



**Report To:** Greater Cambridge Partnership Board

26 July 2017

**Lead Officer:** Chris Tunstall Interim Transport Director

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### **City Access Strategy: Update and proposed next steps**

#### **Purpose**

1. To report to the Board on progress (Appendix A) and direction of travel with the City Access Strategy which aims to reduce traffic flows through the City with provision of more sustainable alternatives, including:
  - (a) A scaling up of the evidence base on which proposals can be made.
  - (b) To provide details of a feasibility study carried out on the potential use of electric and hybrid buses.
  - (c) To provide details of a feasibility study underway on the efficiency of the existing traffic signals on the network.
  - (d) To provide details of the findings in respect of the on-street parking review.
  - (e) The report also provides an update on the relocation of Papworth Hospital and proposed additional transport arrangements to the Cambridge Biomedical Campus (CBC) site.

#### **Recommendations**

2. It is recommended that the Board:
  1. Note the updates.
  2. Note the feasibility studies and receive further reports in September on the findings and recommendations in respect of:
    - a. Use of Electric/ Hybrid buses
    - b. A review of the Cambridge Traffic Signal network
  3. Agree to carry out further consultation and engagement with residents and the business community in both Cambridge and South Cambridgeshire on their transport needs and issues, as part of a wider 'Travel Diary' exercise, to help understand existing travel patterns, issues and incentives to change; including working with businesses to understand needs of employees from travel to work areas outside of the Greater Cambridge area; and
    - a. To determine local transport priorities that could receive funding were a Workplace Parking Levy WPL to be introduced, building on employers' evidence of transport needs and in coordination with the Greater Cambridge Partnership.

- b. To coordinate with and, if feasible, form part of the GCP and the Local Enterprise Partnership's broader engagement with the business community.
- c. To develop and provide practical support for employers and schools looking to manage their parking demand and provision working closely with Travel for Cambridge.

To report back the findings to a future meeting of the Board.

- 4. Agree that the Director of Transport continues to negotiate a potential funding contribution for a Rural Hub Park and Ride service to be located at the soon-to-be-closed Papworth Hospital serving the Cambridge Biomedical Campus; and that a report be brought back to the next meeting

### **Reasons for Recommendations**

- 3. To provide a progress report in respect of the work being undertaken and progress made to achieve the City Access Strategy.
- 4. To provide an understanding of the opportunities, benefits and risks of electric/ hybrid buses and their use within Cambridge.
- 5. To provide an understanding of the opportunities, benefits and risks that an update of the Traffic Signal network in Cambridge would bring.
- 6. To enable officers to engage with residents and businesses travel requirements, within both Cambridge and South Cambridgeshire, to further develop our evidence base particularly in respect of the diary travel exercise. As part of this we will also discuss the implications and the potential impact of a WPL, as required by legislation, to ascertain whether a viable scheme could be developed and brought back to the Executive Board for consideration and discussion. This would be alongside the identification of schemes and priorities that could realise benefits to local businesses, residents and the transport network by initially identify areas/improvements that could be funded using revenue raised through a possible WPL.
- 7. To enable officers to progress consideration and development of evidence based potential measures based on the findings of the ANPR survey and further outcomes based on the findings of the Travel Diary survey.
- 8. To enable officers to negotiate appropriate, viable and mutually satisfactory funding contributions for a Rural Hub Park and Ride arrangement at Papworth serving the Cambridge Biomedical Campus.

### **Background**

- 9. The Greater Cambridge Partnership (GCP) vision is to make it easier to travel in, out and around Cambridge and South Cambridgeshire by public transport, cycle or on foot, and to reduce and maintain lower traffic levels in the city to ease congestion, through the creation of better, greener transport networks that connect people to homes, jobs, study and opportunity, and investment in Smart Technology.
- 10. The public and stakeholder consultation undertaken during July-October 2016 found there to be a range of views on the best options to reduce peak time congestion in the city, and specific views on what would and would not be acceptable. The January 2017 Executive Board' recognised:
  - (a) Doing nothing was not an acceptable option.
  - (b) The need to reduce traffic traveling through Cambridge by 10% -15%.
  - (c) The need to improve air quality.
  - (d) Buses need to be made more viable.

- (e) A different approach towards Traffic (Demand) Management than the originally-proposed Peak-time Congestion Control Points must be investigated.
11. To achieve this the strategy for City Access is looking to reducing traffic flows within the City by between 10-15%. That this would be achieved by providing more sustainable and reliable alternative modes of travel such as bus, cycling and walking, accepting that ultimately some forms of demand management may be required but that such measure need to be clearly evidence-based and -led.
12. A joint Board and Assembly Task and Finish Group is currently reviewing the future Investment Strategy for Transport beyond 2020 which will assist with the further development of the City Access Strategy. The result of this should be available later this year.

### **Evidence Base**

#### *ANPR Camera Traffic Survey*

13. The Automatic Number Plate Recognition (ANPR) survey that took place in Cambridge between 9<sup>th</sup> and 18<sup>th</sup> June 2017 is one of the largest ever undertaken. It will provide data primarily for Traffic Management and other City Access Projects, but can also be added to the Cambridge Sub-Regional Model2 (CRSM2) to provide increased accuracy of modelled data within the city centre area.
14. There is a requirement for buses to move more freely, more reliably and faster through the central area, in particular on north-south and east-west spine routes. This requires an understanding of which traffic is essential to the functioning of the central area and which traffic is using the central area routes to cross the city, the latter of which could be directed onto a more suitable route to free up space on the central network for the former.
15. ANPR camera surveys can discern individual vehicles within traffic, and because of this, a number of cameras used on a network enables vehicles' journey times and potential route options/preferences to be understood and analysed.
16. The data captured will provide valuable insight into traffic movements into, out of, and through the City central core area. From the data gathered, we expect to be able to understand journey times and trip chains (therefore delays, congestion and journey time reliability), fleet make-up (diesel/petrol/hybrid/electric) and therefore impacts on air quality.
17. The data is currently being collated and 'cleaned'. Associated data that the survey company will source from the DVLA includes vehicle types, vehicle emission standards, vehicle weights (for HGVs) and number of seats (for buses); the survey company does not source vehicle owners'/keepers' address details.
18. The finalised dataset is expected to be available mid-summer, at which point it will be interrogated. The information will be very useful and can be used to inform our upcoming engagement with residents and businesses in both Cambridge and South Cambridgeshire and each of the elements of the City Access Strategy, including the City Council's air quality work (which may include electric vehicle and charging aspects), looking at access to the rail stations, Park & Ride P&R aspects, and potentially also travel planning work for key employment areas. This data will also support other developments not associated with the GCP.

#### *Engagement and Travel Diary*

19. Plans are currently being developed for a 'conversation' in the autumn, together with a Travel Diary Questionnaire with all Greater Cambridge residents, in relation to their

future plans for travelling and what they feel that they need to have in place to enable them to make changes to their travel methods.

20. In addition it is intended to enter into dialogue with local businesses in respect of their requirements and of their employees, particularly those who live outside of the Greater Cambridgeshire area.

### Updates

#### Demand Management

21. A component of the City Access programme is the need to consider demand management. However, this work needs to be clearly evidence-led and –based, and as such, has been paused pending the results and findings of the ANPR survey and the emerging findings from the Task and Finish Transport Group (TFTG), which is one of a number of joint GCP Board and Assembly Groups set up to consider and recommend future direction in respect of on-going Transport investment.

#### Workplace Parking Levy WPL

22. Access to workplace parking in the urban environment significantly contributes to congestion and emissions. A WPL does not directly create changes to traffic in the same way as Traffic Management measures might; instead it is identified as being a process through which revenue can be raised, the monies from which can be used to invest in the provision of alternative transport and the transport network. This can enable growth in housing and employment to take place, by increasing sustainable transport use and, therefore, increasing the capacity of the transport network.
23. The majority of the revenue received from the Nottingham WPL is provided by medium to large business; these are likely to have a significant presence on the transport network and a greater impact on congestion, particularly in peak periods. They are, however, often better placed to support change in travel habits by working with their staff to enable flexibility and ease a transition to increased use of sustainable transport. In Cambridge this is already taking place, with some of the larger businesses on the Cambridge Science Park trialling electrically assisted bikes for local business transport.
24. With the addition of Controlled Parking Schemes to restrict the ability of any displaced vehicles from using on-street parking, WPL can have an impact on congestion and encourage modal shift to more sustainable transport modes.
25. Evidence from Nottingham suggests that a WPL does not provide an immediate reduction in congestion, but one that it is likely to happen over time. To support this, it will be important to ensure that other modes of travel are improved. A bus network that is efficient is more likely to encourage modal shift than one that is regularly stuck in congestion alongside the rest of the traffic. Streets that have less traffic become more attractive areas for people to cycle and walk.
26. A WPL would require Secretary of State Approval for implementation to take place. To achieve this we would need to demonstrate that we have consulted widely with the Business community and largely addressed their concerns. We would also need to demonstrate that transport measures we are providing support WPL; this would include improvements to public transport and cycling infrastructure in the areas affected by the levy.
27. Discussions with Nottingham have made it clear that engagement needs to be early and extensive. Their success in delivering a WPL was linked directly to the engagement they had carried out with the business community.
28. As part of the wider engagement ‘conversation’ with the business community in respect of their and their employees’ travel requirements, it is recommended that

early engagement with the business community as part of the travel diary process should start in the autumn.

### Better Bus Services and Air Quality

#### *Electric / Hybrid Buses Feasibility Study*

29. Air quality in large areas of Central Cambridge and along key corridors is poor. Diesel vehicles have been identified as key emitters of pollution, especially those with larger engines, including buses, HGV's and LGV's, and taxis.
30. The Executive Board provided funding on 8<sup>th</sup> March 2017 for co-investment in electric vehicle charging points. This funding is currently assisting in the provision of electric charging points for taxis.
31. In respect of buses, a feasibility study has been commissioned into the possible provision of electric / hybrid public transport options.
32. The feasibility work evaluates a number of elements, including:
  - (a) Cities currently using electric buses, including York, Nottingham and London.
  - (b) Benefits and disadvantages of electric buses.
  - (c) Factors for success, such as:
    1. Infrastructure – charging facilities and locations, priority, depot
    2. Routes – length and complexity
    3. Operations – quality standards, driver training, interchange with other services
    4. Vehicles – costs, reliability, repairs and maintenance, batteries
    5. Commissioning – tenders, buying outright, partnership, Authority leasing
    6. Marketing, ticketing, information etc.
  - (d) Impacts on, and implications for, power distribution networks.
  - (e) Technology, including hybrid and full electric.
  - (f) Options for Cambridge:
    1. Park and Ride only
    2. Incrementally moving towards full city provision
  - (g) Options for Cambridge:
    1. Park and Ride only
    2. Incrementally moving towards full city provision
    3. An inner city shuttle (smaller buses)
33. The results of the initial study and recommendations for electric / hybrid bus opportunities for Cambridge can be found at Appendix B. A further Report in respect of the recommendations will be brought back in due course

### On Street Parking Controls

#### *Parking Review*

34. Steer Davies Gleave were commissioned by to produce a report that provides an understanding of the impact of the proposed Resident Parking Schemes in Cambridge. The report, at Appendix C provides a displaced parking overview and builds on previously undertaken survey work into levels of on-street parking in areas

of Cambridge, to provide an understanding of impacts if resident parking schemes are introduced.

35. The Mott Macdonald 2016 on-street survey results were reviewed and further analysis was undertaken to categorise vehicles parked on-street into resident, commuter and non-resident, non-commuter vehicles. This work provides an updated figure of the commuter displacement that parking restrictions would create and explores public transport considerations, including Park and Ride options and other alternatives for commuters currently parking on-street.

