Public Lighting Group.
Smart Lighting & Smart Cities.

ARUP

Contents.

Executive Summary

Arup was commissioned to explore what smart city projects could leverage smart lighting and other connectivity. The team took a design-led approach to identifying what smart city opportunities are applicable to the nine Victorian Councils, and devised a smart lighting feasibility study to explore the possibility of using smart lighting as the base infrastructure to support these concepts.

The following document is the documentation of this design-led approach produced with The Public Lighting Group (PLG). It is one of five documents in a series. The PLG comprises nine partner Councils, including, City of Greater Geelong, Glen Eira City Council, Hobsons Bay City Council, Manningham City Council, Monash City Council, Mornington Peninsula Shire, Wangaratta City Council, Whittlesea City Council and Wodonga City Council. The following pages outline what a smart city is, what smart lighting is and documents the design process.

Through a series of workshops the group co-designed the *Smart City Concept Deck*, which provides smart city inspiration for Council and developed some concepts to respond to the specific challenges facing Councils today. Two of these concepts have been progressed to *Mini Business Cases*.

These three documents sit alongside a *Smart Lighting Feasibility Study*, produced as part of the same project, which unpacks the feasibility of smart lighting as a connectivity and power source for the aforementioned, and other, smart city opportunities. The documents operate in tandem to answer two questions, what could smart lighting be used for, and does smart lighting provide suitable connectivity to support these uses?

Smart lighting has sparked local government interest as many are replacing existing street lights with internet-compatible LED lights, and through this process Councils have identified a gap in local knowledge about how to proceed from this point towards smart city infrastructure. Smart lighting, dimming and managing maintenance are only small possible gains. Where smart lighting becomes attractive is when you consider how to use the power and/or connectivity from smart lighting as an enabler of the smart city. Therefore, in order to test the applicability, costs and benefits of smart lighting the team first needed to define what smart city concepts they wanted to use smart lighting for. With this in mind, the team put smart lighting aside momentarily and focused on what problems the PLG could solve with technology. Once the concepts were drafted up, we overlaid the smart lighting connectivity lens and considered which ones smart lighting could support.

Together the team developed a series of concepts, including Smart Parking Spaces, On-Street Community Participation, Smart Parking Spaces, Council Kiosks, ParkBuys, Real-time Emergency Notification System, Smart Meter Data Analysis, Community Energy Trading Scheme, Sensor Kit, Footfall Analytics and more. Two of these concepts were selected through the business case lens and developed into mini business cases for two pilot projects: On-Street Community Participation and Smart

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5x Resources

Smart Lighting & Smart Cities

Smart City Concept Deck

On-Street Community Participation **Mini Business Case**

Smart Parking Spaces **Mini Business Case**

Smart Lighting Feasibility Study

What is a Smart City?

Smart cities are information rich and interconnected. They reshape the operational, economic and social dynamics of cities, through the use of technology and new ways to form relationships between government, businesses and citizens.

Cities must be responsive to the changing context within which they operate - especially when that context is offering significantly improved capability or efficiency, or when citizens are adopting new patterns of behaviour that are no longer served by traditional modes of governance.

The smart city is not a vision in and of itself, rather it is a medium to achieve the agreed vision of a city and its citizens. The smart city is an ecosystem of actors. While government has a role, a truly smart city requires the active participation of business and the community.

It uses digital technologies to enable new solutions to old problems. But, it is more than tech. It is tech, governance, ecological, social and economic systems.

