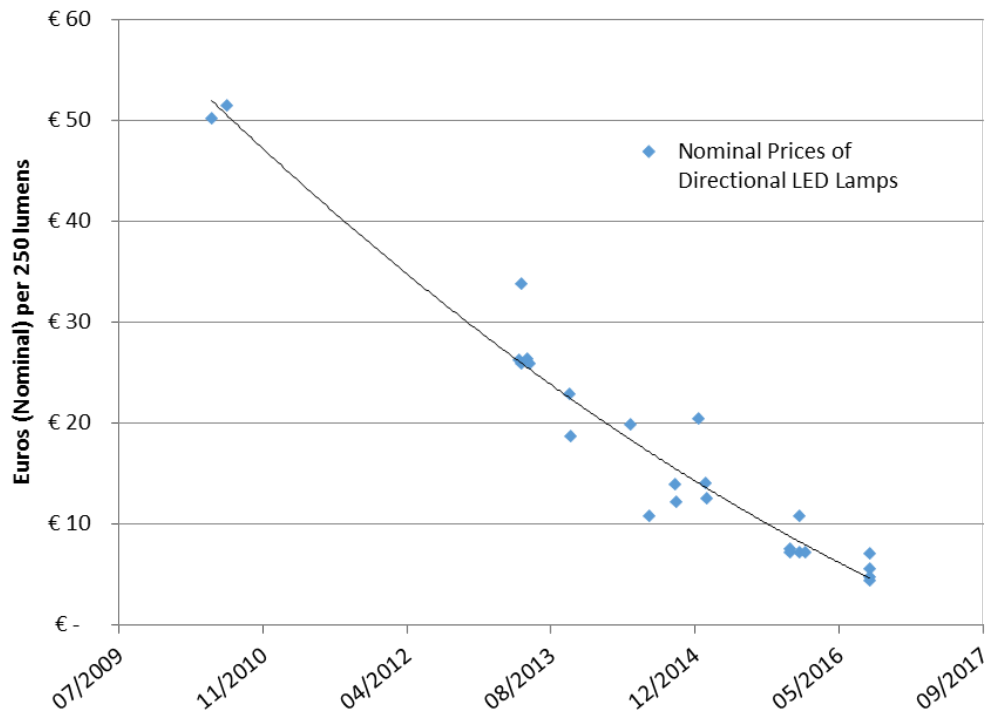


Before (Halogen)

After (LED)

LED Lamp Price Trend for France

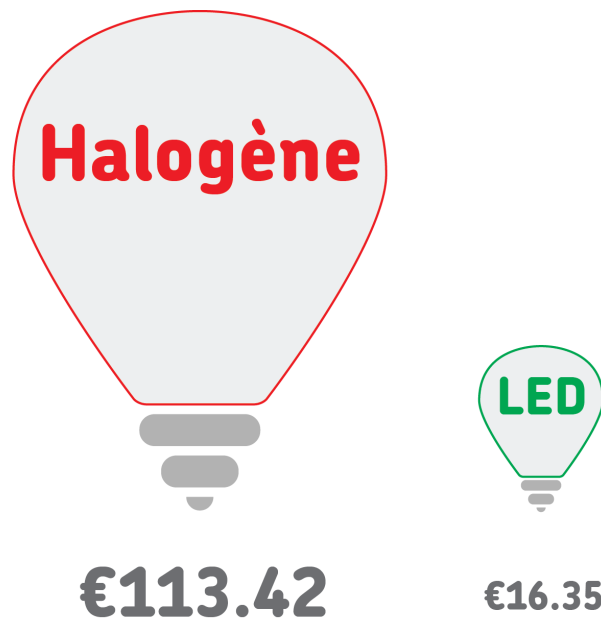
CLASP obtained historic retail prices of mainstream LED bulbs sold between 2010 and 2016 on Amazon.fr. Models changed over the analysis period, but were normalised to a fixed light output of 250 lumens, which is approximately equivalent to a 35W spot light. This normalisation ensures that the price comparison remains fair. Only models from major manufacturers, including Philips and Osram, were chosen to ensure a mainstream, quality sample of lamps. The prices shown were not adjusted for inflation (ie, they are presented as ‘nominal’ Euros) – simply showing the prices when they were listed on the Amazon.fr website (see Appendix for links to the pages). This trend shows that, on a per delivered lumen basis, these lamps went from approximately 50 Euros in 2010 to just under €5 in 2016 – that’s an 90% reduction in price in just six years.



This figure shows that, on a 'per lumen delivered' basis, these lamps went from approximately €50 in 2010 to just under €5 in 2016. That is a 90% reduction in price in just six years.

On a life-cycle basis, with the purchase and electricity running costs included, this means that French consumers today enjoy a rapid payback from switching from halogen to LED lamps. Consider the following scenario – a 50W Osram Halogen Lamp with a 2,000 hour lifetime, costing €1.50, replaced by OSRAM LED Star PAR 16 GU10 lamp, 5W LED, 15,000h lifetime and €5.99 from Amazon.fr;¹ €0.168/kWh (average residential electricity price for France). For sockets operating two hours per day, the LED will pay for itself in eight months, and then go on to operate for a further 20 years, yielding €5.52 of savings each year in electricity costs. If the LED is installed in a socket that operates four hours per day, the benefits are even greater – payback is halved to four months and annual savings double to €11.04 per year in electricity – with the lamp lasting over 10 years.

¹ [Link to the website](#) selling this lamp, accessed on 24 August 2016



Cost to buy and run bulbs in France over a ten year period

Thus, in France, LED directional lamps offer payback period of four to eight months from switching a halogen spot light, with total savings that will accrue to over €100 per lamp over the LED lamps' lifetime.²

² Total savings per lamp, discounted to 2016 Euros at a 5% discount rate, including electricity savings and replacement halogen lamps (price held constant during analysis period).

Table of lamps for the LED lamp price plot, obtained from the Web Archive

MS	Date	Retailer	Lamp	Base	Lifetime	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
FR	24/05/2010	amazon.fr	PAR16	GU10	20000	35W equiv.	5	€ 40.09	Osram - Ampoule LED PARATHOM Spot PAR 16 - 5 Watts - GU10 - Blanc Chaud - 5 Watts	http://web.archive.org/web/20100524143114/http://www.amazon.fr/Osram-Ampoule-PARATHOM-Watts-Blanc/dp/B001QTXJZM?
FR	16/07/2010	amazon.fr	PAR16	GU10	20000	35W equiv	5	€ 41.11	Osram - Ampoule LED PARATHOM Spot PAR 16 - 5 Watts - GU10 - Blanc Chaud - 5 Watts	http://web.archive.org/web/20100716103952/http://www.amazon.fr/Osram-Ampoule-PARATHOM-Watts-Blanc/dp/B001QTXJZM?
FR	23/04/2013	amazon.fr	PAR16	GU10	40000	300	6	€ 31.41	Philips 21073300 Lampe LED à Réflecteur PAR16 6 W GU10 230 V	http://web.archive.org/web/20130423003146/http://www.amazon.fr/Philips-21073300-Lampe-Réflecteur-PAR16/dp/B008A25WEY
FR	01/05/2013	amazon.fr	PAR16	GU10		50W equiv	5	€ 31.00	Philips 929000212301 Led GU10 5 W 50 W WW 36° 1PP 230V	http://web.archive.org/web/20130501132347/http://www.amazon.fr/Philips-929000212301-Led-GU10-230V/dp/B0088YVZP4
FR	04/05/2013	amazon.fr	PAR16	GU10		35W equiv.	4	€ 26.97	Philips 192343 Lampe LED à Réflecteur PAR16 827 25° Gradable GU10 4 W 230 V	http://web.archive.org/web/20130504120149/http://www.amazon.fr/Philips-192343-Lampe-Réflecteur-Gradable/dp/B007FK0HAG
FR	23/05/2013	amazon.fr	PAR16	GU10		35W equiv.	4	€ 21.07	Philips 192404 Lampe LED à Réflecteur PAR16 830 40° Gradable GU10 4 W 230 V	http://web.archive.org/web/20130523082454/http://www.amazon.fr/Philips-192404-Lampe-Réflecteur-Gradable/dp/B007FK0J36
FR	01/06/2013	amazon.fr	PAR16	GU10	25000	50W equiv	5	€ 30.96	Philips 929000212301 Led GU10 5 W 50 W WW 36° 1PP 230V	http://web.archive.org/web/20130601110952/http://www.amazon.fr/Philips-929000212301-Led-GU10-230V/dp/B0088YVZP4?
FR	16/10/2013	amazon.fr	PAR16	GU10		165	4	€ 15.09	Philips 201977 Lampe LED à Réflecteur PAR16 830 36° Non-Gradable GU10 4 W 230 V	http://web.archive.org/web/20131016123122/http://www.amazon.fr/Philips-201977-Lampe-Réflecteur-Non-Gradable/dp/B007JYZVIQ
FR	20/10/2013	amazon.fr	PAR16	GU10	25000	50W equiv	5	€ 22.36	Philips 929000212301 Led GU10 5 W 50 W WW 36° 1PP 230V	http://web.archive.org/web/20131020132357/http://www.amazon.fr/Philips-929000212301-Led-GU10-230V/dp/B0088YVZP4
FR	15/05/2014	amazon.fr	PAR16	GU10	20000	270	5	€ 21.35	Philips CorePro Spot LED GU10 5-50 Watts 2700 K	http://web.archive.org/web/20140515082940/http://www.amazon.fr/Philips-CorePro-Spot-GU10-Watts/dp/B00B1QYIG4
FR	22/07/2014	amazon.fr	PAR16	GU10	20000	270	5	€ 11.55	Philips CorePro Spot LED GU10 5-50 Watts 2700 K	http://web.archive.org/web/20140722174826/http://www.amazon.fr/Philips-CorePro-Spot-GU10-Watts/dp/B00B1QYIG4
FR	20/10/2014	amazon.fr	PAR16	GU10		45W équivalen t	4.5	€ 14.99	Philips 929000246801 Ampoule LED - Culot GU10 - 4,5 Watts consommés - Equivalence incandescence : 45W	http://web.archive.org/web/20141020221347/http://www.amazon.fr/Philips-929000246801-Ampoule-LED-incandescence/dp/B00DSFE5XW?
FR	22/10/2014	amazon.fr	PAR16	GU10		165	4	€ 8.00	Philips 201977 Lampe LED à Réflecteur PAR16 830 36° Non-Gradable GU10 4 W 230 V	http://web.archive.org/web/20141022224753/http://www.amazon.fr/Philips-201977-Lampe-Réflecteur-Non-Gradable/dp/B007JYZVIQ?
FR	08/01/2015	amazon.fr	PAR16	GU10	40000	270	5.5	€ 22.02	Philips 234047 Ampoule LED GU10 5,5W-50 [Classe énergétique A+]	http://web.archive.org/web/20150108190703/http://www.amazon.fr/Philips-234047-Ampoule-GU10-5W-50/dp/B00EO3SPCO
FR	01/02/2015	amazon.fr	PAR16	GU10		300	4.5	€ 16.80	Philips LED Reflektor GU10 4,5W (50W) warmblanc 380 lm	http://web.archive.org/web/20150201210539/http://www.amazon.fr/Philips-LED-Reflektor-GU10-warmblanc/dp/B00MXZBT2S?
FR	04/02/2015	amazon.fr	PAR16	GU10	25000	35W equiv	4.5	€ 12.46	Philips - 929000278601 Ampoule LED Spot Culot GU10 4 Watts Consommés Équivalence Incandescence : 35W [Classe énergétique A]	http://web.archive.org/web/20150204002632/http://www.amazon.fr/Philips-929000278601-Consommés-Équivalence-Incandescence/dp/B008902UM4

