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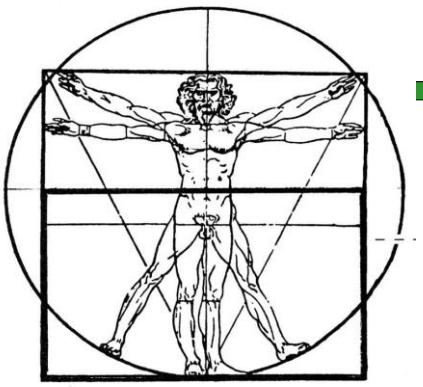

Green Energy Technology Advisory Note

Brighton & Hove City Council
Energy Saving and Economics
of
Traffic Light Replacement

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Technology Advisory Note

by Jim Adams

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1: EXECUTIVE SUMMARY:

This Technology Advisory Note proposes a feasibility study into a programme for the replacement of the current incandescent traffic light signals in Brighton and Hove by energy-efficient, cost-effective **Light Emitting Diode** (LED) based signals. Substantial "green" energy environmental benefits and significant financial savings are possible.

Traffic lights currently and developments:

- The Brighton & Hove City traffic light system at present only uses limited applications of LED technology for some pedestrian signals on pelican crossings[1].
- There is wide implementation of LED traffic lights in the United States, where for example the California Energy Commission's new traffic signals programme assists with low interest loans[2].
- Unmonitored LED traffic lights use *only 20% of the energy* of a conventional system. However, the monitored Siemens Helios LED with automatic LED failure detection uses *40% of the energy* of a conventional system[3].
- In the city of Denver, USA, introduction of LED traffic lights equated to a fall in the electricity bill for traffic lights from $330,000 per year to $26,000 per year, with a saving of CO_2 equivalent to removing 1,000 cars from the road[4]. Significant savings could also be made in Brighton & Hove.
- Whereas in 2004 US purchase costs of LED traffic lights were 60% greater than incandescent traffic lights, they last 10 times longer (figures quoted vary, from up to 6 years, to up to 10 years)[5].
- The reliability of LED traffic lights has been questioned from the point of view that banks of them can fail[6]. However, technical failure is only partial with LEDs, whereas when an incandescent lamp fails, it does so all at once, mean time between failure is 10 times longer for LEDs, and automatic monitoring is possible.
- The claim[1] cannot be correct that Brighton & Hove does not use LED technology because it is not currently integrated into the Siemens automated traffic light replacement signalling system, at present operational. Rather, this aspect can only be one of cost.
- The simple investigations of the financial and environmental cost benefits of replacing traditional traffic lights by LED traffic lights that we have made (a monitored UK compliant LED traffic light is 4 times the cost of a traditional bulb, but lasts 10 times longer, therefore there should be reduced costs on lamps to 4/10 = 40% of

the original costs and moreover there would be reduced energy costs to 40% of the original) – does not square with the present perception from Brighton & Hove City Council Sustainable Transport Division. We would like to know why.

2: INTRODUCTION:

Simon Burgess, Leader of Brighton & Hove City Council has stated: "I want us to be leading nationally on issues such as sustainability"[7] and "I am very keen that this City should be at the forefront of sustainability… I will continue to push the boundaries in this regard"[8].

This draft study is an attempt to progress on one aspect of that sustainability – to reduce the energy consumption by traffic light signals in Brighton & Hove. A successful implementation locally could lead to a national take-up of LED traffic light signalling systems. Brighton would be a significant "early adopter" and leader in demonstrating such "green energy savings".

3: TRAFFIC LIGHTS IN BRIGHTON & HOVE:

For Brighton and Hove City Council, traffic signals procurement is organised in the Sustainable Transport Division in Bartholomew House, Bartholomew Square, Brighton.

According to L.G.O. Sean Power, LED traffic lights have not yet been introduced in Brighton and Hove because whether they are working or not cannot be detected remotely, unlike conventional bulbs. This information is fed in automatically to the traffic light replacement system. Therefore there can be no input to the automatic system, at present.

With reference to successes in the US, he states that the US traffic light systems are different, in that the sequence commonly cannot be varied.

After some preliminary investigation, our perception contradicts this. Brighton & Hove City Council uses a Siemens automatic traffic light monitoring system. The Helios CLS (Central Light Source, i.e. LED) with lamp monitoring is available from Siemens. The Siemens blurb states: "Helios' Central Light Source offers a highly reliable LED signal, but defects in street cables and terminations mean that signal failures may still occur and lamp monitoring is therefore recommended.

