Culver CITY

GENERAL PLAN UPDATE

Smart Cities Report

EXISTING CONDITIONS REPORT | OCTOBER 2021

BACKGROUND

Smart cities integrate technology with city infrastructure, supplying smart solutions based on data to improve community members' quality of life and enhance outcomes for all, especially the most disadvantaged. Various technologies support smart cities, including information and communications technology (ICT) and connected physical devices using the Internet of Things (IoT) network and geographical information systems (GIS) mapping.[1] The Existing Conditions and Opportunities section will describe these technologies further.

There is no universally accepted definition of a "smart city." It can have different meanings among people and across cities and organizations.[2] A community's needs, level of development, climate, and other local factors will inform a unique definition of a smart city. Generally, smart cities aim to provide intelligent solutions based on real-world data and community feedback to meet the basic needs a local agency provides to its community members. These needs include clean water and air, healthy food, shelter, safe and accessible ways to move around, security, and spaces to live, work, play, and create. As cities become denser, applying smart solutions becomes more critical in increasing opportunities to thrive and live safely, efficiently, and inclusively.

As technology and resources evolve and improve, the data needed to support what makes a city "smart" also changes. For example, when the Babylonian Empire took the first known census in 3800 BCE[3]–counting livestock, quantities of butter, honey, milk, wool, and vegetables–it introduced a new tool to understand and meet its residents' needs. Today, the U.S. Census continues to be a critical source of data to serve residents and improve the livability of cities efficiently. Various data, including the socioeconomic data that the Census collects, inform how cities create smart solutions like smart parking meters, environmental monitoring, and "big data" collection.[4]

Smart city components and characteristics can apply to mobility, energy, communication, commerce, health, security, emergency response, economics, and operating and maintaining public facilities (**Figure 1**). In 2019, some ways the City of Culver City (City) provided smart solutions to Culver City (city) community members included:

- real-time updates on Culver CityBus schedules and locations;
- intelligent transportation systems;
- a fiber-optic network transmitting data, voice, and Internet throughout the city efficiently and affordably; and

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[1] CB Insights. December 15, 2020. *What Are Smart Cities?* Accessed December 22, 2020. https://www.cbinsights.com/research/what-are-smart-cities/

[2] Organisation for Economic Co-operation and Development. 2020. *Smart Cities and Inclusive Growth, Box 1.1.* Selected definitions of "smart cities." http://www.oecd.org/cfe/cities/OECD_Policy_Paper_Smart_Cities_and_Inclusive_Growth.pdf

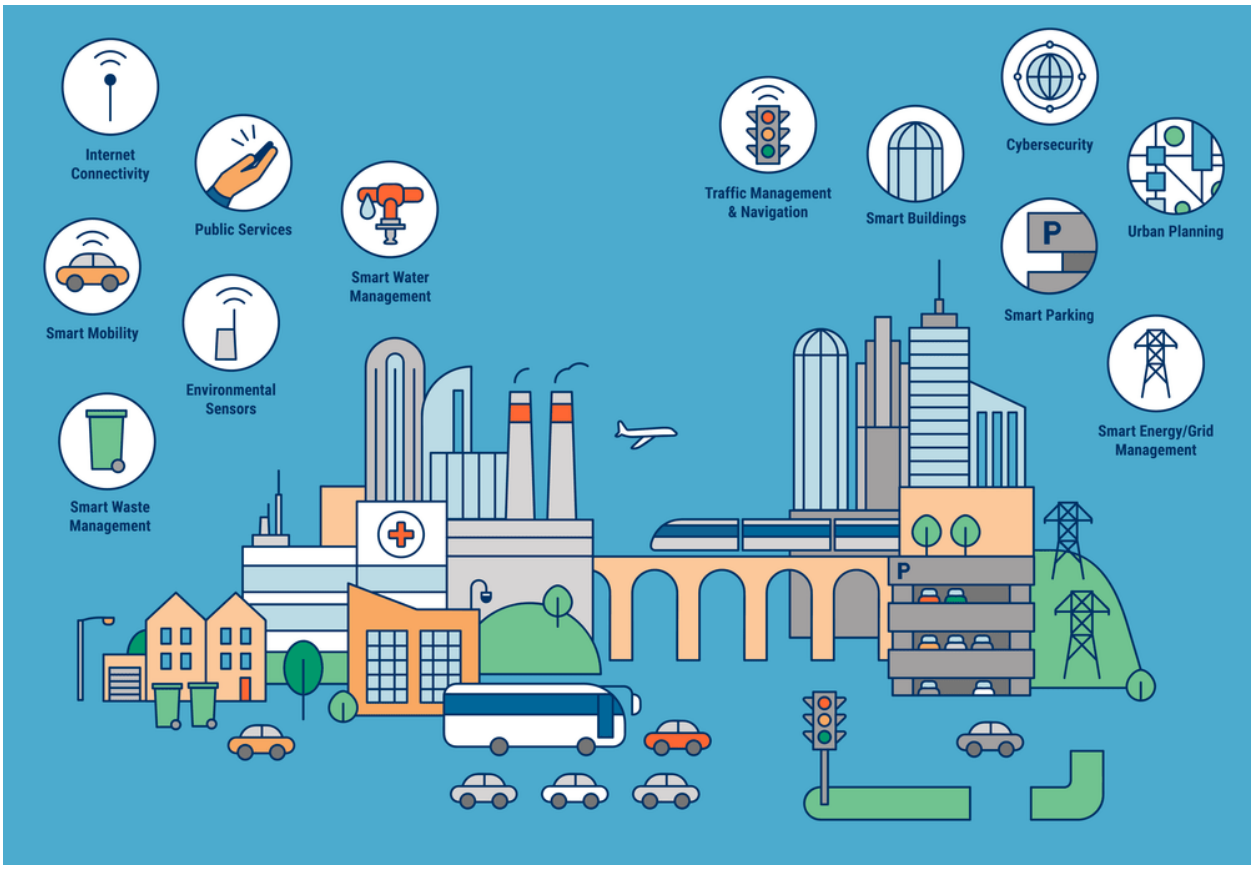
[3] BCE = Before the Common Era

[4] Big data refers to the large volume of structured and unstructured data that businesses collect daily. Analyzing big data can inform strategic business decisions. SAS. n.d. "Big Data: What it is and why it matters." Accessed December 23, 2020. https://www.sas.com/en_us/insights/big-data/what-is-big-data.html#:~:text=Big%20data%20is%20a%20term,with%20the%20data%20that%20matters

- real-time utility monitoring systems to identify water and natural gas leaks, electric power outages, and sewer main blockages.

These and other aspects of the City's existing "smart" practices are documented in this report. The report also outlines new and emerging methods the City could consider throughout General Plan's 2045 horizon.

Figure 1 Examples of Smart City Components and Characteristics



Smart Economy	Smart Governance	Smart Living	Smart Environment	Smart Mobility
•Innovative spirit •Entrepreneurship •Productivity •Flexiblity of labor market •Ability to transform	•Participation in decision-making •Public and social services •Transparent governance	•Cultural facilities •Health conditions •Individual safety •Housing quality •Education facilities •Tourism attraction •Social cohesion	•Attractiveness of natural conditions •Pollution •Environmental protection •Sustainable resource management	•Local accessibility •Availability of ICT infrastructure •Sustainable, innovative and safe transport systems

Source: CB Insights. December 15, 2020. Accessed December 24, 2020. https://www.cbinsights.com/research/what-are-smart-cities/; Nahdenov, Kliment. 2018. Smart Cities – The Future of Urban Planning. Accessed December 24, 2020. https://www.researchgate.net/publication/333058533

KEY CONSIDERATIONS

The key considerations outlined in this section offer a lens through which Culver City can evaluate the conditions and opportunities available to become a smarter city. This section also outlines the potential social, financial, and environmental benefits of being a smarter city.

ANALYZE POTENTIAL IMPACTS

Cities need to understand the positive and negative impacts of interventions when planning smart solutions. **Figure 2** illustrates examples of strengths, weaknesses, opportunities, and threats (SWOT) of implementing smart city initiatives for the City to consider when adopting smart city goals and policies.

Figure 2 Example Smart Cities SWOT Analysis

Source: Organisation for Economic Co-operation and Development. 2020. Smart Cities and Inclusive Growth, Figure 1.1. Accessed December 24, 2020. http://www.oecd.org/cfe/cities/OECD_Policy_Paper_Smart_Cities_and_Inclusive_Growth.pdf

When becoming a smart city, the community must analyze impacts, experiment, and be nimble to improve part of the system. This is especially true when fixing an intervention that has unintended consequences or negative effects.

MOVE TOWARDS A CIRCULAR ECONOMY

Cities drive much of society's innovation and growth. As of 2020, 55% of the world's population lives in urban areas, and cities generate 80% of global gross domestic product. By 2050, the global population is projected to reach 10 billion.[5] By then, middle-class consumers are predicted to double the share of global consumption from one-third to two-thirds, and the world economy is expected to double.[6]

In a large, modern city, delivering clean water, healthy food, shelter, security, and places to live, work, and play requires coordinating complex systems and spaces. As natural resources are limited, plans must keenly balance multiple goals, some of which can compete when setting the community's future direction.

Historically, cities have worked in a "take, make, waste" linear economy,[7] using resources with little consideration for environmental, equity, and economic impacts. This approach creates two potentially catastrophic challenges: resource scarcity and destruction of the natural environment. Both threaten to limit progress and, if unaddressed, undermine progress already made towards a more sustainable economy.

However, communities have become increasingly aware of how much the linear economy damages the environment and economy and have promoted changes that limit environmental damage and increase economic efficiencies. One such change is applying circular economy practices. In a linear economy, raw materials are processed into a product that is thrown away after use. The cycle is closed in a circular economy, meaning items are reused, recycled, and repaired (**Figures 3** and **4**).

A circular economy "aims to redefine growth, focusing on positive, society-wide benefits. It entails gradually decoupling economic activity from consuming finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems[8]

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[5] Brookings. Working paper February 2017. The Unprecedented Growth of the Global Middle Class. https://www.brookings.edu/wp-content/uploads/2017/02/global_20170228_global-middle-class.pdf

[6] World Bank. Updated as of April 20, 2020. *Urban Development.* Accessed May 31, 2020. https://www.worldbank.org/en/topic/urbandevelopment/overview

[7] World Resources Institute. October 2, 2017. Moving Beyond "Take, Make, Waste": Developing Cities Show the Possibilities of the Circular Economy. Accessed December 23, 2020. https://www.wri.org/blog/2017/10/moving-beyond-take-make-waste-developing-cities-show-possibilities-circular-economy

[8] Ellen MacArthur Foundation. n.d. *Concept.* Accessed December 21, 2020. https://www.ellenmacarthurfoundation.org/circular-economy/concept

Figure 3 Linear vs. Circular Economy Diagram

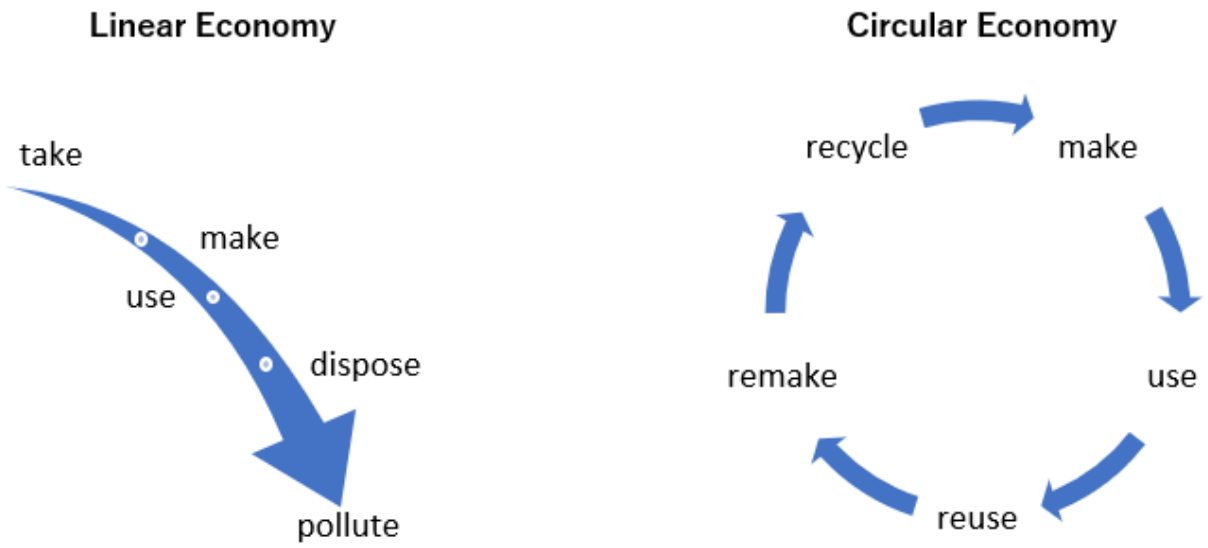

Figure 4 Circular Economy Example Illustration

Source: The Porto Protocol. January 28, 2020. Circular Economy As a Way of Increasing Efficiency in Organizations. Accessed January 2, 2021. https://www.portoprotocol.com/circular-economy-as-a-way-of-increasing-efficiency-in-organizations/

Transitioning to a circular economy reduces the negative impacts of the linear economy and builds long-term resilience, generates business and economic opportunities, and supplies environmental and societal benefits.[9] Closing the cycles requires much more than just recycling. It changes how we create and preserve value and make production more sustainable.[10] For example, a circular economy aims to keep products, equipment, and infrastructure in use for longer, thus improving productivity.