Continuation - 2

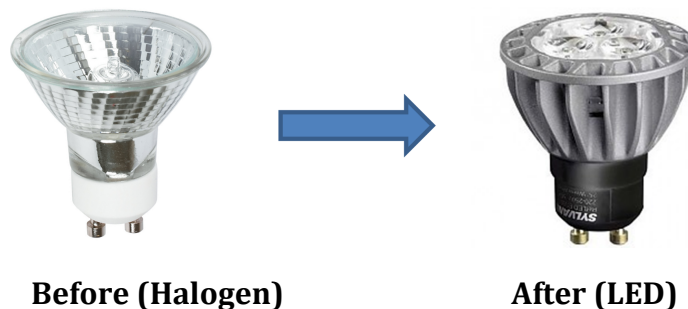
MS	Date	Retailer	Lamp	Base	Lifetime	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
FR	23/11/2015	amazon.fr	PAR16	GU10	25000	35W equiv	4.5	€ 7.49	Philips - 929000278601 Ampoule LED Spot Culot GU10 4 Watts Consommés Équivalence Incandescence : 35W [Classe énergétique A]	http://web.archive.org/web/20151123223129/http://www.amazon.fr/Philips-929000278601-Consommés-Équivalence-Incandescence/dp/B008902UM4
FR	23/11/2015	amazon.fr	PAR16	GU10	15000	50W	5.7	€ 9.99	Philips - Ampoule LED GU10 Compatible Variateur - 5,7 Watts Consommés - Équivalence Incandescence 50W [Classe énergétique a+]	http://web.archive.org/web/20151123205531/http://www.amazon.fr/Philips-Compatible-Variateur-Équivalence-Incandescence/dp/B00MB5Y1AM?
FR	24/12/2015	amazon.fr	PAR16	GU10	15000	350 lm	5.5	€ 9.99	Philips - Ampoule LED Spot - Culot GU10 - 5,5W Consommés (Équivalent 50W Incandescent) - 2700 Kelvin - Compatible Variateur [Classe énergétique A+]	http://web.archive.org/web/20151224171951/http://www.amazon.fr/Philips-Consommés-Équivalent-Incandescent-Compatible/dp/B010UQKOD6
FR	24/12/2015	amazon.fr	PAR16	GU10	15000	50W	5.7	€ 14.99	Philips - Ampoule LED GU10 Compatible Variateur - 5,7 Watts Consommés - Équivalence Incandescence 50W [Classe énergétique a+]	http://web.archive.org/web/20151123205531/http://www.amazon.fr/Philips-Compatible-Variateur-Équivalence-Incandescence/dp/B00MB5Y1AM?
FR	14/01/2016	amazon.fr	PAR16	GU10	15000	350	5.5	€ 9.99	Philips - Ampoule LED Spot - Culot GU10 - 5,5W Consommés (Équivalent 50W Incandescent) - 2700 Kelvin - Compatible Variateur [Classe énergétique A+]	http://web.archive.org/web/20160114184949/http://www.amazon.fr/Philips-Consommés-Équivalent-Incandescent-Compatible/dp/B010UQKOD6
FR	24/08/2016	amazon.fr	PAR16	GU10	15000	350	5.5	€ 7.59	Philips - Ampoule LED Spot - Culot GU10 - 5,5W Consommés (Équivalent 50W Incandescent) - 2700 Kelvin - Compatible Variateur [Classe énergétique A+]	https://www.amazon.fr/Philips-Consommés-Équivalent-Incandescent-Compatible/dp/B010UQKOD6/ref=sr_1_3?ie=UTF8&qid=1471996294&sr=8-3&keywords=LED+GU10
FR	24/08/2016	amazon.fr	PAR16	GU10	15000	250	4	€ 6.99	Philips - Ampoule LED Spot - Culot GU10 - 4W Consommés (Équivalent 35W Incandescent) - 2700 Kelvin - Compatible Variateur [Classe énergétique A+]	https://www.amazon.fr/Philips-Consommés-Équivalent-Incandescent-Compatible/dp/B010UQKA9Y/ref=pd_sim_201_1?ie=UTF8&pssc=1&refRID=Q98TSSH9YBQ3R5FC1CY9
FR	24/08/2016	amazon.fr	PAR16	GU10	15000	350	5	€ 5.99	OSRAM Ampoule LED réflecteur GU10 Star PAR16 / 5W - puissance équivalente à une Ampoule de 50 Watt Spot LED / Design verre Blanc froid - 4000K [Classe énergétique A+]	https://www.amazon.fr/OSRAM-Ampoule-réflecteur-GU10-PAR16/dp/B00KPUFCDU/ref=sr_1_2?s=lighting&ie=UTF8&qid=1471996587&sr=1-2&keywords=LED+GU10
FR	24/08/2016	amazon.fr	PAR16	GU10	15000	350	5	€ 6.49	OSRAM Ampoule LED réflecteur GU10 Star PAR16 / 5W - puissance équivalente à une Ampoule de 50 Watt Spot LED avec angle de rayonnement 120° / Blanc froid - 4000K [Classe énergétique A+]	https://www.amazon.fr/OSRAM-Ampoule-réflecteur-GU10-PAR16/dp/B00ZKHJNLO/ref=pd_sim_sbs_201_4?ie=UTF8&pssc=1&refRID=NYXZ6YTCXEVH56Z5FGOT

Spot retail price analysis found an 80% decline in LED lamp prices over the last 5 years in Germany

*Michael Scholand, CLASP Europe
24 August 2016*

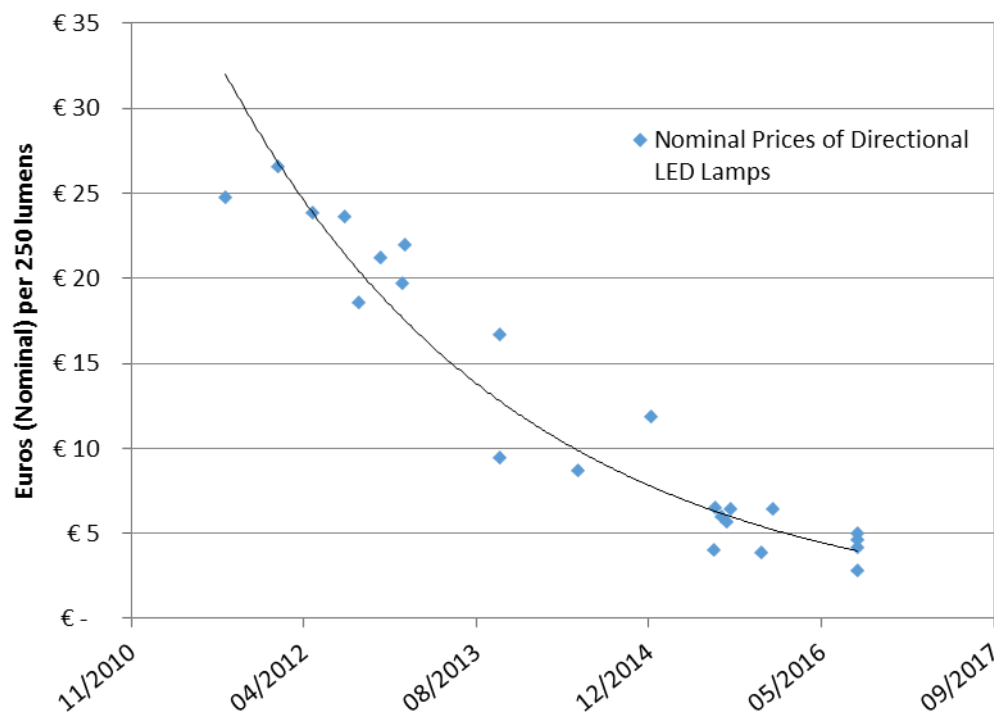
European Policy Context

The price of directional LED lamps in Germany has dropped by 80% over the last five years. Consumers are experiencing payback periods of just a few months followed by years and years of savings. In 2012, an Ecodesign measure was adopted to help steer markets toward high quality, high efficiency lighting products across Europe. Now, starting on 1 September 2016, manufacturers and importers across Europe will stop placing mains-voltage (230V) directional halogen lamps (also called “spot lights”) on the European market. This measure removes the least efficient (D-class) directional lamps from the market, in favour of B-class and better options. There are no C-class directional lamps. This Ecodesign measure is yet another example of how European Union product policies can bring significant financial benefits to households across Europe.



