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

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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).

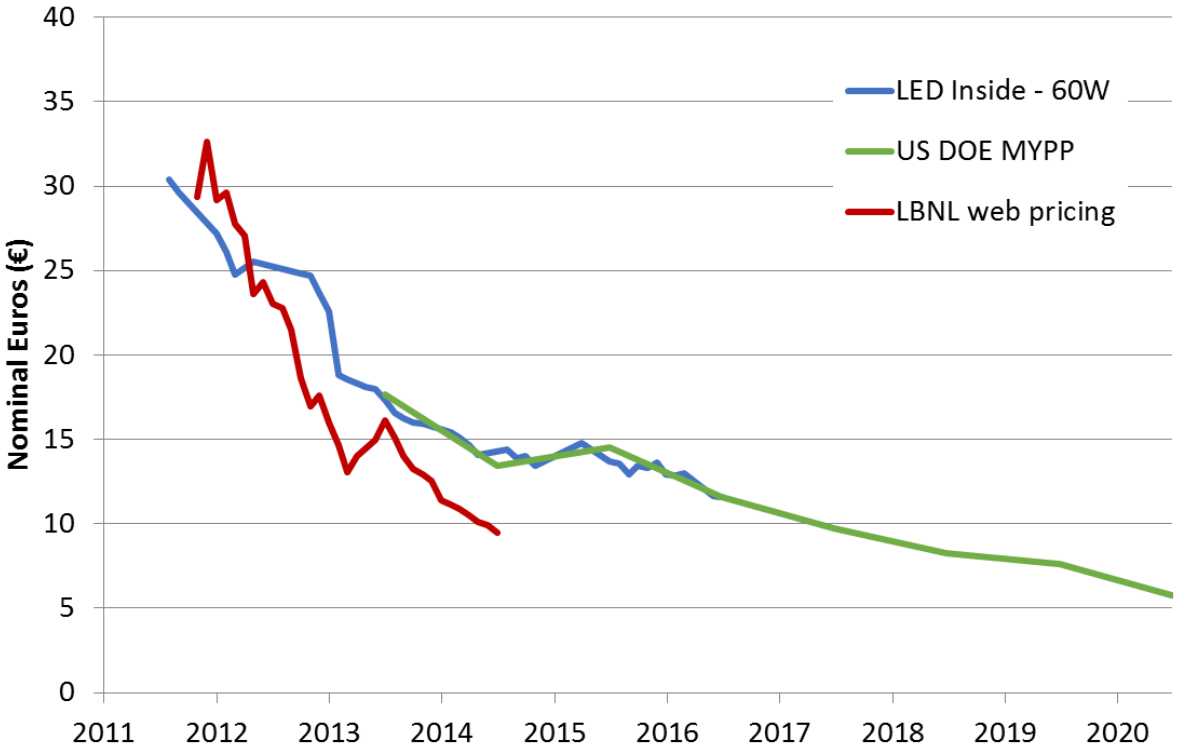

Figure 1. Combined plot of three trends for 60-Watt equivalent LED replacement lamps

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.

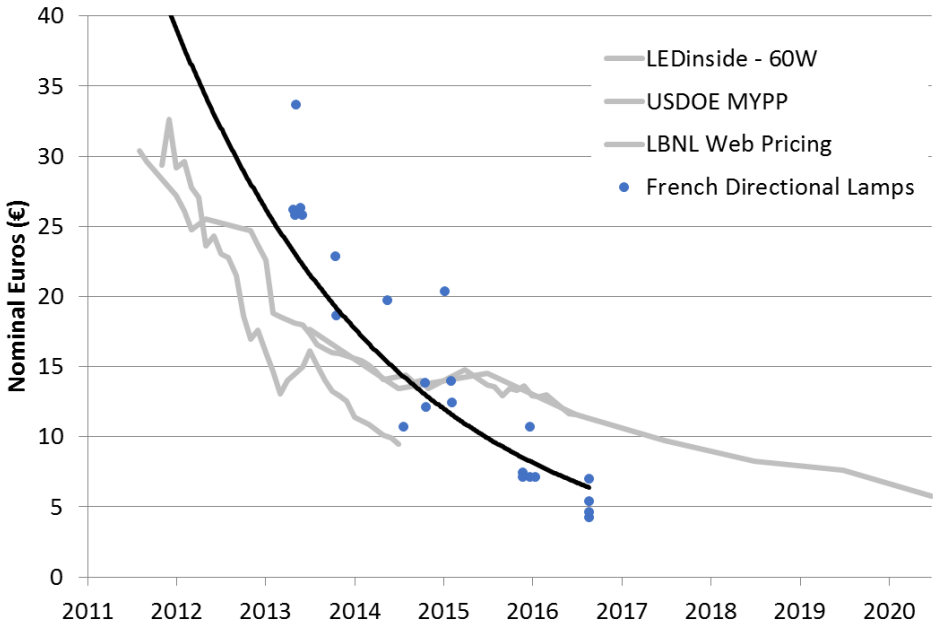

Figure 2. Nominal prices of French LED lamp prices compared with the global trend

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.