### Smart Technology

#### *Traffic Signals Review/Study*

36. Traffic signals are used to improve safety, such as helping people cross the road, or to better manage the flow of traffic or congestion at junctions in the network and also assist with the smoother flow of traffic helping with air quality. Within Cambridge there are currently 184 individual sets of traffic signals, around half of the total within Cambridgeshire. Of the signals within Cambridge 102 are pedestrian crossings and 82 are at junctions. 52 of the 82 junctions in the city have been installed in their current format for over 10 years.
37. Around 40 of the sites in Cambridge on key routes have their signal timings calculated automatically using a SCOOT UTC system. This system uses additional vehicle detectors buried in the road to monitor and then better manage congestion and flow at a strategic level. An additional 20 junctions have a MOVA facility; this works in a similar manner to SCOOT but is used at isolated sites. All signals in the city have a general system to detect vehicles and cycles, changing the signals and green times as required.
38. To ensure the traffic signal network within Cambridge is operating as efficiently as possible a full review of the network is to be undertaken. The review would determine the necessary upgrading needed to make operation of the network as efficient as possible.
39. A full review of all 184 installations in the city will identify where existing sites running under SCOOT need refining, or if the number of sites needs expanding. The same review would audit the SCOOT control system and how it works at a strategic level. Of the remaining sites, the project would identify where junctions are not working as efficiently as possible.
40. The cost of the study will be met by already approved 2017/18 funding from the GCP.
41. The outcome of the work would be a comprehensive report proposing where additional resources should be targeted to improve the general efficiency of the traffic signals asset in Cambridge, and suggest if alternative control strategies would be beneficial. This will be the subject of a further Report.

### Air Quality

42. Air Quality is a key issue for Cambridge, and the City Council has been working closely with the City Access team and other colleagues through the Working Group and Project Boards. The City strongly supports work to improve the evidence base, including the ANPR surveys, as this will provide up-to-date information on transport-

related sources of emissions, which can inform the consideration of a potential Clean Air Zone (CAZ). Work on electric vehicle charging infrastructure, which would support and enable such a CAZ, is also underway, together with the recruitment of a fixed term post to work within the City Council, providing additional capacity to assist with the work currently taking place on Air Quality.

43. Additionally, the City Council have coordinated a response to Defra's recent 'draft UK Air Quality Plan for tackling Nitrogen Dioxide' consultation. The overall feeling was that the draft Plan needed a more robust approach and further information on many elements if it was to be useful and effective, so it is hoped updates to the Plan will remove these concerns. The updated Plan from Defra is due at the end of July.

### **Papworth Hospital / Cambridge Biomedical Campus relocation update**

44. The forthcoming closure of Papworth Hospital and relocation to the CBC site will lead to a marked change in travel patterns of staff and visitors, and will increase travel demand to the already-busy CBC site. Around 1800 staff will transfer from Papworth to the CBC site in early 2018.
45. The University of Cambridge and the CBC have commissioned a West of Cambridge to CBC Bus Service Feasibility Study. The results of which are provided in Appendix D.
46. The study identifies that significant developments are planned at the CBC, including:
  - (a) Expansion of the Cambridge Biomedical Campus (CBC)
  - (b) The new headquarters for Astra Zeneca
  - (c) Abcam
  - (d) Addenbrooke's Seminar / Conference Centre, Learning and Development Centres and hotel (referred to as The Forum)

In addition:

- (e) Countryside Properties will develop Clay Farm (2300 dwellings) and ultimately Glebe Farm (320 dwellings with community facilities)

This level of development will put a notable strain on an already congested area, and it is likely that improvements to existing sustainable travel options such as Trumpington and Babraham Park and Rides will be required to mitigate likely impacts. This will be the subject of a future Report.

47. Consideration of a new bus service, which would be a service bus for all to use, is a planning requirement based on the Travel Plan submitted at the time of the Outline planning application for the CBC site. This sets ambitious targets for mode share by public transport that are far higher than the current Travel to Work mode share by bus in the general Cambridge area, which in the 2011 census was 3.99%.
48. The GCP has already promoted and provided funding for a major transport investment on the A1303 corridor to the west of Cambridge. Cambourne to Cambridge is a bus priority scheme as the A428 and A1303 are key routes into the city from the west. This is often congested between Papworth Everard, Cambourne and Cambridge. The GCP partners are seeking to allow better bus journeys by improving the existing, or creating new, bus infrastructure, and where possible, cycling links too.

49. Investigations are currently ongoing as to whether 200 car parking spaces could be retained at the Papworth site for the immediate and near-future, which would operate as a Rural Hub Park and Ride site that could be serviced by a timetabled shuttle bus running to and from the CBC site.
50. Operational hours of a potential public shuttle bus are currently being considered, with initial thoughts being that the most viable option would be peak-time only operation rather than throughout the working day.
51. The provision of such a facility would operate along the same principles as a Rural Hub Park and Ride, which would reduce demand for travel by (often single-occupancy) private vehicle to the CBC site, which in turn would reduce overall congestion, reduce emissions, and reduce demand for the limited car parking facilities at the CBC site, as well as reduce demand for the limited road network space in the local area and on the nearby Strategic Network (i.e. the M11).
52. Such a facility would also contribute towards a reduction in need to construct an additional 1200-space parking facilities that already has outline planning permission on the CBC site. This would help in ensuring the existing traffic issues at the CBC site are not exacerbated.
53. The operation of a Rural Hub 'Park and Ride' from the Papworth Hospital site would require revenue support to enable a shuttle bus to operate. Initial estimates are that such a service would require revenue support in the region of £100k per annum over a 3 year period.
54. The Board are asked to note the discussions to date and agree that further negotiations take place regarding possible funding as part of GCP Rural Travel Hub initiative.

### **Other City Access Updates**

55. In addition to the above a number of other initiatives are also being developed or considered; these include:
  - Rural Travel Hubs
    - (a) A feasibility study has been commissioned to evaluate the opportunities that rural travel hubs might offer. The project is a GCP initiative that is being jointly delivered with South Cambridgeshire Council .
    - (b) The outcome of the initiative is to offer villages in South Cambridgeshire better opportunities for travel by public transport, cycling and walking.
    - (c) The report is expected in Mid-November and will be brought to the Executive Board with recommendations for two trial hubs to be provided and evaluated
  - Nine Wells Cycle Path
    - (d) City Access are currently looking at opportunities to accelerate the delivery of the Bell School development cycle path, known as the Nine Wells cycle path, that will be provided through S106 developer contributions. Currently we are looking into the legal framework that could support early delivery.

Resources

- (e) A number of jobs have been advertised, to support scheme development and delivery across the City Access workstreams.

**Implications**

**Financial Implications**

- 56. Additional financial resources will not be required, as the work proposed is within the budgets provided for City Access in March 2017.

***Legal***

There are no legal implications arising from this Report

***Risk Management***

City Access and each of the individual Workstreams have Risk Registers which are reviewed on a regular basis. There are no heightened Risks as a result of this Report.

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## Appendix A – Workstream Updates

| Workstream                    | Summary of progress   | Key dates  |
|-------------------------------|---|--|
| Engagement                    | The engagement - Cambridge and South Cambridgeshire (links with ANPR/ Travel Diary work)(subject to decision to proceed)  | Autumn 2017  |
| Workplace Parking Levy        | Liaison with Nottingham.<br>Consultant procured.<br>Engagement with Business re: requirements.(subject to decision to proceed)  | March 2017<br>March 2017<br>Autumn 2017  |
| Traffic Management            | ANPR Survey complete.<br>ANPR data collation / analysis<br>Future Traffic Management proposals.<br>Linkages to Air Quality work and CSRM2 traffic model.<br>Travel Diary<br>'Hubl' urban consolidation centre and 'click and collect' at Trumpington P&R            | 9 <sup>th</sup> - 18 <sup>th</sup> June 2017<br>July – Sept 2017<br>Winter 2017<br>Ongoing<br><br>Autumn 2017<br>June 2017 onwards |
| Parking Management            | Recruitment of additional required project staff.<br>Priority Residents' Parking Schemes workshops.<br>Priority Residents' Parking Schemes consultation.<br>Displaced Parking / P&R capacity report.<br>Papworth Hospital closure / relocation / P&R consideration. | July – Sept 2017<br>July – August 2017<br>October 2017<br>July 2017<br>July 2017 – ongoing   |
| Better Bus Services           | Recruitment of additional required project staff.<br>Discussions with CBC re: mitigating their growth.<br>Rural Transport Hubs study with SCambs.<br>Electric/Hybrid Buses feasibility Study.   | July – Sept 2017<br>Ongoing<br>July – Dec 2017<br>July 2017  |
| Cycling Provision             | Recruitment of additional required project staff.<br>City Council leading on potential 'Spring Clean'.<br>Ofo bike-sharing scheme roll out and expansion.   | July – Sept 2017<br>Ongoing<br>May 2017 – ongoing  |
| Public Spaces                 | City Council developing Places & Movement SPD.<br>Coordination / liaison re: public realm improvements guidelines.  | Ongoing<br>Ongoing   |
| Air Quality / Clean Air Zones | Recruitment of additional required project staff.<br>City Council coordinated response to Defra re: draft UK Air Quality Plan to tackle Nitrogen Dioxide.<br>Investment in Electric Vehicle charging infrastructure.<br>Electric/Hybrid Buses feasibility Study.    | July-Sept 2017<br>June 2017<br><br>March 2017 – ongoing<br><br>July 2017   |
| Travel Planning               | Recruitment of additional required project staff.<br>Greater Cambridge resident Travel Survey development.  | July-Sept 2017<br>July 2017 – ongoing  |
| Smart Technology              | Review of traffic signals / consideration of upgrades.<br>Digital Wayfinding at Cambridge Stations.   | July 2017 onwards<br><br>Ongoing   |

## **Appendix B – Electric Hybrid Bus Feasibility Study**

**DRAFT June 2017**

### **Electric buses in Cambridge – assessment and initial feasibility study**

#### **1. Introduction**

##### **1.1 Cambridge proposal**

Cambridge is an attractive growing city with a thriving economy fuelled by the presence of excellent universities and high tech industries. Significant housing and employment growth is planned. However, the city also suffers from the problems associated with this success – particularly traffic congestion, which increases business costs, affects the health of citizens and inhibits the development of alternative forms of transport which might relieve congestion but which also get caught up in it.

The Greater Cambridge Partnership Transport Strategy is attempting to break this vicious cycle by providing better bus services as well as better organising the limited roadspace in the city, by giving preference to necessary car trips over those that can be substituted by other modes of transport. One aspect of encouraging this substitution is to provide attractive, green and reliable alternatives, for example electric buses, on part or all of the city's bus network.

This is made all the more urgent because of concerns about air quality in the city centre and other areas, and the possibility that quite severe measures might be imposed by the government to ameliorate the problems. Electric buses can be a major contributor to clean air.

##### **1.2 Why electric buses?**

Alternatively fuelled buses are now in operation in various countries, due mostly to concerns about reducing carbon emissions that contribute to climate change and more recently about air pollution in cities and in particular about diesel fuels, although it is fair to say that pure electric buses are sometimes still at the testing stage. Take up has been relatively slow due to high purchase costs and until very recently, like electric cars, worries about range, limited styles and sizes and also from lack of government support in providing supporting infrastructure like charging stations. However it is worth remembering that bus operating companies generally work on a 10-13 year buying cycle, and it is safe to assume that electric buses will become much more common in the next decade.

Concerns about high costs, range and charging facilities have been overcome, for example in London, by extensive use of non plug-in hybrid vehicles, now alongside 121 pure electric buses. TfL has now committed to a full fleet of electric vehicles by 2030. Certain other cities, notably Nottingham in the UK, have already managed to bring a network of true electric vehicles into operation, and there are undoubtedly lessons to learn from that experience. York have recently worked in partnership with First York to bring 12 electric buses into operation on Park and Ride services, and have plans for more.

The measurable benefits of pure electric buses are low running costs and a significant contribution to decarbonisation and air quality. However, there are intangible benefits which may even outweigh these, for example their popularity with the general public and their role in contributing to an image of the city as green and progressive in its management of growth.

##### **1.3. Examples of alternatively fuelled buses**

###### *Definitions*

A **pure electric** bus carries one or more storage batteries which are charged by means of special chargers, either slow charging overnight while the bus is not in operation, and/or rapid chargers which are often used to top up during the day, while the bus is still in operation.

An **electric hybrid** bus works by having both an electric propulsion system and a normal diesel engine on board. Usually the internal combustion engine is used to charge the electric motor or when the electric motor is idle. Times when the electric motor is used can vary for example switching on for maximum efficiency or only in certain locations.