LED Price Trend for Germany

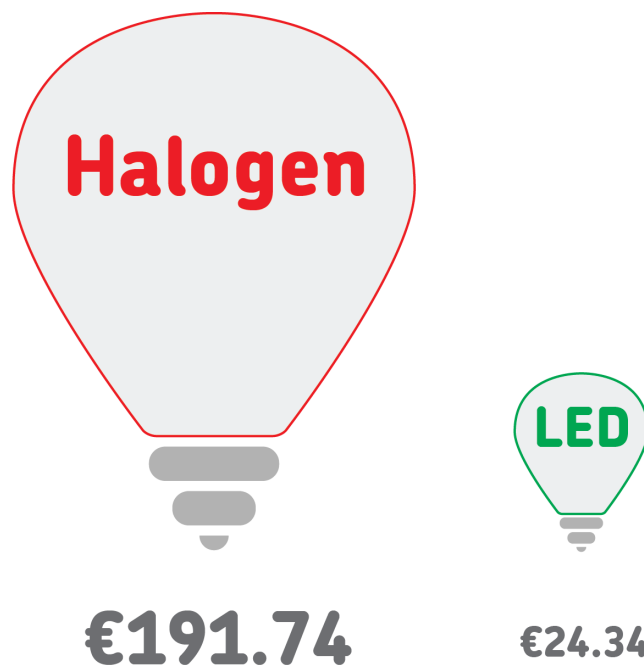
CLASP obtained historic retail prices of mainstream LED bulbs sold between 2011 and 2016 on Amazon.de and www.gruenspar.de. Models changed over the analysis period, but were normalised to a fixed light output of 250 lumens, which is approximately equivalent to a 35W halogen spot light. This normalisation ensures that the price comparison remains fair. Only models from major manufacturers, including Philips and Osram, were chosen to ensure a mainstream, quality sample of lamps. The prices shown were not adjusted for inflation (i.e., they are presented as ‘nominal’ Euros) – simply showing the prices when they were listed on the Amazon.de website (see Appendix for links to the pages). This trend shows that, on a per delivered lumen basis, these lamps went from approximately €25 in 2011 to just under €5 in 2016 – thus an 80% reduction in price in just five years.



This figure shows that, on a 'per lumen delivered' basis, these lamps went from approximately €25 in 2011 to just under €5 in 2016. That is an 80% reduction in price in just five years.

On a life-cycle basis, with the purchase and electricity running costs included, this means that German consumers today enjoy a rapid payback from switching from halogen to LED lamps. Consider the following scenario – a 50W Osram Halogen Lamp with a 2,000 hour lifetime, costing €1.50, replaced by OSRAM LED Star PAR16 GU10 lamp, 5.5W LED, 15,000h lifetime and €4.33 from www.gruenspar.de; ¹ €0.295/kWh (average residential electricity price for Germany). For sockets operating 2 hours per day, the LED will pay for itself in four months, and then go on to operate for a further 20 years, yielding €9.58 of savings each year in electricity costs. If the LED is installed in a socket that operates four hours per day, the benefits are even greater – payback is halved to two months and annual savings double to €19.17 per year in electricity – with the lamp lasting over 10 years.

¹ [Link to the website](#) selling this lamp, accessed on 24 August 2016



The cost to buy and run bulbs in Germany over a ten year period

Thus, in Germany, LED directional lamps offer payback period of two to four months from switching a halogen spot light, with total savings that will accrue to over €160 per lamp over the LED lamps' lifetime.²

² Total savings per lamp, discounted to 2016 Euros at a 5% discount rate, including electricity savings and replacement halogen lamps (price held constant during analysis period)

Table of lamps for the LED lamp price plot, obtained from the Web Archive

MS	Date	Retailer	Lamp	Base	Life	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
DE	18/08/2011	amazon.de	PAR16	GU10	35000	(35W)	4.5	€ 19.79	Osram Parathom 4,5 W PAR16 20 Warm White GU10 Blister	https://web.archive.org/web/20110818094201/http://www.amazon.de/Osram-Parathom-PAR16-White-Blister/dp/B003VM8RUO
DE	18/01/2012	amazon.de	PAR16	GU10	35000	(35W)	4.5	€ 21.27	Osram Parathom 4,5W PAR16 20 Day Light GU10 Blister	https://web.archive.org/web/20120118054712/http://www.amazon.de/Osram-Parathom-PAR16-Light-Blister/dp/B003U3S5VK?
DE	28/04/2012	amazon.de	PAR16	GU10	35000	(35W)	4.5	€ 19.06	Osram Parathom 4,5W PAR16 20 Day Light GU10 Blister	https://web.archive.org/web/20120428184311/http://www.amazon.de/Osram-Parathom-PAR16-Light-Blister/dp/B003U3S5VK?
DE	28/07/2012	amazon.de	PAR16	GU10	35000	(35W)	4.5	€ 18.89	Osram Parathom 4,5W PAR16 20 Day Light GU10 Blister	https://web.archive.org/web/20120728131102/http://www.amazon.de/Osram-Parathom-PAR16-Light-Blister/dp/B003U3S5VK
DE	08/09/2012	amazon.de	PAR16	GU10		(35W)	4.5	€ 14.85	PARATHOM 4,5W, GU10, WW	https://web.archive.org/web/20120908013341/http://www.amazon.de/PARATHOM-4-5W-GU10-WW/dp/B004JO25Z6
DE	10/11/2012	amazon.de	PAR16	GU10	25000	200 lm	5.5	€ 16.99	Osram LED Superstar PAR16 5.5 watts (replacing 35 Watt), Socket GU10, warm color (830), dimmable reflector shape 50 mm, 230 V, 35 ° viewing angle, advanced 975 409	https://web.archive.org/web/20121110085005/http://www.amazon.de/Osram-Superstar-Reflektorform-Abstrahlwinkel-975409/dp/B006LJDTKM?
DE	13/01/2013	amazon.de	PAR16	GU10	25000	200 lm	5.5	€ 15.79	Osram LED Superstar PAR16 5.5 watts (replacing 35 Watt), Socket GU10, warm color (830), dimmable reflector shape 50 mm, 230 V, 35 ° viewing angle, advanced 975 409	https://web.archive.org/web/20130113152027/http://www.amazon.de/Osram-Superstar-Reflektorform-Abstrahlwinkel-975409/dp/B006LJDTKM?
DE	17/01/2013	amazon.de	PAR16	GU10	25000	170 lm	4.5	€14.95	Osram LED Superstar PAR16 4.5 Watt (ersetzt 35 Watt), Sockel Gu10, warmton (830), Reflektorform 50 mm, 230 V, 25° Abstrahlwinkel 976864	https://web.archive.org/web/20130117212726/http://www.amazon.de/Osram-Superstar-Reflektorform-Abstrahlwinkel-976864/dp/B007L8J19K?
DE	19/10/2013	amazon.de	PAR16	GU10	25000	200 lm	5	€13.34	Osram LED Superstar PAR16 5 Watt (ersetzt 50 Watt), Sockel Gu10, extra warmton (850), Reflektorform 50 mm, 230 V, 25° Abstrahlwinkel 973146	https://web.archive.org/web/20131019033017/http://www.amazon.de/Osram-Superstar-Reflektorform-Abstrahlwinkel-973146/dp/B0096CMG96
DE	04/06/2014	amazon.de	PAR16	GU10	25000	200 lm	5	€ 6.99	Osram LED Superstar PAR16 5 Watt (ersetzt 50 Watt), Sockel Gu10, extra warmton (850), Reflektorform 50 mm, 230 V, 25° Abstrahlwinkel 973146	https://web.archive.org/web/20140604165427/http://www.amazon.de/Osram-Superstar-Reflektorform-Abstrahlwinkel-973146/dp/B0096CMG96?
DE	31/12/2014	amazon.de	PAR16	GU10	15000	200 lm	3.9	€9.50	Osram LED Star PAR16 3,9W (ersetzt 35W), Sockel GU10, extra warmton (827), Reflektorform 50 mm, 230V, 36° Abstrahlwinkel 910348 [Energieklasse A]	https://web.archive.org/web/20141231195044/http://www.amazon.de/Osram-ersetzt-Reflektorform-Abstrahlwinkel-910348/dp/B00DI4I3UO
DE	19/10/2013	amazon.de	PAR16	GU10	25000	385 lm	7.5	€14.59	Osram LED Superstar PAR16 50 advanced 7.5W (ersetzt 50W), Sockel Gu10, extra warmton (827), Reflektorform 50 mm, 230 V, 36 Abstrahlwinkel, dimmbar 882714	https://web.archive.org/web/20131019032006/http://www.amazon.de/Osram-Superstar-Reflektorform-Abstrahlwinkel-882714/dp/B00CUU5J4U
DE	26/07/2015	amazon.de	PAR16	GU10	25000	385 lm	7.5	€ 9.27	Osram LED Superstar PAR16 50 advanced 7.5W (ersetzt 50W), Sockel Gu10, extra warmton (827), Reflektorform 50 mm, 230 V, 36 Abstrahlwinkel, dimmbar 882714	https://web.archive.org/web/20150726145618/http://www.amazon.de/Reflektor-PAR1650-W-Ersatz-warmwei%C3%9F-dimmbar/dp/B00CUU5J4U