Circular economies also mimic and support the natural environment at a systems level, building economic activity and rebuilding overall system health. The concept recognizes that the economy needs to work effectively at all scales – for large and small businesses, organizations, individuals – globally and locally. It approaches economic development in a way that benefits businesses, society, and the environment by fostering economic growth while using renewable energy sources and materials. Circular economies are the most effective when interested parties collaborate, from entire countries to cities and individual businesses.

Increasingly, cities are shifting towards implementing circular economy practices that cut waste, reuse resources, create jobs, and continuously improve living standards at all income levels. The General Plan Update's (GPU) Socio-Economic Profile and Market Analysis Existing Conditions Report supplies detailed information on existing demographic and socioeconomic trends and conditions in the Culver City economy as of 2019.[11]

DISMANTLE SYSTEMIC INEQUITIES

Smart city practices must also consider how to dismantle long-standing inequities. For example, many cities were historically developed to ensure systemic racism. These cities segregated communities by race or income and limited the economic mobility and social capital for populations subjected to discriminatory practices. Other populations that tend to experience systemic inequalities include persons with disabilities, persons experiencing homelessness, women, and the LGBTQ+ community.

Smart city approaches and policies must encourage live, work, and play neighborhoods that increase equitable opportunities for all people. They must also create an inclusive and diverse community that squarely addresses and deals with implicit and explicit bias openly, honestly, and directly. The GPU's Community Health and Environmental Justice Existing Conditions Report details Culver City's history and outlines demographic and socioeconomic assessments.[12]

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[9] Ellen MacArthur Foundation. n.d. *Concept.* Accessed December 21, 2020. https://www.ellenmacarthurfoundation.org/circular-economy/concept

[10] Het Groene Brein. n.d. *How is a circular economy different from a linear economy?* Accessed October 26, 2020. https://kenniskaarten.hetgroenebrein.nl/en/knowledge-map-circular-economy/how-is-a-circular-economy-different-from-a-linear-economy/

[11] City of Culver City. 2020. General Plan Update Socioeconomic Profile and Market Analysis. https://www.pictureculvercity.com/s/CCGPU_DemographicProfileMarketAnalysis_2020_0529.pdf

[12] City of Culver City. 2021. General Plan Update Community Health and Environmental Justice Existing Conditions Report. https://www.pictureculvercity.com/s/CCGPU_HEJECR_FinalDraft_21_0519.pdf

PLAN FOR REMOTE WORKING AND SERVICES

The shutdowns from the COVID-19 crisis pushed work culture to adapt and allow any employees who could work remotely from home. When people had to be in the same space, they were required to maintain six feet of physical distance. These adaptations led to changes in mobility, retail, and how people generally interacted in their communities. Remote working is expected to remain a part of the work culture into the future. To an unknown degree, this means long-term impacts to commuting levels and consumer practices.

The mandated working remotely from home also increased the demand for home delivery, the need for stronger and faster Internet connections, and daytime energy use at home. It highlighted issues and challenges for households without access to computers or the Internet, people with learning disabilities, and households with children in school. The shutdowns associated with the crisis also resulted in a significant increase in certain service industries like healthcare, offering increased online services. Although online shopping had a huge market before the crisis, its market significantly grew and will continue growing beyond COVID-19.

The City successfully helped many of its staff work remotely during the COVID-19 pandemic. However, it is considering more solutions to streamline remote access further. One of the most challenging issues was procuring hardware and laptops. The City will continue reviewing and implementing additional improvements to its network infrastructure and security to enable remote work further.

How communities use and design spaces will also remain changed. Such changes include potentially larger lot sizes, multi-generational homes, office spaces, space designed for package delivery, and technologies that reduce the need to touch doorknobs, light switches, and surfaces.[13] The future state of these trends will depend on how the pandemic evolves, how society responds, and how recovery plans are shaped.

COMPLEMENT LOW-TECH INITIATIVES

Implementing smart city interventions should not come at the expense of low-tech solutions that have been working. Instead, communities can complement smart technology with low-tech solutions. An example of complementing smart technology with low-tech solutions is installing remote sensors on dynamic parking meters on the same street as a separated bike lane. Both help the community reach its goal around access.

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[13] Anas, B. n.d. *This is how COVID-19 could affect homes of the future*. MarketWatch. Accessed September 8, 2020. https://www.marketwatch.com/story/this-is-how-covid-19-could-change-our-homes-in-the-future-2020-06-29

EXISTING CONDITIONS AND OPPORTUNITIES

DATA STRATEGY

DATA MANAGEMENT

A smart city should have a robust plan for gathering, managing, analyzing, sharing, and using data at its foundation. Having such a plan allows agencies to understand if they are equitably serving their community, managing and operating systems efficiently and effectively, and improving services and systems to help community members improve their quality of life. It is also key to have an open data policy to have a shared understanding and accountability for how data is collected, used, and shared.[14]

The City currently does not have a data management plan or staffing solely devoted to data management. All departments gather and manage data for different programs and purposes through various methods. Departments may coordinate on certain projects or initiatives. However, there is no holistic policy in place. Setting up a data management plan has benefits, but it also needs to consider the data systems. The City currently does not develop in-house software systems. Instead, the Information Technology (IT) Department contracts with third-party vendors. If systems need to be integrated, IT works with the vendors to develop database interfaces as appropriate.

Any smart city initiative should prioritize breaking down silos. A data management and sharing policy could ensure that departments collaborate, reduce duplicative efforts, improve inputs on all projects, and create a data awareness culture. In the future, the City could consider developing a smart city plan that outlines strategies for gathering, automating, managing, analyzing, and sharing data. The City of Edmonton's Smart City Framework (**Figure 5**) illustrates such a data feedback loop.

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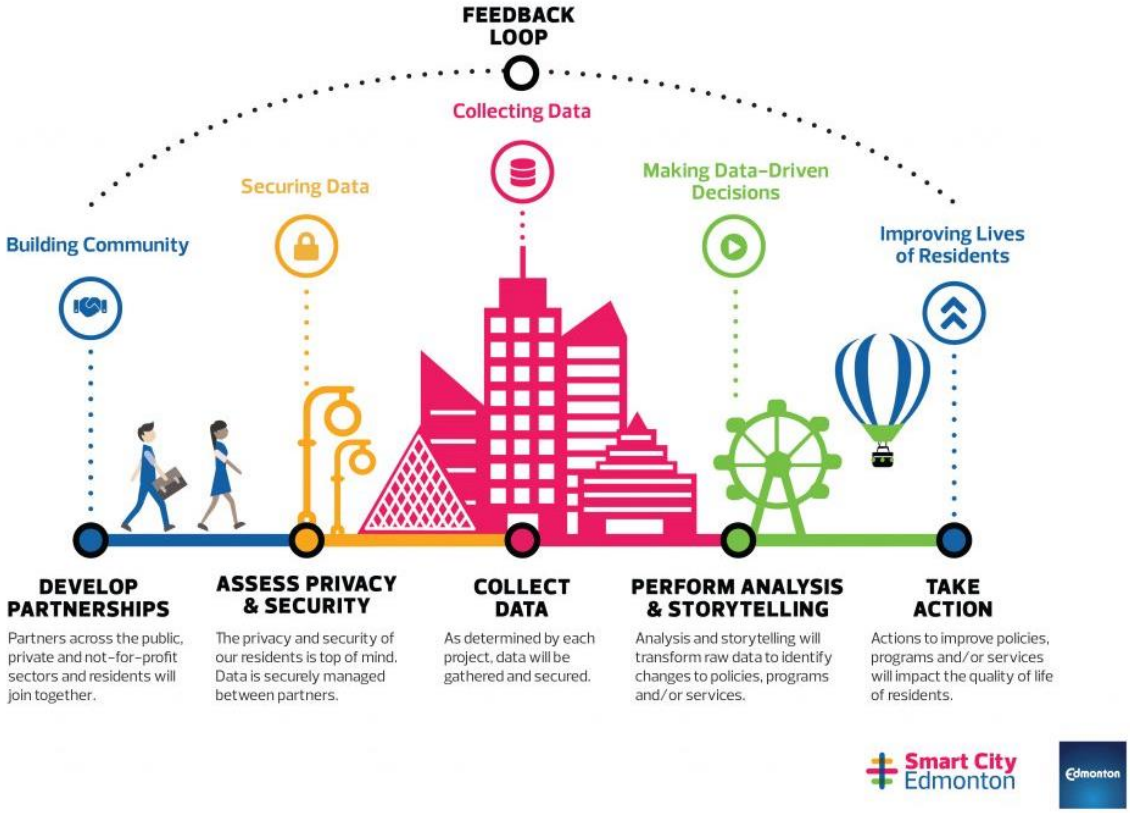
[14] G20 Global Smart Cities Alliance. n.d. Open Data. Accessed December 24, 2020. http://globalsmartcitiesalliance.org/

Figure 5 Example of a Smart City Framework: City of Edmonton



Source: Smart City Edmonton, n.d. Smart City Framework diagram. https://smartcities.edmonton.ca/our-smart-city-program/

ETHICAL PRACTICES

It is good practice for agencies that manage or plan to manage community data to have a data strategy to guide employees on using data ethically. Implementing this strategy is location-specific, but the basic principles are best practices and similar between governmental organizations. A good place to start is with the Federal Government's Federal Data Strategy practices, which are organized into three categories:

- Building a Culture that Values Data and Promotes Public Use
- Governing, Managing, and Protecting Data
- Promoting Efficient and Appropriate Data Use

The practices "represent aspirational, actionable goals that, when fully realized, will continually challenge and guide agencies, practitioners, and policymakers to improve the government's approach to data stewardship and to leveraging data to create value."[15] The growing importance of

[15] Federal Data Strategy. n.d. *Practices Website*. Accessed August 23, 2020. https://strategy.data.gov/practices/

data in our lives means municipalities need to follow practices like these to fully empower the community with their data.

States play a vital role in producing documents like birth certificates, marriage licenses, driver's licenses, death certificates, and other licenses and permits. By issuing these documents, the State empowers its residents to defend their rights in the court system. Much like the State and regional agencies, local cities play a role in keeping essential documents like business licenses, land use and building permits, and compliance records. With personal information included on forms and records, agencies must be responsible stewards of their community members' security and rights to documents.

