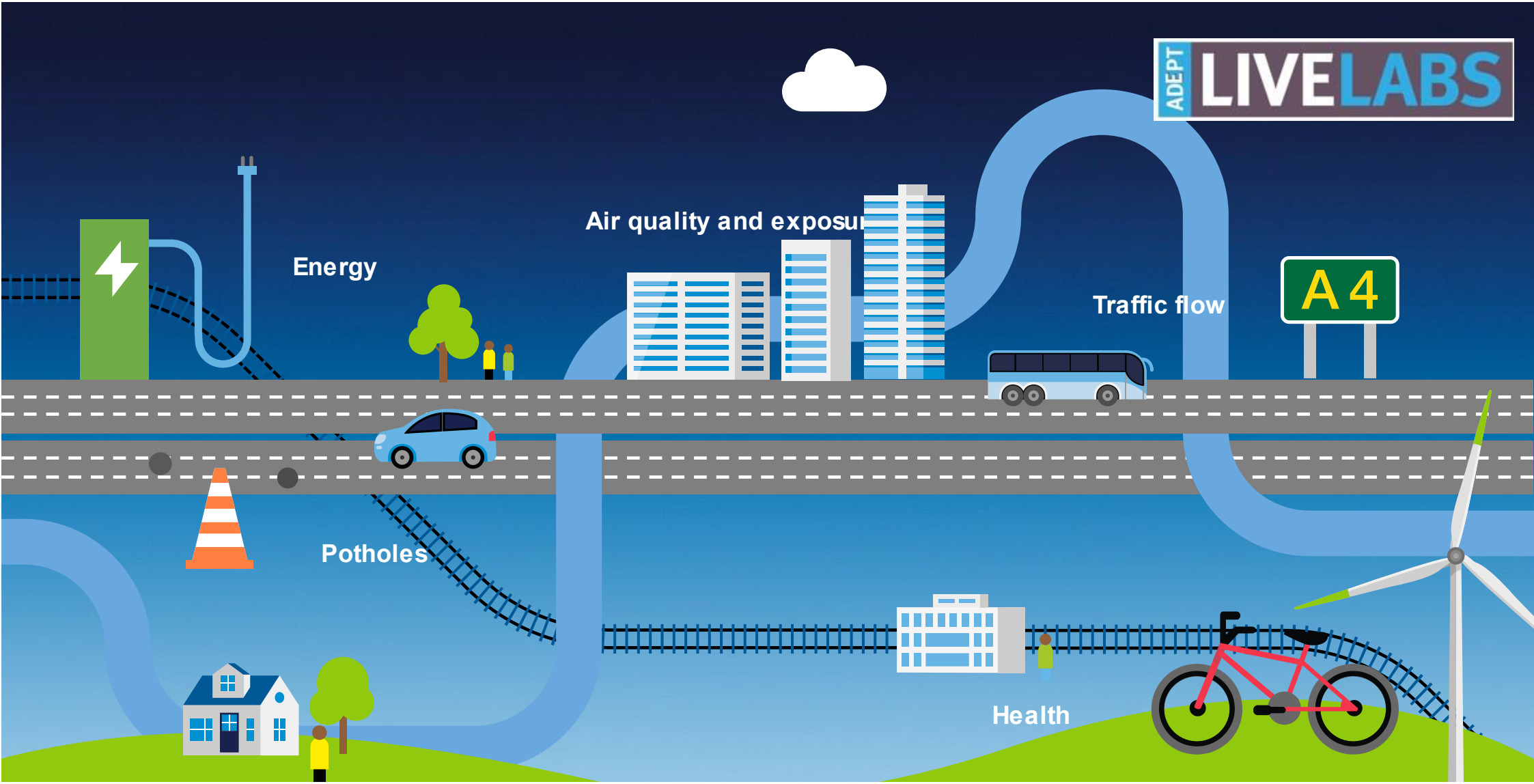
Thames Valley Berkshire Live Labs - Overview of Final Project Outputs

April 2023



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Reading Borough Council (Project Lead)

West Berkshire Council

Wokingham Borough Council

Bracknell Forest Council

Slough Borough Council

Royal Borough of Windsor and Maidenhead

Private Sector

Stantec (formerly Peter Brett Associates)

O2 - Telefonica

Yunex Traffic (formerly Siemens)

Smarter Grid Solutions

Shoothill

Academia

University of Reading (UoR)

Other

Thames Valley Berkshire Local Enterprise Partnership

Introduction

The Thames Valley Berkshire Live Lab was a £5.6m (£4.75m of ADEPT / DfT grant with match funding) research and development project which spanned the 6 Berkshire Authorities. It was wide ranging in scope, covering five main themes; Transport, Energy, Air Quality, Health and Potholes. At its core was exploring the use of big data to develop new insights for transport planning, network management and for informing the public.

The purpose of this note is to give an overview of the project and to guide the reader to further information within the technical documents.

A range of technical documents have been produced to share the output from the project. There are a range of reports from academic papers, technical reports, and shorter summaries of the key findings. These outputs are referenced in the text and there is a summary list in **Appendix 1**.

The Project Team

The project was led by Reading Borough Council and involved the other 5 Berkshire Unitary authorities: Wokingham, West Berkshire, Bracknell Forest, Slough and the Royal Borough of Windsor and Maidenhead. Stantec (formerly Peter Brett Associates) provided programme management support alongside specialist technical support to the Energy and Air Quality deliverables. O2 provided the data insights platform and they onboarded the specialist sub-contractors to deliver the potholes, health, and travel behavioural change app workstreams as well as supporting insights to the air quality work. Yunex (formerly Siemens), with specialist sub-contractor support, delivered the air quality sensors, air quality monitoring and a range of other technical inputs to the project.

The energy work was delivered by Smarter Grid Solutions and Shoothill undertook work on the open data platform. The University of Reading provided academic rigour to the evaluation of the air quality and energy work streams.

Air Quality

Energy

Mobility & Health

Potholes

Transport

Air Quality

The air quality trial was the most integrated of the project themes, linking air quality with Transport, Health and Potholes.

The air quality trials centred around the deployment of 27 EarthSense air quality sensors across Reading, Thatcham and Wokingham which were delivered by Yunex. The sensors were deployed across 3 authorities and the locations were identified and agreed through a study undertaken by Stantec and supporting cross sector local authority workshops to identify objectives (**Ref:AQ1**) with input from EarthSense using their 100m resolution air quality model of the country (**Ref:AQ2**). These sensors measured NO_2 and NOx and the accuracy of the sensors was evaluated by the University of Reading (**Ref:AQ3**). As part of the trial a 10m resolution model was also developed for Thatcham. Air quality data was incorporated into the project in the following trials:

1) A trial of the integration of the EarthSense sensors into Yunex STRATOS urban traffic control system to evaluate different control strategies on air quality in Thatcham (**Ref:AQ4**). This is also evaluated in a peer reviewed paper published by the University of Reading (**Ref:AQ5**)**.**
2) A trial of the Integration of the EarthSense sensors with O2's data insights platform with a dashboard produced by GPC. This combined air quality data from the sensors with pothole data and O2 real time mobile network data to start to better understand people's exposure to poor air quality. (**Ref:AQ6**).
3) A trial of the integration of air quality data (EarthSense 100m resolution model) into the Innovation Valley Rewards app behavioural change app. (**Ref:BC1, Ref:BC2**).
4) Development (EarthSense) of a 10m resolution accuracy for air quality in Thatcham built as a development of the existing 100m resolution model, incorporating additional data from the EarthSense sensors deployed in Thatcham.
5) It was intended that the air quality data be integrated into a respiratory health evaluation report undertaken by Space Syntax, however, this report was commissioned and completed before the air quality data was live due to contracting delays. See the Health section. (**Ref:H1**).