Continuation - 2

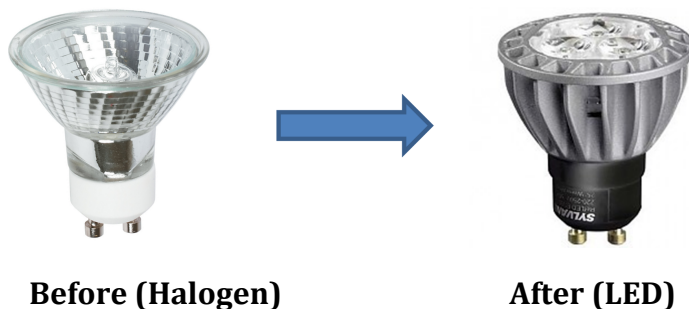
MS	Date	Retailer	Lamp	Base	Life	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
DE	06/07/2015	amazon.de	PAR16	GU10	15000	200 lm	3.9	€5.23	Osram LED Star PAR16 3,9W (ersetzt 35W), Sockel GU10, extra warmton (827), Reflektorform 50 mm, 230V, 36° Abstrahlwinkel 910348 [Energieklasse A]	https://web.archive.org/web/20150706093241/http://www.amazon.de/Osram-ersetzt-warmton-Reflektorform-Abstrahlwinkel/dp/B00DI4I3UO
DE	01/07/2015	amazon.de	PAR16	GU10	15000	350	5.5	€5.59	OSRAM LED Reflektor PAR16 5,5W (50W-Ersatz) warmweiß GU10 [Energieklasse A+]	https://web.archive.org/web/20150701013529/http://www.amazon.de/OSRAM-Reflektor-PAR16-50W-Ersatz-warmwei%C3%9F/dp/B00E67INOC?
DE	09/08/2015	amazon.de	PAR16	GU10	15000	350	5.5	€7.99	OSRAM LED Reflektor PAR16 5,5 Watt, GU10 (50W-Ersatz) warmweiß [Energieklasse A+]	https://web.archive.org/web/20150809082315/http://www.amazon.de/OSRAM-Reflektor-PAR16-50W-Ersatz-warmwei%C3%9F/dp/B00E67INOC
DE	21/08/2015	amazon.de	PAR16	GU10	15000	350	5.7	€8.99	Philips LED Lampe ersetzt, 50 Watt, 2700 Kelvin, 345 Lumen, warm-weiß 8718291749073	https://web.archive.org/web/20150821161641/http://www.amazon.de/Philips-ersetzt-Kelvin-warm-wei%C3%9F-8718291749073/dp/B00MB5Y1AM?
DE	16/11/2015	amazon.de	PAR16	GU10	15000	350	5.5	€5.46	Philips LED Lampe ersetzt 50W, GU10, warmweiß (2700 Kelvin), 350 Lumen, Dimmbar, 8718696483848 [Energieklasse A+]	https://web.archive.org/web/20151116060224/http://www.amazon.de/Philips-ersetzt-warmwei%C3%9F-Dimmbar-8718696483848/dp/B010UQKOD6
DE	22/12/2015	amazon.de	PAR16	GU10	15000	350	5.7	€8.99	Philips LED Lampe ersetzt, 50 Watt, 2700 Kelvin, 345 Lumen, warm-weiß 8718291749073	https://web.archive.org/web/20151222092011/http://www.amazon.de/Philips-ersetzt-Kelvin-warm-wei%C3%9F-8718291749073/dp/B00MB5Y1AM
DE	23/08/2016	amazon.de	PAR16	GU10	15000	350	7	€3.95	OSRAM LED-Reflektorlampe GU10 Star PAR16 / 5W - 50 Watt-Ersatz, LED-Spot / warmweiß - 2700K [Energieklasse A+]	https://www.amazon.de/OSRAM-LED-Reflektorlampe-GU10-Star-PAR16/dp/B00E67INOC/ref=sr_1_4?ie=UTF8&qid=1471952759&sr=8-4&keywords=GU+10+LED
DE	23/08/2016	amazon.de	PAR16	GU10	25000	350	6	€5.89	OSRAM LED Reflektorlampe GU10 dimmbar PAR16 Superstar LED-Energiesparlampe / 5,5W - 50 Watt-Ersatz, LED-Spot / warmweiß - 2700K [Energieklasse A+]	https://www.amazon.de/gp/product/B00CUU5J4U/ref=pd_cp_0_4?ie=UTF8&psc=1&refRID=184ZJWDHN050VEH58CYX
DE	23/08/2016	amazon.de	PAR16	GU10	15000	350	5.5	€6.49	Philips LED Lampe ersetzt 50W, EEK A+, GU10, warmweiß (2700 Kelvin), 350 Lumen, Dimmbar, 8718696483848 [Energieklasse A+]	https://www.amazon.de/gp/product/B010UQKOD6/ref=pd_cp_0_3?ie=UTF8&psc=1&refRID=N590WBKTK8KHB0S2FA3F
DE	23/08/2016	amazon.de	PAR16	GU10	15000	250	4	€4.99	Philips LED Lampe ersetzt 35W, EEK A+, GU10, warmweiß (2700 Kelvin), 250 Lumen, Dimmbar, 8718696483824 [Energieklasse A+]	https://www.amazon.de/Philips-ersetzt-warmweiß-Dimmbar-8718696483824/dp/B010UQKA9Y/ref=pd_sim_201_1?ie=UTF8&psc=1&refRID=J563AM15FP3ZCYZ8YH2E
DE	24/08/2016	www.gruenspar.de	PAR16	GU10	15000	350	5.5	€ 4.33	Osram LED spot GU10 5W (replaces 50 Watt), 350 lumens, warm white	http://www.gruenspar.de/osram-led-star-par16-50-36-gu10-led-spot-5-5w.html

Spot retail price analysis found an 80% decline in LED lamp prices over the last 4 years in Italy

*Michael Scholand, CLASP Europe
24 August 2016*

European Policy Context

The price of directional LED lamps in Italy has dropped by 80% over the last four years. Consumers are experiencing payback periods of just a few months followed by years and years of savings. In 2012, an Ecodesign measure was adopted to help steer markets toward high quality, high efficiency lighting products across Europe. Now, starting on 1 September 2016, manufacturers and importers across Europe will stop placing mains-voltage (230V) directional halogen lamps (also called “spot lights”) on the European market. This measure removes the least efficient (D-class) directional lamps from the market, in favour of B-class and better options. There are no C-class directional lamps. This Ecodesign measure is yet another example of how European Union product policies can bring significant financial benefits to households across Europe.

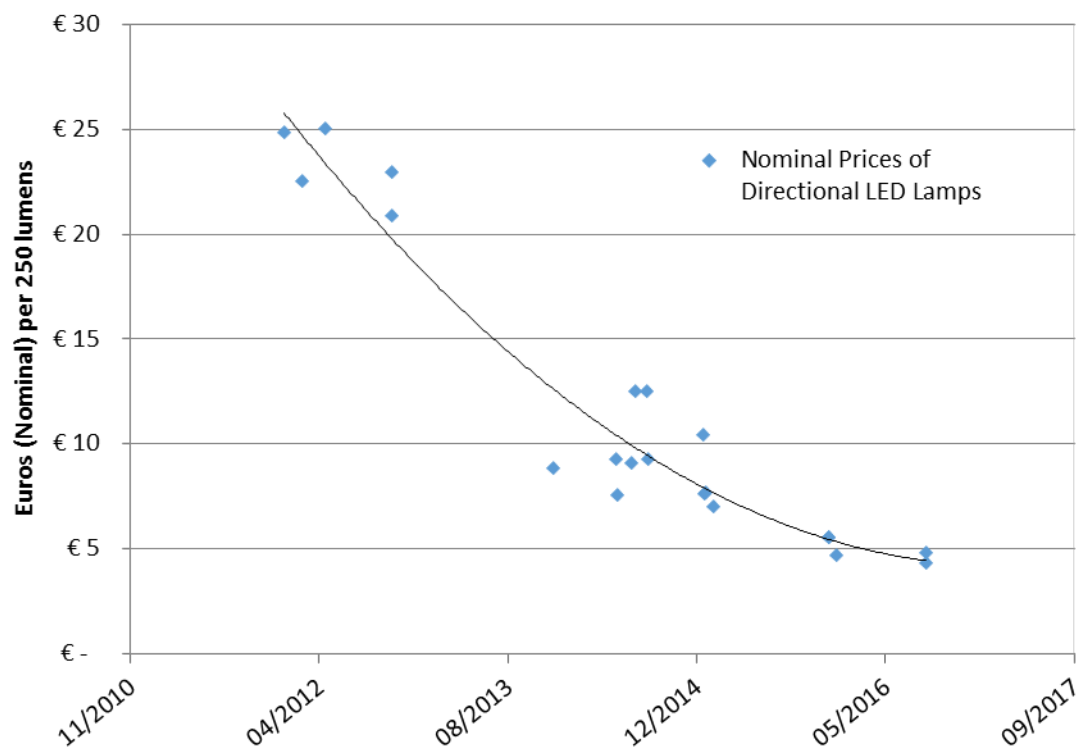


Before (Halogen)

After (LED)

LED Lamp Price Trend for Italy

CLASP obtained historic retail prices of mainstream LED bulbs sold between 2012 and 2016 on www.lampadadiretta.it and www.amazon.it. Models changed over the analysis period, but were normalised to a fixed light output of 250 lumens, which is approximately equivalent to a 35W halogen spot light. This normalisation ensures that the price comparison remains fair. Only models from major manufacturers, including Philips and Osram, were chosen to ensure a mainstream, quality sample of lamps. The prices shown were not adjusted for inflation (ie, they are presented as ‘nominal’ Euros) – simply showing the prices when they were listed on the two websites (see Appendix for links to the pages). This trend shows that, on a per delivered lumen basis, these lamps went from approximately €25 each in 2012 to just under €5 in 2016 – that’s an 80% reduction in price in just four years.



This figure shows that, on a 'per lumen delivered' basis, these lamps went from approximately €25 in 2012 to just under €5 in 2016. That is a 90% reduction in price in just four years.

On a life-cycle basis, with the purchase and electricity running costs included, this means that Italian consumers today enjoy a rapid payback from switching from halogen to LED lamps. Consider the following scenario – a 50W Osram Halogen Lamp with a 2,000 hour lifetime, costing €1.50, replaced by Philips Lampadina LED, 5W LED, 15,000h lifetime and €5.99 Euro from Amazon.it;¹ €0.243/kWh (average residential electricity price for Italy). For sockets operating two hours per day, the LED will pay for itself in seven months, and then go on to operate for a further 20 years, yielding €7.98 Euros of savings each year in electricity costs. If the LED is installed in a socket that operates four hours per day, the benefits are even greater – payback is halved to less than four months and annual savings double to €15.97 per year in electricity – with the lamp lasting over 10 years.

¹ [Link to the website](#) selling this lamp, accessed on 24 August 2016



This info-graphic shows the cost to buy and run bulbs in Italy over a ten year period

Thus, in Italy, LED directional lamps offer payback period of four to seven months from switching a halogen spot light, with total savings that will accrue to over €130 per lamp over the LED lamps' lifetime.²

² Total savings per lamp, discounted to 2016 Euros at a 5% discount rate, including electricity savings and replacement halogen lamps (price held constant during analysis period).