Over the last decade, the smart cities concept has emerged to represent the opportunities and challenges enabled by digital technology in an urban context. Technologies such as sensors, smartphones, robots, augmented reality, cloud computing and data analytics, are being used to make cites more frictionless, more productive, and more democratic.
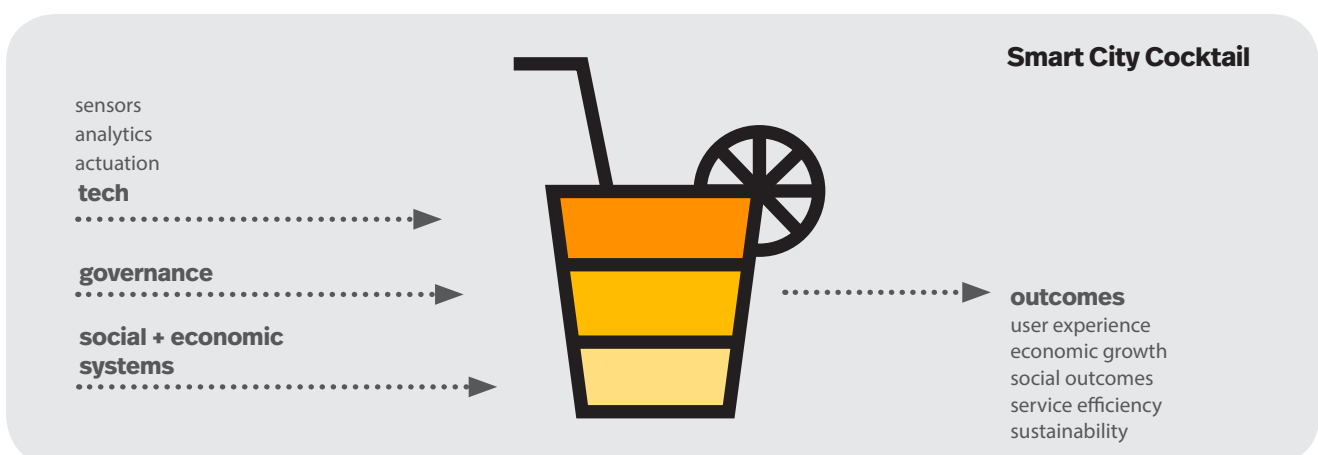
These benefits are growing in importance as more people move into cities globally and as urban lifestyle expectations rise. At the same time, this wave of technological innovation has brought challenges. Digital technology can isolate and exclude sectors of society. It can threaten individual privacy and national security, displace labour, and become obsolete and expensive.

Therefore, tech is simply an enabler to help achieve council visions, it is important to remember that the smart solution is only sometimes the most appropriate ones, and be mindful of any unintended consequences.

The successful smart city can be described by the following principles.

- **Evidence-based governance,** where decision making is driven from data.
- More than tech. It is creating a high quality experience for the user. It's about what we are delivering not about how we do it.
- Bringing systems, people and the Council closer together.
- Embedding flexibility to allow the Council and the community to evolve.
- Collecting the right data. Making sense of this data in a coordinated and centralised way, and finding ways to automatically or manually act on that data.

Smart City Cocktail

sensors
analytics
actuation
tech

governance

social + economic systems

outcomes
user experience
economic growth
social outcomes
service efficiency
sustainability

What is Smart Lighting?

Smart Lighting is lighting that is connected to each other, or the Internet through networking devices. This enables more efficient lighting management using a Central Management System. The network connectivity inbuilt into smart lighting can also provide Internet access for other smart city uses.

Councils in Victoria are in the process of upgrading their street light networks to LED lighting. This has been largely driven by Council's desire to reduce the cost of street lighting by benefiting from more energy efficient LED lights.

LED lights are now being manufactured to have networked connectivity, which enables an interconnected network at every street light that they are installed on - this concept is called Smart Lighting. Smart lighting presents a number of opportunities to reduce the operational costs of street lighting, along with the possibility to leverage the connectivity to enable a Smart City.

'Smart Lighting' is a term used by lighting and networking companies to describe LED lighting which has the ability to be controlled by a **Central Management System** (CMS) in order to provide functional and flexible lighting. The CMS is a system that enables two way communication of information on the lamp life of individual lanterns to be relayed back to a control centre, informing the operator whether or not any given lantern is operational. Therefore, unnecessary day burning of lamps can be prevented, and costly night time inspections of installations may be avoided.

CMS systems also provide operators with intelligent and flexible lighting control, individual control to street lights, dimming, and asset management. Smart lighting allows cities to adapt their lighting strategies to suit specific conditions - for example different colour lights or lighting profiles at different times, or in different places. Having a CMS system in place increases energy savings with additional dimming and enables better monitoring of the entire system.