Utilising Siemens' patented lamp monitoring technology, Helios CLS can be monitored by a wide range of Siemens equipment. This allows standard incandescent signals to be replaced with LED optics, eliminating the need for expensive street cable or controller alterations. For applications where lamp monitoring is not required, Helios CLS Lite provides a cost effective alternative"[3]. Thus, at least one company offers compatible monitoring technology, and other companies in the UK, for example Coeval Group, provide compatibility to most modern monitoring technologies.

4: LED TRAFFIC LIGHT HISTORY:

In 2002 ½ million traffic lights were lit up by LEDs in the US. This saved 400 terawatt-hours[9]. The UK equivalent might be around 15 terawatt-hours.

For example, between 1999 and 2006 in Salt Lake City in Utah, a City with a population three quarters the size Brighton & Hove, 1,630 traffic lights were converted to LEDs, which saved more than 500 tons of CO_2 pollution each year and cost the city $53,000 less than conventional bulbs[10].

In California in 2002 the LED replacement programme had total project costs of $41 million, of which funding requested was $21.7 million. Funding is available from the Californian Energy Efficiency Financing Program via low interest loans for feasibility studies and installation of energy-saving measures, which must have a pay back of 9.8 years or less[2]. The State Legislature, following previous "brown-outs" of electricity supply in the State in 2001, considered this project very important[11].

In Indiana, 16% of the incandescent traffic lights are being replaced by LEDs every year.

The traffic light replacement programme in the US is included in the Sierra Club "cool cities" program, of collective involvement by citizens and mayors acting against climate change and independent of the Bush administration[12].

The take-up in Europe has been slower.

In the framework of a joint project between Siemens, the City of Aachen and AIXTRON, the first LED traffic lights had been installed in 1998 at the junction of Roermonder Str./Kacker Str. in Aachen.

In a contract awarded to Siemens, the City of Aachen then decided to retrofit 111 City traffic lights with LEDs[13]. This system is now functioning.

In Britain the take up has been sporadic. Early limited tests of LED traffic lights first took place in Bristol and London. We investigated the situation in Bristol, and spoke to Emma Foreman of Bristol Traffic Department.

Together with London, Bristol was one of the first trial areas for LED traffic lights in the UK. The original junction that used LEDs has now been completely redesigned, and LEDs are not now used in that locality. LED traffic lights are at present used in Bristol in areas where the signals cannot be reached by ladders, in a limited number of other areas, and in a number of pelican crossings.

Bristol is tied in to an agreement with Siemens for all its traffic lights, monitoring and control equipment. Siemens LED traffic lights cost £800 a head, whereas the incandescent bulbs cost £200 a head. Siemens will provide LED traffic lights at £400 a head in orders of over 1,000.

Bristol Traffic Department is independent of, and does not therefore consider accounting for, electricity provision for its systems. There is thus no practical incentive to reduce energy costs.

I spoke to Andrew Westwood, manager of Brighton & Hove City Council Sustainable Transport Division, and he assures me that Brighton & Hove do account for energy costs in deciding on the type of traffic light. He points out that if TfL (Transport for London) bought large numbers of LED traffic lights, this would bring down costs, as had been indicated in Bristol. Brighton & Hove are not tied to any one supplier, and they work with ESCC (East Sussex County Council) in tendering for the cheapest option. He points out that American suppliers (compare the cost of £800 for the Siemens head with £113 - £137 mentioned subsequently for comparable American costs) are not compliant with Department of Transport standards. I queried whether they could become so.

5: LED TECHNOLOGY:

In one guise or another, LEDs (Light Emitting Diodes) have been around for almost 45 years. In 1991, Theodore Moustakas of Boston University and Shuji Nakamura of Nichia Corporation in Japan discovered how to make gallium nitride buffer-layers, and Nakamura went on to build the first working LED from gallium nitride in 1994[9].

These LED units are available in multiple colours, and are the LEDs now used in traffic lights[14].

The main manufacturers are in the US (e.g. Cree Lighting Inc.) and South East Asia (including Japan, e.g. Nichia Corporation)[9].

In Germany, CML Innovative Technologies manufacture them[15].

Companies in Britain in this sector are Forge Europa and Marl International, both in Ulverston, DG Controls in Swadlingcote and Graphite UK in Nottingham[16]. UK sourced technology and engineering support is therefore available.