Table of lamps for the LED lamp price plot, obtained from the Web Archive

MS	Date	Retailer	Lamp	Base	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
IT	31/12/2011	www.lampadadiretta.it	PAR16	GU10	50W eq.	7	€ 29.79	Philips MASTER LEDspot MV 7-50W GU10 2700K 40D	http://web.archive.org/web/20111231081328/http://www.lampadadiretta.it/philips-master-ledspot-mv.html
IT	15/02/2012	www.lampadadiretta.it	PAR16	GU10	50W eq.	7	€ 26.99	Philips LEDspot MV 7-50W GU10 2700K 25D (MASTER)	http://web.archive.org/web/20120415125452/http://www.lampadadiretta.it/philips-master-ledspot-mv-7-50w
IT	15/04/2012	www.lampadadiretta.it	PAR16	GU10	35W eq.	4	€ 19.99	Philips LEDspot MV 3-35W GU10 2700K 25D (MASTER)	http://web.archive.org/web/20120415125416/http://www.lampadadiretta.it/philips-master-ledspot-mv-3-4-35w
IT	10/10/2012	www.lampadadiretta.it	PAR16	GU10	50W eq.	7	€ 24.99	Philips LEDspot MV 7-50W GU10 2700K 25D (MASTER)	http://web.archive.org/web/20120415125452/http://www.lampadadiretta.it/philips-master-ledspot-mv-7-50w
IT	10/10/2012	www.lampadadiretta.it	PAR16	GU10	50W eq.	8	€ 27.49	Philips LEDspot MV 7-50W GU10 2700K 25D (MASTER)	http://web.archive.org/web/20121010030549/http://www.lampadadiretta.it/philips-master-ledspot-mv-8-50w
IT	13/12/2013	amazon.it	PAR16	GU10	270 lm	3.5	€ 9.49	Philips LEDTWIST4B1 Twistline Faretto LED, 4W (Corrispondenti a 35W), Attacco a Spina GU10, Luce Bianca	http://web.archive.org/web/20131213031004/http://www.amazon.it/Philips-LEDTWIST4B1-Twistline-Faretto-Corrispondenti/dp/B0087OSN64
IT	27/05/2014	amazon.it	PAR16	GU10	50W eq.	7	€ 12.95	Led Osram 7w Gu10 2700K 36° luce calda pari a 50w alogena parathom	http://web.archive.org/web/20140527024724/http://www.amazon.it/Osram-2700K-calda-alogena-parathom/dp/B00EGBJFCS
IT	31/05/2014	amazon.it	PAR16	GU10	50W eq.	6.5	€ 10.56	Osram 910355 - LED Star PAR16 50, Faretto a LED 6.5W (equivalente a 50 W) a forma di riflettore, GU10, angolo di diffusione: 36°, 50 mm, 230 V, luce bianca extra calda (827)	http://web.archive.org/web/20140531042029/http://www.amazon.it/Osram-910355-equivalente-riflettore-diffusione/dp/B00E67INOC
IT	05/07/2014	amazon.it	PAR16	GU10	50W eq.	7	€ 12.64	Led Osram 7w Gu10 2700K 36° luce calda pari a 50w alogena parathom	http://web.archive.org/web/20140705162343/http://www.amazon.it/Osram-2700K-calda-alogena-parathom/dp/B00EGBJFCS
IT	16/07/2014	amazon.it	PAR16	GU10	45W eq.	4.5	€ 14.99	Philips LEDTWIST5B1 Twistline Faretto LED, 4.5W (Corrispondenti a 45W) Attacco a Spina GU10, Luce Bianca Calda	http://web.archive.org/web/20140716055534/http://www.amazon.it/Philips-LEDTWIST5B1-Twistline-Faretto-Corrispondenti/dp/B00DSFE5XW
IT	17/08/2014	amazon.it	PAR16	GU10	45W eq.	4.5	€ 14.99	Philips LEDTWIST5B1 Twistline Faretto LED, 4.5W (Corrispondenti a 45W) Attacco a Spina GU10, Luce Bianca Calda	http://web.archive.org/web/20140817084222/http://www.amazon.it/Philips-LEDTWIST5B1-Twistline-Faretto-Corrispondenti/dp/B00DSFE5XW
IT	20/08/2014	amazon.it	PAR16	GU10	270	3.5	€ 9.99	Philips LEDTWIST4B1 Twistline Faretto LED, 4W (Corrispondenti a 35W), Attacco a Spina GU10, Luce Bianca	http://web.archive.org/web/20140820153802/http://www.amazon.it/Philips-LEDTWIST4B1-Twistline-Faretto-Corrispondenti/dp/B0087OSN64

Continuation - 2

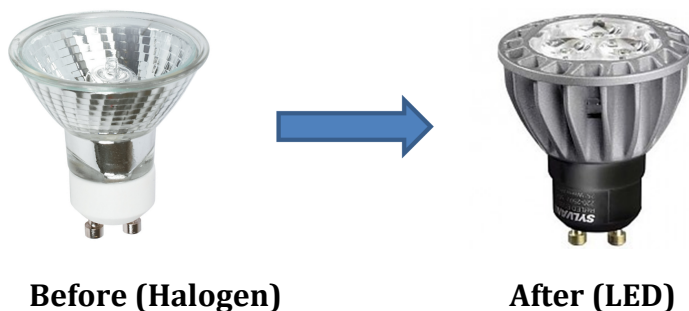
MS	Date	Retailer	Lamp	Base	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
IT	14/01/2015	amazon.it	PAR16	GU10	45W eq.	4.5	€ 12.48	Philips LEDTWIST5B1 Twistline Faretto LED, 4.5W (Corrispondenti a 45W) Attacco a Spina GU10, Luce Bianca Calda	http://web.archive.org/web/20150114083853/http://www.amazon.it/Philips-LEDTWIST5B1-Twistline-Faretto-Corrispondenti/dp/B00DSFE5XW
IT	15/01/2015	amazon.it	PAR16	GU10	270	3.5	€ 8.19	Philips LEDTWIST4B1 Twistline Faretto LED, 4W (Corrispondenti a 35W), Attacco a Spina GU10, Luce Bianca [Classe di efficienza energetica A]	http://web.archive.org/web/20150115070434/http://www.amazon.it/Philips-LEDTWIST4B1-Twistline-Faretto-Corrispondenti/dp/B0087OSN64
IT	19/01/2015	amazon.it	PAR16	GU10	50W eq	6.5	€ 10.68	Osram 910355 - LED Star PAR16 50, Faretto a LED 5.5W (equivalente a 50 W) a forma di riflettore, GU10, angolo di diffusione: 36°, 50 mm, 230 V, luce bianca extra calda (827)	http://web.archive.org/web/20150119085812/http://www.amazon.it/Osram-910355-equivalente-riflettore-diffusione/dp/B00E67INOC
IT	09/02/2015	amazon.it	PAR16	GU10	380	4.5	€ 10.60	Philips LEDTWIST5B1 Faretto LED, 50W, GU10, WW, 230V, 36D, ND/4 [Classe di efficienza energetica A]	http://web.archive.org/web/20150209055913/http://www.amazon.it/Philips-LEDTWIST5B1-Faretto-GU10-230V/dp/B00MXZBT2S
IT	11/12/2015	amazon.it	PAR16	GU10	270	3.5	€ 5.93	Philips LEDTWIST4B1 Twistline Faretto LED, 4W (Corrispondenti a 35W), Attacco a Spina GU10, Luce Bianca	http://web.archive.org/web/20151211232435/http://www.amazon.it/Philips-LEDTWIST4B1-Twistline-Faretto-Corrispondenti/dp/B0087OSN64
IT	11/12/2015	amazon.it	PAR16	GU10	270	3.5	€ 5.93	Philips LEDTWIST4B1 Twistline Faretto LED, 4W (Corrispondenti a 35W), Attacco a Spina GU10, Luce Bianca [Classe di efficienza energetica A]	http://web.archive.org/web/20151211232435/http://www.amazon.it/Philips-LEDTWIST4B1-Twistline-Faretto-Corrispondenti/dp/B0087OSN64
IT	31/12/2015	amazon.it	PAR16	GU10	350	5	€ 6.52	Philips Lampadina LED, Attacco GU10, 5W equivalente a 50W, 230V Bianco Caldo 2700°K [Classe di efficienza energetica A+]	http://web.archive.org/web/20151231155438/http://www.amazon.it/Philips-Lampadina-Attacco-equivalente-Bianco/dp/B010UQJW34
IT	24/08/2016	amazon.it	PAR16	GU10	50W eq	5	€ 5.99	Philips Lampadina LED, Attacco GU10, 5W equivalente a 50W, 230V Bianco Caldo 2700°K [Classe di efficienza energetica A+]	https://www.amazon.it/Philips-Lampadina-Attacco-equivalente-Bianco/dp/B010UQJW34/ref=sr_1_8?ie=UTF8&qid=1472016587&sr=8-8&keywords=LED+GU10
IT	24/08/2016	amazon.it	PAR16	GU10	460	6.5	€ 8.79	Philips - 8718696484029, Lampadina LED, 6.5W, classe di efficienza energetica A+, attacco: GU10, luce bianca, 3000 Kelvin, 460 Lumen [Classe di efficienza energetica A+]	https://www.amazon.it/Philips-8718696484029-Lampadina-efficienza-energetica/dp/B01129XSC4/ref=pd_sim_201_17?ie=UTF8&pvc=1&refRID=8F8CS7842V8X1GAGVN49

Spot retail price analysis found an 85% decline in LED lamp prices over the last 5 years in Spain

*Michael Scholand, CLASP Europe
24 August 2016*

European Policy Context

The price of directional LED lamps in Spain has dropped by 85% over the last five years. Consumers are experiencing payback periods of just a few months followed by years and years of savings. In 2012, an Ecodesign measure was adopted to help steer markets toward high quality, high efficiency lighting products across Europe. Now, starting on 1 September 2016, manufacturers and importers across Europe will stop placing mains-voltage (230V) directional halogen lamps (also called “spot lights”) on the European market. This measure removes the least efficient (D-class) directional lamps from the market, in favour of B-class and better options. There are no C-class directional lamps. This Ecodesign measure is yet another example of how European Union product policies can bring significant financial benefits to households across Europe.

