smart CAMBRIDGE 2019-2020

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What is Smart Cambridge?

Smart Cambridge is exploring how data, emerging technology and digital connectivity can be used to transform the way people live, work and travel in the Greater Cambridge area and beyond. This rapidly evolving programme is looking at how the latest technologies can improve quality of life, sustainability and the economic strength of the area. Local councils, technology businesses, university researchers and partner organisations are working together to find smart ways to tackle city challenges, such as transport and air quality.

The Smart Cambridge programme aims to ensure that Greater Cambridge is a 'smart city region' by providing the infrastructure needed to collect and analyse data that can be used to develop innovative solutions for some of the area's challenges. The work supports the wider ambition of the Greater Cambridge Partnership, which is investing in transport, housing and skills to facilitate sustainable economic growth in the region.

The programme is delivering a wide range of initiatives including those in the key areas of:

- Better travel and transport information for journeys, along with easier payment options
- Understanding and managing the road network better
- Transport trials including driverless vehicles
- Creating a baseline of city data including air quality measurements and traffic counts

Investment comes primarily from the Greater Cambridge Partnership and is overseen by their board. Smart Cambridge has also been successful in securing Government funding to support innovative projects in collaboration with business, community and academic sectors.

This pioneering work is supported by the Connecting Cambridgeshire partnership programme, led by Cambridgeshire County Council, which is improving the county's digital infrastructure with better broadband, free public access Wifi and wider mobile coverage.

> **Smart Cambridge is making progress - using data and new technology well, to make it possible for more people to choose sustainable journeys, helping to improve access to jobs whilst reducing congestion and pollution. We are catalyzing new developments that will help other places as well as Greater Cambridge.**

Claire Ruskin, Executive Board Member for the Greater Cambridge Partnership and Chair of the Smart Cambridge Working Group

What makes a Smart City?

The definition of a 'Smart City' varies between cities and from country to country. Although there is no single agreed definition, the most common theme is the use of technology and data to create better places for people to live and work.

Cities have always evolved and grown as new infrastructure is introduced to seed innovation, whether that's the development of roads which allow cities to be better connected or an electricity infrastructure which underpins a sustained period of economic development.

The latest innovations see cities expanding their communications infrastructure with technologies such as fibre broadband to improve digital connectivity. This increases a city's ability to gather a wide range of data, building a comprehensive picture of what happens within the city boundaries.

Analysis of this data offers new opportunities for cities to improve the quality of life for citizens by helping to address challenges such as congestion and poor air quality, as well as supporting economic growth and suggesting where investments can have the most positive impact. The only difference is that this period of change is happening faster than ever before.

Although we use the term 'Smart City', we actually mean 'Smart Places', as the opportunity for Cambridgeshire lies not just in the cities but also in its market towns and rural areas. The Smart Cambridge programme was set up to begin exploring these opportunities looking at new infrastructure and the applications it supports. Applications that could be built on this infrastructure are hugely varied, and include everything from journey planners to autonomous vehicles.

Laying the foundations for more smart city technologies

Cambridge isn't starting from scratch. The city already has infrastructure that is connected and producing data, such as traffic lights, pay and display machines, real time bus displays and apps for public transport. Our programme builds on this work, developing the supporting infrastructure and working with a diverse range of partners, to join these networks up, using technology and data as tools that benefit the whole community.

COLLECT · STORE · ANALYSE · PREDICT · ADAPT · OUTPUT
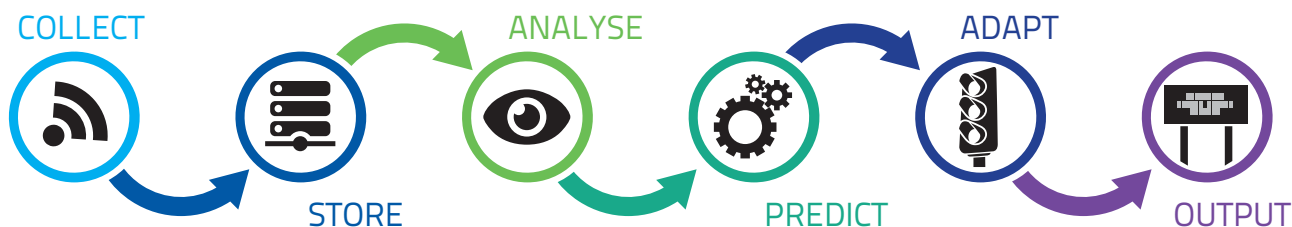
"Our region is benefiting directly from insights derived from the Intelligent City Platform such as detailed journey times on commuter routes into and around the city. This has provided an additional evidence base to better understand transport issues, and as we add further sources of data to the platform, including data from advanced sensors deployed to monitor vehicle, cyclist and pedestrian counts, our capabilities are increasing - building a more comprehensive understanding of our city that can be shared with everyone."