Governmental agencies must keep records of certain documents per the Secretary of State's Local Government Records Management Guidelines.[16] Most local agencies, including Culver City, also have their retention policies. Ongoing education on protocols to help consistently apply these guidelines and policies is important for the City since community members have the right to request access to information through a Public Records Act request. For the community, this is important because it builds trust that the City is managing public records responsibly and transparently. The City could consider setting up a foundation of ethical practices for digital governance as a part of a data management/strategy plan.

CONNECTIVITY

A robust and resilient information and communications technology (ICT) network is the backbone of a smart city. ICT networks are made up of various infrastructures that transmit data, information, and communications, such as Culver City's municipal fiber system discussed below. COVID-19 has shown how important an accessible and fast communications network can be for a city as more people work from home, attend school online, and safely stay in touch with friends and loved ones. Fortunately, Culver City has established fiber and wireless networking technologies.

On September 11, 2019, Culver City welcomed Joanne Hovis, President of CTC Technology & Energy and CEO of the Coalition for Local Internet Choice (CLIC) , for a presentation on 'Broadband and Economic Vitality: The Role of Culver City's Fiber Network' as a part of the General Plan Update Speaker Series. This video and the corresponding slides and summary are on the City's website and provide a broad picture of communications infrastructure and how it is poised to meet the current and future needs of the community.[17]

FIBER

Culver City constructed a 21.7 mile-long fiber network in July 2018 (**Figure 6**). The network consists of 576 strands of fiber and is entirely underground. There are three hub facilities in the city that house City-owned network electronics. The City leases two fiber connections to strategic locations that house networks and cloud services at One Wilshire in Los Angeles and Equinix in El Segundo.

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[16] Secretary of State. 2006. *Local Government Records Management Guidelines.* https://archives.cdn.sos.ca.gov/local-gov-program/pdf/records-management-8.pdf

[17] City of Culver City. n.d. *Broadband And Economic Vitality*. https://www.culvercity.org/City-Hall/Departments/Community-Development/City-Hall/Get-Involved/Broadband-And-Economic-Vitality

The City is currently directing efforts to build connections to multi-tenant commercial properties. The connections will further advance the network's operations and stimulate economic development. The network serves city facilities, commercial properties, and potentially the Culver City Unified School District.[18] The City has extensive fiber infrastructure currently used for municipal operations (connectivity between all City buildings) and closed caption video at most intersections.

WIRELESS

The City of Culver City owns Federal Communications Commission (FCC) licenses for communication, which Culver CityBus uses. The FCC licenses allow the City to serve the needs and interests of the community to provide local service. Current cellular offerings include fourth-generation wireless (4G LTE (Long Term Evolution) and LTE-A (LTE-Advanced). Construction is now underway to deploy fifth-generation wireless (5G). Fifth-generation wireless offers significantly improved bandwidth. However, this requires an increased number of access points (5G small cell sites) found on utility poles, streetlights, traffic signals, and rooftops. Negotiating public space use with the carriers has ended, and 5G deployment in many municipalities is underway or has concluded.[19]

The City has FCC licenses on two different bands. The City secured a 900 megahertz (MHz) band to explore its use as a redundant part to the sanitary sewer pump stations' Supervisory Control and Data Acquisition (SCADA) system.[20] The 460-470 MHz bands are used for land mobile systems for public safety interoperable communications between Federal, State, and local public safety entities.[21]

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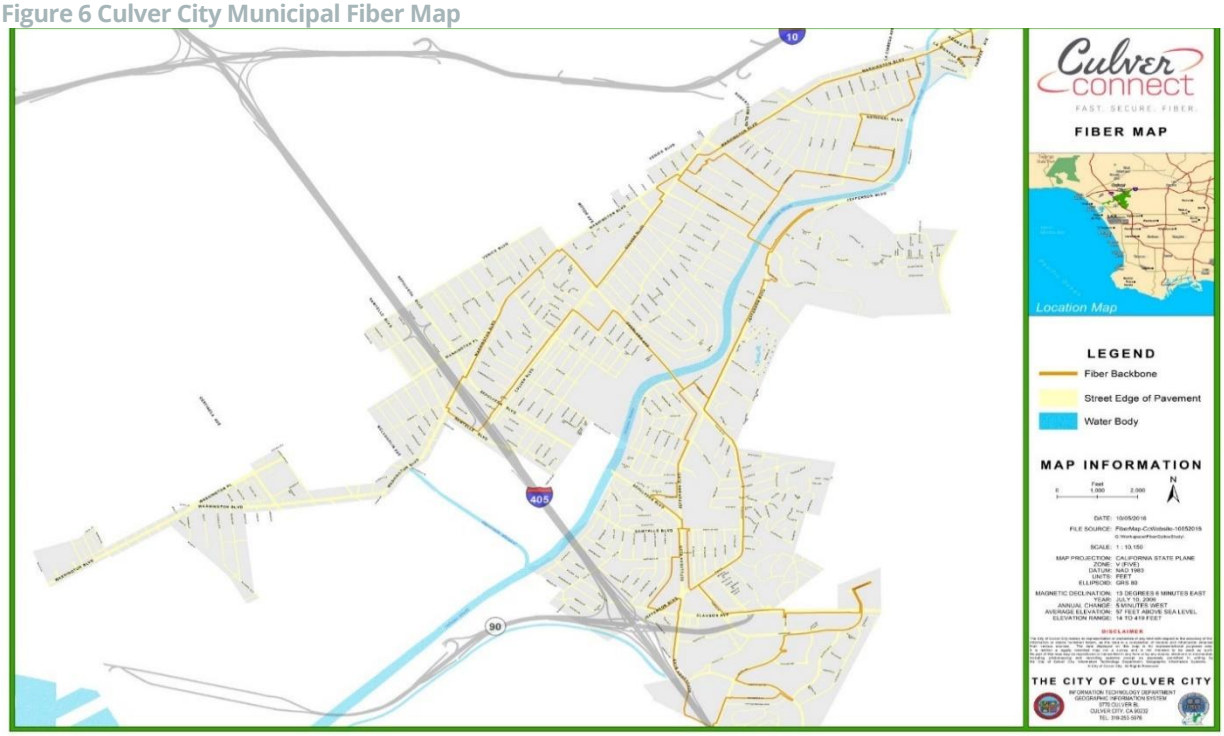
[18] City of Culver City. *Municipal Fiber Network Project | Culver City, CA*. n.d. Accessed August 24, 2020. https://www.culvercity.org/how-do-i/learn/municipal-fiber-network-project

[19] City of Culver City. January 14, 2019. ORDINANCE NO. 2019-.2.Q2. Accessed August 24, 2020. https://www.culvercity.org/home/showdocument?id=17836

[20] SCADA is a control system architecture comprising computers, networked data communications and graphical user interfaces for high-level supervision of machines and processes. It also covers sensors and other devices, such as programmable logic controllers, which interface with process plant or machinery. Wikipedia. N.d. *SCADA.* https://en.wikipedia.org/wiki/SCADA

[21] National Telecommunications and Information Administration (NTIA). n.d. Federal Government Spectrum Use Reports 225 MHz to 5 GHz (as of 04/11/2014). Accessed October 20, 2019. https://www.ntia.doc.gov/other-publication/2014/federal-government-spectrum-use-reports-225-mhz-5-ghz_04112014

Figure 6 Culver City Municipal Fiber Map



Source: City of Culver City, 2016.

As the City connects more Internet of Things (IoT) networked devices and sensors, it will need added communications systems. The City could explore a low-power wide-area network (LPWAN)[22] system like (LoRa).[23] LoRa (long-range) is often used in IoT networks for energy management, pollution control, infrastructure efficiency, and disaster prevention. These systems use radio frequency bands 915 MHz and enable long-range transmissions of more than six miles in rural areas with low power consumption. The City could explore such a system given policy decisions and appropriate funding allocation.

A related concept is wearable devices, which can come in many forms but include smartwatches and clothing. Sensors in these devices can communicate with a smart system to monitor health crises in elderly residents, prioritize traffic flows, help visitors move around the city, and alert the wearer if the smoke level in a room exceeds a safe threshold. The City could consider a pilot program to test the benefits of using such devices, potentially partnering with local non-profit groups to assist with implementation and monitoring.

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[22] A LPWAN network is a type of wireless telecommunication wide area network designed to allow long-range communications at a low bit rate among things (connected objects), such as sensors operated on a battery. Wikipedia. N.d. *Low-power wide-area network.* https://en.wikipedia.org/wiki/Low-power_wide-area_network

[23] LoRa is the physical layer or the wireless modulation used to create a long range communication link. LoRa Alliance. n.d. What is LoRaWAN. Accessed December 23, 2020. https://lora-alliance.org/resource-hub/what-lorawanr

SECURITY

Having a secure network is of the utmost concern. It is especially critical for a governmental agency with a smart system connected to multiple services, including traffic management, utilities, and public records keeping. Any breach of security into one of these systems could have significant financial and even political impacts.

Examples of security measures that Culver City does not currently offer or could be improved, which may benefit the community include additional Open Data and My Data management services and policies to implement transparent vendor management (including opt-in/out choices for secure COVID-tracking), trip-planning, and in-home care-delivery.

PRIVACY

As explained in the Ethical Practices section above, municipalities must empower community members by granting them easy access to their data. When developing tools and legislation to protect the community's privacy, the following factors are important to consider:

- **Privacy asymmetries** are related to courts providing records to law enforcement but not to the individual or their counsel who is being tried. While this phenomenon relates mostly to criminal law enforcement and court proceedings, the lesson it offers is that all parties should have "symmetrical" or equal access to data to ensure high ethical standards are applied.[24] Ensuring community members have access to all records a City may be required to keep due to retention policies helps address any risk of asymmetry.

  Identify theft is the deliberate use of someone else's identity, usually to gain a financial advantage or obtain credit and other benefits in the other person's name and perhaps to the other person's disadvantage or loss.[25] Cities must have safeguards in place to prevent identity theft of their community members who provide personal information. To the extent feasible, if community members can manage their personal information themselves and make it available to municipalities on request, it allows cities to carry less data, reducing the risk of them being the source of identity theft. However, there is certain information that agencies are required to maintain, as discussed in the Ethical Practices section. Retaining needed information only and destroying other personal information in keeping with retention and destruction policies ensures the privacy of community members' personal information.

- **Algorithm biases** are systematic errors that create an unfair outcome. As data-driven tools become more integrated into systems, agencies need to be aware of such biases, ensure programs don't result in biases and monitor to ensure any unforeseen biases are remedied.

The risk of these harms will increase as third-party service providers, such as a local agency, collect more medical, location, financial, political, and commercial information about residents. The City

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24 Wexler, Rebecca. July 29, 2019. *Privacy Asymmetries: Access to Data in Criminal Investigations*. UCLA Law Review, Vol. 68, No. 1, 2021. https://ssrn.com/abstract=3428607

25 USAGov. Last updated September 9, 2020. *Identity Theft Website.* Accessed October 26, 2020. https://www.usa.gov/identity-theft

could consider establishing its foundation of agreed-upon privacy practices for digital governance as a part of a data management/strategy plan.

ONLINE SERVICES

The benefits of supplying online municipal services are clear. Culver City was already taking steps to offer online services before the COVID-19 crisis. For example, below are some of the online services the City provides:

- Submit ideas on how the City can save money or improve City services through a suggestion form
- Book appointments for passport services
- Report an incident of fraud, waste, and abuse of City resources
- Request Geographic Information System (GIS) map data
- Submit a complaint about discrimination, retaliation, or harassment
- Submit a planning application
- Submit a permit application
- Submit a code enforcement services request
- Submit a business license application, renew, pay a balance, close a license, search for licensed businesses, and report a problem
- Apply for jobs
- Watch a live or archived City Council, Committee, or Commission meeting
- Apply for, or renew various permits
- Apply for, and obtain resident and guest parking permits per designated areas
- Report traffic and parking operational and safety concerns

As the crisis made it difficult, and at times impossible, to offer in-person services, it highlighted the critical need for cities to expand further the scope of online services provided. Therefore, increased emphasis needs to be placed on how cities develop robust, extensible, responsive, and complete online services today and into the future.

