

Review of LED Replacement Strategy Phase One

November 2015

Executive Summary

The pilot has been a success with 1562 units installed. This has formed the basis for a review to confirm that the business projections / assumptions have been achieved.

The following aspects have been reviewed:

- Installation Costs
- Energy and Carbon Savings
- Maintenance Savings
- Public Feedback
- Lessons Learnt

Looking at the installation costs there was a significant reduction in cost due to the materials being purchased at lower rates. The labour costs increased due to the accelerated program and the need to carry out the works at night time. However the costs were still 25% lower than originally projected and this information will be used in the phase two business case.

The energy saving assumptions have been in line with what was projected and is within 1% accuracy and due to the change in profile (50% / 25% light reduction) we are now seeing an 5% increase in savings by end of year 2.

Due to pressure on the revenue funding for the street lighting budget only £186k can be identified for all night lights. We can no longer show the savings for routine maintenance. It must be noted that if the lanterns are not changed to LED there would be an increase in lights out and additional capital / revenue would then be required to resolve the issue. We can however show that the reactive maintenance profile over 25 years is 8% greater than projected.

There was a number of public complaints relating to the LED brightness and there are a number of lessons learnt that will be put in place to ensure that the public perception of the brightness is managed and that shields are incorporated into the lanterns at the beginning to reduce glare in areas of concern.

Overall the pilot has been a success and we have a lot of information that will be used to ensure that phase two will be a success in terms of savings and public satisfaction.

Introduction

This report looks at the Essex LED pilot that undertook replacing 1720 lanterns to LED units in the following areas:

- Stansted Mountfitchet
- Burnham Town
- Maldon Town
- Great Dunmow
- Saffron Walden
- Colchester Town

The new LED implementation adopted a variable lighting profile to ensure that the LED replacement program achieves the maximum savings. The three stage variable lighting strategy proposed was:

- Stage one - 100% light output at 05:00 – 20:00
- Stage two - reduce to 70% light output at 20:00 – 00:00
- Stage three - reduce to 50% light output at 00:00 – 05:00

The business case projected that there would be a saving of **£2.94m** over 25 years. The Energy Saving were projected in year one saving to be **£64k** and **£94k** in year two once the full installation had taken place.

Table 1 – Business Case Quantities

Existing to be Replaced	Totals	New Installation	Totals
100 SON ST	137	Ampera Midi 32x 64W	374
100 SON ST	20	Ampera Midi 48x 97W	1,022
135 SOX LL	8	Ampera Maxi 80x 162W	240
135 SOX ST	51	Ampera Maxi 128x 253W	84
150 SON ST	743		
150 SON LF	228		
250W SON	240		
400W SON	84		
90 SOX LL	118		
90 SOX ST	91		

The commission was given mid-December 2014 and to ensure that we could deliver the project the lanterns were ordered before the designs were carried out. This meant that we could not tailor the designs to ensure the lowest wattage lantern could be used in each area. The designs needed to use the Central Management System (CMS) to reduce the output of the lanterns.

Due to the installation process it took up to two weeks for the new lanterns to be configured to the CMS system. During this period the lanterns were running at full output which may have been conceived by some members of the public as being too bright. A decision was therefore taken by the cabinet member to reduce the output to 50% (25% for Great Dunmow) which was actioned in April.

Installation

1720 columns were selected for conversion to LED and by April 1562 LED lanterns (92%) were installed with 158 units remaining.

Through the design process it was identified that there were some lanterns that could not be installed due to concrete columns. This is because they have passed their expected design life and a decision was made not to install a possibly heavier LED lantern as this could cause the column to have a catastrophic failure. However since phase one we have identified that one of our supply chain partners have the ability to test these columns using a specialist method to determine if they are suitable for the new units and it is proposed that we will use this process for phase two.

The remaining lanterns will be utilised at appropriate location during this year capital programme including the upgrade of junction 7 of the M11/A414.