A **gas** bus replaces diesel with gas, usually Compressed Natural Gas (CNG), often from the national grid but replaced with equivalent biogas, usually methane, returned to the grid from a plant elsewhere.

A **hydrogen** bus uses a hydrogen fuel cell to power the bus, sometimes also including batteries for storage. TfL is experimenting with one hydrogen bus, but the technology is considered too risky for serious consideration in this report.

**Induction charging** is charging at bus stops or other road sites via a plate in the road surface. The bus needs to stop for 10 minutes minimum. London and Milton Keynes are testing the technology, more information at <http://www.cbi.org.uk/insight-and-analysis/milton-keynes-wirelessly-charged-electric-buses/>

### *Zeeus Project*

The Zeeus project <http://zeeus.eu/news/zeeus-ebus-report-is-out> lists electric bus projects in Europe, including hybrids. It also usefully lists manufacturers worldwide and their current offers in 2016. Interest in electric buses is widespread in Europe, and the manufacturers are responding with an increased variety of bus types. Most European electric bus services rely on overnight slow charging at depots, and sometimes also at terminals. However, cities are trying a variety of additional opportunity charging methods, including induction at bus stops (Germany); pantographs (Germany and Sweden); and overhead/articulated arms.

Most services are operating on flat, short, city routes. London stands out because of the variety of different buses and types of charging being tested (and since the report has developed a substantial electric bus network), and Nottingham stands out as the only city at the time of the report with a network of 45 (now 58) electric buses.

According to the Zeeus report, in 2016 there were 27 suppliers of electric buses. This includes Optare and Alexander Dennis in the UK. So far Optare have provided most of Nottingham's fleet, all in Manchester, York and Inverness, as well as some of the London buses. Their most significant competitor so far in the UK is the Chinese company BYD, now working with Alexander Dennis, and the only company to be offering a double decker electric bus. Whilst there now appears to be a good range of single decker sizes, charging options and styles, electric double deckers have proved more of a problem and their development has been driven entirely by demand from London, who now have 121 electric double decker's in operation and are planning more (see <https://tfl.gov.uk/info-for/media/press-releases/2017/february/gla---mayor-announces-two-new-electric-only-bus-routes> ). A summary of London bus characteristics and demonstration projects can be found at <https://tfl.gov.uk/modes/buses/improving-buses>

## **2. Case Studies**

### **2.1 Nottingham electric bus network**

The Nottingham example is worth further consideration, as it includes a variety of different services, including Park and Ride, and is operating successfully, some services for three or

four years. Figure 1 below lists buses bought, funding (all include Workplace Parking Levy contribution), and the services they are used for.

**Figure 1: Electric buses in Nottingham**

| Funding      | Year | No. Buses | Type                     | Service                     |
|--------------|------|-----------|--------------------------|-----------------------------|
| GBF1         | 2012 | 4         | Optare EV Solos          | Centrelink                  |
| GBF2         | 2013 | 4         | Optare EV Solos          | Locallink                   |
| GBF3         | 2014 | 20        | Optare EV Solos & Versas | Medilink P&R and Locallinks |
| GBF4         | 2015 | 17        | Optare EV Solos          | Locallinks/Worklinks        |
| GBF4b        | 2015 | 13        | BYD saloon               | City P&R                    |
| OLEV         | 2016 | 0         | Charging infrastructure  | All services                |
| <b>Total</b> |      | <b>58</b> |                          |                             |

Virtually all the city's non-commercial network now runs with electric buses, with 6 million trips pa. The 45 Optare buses have a range of 60-70 miles, are trickle charged overnight at the depot and many are topped up during the day at one of eight locations with rapid chargers. The 13 BYD buses only need 5 hours overnight charging, despite operating for long hours and over 180 miles per day. The whole project has cost at least £15m, funded by the various grants enabled by match funding from the City's Workplace Parking Levy. The buses are owned by Nottingham City Council and their operation is tendered to Nottingham Community Transport (NCoT). According to Nottingham City Council, savings of £300,000 pa and at least 1050 tonnes reduction in carbon emissions have been achieved.

**Lessons learnt:**

- Although popular, electric buses are not major contributors to congestion relief in themselves. This will only happen if the electric buses are operating with other tried and tested means of encouraging modal shift (including integrated ticketing, bus priority, good information and passenger comfort levels, and most importantly attractive fares).
- Electric buses are however major contributors to the city's climate change and air quality strategies, as well as saving revenue
- In Nottingham an incremental and opportunistic approach, following a set of known desired outcomes (emissions, costs, full provision on subsidised network), has worked. However matching sums from the Workplace Parking Levy has been key.
- The vital need for expertise throughout the project, including the Council officers commissioning the buses and specifying the tenders, through to having trained drivers and skilled mechanics. NCoT found that there were a lot of small logistical, operational and maintenance issues that had to be 'ironed out' – but once resolved, operation has been smooth, with significantly reduced costs. Driver training is vitally important in order to manage the range limitations. Drivers have to get the best out of the system, for example by using the regenerative braking systems properly. NCoT has purchased a bus tracking system that also provides battery information, so there is always central information on battery status, finding for example that 36% of power comes from regenerative braking.
- Passengers are generally happy (or at least content) with the electric buses, as long as they continue to have the same or better benefits as traditionally-fuelled buses. Feedback was positive at the start, but comments have now levelled off as passengers get used to them.
- Park and Ride sites are relied upon for the majority of the charging infrastructure, and provide other support functions in an area managed by the City Council.
- NCoT has also found that because of the operational issues, more electric buses are required than diesel ones. This is partly because Nottingham is in the vanguard of electric bus provision and has had to resolve each operational or maintenance issue as it comes up, which will diminish as more buses come into operation. But it would be

prudent to plan for more vehicles than would normally be the case. NCoT have good relationships with both suppliers, finding Optare have the edge in better vehicles and ride quality, but BYD have the longer range. NCoT has developed considerable expertise in electric bus operations over the last few years and would be willing to discuss these matters with City Access Team or operators if required.

- Getting the right power supply requires good working relationships with the electricity companies. The BYD buses in particular need enormous amounts of electricity, which was provided via additional sub-stations at the eco energy centre at a total capital cost of £200k.
- Initial concerns about battery reliability have not been realised. Both Optare and BYD buses are performing better than predicted, with no apparent degradation of battery capacity. Earlier ideas about moving to using induction charging have been put on hold as the supplied batteries are proving so reliable.
- The main concern about electric buses is now more related to the longevity of the batteries, coupled with the speed of battery degradation and costs of maintaining the drive train. There is now evidence that these risks are lower than thought – with suppliers providing attractive 8 year warranties.

## 2.2. York Park and Ride electric bus case study

York is an example of a city working successfully with a commercial bus operator to provide electric buses on Park and Ride services. As part of their Low Emission Strategy, Green Bus Funding was obtained to provide capital grants towards the purchase of 12 electric buses to serve 2 Park and Ride sites, after it had been found that 25% of NO<sub>x</sub> emissions in the city centre came from Park and Ride buses, which are a significant part of the local transport system carrying 4m passengers pa. The electric buses are now in operation and more are planned if further grant aid is made available. The grant aid covered the difference in capital cost between a new Euro 6 and electric (around £93,000 per bus). The buses were purchased direct by First York from Optare. Buses are charged at a Park and Ride site, with charging points and an electricity sub-station provided through another grant scheme at a cost of £30,000.

At the beginning, First York were not keen on buying or operating electric buses and needed the incentive of a considerable capital grant. They had doubts about fuel and operating costs being reduced as much as was claimed (or at all). To start with, these operating issues were quite serious and had to be worked through. However they have been alleviated and First York are now willing to operate more services (with similar grant contribution). Since starting electric bus operation, First York have won a further 8 year operating contract for York Park and Ride buses, which has also given them more confidence to operate more electric buses. More information at <https://www.itravelyork.info/news/council-and-first-to-extend-successful-park-ride-partnership>

## 2.3 Bristol Hybrid geo-fencing project

In Bristol hybrid buses have been adapted to switch to electric power only in areas of identified higher pollution. This benefits specific areas but constrains the possible routes that are suitable. More information at <https://www.firstgroup.com/about-us/news/first-west-england-launches-revolutionary-electric-buses>

## 2.4 Nottingham and Reading biogas buses

Both Nottingham City Transport and Reading Buses have chosen gas buses over electric or hybrid and have invested in quite large fleets, with grant aid. Both have linked their use of gas from the national gas grid, via a compression unit to create CNG, with a biogas plant that inputs equivalent amounts to the grid. Note the high cost of compression units (£2m). More information at <https://www.nctx.co.uk/about-us/gasbus/> and <http://www.reading-buses.co.uk/cng-faqs/>

### 3. Option development and assessment - fuel options

3.1 The first phase of option development and assessment relates to fuel options, identified as pure electric, hybrid (covering a variety of electric/diesel hybrid options) and gas. Physical requirements for Cambridge for new buses of all three fuel types are summarised in the Appendix. Financial requirements for initial capital are significant, especially for pure electric buses:

**Figure 2: Financial requirements (initial capital)**

|                      | <b>Vehicles</b>             | <b>Fueling infrastructure</b>  | <b>Fuel supply enhancement</b>            |
|----------------------|-----------------------------|--|---|
| <b>Pure electric</b> | Up to 100% more than diesel | Overnight chargers (Nottingham £300k for 80-100 buses) and possibly rapid chargers (£12k each) depending on type of bus (govt grant 75% in past) | Depends on type of buses and survey       |
| <b>Hybrid</b>        | Up to 50% more than diesel  | May need overnight chargers. Govt grant in past.   | Unlikely                                  |
| <b>Gas</b>           | Up to 35% more than diesel  | Compression unit needed. Very expensive - £2m. Govt grant in past.   | Needs additional plant or access to grid. |

3.2 Figure 3 provides a high-level assessment against objectives. All options contribute to carbon reduction objectives, and all appear to receive good passenger feedback, being quieter and often with a more comfortable ride than diesels. By themselves, they do not contribute to congestion reduction but all can form an important part of a congestion reduction and air quality improvement package. Pure electric buses achieve most benefit overall but with higher initial costs and possibly more risk, though this is reducing over time. Hybrid electric buses provide less overall benefit but at less cost and less risk. They can also be adapted to specific circumstances to target for example the air quality benefit. Gas is really a mid-way option, also with less overall benefit and less risk.

**Figure 3: Fuel options assessed against objectives**

|                        | <b>Air quality</b>   | <b>Carbon reduction</b>                                      | <b>Revenue saving</b>                                    |
|------------------------|--|--|--|
| <b>Pure electric</b>   | <b>Zero vehicle emissions</b>  | <b>Excellent and can be linked to sustainable generation</b> | <b>85% saving in operational costs (Nottingham)</b>      |
| <b>Hybrid electric</b> | <b>Variable. Between 30-40% reduction in emissions in London. Can be improved eg Bristol</b> | <b>Partial and variable</b>                                  | <b>Variable but usually small reductions only</b>        |
| <b>Gas</b>             | <b>Nottingham - cleaner than Euro 6. Reading - 55% less NOx</b>                              | <b>Good if linked to sustainable generation (bio-gas)</b>    | <b>Evidence so far on efficiency and costs not clear</b> |

3.3 The current prevailing view is that hybrids and gas buses are temporary expedients, often helping to ease the way to the real solution, which is pure electric. London is proposing to stop buying diesel only buses by 2018, and to continue expanding their hybrid fleet but are

increasingly also buying electric buses, in effect missing out the hybrid interim stage. While most commercial operators are not buying pure electric without subsidy, as the business case cannot currently be sustained, they are increasingly looking to electric as the likely fuel for the future.