Examples of online services that Culver City does not currently offer, or could be improved, which may benefit the community include additional "always-ON" WiFi resilience hotspots (lampposts) enabling digital-services for essential workers and emergency services for fire, police, ambulance, and in-home care.

EQUALITY AND THE DIGITAL DIVIDE

As more services move online, it is important to ensure access to everyone regardless of wealth, ability, or race. In a community as dense as Culver City, supplying public WiFi access at all municipal buildings, the School District, and core commercial corridors is a good first step. As of 2020, the City has WiFi at Veterans Memorial Park and in City Hall's courtyard. Adding public access terminals at libraries and other public places where services are provided ensures convenient access for all community members. Extending WiFi into public transit would also greatly improve access. In a crisis like the current COVID-19 pandemic, buses could serve as access points. The City's Transportation Department has plans to provide WiFi on Culver City buses.

The City could help close the divide further by promoting existing programs like the Federal government's Lifeline program,[26] collecting data on which areas of the city have the greatest need. This can help prioritize investments and provide free WiFi to the areas of the city most in need. The City could set up locations where a bank of computers is available for use at no cost.

Another technology barrier for economically disadvantaged persons is a lack of banking and financial services. The Federal Reserve estimated 55 million unbanked or underbanked adult Americans in 2018, which account for 22% of U.S. households. It is both hard to do business online and to receive benefits from online services without a bank. This problem was highlighted recently when the federal government tried to distribute a $1,200 financial hardship payment during the pandemic. While our economic system moves trillions of dollars a day and serves billions of people, it is cumbersome. It adds cost through fees and delays, creates friction through redundant and onerous paperwork, and opens opportunities for fraud and crime. This all adds cost, with consumers bearing the burden. For the economically disadvantaged, this can be a barrier to entry that is insurmountable.

Distributed ledger technology[27] is a way to reduce this friction, opening opportunities for low-value, secure transactions online. By lowering transaction costs, millions of those without bank accounts could access a wide range of financial services securely, privately, and without the institutional overhead. Using this technology, two or more parties, whether businesses or individuals, can forge agreements, make transactions, and build value without relying on intermediaries to verify their identities, show trust, or perform tasks foundational to all forms of commerce.

By closing this digital divide in this way, Culver City could move added municipal services online, reducing costs and supplying more convenient services. Further, the City could extend these services to non-governmental organizations (NGOs) to support services like Mercy Corp's Community Investment Trust (CIT), which builds community ownership of real-estate for investors only able to invest small amounts a month (as low as $10). Using these technologies, communities can reduce the digital divide, supply a steppingstone out of poverty and build community ownership. Distributed ledger and other enhanced banking options will require policy analysis and decision by the City. Privacy and security issues will also need to be addressed when incorporating the new policy directives.

The City could consider closing the digital divide through solutions such as publicizing existing low-income broadband plans, collecting better data on Internet access, expanding the publicly-owned broadband network to residential and other uses, and partnering with local Internet service providers. As of late 2020, the City approved an agreement with Ting, a service provider, to deliver fiber Internet for residential service.

PERMITTING

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[26] Universal Service Administrative Co. n.d. *Get Connected.* Accessed December 28, 2020. www.lifelinesupport.org

[27] Distributed Ledger Technology refers to the technological infrastructure and protocols that allows simultaneous access, validation, and record updating in an immutable manner across a network that's spread across multiple entities or locations.

Culver City launched a new website before the end of 2020. To prepare for this transition, the City's new website vendor offered several courses to staff who create and update pages on the City's website on how to write and design content that is easy to understand. As the City continually updates content, it is useful to keep these questions in mind:

- Which licenses or permits are required to ensure public health and safety?
- What are the eligibility requirements for the licenses or permits?
- What processes are used to issue, renew, or revoke permits or licenses?

While Culver City offers its permitting forms online, there is always an opportunity for continued improvements to remove barriers to the permitting and licensing process. For example, the City could consider forming an ad-hoc committee with small and large businesses, planning and development applicants, and community groups to incorporate their recommendations and feedback on the process.[28]

COMMUNITY ENGAGEMENT

Successfully creating a smart city requires community engagement to understand how members evaluate their quality of life and respond to changing desires. Using tools like the 'Place Standard tool'[29] supplies a simple framework to structure conversations about place. It allows you to think about the physical elements of a place (for example, its buildings, spaces, and transport links) and the social aspects (for example, whether people feel they have a say in decision-making).

Additionally, applications, websites, and events that supply information about City services and a place for community members to express their desires are needed so that the City can understand the community's needs. It also ensures people can be heard and create the systems that support the community.

City Council and other public meetings are available to watch from home on a live stream, and community members can comment in real-time. This allows for more flexibility and access, especially for people who may not have childcare, have limited mobility, or otherwise typically find it challenging to attend meetings in person.

There are many ways to engage with the community on projects and initiatives virtually. The pandemic pushed agencies to shift engagement methods mostly all virtually with the pandemic's stay-at-home orders. Some cities host online open houses for projects, which imitate the experience of walking around and viewing maps, boards, and other information. Online surveys, mapping activities, and other methods are useful tools to get input from the community-allowing people to take part when they have time.

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[28] Harvard Kennedy School, Ash Center for Democratic Governance and Innovation, Data-Smart City Solutions. n.d. *Streamlined Permitting & Licensing, Regulatory Reform for the 21st Century*. Accessed September 6, 2020, from https://datasmart.ash.harvard.edu/news/article/streamlined-permitting-licensing-599

[29] NHS Scottish Health. n.d. *The Place Standard Tool*. Accessed December 23, 2020. http://www.healthscotland.scot/health-inequalities/impact-of-social-and-physical-environments/place/the-place-standard-tool

Examples of how Culver City has recently shifted community engagement online include the General Plan Update (GPU) project's educational forum, where videos summarizing existing conditions reports were posted on YouTube.[30] Also, the virtual platform that was used to review and comment on the GPU's proposed vision and principles where anyone can go to the project website and suggest revisions and comment on the draft document. Another example is the Move Culver City project. Users can interact with the site, design roadway segments, and leave suggestions for improvements on an interactive map of the city.[31]

Culver City makes it easy for residents to supply input on City policies, ordinances, and development projects via its website. It uses tools from companies like Granicus, Recycle Coach, and social media platforms like Nextdoor to increase its outreach. Cities can base their decisions on a much clearer, more current, and more detailed picture of all aspects of their city. City planners can analyze the trends seen in that information to predict future needs and plan responses.

Examples of smart community engagement that Culver City does not currently offer, or could be improved, which may be beneficial to the community include permitting the activation of public realm as activity centers with digital infrastructure supporting eldercare, childcare, and essential worker access support services. "For example, imagine an age-friendly smart city "layer" linked to a smartwatch to highlight facilities such as public toilets, water fountains, and shaded rest stops along exercise routes. Access Map Seattle is an example of an age-friendly, interactive, smart city map that shows the steepness of pedestrian footpaths and raised [curbs]. The National Public Toilet Map, created by the Australian Department of Health and Ageing, and Barcelona's smartappcity are other mobile apps integrating city services and urban plans."[32]

APPLICATIONS

Cell phones have changed the landscape of communication, both for accessibility and the speed at which communication happens. While equity issues are inherent with digital services discussed further in the Equality and the Digital Divide section, most of the population has some degree of access to mobile communication. The City has started exploring how applications can better serve its people, including the 2019 release of Culver CityBus's NextCCBus app, which allows users to get real-time updates of bus arrival times.

There is an opportunity to explore further how using apps could help community members convey public health and safety information. For example, online pandemic tracking data could be translated into a city notification app to supply updates through push notifications.[33]

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[30] Culver City General Plan Update Educational Forum. N.d. https://www.pictureculvercity.com/educational-forum. Accessed December 24, 2020.
[31] Move Culver City. N.d. www.moveculvercity.com. Accessed December 24, 2020.
[32] World Economic Forum. March 19, 2021. Here's how digital infrastructure can make cities more inclusive for elderly people. https://www.weforum.org/agenda/2021/03/this-is-how-we-create-the-age-friendly-smart-city/
[33] SmartCitiesWorld. December 24, 2020. Smart city tracker: the top stories of 2020. https://www.smartcitiesworld.net/special-reports/smart-city-tracker-the-top-stories-of-2020

SOFTWARE SERVICES

The accepted historical practice for municipal software services is for agencies to buy a third-party software package and tailor it to their specific needs. This linear approach to software development, referred to as a "waterfall process," includes many steps to tailor the software to each agency's requirements. The process can span many years for large projects, and the software is sometimes out-of-date before delivery.

In contrast, leading commercial organizations have adopted an iterative, agile, and open approach to delivering and improving the software. It starts by rapidly providing the first version of an application, called a "minimum viable product," meeting the basic user requirements. Then, the application producer continues to improve the product over short, timed phases called "sprints." After the organization receives the deliverables from the sprint, they adjust their processes and direct the producer on prioritizing the deliverables for the next sprint. This approach improves the waterfall process because it is faster, nimbler, and more efficient.

More municipalities are actively embracing the approach already adopted by the private sector. California's Government Operations Agency recently launched the California Code website - an open collaboration between agencies, industry partners, and producers working to create a more innovative, collaborative, and effective government.[34] Culver City is well-positioned to transition to this iterative, agile, and open approach.

The City currently runs various network servers on an open-source operating system in a limited capacity, and various services are already moving to the cloud. As the City continues transitioning its services to the cloud, Information Technology Department staff are freed from managing in-house servers to manage the internal network and interfaces between cloud-hosted applications. The City and community could benefit from having an Open Source Program Office (OSPO) because half of software service delivery is vendor validation, integration, and upgrade certification. A more agile, upgrade service management process is required. If the City were to consider OSPO in the future, a thoughtful analysis to explore the benefits and challenges it presents would be useful as OSPO may not result in actual cost savings.

As these services grow, it will be beneficial to consider an integrated control center for City operations like emergency response, fire, police, power, and traffic. Cities have saved money and improved processes from this kind of integration.[35] For example, cities experience cost savings by enhanced fleet resources and shared infrastructure assets enabling improved operations from improved coverage and response time to emergency alerts.

Examples of software services that Culver City does not currently offer or could be improved and beneficial to the community include Digital City Testbed Centers for scenario planning and response testing, resilient services development, validation, and vendor certification.

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[34] David Egts. December 20, 2018. *Four Myths About Open Source in Government*. Accessed December 23, 2020. https://www.govtech.com/opinion/Four-Myths-About-Open-Source-in-Government-Contributed.html

[35] Innovate UK. n.d. *Glasgow Operations Centre Website*. Accessed August 24, 2020. https://futurecity.glasgow.gov.uk/ops-data/

UTILITIES

SOLID WASTE

There is ample evidence of the wastefulness of our "take-make-waste" economy. The average car is parked 95% of the time,[36] 30-40% of the food supply is wasted,[37] and the average office is used only 60-70% of the time[38] Shifting to a circular economy can decrease waste. For example, in food production, effectively using by-products, regenerative agriculture techniques,[39] and marketing healthier food could save 2.7 trillion dollars a year globally by 2050.[40]

There are many ways a city's waste system can contribute to a circular economy. For example, Culver City has deployed a Big Belly Smart Waste & Recycling System. This intelligent garbage solution informs trash collectors when the waste bins are full and cuts checking trips. This saves money and reduces carbon dioxide emissions by only deploying collection trucks when needed. The City also has a Food Recovery and Organics Collection Program that supports a circular economy.[41]

Figure 7 Bigbelly Bins

Source: urban.systems, Inc.