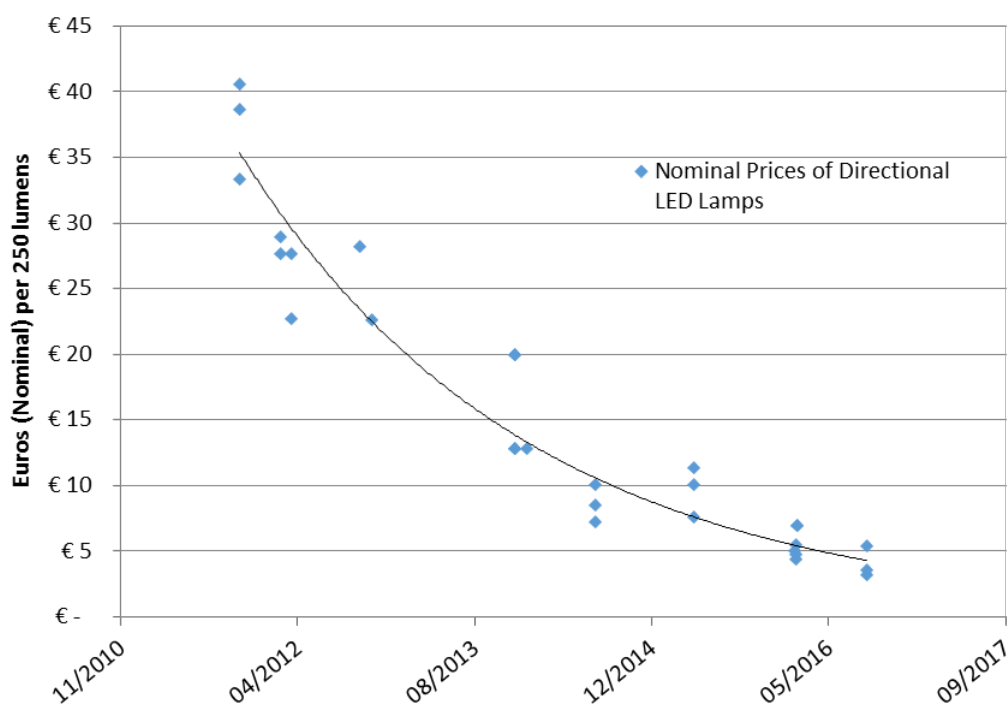


Before (Halogen)

After (LED)

LED Lamp Price Trend for Spain

CLASP obtained historic retail prices of mainstream LED bulbs sold between 2011 and 2016 on www.lamparadirecta.es. Models changed over the analysis period, but were normalised to a fixed light output of 250 lumens, which is approximately equivalent to a 35W halogen spotlight. This normalisation ensures that the price comparison remains fair. Only models from major manufacturers, including Philips and Osram, were chosen to ensure a mainstream, quality sample of lamps. The prices shown were not adjusted for inflation (ie, they are presented as ‘nominal’ Euros) – simply showing the prices when they were listed on www.lamparadirecta.es website (see Appendix for links to the pages). This trend shows that, on a per delivered lumen basis, these lamps went from approximately €35 each in 2011 to less than €5 in 2016 – that’s an 85% reduction in price in just five years.



This figure shows that, on a 'per lumen delivered' basis, these lamps went from approximately €35 in 2011 to less than €5 in 2016. That is an 85% reduction in price in just five years.

On a life-cycle basis, with the purchase and electricity running costs included, this means that Spanish consumers today enjoy a rapid payback from switching from halogen to LED lamps. Consider the following scenario – a 50W Osram Halogen Lamp with a 2,000 hour lifetime, costing €1.50, replaced by Philips CorePro LEDspot, 5W LED, 15,000h lifetime and €5.51 from www.lamparadirecta.es,¹ €0.237/kWh (average residential electricity price for Spain). For sockets operating two hours per day, the LED will pay for itself in six months, and then go on to operate for a further 20 years, yielding €7.70 of savings each year in electricity costs. If the LED is installed in a socket that operates four hours per day, the benefits are even greater – payback is halved to three months and annual savings double to €15.40 per year in electricity – with the lamp lasting over 10 years.

¹ [Link to the website](http://www.lamparadirecta.es) selling this lamp, accessed on 24 August 2016

² Total savings per lamp, discounted to 2016 Euros at a 5% discount rate, including electricity



This info-graphic shows the cost to buy and run bulbs in Spain over a ten year period

Thus, in Spain, LED directional lamps offer payback period of three to six months from switching a halogen spot light, with total savings that will accrue to over €130 per lamp over the LED lamps' lifetime.²

² Total savings per lamp, discounted to 2016 Euros at a 5% discount rate, including electricity savings and replacement halogen lamps (price held constant during analysis period).

Table of lamps for the LED lamp price plot, obtained from the Web Archive

MS	Date	Retailer	Lamp	Base	Dim	Lifetime	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
ES	20/10/2011	www.lamparadirecta.es	PAR16	GU10	No	45000	250	7	€ 40.45	Philips MASTER LEDspot MV 7-35W GU10 2700K 40D	http://web.archive.org/web/20111020213543/http://www.lamparadirecta.es/philips-master-ledspot-mv-7-35w-gu10-2700k-40d.html
ES	20/10/2011	www.lamparadirecta.es	PAR16	GU10	Yes	40000	270	7	€ 41.64	Philips MASTER LEDspot MV 7-50W GU10 2700K 25D	http://web.archive.org/web/20111020213549/http://www.lamparadirecta.es/philips-master-ledspot-mv-7-50w-gu10-2700k-25d.html
ES	20/10/2011	www.lamparadirecta.es	PAR16	GU10	No	25000	170	4	€ 22.60	Philips LEDspot MV 4-35W 2700K GU10 40D (MASTER)	http://web.archive.org/web/20111020213513/http://www.lamparadirecta.es/philips-ledspot-mv-4-35w-2700k-gu10-40d-master.html
ES	11/02/2012	www.lamparadirecta.es	PAR16	GU10	No	45000	250	7	€ 28.89	Philips MASTER LEDspot MV 7-35W GU10 2700K 40D	http://web.archive.org/web/20120211093353/http://www.lamparadirecta.es/philips-master-ledspot-mv.html?
ES	11/02/2012	www.lamparadirecta.es	PAR16	GU10	Yes	40000	270	7	€ 29.79	Philips MASTER LEDspot MV 7-50W GU10 2700K 25D	http://web.archive.org/web/20120211093353/http://www.lamparadirecta.es/philips-master-ledspot-mv.html?
ES	13/03/2012	www.lamparadirecta.es	PAR16	GU10	No	45000	250	7	€ 22.60	Philips MASTER LEDspot MV 4-35W GU10 2700K 40D	http://web.archive.org/web/20120313114937/http://www.lamparadirecta.es/philips-master-ledspot-mv.html?
ES	13/03/2012	www.lamparadirecta.es	PAR16	GU10	Yes	40000	270	7	€ 29.79	Philips MASTER LEDspot MV 7-50W GU10 2700K 25D	http://web.archive.org/web/20120313114937/http://www.lamparadirecta.es/philips-master-ledspot-mv.html?
ES	23/09/2012	www.lamparadirecta.es	PAR16	GU10	Yes	25000	180	4	€ 20.22	Philips LEDspot MV 4-35W 2700K GU10 25D (MASTER)	http://web.archive.org/web/20120923052750/http://www.lamparadirecta.es/philips-ledspot-mv-4-35w-2700k-gu10-25d-master/
ES	28/10/2012	www.lamparadirecta.es	PAR16	GU10	Yes	25000	180	4	€ 16.20	Philips LEDspot MV 4-35W 2700K GU10 40D (MASTER)	http://web.archive.org/web/20121028145606/http://www.lamparadirecta.es/philips-ledspot-mv-4-35w-2700k-gu10-40d-master
ES	05/12/2013	www.lamparadirecta.es	PAR16	GU10	Yes	40000	50W eq.	6	€ 23.89	Philips LEDspot MV D 6-50W GU10 2700K 40D (MASTER)	http://web.archive.org/web/20131205050934/http://www.lamparadirecta.es/philips-ledspot-mv-d-6-50w-gu10-2700k-40d-master/
ES	05/12/2013	www.lamparadirecta.es	PAR16	GU10	yes	40000	50W eq.	6	€ 23.89	Philips LEDspot MV D 6-50W GU10 3000K 25D (MASTER)	http://web.archive.org/web/20131205140740/http://www.lamparadirecta.es/philips-ledspot-mv-d-6-50w-gu10-3000k-25d-master/
ES	05/12/2013	www.lamparadirecta.es	PAR16	GU10	No		180	4	€ 9.19	Philips CorePro LEDspotMV 4-35W GU10 830 36D	http://web.archive.org/web/20131205051215/http://www.lamparadirecta.es/philips-corepro-ledspot-mv-4-35w/
ES	05/12/2013	www.lamparadirecta.es	PAR16	GU10	No	20000	300	5	€ 15.29	Philips CorePro LEDspotMV 5-50W GU10 2700K 36D	http://web.archive.org/web/20131205050911/http://www.lamparadirecta.es/philips-corepro-ledspot-mv-5-50w/
ES	07/01/2014	www.lamparadirecta.es	PAR16	GU10	No	25000	180	4	€ 9.19	Philips CorePro LEDspotMV 4-35W GU10 830 36D	http://web.archive.org/web/20140107073735/http://www.lamparadirecta.es/philips-corepro-ledspot-mv-4-35w/
ES	21/07/2014	www.lamparadirecta.es	PAR16	GU10			250	4.8	€ 9.99	Osram Parathom PAR16 35 Adv 4.8W/830 36D GU10	http://web.archive.org/web/20140721031137/http://www.lamparadirecta.es/osram-parathom-par16-35-adv-4-8w-827-36d-gu10
ES	21/07/2014	www.lamparadirecta.es	PAR16	GU10			350	7	€ 11.79	Osram Parathom PAR16 50 Adv 7W/827 36D GU10	http://web.archive.org/web/20140721031142/http://www.lamparadirecta.es/osram-parathom-par16-advanced
ES	21/07/2014	www.lamparadirecta.es	PAR16	GU10			350	7	€ 9.99	Osram Parathom PAR16 50 Adv 7W/840 36D GU10	http://web.archive.org/web/20140721031142/http://www.lamparadirecta.es/osram-parathom-par16-advanced
ES	24/04/2015	www.lamparadirecta.es	PAR16	GU10		25000	200	5	€ 7.99	Osram Parathom PAR16 35 5W/827 36D GU10	http://web.archive.org/web/20150424140944/https://www.lamparadirecta.es/osram-parathom-par16