Table 2 – Actual Quantities

Existing to be Replaced	Totals	New Installation	Totals
100 SON ST	145	Ampera Midi 48x 73W	361
100 SON ST	41	Ampera Midi 48x 97W	484
135 SOX LL	18	Ampera Maxi 64x 127W	452
135 SOX ST	59	Ampera Maxi 80x 162W	191
150 SON ST	688	Ampera Maxi 128x 253W	74
150 SON LF	92		
180 SOX ST	16		
250W SON			

	246
400W SON	67
90 SOX LL	118
90 SOX ST	72

Installation Costs

Looking at table 3 it can be seen that the business case average cost per unit was £506 and the actual cost is £376. The reduction in cost was significantly helped due to combined purchasing with our other contract in Hertfordshire. This negated the increase in labour costs that were incurred when the site visits were undertaken through the hours of darkness due to the program being brought forward and the need to complete within two months. A breakdown of the installations costs are shown in Appendix A.

Table 3 – Installation Cost Comparison

	Business Case Costs	Average Cost / Unit	Actual Costs	Average Cost / Unit
Labour	£ 46,560.10	£ 29.81	£ 65,274.24	£ 41.79
Material	£ 719,132.30	£ 460.39	£ 493,699.00	£ 316.07
Traffic Management	£ 25,304.40	£ 16.20	£ 28,001.19	£ 17.93
Total	£ 790,996.80	£ 506.40	£ 586,974.43	£ 375.78

The design, supervision and project management were in line with what was expected. Table 4 shows the total cost comparison.

Table 4 – Project Cost Comparison

	Business Case Costs	Actual Costs
Design Cost	£ 40,866	£ 36,968
Supervision / Management	£ 30,323	£ 29,349
Overhead Fee	£ 41,521	£ 34,266
Installation / Materials	£ 790,996	£ 586,974
Total	£ 903,706	£ 687,557

Energy Saving

Looking at the projected energy increase the cost per kWh was **10p** up to March 2016. The forecast increase provided by ECC will be **10.42p** giving a total increase of 4.03%. Which shows a higher increase in energy saving than projected.

We can now see that the original projection using the Department of Energy and Climate Change (DECC) are closer to the actual increase. Essex County Council officers are carrying out an assessment to show the potential range in increase for the second phase of the LED project.

Table 5 – Energy Increase Comparison

Energy inflation rate as below and then 3.2% thereafter (Based upon RPI figures provided by ECC).

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
ECC Inflation Forecast based on RPI	0.00%	2.90%	3.20%	3.10%	3.20%	3.20%	3.20%	3.20%	3.20%
Actual	0.00%	4.03%							

Looking at the business case and the lanterns that were actually installed it can be seen that the reduction in energy has exceeded the forecast for year one due to the accelerated program and that levels were reduced further to 50% and 25% in Great Dunmow.

Original Profile

Although there has been a decision to reduce the lighting levels, it is important to compare the savings that would have been achieved under the original variable lighting regime.

In year one the projected savings in the business case (1720 units) was **46%** (642,270 kWh). With the 1562 units that were installed under the accelerated program we would have saved **62%** (786,515 kWh).

In year two the projected savings in the business case (1720 units) was **66%** (923,940 kWh). With the 1562 units that were installed we would have saved **65%** (815,559 kWh). As 92% of the original numbers were the savings reduce from **£94k** (1720 units) to **£87k** just under 8% which demonstrates that this is in-line with the projections using the installed 1562 units see tables 6- 8.

It can be seen that the business case assumptions are within 1% accuracy.

Actual Profile

As there was a decision to reduce the light levels even further, this has increased the savings that were originally projected. For year one the cost savings increase to **66%** and a reduction of 860,416 kWh.

In year two the projected savings also increase to **71%** (891,714 kWh) giving a total cost saving of **£93k**.

Overview

Looking at table six which shows the projected saving and actual to date. It can be seen that there is an additional **£9k** saving this is due to the additional request to reduce the light output further.