#### **4. Option development and assessment - routes and services**

4.1 Technology has now reached the point that most urban and suburban services can be used by all three alternatives if the required charging/fuelling infrastructure can be provided. Given the additional capital costs of all three, but especially pure electric, it would seem best to focus on the routes and services with the biggest impact in terms of air quality and image. In Cambridge these have been identified as:

- Park and Ride services, either a pilot for one or two Park and Ride services or all
- Busway services, again either some or all
- Inner city shuttle

4.2 Park and Ride services offer the following advantages:

- They have space at the Park and Ride sites for charging equipment and any other requirements such as electricity substations
- Services are normally contracted to operators with good quality service standards already required
- Routes are usually reasonably short, direct and seen as prestigious
- They offer the best demonstration potential as they serve a wider range of passengers

The Park and Ride sites around Cambridge are currently operated by Stagecoach East under a partnership arrangement with the County Council. They are not subject to a formal contract as they are commercial services. They use double deckers, 22 of which are new Euro 6 diesels costing a total of £3.5m in 2016. It should be noted that the difference between these and new alternatively-fuelled vehicles may not be great in terms of passenger perception or impact on air quality. A full electric Park and Ride service would require at least 30 double deckers costing approximately £7.5m, although a trial could be undertaken for two services with 12 vehicles (£3m total cost). Capital costs could probably be reduced if double deckers were replaced with 70-passenger large single deckers like Nottingham's BYD buses, but these are not currently favoured by Stagecoach East as they still have lower capacities and could be inadequate at peak times.

4.3 Also it appears that there is insufficient power supplies at any of the Park and Ride sites and a survey would be required to identify capacity and what needs to be done to improve it. This could be expensive, depending on what is currently there and what type of buses are chosen. In Nottingham the costs of power supply enhancement have exceeded £200,000.

4.4 Induction charging is not considered necessary in Cambridge, and has some disadvantages. Induction systems used to be attractive since they only required one small on-board battery leaving valuable seating space. This advantage has been reduced now with better batteries taking up far less space and giving 18 hours service on one charge. With induction chargers, if one charger is down or inaccessible, it affects all buses in the service, while top-up rapid chargers, if they are required at all, can be doubled up.

4.5 A further option is to replace some or all of the buses on the guided busway to St Ives. This serves more distant Park and Ride sites as well as the Northstowe development and would be a unique development of alternatively fuelled buses with an already innovative infrastructure, which may be of particular interest to potential grant providers. Some of the buses on the busway are already single decker's, and some do not travel the entire busway length, so this could be quite a flexible option depending on finances available. There would be space for charging locations along the route, though electricity supply would have to be

assessed and possibly enhanced. Both Stagecoach and Whippet operate on the busway, and an initiative to provide electric buses here could potentially include both operators.

4.6 Nottingham runs an electric city centre shuttle bus service that serves the two shopping centres, the two bus stations and the rail station. This was once free to use but now forms part of a Park and Ride service with standard fares and using the large BYD buses. Charging facilities are available at one bus station and at the Queens Drive Park and Ride site eco hub. Making the bus electric has been a benefit to city centre air quality, and therefore to shoppers and visitors. A similar service in Cambridge, joining the rail station, bus station and major shopping facilities and visitor attractions could provide similar benefits, with significant demonstration potential. Care would have to be taken to ensure it did not duplicate routes or take passengers away from existing services, and in finding a suitable uncongested route. As it would be a new service, new vehicles and bespoke contract arrangements would be needed anyway. If suitable capital and revenue funds were available, this could be a quick win for the city.

## **5. Option development and assessment - commissioning the services**

5.1 Alternatively fuelled bus services can be procured in the following ways:

- a. By standard competitive tender for operators to bid for the provision of the buses and operation of non-commercial or special services (eg Park and Ride services). The tender could make allowance for additional capital costs and reduced ongoing costs of the alternatively fuelled buses. This option would be likely to be acceptable to operators and is probably the most straight-forward, being purely a financial transaction.
- b. By standard competitive tender for operators to bid for the operation of non-commercial or special services with the buses themselves bought and retained by the County Council. The contract could be specified so that the local authority receives the benefit of the lower ongoing costs. This option has been suggested by the Greater Cambridge Partnership Access Team as it is similar to the Nottingham model and might be more easily linked to capital grant aid (eg Green Bus funds) and demonstrable savings.
- c. By entering into a Quality Bus Partnership (QBP) with one or more selected operators (or extending an existing one), the Councils could negotiate the provision of the buses and services, and also negotiate additional contributions to a better bus strategy in general. For example, improvements to fares, ticketing, information and other benefits could be negotiated, in return for the Council providing better infrastructure and/or foregoing some of the benefit of the lower operational costs. This is the appropriate option for commercial services and is likely to be complex but with greatest benefit.
- d. By persuading one or more operators to introduce alternatively fuelled buses themselves, without reference to any contracts or partnerships, for use on their commercial networks. This is unlikely to work without some subsidy or grant aid offered to the operators, as currently business cases do not stack up. If subsidy is offered, it would have to be on the basis of the same offer to all commercial operators, and it should be noted that without a suitable partnership arrangement the ongoing reduction in costs would accrue to the operator.

5.2 Which if these methods is chosen should be carefully considered internally. In Cambridge option c is considered preferable, because:

- a. It is likely to be acceptable to the potential operators, and offers them a say in the details of the proposal
- b. It is most appropriate for a pilot scheme, and encourages true partnership working
- c. It does not provide for the buses to be bought and retained by the local authority, as was requested. But it should be recognised that the operators are skilled in bus purchase and specifications and there are other ways of exploiting the ongoing cost

reductions for general benefit. As only one electric double decker bus is available for purchase suitable for P&R services there will not be selection issues, although there could be for an inner city shuttle.

- d. There is already a QBP arrangement for serving the P&R sites, and it would be relatively straightforward to review this (due anyway in 2018) and include provision for electric buses and services. Further extensions could ensure the expansion of the scheme to all P&R services.

## **6. Conclusion and recommendations**

6.1 Alternatively fuelled buses are now developing fast and most have been through the testing phase and moving into the 'tried and tested' phase. Therefore many of the initial doubts about all types are being removed, and decision making criteria are becoming clearer. Essentially the decision is between the greater benefits but higher initial costs of a pure electric solution and the lesser benefits but possibly lower initial costs of hybrid and gas.

6.2 In addition, electric buses fall more easily into co-ordinated low emission and energy saving strategies. Being zero emission at point of use, they have an excellent green image, are easily understood by residents and others, and can be promoted as an exemplary initiative for tackling air quality issues. Nottingham has also shown that they can represent a clever maximisation of financial opportunities - grant aid covers the higher capital costs, but the lower operational costs, which normally cannot be grant-aided, are captured by the Council. Now that TfL is buying electric in large numbers, there is a greater choice of bus types that are more reliable and better oriented to the UK market. This means that operators are losing their initial worries about the riskiness of the new technology.

6.3 Hybrid and gas buses do provide benefits but do not represent a step-change that would inspire and give confidence to Greater Cambridge Partnership partners and the general public as a serious contribution to a more sustainable future.

6.4 Electric buses are now widely available in a range of sizes and types. Virtually any route and service in Cambridge could be served, if suitable infrastructure is provided. Local commercial operators are willing to consider them if appropriate capital subsidy can be provided. However the most practical services to convert would be Cambridge P&R services, possibly including the busway services with more distant P&Rs. A new inner city shuttle could also be a candidate. A new initiative is really only limited by the appetite and the capital funds available.

6.5 The following is suggested as a first phase:

- A pilot scheme with 12 electric buses serving 2 Park and Ride sites is developed. The suggested approximate capital requirement from the Greater Cambridge Partnership would be £1.5m for the buses (assuming 50% contribution to capital cost), with an allowance of £0.5m for chargers and electricity supply enhancement - £2m in total.
- Overnight charging infrastructure could be provided at one of the chosen P&R sites, with top-up charging provided if required at the other site and/or in the city centre, perhaps at Drummer St bus station. There is an advantage in providing chargers at public locations as other operators can also use them if the scheme is extended in the future.
- The existing QBP for the P&R services is due for review in 2018. Now would be a good time to look at changing the provisions of the partnership to allow for firstly a pilot scheme and secondly the rollout of electric buses to all P&R sites, in return for bus quality improvements over the whole network.

6.6 Summary of next steps:

- a. Visit the case study sites mentioned above to see the buses in action and talk directly to relevant Councils and operators.
- b. After discussion with relevant operators, put together a pilot project for electric buses in Cambridge, focusing on selected Park and Ride sites. Allow for the pilot project to be extended to all P&R sites including the busway in future years.
- c. Choose the pilot services and likely bus types and commission a survey to identify charger sites and electricity supply works required.
- d. Again after discussion with operators, consider a new or extended Quality Bus Partnership to lock in wider benefits.

*Thanks to:*

*Andy Campbell, MD Stagecoach East*

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*Derek McCreadie, i-Travel Programme Manager, City of York*

*Tony Oldham, Fleet Manager, Nottingham Community Transport*

*Campbell Ross-Bain, Bus Operations and Facilities Manager, Cambridgeshire County Council*

### Appendix: Requirements for Cambridge

|  | <b>Pure electric</b>   | <b>Hybrid</b>   | <b>Gas</b>  |
|--|--|---|---|
| <b>Infrastructure</b><br><b>Charging/fuelling</b><br><b>Top up charging</b><br><b>Supply</b>             | Slow overnight charging at base or terminal, fast charging top ups. Could need power supply enhancements and/or sub-station  | Diesel fueling at base, generate own electricity. Some need overnight trickle charging as top up.                                     | Ability to get gas supply from grid or direct from plant.   |
| <b>Routes and services</b><br><b>Length</b><br><b>Type</b><br><b>Special factors</b>                     | Range between 125-200km before top-up. Normal service length under 20km. Urban services. Flat preferred.   | Length of route/service same as diesel (up to 400km service per day).   | Length of route/service same as diesel (up to 400km service per day)  |
| <b>Vehicles</b><br><b>Choice</b><br><b>Price/viability</b><br><b>Availability</b><br><b>Adaptability</b> | Large choice now available for single decker's, at higher prices than diesels (x2). Double decker's only one option (ADL/BYD - tested in London). Nottingham bought from Optare and BYD, York from Optare. | Large choice from many suppliers, prices 50% more than comparable Euro 6 diesels. London has had considerable quality control issues. | Nottingham City Transport bought 53 gas buses from Scania and ADL in 2017. Reading have 20 from the same suppliers bought in 2012/13. Prices 35% more than Euro 6 diesel. |
| <b>Power supplies</b><br><b>Availability</b><br><b>Cost</b>  | Likely requirement to enhance electricity supply and provide sub-station. Nottingham cost £200k, York £30k.  | Unlikely  | Need for access to grid or bio-gas plant. Compression unit also required at considerable cost.  |
| <b>Maintenance facilities</b>  | New technology so training and local facilities required. Can be opportunity for local employment.   | Same  | Same  |

## **Appendix C – Residents Parking and Park and Ride capacity**

- 1.1 Steer Davies Gleave have been commissioned to assess the likely displacement from on street parking in Cambridge should the current residents parking zones be extended to the whole of the City.
- 1.2 In doing this an assumed profile of the potential roll out of new zones has been provided to the consultant, this essentially building from the existing central zone outwards to cover the whole of the City over a period of three years. This is an assumption only for the purposes of modelling and does not suggest that either all of the City will be covered by a zone or that the pace of the roll out will be that fast. Ultimately, the decision of whether to have a residents' zone in a particular area rests with local residents themselves.
- 1.3 A potential build up in park and ride capacity has also been assumed for this exercise. There are already some minor increases in park and ride capacity at existing sites that are being developed and it has been assumed that by 2020/21, at least one of the new sites that the Greater Cambridge Partnership is planning on either the A1307, the A10 (south) or the A428 will have been constructed alongside the bus infrastructure proposals on each of those routes.
- 1.4 At present, there is an average of at least 1,800 free spaces at the existing five park and ride sites around Cambridge on a daily basis. In total, these currently have a capacity of 6,800 spaces.
- 1.5 In modelling the balance between supply and demand for park and ride spaces as a result of an extension to the residents parking zone, two scenarios have been considered. In both cases, it is assumed that the first new residents parking zone will not be introduced until 2018.
  - Scenario 1: All commuter on-street parking in residential parking zones is displaced to Park and Ride.
  - Scenario 2: Only commuter on-street parking that is estimated to originate from outside of Cambridge is displaced to Park and Ride, on the basis that Park and Ride is less convenient to commuters based within Cambridge who would be more likely to use public transport, walk, cycle or use off-street parking.
- 1.6 The following table shows the results from this modelling.
- 1.7 In presenting this analysis, it should be noted that this is only a theoretical exercise to demonstrate to likely relationship between demand for and supply of Park and Ride spaces. The actual balance between the two will depend on a number of factors including the pace at which the residents parking zones are rolled out, the ability to deliver the new Park and Ride capacity and other factors in addition to this that may change the demand for Park and Ride spaces.
- 1.8 However, it is felt that overall this presents a worst-case scenario particularly given the likely extent and pace of the roll out of residents parking zones and that in reality displacement is likely to be to a range of transport modes rather than just Park and Ride.
- 1.9 On this basis, the analysis demonstrates that the Park and Ride system has the capacity to absorb displaced demand from the planned residents parking zone roll out.