Resources to help communities achieve a circular economy model and reduce solid waste include applications that allow community members to share products, platforms with peer-to-peer instructions for repairing things, 3D printing, products or product parts from sustainable and

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[36] Streetsblog LA. March 10, 2016. *It's True: The Typical Car Is Parked 95 Percent of the Time.* https://usa.streetsblog.org/2016/03/10/its-true-the-typical-car-is-parked-95-percent-of-the-time/

[37] USDA. n.d. Food Waste FAQ. https://www.usda.gov/foodwaste/faqs

[38] JLL. 2019. Occupancy Benchmarking Guide 2019-2020. https://images.hello.jll.com/Web/JLLAmericas/%7Bcb6d394b-93a8-4a60-a150-0af70a092678%7D_jll-us-the-2019-2020-occupancy-benchmarking-guide2.pdf

[39] Regenerative Agriculture describes farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle. Regeneration International. February 24, 2017. What is Regenerative Agriculture? https://regenerationinternational.org/2017/02/24/what-is-regenerative-agriculture/

[40] Ian Banks, & Joe Iles. 2019. *Cities and Circular Economy for Food* (p. 73). Ellen MacArthur Foundation. https://www.ellenmacarthurfoundation.org/assets/downloads/CCEFF_Full-report-pages_May-2019_Web.pdf

[41] City of Culver City. n.d. Trash and Recycling. https://www.culvercity.org/Services/Trash-Recycling

recycled materials, and electronic transaction blockchain technology[42] that helps track new and recycled materials throughout their lifecycle.[43]

Examples of circular economy programs that Culver City does not currently offer or could be improved, which may benefit the community, include a more inclusive framing of program goals, services, and outcomes. Community support of safe, secure, trusted services is key. A Doughnut Economy Action Lab (DEAL) approach enables community-led initiatives to be sustained through more agile, open programs. DEAL is "a compass for human prosperity in the 21st century, to meet the needs of all people within the means of the living planet. It consists of two concentric rings: a social foundation, to ensure that no one is left falling short on life's essentials, and an ecological ceiling, to ensure that humanity does not collectively overshoot the planetary boundaries that protect Earth's life-supporting systems. Between these two sets of boundaries lies a doughnut-shaped space that is both ecologically safe and socially just: a space in which humanity can thrive."[44]

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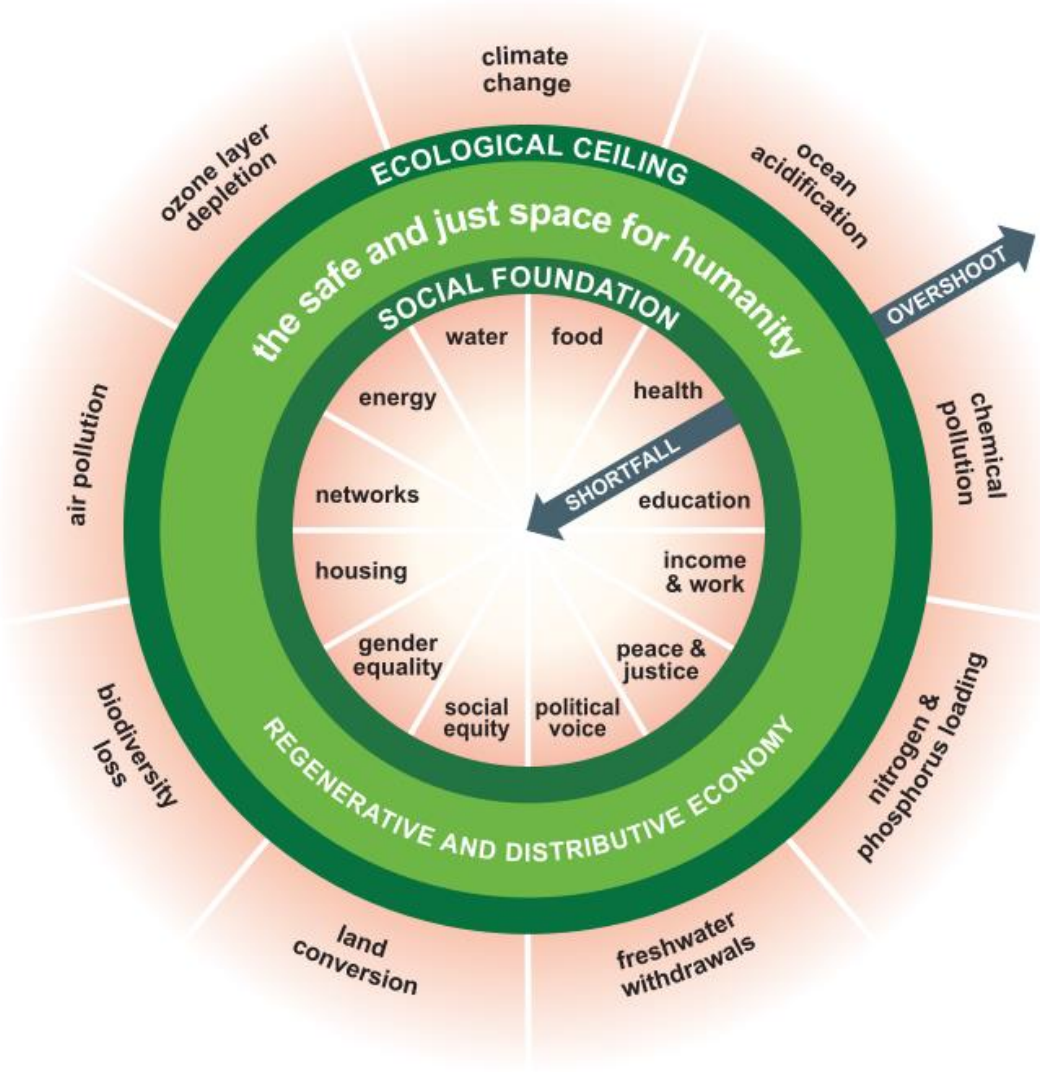
[42] "Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network. An *asset* can be tangible (a house, car, cash, land) or intangible (intellectual property, patents, copyrights, branding). Virtually anything of value can be tracked and traded on a blockchain network, reducing risk and cutting costs for all involved." IBM. N.d. *What is blockchain technology?* https://www.ibm.com/topics/what-is-blockchain

[43] Johanna Tilkanen. n.d. *How to smooth the path to a circular economy? 4 circular economy enablers*. Bioregional. Accessed May 31, 2020. https://www.bioregional.com/news-and-opinion/4-key-enablers-that-will-speed-up-the-circular-economy-part-1

[44] Doughnut Economics Action Lab. n.d. *About Doughnut Economics.* https://doughnuteconomics.org/about-doughnut-economics

Figure 8 DEAL Doughnut Approach



Source: Doughnut Economics Action Lab

SMART WATER/WASTEWATER

"Smart water" refers to water and wastewater infrastructure that transport and manage water and the energy necessary to transport it effectively. A smart water system is designed to gather meaningful and actionable data about the flow, pressure, and distribution of a city's potable water or wastewater system. This data helps cities find sources of waste. Fixing those issues reduces waste, ensuring that sources are not depleted, and the City supports a sustainable system. Also, creating a smart water system requires educating and engaging residents in the process.

Currently, Culver City uses large amounts of potable water (121 gallons per capita per day [gpcd] in 2015), and 90% of that becomes wastewater. This amount is generally lower than other cities within the same service area, with a base per capita daily water use of 154 gpcd.[45] Culver City residents receive their water from one of two sources. The first is from the Golden State Water Company or the Los Angeles Department of Water and Power with water from the Colorado River Aqueduct. The second is from the Metropolitan Water District of Southern California with water from the State Water Project. As a drought-prone state, California State law prohibits actions that result in water waste. Further, the City must follow the Municipal Separate Storm Sewer System (MS4) permit issued by the Los Angeles Regional Water Quality Control Board (LA RWQCB).

The City is making strides in transitioning to a more circular and smart approach to water and wastewater management. For example, Culver City started residential and municipal runoff stormwater management programs. In 2010, the City initiated the Culver City Rainwater Harvesting (CCRH) Program. This pilot project teaches Culver City residents and property owners about urban water management and provides them with resources to follow best management practices on their properties.[46] Water barrel distribution events continue to advance this program.[47]

The City is incorporating technology with its Stormwater Quality Master Plan (SWQMP) in large-scale - regional projects such as the Culver Boulevard Project and is adding to the Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) to address drought, flooding, and wildfire. The City is expanding the SWQMP to include mitigation action items from the MJHMP due to overlapping features. These items include low impact development, identifying and pursuing alternative water sources, evaluating the effectiveness of City-owned drainage infrastructure, and developing additional water infrastructure:

- Identify and pursue alternative water sources to supplement imported Golden State Water Company deliveries to protect the community from repeating regional drought conditions, including expanding groundwater recharge, and making recycled water available in Culver City in case of fire.

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[45] City of Culver City. 2020. General Plan Update Infrastructure Existing Conditions Report.
[46] Santa Monica Bay Restoration Commission and Great Ecology. January 31, 2012. Culver City Rainwater Harvesting Program - Toolbox.
http://toolbox.calwep.org/wiki/Culver_City_Rainwater_Harvesting_Program
[47] West Basin Municipal Water District. (January 20, 2018. *Rain Barrel Distribution Event - Culver City*.
https://www.westbasin.org/events/rain-barrel-distribution-event-culver-city

- Identify locations and explore constructing additional water storage facilities and emergency connections to supplement water supplies during drought conditions or short-term shortages.
- Identifying locations in the city where urban flooding may occur and evaluate potential impacts to critical infrastructure.
- Coordination with Culver City Unified School District to identify opportunities within their property that may protect critical infrastructure.

In addition, the City follows regulations like the Municipal Code § 17.310.025 on Landscape Standards, the State's Model Water Efficient Landscape Ordinance, and anticipated changes to Assembly Bill 1881 regarding water conservation.

Recognizing Culver City's role in the regional water system, the City has been coordinating with regional bodies on water issues. In 2016, the City joined the Ballona Creek Watershed Management Group (BC WMG) along with the cities of Beverly Hills, Inglewood, Los Angeles, Santa Monica, West Hollywood, and unincorporated areas of Los Angeles County. These cities created the Enhanced Watershed Management Program for the Ballona Creek Watershed.[48] The cities of Culver City and Los Angeles, the County, and the County Flood Control District created the Marina del Rey Enhanced Watershed Management Program Plan.[49]

Culver City has been connecting parts of its municipal irrigation systems for remote monitoring and control. Automating data collection can help identify opportunities to reuse, recycle, restore, and recover water, and measure how effectively actions improve water reuse. In 2015, the City adopted a Water Conservation Plan that included several measures to reduce potable water use. It also posted information about existing regulations regarding water use restrictions at www.culvercity.org/waterconservation. Other methods the City could consider towards this end include urban canopy and bio-swale placemaking and citywide replacing aging City-owned irrigation infrastructure.

ENERGY

The linear economy relies on limited resource carbon-based fuels (oil, coal, and natural gas). Extracting these fuels contributes to land degradation, water, and air pollution, global warming, and ocean acidification. Furthermore, using these fuels have a detrimental effect on the economy and makes it difficult to deliver clean air, water, and healthy food to our community.