Project outcomes have been evaluated from the perspective of technical delivery of the technology and from the perspective of 'so what?', do the outputs provide benefits in economic and non-economic terms. The main project outcomes were as follows:

Air Quality Sensors

Low-cost air quality sensors have long been known to be quite variable in terms of the absolute accuracy of the data, and in some cases also the level of consistency of the data. In programmes, such as using low-cost sensors to raise awareness of air quality, for example, programmes with school children, the absolute accuracy is not so critical. However, if the data is being used to change the optimisation of traffic signals to improve air quality, then accuracy is key, as we need to know that the strategies are providing actual benefits.

In measuring air quality, the project investigated the accuracy of the EarthSense sensors, and they proved to be accurate in terms of NO_2 readings. In lower cost sensors such as the EarthSense sensors, NO_2 is a derived output from a range of other readings as the direct NO_2 sensors found in the permanent air quality sites in Berkshire, are expensive. The sensors and associated algorithms proved accurate in the measurement of NO_2 and this gave confidence in the use of the data for decision making (**Ref:AQ3**). NO_2 data was used in the traffic signals optimisation trial.

EarthSense Zephyr Solar Powered Air Quality Sensor

As more vehicles become electric and NO_2 falls and our understanding of the harmful effects of particulates increases, PM_{10} and $PM_{2.5}$ measurements are going to be seen as more important in air quality and health. Particulates (PM_{10} and $PM_{2.5}$) were measured by the EarthSense sensors and PM_{10} was evaluated. When compared to reference sensors, the reference sensors are low down in cages whereas the EarthSense sensors are mounted higher on the poles (around 2m) to prevent them getting knocked. PM_{10} concentrations reduce with height and are affected by weather and atmospheric conditions which can have a large effect on the readings. It was found that particulate measurements showed different trends to PM measured by the reference sensors and hence they would require outfield calibration to further improve their measurements. (**Ref:AQ3**).

The air quality sensors were a mix of mains powered sensors located on traffic signal infrastructure and solar powered sensors, located in positions that were based on optimum positions to collect air quality data and the position of infrastructure (lamp columns) to locate it on. A problem that occurred was that several of the solar powered sensors ran out of power in the winter with loss of data during the power outages and as the sensors bedded back in again after each restart. A solution to this could have been to either:

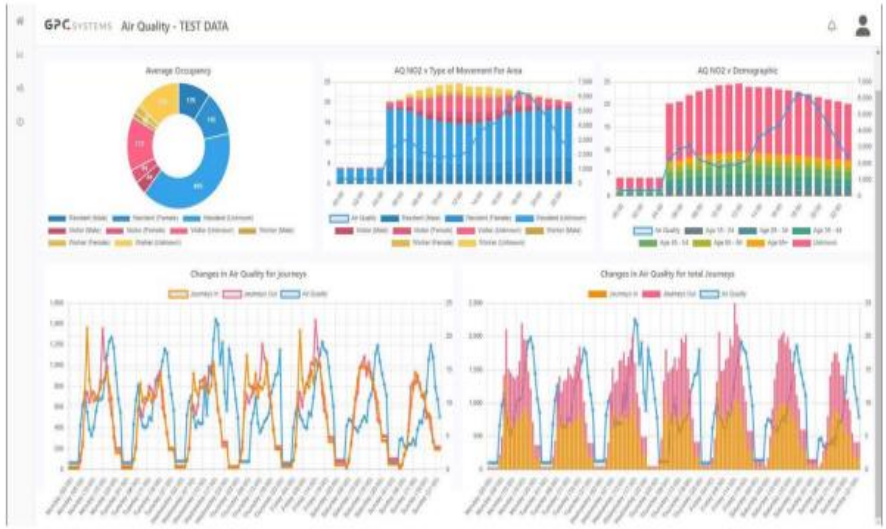
- reduce the frequency of data recording which would have not produced enough live data for the traffic management strategy, but would be sufficient for other monitoring applications,
- to have compromised the location to maximise the amount of sunlight on the solar panels or
- to have permanently powered the sensors (wiring of the lamp column power was not agreed for the trial but could be a solution for a permanent sensor site).

Traffic Management Strategies and Air quality Exposure

The Thatcham trial of using EarthSense sensor data integrated into the Siemens Stratos Urban Traffic Management and Control system successfully demonstrated the integration into the strategy management tool and the ability to implement air quality strategies in a SCOOT controlled traffic signal region, that changed the air quality in Thatcham (**Ref:AQ4**). Through implementing the strategies, we were able to reduce extreme peak exceedances of NO_2 in peak periods, although we saw a small increase in the general background level of NO_2 (**Ref:AQ4**). Hence, this would benefit, for example, school children going to school along the road where the reduction in exceedances was significant, but would worsen the

air quality for someone who is in the vicinity of the road for extended periods of time.

The Thatcham trial highlighted the importance of understanding people's exposure to poor air quality in determining the best strategy to implement. Exposure was considered across all the air quality areas using O2's Motion data in a dashboard produced by GPC (**Ref:AQ6**). O2 Motion mobile phone data gives a range of data including the volume of people in an area by hour, their purpose for being in that area, their mode of travel and direction of travel and their demographic breakdown. This was combined with the air quality data from a live feed from the Yunex EarthSense sensors. The dashboard gave an interesting overview of the data but was not of sufficient granularity as the O2 Motion data was at Middle Super Output Area (MSOA) level and hence not accurate enough to place people on the key roads where the local air quality issues were. Air quality improves rapidly with distance from the traffic source, and hence accuracy to enable the placing of people on specific roads is required. Subsequent to the trial, O2 Motion have further developed granularity options and have identified a capability that could deliver an increased level of granularity which would require further testing.



GPC Air quality dashboard

EarthSense 10m model

As a part of the trial, EarthSense developed a 10m resolution model of Thatcham and this was compared at a high-level to traditional modelling techniques used in air quality assessments (ADMS, CERC Ltd, Advanced Dispersion Model developed for regulatory authorities in the UK). The initial EarthSense model, based on their 100m national air quality model and default parameters did not have sufficient accuracy to be useable. The new sensor monitoring locations chosen were also unsuitable for model verification due to very particular microclimates in their placement. With the further model development including the introduction of the more accurate local traffic flow data and the introduction of the buildings, good outputs were achieved. These could be useful, for example, in showing relative air quality of different routes

for walking to school and where children should stand whilst waiting for parents. However, the EarthSense 10m modelling was an addition to the original project scope and as such no allowance had been made in the programme or budget for a comparative ADMS or a more accurate CFD (Computational Fluid Dynamics) model to be made to compare. Hence, the accuracy of the model was not evaluated in detail.

EarthSense 10m model

Other applications of Air Quality Sensor Data

In addition to the specific trials, Environmental Health officers and Air Quality officers in West Berkshire, Reading and Wokingham had access to the sensor data in their boroughs via the EarthSense dashboard and used the data to better understand air quality.

Although it did not form part of the detailed project evaluation, there were a number of examples where the sensor data was used to provide benefit including:

- Understanding the local variation in air quality and the impact on exposure to health from just crossing the road to the side of the road with more open areas around it – could be useful for advice on routes to school, for example.
- Identifying high pollution events such as from a takeaway
- Understanding the impacts of Reading Festival on air quality
- Improving the understanding of school peak pollution events and diurnal variations.
- Understanding the air quality issues generated inside a building on a main road where the air conditioning intakes are around the side of the building but at ground level. New regulations require air intakes on the roof but there will be a lot of older buildings where air conditioning effectively circulates poor levels of air quality around the buildings to all occupants. Levels do not necessarily exceed safe levels but are higher than desirable and exposure is high.
- Used to monitor construction dust for a construction site in Reading near the railway station and whether they were meeting their obligations.
- Understanding the impacts of the Railway through Reading. NOx is not an issue post electrification, but particulates remain an issue, raising further questions around what percentage is from the generation of brake wear.
- Impact of COVID on AQ due to reduction in traffic. The improvement in air quality was not seen linearly due to increase in other sources, such as increased use of boilers in homes.