- 1.10 Further refinement of this analysis will be undertaken and the full results will be presented to the Greater Cambridge Partnership Board and the County Council's Highways and Community Infrastructure Committee in September.

### Future Park and Ride supply and demand

| Year        | Supply            |              | Spare capacity<br>Assume all <b>new</b> supply available to absorb displacement | Displaced commuter demand                            |  |
|-------------|-------------------|--------------|---|--|--|
|             | Additional Spaces | Total Spaces |   | <b>Scenario 1:</b><br>All commuters displaced to P&R | <b>Scenario 2:</b><br>Commuters outside Cambridge displaced to P&R |
| 2017        | -                 | 6,800        | 1,800   | -  | -  |
| 2018        | 200               | 7,000        | 2,000   | 900  | 700  |
| 2019        | 400               | 7,400        | 2,400   | 2,400  | 2,000  |
| 2020/<br>21 | 2,000             | 9,400        | 4,400   | 4,300  | 2,900  |

**Appendix D - Papworth Hospital / Cambridge Biomedical Campus relocation**

University of Cambridge Access Strategy  
Reference number 105544

20/06/2017

**WEST OF CAMBRIDGE TO CBC BUS SERVICE  
FEASIBILITY STUDY**



**SYSTRA**

# UNIVERSITY OF CAMBRIDGE ACCESS STRATEGY

## WEST OF CAMBRIDGE TO CBC BUS SERVICE FEASIBILITY STUDY

### IDENTIFICATION TABLE

|                             |  |
|-----------------------------|--|
| <b>Client/Project owner</b> | CBC and University of Cambridge                        |
| <b>Project</b>              | University of Cambridge Access Strategy                |
| <b>Study</b>                | West of Cambridge to CBC Bus Service Feasibility Study |
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## **1. Introduction**

### **1.1 Study Requirements**

Systra has been commissioned by the University of Cambridge and the Cambridge Biomedical Campus Delivery Group to consider the potential for a new bus route to access the Campus from the west.

The aim of the study is to consider options for the provision of such a service, assess the costs and likely revenues involved and to make a recommendation as to how a service could be delivered.

This report sets out the findings of our investigations and analysis.

## 2. Study Context

The Cambridge Biomedical Campus (CBC) is planned to expand significantly in the years to 2025. An outline planning consent obtained in 2006 indicated that the expansion would entail:

- Expansion to the Cambridge Biomedical Campus development (referred to as the CBC). Promoted by Cambridge University Hospitals NHS Foundation Trust (the Addenbrooke's Trust) and the Pemberton Trustees in partnership with Countryside Properties and Liberty Property Trust UK. This development will extend the existing Addenbrooke's campus to expand provision of clinical services offered on the campus and to provide complementary Research and Development facilities. The development will have a gross floor area of 215,000m<sup>2</sup>, it will also include areas of public realm including the Circus, and provide part of the future Piazza along the central core of the extended campus and will connect the new and existing campus areas.
- Cambridge University Hospitals NHS Foundation Trust is planning to develop the Addenbrooke's Seminar / Conference Centre, Learning and Development Centres and hotel (referred to as The Forum). This is located on the western edge of the existing campus immediately adjacent to the CBC and serving the whole of the campus.
- In addition, Countryside Properties will develop Clay Farm and ultimately Glebe Farm. Clay Farm is located immediately east of Trumpington. It will provide approximately 2,300 dwellings, along with a Green Corridor and essential community facilities. The community facilities provided will complement rather than compete with those that already exist in Trumpington. Glebe Farm is located to the south of Trumpington between Hauxton and Shelford Roads. It would provide up to 320 dwellings.

A detailed schedule of the planned developments in terms of the new jobs expected on site is included in this report.

This level of development will place notable strain on the already congested road network in the Cambridge urban area, albeit with the provision of major infrastructure such as the Addenbrooke's Road to support the levels of movement expected.

The justification for the consideration of a new bus service is based on the Travel Plan submitted at the time of Outline planning application. This sets ambitious targets for mode share by public transport that are far higher than the current travel to work mode share by bus in the general Cambridge which in the 2011 census was 3.99%.

Bus access to the CBC from the city centre and rail station is supported by the southern section of the Cambridge guided busway which commenced operation in 2011. This allows a high frequency, high speed service to be provided.

The Universal bus route (service U) currently links the West Cambridge university site and the Madingley Road P+R site to city centre, the railway station and the CBC. This

operates between the Madingley Road P+R and CBC on a 15 minute frequency with 6 vehicles provided by Whippet Coaches after a 2015 tendering exercise. The stated objectives of the service which is subsidised by the University are to:

- Demonstrate a strong transport policy to local planning authorities
- Improve the staff and student experience
- Reduce congestion in Cambridge and associated negative impacts
- Unlock car parking space for additional development

From September the Universal route will be changed to serve Eddington instead of Madingley Park and Ride. The service will still serve Madingley Road Park and Ride users via a footpath to Eddington Avenue.

Investigations into bus priority measures for the Trumpington P+R site are being made. These, if successful could allow an effective bus route from the CBC to the M11 to be achieved. In the short term use could be made of M11 junction 11.

The Greater Cambridge city deal has promoted and secured potential funding for a major transport investment on the A1303 corridor to the west of Cambridge. Cambourne to Cambridge is a bus priority scheme. The A428 and A1303 are key routes into the city from the west and is often congested between Papworth Everard, Cambourne and Cambridge. The City Deal partners are seeking to allow better bus journeys by improving the existing, or creating new bus infrastructure, and where possible cycling links too. At the current time, detailed investigations into a park and ride site are underway as is development of a possible route for a new busway between Cambourne and the fringe of inner Cambridge. Current proposals suggest a city centre bus terminus in the Silver Street area of the city. An element of the scheme to provide a P+R facility at Madingley Mulch (A1303) is now under review as none of the possible sites identified proved satisfactory for further development work.

It is emphasized that the A428 and A1303 busway is a long term proposal which is unlikely to influence the short and medium term delivery of a Papworth Everard / Cambourne to CBC bus route.

A further potential P+R location is for a less formal site at Papworth Everard. This is not a City Deal project but could come forward independently given the probable long development period for the City Deal scheme.

### 3. Potential bus routes

#### 3.1 Introduction

The potential routes for a bus service linking Cambourne and the CBC need careful consideration. Urban traffic speeds in Cambridge are among the lowest in the country at 13.8mph. Without bus priority, any new bus service would be committed to running at this speed in line with general traffic.

From inspection of DFT data and the Cambridge LTP we have derived a set of typical bus operating speeds to allow timetables and vehicle requirements to be determined.

**Table 1.** Cambridge Bus speeds

| Bus Speeds | mph  |
|------------|------|
| Busway     | 37.2 |
| Urban      | 13.8 |
| Rural      | 24.0 |
| Motorway   | 50.0 |

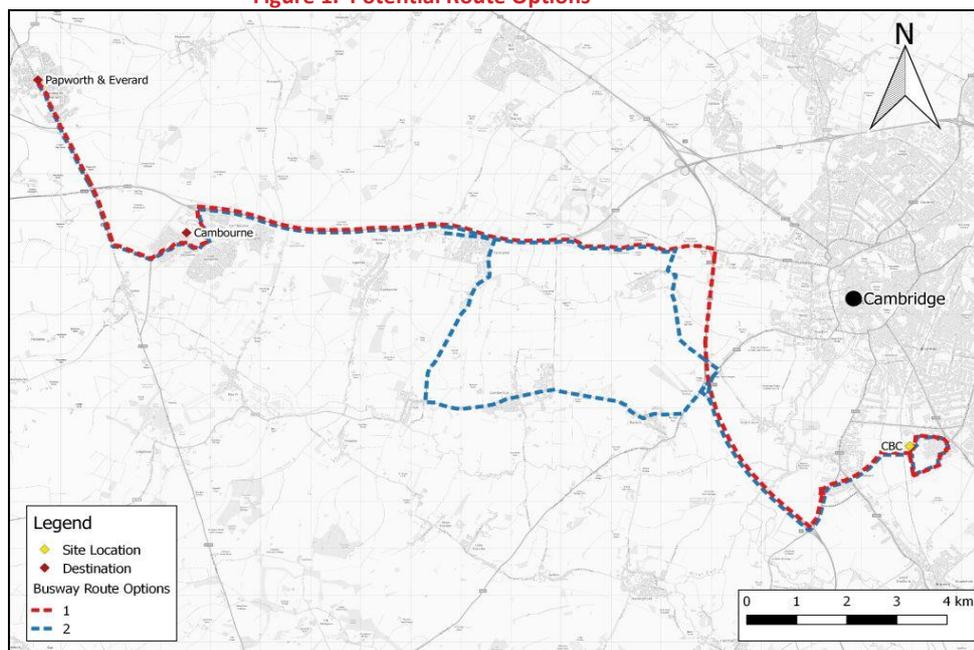
#### 3.2 Routes and timetables

The routes developed for a dedicated service comprise three broad approaches:

- Option 1 - A route that operates on existing roads in the urban area (including the busway), uses the M11 between junctions 11 and 13 and the A1303 and A482 to Cambourne and a P+R site located at Papworth Everard.
- Option 2A - A route that leaves the urban road network at the earliest opportunity and uses rural roads to reach Cambourne and a P+R site located at Papworth Everard.
- Option 2B – A variation on Option 2A which operates via Coton instead of Hardwick in the rural area.

These routes are shown on the graphic below.

**Figure 1. Potential Route Options**



The distances involved for these routes are shown below.

**Table 2. Route Distances**

| Route     | Miles (one way) | Miles (round trip) |
|-----------|-----------------|--------------------|
| Option 1  | 16.3            | 32.6               |
| Option 2A | 17.7            | 35.5               |
| Option 2B | 15.7            | 31.4               |

Applying the speeds and distances involved for the three options and an allowance for turn round time at one of the route has generated a set of journey times for a single round trip on the routes.

**Table 3. Journey times**

| Route     | Single Journey time (mins) | Round trip time (mins) | Turn round time at CBC (mins) | Overall cycle time (mins) |
|-----------|----------------------------|------------------------|-------------------------------|---------------------------|
| Option 1  | 36                         | 72                     | 4                             | 76                        |
| Option 2A | 45                         | 90                     | 4                             | 94                        |
| Option 2B | 50                         | 100                    | 4                             | 104                       |

### 3.3 Current Services

Both Papworth / Cambourne and the CBC are currently served by existing bus services. In all cases a journey between Papworth Everard / Cambourne and the CBC requires interchange in the city centre or at the Maddingley Road P+R site.

The current key services are:

- Citi 4 – Cambourne to City typically every 20 minutes, journey time 47 minutes (peak) 37 minutes (off-peak)
- Citi 1 - Cambridge – Addenbrooke’s – Fulbourn typically every 10 minutes, journey time Cambridge to Addenbrookes 17 minutes
- Universal – Eddington (Madingley P+R) to CBC typically every 15 minutes, journey time 34 minutes.

Allowing for an interchange time penalty, a typical Papworth Everard / Cambourne to CBC journey time would be between 59 and 67 minutes.

Given this journey time assessment for the current services we consider that two facts emerge:

- That the number of current bus journeys from Papworth Everard / Cambourne to CBC are likely to be limited due to the time taken and the inconvenience of a bus to bus interchange *en-route*.
- That the current service offer would not suffer abstraction of passengers to a new direct service.

### 3.4 Timetables

Based on the need to provide a high level of service to make the new link attractive to passengers a series of timetable options have been identified.