Dr Ian Lewis, Director of Infrastructure Investment, University of Cambridge.

Existing Cambridge sensors collect the following data:

Buses
Real time locations

Bus Stops
Real time displays show how many minutes until the next bus is due

Air Quality
Monitoring the level of various gases

Traffic Lights
Number of cars crossing a set point

Blue tooth detectors
Number of cars and average speed between two points in real time

Bike sensors
Number of bikes that have crossed a point

Bin sensors
How full the bin is to inform collection

Flood sensors
That show the river levels in real time

Weather Stations
Give real time weather reporting (temp/humidity/rainfall etc).

Car Park sensors
Show the main council-operated and Park & Ride car parks filling up and emptying – number of available spaces (real time)

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The journey so far

Using data to plan smart solutions

Smart Cambridge has worked with the University of Cambridge to develop a leading digital platform that supports a myriad of smart solutions. Launched in March 2017, the Intelligent City Platform (iCP) collates and processes real time data from sensors around the city that can be used in a host of applications.

The first phase of the iCP platform development involved setting up a data network to support 'Internet of Things' technology – allowing products to 'talk' to each other - and a data hub to collate and process the data. The city-wide sensor network is gathering data from existing systems such as traffic lights, bus movements, and car parks, together with traffic monitoring cameras and air quality sensors. These can be used to monitor a range of measures including traffic, cycle and pedestrian movements.

The next phase of the programme will continue to drive innovation in the way data is used and displayed. It will for example support the further deployment of SmartPanel screens and a new Pocket SmartPanel app which both offer travellers the opportunity to make more sustainable journey choices by providing reliable real time travel and city information. The iCP is a comprehensive research and testing tool, which supports our ambitions to remain at the leading edge of city data analysis by collaborating with researchers at the university and building their insights into our solutions for the benefit of the whole community.

Low power, long range networks, such as LoraWAN and Sigfox have been deployed in collaboration with the University of Cambridge to transfer the data flowing in from the sensors to the data hub. The combined data can then be analysed and visualised to plan smart solutions including making transport systems more reliable and easier to use.

The platform also allows citizens, third-party developers and commercial partners to use the data to design and build innovative applications, following examples such as the MotionMap travel app, Digital Wayfinding Screens and SmartPanels (see page 6).

Open Data

Smart Cambridge shares all the data behind the digital platform. The programme has secured funding from the Department for Transport to also unlock data from traffic light counters, Bluetooth sensors and on-street pay and display machines to add to the iCP. As this work continues all the data will be available at **smartcambridge.org**.

Intelligent City Platform (iCP)

| DATA COLLECTION | •)) LOW POWER LONG RANGE NETWORK → | DATA HUB | → | DATA TO END USERS |

Low Power Long Range Network

This is the communication layer that transfers data from sensors to the hub. The technology allows it to cover most of Greater Cambridge.

TRAFFIC CONTROL

ROAD NETWORK

OTHER DATA SOURCES

PARKING

BUSES

AIR QUALITY

AIR TEMPERATURE

WASTE

DATA HUB
Data flows into the hub from sensors where it is processed and structured for use.

3rd PARTY DEVELOPERS

Apps for the public to use.

Web based applications and analytics using combined data.

ANALYTICS AND VISUALISATION

Use data to create analysis to support policy, delivery and engage citizens by presenting data in a 'friendly' way.

CITY MANAGEMENT

Data driven City management applications

MotionMap mobile travel app

SmartPanel Screens Pocket SmartPanel

Smart Wayfinding Digital Information Screens

Glossary

Data Hub – This includes storage for data on either the Cloud or servers and software to collate and analyse data.