In addition to the lighting efficiencies associated with smart lighting and a CMS, many smart lighting products have inbuilt connectivity that can help connect other **Smart City** uses and products to the Internet. For example, a smart parking system (that monitors how long cars occupy a parking bay) can connect to the Internet via a smart lighting system to send data back to council officers or to car park users.

The cost associated with adding this type of smart city functionality on-top of a lighting controller and CMS functionality is generally incremental. In one Irish city, Arup found that adding smart city connectivity ontop of a smart lighting system would increase capex costs by around 8%. Therefore, for the purposes of this research, smart lighting includes the benefits of CMS functionality as well as smart city connectivity.

For more information about smart lighting see the **Smart Lighting Feasibility Study**.

A Process of Co-Creation

The following pages describe each of the workshops, focusing on the workshop activities and outcomes of each. The workshops were a mix of learning about smart cities and smart lighting and developing smart city concepts for the Councils.

The project had four phases, Discovery, Define, Design and Documentation. Along the way the team did workshops, surveys, interviews and desktop research to develop the five complementary documents: What we did, Smart City Concept Deck, Mini Business Case: On-Street Community Participation, Mini Business Case: Smart Parking Spaces and Smart Lighting Feasibility Study.

The team started with a survey to gauge how far progressed the councils were in the smart cities and lighting spaces, and where they saw that tech could help solve their problems. With the results in mind, the Discovery workshop focused on exploring what smart lighting is, what a smart city is, and initiate thinking about what smart cities use cases are applicable and interesting to the partner councils.

With a collective understanding of smart lighting and smart cities established, in the Define workshop the team unpacked what the problems, priorities and pain points of Council are today and started to think about where tech can help. For some of Council's problems a low-tech or no-tech solution is more effective and efficient, these were not developed further in this project. All concepts developed in this process started with these problems, and all concepts the Council considers in the future should return to the problems and evaluate possible projects through this lens. With problems fresh in their mind the group used inspiration from around the world to think about what smart cities concepts could help to solve these.

The Arup team worked offline to build upon these early ideas and develop them into sketch concepts for the Design workshop the following day. During the workshop the team continued to develop the concepts that had the greatest applicability and social, environmental and economic impacts. The process is explained in more detail further in this document.

Discovery   Define   Design   Documentation
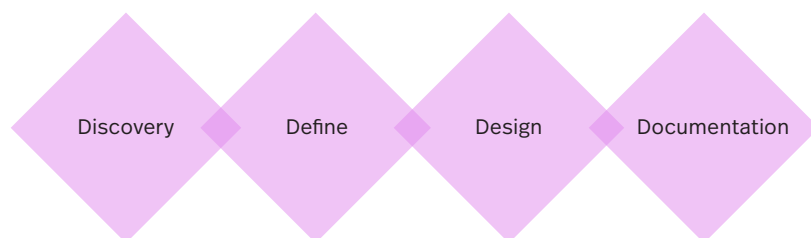
Discovery Workshop
Getting Acquainted

What we did

At the first workshop the team explored what smart lighting was and it's relationship to smart cities. The group went through a series of exercises to unpack the status of smart lighting in their Councils today, the challenges so far, and brainstorm what smart cities use cases might apply to their Councils.

What are the key lessons you've learnt so far?
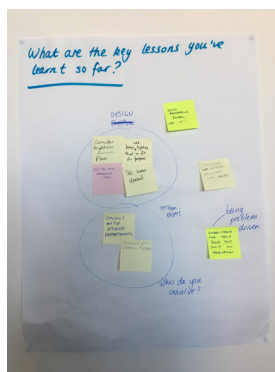
Who needs to be involved?	We need to understand the tech before we buy
DNSPs pose a barrier	Consider the human experience of LED lighting

Why is your Council interested in smart lighting?
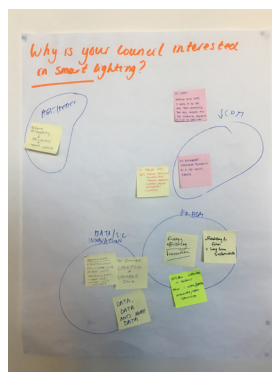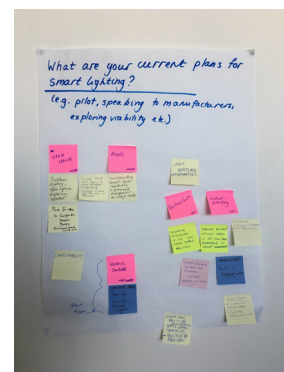

Aesthetic	Cost
Data	Energy Efficiency

What are your current plans for smart lighting?