Table 6 - Year 1 Savings to date:

	Column1	Business Case - 1720 units	Installed - 1562 - Original profile	Installed - 1562 - 50% / 25%
	Existing	669,922 kWh	605,357 kWh	605,357 kWh
	New	361,758 kWh	243,133 kWh	209,082 kWh
	Saving	308,164 kWh	362,224 kWh	396,275 kWh
Cost	Existing	£66,992	£60,536	£60,536
	New	£36,176	£24,313	£20,908
	Saving	£30,816	£36,222	£39,627
	Percentage	46%	60%	65%

Table 7 – Year 1 - Projections to year end (March 2016)

		Business Case - 1720 units	Installed - 1562 - Original profile	Installed - 1562 - 50% / 25%
Consumption	Existing	1,396,238 kWh	1,262,617 kWh	1,262,617 kWh
	New	753,969 kWh	476,102 kWh	402,201 kWh
	Saving	642,270 kWh	786,515 kWh	860,416 kWh
Cost	Existing	£139,611	£126,262	£126,262
	New	£75,457	£47,610	£40,220
	Saving	£64,154	£78,652	£86,042
	Percentage	46%	62%	68%

Table 8 – Year 2 Projections

	Column1	Business Case - 1720 units	Installed - 1562 - Original profile	Installed - 1562 - 50% / 25%
Consumption	Existing	1,396,238 kWh	1,262,617 kWh	1,262,617 kWh
	New	472,298 kWh	447,058 kWh	370,903 kWh
	Saving	923,940 kWh	815,559 kWh	891,714 kWh
	Percentage	66%	65%	71%
Cost	Existing	£143,659	£131,565	£131,565
	New	£49,353	£44,706	£38,648
	Saving	£94,306	£86,859	£92,917
	Percentage	66%	66%	71%

Carbon Savings

As seen above the carbon savings have also been higher than projected in year one and the year two saving are in line with what was projected.

Table 9 – Year 1 - Projections to year end (March 2016)

	Business Case - 1720 units	Installed - 1562 - Original profile	Installed - 1562 - 50% / 25%
Cost per tonne	18	18	18
Existing Tonnes	732.47	662.37	662.37
Existing Cost	£13,184	£11,923	£11,923
New Tonnes	495.15	249.76	210.99
New Cost	£8,913	£4,496	£3,798
Cost Saving	£4,272	£7,427	£8,125

Table 10 – Year 2 Projections

	Business Case - 1720 units	Installed - 1562 - Original profile	Installed - 1562 - 50% / 25%
Cost per tonne	18.58	20	20
Existing Tonnes	732.47	662.37	662.37
Existing Cost	£13,605	£13,247	£13,247
New Tonnes	250.80	234.53	194.58
New Cost	£4,660	£4,691	£3,892
Cost Saving	£8,945	£8,557	£9,356

Maintenance Savings

The original business case provided maintenance savings based on industry information for failures and routine maintenance. Due to pressure on the revenue funding for the street lighting budget only £186k can be identified for all night lights. However whilst we can no longer show the savings for routine maintenance it must be noted that if the lanterns are not changed to LED there would be an increased in lights out and additional capital / revenue would then be required to resolve the issue.

For year one we will still meet our maintenance savings through the reduced reactive maintenance. The reactive maintenance saving over 25 years using the same inflation rates as in the business case would increase by 8%.

Table 11 – Year 1 Projections

	Business Case Projection Year One	New Projection
Routine Maintenance	£ 7,855	£ 0
Reactive Maintenance	£ 13,065	£ 13,921
Post Retro		
Routine Maintenance	£ 1,647	£ 0
Reactive Maintenance	£ 13,065	£ 7,517
Savings		
Routine Maintenance	£ 6,209	£ 0
Reactive Maintenance	£ 0	£ 6,404

Table 12 –Projections over 25 Years

	Business Case Projection 25 years	New Projection
Routine Maintenance	£ 294,039	£ 0
Reactive Maintenance	£ 489,066	£ 521,077
Post Retro		
Routine Maintenance	£ 152,267	£ 0
Reactive Maintenance	£ 259,280	£ 281,382
Savings		
Routine Maintenance	£ 141,772	£ 0
Reactive Maintenance	£ 229,785	£ 239,695

Public Feedback

The LED pilot in some areas has confirmed that the perception of the lights were too bright even though lighting levels have been reduced in accordance with the latest British Standard. This is due the light source being of a white light which provides a better colour rendition. This means you can see defined colours better. This public perception is a problem that is faced all across the UK not only for LED but for fluorescent and other white light sources. There is normally an initial surge of complaints which tends to reduced once the residents become used to the change. It is also worth noting that LED's also have a higher discomfort glare when looking directly at the light source which adds to the perception of being brighter.