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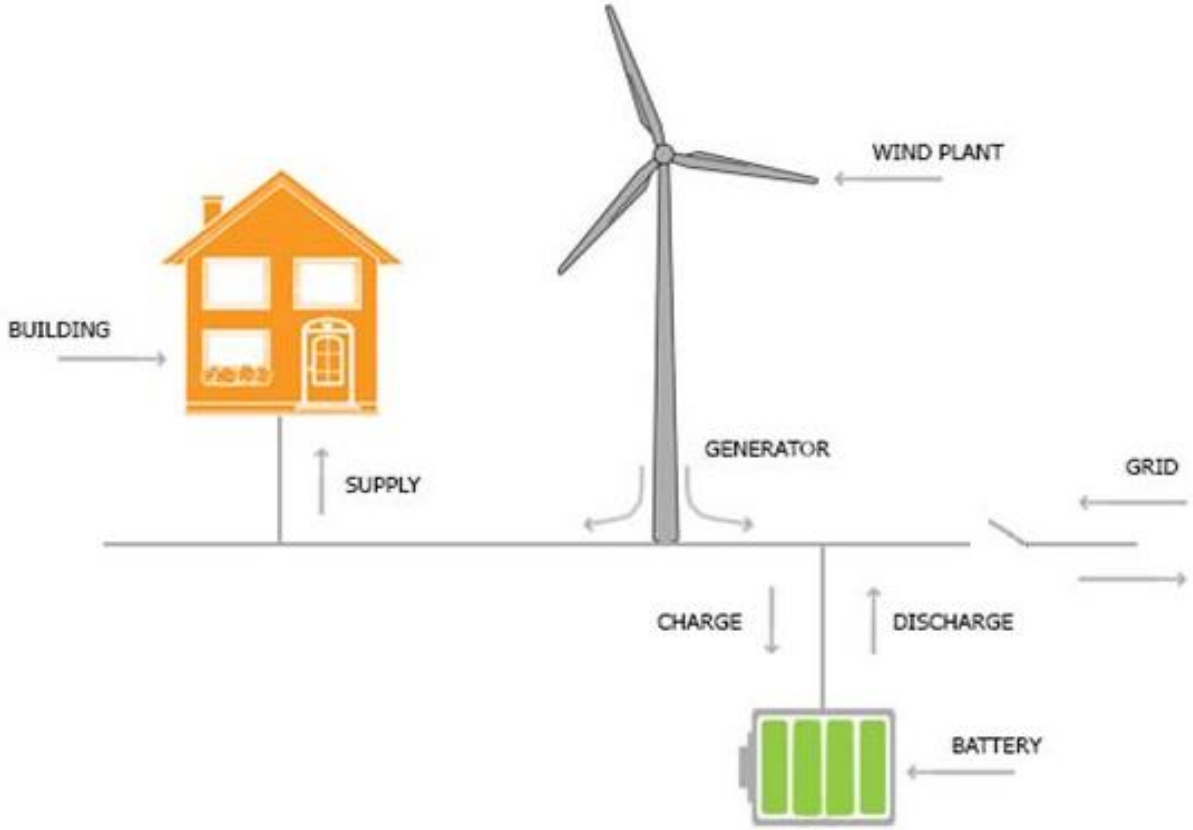
[48] Ballona Creek Watershed Management Group. 2016. *Enhanced Watershed Management Program for the Ballona Creek Watershed* (p. 254). https://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/watershed_management/ballona_creek/BallonaCreek_RevisedEWMP_corrected2016Feb1.pdf

[49] Weston Solutions. 2016. *Marina del Rey Enhanced Watershed Management Program Plan.* https://www.waterboards.ca.gov/rwqcb4/water_issues/programs/stormwater/municipal/watershed_management/marina_delrey/MdR_EWMP_Final_wAppendices4-26.pdf

Since 80% of the world's energy needs are met by fossil fuels today,[50] it is logical that a transition away from these fuels may take decades. Since the limited supply of fossil fuels cannot meet demand, growing diversity of sources and experimentation to improve the availability and cost of alternatives is needed and anticipated to continue to emerge.

Electrical power systems are typically referred to as grids. These grids are networks of generating plants, transmission lines, substations, transformers, and users. A smart grid differs from the traditional grid in that it allows two-way communication of electricity data rather than a one-way flow. A microgrid is a grid within clearly defined electrical boundaries that acts as a single, controllable entity (**Figure 9**). A microgrid can connect and disconnect from other grid resources to run in both grid-connected and island mode.[51]

Figure 9 Connected Microgrid with Wind and Storage



Source: Microgrid Institute, 2014, http://www.microgridinstitute.org/microgrid-background.html

Smart microgrids are sustainable, efficient, and dependable compared to traditional, one-way flow grids. The electrical energy on the national grid is dominated by fossil fuels (64%), with only 17%

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[50] Environmental and Energy Study Institute. N.d. *Fossil Fuels.* https://www.eesi.org/topics/fossil-fuels/description

[51] Island Mode refers to a microgrid being able to operate in isolation from the national grid because they generate enough electricity on-site to meet their needs absent grid-delivered power.

renewable.[52] Some users want to move more quickly to sustainable sources leading to a local, sustainable generation like solar panels. To connect these local energy sources to the grid requires a two-way flow. For this reason, smart grid technologies that support mechanisms that credit solar energy system owners for the electricity they add to the grid (net metering) have become common.

User-generated energy has benefits like efficiency gains since the distribution grid has losses averaging 5%. User-generated energy also increases reliability for the user since separation from the grid does not cut all power. Because of their ability to run in island mode, microgrids offer more options for a community to build resiliency. For example, certain communities with microgrids could continue operating during the 2017 wildfires in California, even though the fire disabled parts of the grid.[53]

Households and businesses worldwide get most of their power from the electricity grid. This stays true even as more microgrids are connected. When an entity is connected to a grid, the net energy use is as clean as that grid's energy. If the carbon content of grid energy is reduced, every electrical device gets cleaner. For example, a natural gas furnace's rate of carbon emissions will remain fixed throughout its 20-year lifespan, while a heat pump using an electricity grid will get cleaner with the grid over the same lifespan. The electric heat pump's environmental performance improves as the grid improves. Because the electrical grid is not a source of energy but a mechanism to distribute and store energy, the grid can use cleaner technologies to produce electricity such as solar, wind, hydro, and geothermal as they become available.

Culver City is exploring building a solar and battery microgrid to support the Senior Center and Veteran's Memorial Complex. The microgrid would supply 100% of their power needs and provide electricity during emergencies and power failures at these facilities (which serve as a 450-bed evacuation shelter). In addition to resiliency, the microgrid may reduce energy bills by using its battery system to proactively manage overall demand, ending short-term demand spikes, smoothing out peak loads, and reducing the overall cost - called peak shaving. This supplies a good foundation for a regenerative microgrid that will allow Culver City to build a sustainable, efficient, reliable energy future.

Whether on the grid or a microgrid, using CPA green energy or not, there are ways to construct buildings to make them more energy-efficient. For example, intelligent building management systems that monitor and regulate electricity use can maximize efficiencies and reduce costs. These systems can also use motion sensors to measure occupancy and match energy use accordingly for ventilation and lighting. This can reduce power consumption automatically if there is a brown-out or high load on the grid.

Culver City is working towards shifting away from fossil fuels and supporting renewable systems. For example, in 2019, the Clean Power Alliance (CPA) became the city's main electricity provider, and the City is working towards electrifying its fleets.[54] Southern California Edison (SCE) services

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[52] U.S. Energy Information Administration. n.d. *What is U.S. electricity generation by energy source? - FAQ.* Accessed October 26, 2019. https://www.eia.gov/tools/faqs/faq.php?id=427&t=3

[53] MicroGrid. n.d. Stone Edge Farm Estate Vineyards & Winery. Accessed September 7, 2020. https://www.stoneedgefarm.com/microgrid/

[54] Ibid 43.

Culver City's energy using a net metering program, allowing customers who produce their electricity through a renewable system to receive a credit to surplus energy supplied to the grid. Through its membership with CPA, 95% of businesses and residents are enrolled into CPA's 100% renewable, carbon-free power option. Southern California Gas (SoCalGas) supplies natural gas services to the city. It has an automated monitoring system for gas line leaks as a safety measure to alert technicians to fix leaks quickly and not waste gas.

Examples of energy practices that Culver City does not currently offer or could be improved, and which may be beneficial to the community include adding more municipal, residential, and commercial microgrids; starting a program to inform residents and businesses about microgrids; continuing to encourage opting in to the 100% clean CPA option; and implementing a smart buildings initiative to encourage or require smart building construction.

MOBILITY

Since the start of the twentieth century, the automobile has played an influential role in all aspects of city life. While the car has helped connect people, goods, and services, it also has negative impacts. Road networks can create barriers between neighborhoods, making it difficult and dangerous for people to get to schools, shops, churches, and parks without a car. Creative solutions to move people throughout a community can improve these barriers, such as protected bike and pedestrian paths (**Figure 10**). Monitoring these solutions and improving them is an important aspect of keeping the community safe and increasing mobility access for all community members. The City's Bicycle and Pedestrian Action plan includes data on collisions, local roadway safety, and actions to improve safety throughout the city.[55]

Figure 10 Example of a protected bicycle path

Source: Lifegate April 2014, https://www.lifegate.com/netherlands-utrecht-bicycle-bridge-school

Environmental stressors such as noise and air pollution, including vehicles, are becoming increasingly important to mitigate in our industrialized world. Numerous studies show that noise pollution, including from traffic, is linked to cardiovascular and metabolic disease.[56] Vehicular emissions are commonly related to public health issues like disabilities and respiratory diseases and cause ozone depletion, representing the most significant contributor to our changing climate.[57]

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[55] City of Culver City. 2020. *Bicycle & Pedestrian Action Plan.* https://www.culvercity.org/files/assets/public/documents/city-manager/culvercitybpap_opt.pdf

[56] Münzel, T., Sørensen, M., Schmidt, F., Schmidt, E., Steven, S., Kröller-Schön, S., & Daiber, A. 2018. *The Adverse Effects of Environmental Noise Exposure on Oxidative Stress and Cardiovascular Risk. Antioxidants & Redox Signaling, 28(9), 873–908.* https://doi.org/10.1089/ars.2017.7118

[57] Environmental Protection Agency. N.d. *Sources of Greenhouse Gas Emissions.* https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

For these reasons, many cities, including Culver City, are committed to enhancing alternative mobility options more conducive to live, work, and play neighborhoods. This section will focus on how existing and future mobility-related solutions could be smarter. A complete report on Culver City's existing mobility conditions can be found in the City's Mobility and Transportation Existing Conditions Report.[58]

ACTIVE TRANSPORTATION

Walking, biking, scooting (human-powered and electric), skating, or using a wheelchair are all active forms of transportation, and accommodating these modes is essential.[59] Biking and walking are the most energy-efficient form of transportation (**Figure 11**).[60] People rely on walkways, bikeways, and public transit to travel to and from home, school, and work and access shopping, downtowns, critical services, or other destinations. A perfect example is Paris's "15-minute city" model, with neighborhoods in a city where you could live, work, play, make a short trip to everything in 15 minutes.[61]

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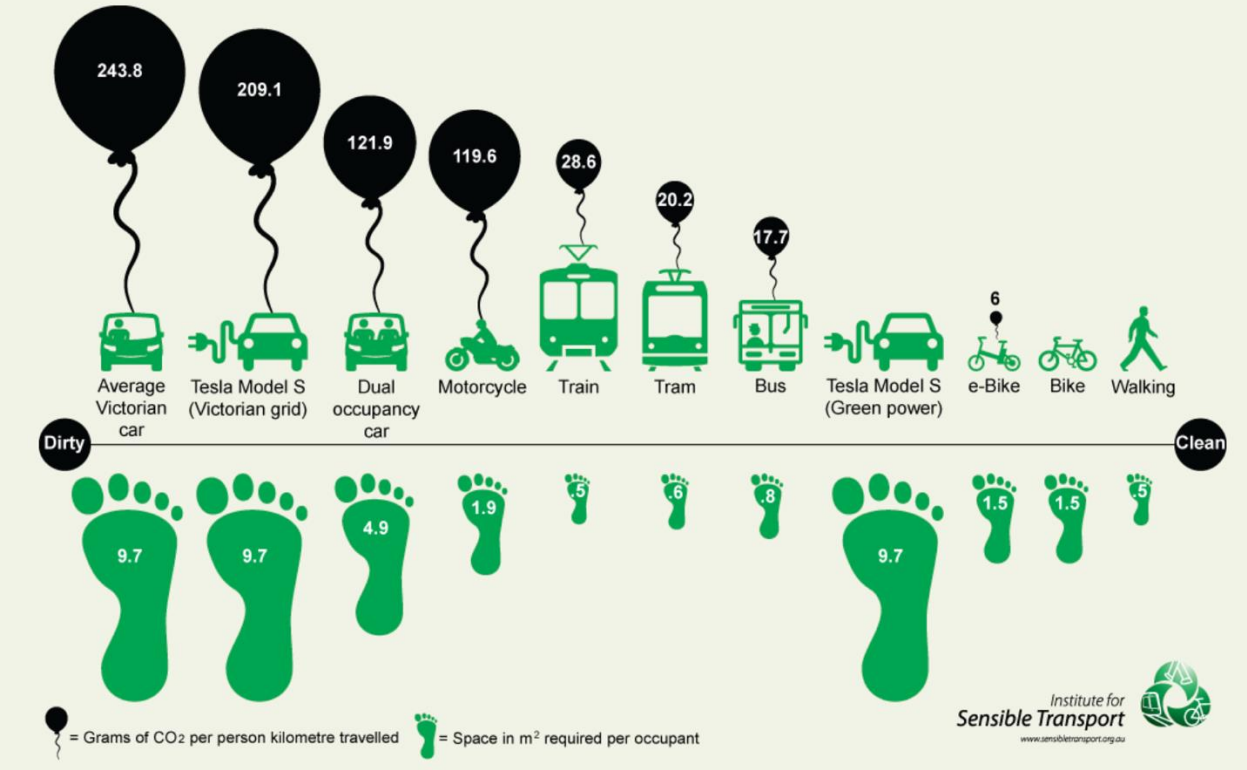
[58] City of Culver City. November 2020. *Culver City General Plan Update Mobility and Transportation Existing Conditions Report.* *https://static1.squarespace.com/static/5d950bfaae137b5f0cbd75f5/t/5fa5f48d8657be665ece8639/1604711665351/CCGPU_TransportationMobilityECR_Final*

[59] Colville-Andersen, M. June 2, 2015. *The 20 Most Bike-Friendly Cities on the Planet.* Wired. https://www.wired.com/2015/06/copenhagenize-worlds-most-bike-friendly-cities/

[60] Energy efficiency in transport. 2020. In Wikipedia. https://en.wikipedia.org/w/index.php?title=Energy_efficiency_in_transport&oldid=970395770.