Platform – A group of technologies that is used as a base on which other applications, processes or technologies are built.

Open Data – Open data is data that anyone can access, use and share.

'Internet of Things' – Connection of physical objects to the internet which allows them to exchange information and be more joined up.

Open Standards – Enables different systems to talk to each other and open to all.
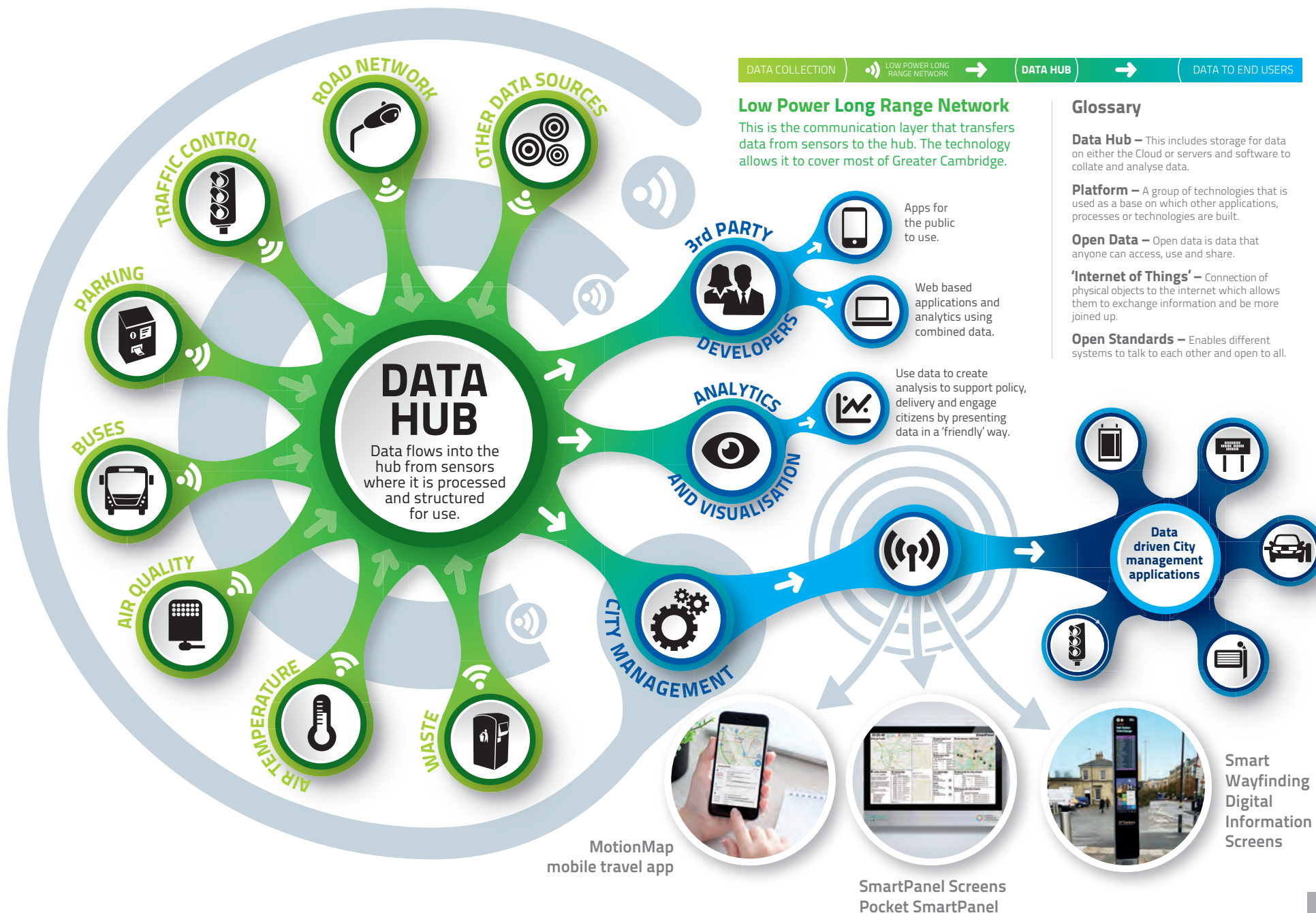
How are we using the data?