The street lighting team received 16 responses from Members and the public and all of these related to the perceived brightness of the LED's. Unfortunately to ensure that the number of lanterns were minimised and the installation could be brought forward, the lanterns were ordered before the design was carried out. This meant that there are a number of lanterns that were installed initially to bright and once connected to the central management system the lights would then reduce to the required output. Unfortunately in some cases once the perception was that they were too bright this was hard to mitigate the problem. A log of the issues reported can be seen in Appendix B.

Cllr Bass had also had a number of complaints about the levels of lighting and requested that the lights were reduced to 50% (25% in Great Dunmow), this was actioned in April. This will be reviewed through the winter months and will provide information for the variable lighting profiles for phase two.

Lessons Learnt

Planning

There was a request to install the first phase of the LED replacement program before the end of the financial year. This highlighted a need for more time to prepare and plan for the proposed phase two to ensure that issues such as concrete columns, over lighting, bracket fixings etc. can be resolved before the installation phase.

Concrete Columns

We have now identified through our supply chain partners that we can now test columns to determine their suitability for the proposed LED lanterns. However the liability would still remain with the Authority. The main failure for concrete columns are where the bracket joins the shaft so only concrete columns that have steel sleeves fitted will be assessed as part of the second phase. Concrete column which do not have a "sleeve" will be replaced.

Light Control

Lantern Tilt

Originally the lanterns were installed with a 5 degree tilt however a number of complaints were resolved by reducing this tilt to 0 degrees. The second phase would ensure that all lanterns were installed at 0 degree where possible. However there are some situations where the existing bracket tilt is 15 degrees and we can only reduce the lantern tilt to -10 degrees. In these situations where there is still a 5 degree tilt we will wait for public feedback before taking any further action.

The supply chain partner will be required to confirm all locations where 0 degree tilt is not achievable during the installation phase.

Internal Shield

There were a number of reported issues with light spill, for the second phase of the project there is the option to include an internal shield in the lantern. This does affect the lighting output but for all residential areas the design team will ensure that these are used, where possible, as standard. This will also help reduce light into residential properties.

Also a number of shields will need to be ordered to ensure that when there is a compliant where the shields have not been already fitted, the supply chain partner will be able to install a shield quickly to resolve the public concern.

Variable Lighting Review

Due to a number of complaints with regard to the lights being too bright, received by various members, there was a request to the street lighting team to reduce the light output to 50%

(25% in Great Dunmow). This can be evaluated to determine whether the authority would like to continue light below the levels recommended in the British standards.

As this request happened in the summer months this has not, until now, operated during peak traffic flow period. During the winter months the peak traffic flows are in the hours of darkness this means that there is a higher number of moving vehicles and pedestrians and in turn is harder to assess the road dynamics. The British standards recommended increasing the light levels in these times aids road users to evaluate these conflict more easily. We recommend that accident data for roads within phase one are analysed over a 2 year period to determine whether these levels are suitable throughout this peak traffic period. This could form the basis for a further reduction across the Authority.

For phase two it is recommended that the proposed profile to increase the light output when lights are in operation during the peak traffic hours (rush hour) is followed. We can then monitor the public perception, if feedback is that the level is too high then we can assess whether the light output can be reduced safely.

It is important to note that across the UK when authorities have changed to a white light source like Cosmopolis, LED, etc. the public perception is that the lights are too bright even though lighting levels have reduced. This is due the lighting providing a better colour rendition meaning that you can see defined colours better and improves visibility. There is normally an initial surge of complaints which tends to reduced once the residents become used to the change. For phase two we are looking to promote a 4 week period following the installation of the LED lantern to allow the public to get use to the new lighting. Once this period has passed we will then review any responses we receive.

Business Case Costing

The pilot has demonstrated that there are some variances in the installation costs and we will ensure that the business case for phase two can be refined to ensure that the costs are in line with the lessons learnt in phase one.