Outcomes

Whilst the trials demonstrated the use of the air quality sensors for traffic management and were found to be useful by environmental health officers and air quality officers, funding was not found by the

authorities to support the ongoing maintenance costs following the trial. There were several reasons for this including:

1) Funding – there was no specific budget allocated for the ongoing maintenance of the sensors and supporting services. The sensors were around £5k each to supply and install, with ongoing annual maintenance and sensor replacement and data service costs.
2) A lack of a clear business case as there was no connection between those that benefit financially from improved air quality (health related services) and those that pay for the installation and maintenance of the sensors. There was a look towards highways to fund them as part of the ITS (Intelligent Transport Systems) Equipment.

The project has prompted a number of the authorities to seek additional funding to secure more air quality sensors as the benefit of the data has had a wide range of applications.

The project successes were in the deployment of the sensors, their accuracy in terms of NO_2 measurements, successful traffic management strategy development, and the local insights given by having higher sensor density and by locating them in locations that would not normally be covered, and in delivering realistic 10m accuracy air quality modelling.

Where the project was not so successful and where further work would be required was in developing insights around air quality and exposure to people using big data, the accurate measurement of particulates, and the use of solar power to provide live air quality data with frequent updates, in the winter months.

Summary of Air Quality Outcomes:

The EarthSense sensors proved accurate in measuring NO_2 when compared to reference stations, however particulate measurement was less consistent, and require more local validation.

The solar powered EarthSense sensors had power outages in the winter. Mains power or a compromise in location /frequency of readings would be required to avoid this problem.

The integration of the air quality sensors into the Yunex traffic control system and their use to optimise signal timing strategies was successful. The results showed a significant fall in dangerous peak exceedances in NO_2, but a small increase in general background NO_2.

The optimum strategy for air quality and health requires an understanding of people's exposure to the poor air quality. O2 Motion data based on mobile phones was trialled, but the resolution of the data was too low to place people next to a specific road. O2 have subsequently improved data options to address this.

10m resolution modelling was undertaken by EarthSense which demonstrated that useful outputs could be produced that could inform walk routes to school for example. The project did not demonstrate whether the accuracy was of a sufficient level to replace traditional modelling techniques, and this would require further study.

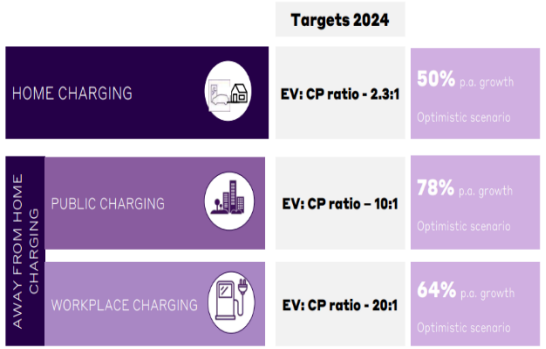
Funding for the sensors was not secured beyond the trial. Whilst the air quality sensors provided a wide range of data and useful insights and were used by , highways, environmental health and air quality officers, no one team could provide the funding. However, the value of the data has been recognised and additional funding is being sought from DEFRA and other funding streams.

Energy

The energy workstream consisted of two main interrelated outputs, the trial of a smart energy operations platform with supporting University of Reading research and evaluation, and a Berkshire wide public study of EV charging infrastructure and projected demand and supply. At the core of this work was the principle that we need to think more holistically around EV charging, integrating it effectively with building energy, local energy generation such as rooftop solar, and the carbon intensity of energy in the national grid. This will enable energy demand to better align with low carbon energy supply and reduce the reliance on fossil fuels as the UK continues to decarbonise the national grid.

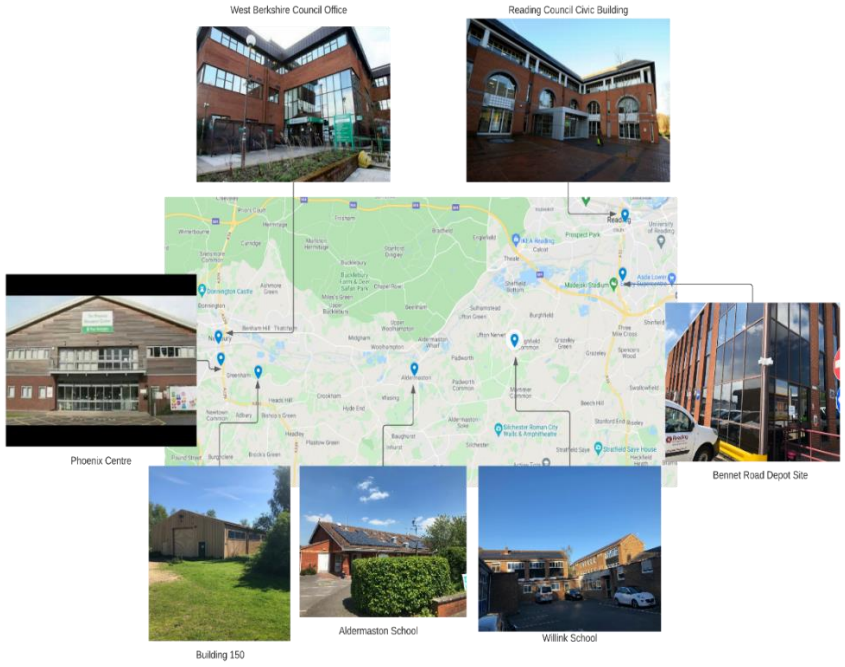
The **Energy Insights Report (Ref:E1)**, provides an overview of energy policy at national and local levels; a summary of the state of readiness of the Berkshire local authorities to better manage energy; and the energy schemes that they have delivered and / or are in planning. This included a review of the authorities Carbon Plans and the more strategic energy strategy work undertaken by the Thames Valley Berkshire Local Enterprise Partnership. The report also sets out the findings of a desktop study undertaken by UoR of good practice examples of what other authorities have been delivering for building energy, fleet electrification and EV charging infrastructure including technology and funding options including participation in the energy market, lessons learnt and considerations for other authorities. Examples of charging infrastructure that have been reported on include; lamppost charging, dedicated on-street charging, providing residents charging in council owned car parks etc. With charging infrastructure, there is no one best solution as many factors influence what is the optimum solution in any one area to reflect asset ownership, land ownership, grid capacity constraints and grid reinforcement requirements, demand for charging and the likely demand profiles of those who will use the chargers. This work sets the context for the EV charging study and the Smart Energy Platform implementation.

The Berkshire specific EV charging study was undertaken by ev.energy, a charge point supplier, and Hubject Consulting as sub-consultants to O2 and the output was a series of 3 reports (**Ref:E2**) which covered all six Berkshire authorities and included an EV Ownership Analysis & Growth Forecast Report (Report 1), an EV Usage Analysis & Growth Forecast Report (Report 2), and EV Charging Infrastructure – Analysis & Growth Forecast (Report 3). The reports used EV ownership to Charging Point ratio's for home, public and workplace charging to analyse the impact of growth on charging requirements. The reports were also output as separate reports for each of the 6 Berkshire Authority areas at their request to help them develop their EV Charging Strategies. The success of the project has been evaluated by O2 **(Ref:E3)** where it was concluded that the report provided a solid set of data insight into the growth in EV demand and how the authorities were responding to this and the level of shortfall in charging provision. However, the report was not scoped to identify specific locations for charge points across the authority areas which is a key challenge for the Berkshire Authorities and would have involved a much more extensive study.