'Smart City' innovations are designed to improve the experience of all citizens living, working and travelling in and around the city.

To be persuaded to shift to sustainable modes of transport, travellers have told us they need to have confidence in using public transport, including having better information and certainty about their journeys. Accurate bus arrival times are one of the key pieces of information required to encourage this modal shift. However, predicting bus locations and journey times is more complex and challenging than other forms of public transport because buses contend with traffic flows that are unpredictable, particularly in a busy city.

A mobile travel app, improved real time bus updates and digital information screens are just some of the evolving practical applications being developed under the Smart Cambridge programme, together with opportunities for business growth.

MotionMap

Available in Cambridge since summer 2018 and free to download to smart phones, the innovation-driven MotionMap app brings together real time and local timetable information to accurately predict travel times and suggest the best routes using a mix of buses, trains, walking and cycling. Developed with Cambridge start-up Building Intellect, the app has a carbon counter, displays the position of buses in real time so travellers can 'see' the bus approaching the stop, and invites feedback from users to improve functionality and add

new features through regular upgrades. It also has the potential to provide additional useful information such as how full the buses are, car-parking availability and weather conditions.

Investing in the development of a free-to-use, multi-operator, multi-modal travel app for Cambridge has helped Smart Cambridge better understand the challenges, working with operators and other smart cities to stimulate the market and improve journey planning options for customers.

SmartPanels and Wayfinding screens

SmartPanels and Wayfinding screens also use real time travel and static data collated through the iCP to predict traffic movements and provide real time information.

SmartPanel screens are being installed in the foyers of public buildings and large employers around Cambridge, offering specific travel updates and other information for staff and visitors. The screens display live bus and train times specific to the location, together with road traffic maps, travel updates on Twitter, and weather reports.

Following the positive response to the SmartPanel screens, the Pocket SmartPanel can be accessed via your smart phone. It uses the same data as the SmartPanel screens to show real-time travel updates providing travellers with bespoke and up-to-date information on their phones to help inform travel choices.

Wayfinding screens showing the latest travel updates and useful visitor information have been placed at two key transport interchanges to make it easier for people to find their way around the city. The screens outside Cambridge's Central Train Station are providing much-needed signposting for visitors, and another has been installed at Trumpington Park and Ride.

In the longer term, we envision travel planning tools being provided commercially alongside developing concepts such as Mobility as a Service, bringing together real time data, ticketing and the ability to pay for a whole journey in one transaction.

" Having a SmartPanel set up in our office is really useful, helping to plan journeys whether by car, bus or train with live feeds showing delays or clear runs. It is also a handy tool to get live Twitter feeds, for travel further afield. All this and a very easy set up ! "

Ben, Highways Service, Huntingdon

Working with partners

Smart Cambridge works with a wide range of leading edge technology businesses. The programme is keen to collaborate with others to develop solutions that can also benefit other cities worldwide.

AppyWay

Smart Cambridge has been working with AppyWay to digitise Cambridge's Traffic Regulation Orders ('TRO's" - which are the legal mechanism for governing the kerb) and build a management tool for creating or changing orders. Through Innovate UK funding and with developmental help from Cambridgeshire County Council and the Smart Cambridge team, Mapper has been built to address the challenges local authorities around the UK face today

whilst also unlocking the TRO data that will enable the intelligent mobility solutions of the future. With standardised kerbside data available via smart APIs, fleet operators, transportation providers and mobility developers will be able to provide better services and solutions for Cambridge residents, businesses and visitors.

Data in Google Transit

Google Transit is one of the primary travel planning tools used by visitors to Cambridge. Smart Cambridge

has worked in collaboration with Stagecoach, Google Maps and transit data specialist Ito World, a local Cambridge-based company, to feed data into the Google Transit app. Google has engaged Ito World on other complex transit data projects in cities, such as London, Los Angeles, Chicago and Toronto, delivering enhanced static, real time, and journey prediction data.

This means that travellers using the app in Cambridge have the best possible experience, benefitting from the enhancements made by other cities worldwide.