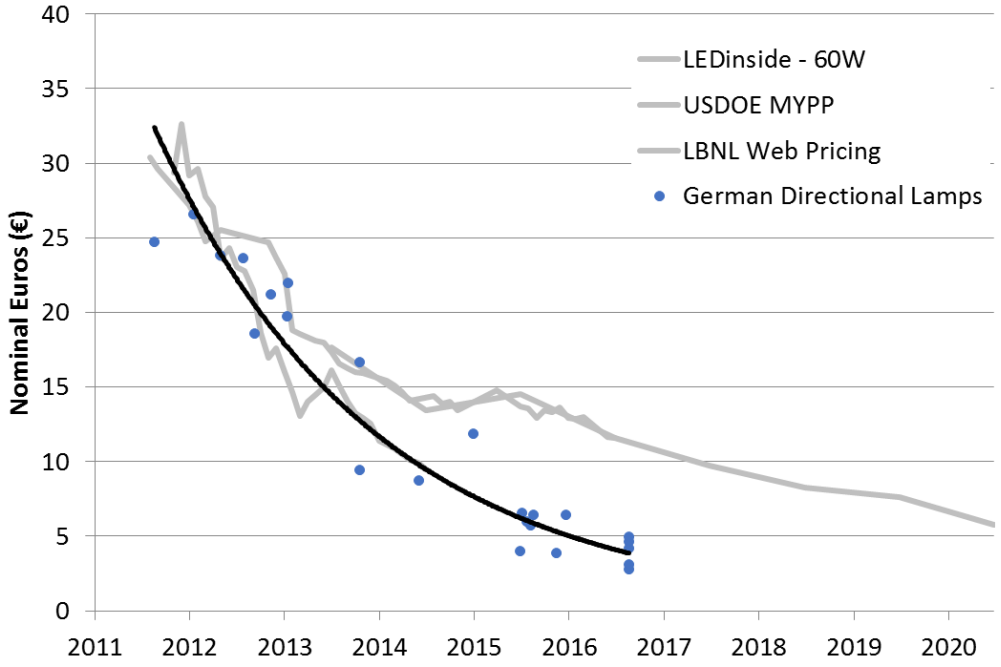

Figure 3. Nominal prices of German LED lamp prices compared with the global trend

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.

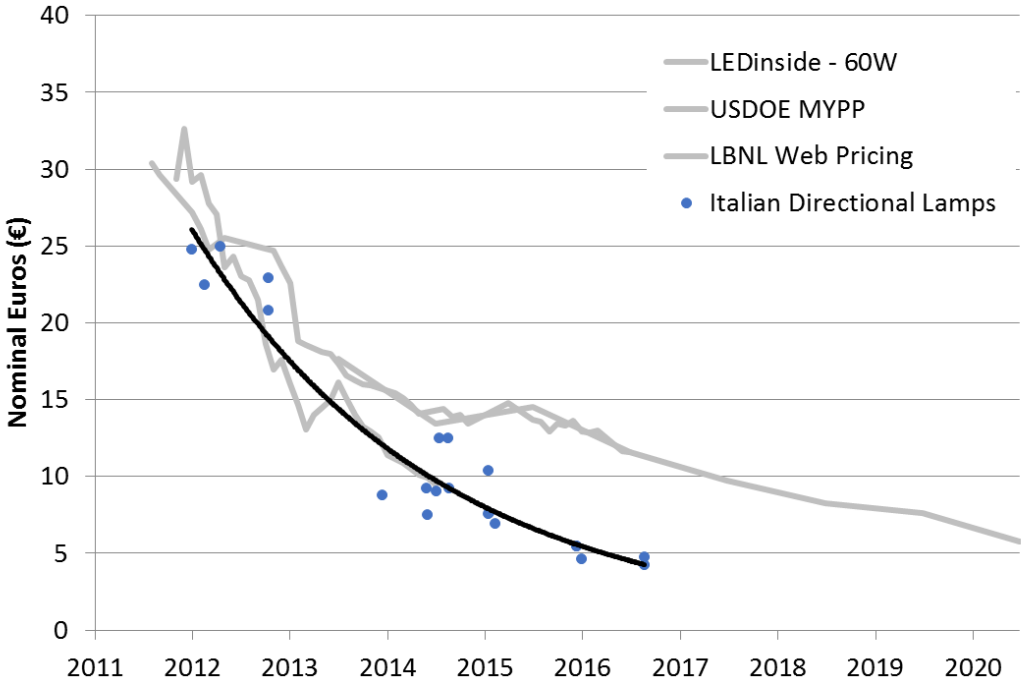

Figure 4. Nominal prices of Italian LED lamp prices compared with the global trend

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).