Roads and open spaces	Partnerships
Council-owned street lights	Getting educated

Define Workshop
Defining the Problem

What we did

At the next workshop the team focused on smart cities. We started by unpacking the most pressing problems Council faces, and looked at the ones which tech can help to solve. With the problems established the group drew on local and global smart cities inspiration to start to develop concepts that responded to these.
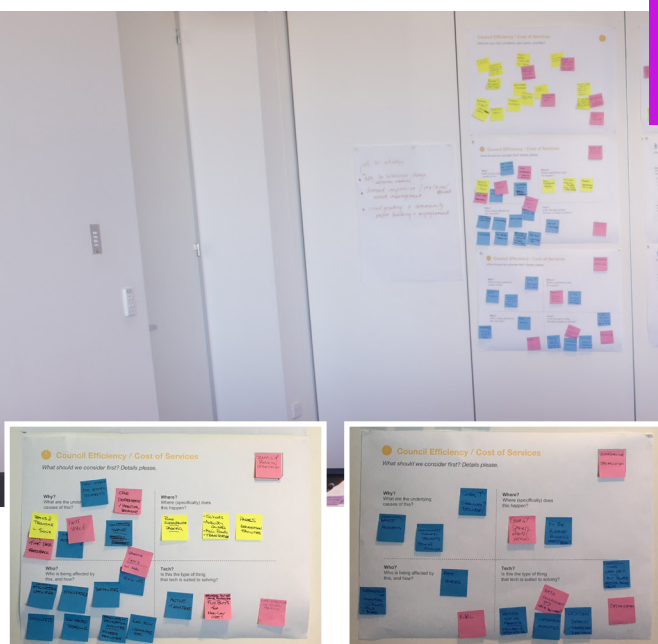
What are your cities problems, priorities and pain points?

Traffic and parking optimisation	Infrastructure optimisation	Economic vitality of small activity centres
Lack of engagement with Council communications	Digital divide	Efficient management of parking
Energy efficiency of Council operations	GHG emissions High energy costs	Emissions from traffic

Design Workshop
Concept Design

What we did

The team took the ideas that were brainstormed in the Define workshop and translated these into sixteen sketch concepts. These were the starting point of the Design workshop. As a group we developed the most impactful concepts and explored the range of connectivity options for each concept.

See **Smart City Concept Deck** for all concepts.

Community data storytelling for behaviour change	Free public Wi-Fi	Community energy trading scheme	Sensing kit
Real-time emergency notification system	Smart parking	Discovering local businesses	Energy sensing for behaviour change and reporting
Parkbuys	On-street community participation	Demand responsive public transport	Movable smart bins
Open data platform	Open infrastructure	Exploring on foot	Crowdgranting platform

Design Workshop
Business Case

What we did

To introduce the Better Business Case: Five Case Model the group voted on concepts they deemed to be most socially, environmentally and financially impactful. For the two that were selected the team considered the benefits, barriers and deliverability of each to determine whether it should be considered further. This exercise helped to unpack where Council should focus their attention. For the selection of the mini business case pilot projects a survey was conducted offline, again drawing on the Five Case Model.

See **Mini Business Cases** for the final cases.