Appendix A - Actual Installation Costs

Description Of Work	Qty	Unit	Rate	Total	Comments
Lanterns Wired Up At Springfield Depot Approx. 40 No Units A Night Man & A Van	1562	Nr	£ 4.65	£ 7,263.30	ESL Ltd
Lanterns Wired Up That Had To Be Changed At Springfield Depot. 40 No Units A Night Man & A Van	270	Nr	£ 4.65	£ 1,255.50	ESL Ltd
Lanterns Installed On Columns That Has To Be Rewired. 30 No Unit A Night Man & MEWP	140	Nr	£ 7.57	£ 1,059.80	ESL Ltd
Existing Lanterns Removed From Street lighting Column And Returned To Springfield Depot. 30 No Unit A Night Man & MEWP - Including Revisits	1720	Nr	£ 10.09	£ 17,354.80	ESL Ltd
To Remove And Install Brackets Various Size Brackets And Locations	324	Nr	£ 12.11	£ 3,923.64	ESL Ltd
Collect and install lanterns - Including Revisits	1720	Nr	20.01	£ 34,417.20	ESL Ltd
Various Lighting Columns Brackets	302	Nr	£ 44.91	£ 13,562.00	The amount from Requisitions
Various Lighting LED Lantern	1562	Nr	£ 247.19	£ 386,104.60	The amount from Requisitions
Conduit Dimming Telecell	1562	Nr	£ 45.90	£ 71,695.80	The amount from Requisitions
2.5 Flex Cable	20306	m	£ 1.10	£ 22,336.60	
Traffic Management	1	Nr	£ 28,001.19	£ 28,001.19	The amount from Requisitions
Total				£ 586,974.43	
Prorated Unit Rate				£ 375.78	

Appendix B - Project Feedback

Date	Name	Address/Location	Details of Complaint	Details of Complement	Action
5/3/15	Resident 1	Cambridge Road Stansted	Opposite – property, check lantern tilt, intrusive	Likes the scheme overall as improves security	Reduce the tilt to 0 degree use spirit level – if still not at 0 degrees then report back the bracket diameter. Reduce the light to 50%
9/3/15	Resident 2	North Street , Great Dunmow Cm6 1ba	Light opposite shining window		Reduce the tilt to 0 degree use spirit level – levels reduced as per original design outputs
9/3/15	Resident 3	East Hill Colchester opposite Belgrave / priory road.	Light opposite is shining in the window		Reduce the tilt to 0 degree levels reduced as per original design outputs use spirit level
18/03/15	Cllr Margaret Fisher	Bergholt Rd and North Station Rd are the two streets	Could engineers please reduce the level of lighting please		Lights reduced to 50%
27/03/15	Resident 4	Pyms Road O/S number 64	light has been installed, it's incredibly bright and is not turning off with part night lighting, staying on all night.		Levels reduced to 50% and convert back to part night lighting
27/03/15	Resident 5	O/S No 302. This is a new development but showing as open field on the map. MILL ROAD	Two of the street lamps on the roundabout is far too bright as it penetrates a child's front bedroom window and keeps her awake. Requesting shades to cover the glare.		Levels reduced to 50%
30/03/15	Resident 6	Colchester Road, outside house number 10	LED version and is far too bright and also stays on all night.		Levels reduces to 50%
31/03/15	Resident 7	Godfrey way / facing B184	Light shining through window Reduce tilt to	Now happy with the	Reduce the tilt to 0 degree use spirit level and dim light

			0 and add shield to roundabouts	levels	further
31/03/15	Resident 8	Hansalls butcher shop 5A high street	The bright street lights in Maldon. Tilt one more down	Now happy now that the lantern is correctly tilted	Reduce the tilt to 0 degree use spirit level
09/04/15	Resident 9	Straight Road, Lexden Colchester Essex	LED lights at an adjacent junction to our property and the resulting misery it is causing.		Light Output reduced to 50%
10/04/15	Resident 10	King George's Place,	My flat shining directly into my lounge looks like daytime		Levels reduces to 50%
10/04/15	Resident 11	The Courtyard, Spital Road, Maldon Essex	Light shining into all windows		Levels reduces to 50%
13/04/15	Resident 12	opposite 41 Parsons Heath, Colchester	front louvre fitted to the LED		Tilt down to 0 degrees levels reduced as per original design outputs
	Cllr Harris	4 & 6 Blackheath	LED are too bright		Lights reduced to 50%
28/04/15	Members Enquiry	10 Willow Road Great Dunmow?			Lights reduced to 25%
15/06/15	Cllr Fisher and Cllr Turrell	Lights not dimmed			Confirmed that the lights are dimmed