Continuation - 2

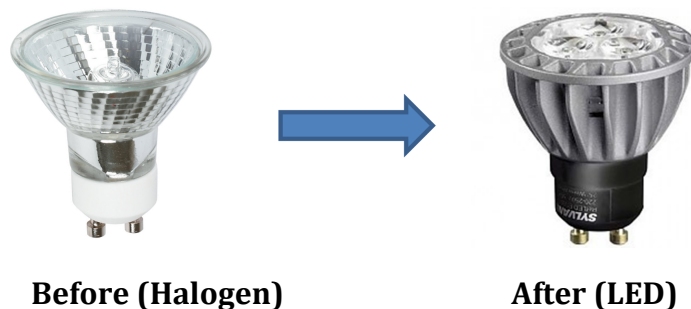
MS	Date	Retailer	Lamp	Base	Dim	Lifetime	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
ES	24/04/2015	www.lamparadirecta.es	PAR16	GU10			200	3.6	€ 8.99	Osram Parathom PAR16 35 Adv 3.6W/827 36D GU10	http://web.archive.org/web/20150424143050/https://www.lamparadirecta.es/osram-parathom-par16-advanced
ES	24/04/2015	www.lamparadirecta.es	PAR16	GU10			300	5.3	€ 8.99	Osram Parathom PAR16 50 Adv 5.3W/840 36D GU10	http://web.archive.org/web/20150424143050/https://www.lamparadirecta.es/osram-parathom-par16-advanced
ES	05/02/2016	www.lamparadirecta.es	PAR16	GU10			250	3	€ 4.99	Osram Parathom PAR16 3-35W 827 36D GU10	http://web.archive.org/web/20160205145013/https://www.lamparadirecta.es/osram-parathom-par16
ES	06/02/2016	www.lamparadirecta.es	PAR16	GU10			250	3	€ 5.39	Osram Parathom PAR16 3-35W 827 120D GU10	http://web.archive.org/web/20160205145013/https://www.lamparadirecta.es/osram-parathom-par16
ES	07/02/2016	www.lamparadirecta.es	PAR16	GU10			350	5	€ 6.49	Osram Parathom PAR16 5-50W 827 36D GU10	http://web.archive.org/web/20160205145013/https://www.lamparadirecta.es/osram-parathom-par16
ES	08/02/2016	www.lamparadirecta.es	PAR16	GU10			350	5	€ 6.09	Osram Parathom PAR16 5-50W 827 120D GU10	http://web.archive.org/web/20160205145013/https://www.lamparadirecta.es/osram-parathom-par16
ES	09/02/2016	www.lamparadirecta.es	PAR16	GU10			400	5.5	€ 10.99	Osram Parathom PAR16 5.5-65W 827 36D GU10	http://web.archive.org/web/20160205145013/https://www.lamparadirecta.es/osram-parathom-par16
ES	10/02/2016	www.lamparadirecta.es	PAR16	GU10			500	6.7	€ 13.75	Osram Parathom PAR16 6.7-80W 830 36D GU10	http://web.archive.org/web/20160205145013/https://www.lamparadirecta.es/osram-parathom-par16
ES	24/08/2016	www.lamparadirecta.es	PAR16	GU10	No	15000	390	5	€ 5.51	Philips CorePro LEDspot MV 5-50W 827 36D GU10	https://www.lamparadirecta.es/philips-corepro-ledspot-mv-5-50w-827-36d-gu10
ES	24/08/2016	www.lamparadirecta.es	PAR16	GU10	No	15000	435	5	€ 5.43	Philips CorePro LEDspot MV 5-50W 840 50D GU10	https://www.lamparadirecta.es/philips-corepro-ledspot-mv-5-50w-840-50d-gu10
ES	24/08/2016	www.lamparadirecta.es	PAR16	GU10	Yes	25000	350	5.5	€ 7.42	Osram Parathom PAR16 Adv 5.5-50W 827 36D GU10	https://www.lamparadirecta.es/osram-parathom-par16-adv-5-5-50w-827-36d-gu10

Spot retail price analysis found an 85% decline in LED lamp prices over the last 6 years in the United Kingdom

*Michael Scholand, CLASP Europe
24 August 2016*

European Policy Context

The price of directional LED lamps in the United Kingdom has dropped by 85% over the last six years. Consumers are experiencing payback periods of just a few months followed by years and years of savings. In 2012, an Ecodesign measure was adopted to help steer markets toward high quality, high efficiency lighting products across Europe. Now, starting on 1 September 2016, manufacturers and importers across Europe will stop placing mains-voltage (230V) directional halogen lamps (also called “spot lights”) on the European market. This measure removes the least efficient (D-class) directional lamps from the market, in favour of B-class and better options. There are no C-class directional lamps. This Ecodesign measure is yet another example of how European Union product policies can bring significant financial benefits to households across Europe.

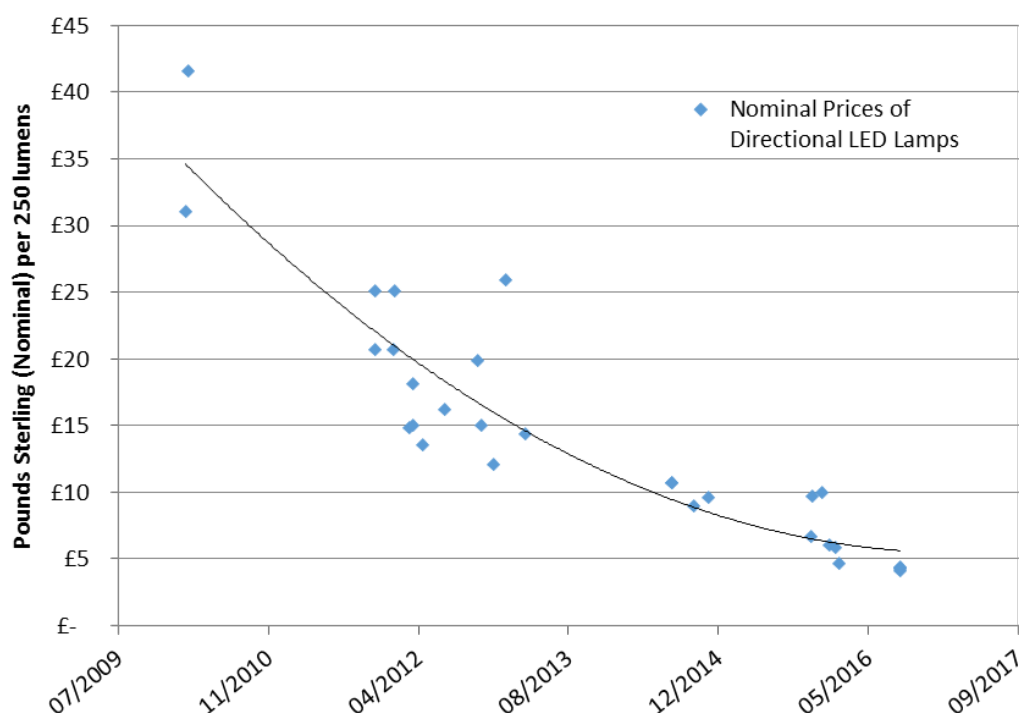


Before (Halogen)

After (LED)

LED Lamp Price Trend for the United Kingdom

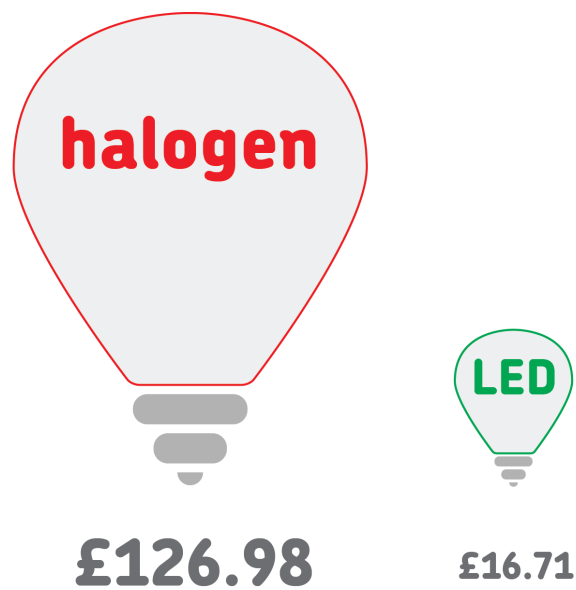
CLASP obtained historic retail prices of mainstream LED bulbs sold between 2010 and 2016 on www.amazon.co.uk. Models changed over the analysis period, but were normalised to a fixed light output of 250 lumens, which is approximately equivalent to a 35W halogen spot light. This normalisation ensures that the price comparison remains fair. Only models from major manufacturers, including Philips and Osram, were chosen to ensure a mainstream, quality sample of lamps. The prices shown were not adjusted for inflation (ie, they are presented as ‘nominal’ Pounds) – simply showing the prices when they were listed on the Amazon.co.uk website (see Appendix for links to the pages). This trend shows that, on a per delivered lumen basis, these lamps went from approximately £35 in 2010 to less than £5 in 2016 – thus an 85% reduction in price in just six years.



This figure shows that, on a ‘per lumen delivered’ basis, these lamps went from approximately £35 in 2010 to less than £5 in 2016. That is an 85% reduction in price in just six years.

On a life-cycle basis, with the purchase and electricity running costs included, this means that British consumers today enjoy a rapid payback from switching from halogen to LED lamps. Consider the following scenario – a 50W Osram Halogen Lamp with a 2,000 hour lifetime, costing £1.50, replaced by Philips Philips GU10 LED spot light, 5W warm-white, 15,000h lifetime and £4.99 from www.amazon.co.uk;¹ £0.19/kWh (average residential electricity price for the UK). For sockets operating 2 hours per day, the LED will pay for itself in seven months, and then go on to operate for a further 20 years, yielding £6.24 of savings each year in electricity costs. If the LED is installed in a socket that operates four hours per day, the benefits are even greater – payback is halved to three months and annual savings double to £12.48 per year in electricity – with the lamp lasting over 10 years.

¹ [Link to the website](#) selling this lamp, accessed on 24 August 2016



The cost to buy and run bulbs in the UK over a ten year period

Thus, in the UK, LED directional lamps offer payback period of three to seven months from switching a halogen spotlight, with total savings that will accrue to over £110 per lamp over the LED lamps' lifetime.²

² Total savings per lamp, discounted to 2016 Pounds at a 5% discount rate, including electricity savings and replacement halogen lamps (price held constant during analysis period).