[61] SmartCitiesDive. December 15, 2020. 11 experts predict what will shape smart cities in 2021. Accessed December 24, 2020. https://www.smartcitiesdive.com/news/11-experts-predict-what-will-shape-smart-cities-in-2021/592063/

Figure 11 Emissions and space requirements of different transport modes



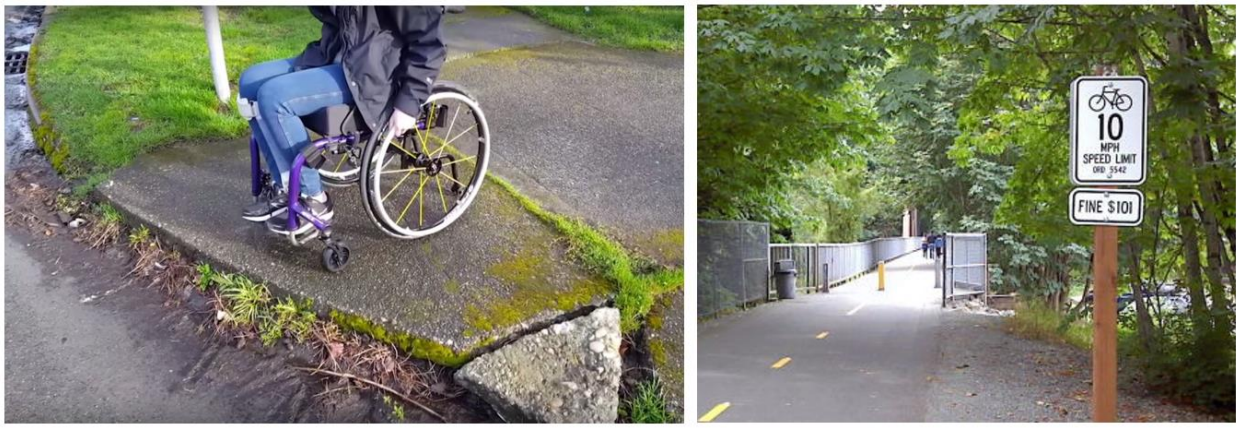
Source: Sensible Transport December 2020, https://sensibletransport.org.au/project/transport-and-climate-change/

While active transportation such as walking and biking offers health benefits and is low-cost, many U.S. cities do not have safe active transportation networks. Active transportation is a high priority for local agencies, especially in urban settings, but cars will continue to have a role in mobility into the foreseeable future. Balancing the infrastructure, flows, and safety of all mobility modes is a primary concern for any city, and applying smart practices offers opportunities for improvement.

The danger comes from spaces for active transportation (e.g., sidewalks and bike lanes) not being safely separated from fast-moving vehicles (**Figure 12**). To address this, cities throughout the country, including Culver City, have embraced Vision Zero - a global road traffic safety project aiming to achieve a system with no fatalities or serious injuries involving road traffic. The City's Bicycle & Pedestrian Action Plan[62] details the City's bicycle and pedestrian program and Complete Streets policy and has committed to Vision Zero objectives. More information on these efforts can also be found in the Mobility and Transportation Existing Conditions Report. The City is also researching the use of smart streetlights and potential funding sources and retrofitting some traffic control devices with short and long-range detection (**Figure 13**).

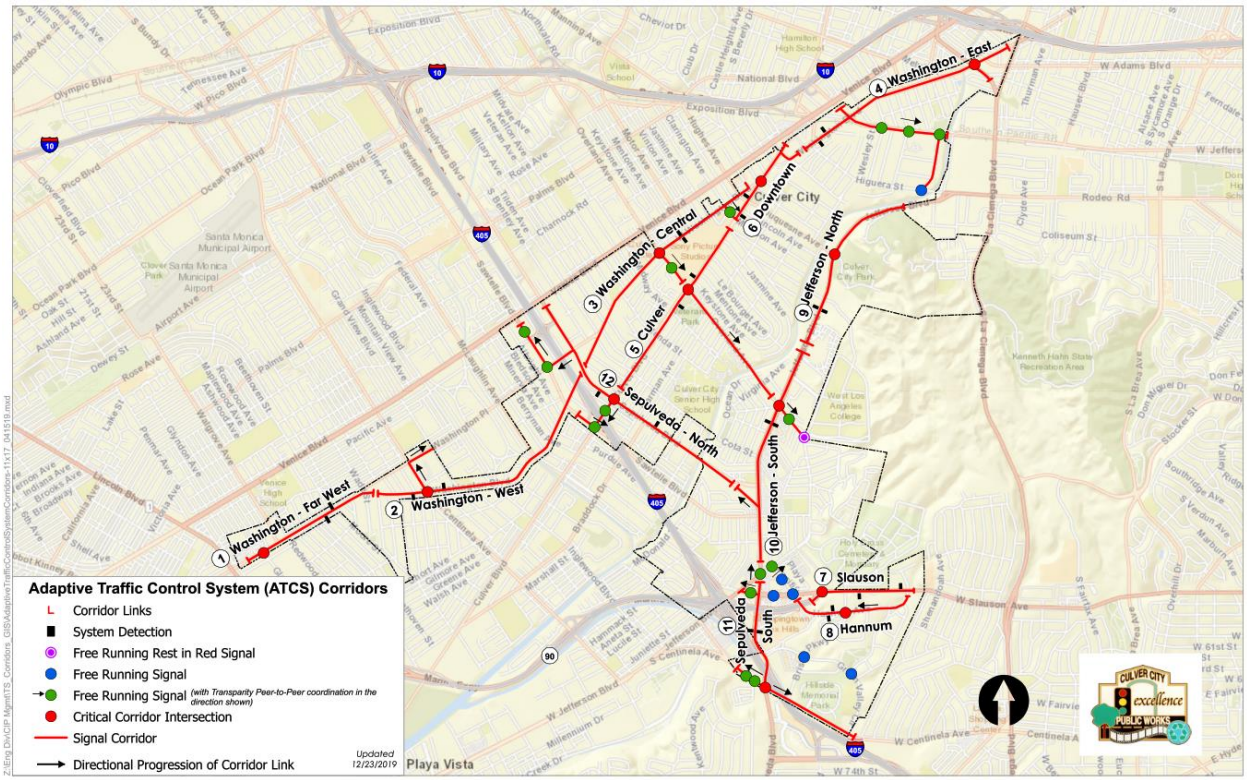
[62] City of Culver City. 2020. *Bicycle & Pedestrian Action Plan.* https://www.culvercity.org/files/assets/public/documents/city-manager/culvercitybpap_opt.pdf

Figure 12 Example of a bad sidewalk curb cut and bicycle speed limit signage



Sources: Bike Biz, August 2010, https://www.bikingbis.com/2010/08/23/cedar-river-trail/

Figure 13 Adaptive Traffic Control System (ATSC) Corridors Map



Source: City of Culver City Public Works Department, 2019

As more people choose to walk and bike, improving infrastructure connectivity and safety will help encourage people to use this infrastructure. Dedicated walking paths that supply shade or are protected from rain and other weather-related factors can help encourage people to use them. Any shelter infrastructure for active transit users could capture solar power and rainwater. These active transit networks can be lined with low-level LED lighting at night, security cameras, and call stations to report safety issues.

Smart city initiatives the City could consider implementing that can further support such programs include apps that find and manage shared bicycles and scooters and data collection to inform infrastructure improvements. Applications like OpenSidewalks[63] and other crowd-sourced information systems can help plan trips to avoid obstructions like bad or missing curb cuts and roadworks. These applications can also show street elevations and inclines to help users prevent difficult routes like steep hills. Seeing elevation information on routes can help people with disabilities, those with limited mobility, the elderly, people pushing strollers, and other users.

MASS TRANSIT

Mass transit continues to be the primary way to efficiently move many people around the city and the region. The City has taken steps towards improving the mass transit experience for users. For example, it implemented emerging methods of mass transit, including the first/last mile solutions like e-scooter share service and the NextCCBus real-time information system with mobile apps. The City is also in the process of implementing the Move Culver City transit lane pilot along three key corridors (Spring 2021) and planning on the future microtransit pilot, an upcoming bike share service, and a signal prioritization system for buses to reduce delay. The City also completed a transit signal priority project to reduce travel time and increase ridership.

Examples of mobility services that Culver City does not currently offer, or could be improved, which may benefit the community include digital-twin infrastructure choices, enabling better access for trip-planning and wayfinding for service appointments. In addition to multimodal trip planning, a Transit Demand Management (TDM) program could improve the productivity of resources (less parking) and better access to transit choices (bus, bike, and walk).

ELECTRIFICATION

The City has a few initiatives supporting electric mobility options in the city. The City has been rolling out electric vehicle (EV) charging stations in certain locations in the city. Electrification enables a wide range of smaller, lighter-weight motorized cars for people to use, including e-scooters and e-bikes. Electric bikes and e-scooters also expand the active transportation network and support less-mobile members of the community. These options can be safe if their users conform to traffic rules, such as yielding to pedestrians. Using information technology, community members can share such vehicles instead of owning one, further reducing their costs. Also, as autonomous capabilities improve, trikes and small delivery vehicles can safely deliver goods and vehicles wherever they are needed.

Supporting the effort to reduce air pollution caused by vehicles, the City received a Southern California Association of Governments grant in 2019 to prepare the City's first Electric Vehicle Infrastructure Plan (EV Plan). The EV Plan will foster the transition from fossil-fuel-powered vehicles to electric by recommending incentives to encourage their acquisition and developing the infrastructure necessary to support them. The EV Plan will be completed in late-2022 and will focus

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[63] The Taskar Center for Accessible Technology (TCAT). (n.d.). *OpenSidewalks.* Accessed June 1, 2020. http://www.opensidewalks.com/

on finding potential EV Charging Station sites in multi-family dwellings, commercial properties, and public/private parking facilities.

The Air Quality Management District requires the City to transition to an all-electric bus fleet by 2040. However, the City hired a consultant to collaborate with staff by 2028, 12 years ahead of the deadline. Also, in 2020, the City completed an intelligent traffic signal timing project at 105 intersections that automatically adapts to traffic volumes along 12 major corridors.

Examples of electric mobility that Culver City does not currently offer, or could be improved, which may benefit the community, include vehicle-to-grid (v2g) battery charging and peak-demand-response services. Urban fleets, such as school buses, have large batteries to improve community grid services and resilience.