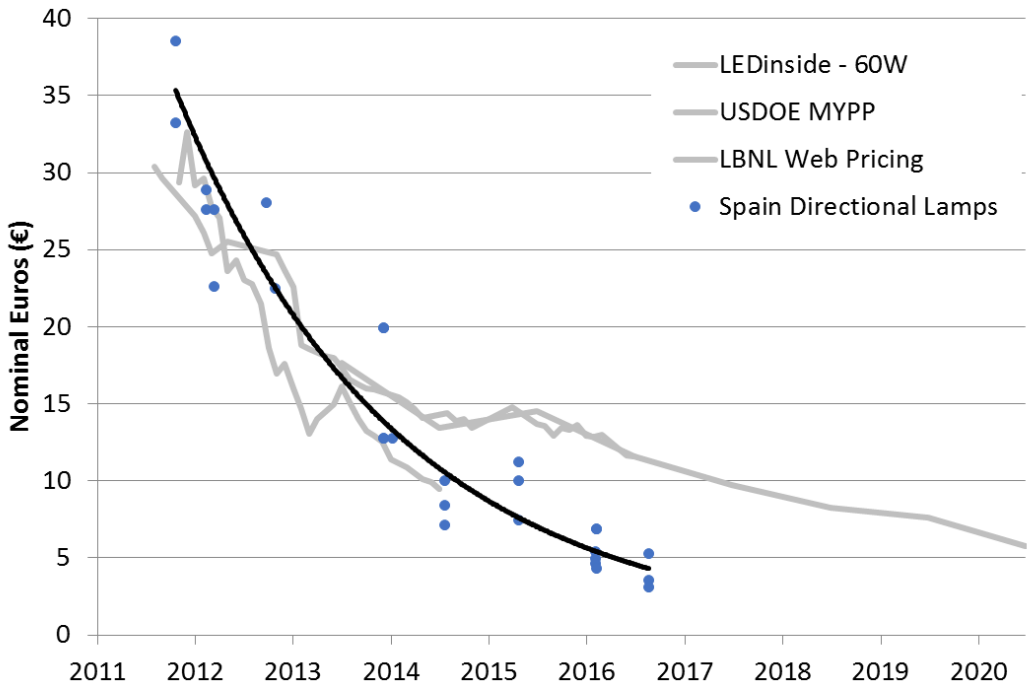

Figure 5. Nominal prices of Spanish LED lamp prices compared with the global trend

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.

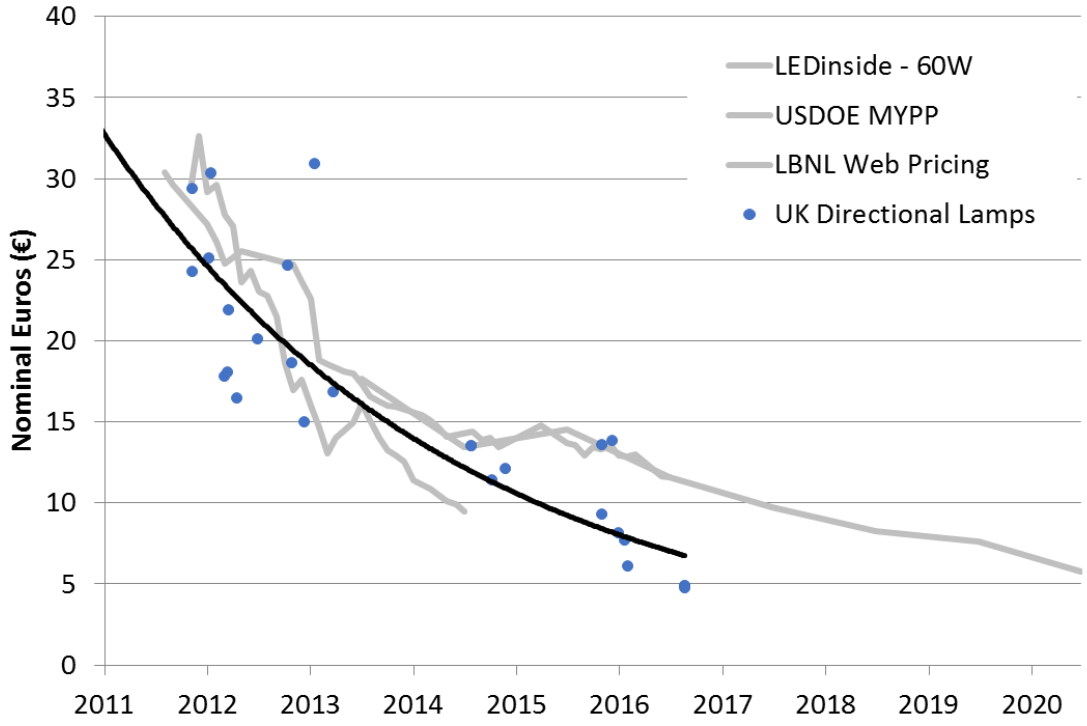

Figure 6. Nominal prices of UK LED lamp prices compared with the global trend

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 lamps[4] 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