" We are thrilled to have a shared vision with Cambridge of smarter, more liveable, thriving cities. With engaged partners like Smart Cambridge, we can demonstrate to the rest of the UK the potential of our approach - open access to accurate and standardised kerbside restriction data. This approach is essential if the UK is to fulfil its potential of becoming a world-leader in intelligent mobility and with the Mapper platform, we're excited that we can empower local authorities like Cambridgeshire to truly be in the driver's seat on that journey " *Dan Hubert, CEO AppyWay*

Telensa

Telensa, a leader in smart street lighting and smart city applications, announced in 2019 that Cambridge would be the first city in the UK to benefit from a trust platform for urban data, enabling the city to collect, protect and use their data for the benefit of all citizens. Urban data is the mosaic of street-by-street, minute-by-minute information that makes up a city's 'digital twin' (see p.11).

It includes mapping how people use the city, the mix of traffic on the roads, the hyper-local air quality and noise levels. The Urban Data Project platform protects privacy, enforces responsible data use, and makes data policy visible to all.

The data will be incredibly valuable for designing better city infrastructure and delivering more efficient city services.

> **"Like many companies in the Cambridge tech community, Telensa shares the Smart Cambridge ethos of pioneering people-centric smart technologies. Telensa is working to embed digital trust for citizens through its Urban Data Project, and Cambridge was the natural choice as our launch partner."**
>
> *Will Franks, CEO Telensa*

Mill Road Project

Fifteen smart traffic sensors, that will help to build a detailed picture about how thousands of people use specific roads in Cambridge, were installed in May 2019.

The sensors installed on Mill Road and the surrounding streets will record numbers of pedestrians, bicycles, cars and other vehicles. The sensors are set to be in place for at least 18 months to gather data before, during and after the closure of the Mill Road Bridge; allowing transport planners to see the impact the closure has on road use and air quality in the Mill Road area. Keeping the sensors in place for this length of time will allow the team to make greater comparisons, by taking into account daily, weekly, monthly and annual variations in traffic levels. Using this opportunity while part of Mill Road is closed to vehicles will help the city to better understand the impact that road closures and road works have on traffic levels and routes, including how people choose alternatives and will inform future decisions about managing increased congestion and providing solutions for getting people around our city.

Changes in air quality will be monitored through seven additional sensors set up by Cambridge City Council, and all data will be publicly available.

GeoSpock

In March 2019, Smart Cambridge entered a partnership with GeoSpock. This Cambridge based company offer a unique information platform, giving us the ability to adapt the way we visualise our significant volume of city data.
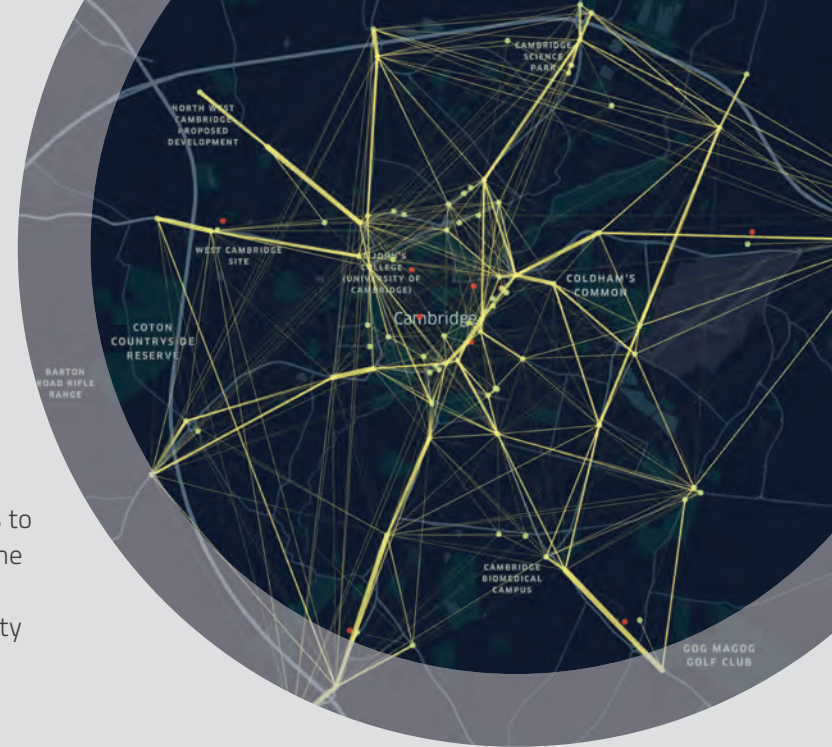
GeoSpock's spatial big data platform processes information to provide analytics and builds insight which enables predictions that will help to develop a 'data-first' smart city strategy. By providing greater understanding of traffic flow and mobility, the work will bring tangible benefits to the lives of residents, businesses and visitors enabling better decision making for the future planning of the city.