As the A1303/ A428 busway scheme is still under development any guarantee about its availability cannot be given and this would not be open in time for the start of this bus service

As such, the use of the M11 offers the best journey time prospect for a Papworth / Cambourne to CBC service. This route choice could make use of the Trumpington P+R to CBC busway.

On that basis the timetable options developed will respond to the demand assessments made in section 3 of this report and the need to provide the most attractive service possible the following timetable variants have been developed:

- Alternative A - Direct all day Papworth P+R / Cambourne to CBC service (via M11) every 30 minutes.
- Alternative B - Direct Papworth P+R / Cambourne to CBC service in peak hours only (via M11) every 20 minutes

Recent good practice has shown where a direct and limited stop bus service has been instigated the use of a flexible routing between the main boarding points planned interactively to avoid congestion has been an effective way to ensure reliable journey times. Consideration of this approach would be relevant to both alternatives..

As a further option we examined the potential to extend the Universal service beyond its current northern terminus at Eddington. The option developed allowed for the following service pattern:

- Extension of the current Universal service to Papworth P+R / Cambourne. Journeys that commence at Eddington to start back at Papworth P+R / Cambourne with alternate buses off peak extended from Eddington to Papworth P+R / Cambourne. This proposal would include a limited direct peak hour service from Papworth / Cambourne to CBC to allow for commuters avoiding the need to travel through the city centre. Also included is an option to run the first journey from the railway station to Eddington from Papworth / Cambourne directly to the CBC and hence to the railway station

On further review, amending the Universal service has been found to have less potential value than a new, direct, service. This is because of the extended journey times involved (60 + minutes in each direction) would not result in a sufficiently attractive alternative to car journeys. The mix of different service patterns involved is counter-productive to passenger confidence in the bus service with policy guidance indicating that “the service pattern on each route be as simple as possible”.<sup>1</sup> On this basis we have not reviewed use of the Universal service in further detail.

Details of the timetable options developed are included as an Appendix to this report.

### 3.5 Operating Costs

The operating costs of each option have been assessed using an industry standard cost model. The model covers fixed costs (e.g. vehicle acquisition, insurance, excise duty and an element of depot costs), mileage dependant costs (e.g. maintenance, lubricants, tyres and fuel) and time dependent costs (e.g. driver’s wages).

To reflect local circumstances the model includes the following:

- Busway access charge of £1.74 per single journey
- Option for hybrid vehicles based on UK industry experience of a reduction in mileage based costs of circa 30%.

**Table 4.** Alternative A – All day stand- alone service every 30 minutes

| Cost Per Year | Cost Per Bus Hour | PVR | Cost Per Vehicle |
|---------------|-------------------|-----|------------------|
| £571,882      | £63.04            | 3   | £190,627         |

**Table 5.** Alternative A – All day stand- alone service every 30 minutes with hybrid buses

| Cost Per Year | Cost Per Bus Hour | PVR | Cost Per Vehicle |
|---------------|-------------------|-----|------------------|
| £561,555      | £61.90            | 3   | £187,185         |

<sup>1</sup> e.g TfL Bus Service Planning Guidelines 2012, para 24

**Table 6.** Alternative A – All day stand- alone service every 20 minutes peaks and every 30 minutes off-peak (to cater for additional peak demand)

| Cost Per Year | Cost Per Bus Hour | PVR | Cost Per Vehicle |
|---------------|-------------------|-----|------------------|
| £688,686      | £66.66            | 4   | £172,172         |

**Table 7.** Alternative B - Peak hour only service every 30 minutes

| Cost Per Year | Cost Per Bus Hour | PVR | Cost Per Vehicle |
|---------------|-------------------|-----|------------------|
| £321,410.57   | £70.86            | 3   | £107,136.86      |

**Table 8.** Alternative B - Peak hour only service every 30 minutes with hybrid buses

| Cost Per Year | Cost Per Bus Hour | PVR | Cost Per Vehicle |
|---------------|-------------------|-----|------------------|
| £332,502.32   | £73.30            | 3   | £110,834.11      |

The costs include:

- Standard single decker vehicle capital cost of £180,000 per vehicle, annual lease charge of £64,490 for a fleet of 3, based on an industry standard 15 year vehicle life.
- Hybrid single decker vehicle capital cost of £275,000 per vehicle, annual lease charge of £94,045 for a fleet of 3, based on an industry standard 15 year vehicle life.

## 4. Demand Assessment

### 4.1 Growth Profile of the CBC

The CBC is expanding, the 2006 outline planning application covered a number of individual buildings and development sites. The sites currently expected to be developed are:

- Papworth Hospital
- AstraZeneca
- Abcam
- University extensions
- Atria
- Forum
- “Phase 2”
- Cambridge University Hospitals
- “Phase 3”

In terms of potential jobs at these sites and their timing the following information is the latest available. The type of development has also been recorded to inform the likely trip rates by various modes of travel.

**Table 9. Predicted Jobs at CBC**

|                   | TYPE             | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|-------------------|------------------|------|------|------|------|------|------|------|------|------|------|------|
| <b>Committed</b>  |                  |      |      |      |      |      |      |      |      |      |      |      |
| Papworth          | Hospital         | 1800 |      |      |      |      |      |      |      |      |      |      |
| Astra Z           | Medical Research |      | 1600 |      |      |      |      |      |      |      |      |      |
| Abcam             | R&D              |      | 500  |      |      |      |      |      |      |      |      |      |
| University        | R&D              |      | 700  |      |      |      |      |      |      |      |      |      |
|                   |                  |      |      |      |      |      |      |      |      |      |      |      |
| <b>Indicative</b> |                  |      |      |      |      |      |      |      |      |      |      |      |
| Atria (low est)   | Medical Research |      |      |      | 150  | 150  | 200  |      |      |      |      |      |
| Forum             | MRC (main use)   |      |      |      |      | 2000 |      |      |      |      |      |      |
| Phase 2           | R&D              |      |      |      | 500  | 500  | 500  | 500  | 500  |      |      |      |
| CuH (est)         | Hospital         |      |      |      |      |      |      |      | 500  | 500  | 500  | 500  |
| Phase 3           | Medical Research |      |      |      |      |      |      |      | 750  | 750  | 750  | 750  |
|                   |                  |      |      |      |      |      |      |      |      |      |      |      |
| Max Dev           |                  | 1800 | 2800 | 0    | 650  | 2650 | 700  | 500  | 1750 | 1250 | 1250 | 1250 |

### 4.2 CBC mode share

The outline planning application for the CBC extension sets a series of mode share targets by type of use. For buses these are:

**Table 10. CBC Bus Mode Share**

| Use Type                       | Mode share |
|--------------------------------|------------|
| Hospital                       |            |
| clinical                       | 27.44%     |
| patients                       | 16.85%     |
| R&D                            |            |
| staff                          | 21.65%     |
| visitors                       | 24.12%     |
| Medical Research Centres (MRC) |            |
| Staff                          | 22.94%     |
| visitors                       | 25.59%     |

### 4.3 Papworth Hospital relocation

The Papworth Hospital will relocate to the CBC from 21 April 2018. As such, the Papworth Hospital would provide a base level of demand for new bus service.

At the time of its most recent travel survey the hospital had the following employees living in the Papworth and Cambourne areas:

- Papworth – 256
- Cambourne – 121
- Total - 377

Of these it can be assumed that due to the travel plan measures at the site a number will travel by bus to work. At present no valid alternative to car exists with bus journeys taking substantially over 1 hour, inclusive of a city centre interchange.

Applying the hospital target staff bus mode share we estimate that 116 of the 377 employees currently living at Papworth / Cambourne will use bus to access the CBC site. At its maximum level this equates to a potential annual patronage of 58,464 new single journeys per annum (based on 252 working days per year and a round trip being 2 journeys).

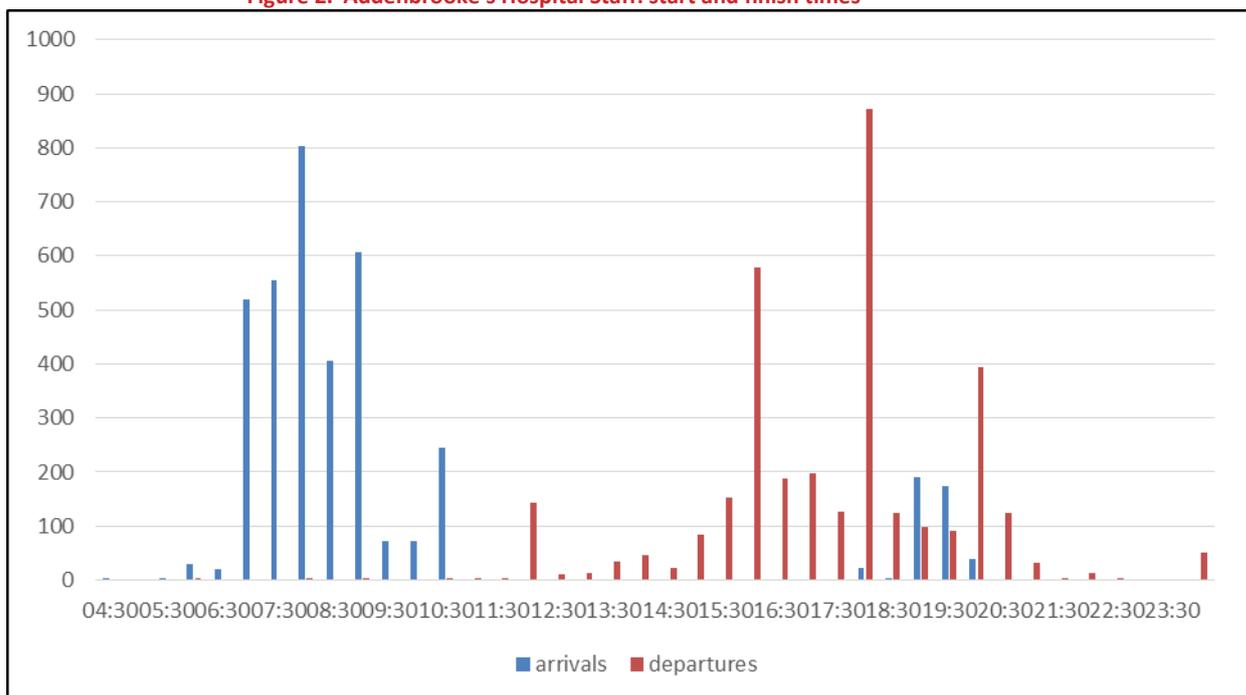
As the Papworth clinical staff has a 07:00 shift start, the timetable of the bus route will need to reflect this.

The move of the hospital to the CBC is a potential opportunity to review the current parking eligibility criteria which could generate greater levels of bus travel. At the current time, the specific policies are being determined but the commitment to a new bus service offer could assist in the development of new criteria for parking eligibility.

### 4.4 Hospital Staff Working Patterns

To assess the potential demand for travel to the CBC we have reviewed the travel to work data from the Addenbrooke's hospital site.

Figure 2. Addenbrooke's Hospital Staff: start and finish times



The evidence from recent staff surveys suggests that there is a willingness on behalf of employees, where possible, to flex their journey times to coincide with the public transport offer at the hospital. The majority of non-clinical staff have potential access to flexible working initiatives that would support this view.

#### 4.5 CBC employees locations

The location of CBC employees is the key to determining the likely demand for a new bus service.

Addenbrooke's Hospital has a detailed travel survey that identifies home locations by postcode. In this case CB23 is the most likely area from which employees would use the new bus route. The hospital survey indicates that 4.4% of employees travel from CB23 to the hospitals.

A further survey of University staff indicated that 8.1% of staff surveyed lived in the CB23 postcode area. Of these, 4.0% of the overall sample worked at the CBC / Addenbrooke's location.

As such, the indicated rate of 4.4% of trips to work at the hospitals has been used as a proxy for CBC employees being 'in range' of the new bus service has been assumed. This excludes P+R demand from postcode areas to the west of Cambourne which is considered below.

Of these from the hospital survey data 48.2% arrived at work between 08:00 and 09:00. Between 07:00 and 09:00 76.8% of staff arrived.