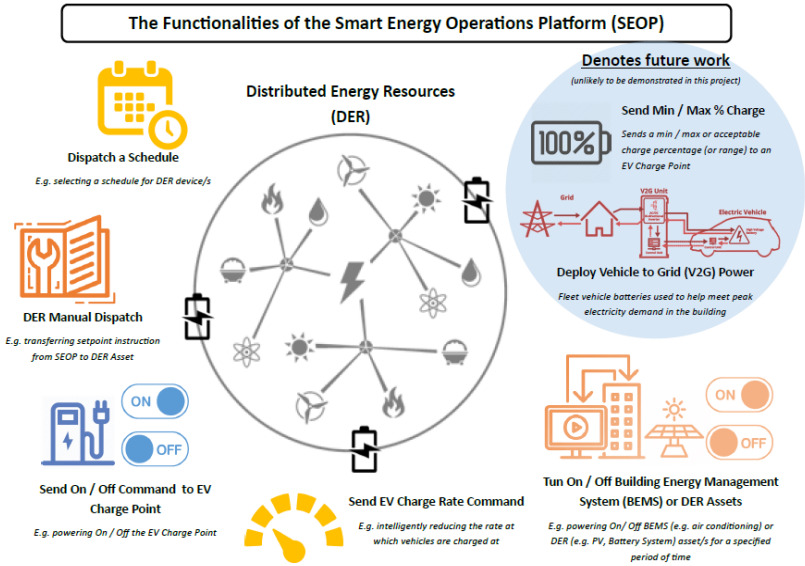
A solid ramp up of the 3 main types of charging infrastructure is required in order to meet projected growth in EV demand

The smart energy operations trial is set out from Section 5 in **Energy Insights Report (Ref:E1)**, which describes the trial deployment, analysis and results and discusses the decarbonisation impacts of scaling deployment and provides recommendations for transferability to other authorities. Trials of the Smarter Grid Solutions (SGS) Smart Energy Operations Platform (SEOP) were undertaken across sites in Reading and West Berkshire. In addition, a smaller trial was also undertaken with Measurable Energy Smart sockets (**Ref:E3**) to show the potential of small energy management and to understand how this could be integrated into the wider SGS solution.



Energy trial installation locations

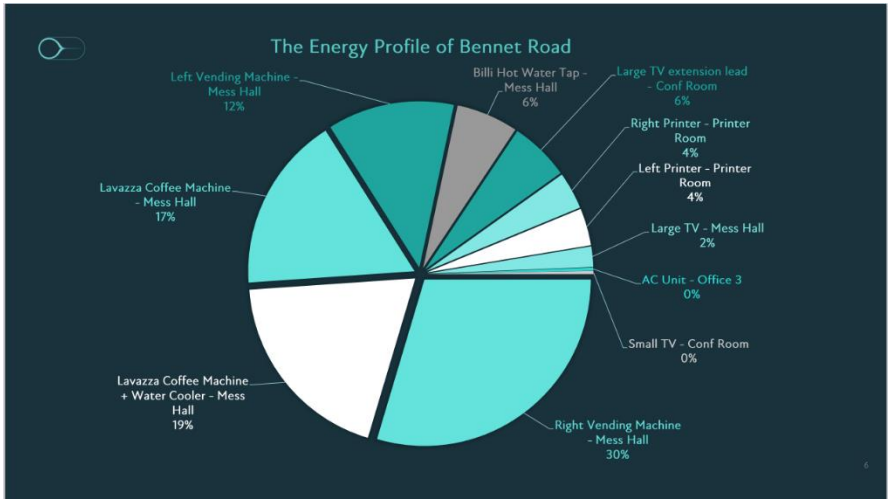
Through the trial we were able to connect a number of building and solar assets to the platform, which are detailed in the report along with the grid carbon intensity feed. The value of a single flexible and scalable energy dashboard to help them with their net zero transition were recognised by the local authorities and the local authorities are continuing to develop the platform beyond the trial. A simple re-timing of EV charging, for example, to lower tariff times of day was seen as a way to more than offset the platform costs which would underpin wider benefits.



The project did not proceed as far as planned with fewer assets connected and the project did not bring the energy assets under control to test the energy management value streams. This was due to a combination of technical integration with legacy systems, data ownership and institutional structural issues that took substantially more time than anticipated. A key learning from the project was the need for effective internal stakeholder

engagement within the authorities to ensure that all relevant people are identified and engaged and that there is clear leaderships to address cross-departmental interaction. It is also important that contracts for energy management assets, such as EV chargers, are let in such a way that their data can be accessed by the authority, and this should be part of a data management strategy. Further, it is important that time is allowed for the integration with legacy systems.

The measurable smart sockets trial (**Ref:E4**) showed how carbon from small power energy (assets plugged into sockets such as computers, monitors, coffee machines etc.) could be reduced by around 35%, although there were some technical issues with the Wi-Fi in the trial location which have been subsequently resolved. Provisional discussions were held during the project into how data could be shared, and the systems integrated into the SEOP although this was not undertaken during the trial.



Summary of Energy Outcomes:

UoR's desktop study, included in the Energy Insights Report (**Ref:E1**), of good practice and lessons learnt from other authorities in how to reduce energy provides good insight for transferability.

The EV charging study (**Ref:E2**) for the Berkshire authorities provided a useful evaluation of current and required electric vehicle charging provision which has been used to inform EV strategies.

The Energy Management Trial in Reading and West Berkshire showed that the smart energy operations platform could more than pay for itself in saving EV charging costs.

The trial showed that there is a clear opportunity to significantly reduce carbon, optimising solar usage and the grid at low carbon times by connecting up and managing all of an authorities' energy assets.

The trial also highlighted challenges of integrating existing energy assets onto a common platform and authorities should work to prepare for energy asset integration in:

- Contracts to ensure that the LA has rights over the energy data from the assets, such as EV chargers, that they procure.
- Recognising the need for a clear management structure within the authority that can pull together all the relevant parties as energy assets, including solar, electric vehicle charging etc can be the responsibility of a number of different departments.
- Recognising that technical integration of legacy systems onto a common management platform that will allow control of those assets can be challenging.

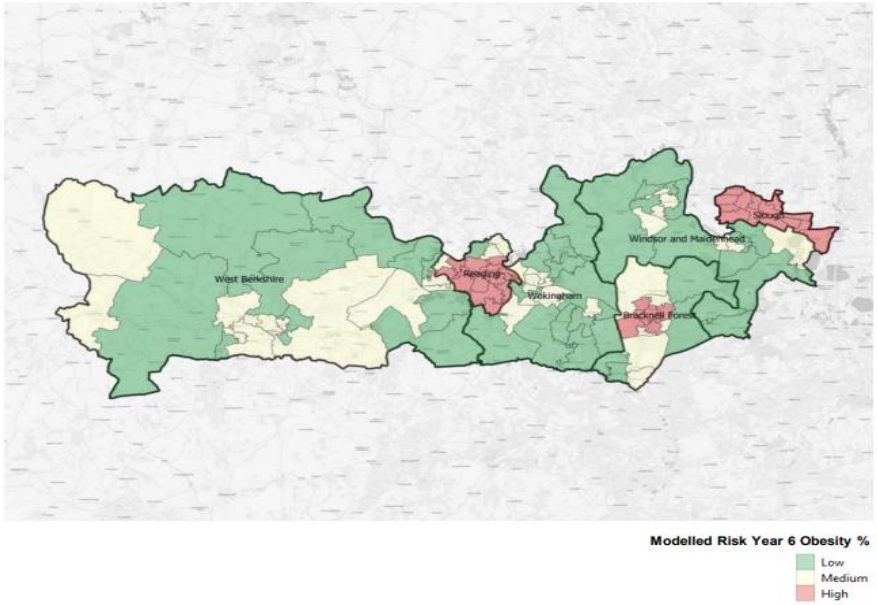
Due to the above this trial was not able to implement control of the assets, and hence the main outcome was the above learning of the real challenges of delivering the technology.

Mobility and Health

The objectives of the public health insights study focused on transport and childhood obesity, adult obesity, and respiratory illness. The project was delivered by Space Syntax as sub-contractors to O2. In their health risk mapping report (**Ref:M_H1**) Space Syntax drew together a range of datasets including child obesity, O2's Trip End, O2's Origin and Destination, Siemens traffic, public transport accessibility, car ownership, Socio-economic, demographic and Environmental datasets. It was originally intended that air quality data from the EarthSense sensors be incorporated, however, due to delays in the deployment of the sensors due to contracting issues, this data was not included. Also, it was not possible to secure the adult obesity data for the Berkshire area from the Local Authorities.