> **"Cambridge is one of the leading and most progressive smart cities in the UK, and we're thrilled to be embarking on this partnership to showcase how GeoSpock's technology can develop the city's future smart ecosystem – particularly as the area is also home to GeoSpock's headquarters."**
>
> *Richard Baker, CEO of GeoSpock*

Meeting the challenges

While the rapid growth of the Greater Cambridge area offers many opportunities, it also brings significant challenges for the region.

These challenges have been distilled into key targets and policies that we are working to address with the Greater Cambridgeshire Partnership. The policies are aimed at reducing congestion by getting 1 in 4 people out of their cars by 2031, improving air quality and building 33,500 new homes in the city. The ambition behind these targets is to ensure that the eco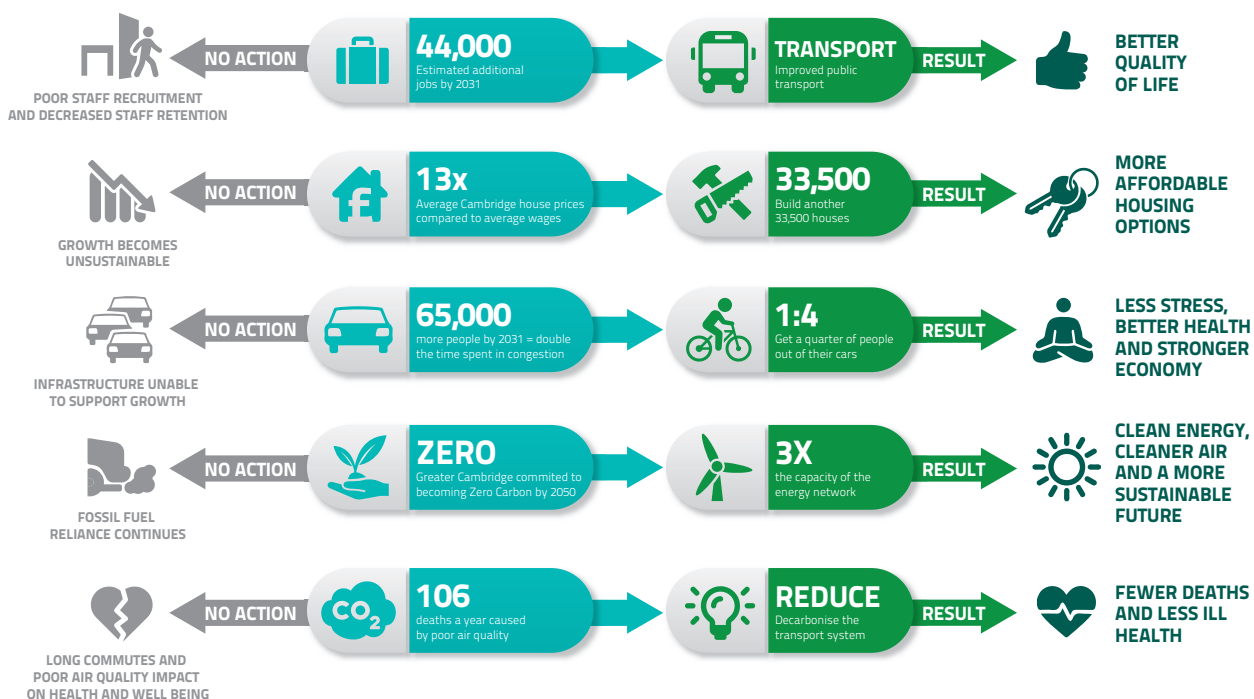nomic benefits of growth are realised here in Cambridgeshire, creating communities that people want to live and work in.