#### 4.6 Bus service demand – ‘normal passengers’

To assess the ‘normal’ demand for a new bus service we have taken the assessment of employee locations and considered these against a number of trip rates.

The trips rates used reflect the following

- The mode share target for buses from the CBC established in the outline application travel plan (varies by type of use in individual buildings)
- An increased mode share for bus based on the possibility that the planned 600 space multi-story car park at the CBC may not be constructed. In effect, the car borne trips that would have used the car park have been proportionally reallocated to non-car modes. It is important to note that the Cambridge University Hospitals plan to make a planning application for this car park in the near future.
- These targets are also specific to the type of use envisaged.

**Table 11. CBC Bus Mode Share**

| PT mode share    | From CBC Travel Plan | Uplifted Rate Due to Car Park Quantum Reduction |
|------------------|----------------------|---|
| Hospital         |                      |   |
| clinical         | 27.44%               | 30.55%  |
| patients         | 16.85%               |   |
| R&D              |                      |   |
| staff            | 21.65%               | 24.36%  |
| visitors         | 24.12%               |   |
| Medical Research |                      |   |
| Staff            | 22.94%               | 25.82%  |
| visitors         | 25.59%               |   |

The demand assessment has used this mode share information and the employee locations to determine the number of employees who would travel by the proposed bus service and demand between 08:00 and 09:00.

**Table 12. Daily Demand At CBC Travel Plan bus mode share**

| year                   | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Total                  | 0    | 30   | 2    | 8    | 27   | 6    | 6    | 20   | 14   | 14   | 14   |
| Cumulative             | 0    | 30   | 32   | 40   | 67   | 73   | 79   | 99   | 113  | 127  | 141  |
| 0800 - 0900 cumulative | 0    | 15   | 16   | 20   | 34   | 37   | 40   | 50   | 57   | 64   | 71   |
| 0700-0900 cumulative   | 0    | 24   | 26   | 33   | 54   | 59   | 64   | 80   | 91   | 102  | 113  |

**Table 13.** Daily Demand at CBC Travel Plan bus mode share + car park redistribution (to work trip only)

| year                   | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Total                  | 0    | 33   | 2    | 8    | 32   | 6    | 6    | 21   | 15   | 15   | 15   |
| Cumulative             | 0    | 33   | 35   | 43   | 75   | 81   | 87   | 108  | 123  | 138  | 153  |
| 0800 - 0900 cumulative | 0    | 16   | 17   | 21   | 37   | 40   | 42   | 53   | 60   | 67   | 74   |
| 0700-0900 cumulative   | 0    | 26   | 27   | 34   | 58   | 63   | 67   | 83   | 95   | 106  | 118  |

#### 4.7 Site Visitors – Hospital

Hospital “visitors” fall into four distinct categories.

- Admitted
- Outpatients
- Emergency
- Visitors / persons accompanying patients

Data from the Addenbrooke’s site indicates that on a sample day surveys indicated that the following visits took place:

**Table 14.** Addenbrooke’s “Visitors”

| Postcode | Admitted | Outpatients | Emergency |
|----------|----------|-------------|-----------|
| CB23     | 22       | 173         | 15        |
| PE28     | 13       | 53          | 3         |
| PE29     | 11       | 4           | 0         |

To fully assess the demand for the bus service we have assumed that all emergency patients due to their condition would arrive by ambulance or car. We have further assumed that ‘visitors’ will arrive in accordance with the target mode shares (bus 16.85%) and that each ‘visitor’ for the Admitted and Outpatients categories generate a further trip by an accompanying person.

**Table 15.** Addenbrooke’s Hospital ‘Visitor’ Numbers

|       | Admitted | Outpatients | Assumed Accompanying person | Emergency |
|-------|----------|-------------|-----------------------------|-----------|
| CB23  | 4        | 30          | 34                          | 0         |
| PE28  | 3        | 9           | 12                          | 0         |
| Pe29  | 2        | 1           | 3                           | 0         |
| Total | 9        | 40          | 49                          | 0         |

In addition to the Addenbrooke’s visitors, Papworth when located at CBC will generate a similar type of traffic in ‘visitors’. In the absence of any current data we have made an assumption that this would be at 50% of the rate at Addenbrooke’s.

Applying this 50% uplift gives the following hospital visitor numbers.

**Table 16. Hospital Visitor Number Including Papworth Hospital**

|                         | Admitted | Outpatients | Assumed Accompanying Person | Emergency |
|-------------------------|----------|-------------|-----------------------------|-----------|
| CB23                    | 4        | 30          | 34                          | 0         |
| PE28                    | 3        | 9           | 12                          | 0         |
| Pe29                    | 2        | 1           | 3                           | 0         |
| Total – Non Papworth    | 9        | 40          | 49                          | 0         |
| Papworth Visitors (est) | 5        | 20          | 25                          | 0         |
| Total Daily             |          |             |                             | 148       |

#### 4.8 Site Visitors – Non Hospital

The CBC Travel Plan /Transport Assessment indicates that non-hospital visitors will be at a ratio of circa 20% of employee numbers. If this is applied to the overall demand numbers, the following daily demand can be expected.

**Table 17. Non Hospital Visitors**

|   | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|------|------|------|------|------|------|------|------|------|------|------|
| Non-hospital site visitors (20% estimate from TA) | 0    | 33   | 34   | 36   | 43   | 45   | 47   | 50   | 52   | 54   | 56   |

#### 4.9 P+R demand

To assess the Park and ride demand we have reviewed the Addenbrooke’s Hospital and University travel surveys to identify the level of users that would be likely to use the A428/A1303 route to the CBC from the west. This has considered the following postcodes:

- SG9
- SG19
- PE19
- SG18
- SG7
- MK1 to MK43

Journeys from these postcodes represent 2.97% of the overall employee total in the Hospital survey.

We have further considered the relative journey times by current bus services between Cambourne and City Centre and a new direct route as well as assessing the time of journeys expected by bus and car. This when coupled with the relative values of time for bus passengers and car drivers indicates that if the busway option were followed to deliver a P+R offer then a potential uplift of 43% in bus share beyond the figures already identified could be achieved.

A note of caution is that this high figure would only apply to the M11 option due to the lack of improvement in on-road journey times in other, rural, routings considered.

If the M11 option were followed the estimated maximum uplift in passenger numbers due to P+R would be:

**Table 18. P+R Daily Demand Uplift**

| Year       | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|------------|------|------|------|------|------|------|------|------|------|------|------|
| Increase   | 0    | 31   | 2    | 7    | 29   | 6    | 6    | 20   | 15   | 15   | 15   |
| Cumulative | 0    | 31   | 33   | 40   | 69   | 75   | 81   | 101  | 116  | 131  | 146  |

At this stage of development of the A428 busway scheme the demand assumed to be attributable to P+R to the CBC should be treated with caution. P+R demand to CBC would be possible should a hybrid option be developed or the option to run via the M11 motorway for part of the route be taken forward.

Also it is known that, beyond general P+R demand a specific demand for P+R use by Papworth employees can be identified.

The Papworth hospital travel survey indicates that the following towns are the home location for the following number of employees:

- Bedford - 21
- St Neots - 176

Due to the potential to manage the parking habits of this group into P+R we have assumed that this group would access the CBC site according to the travel plan bus mode share for employees (27.44%).

This would indicate that this would generate a further 54 users each day.

#### 4.10 Overall Demand Profile and Annual Demand

To make a revenue estimate for the new service the base demand and the predicted new demand have been summated to give a full picture of the likely demand for a new bus service. This assessment includes all know demand from the calculations above.

At this stage we have assumed that the enhanced mode share for buses is viable given the limited prospects for the provision of an additional multi-story car park.

**Table 19. Overall Demand Assessment**

|  | 2018    | 2019    | 2020    | 2021    | 2022    | 2023    | 2024    | 2025    | 2026    | 2027    | 2028    |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Papworth relocation  | 116     | 116     | 116     | 116     | 116     | 116     | 116     | 116     | 116     | 116     | 116     |
| Employees  | 0       | 33      | 35      | 43      | 75      | 81      | 87      | 108     | 123     | 138     | 153     |
| Non-hospital visitors                                      | 0       | 7       | 14      | 23      | 38      | 55      | 73      | 95      | 120     | 148     | 179     |
| Hospital patients + visitors (including Papworth estimate) | 148     | 148     | 148     | 148     | 148     | 148     | 148     | 148     | 148     | 148     | 148     |
| Non Papworth P+R   | 0       | 31      | 33      | 40      | 69      | 75      | 81      | 101     | 116     | 131     | 146     |
| Papworth P+R   | 54      | 54      | 54      | 54      | 54      | 54      | 54      | 54      | 54      | 54      | 54      |
| TOTAL (estimated daily single journeys)                    | 319     | 390     | 401     | 425     | 501     | 530     | 560     | 623     | 678     | 736     | 797     |
| Estimated Single Journeys / Annum                          | 160,776 | 196,560 | 202,104 | 214,200 | 252,504 | 267,120 | 282,240 | 313,992 | 341,712 | 370,944 | 401,688 |

#### 4.11 Growth

There is a general need for more housing in the Greater Cambridge area. Initial indications suggest that further iteration of the Local Plans involved would result in the need to allocate a large number of additional houses in the Cambourne area.

A preliminary review of possible numbers suggests that up to 3,100 new houses could be accommodated on the Cambourne West and Bourne Airfield sites by 2031. The potential for a further 2,100 new homes post 2031 is also under consideration.

Whilst these numbers are not confirmed nor formally included in the planning system it would be appropriate to conduct a sensitivity test only to account for this growth. Given the current level of demand predicted a 50% increase in service demand would reflect this additional source of demand. If this is applied to the workforce and visitors the daily demand would be:

**Table 20. Annual Demand Sensitivity Test (+50%)**

|             | 2018    | 2019    | 2020    | 2021    | 2022    | 2023    | 2024    | 2025    | 2026    | 2027    | 2028    |
|-------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Base Demand | 160,776 | 196,560 | 202,104 | 214,200 | 252,504 | 267,120 | 282,240 | 313,992 | 341,712 | 370,944 | 401,688 |
| Growth +50% | 241,164 | 294,840 | 303,156 | 321,300 | 378,756 | 400,680 | 423,360 | 470,988 | 512,568 | 556,416 | 602,532 |

#### 4.12 Capturing the Demand

The key to implementation of a new Papworth / Cambourne to CBC bus service will be the timetable offered. The demand calculations assume that the current presumptions about car parking spaces are maintained and that the car park management arrangements remain at least at the current level of intervention.

We have noted that the current mode share by bus to the CBC site (the University / Addenbrooke's / CUH site only) is circa 13%. Improved bus services and further enhancements to parking the staff car parking eligibility criteria and associated policies

will enable further increases in mode shares to the predicted levels and will be policed by the relevant planning requirements.

The demands are from disparate sources:

- Papworth Hospital relocation (Cambourne and Papworth located staff)
- Non-hospital employees
- Non-hospital site visitors
- Hospital patients + accompanying visitors (including an estimate for Papworth Hospital relocation)
- Non-Papworth Hospital P+R
  
- Papworth Hospital related P+R

Given the disparate sources of demand and the specific hospital requirements for all day movements, e.g. for flexible hours staff and patients / visitors. An all-day service would appear to be most relevant to attracting the highest level of demand.

#### 4.13 Revenue

As parking at the CBC is currently charged in line with the existing Addenbrooke's Hospital pricing strategy any bus service pricing strategy would need to reflect this. It would also need to reflect the pricing strategy at the nearby Trumpington (M11) P+R site which is subject to expansion plans to address known capacity issues.

A further direct comparator is the Universal service which currently has a £2 fare for general users and a £1 fare for University card holders for single journeys unless a concessionary pass is used.

Given the additional distance from Eddington to Papworth / Cambourne it is suggested that for comparative purposes a £2 fare for all single journeys represents a useful starting point for a revenue analysis.

By way of considering 'normal' bus services a weekly Stagecoach pass for the wider Cambridge area is £25.00 for 7 days so the £2 single fare represents a broadly valid comparator.

In terms of P+R, the current P+R Cambridge wide offer of £1 to park and £3.30 per person on the bus (at the Trumpington P+R) is an appropriate benchmark but in the light of the current CBC parking arrangements is unlikely to gain traction in the short term unless accompanied by further CBC parking management measures.