SHARED MOBILITY

Culver City has been experimenting with shared e-bicycle, e-scooter, and vehicle programs.[64] In its first phase, Culver City piloted e-scooter share services with Bird and Lime, which concluded in March 2020. The City started the second phase of the e-scooter pilot in August 2020, adding Wheels, Bolt, JUMP, Lyft, Sherpa, and Spin. Through this pilot program, the City collected data and public feedback to inform comprehensive regulations for scooter sharing. Car share systems like Zipcar and rideshare/ride-hailing services like Uber and Lyft enable users to meet their needs with fewer personally owned cars. All three services are experimenting with electric vehicles, and some municipalities, including LA, may require electric vehicles in the future.[65] An example of shared mobility that Culver City does not currently offer, or could be improved, which may benefit the community, is improved integration with rideshare services (community carshare paid by rideshare trip-pooling).

CURB MANAGEMENT

Curb management refers to how cities manage the needs of different modes of transportation at the curbside. The goal is to minimize conflicts between rideshare services, freight, and e-commerce companies picking up and delivering goods.[66] The continued demand for online shopping accelerated by the COVID-19 crisis creates a challenge for the last 50 feet of delivery, i.e., curb management of delivery trucks. Delivery trucks park illegally 25% of the time[67], blocking traffic and causing hazards and delays. Various options to address this problem are emerging in the market, including bicycle delivery, small robotic delivery vehicles, and drones (**Figure 14**). These systems

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[64] See the Mobility and Transportation Existing Conditions Report for more information on the City's mobility services.

[65] InsideClimate News. December 27, 2019. *Electric Vehicles for Uber and Lyft? Los Angeles Might Require It, Mayor Says.* https://insideclimatenews.org/news/27122019/all-electric-vehicles-uber-and-lyft-los-angeles-mayor-says-city-may-require-evs

[66] See the Mobility and Transportation Existing Conditions Report for further details on the City's curb management.

[67] Transportation Research Record Journal of Transportation Research Board. January 2005. TRR_1906_2005_Han_Chin_Franzese_Hwang.pdf

will need spaces designed for package delivery. Increased demands for drop-off/pick-up activities also adversely impact bikeways' operational and safety conditions, including bike lanes.

The City could consider how to plan for these emerging delivery solutions in their curb management strategies as they start to deploy in years to come, including opportunities for data collection to accommodate all road users better. Examples of smart curb management that Culver City does not currently offer or could be improved, which may benefit the community, include door-to-door wayfinding for eldercare appointments and home care delivery.

Figure 14 Examples of Urban Delivery Vehicles

Sources: Starship, https://www.starship.xyz; UPS 2019, https://www.wearethecyclists.com/blog/ups-tests-electric-cargo-bike-delivery/; Amazon 2017, https://www.theatlantic.com/news/archive/2016/07/amazon-drone-delivery/493055/

PARKING

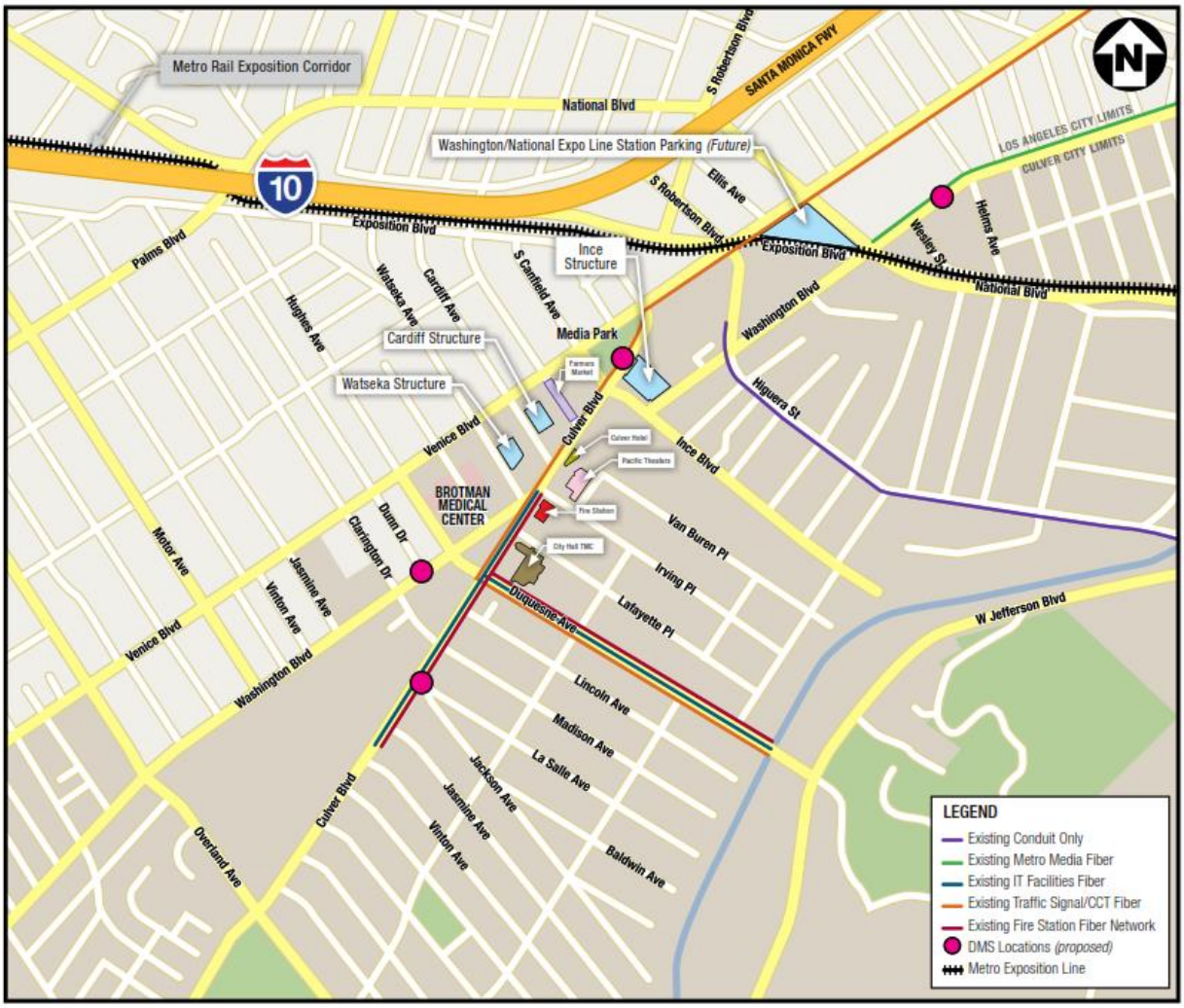
A variety of off- and on-street parking is available in Culver City. The City operates four public parking structures (1,669 spaces total) with automated payment systems and approximately 2,059 on-street single-space parking meters and 16-multi-space pay stations. There are also three valet parking service stations in Downtown Culver City.

The parking meters are connected using second-generation wireless (2G), allowing them to be remotely managed and for customers to use their credit cards. As second-generation wireless technology is phased out, the City will either need to update these meters to run on third or fourth-generation technology or replace them with something else. Updating the meters' technology will be costly, but many benefits balance or outweigh the initial costs.[68]

The City completed an Advanced Parking Information System project with real-time signage that identifies the number of available parking spaces in the individual public parking structures. This assists in relieving congestion caused by cars circulating in search of parking, particularly in the Downtown area (**Figure 15**).

[68] Sightline. *Portland now has the smartest parking policies in the northwest.* Https://www.sightline.org/2018/08/13/portland-smartest-parking-policy-in-america/

Figure 15 Real-Time Parking Information Map



Source: City of Culver City Public Works Department, 2021

The application of intelligent transportation systems for transportation and parking also has positive economic effects. For example, a traveler/delivery can choose a route by checking information on signal operation, incident management, and congestion level to minimize delays and increase productivity.

Culver City has begun to study dynamic parking pricing in certain high trafficked areas. There is an opportunity for the City to consider implementing this practice in more areas of the City to manage parking effectively. Smart meters and data collection are key to a successful dynamic parking program. Also, the City could consider implementing smart underground parking solutions using multi-level lift systems and automated parking systems.

PUBLIC SAFETY

Technologies such as drones, surveillance cameras, and body cameras are becoming more common in law enforcement, firefighting, and emergency services. The Culver City Police and Fire Departments began an Unmanned Aerial Vehicles (UAV) Pilot Program in 2018 to enhance public

safety and search and rescue operations. Police and Fire use the UAVs to provide aerial support during emergencies and record these incidents to provide an added layer of transparency and accountability. The community had privacy concerns with drones, so policies and public reporting were established to address the concerns.[69]

Surveillance cameras ensure security by monitoring activities that officers do not frequent. One aspect of the Police Department's investigation process includes canvassing areas for third-party evidence, including surveillance footage.[70] Officers wear body cameras to capture interactions between themselves and others to ensure safety for both parties. The Police Department also has several automated red light running cameras at certain key intersections used for enforcement purposes. The Culver City Red Light Photo Enforcement Program was started in March 1999. It became fully operational in January 2000. The Police Department states on the project web page that the red light cameras have been shown to reduce red light violations substantially.[71] Some jurisdictions, including San Jose and San Francisco, are currently underway to establish legislation on the state level for automated speed enforcement to enhance safety conditions with minimal staff resources.[72]

Smart public safety interventions that Culver City does not currently offer or could be improved, which may benefit the community, include digital infrastructure to improve transit safety and shelter security. "Always-ON" hotspots enable improved monitoring and community access to security services. Secure digital infrastructure allows equitable access to food security and mental health services.

ECONOMIC DEVELOPMENT

Along with most businesses globally, businesses in Culver City have been affected by the COVID-19 pandemic. The City has been working with the business community on staying open, serving the community, and doing so safely. This has been done primarily through an Economic Recovery Task Force managed by the City and made up of about 60-70 local businesses.

During the pandemic, one of the accommodations for businesses is outdoor dining and the adjacent bus/bike lane. The City's Public Works Department worked with GPS providers not to direct traffic towards the Culver Boulevard bus/bike lane and notified the public of inoperable smart meters due to the outdoor dining facilities being in the public right-of-way.

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[69] City of Culver City. N.d. Unmanned Aerial Vehicle (UAV) Pilot Program. Accessed January 6, 2021. https://www.culvercitypd.org/Bureau-Information/Operations-Bureau/Unmanned-Aerial-Vehicle-UAV-Pilot-Program

[70] City of Culver City. N.d. Compliant Reporting Procedure. Accessed January 6, 2021. https://www.culvercitypd.org/Bureau-Information/Administration-Bureau/Complaint-Reporting-Procedure

[71] City of Culver City. N.d. Photo Enforcement. Accessed February 23, 2021. https://www.culvercitypd.org/Bureau-Information/Operations-Bureau/Photo-Enforcement

[72] The Mercury News. June 25, 2019. Speed cameras may be on the table again for San Jose and San Francisco. Accessed February 23, 2021. https://www.mercurynews.com/2019/06/25/speed-cameras-may-be-on-table-again-for-san-jose-and-san-francisco/

At the same time, an influx of information service and tech industry companies are already in or moving into Culver City. Partnerships with such companies offer opportunities to support the community, i.e., using technology and information solutions to help businesses reopen safely, communicate vital public health information, and otherwise connect the community. West Hollywood's "WeHo SMART" initiative shows how this could work through a graphic novel. It illustrates how residents plan their route to a new business, visitors plan their day exploring the city, and local business caters to the community (**Figure 16**). The City also has an opportunity to partner with local artists and designers to make smart interventions fun, easier to use, accessible, and tied to Culver City's history as one filled with the arts.

Another benefit of adopting smart city practices is that future businesses will be attracted to a city that makes it easy for people to get around and access their services. A smart city should create excitement for the private sector, whether it is through investment, partnership, or location.

Figure 16 WeHo Smart City Graphic Novel

Source: City of West Hollywood. 2020. Smart City Graphic Novel. Accessed December 24, 2020. http://wehosmartcity.org/wp-content/uploads/2018/04/WeHo-Smart-City-Graphic-Novel.pdf