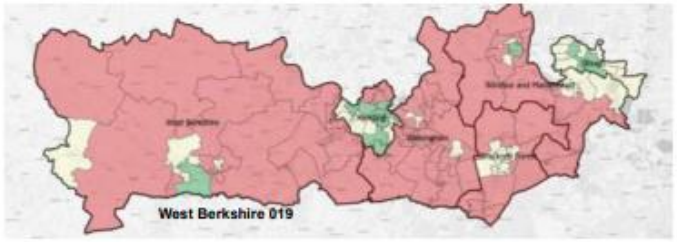
The project has been evaluated by O2 in their end of project evaluation report (**Ref:M_H2**). It identifies that due to the lack of air quality data, Space Syntax's data analysis in this area was not able to provide meaningful findings, however they did provide good output for the authorities in relation to childhood obesity and adult obesity health risks across Berkshire. The link between deprivation and childhood obesity is shown with the greatest risk of obesity in deprived urban areas, with the reverse for adult obesity which is primarily influenced by commuting behaviour and the ability to use public transport and active travel. The report also provided a number of supporting visualisations of relationships between the health and mobility datasets.

The O2 motion data and childhood obesity data was only available at MSOA (Middle Layer Super Output Areas) level and hence the insights were spatially quite broad and a finer level of granularity would likely have improved the insights. LSOA (Lower Super Output Area) level data would have been more useful for the Local Authorities and some data interpolation was undertaken to produce likely health risks at this level.

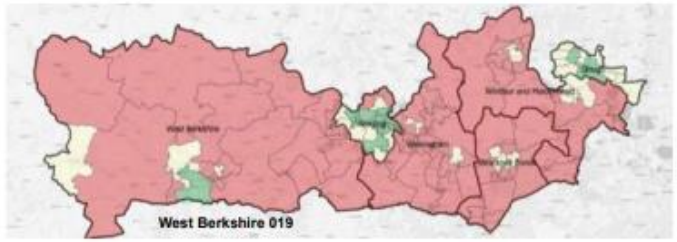


Modelled Risk of Childhood Obesity for Berkshire – Year 6

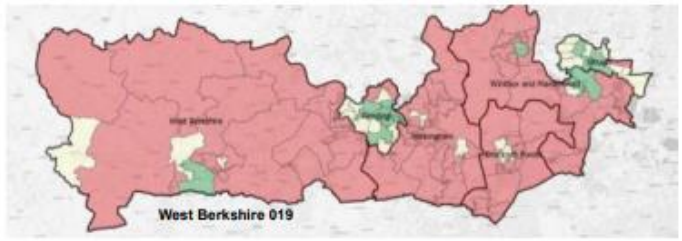
Modelled Risk - 'No Car' ownership per population



Modelled Risk - Public Transport Use per population



Modelled Risk - Active Travel Use per population



Modelled Risk of Adult Obesity

Summary of Mobility and Health Outcomes:

The study demonstrated the ability to ingest data from publicly available datasets and from O2 mobile phone data and traffic data from the traffic control system.

The report demonstrated the power of data analytics and visualisation to present key findings around transport and obesity in adults and children.

Childhood obesity is driven much more by socio economic factors with deprivation leading to obesity. Adult obesity is most heavily influenced by how they travel with clear health benefits of active travel and public transport.

Limitations of some datasets in terms of granularity including the mobile phone-based data and childhood obesity, and limitations in data availability limited the outputs. The results presented a good cross Berkshire understanding of health risks which provides useful insights at a strategic level, but greater granularity would be required to provide benefit to the individual local authorities.

Availability to good quality data is key to delivering insights.

Potholes

The objective of the trial was to deliver an automated approach to identification of the severity and impact of potholes across the six Berkshire Authorities. The solution developed was an AI based visual imaging approach to the identification of potholes, developed by GPC as sub-contractors to O2. The overview of the project and evaluation are set out in O2's – End of project evaluation report (**Ref:P1**).

Refuse vehicles were used to mount the cameras as they covered a high proportion of the authority's roads every couple of weeks. 24 cameras were fitted for the trial and data collected which was then processed by GPC. GPC used an AI approach to train the software to identify the length, width, depth and area of potholes from the images. GPC also imported O2 motion data to incorporate traffic flow into the model to provide an improved prioritisation score depending on how busy roads were. A dashboard was provided to the local authorities to see the data.

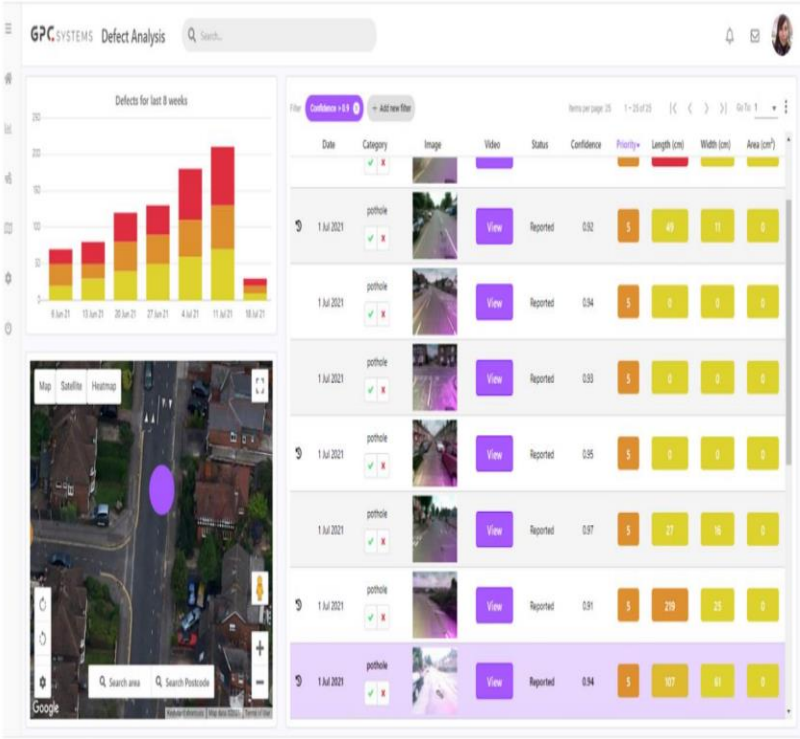
For the trial, it was not possible to make the vehicle modifications to hard wire the on-vehicle equipment into the vehicle battery and hence it needed to be connected by the 12v Aux socket. Unfortunately, this was a major barrier to the success of the trial as it was very difficult to get the drivers to plug it in, a problem which was made worse by the HGV driver shortage at the time and frequent changes in staff. This resulted in less data for training of the AI and supplementary data collection on separate vehicle driven by GPC had to be undertaken.

The trial was successful in providing a capability option to identify and prioritise potholes on a far more regular basis than current practices, however further training would be required to fully align the AI with the local authority business practices and requirements, which varied from authority to authority. For example, it is not just the location (Street and

In vehicle system

where in the street) and the size and depth of the pothole but also the characteristics of the shape of the pothole (vertical sides or more of a bowl shape) that also effect prioritisation for repair. To be adopted by the local authorities more development work with the authorities would be required to change their current way of working and to fully address

concerns with liability. In feedback from the authorities, a potential initial use case could be in the identification of the prioritisation of resurfacing of the minor roads which are not regularly surveyed. The system would provide a comparative output across all minor roads, whereas the current approach compares the views of a range of different inspectors who do not necessarily provide consistent analysis. Coupled with using the system to monitor the main routes, this could then help build confidence for its wider application. Costs for permanent deployment of 24 cameras would be in the order of £200k in the first year with reduced costs in subsequent years.



GPC dashboard showing pothole location and characteristics.