Table of lamps for the LED lamp price plot, obtained from the Web Archive

MS	Date	Retailer	Lamp	Base	Dim?	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
UK	15/02/2010	amazon.co.uk	PAR16	GU10	Yes	270	7	£33.53	Philips Master LED GU10 7W equivalent to 50W 40 deg	http://web.archive.org/web/20100215133146/http://www.amazon.co.uk/Philips-Master-LED-GU10-equivalent/dp/B002TSS8QE
UK	21/02/2010	amazon.co.uk	PAR16	GU10	No	150	3	£24.95	Philips Econic GU10 LED Light Bulb Econic 3Watt	http://web.archive.org/web/20100221025115/http://www.amazon.co.uk/Philips-Econic-GU10-Light-3Watt/dp/B002NZC2CE
UK	07/11/2011	amazon.co.uk	PAR16	GU10	Yes	165	4	£16.57	Philips Master LED GU10 240V 4W Very Warm White 40 Degrees Dimmable	http://web.archive.org/web/20111107050042/http://www.amazon.co.uk/Philips-Master-White-Degrees-Dimmable/dp/B004VL54DM
UK	07/11/2011	amazon.co.uk	PAR16	GU10	Yes	200	4	£16.57	Philips Master LED GU10 240V 4W Very Warm White 40 Degrees Dimmable	http://web.archive.org/web/20111107050042/http://www.amazon.co.uk/Philips-Master-White-Degrees-Dimmable/dp/B004VL54DM
UK	07/01/2012	amazon.co.uk	PAR16	GU10	Yes	200	4	£16.57	Philips Master LED GU10 240V 4W Very Warm White 40 Degrees Dimmable	http://web.archive.org/web/20120107032124/http://www.amazon.co.uk/Philips-Master-White-Degrees-Dimmable/dp/B004VL54DM
UK	13/01/2012	amazon.co.uk	PAR16	GU10	Yes	165	4	£16.57	Philips Master LED GU10 240V 4W Very Warm White 40 Degrees Dimmable	http://web.archive.org/web/20111107050042/http://www.amazon.co.uk/Philips-Master-White-Degrees-Dimmable/dp/B004VL54DM
UK	29/02/2012	amazon.co.uk	PAR16	GU10	No	165	4	£9.80	Philips MyVision 929000200301 GU10 4 Watt LED Bulb	http://web.archive.org/web/20120229173702/http://www.amazon.co.uk/Philips-MyVision-929000200301-GU10-Watt/dp/B005OJTQRA
UK	12/03/2012	amazon.co.uk	PAR16	GU10	No	165	4	£9.92	Philips MyVision 929000200301 GU10 4 Watt LED Bulb	http://web.archive.org/web/20120312080428/http://www.amazon.co.uk/Philips-MyVision-929000200301-GU10-Watt/dp/B005OJTQRA
UK	14/03/2012	amazon.co.uk	PAR16	GU10	Yes	165	4	£11.99	Philips MyAmbiance 929000200401 GU10 4 Watt LED Bulb, Dimmable	http://web.archive.org/web/20120314165116/http://www.amazon.co.uk/Philips-MyAmbiance-929000200401-GU10-Dimmable/dp/B005OCYCMQ
UK	15/04/2012	amazon.co.uk	PAR16	GU10	No	165	4	£8.97	Philips MyVision 929000200301 GU10 4 Watt LED Bulb	http://web.archive.org/web/20120415031001/http://www.amazon.co.uk/Philips-MyVision-929000200301-GU10-Watt/dp/B005OJTQRA
UK	27/06/2012	amazon.co.uk	PAR16	GU10	Yes	200	4	£13.00	Philips Master LED GU10 240V 4W Very Warm White 40 Degrees Dimmable	http://web.archive.org/web/20120627012959/http://www.amazon.co.uk/Philips-Master-White-Degrees-Dimmable/sim/B004VL54DM/2
UK	13/10/2012	amazon.co.uk	PAR16	GU10	Yes	270	7	£21.50	Philips Dimmable Master LED GU10 7W equivalent to 50W 40 deg	http://web.archive.org/web/20121013223210/http://www.amazon.co.uk/Philips-Dimmable-Master-GU10-equivalent/sim/B002TSS8QE/2
UK	27/10/2012	amazon.co.uk	PAR16	GU10	No	200	4	£12.00	Philips MyVision GU10 4 Watt LED Low Energy Light Bulb. 240v Warm White	http://web.archive.org/web/20121027050459/http://www.amazon.co.uk/Philips-MyVision-Energy-Light-Bulb/dp/B005OJTQRA
UK	08/12/2012	amazon.co.uk	PAR16	GU10	No	270	5	£13.06	Philips 5W (50W) GU10 Warm White LED Spot Light Bulb	http://web.archive.org/web/20121208075244/http://www.amazon.co.uk/Philips-GU10-Warm-White-Light/dp/B0088YVZP4
UK	16/01/2013	amazon.co.uk	PAR16	GU10	Yes	270	5.5	£27.99	Philips 5.5W 40 Degrees GU10 Very Warm White	http://web.archive.org/web/20130116105919/http://www.amazon.co.uk/Philips-5-5W-Degrees-GU10-White/dp/B005M1XT50
UK	22/03/2013	amazon.co.uk	PAR16	GU10	Yes	200	4	£11.49	PHILIPS MASTER LED 4W GU10 2700K WARM 25°	http://web.archive.org/web/20130322074439/http://www.amazon.co.uk/PHILIPS-MASTER-GU10-2700K-WARM/dp/B004W5UYAA
UK	24/07/2014	amazon.co.uk	PAR16	GU10	Yes	375	5.5	£16.09	Philips MASTER LED 5.5W GU10 Spot Light, Warm White, Dimmable (50W Halogen Replacement)	http://web.archive.org/web/20140724171936/http://www.amazon.co.uk/Philips-MASTER-Dimmable-Halogen-Replacement/dp/B00EQ6KMKW
UK	24/07/2014	amazon.co.uk	PAR16	GU10	Yes	375	5.5	£16.09	Philips MASTER LED 5.5W GU10 Spot Light, Warm White, Dimmable (50W Halogen Replacement)	http://web.archive.org/web/20140724171936/http://www.amazon.co.uk/Philips-MASTER-Dimmable-Halogen-Replacement/dp/B00EQ6KMKW

Continuation - 2

MS	Date	Retailer	Lamp	Base	Dim?	Lumen output	Watts	Price	Manufacturer and lamp info	Weblink
UK	07/10/2014	amazon.co.uk	PAR16	GU10	Yes	375	5.5	£13.49	Philips MASTER LED 5.5W GU10 Spot Light, Warm White, Dimmable (50W Halogen Replacement)	http://web.archive.org/web/20141007100817/http://www.amazon.co.uk/Philips-MASTER-Dimmable-Halogen-Replacement/dp/B00EQ6KMKW
UK	24/11/2014	amazon.co.uk	PAR16	GU10	Yes	350	5.5	£13.45	Philips MASTER LED 5.5W GU10 Spot Light Bulb, Very Warm White, Dimmable (50W Halogen Replacement)	http://web.archive.org/web/20141124191400/http://www.amazon.co.uk/Philips-MASTER-Dimmable-Halogen-Replacement/dp/B00EQ3SPCO
UK	31/10/2015	amazon.co.uk	PAR16	GU10	Yes	300	5	£7.99	Philips LED Spot Bulb, Dimmable (GU10 5W) - Warm White [Energy Class A+]	http://web.archive.org/web/20151031182219/http://www.amazon.co.uk/Philips-Spot-Bulb-Dimmable-GU10/dp/B00MB5Y1AM
UK	03/11/2015	amazon.co.uk	PAR16	GU10	Yes	375	5.5	£14.57	Philips MASTER LED 5.5W GU10 Spot Light, Warm White, Dimmable (50W Halogen Replacement) [Energy Class A+]	http://web.archive.org/web/20151103035904/http://www.amazon.co.uk/Philips-MASTER-Dimmable-Halogen-Replacement/dp/B00EQ6KMKW
UK	08/12/2015	amazon.co.uk	PAR16	GU10	Yes	350	5.5	£14.02	Philips MASTER LED 5.5W GU10 Spot Light Bulb, Very Warm White, Dimmable (50W Halogen Replacement) [Energy Class A+]	http://web.archive.org/web/20151208022808/http://www.amazon.co.uk/Philips-MASTER-Dimmable-Halogen-Replacement/dp/B00EQ3SPCO
UK	30/12/2015	amazon.co.uk	PAR16	GU10	Yes	385	5.3	£9.29	Philips 5W (50W) GU10 Master LED Value Spot Light, 2700K Warm White, Dimmable [Energy Class A+]	http://web.archive.org/web/20151230152858/http://www.amazon.co.uk/Philips-Master-Value-Light-Dimmable/dp/B00KJF1XIY
UK	20/01/2016	amazon.co.uk	PAR16	GU10	Yes	385	5.3	£8.99	Philips 5W (50W) GU10 Master LED Value Spot Light, 2700K Warm White, Dimmable [Energy Class A+]	http://web.archive.org/web/20160120211829/http://www.amazon.co.uk/Philips-Master-Value-Light-Dimmable/dp/B00KJF1XIY
UK	02/02/2016	amazon.co.uk	PAR16	GU10	Yes	355	4.3	£6.65	Philips 45709200 GU10 4.3 W 2700 k 355 lm Master LED Energy Class A++ Dimmable Value Spotlight, Warm White	http://web.archive.org/web/20160202200002/http://www.amazon.co.uk/Philips-45709200-Master-Dimmable-Spotlight/dp/B00ZMWSARG
UK	24/08/2016	amazon.co.uk	PAR16	GU10	Yes	180	4.5	£2.99	Philips GU10 LED Spotlight Dimmable Light Bulb, 4.5 W - Warm White [Energy Class A]	https://www.amazon.co.uk/Philips-GU10-Spotlight-Dimmable-Light/dp/B008902UM4/ref=sr_1_4?ie=UTF8&qid=1472052944&sr=8-4&keywords=Philips+GU10+LED
UK	24/08/2016	amazon.co.uk	PAR16	GU10	Yes	350	5.5	£5.99	Philips 230 V GU10 5.5 W LED Dimmable Spot Light - Warm White/Silver [Energy Class A+]	https://www.amazon.co.uk/Philips-GU10-Dimmable-Spot-Light/dp/B010UQKOD6/ref=pd_sim_201_2?ie=UTF8&psc=1&refRID=TSJQ69VAVCMAYDQRK9K7
UK	24/08/2016	amazon.co.uk	PAR16	GU10	Yes	350	5.3	£6.00	OSRAM LED reflector lamp GU10 dimmable PAR16 Superstar LED energy-saving lamp / 5.3W - 50 watt replacement LED spot / warm white - 2700K [Energy Class A+]	https://www.amazon.co.uk/OSRAM-reflector-dimmable-Superstar-energy-saving/dp/B00CUU5J4U/ref=sr_1_4?s=lighting&ie=UTF8&qid=1472053144&sr=1-4&keywords=osram+gu10+led
UK	24/08/2016	amazon.co.uk	PAR16	GU10	No	350	5	£6.13	OSRAM LED PAR16 50 36 GU10 5W Warm White-2700K 350Lumen [Energy Class A]	https://www.amazon.co.uk/PAR16-GU10-Warm-White-2700K-350Lumen/dp/B00E67IN0C/ref=pd_sim_201_2?ie=UTF8&psc=1&refRID=9PKKQB01DKRZW5PCB8Q1