Smart Cambridge is working across three main categories, each aligned to support the policies. We have a strong portfolio of work, with exciting projects underway and more in the pipeline. Under Intelligent Mobility we are examining the possibility of using autonomous shuttles as part of our public transport offering. We are trialling new sensors to monitor the impact of infrastructure projects in the City as a Platform category and are working with planning partners to ensure that the exciting projects that we are working on in the city reach further into our market towns and rural areas through Enhancing Communities.

The delivery of these projects is supported by excellent connectivity and extensive collaboration with our partners.

Finding Smart Solutions for City Challenges

POOR STAFF RECRUITMENT AND DECREASED STAFF RETENTION — NO ACTION
44,000 Estimated additional jobs by 2031 → **TRANSPORT** Improved public transport → RESULT → **BETTER QUALITY OF LIFE**

GROWTH BECOMES UNSUSTAINABLE — NO ACTION
13x Average Cambridge house prices compared to average wages → **33,500** Build another 33,500 houses → RESULT → **MORE AFFORDABLE HOUSING OPTIONS**

INFRASTRUCTURE UNABLE TO SUPPORT GROWTH — NO ACTION
65,000 more people by 2031 = double the time spent in congestion → **1:4** Get a quarter of people out of their cars → RESULT → **LESS STRESS, BETTER HEALTH AND STRONGER ECONOMY**

FOSSIL FUEL RELIANCE CONTINUES — NO ACTION
ZERO Greater Cambridge commited to becoming Zero Carbon by 2050 → **3X** the capacity of the energy network → RESULT → **CLEAN ENERGY, CLEANER AIR AND A MORE SUSTAINABLE FUTURE**

LONG COMMUTES AND POOR AIR QUALITY IMPACT ON HEALTH AND WELL BEING — NO ACTION
CO_2 106 deaths a year caused by poor air quality → **REDUCE** Decarbonise the transport system → RESULT → **FEWER DEATHS AND LESS ILL HEALTH**

Enhancing Communities
Engaging with communities to understand local challenges and evaluate how data and technology can offer solutions and enhance the community.

Intelligent Mobility
Investigating ways that emerging technology can support the city to reduce congestion and improve mobility for residents and visitors.

City as a Platform
Projects that contribute to improving the management of the city through controlled sharing of data and improving collaboration.

> **Aurrigo are excited to work with Smart Cambridge to bring autonomous vehicles to Cambridge, creating a cost-effective and efficient service that will benefit residents and visitors to the city, as well as showcasing the UK as leaders in the design and engineering of autonomous technology.**
>
> *Dr Richard Fairchild, Operations Director Aurrigo (a division of RDM Group)*

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What's next?

Smart Cambridge is exploring new ideas and trialling innovative solutions to analyse data and share knowledge which will support the Greater Cambridge Partnership's aims to help the region grow more sustainably.

Cambridge Autonomous Shuttle Trials

To support the aim of getting 1 in 4 people out of their cars and using more sustainable modes of transport, Smart Cambridge is working on a project to trial autonomous shuttles as part of the public transport network. Twelve-seater shuttles designed and manufactured by engineering firm Aurrigo, the autonomous vehicle division of RDM Group based in Coventry, will run an initial out-of-hours trial on the southern section of the Guided Busway (segregated from other traffic). It is hoped that this trial will demonstrate how autonomous vehicles could support people moving easily, safely and reliably around key sites in Cambridge without relying on their cars. Since 2018, this exciting project has secured £3.2m of funding from industry and the Government.

As with all leading edge technology, a significant amount of testing and trialling is required to find the best solution, and there is always a risk it will not prove viable. The next phase of the programme is building upon studies already underway to investigate the future use of 'intelligent mobility', and autonomous vehicle passenger trials are expected to begin in late summer 2020.