Summary of Potholes Outcomes:

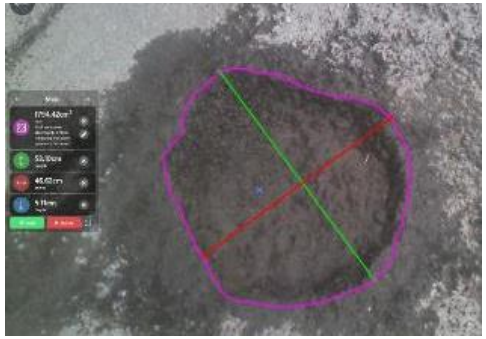
The trial successfully installed cameras in refuse lorries and demonstrated that the technology and AI was capable of identifying road defects.

The temporary nature of the trial and hence the need to plug the on-vehicle devices in each day had a major impact on the trial. Any deployment would have to be hard-wired into the vehicles.

Sufficient data was collected to demonstrate the functionality of the system. The system provided good data on general road condition and was able to categorise potholes.

Feedback from the authorities identified that further development work would be required to train the AI to achieve a level at which they would be confident in using it for potholes given the potential legal challenges if there is an incident. Also different authorities have slightly different approaches, and it was identified that the AI would need to be bespoke to the authority.

A potential initial use was identified as to monitoring the minor roads which are only inspected maybe annually.



Transport

The transport work package brought together innovation trials around data collection, data sharing and publication and the application of data to provide transport information for local authority network managers and transport planners.

The project primarily brought Yunex data together with O2 mobile phone based Real Time Travel Insight (RTTI) data. Innovation in data collection is set out in the Yunex IoT report (**Ref: T1**) which explored how data from existing traffic sensors can be more cost effectively collected using O2's LTE-M Internet of Things (IoT) network and in a way that can also enable the data to be used for a much wider range of applications. Yunex also undertook a trial of a data brokerage system to open-up data from Yunex Stratos Urban Traffic Management and Control (UTMC) system in a user friendly way such that it can be accessed by 3rd parties (**Ref: T2**). An additional sub project was undertaken to provide a local authority open data platform for a range of travel data. O2 undertook an evaluation of their RTTI data against ANPR as a cost-effective way of providing network journey time information and as a potential input to UTMC (**Ref: T3**). To trial enhanced traffic management, Yunex developed their RoadCast traffic prediction engine in Thatcham (**Ref: T4**).

Edge IoT (Ref:T1)

This sub-project explored how data from existing sensors could be cost effectively collected in a cloud service using Internet of Things (IoT) protocols and narrow band communications. The data could then be consumed by a data broker and published to a wide range of subscribers for insights generation.

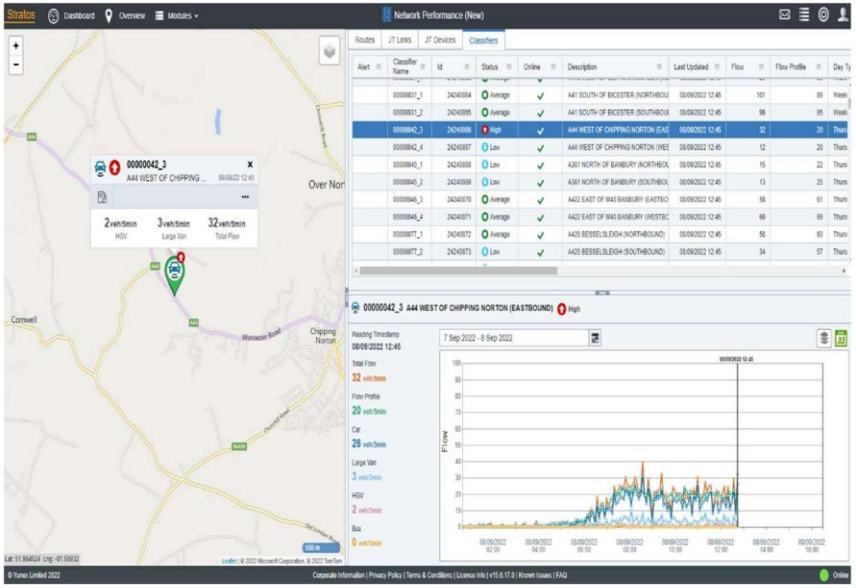
The opportunity was for existing vehicle sensing assets, which have been installed for a single purpose, e.g. inductive traffic loops to enable local traffic controllers to react to approaching vehicles, to become much more useful via a low cost upgrade. This upgrade enables the extraction of richer, low-level data such as classified traffic count data, not required by their original application, and the provision of this data to a cloud service from where it can be further processed to allow for insight generation.

UT-IoT base board developed for the TVB trials

This sub-project successfully prototyped a low cost, retrofittable Internet of Things communications device to enable legacy products, with serial interfaces, to expose their data via narrow band LTE based communications. The project linked the data to a brokerage and publishing service (**Ref: T2**) developed as another sub-project which enabled expert consumers to evaluate the resulting data for their own needs. Example use cases of providing classified vehicle counts and estimated pollution were delivered by Yunex Traffic to show that end to end delivery was successful in this project.

A business case to commercialise a solution is being explored. It is dependent on user demand for vehicle classification data (strong demand) and willingness to pay for the service (very much the challenge in the business case so far). Compared to installed cost of a UK based smart camera, the addition of the UT-IoT to a traffic controller with existing loops is around 1/15th to 1/20th of the cost of the camera and operating costs due to the significantly lower communications costs.

Whilst work on that is ongoing, the Stratos development team have produced a new module to enable count classified data to be visualised and used strategically in triggering strategy actions.



Yunex Stratos network performance module enhancements resulting from learning from this sub-project.

ITS Data Brokerage (Ref: T2)

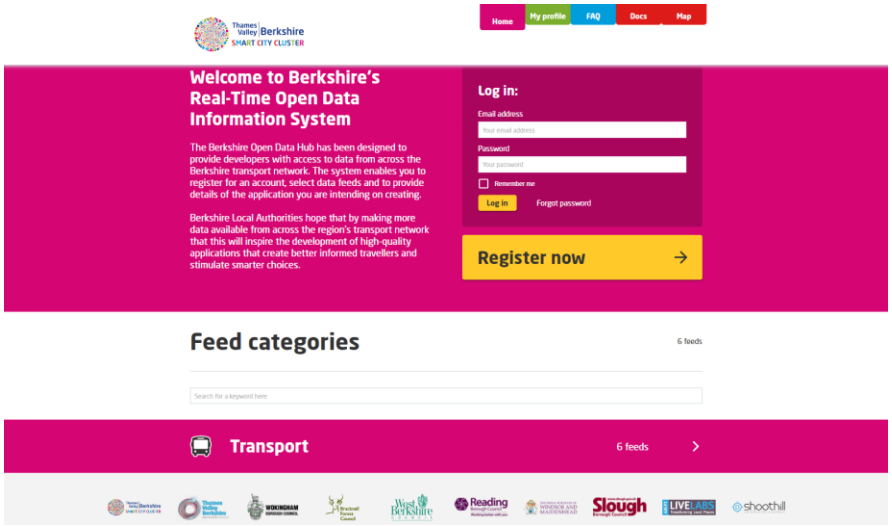
The need to share Yunex UTMC data with O2 and their partners highlighted the value of developing a data brokerage to open data within the existing ITS systems and enable project partners to explore use cases based on the exposed datasets. For example, EarthSense subscribed to a new data feed which gives information on real time vehicle flows, in order to assess how they might improve the accuracy of their air quality models (i.e. for the development of the 10m resolution model), which are currently based on data averages collected during local transport model production.

The project was technically successful which has led to Yunex working to develop a business model for the consumption of ITS data. The value of data remains a sticking point in the scaling up of such systems as the costs of processing, storing and moving data are potentially higher than the market is prepared to pay. Most people consulted agree that the data is useful but without operational business case, the creation of enough value to warrant further investment in development and operation is uncertain.

There is a culture of free data which stems from a handful of large companies using people's data to target revenue generating products and services and thus creating revenues from advertising. The transport sector does not currently enjoy the global advertising budgets which drive the investment in data processing and exchange and so "use case stacking" needs to be considered in ITS data projects.