It should be noted that any normal new bus service would experience a build-up in demand of between 1 and 3 years as travel patterns adjust. In the case of the CBC, the rate of expansion, the ability to manage car parking proactively and the step change in potential demand due to the Papworth Hospital relocation all indicate that this would be less prevalent at the CBC.

A baseline assessment of the highest patronage scenario indicates maximum revenues set out in the table below when allowance for inflation at 3.0% per annum is made.

**Table 21. Initial Annual Revenue Assessment – Maximum Revenue (£)**

| Year                                    | 2018    | 2019    | 2020    | 2021    | 2022    | 2023    | 2024    | 2025    | 2026    | 2027    | 2028    |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Revenue (£2 single fare) + inflation 3% | 321,552 | 404,914 | 416,334 | 441,252 | 520,158 | 550,267 | 581,414 | 646,824 | 703,927 | 764,145 | 827,477 |

#### 4.14 Scheme Cash Flow Estimate

To allow an informed decision about procurement of the service we have undertaken a cash flow analysis based on the known demand and costs information. At this stage the cash flow analysis takes the estimate revenue and operating costs for the service using a high specification standard single decker bus on a 30 minute frequency all day service.

Inflation has been applied to costs and revenues at 3% p.a.

This excludes any effect of housing growth in the Papworth and Cambourne area.

**Table 22. Cash Flow**

| Year             | 2018      | 2019      | 2020      | 2021      | 2022      | 2023      | 2024      | 2025      | 2026      | 2027      | 2028     |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| Costs (inflated) | £571,882  | £589,038  | £606,710  | £624,911  | £643,658  | £662,968  | £682,857  | £703,343  | £724,443  | £746,176  | £768,562 |
| PE P+R lease     | £150,000  | £150,000  | £150,000  | £150,000  | £150,000  | £150,000  | £150,000  | £150,000  | £150,000  | £150,000  | £150,000 |
| Est Revenue      | £321,552  | £404,914  | £416,334  | £441,252  | £520,158  | £550,267  | £581,414  | £646,824  | £703,927  | £764,145  | £827,477 |
| Nett             | -£400,330 | -£334,125 | -£340,375 | -£333,659 | -£273,500 | -£262,701 | -£251,443 | -£206,519 | -£170,516 | -£132,032 | -£91,084 |

The CBC has, in principle, secured the following funding contributions to the annual operating costs for at least 3 years:- £125,000. Taking this into account the net year 1 operating loss is therefore estimated to be:

$$£400,330 - £125,000 = \underline{\underline{£275,330}}$$

This would make the cash flow situation for the first 4 years of operation:

**Table 23. Revised 4 year Shortfall after 'external' funding is included**

| Year          | 2018      | 2019      | 2020      | 2021      |
|---------------|-----------|-----------|-----------|-----------|
| Nett Position | -£275,330 | -£209,125 | -£215,375 | -£208,659 |

#### 4.15 Procurement and Exit Strategies

The procurement of the operation of the new bus route should be straightforward in principle. A lead organisation from amongst the CBC partners would need to be identified to lead the procurement exercise and allocation of subsidy payment levels between CBC organisations agreed.

The tender specification should include:

- Operator Qualification – PSV operator’s licence, insurances, H&S & employment management systems etc.
- Experience and market knowledge requirements
- Base specification
- Reporting and monitoring requirements

The tender should include opportunity for bidding bus operators to provide alternative service and vehicle specifications that would achieve the new service’s objectives. We would also recommend that a revenue sharing arrangement be considered to give incentives for operators to market and deliver an excellent service and to give incentives to CBC organisations to promote their travel plan policies.

We envisage that it would be correct to test the market for the service operation on a regular basis. This would include reappraisal of the service’s needs and uptake including timing of an increased peak hour frequency as demand develops. At this point a decision would need to be made about how to continue or not. At that point consideration would be given to the residual value and redeployment of any publically funded assets (e.g. buses). Although a local authority can let a bus operations (subsidy) tender for up to 8 years<sup>2</sup>, it would appear prudent that a shorter contract would be desirable given the untried principles of a direct ‘orbital’ bus route such as this.

Whilst commercial operation is highly unlikely in the short term, with careful management attention such a situation is possible in the medium / long-term. Both this long-term possibility and the regular review and re-letting of the operating contract indicate that an exit strategy would be available should this be proved necessary.

<sup>2</sup> Local Transport Act 2008, section 70 - Extension of maximum length of subsidised services agreements

## 5. Review of Route and timetable options

### 5.1 Introduction

This section compares the options identified and the opportunities and issues with each. An assessment of the potential for delivering the predicated demand is also made. At this stage no formal recommendation as to a best option is made to allow the proposals to be subject to review by the University and CBC partners.

### 5.2 Options Summary

#### Route Options

- Option 1 – Via M11
- Option 2A – Rural via Hardwick
- Option 2B – Rural via Coton.

#### Timetable Options

- Alternative A – ‘All day’ (including sub-option for 20 minute and 30 minute off peak service)
- Alternative B – ‘peak hours’ only.

### 5.3 Analysis

5.3.1 The analysis has developed three route options (“Options 1, 2A and 2B) and two timetable options (“Alternatives A and B”) to provide a Papworth Everard P+R / Cambourne to CBC service. Observations on each is made around key themes and key questions.

#### Route

Is the route suitable to providing a direct Papworth Everard to Cambourne to CBC service ?

Will the route pick up P+R demands ?

#### Infrastructure

Is bus priority infrastructure available ?

What are timescales for infrastructure investment ?

#### Timetable

Does the proposed timetable deliver a direct (no interchange) service from Papworth Everard to Cambourne to CBC ?

Does the timetable make use of existing resources or does it require a stand-alone new set of resources ?

### Costs

Does a breakeven position appear likely ?

### Demand

Does the service proposed appear likely to attract a large proportion of calculated demand ?

**Table 24. Route Assessment**

| Route                          | Strength   | Opportunity  | Weakness  | Threat   |
|--------------------------------|--|--|---|--|
| Option 1 – Via M11             | <p>No new infrastructure requirements</p> <p>Good end to end journey time.</p> <p>Make use of existing southern busway section between Trumpington P+R and CBC)</p>          | <p>Early delivery possible</p> <p>Longer term potential benefits from Western Orbital road</p> |   | <p>Expansion to Trumpington P+R</p>  |
| Option 2A – Rural via Hardwick | <p>No new infrastructure requirements</p> <p>Avoids some key congestion ‘hotspots’</p> <p>Makes use of existing southern busway section between Trumpington P+R and CBC)</p> | <p>Early delivery possible</p>   | <p>Still requires bus to run on rural roads with slower journey time</p>      | <p>Would require delivery on road bus priority for competitive journey times</p> |
| Option 2B – Rural via Coton    | <p>No new infrastructure requirements</p> <p>Avoids some key congestion ‘hotspots’</p> <p>Makes use of existing southern busway (Trumpington to CBC)</p>                     | <p>Early delivery possible</p>   | <p>Still requires bus to run on rural existing roads, slower journey time</p> | <p>Would require delivery on road bus priority for competitive journey times</p> |

**Table 25. Timetable Review**

| Timetable                            | Strength   | Opportunity  | Weakness  | Threat   |
|--------------------------------------|--|--|---|--|
| Alternative A<br>– ‘All day’         | <p>Fast route – direct service</p> <p>All day service – maximum opportunity to capture users</p> <p>Could run via A1303 busway in the future</p> <p>Stand-alone operation reduces operational delay risk</p> | <p>Provide new service and journey opportunities – scope for growth may be wider</p> <p>New branding possible for stand-alone service</p>  | <p>High operating mileage</p> <p>Limited sharing of resources with other services</p>   | <p>Commercial risk due to new route</p>  |
| Alternative B<br>– ‘peak hours’ only | <p>Fast route – Direct service</p> <p>Could run via A1303 busway when open</p> <p>Stand-alone operation reduces operational delay risk</p>   | <p>Provide link for majority of users at lower costs</p> <p>Could be extended into all day service when demand proven</p> <p>New branding possible for stand-alone service</p> <p>Could have other off-peak use for the vehicles</p> | <p>Limited potential for additional patronage due to service hours</p> <p>Peak hours service only does not cater for wide range of return journey times – service would need to be tailored around return times</p> | <p>Commercial risk due to new route but lower operating cost requirements than Alternative A</p> |

**Table 26. Costs Review**

| Costs                        | Strength                                   | Opportunity   | Weakness          | Threat                      |
|------------------------------|--|---|-------------------|-----------------------------|
| Alternative A<br>– ‘All day’ | <p>Robust costs on a stand-alone basis</p> | <p>Ability to reduce costs should more bus priority be delivered</p> <p>Potential to reduce off-peak frequency to</p> | <p>High costs</p> | <p>High commercial risk</p> |

|                                   |                                     |   |  |                      |
|-----------------------------------|-------------------------------------|---|--|----------------------|
|                                   |                                     | reduce costs  |  |                      |
| Alternative B – ‘peak hours’ only | Robust costs on a stand-alone basis | Ability to reduce costs should more bus priority be delivered | High costs for level of service due to fixed costs of 4 vehicles | High commercial risk |

**Table 27. Demand Considerations**

| Demand                            | Strength  | Opportunity   | Weakness  | Threat   |
|-----------------------------------|---|---|---|--|
| Alternative A – ‘All day’         | <p>Good for Papworth and Cambourne to CBC demand</p> <p>Provides maximum opportunity to tap into estimated demand</p> | <p>As a stand-alone product easy to promote to new markets</p> <p>Can attract non-employee markets</p>                          | <p>Limited intermediate markets – may not fully realise predicted demand</p> <p>Breakeven unlikely in medium term</p>   | <p>P+R demand uncertain due to CBC parking management requirements</p> <p>May need to rely on Cambourne housing growth to achieve viability</p> <p>Long time for demand build-up</p> |
| Alternative B – ‘peak hours’ only | <p>Good for P+R and Cambourne to CBC demand</p> <p>Captures high % of estimated demand</p>                            | <p>As a stand-alone product easy to promote to new markets</p> <p>Could be extended into all day service when demand proven</p> | <p>Limited intermediate markets – may not fully realise predicted demand</p> <p>Return traffic may be choked by lack of off-peak return journeys</p> <p>Breakeven unlikely in medium term</p> | <p>P+R demand uncertain due to CBC parking management requirements</p> <p>Long time for demand build-up</p>  |

Table 28.

Appendix – Indicative Bus Timetables

Alternative A – Every 30 minutes all day service Papworth / Cambourne to CBC via M11

|           |       |       |                        |       |       |
|-----------|-------|-------|------------------------|-------|-------|
| PE P+R    | 06:10 | 06:40 | every 30 minutes until | 18:00 | 18:30 |
| Cambourne | 06:13 | 06:43 |                        | 18:03 | 18:33 |
| CBC       | 06:46 | 07:16 |                        | 18:36 | 19:06 |
|           |       |       |                        |       |       |
| CBC       | 06:50 | 07:20 |                        | 18:40 | 19:10 |
| Cambourne | 07:23 | 07:53 |                        | 19:13 | 19:43 |
| PE P+R    | 07:26 | 07:56 |                        | 19:16 | 19:46 |

Alternative B - Every 30 minutes peak hours only day service Papworth / Cambourne to CBC via M11

|           |       |                        |       |  |       |                        |       |
|-----------|-------|------------------------|-------|--|-------|------------------------|-------|
| PE P+R    | 06:10 | every 30 minutes until | 09:10 |  | 15:10 | every 30 minutes until | 18:40 |
| Cambourne | 06:13 |                        | 09:13 |  | 15:13 |                        | 18:43 |
| CBC       | 06:46 |                        | 09:46 |  | 15:46 |                        | 19:16 |
|           |       |                        |       |  |       |                        |       |
| CBC       | 06:50 |                        | 09:50 |  | 15:50 |                        | 19:20 |
| Cambourne | 07:23 |                        | 10:23 |  | 16:23 |                        | 19:53 |
| PE P+R    | 07:26 |                        | 10:26 |  | 16:26 |                        | 19:56 |