Intelligent Mobility

Smart Cambridge's pioneering research into intelligent mobility includes:

- Exploring first/last mile transport solutions

- Investigating better traffic network management

- Improving customer experience

- Building the foundations to gather better data

- Creating an environment which encourages companies to innovate to help solve mobility challenges
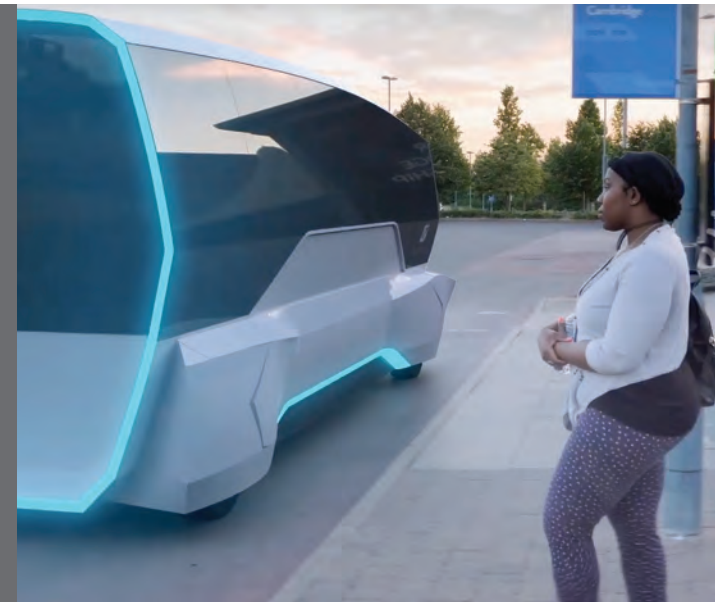
Digital Twins – Helping to design a better city infrastructure

The term 'digital twin' is used to describe a virtual model of something physical (the city in this case), supplemented with data collected from sensors and systems in the surrounding environment. Visualising data means that digital twins have the potential to help cities develop more holistic policies covering multiple departments such as energy, traffic and waste management. Collaborating in this way offers a greater flexibility to assist in addressing some of the very real challenges urban areas face such as congestion, pollution and the need to become more sustainable.

Smart Cambridge is working with the Centre for Digital Built Britain and the Centre for Smart Infrastructure and Construction, based at the University of Cambridge as they explore the future of commuting into Cambridge, including how congestion can be reduced and air quality improved. The collaboration will plan how digital technology and data can be used to support traffic management planning decisions to make improvements, and will focus on delivering a digital twin prototype, combining traditional urban modelling techniques, new data sources and advanced data analytics.

The prototype will include journey to work trends in Cambridge, including how people of different ages and employment status travel to work, and how different factors affect their travel. It will also explore possible future journeys to work based on transport investment and new housing developments, as well as how flexible working and emerging technology may impact commuting.

Cambridgeshire Insight Open Data

Other static and more contextual data can be found on Cambridgeshire Insight – an open data portal that has been recognised by the Cabinet Office as one of the UK's leading sources of open data. This partnership platform provides an easy way for users to access and share data, information and research for deeper insights into the local area.

Find out more at:
opendata.cambridgeshireinsight.org.uk

Air Quality monitoring

Poor air quality impacts both the health of residents and their quality of life. Smart Cambridge has worked with Cambridge City Council, the University of Cambridge (Department of Chemistry and Computer Laboratory) and Cambridge Environmental Research Consultants to look at how air quality can be better measured within the city.

Over twenty sensors have been placed at key points around Cambridge using a larger number of measurement nodes to understand how air quality varies across the city, particularly in main transport corridors and areas of construction activity.

The first phase proved that the sensors compared well to the existing roadside monitoring stations. The second phase will see the project compare the air quality data with other sources of data such as weather and traffic flows to begin to really understand what the sources of pollution are. This will then feed into work lead by Cambridge City Council to improve air quality across the city.

Smart Cambridge

Find out more

Smart Cambridge programme: **www.connectingcambridgeshire.co.uk/smartcamb**

Smart Cambridge technology data **www.smartcambridge.org**

Greater Cambridge Partnership **www.greatercambridge.org.uk**

Cambridgeshire Insight Open Data: **opendata.cambridgeshireinsight.org.uk**

Contact Smart Cambridge Programme Team
Call: **01223 703293**
Email: **smart.cambridge@cambridgeshire.gov.uk**
Twitter: **@SmartCamb @GreaterCambs**

A selection of our latest research and reports are available for everyone
on the Smart Cambridge Resources page:
www.connectingcambridgeshire.co.uk/smart-places/smart-cambridge/resources

- Autonomous vehicle feasibility study, delivered with the University of Cambridge
- Affordable Very Rapid Transit (AVRT) report
- Integrated Ticketing Feasibility Study
- Greater Cambridge Partnership Integrated Ticketing Study

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