Open Data

A separate open data platform was created by Shoothill as a part of the project. This linked to a range of data feeds from UTMC (Yunex), public transport and other data sources and was developed to be a cross Berkshire service. There was good engagement at the start of the project and whilst technically this was delivered and data feeds were integrated, changes to data systems in the authorities resulted in a number of the data feeds being broken during the project. The project was unable to obtain sufficient buy-in from the relevant LA officers to provide the information to re-connect and hence also to provide the certainty that if the site went live, that the authorities would ensure a quality of service for any third parties using the data. Bracknell Forest are looking further into this and may potentially support the platform.



Open Data Platform

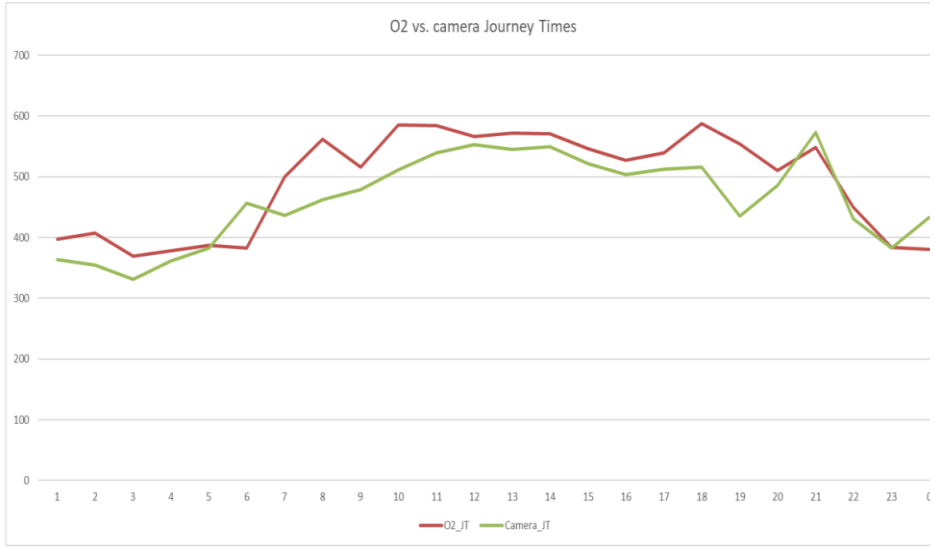
Traffic Flow (Ref: T3)

O2 developed a new platform capable of ingesting the mobile network event data in real time and this was analysed to understand how to translate the events into road specific insights (RTTI data). This was calibrated against known data, such as automatic number plate (ANPR) journey time links, and additional demographic attributes were also added to the data. Links were set up for Berkshire and the trial involved developing a way of sharing the data with Yunex for traffic control inputs.

The RTTI data includes Journey Counts expanded from the O2 sample to the UK population and average journey times. It is coupled with profile data including gender, age bracket, socioeconomic grade, spend power, home location (postal area) and work location (postal area) to give greater insight.

The RTTI uses mobile base station connection data to link mobile phone movement to road and rail links which are defined by a series of segments. Due to the spacing of base stations, the data is best used for the strategic road network (SRN) and main roads (MRN). For example, the trial included an evaluation of the RTTI journey time data against ANPR for the main A33 route from M4 junction 11 into the centre of Reading.

The project was successful in demonstrating a good match with journey times monitored using ANPR, although some local validation may be required for some routes. From a cost perspective, O2 data can be more cost effective than the installation and operation of ANPR data and also Bluetooth / Wi-Fi systems, where there is a large coverage to provide economies of scale. Also, reliability is expected to be better with the O2 data as it is based on a large number of mobile phones and not locally maintained on-street sensors. RTTI data is available for the whole country.

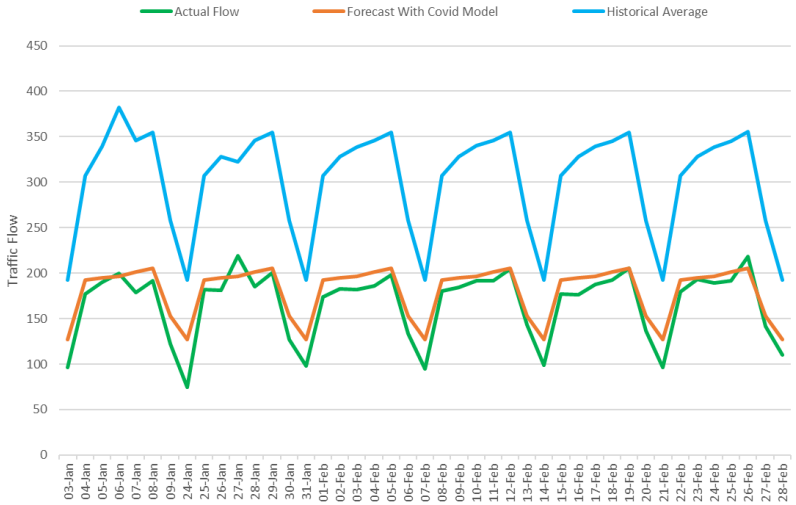


O2 comparison of RTTI data with ANRP data in providing journey road times.

RoadCast (Ref: T4)

RoadCast is a real time highway network journey time tool developed by Yunex that can track current journey times and can predict network journey times in the near future. It uses historical and real time data from on-street detectors alongside contextual data such as public holidays, sporting events and school term dates within a machine learning algorithm to forecast traffic conditions multiple days in advance. The advantage of machine learning is that it can automatically learn the effect of each context which makes the tool transferable, and the process is detailed in the supporting note.

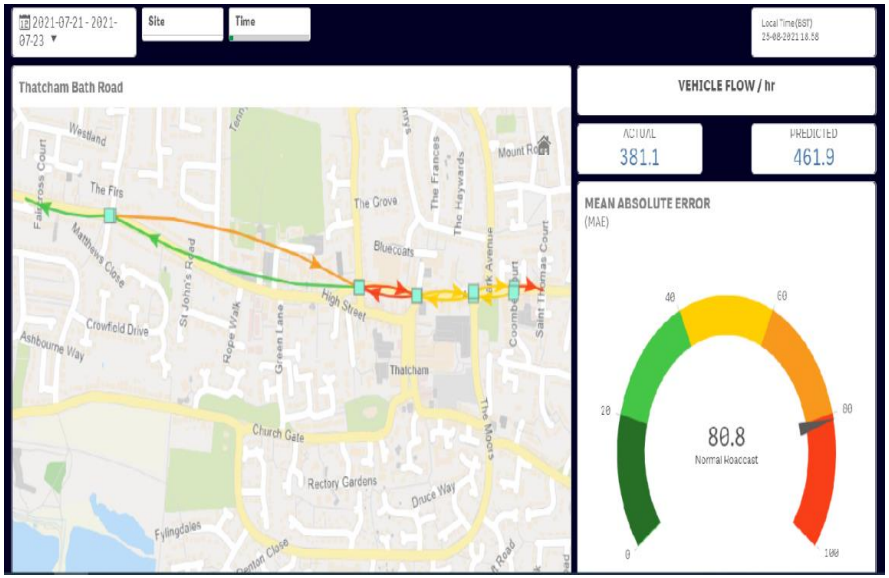
RoadCast was trialled in Thatcham and with additional Bournemouth data which was local to Yunex offices. SCOOT traffic loop data was used to train the model with 2017 and 2018 historical data and 2020 data for the pandemic. The trial was very successful with the model showing that it could accurately predict traffic flow in Thatcham and could allow for the impact of COVID 19.



Comparison of Actual flow and RoadCast with Covid model alongside a historical average projection.

A RoadCast dashboard was also created, and engagement was undertaken with the project team for feedback. The key outcome of the engagement was that RoadCast is better suited for the authorities with large signal networks such as Reading and Bracknell and that integration with STRATOS would make it much more useable in operating traffic management strategies than as a stand-alone platform. Bracknell Forest saw a key

potential for drawing in wider datasets from the strategic road network to predict the effects of incidents on the M4, M3 or M25 which have a large effect on Bracknell.