Not all concepts should be progressed by Council - start by asking these questions:
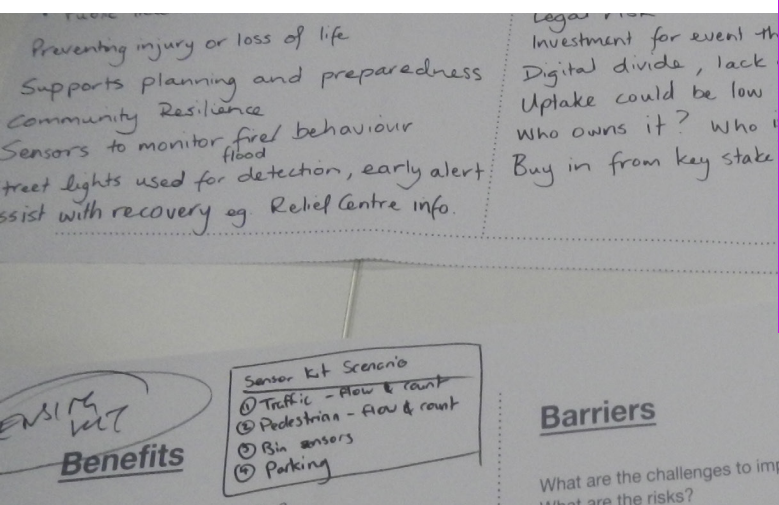
Benefits	Barriers	Deliverability
What are the direct benefits?	What are the challenges to implementation?	How would we procure this?
What are the indirect benefits?	What are the risks?	How would we fund this?
		Do we have the capacity and capability to deliver this?

Next steps

Beyond this project, Council should consider running a smart lighting pilot as recommended in the Smart Lighting Feasibility Study. Additionally, ancillary observations made through the process are described for consideration.

The primary outcome of the *Smart Lighting Feasibility Study* is a:

* **Smart Lighting Pilot** on council-owned assets in activity centres to test the costs and benefits and how they respond to the driving priority or problem, build technical capability, and test the tech and it's fit for a wider roll-out.

Throughout the engagement the team noted that among the Councils there is a need to consider the following:

* **The Public Lighting Group** should continue to share learnings about smart cities and smart lighting across the PLG. The collective interest of this group was strongly demonstrated in this project, and should be maintained and fostered wherever possible. Including, exploring the regulatory barriers and barriers presented by the technical standards. As outlined in the Feasibility Study.

* **Develop a Lighting Masterplan** for key areas (e.g. activity centres) to ensure lighting, smart or otherwise, fits its context and delivers a legible and high quality experience for residents.

* **Develop a Smart Cities Strategy** at LGA level to develop a coordinated approach within Council to approaching smart, find the efficiencies, ensure interoperability of concepts, take advantage of the right resources, identify required capacities and skills and any gaps.

* **Undertake a Smart City Pilot** to explore the interest from each Council in pursuing other concepts contained in the *Smart City Concept Deck*, particularly those that are independent of smart lighting connectivity.

The Councils should endeavour to maintain the momentum of this study, and begin to experiment with smart cities and smart lighting to help them to drive and respond to the changing opportunities presented by tech in cities.

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Community and Social Development

What are your city's problems, pain points, priorities?

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Community and Social Development

What should we consider first? Details please.

Why?
What are the underlying causes of this?

Where?
Where (specifically) does this happen?

Who?
Who is being affected by this, and how?

Tech?
Is this the type of thing that tech is suited to solving?

Community and Social Development

What should we consider first? Details please.

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Where (specifically) does this happen?

Who?
Who is being affected by this, and how?

Tech?
Is this the type of thing that tech is suited to solving?

Economic Development

What are your city's problems, pa

Economic Develo

What should we consider first? D

Why?
What are the underlying causes of this?
- LACK OF CONSUMER KNOWLE
- LACK OF DIVERSITY OF RET
- COMPETITION
- PARKING
- LACK OF GDS ENOUGH CUSTO
- PRESENTATION OF CENTRE/
- AREAS
- HOURS OF OPERATION LIMITED

Who?
Who is being affected by this, and how?
- CONSUMERS
- TRADERS
- LOCAL RESIDENTS

Economic Develo

What should we consider first? D

Why?
What are the underlying causes of this?
- LAZINESS (WANT TO PARK IN FRONT O
- PERCEPTION / LACK OF REAL TIME
- POOR UPTAKE OF ACTIVE TRAVEL
- CAPACITY OF PUBLIC TRANSPORT
- CONNECTIVITY — MULTIPLE ROUTES
- LACK OF KNOWLEDGE OF WHAT IS AVA

Who?
Who is being affected by this, and how?
- RESIDENT
- VISITORS
- CUSTOMERS / CONSUMERS
- COUNCIL
- TRADERS
- WORKERS/STAFF
- COMMUTERS