As distinct from LED manufacturers, we have identified three UK manufacturers of LED traffic signals. There may well be more. These are The Coeval Group in Edinburgh, Microsense Systems in Fareham and Siemens Traffic Controls in, for example, Poole.

A traditional traffic lamp has a significant loss of brightness after 5,000 hours, no uniform brightness, low contrast with sunlight, and involves a yearly interior cleaning of the lamp, with preventative six-monthly maintenance.

A LED traffic light has a brightness loss after 10,000 hours of only 6% - 12%, very uniform brightness, a high contrast with sunlight, and involves no interior cleaning of the lamp and no preventative maintenance. An additional advantage of LEDs is their ability to concentrate light in a very tight angle, which permits visibility even from long distances and in bad conditions[17].

6: LED ENERGY EFFICIENCY:

Gallium nitride LEDs use *only 20% of the power* of an equally bright conventional bulb.

An example is the Werma 890 traffic light[18].

In California, the new LED lights reduce the State's need for electricity by nearly 10 megawatts: enough electricity to power nearly 10,000 typical California homes[11].

7: LED COSTS:

In 2004, typical US LEDs for a set of three traffic lights cost $225 - $250 (£113 - £137), compared with traditional lights at $150 (£82)[4]. The cost of LED traffic lights is going down. On a cost benefit analysis, LED signalling has rapid payback and substantial cost savings thereafter.

In the US it has been found LEDs provide other cost benefits as well. When an incandescent traffic signal lamp fails, it burns out all at once, and incandescents typically need to be replaced every two years. The pinpoints of light in an LED lamp, on the other hand, do not burn out at the same time and LED lamps have a lifespan of up to 10 years. Fewer burned out traffic signals mean safer intersections, an important improvement in public safety. Agencies that have installed have discovered savings, additional to the energy savings and cost reductions, in traffic signal maintenance and lamp replacement costs because highway crews need to replace burned-out signals less frequently[11].

Costs are high when the production volume is relatively low. Large-scale procurements definitely have an impact on first costs, which leads to more buyers in the market.

Life cycle costs have also to be considered[19].

8: RECOMMENDATIONS:

- That a feasibility study is begun into determining whether to proceed with a programme of replacement of traffic light signals in the City of Brighton and Hove by LED traffic light signals.

- If such a decision is made, it is required to determine
  (1) The start date.
  (2) Whether an initial test-phase is required – and at which junction(s).
  (3) The funding, which affects (4) below.
  (4) The replacement rate, bearing in mind cost effectiveness, energy efficiency, and climate change criteria.
  (5) Where LED versions using the current automatic traffic light replacement notification system are still needed (or where they are not needed).
  (6) To redesign working practices to accommodate the new system.
  (7) To determine suppliers.
  (8) To determine whether the project should involve partners other than Brighton and Hove City Council.
  (9) To ensure that the people who are affected 'own' the system, and can openly discuss and criticize its development and consequent changes to working practices.
  - If such a programme is agreed and successful, to lobby Government to encourage and provide funds for a national energy efficient traffic signals replacement programme. It should be noted that there are government funds, via the Energy Saving Trust and the Carbon Trust, to support such projects.

9: CONCLUSIONS:

LED traffic lights are yet another good example of technical innovation. The UK urgently needs to adopt it. It seems likely that eventually the production of traditional traffic lights will go the way of candle making after the invention of the electric light bulb. To quote from Pat Johnson, a senior US traffic engineer for Louisville metro government "Waiting for technology to improve and the cost of the new lights to drop was a good strategy. Now, the cost has come down where it's a no-brainer. If you didn't use LEDs … you'd be stupid".[4]

In terms of a broader scope, climate change is now THE problem that we individually and collectively have to face, more important now, we believe, for our 'Global Republic' than most other international political issues of war and peace.

The issue of reducing carbon emissions by introducing LED traffic lights might be only a very small part of what must be done, but the long

journey we must make in tackling climate change is composed of many small steps.

We offer this Technology Advisory Note as a ‘small step’ as part of our contribution to tackling climate change.

CAVEAT:

This report has been prepared “pro bono”. It is a “Public Science” document. Wherever contentious statements are made, these are qualified, where required, as an expressed legal-technical-scientific opinion on a matter of public policy and concern. The opinions expressed herein, are entirely those of the author.

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