Dashboard created for RoadCast

Summary of Transport Outcomes:

Yunex successfully demonstrated how existing traffic sensors could be used, with a new IoT based interface, to cost effectively provide detector data, such as count data, to a wide range of applications, rather than just the signal controller with the potential to open up an existing large and underutilised dataset across towns and cities.

Yunex successfully demonstrated a data brokerage that can open up and publish data, such as used in traffic control systems, to 3rd parties. To develop further into a full product the business case for the data publication needs to be made.

O2 successfully demonstrated the potential to use their mobile phone based (RTTI) journey time data for the SRN and main roads as an alternative to ANPR camera data. With the right scale of data service, RTTI can be more cost effective than supply, installation and maintenance of an ANPR camera network.

An open data platform was created for Berkshire however, data feed reliability was a key issue and hence the platform has not been launched as it will not deliver sufficient quality of service for 3rd parties to develop services on it. A key commitment will be required from the LAs to maintain the data feeds to enable launch.

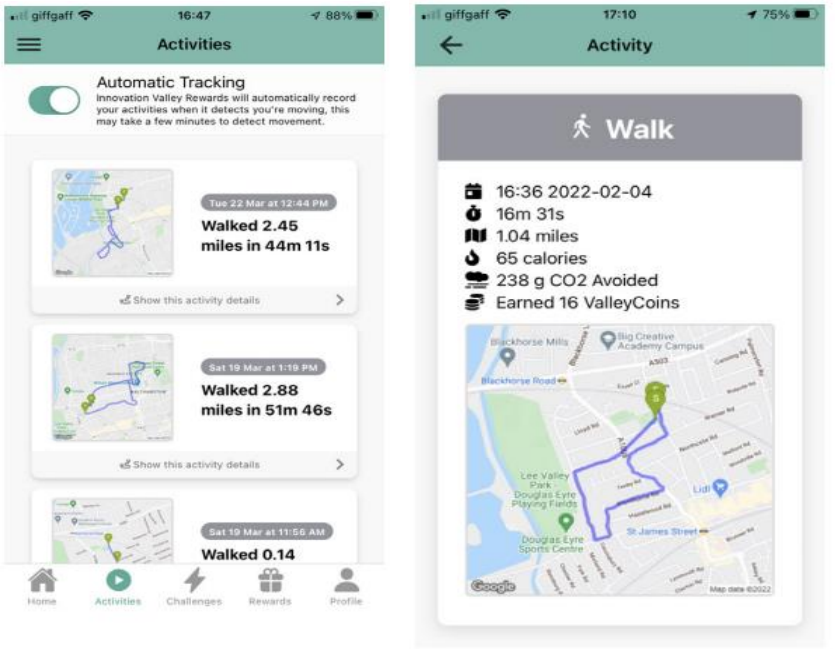
RoadCast was trialled in Thatcham. This predicts traffic flows and Covid was used as the test case with the prediction model proving very accurate. RoadCast has the potential to significantly enhance traffic management strategies, however, it is not integrated into the Stratos traffic control system and hence is less desirable as a stand-alone system.

Behavioural Change

A behavioural change programme was delivered by O2 with their sub-contractor BetterPoints and the programmes has been evaluated by O2 (**Ref: BC1**). The intervention was the Innovation Valley Rewards App which was developed to reward sustainable travel behaviours and improve public health and was further developed to include Air Quality data from the EarthSense 100m resolution model of the country. In addition, Betterpoints produced an interim evaluation report on the take up of the app at the end of the main Adept project funding which presents the outcomes of the programme (**Ref: BC2**)

The app was launched with a strong marketing campaign including O2 customer marketing, billboards at stations around Berkshire and wider social media campaigns. The Innovation Valley Rewards app tracked user travel and mode of travel and encouraged sustainable travel with rewards, which were purchased by the project, and competitions. Of those that participated, the results were very positive, with users reporting that 49% of journeys replaced a car journey, and 5 times as many participants, on average, being active compared to the baseline. BetterPoints estimated that the project saved around 28,000kg of CO2 with over 112,000 miles of sustainable travel miles.

However, the Innovation Valley Rewards app was not funded beyond the term of the contract with O2 and ceased in October 2022. Despite its success for the participants, less than 1,000 participants signed up from across Berkshire and hence impact was very low and did not justify the investment in the rewards. 71% engagement was high for an App but may in part reflect the high chance of winning rewards given the low numbers. The BetterPoints App was, however, used by Wokingham for their -journey challenges.



Innovation Valley Rewards Screenshots

Summary of Behavioural Change Outcomes:

The trial showed that behavioural change programmes can make a real difference to promoting healthy lifestyles and climate and could be a key part of meeting net zero. However, it should not be seen as low-cost and significant long term marketing investment is required alongside funding for challenges and rewards for it to succeed.

Appendix 1 – Summary of Supporting Documents

Text Reference	Report Title	Primary Author(s)	Description
Air Quality			
AQ1	Air Quality Sensor Siting Outcomes	Stantec	Air quality sensor siting report
AQ2	ADEPT – Zephyr Siting Consultation	EarthSense	Evaluation of proposed air quality sensor location based on 100m model
AQ3	Spatiotemporal Analysis and Sensor Calibration Report	UoR	Paper evaluating the Air Quality Sensors
AQ4	Management Strategies and their Impacts on Air Quality and Traffic Flow Including End of Project Evaluation	Yunex	Report describing the air quality and network management trial
AQ5	The impact of smart traffic interventions on roadside air quality employing machine learning approaches	UoR	Paper evaluating the air quality and network management trial
AQ6	Telefonica, Air Quality Exposure – End of Project Evaluation Report	O2-Telefonica	Evaluation of the O2 / GPC data analysis work on air quality and people's exposure
Energy			
E1	Energy Insights Report	SGS, UoR, Stantec	Report covering energy policy, good practice, and the delivery of the energy management trial
E2	Report 1: EV Ownership & Analysis & Growth Report. Report 2: EV Usage Analysis & Growth Forecast Report Report 3: EV Charging Infrastructure – Analysis & Growth Forecast	Ev.Energy, Hubject Consulting	Study undertaken for the Berkshire Authorities covering current EV ownership and charging provision and projected growth in EV usage and required charging provision to 2024.
E3	EV Charging – End of project Evaluation Report	O2-Telefonica	Evaluation of the EV charging study undertaken into predicting demand for EV charging infrastructure across Berkshire.
E4	RBC m.e Pilot Report	Measurable.me	Outcome of smart sockets trial
Mobility and Health			
M_H1	ADEPT Smart Places – Health Risk Mapping Report	O2, Space Syntax	Berkshire wide insights into obesity in children and adults and transport and air quality and transport.
M_H2	Public Health Insights Study – End of project evaluation report	O2 - Telefonica	Evaluation of Space Syntax health report.
	Potholes		
P1	Potholes and road surface quality trial	O2, GPC	Evaluation of the work undertaken to trial automatic pothole detection using video analytics.
Transport			
T1	TVB Live Labs, Edge IoT	Yunex	New IoT coms to open up existing traffic sensor data for other parties

T2	TVB Live Lab ITS Data Brokerage	Yunex	Data platform to allow traffic management data to be easily accessed by 3rd parties.
T3	Traffic Flow – End of project evaluation report	O2-Telefonica	Evaluation of O2 phone generated journey time data.
T4	Traffic Prediction Algorithm – RoadCast Including End of Project Evaluation Report	Yunex	Application of traffic flow prediction system in Thatcham
Behavioural Change			
BC1	Behaviour Change (BetterPoints App) - End of project evaluation report	O2-Telefonica	Evaluation of the behavioural change app trial
BC2	Innovation Valley Rewards Interim Report	BetterPoints	Report by BetterPoints quantifying outcomes