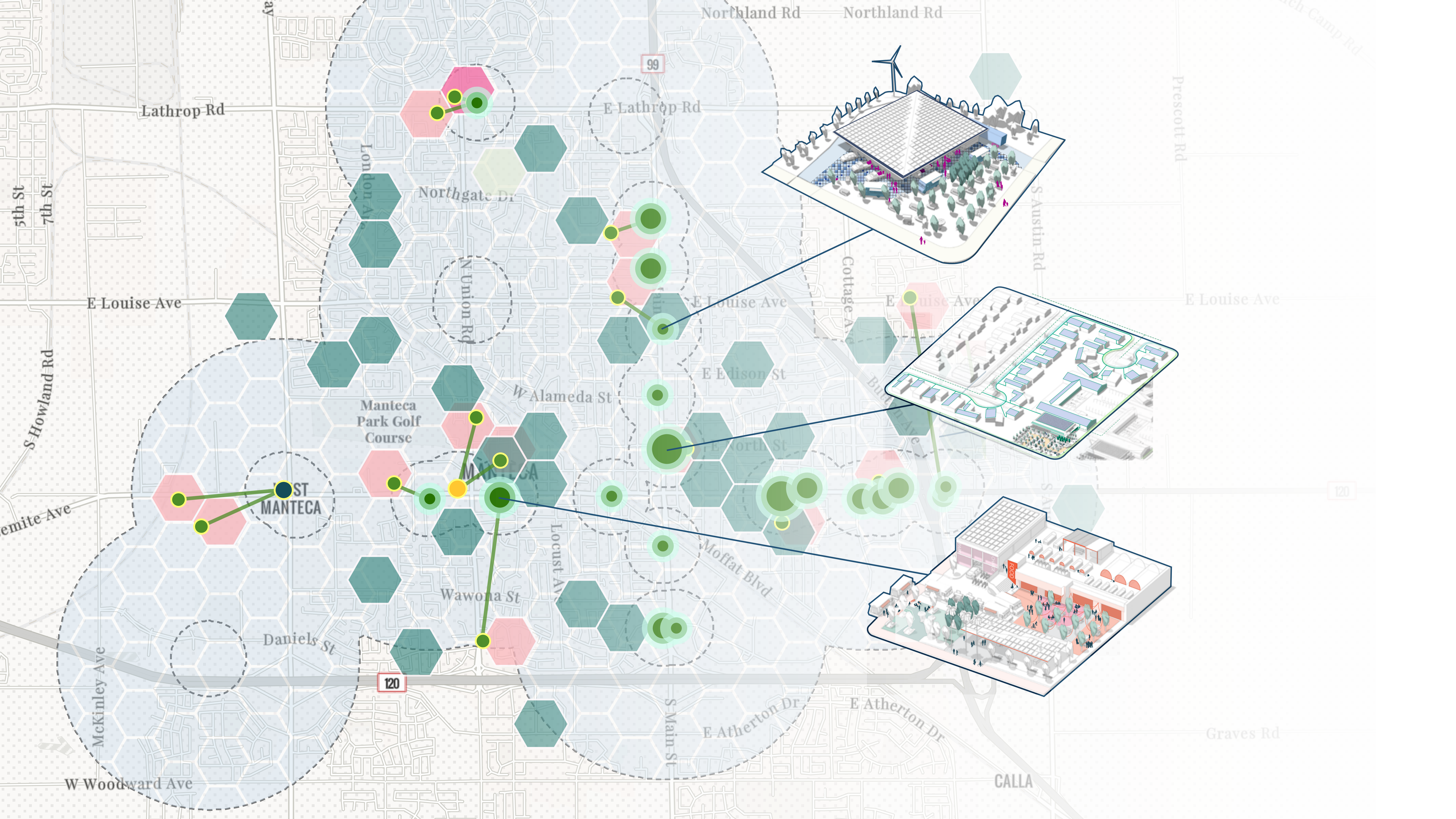
2020 Fall Innovation Incubator

Fuel the Future

A HOLISTIC AND INCREMENTAL APPROACH FOR GAS STATION ADAPTATION

Perkins&Will

Yao Lu, Oblio Jenkins


Northland Rd
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Prescott Rd
5th St
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London Ave
Northgate Dr
N Union Rd
E Louise Ave
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E Louise Ave
Cottage Ave
S Austin Rd
S Howland Rd
E Edison St
W Alameda St
Manteca Park Golf Course
E North St
MANTECA
MANTECA
Locust Ave
Moffat Blvd
Wawona St
Daniels St
McKinley Ave
120
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E Atherton Dr
E Atherton Dr
S Main St
Graves Rd
W Woodward Ave
CALLA

Abstract

This research project proposes a Framework and Toolkit to create a holistic, incremental approach to gas station adaptation & transformation.

Given the current policy timeline of phasing out production of combustable-engine vehicles by 2035 in California and transition to a carbon-free economy nation-wide by 2050, the adaptation scenarios focus on tangible strategies for a near-term transformation, with an eye towards addressing longer-term needs for the communities they serve. These adaptation scenarios explores potential solutions to last mile delivery, resilience of energy system, equal access to goods and services.

This Framework and Toolkit looks at two scales; the city and individual gas station. At the city scale we consider gas station sites as key components of a larger ecosystem of land uses and transportation network. This research project has developed a Spatial Analysis Tool that automates the analysis process to help understand adaptation potentials of each site. At the site and building scale, we consider design interventions that both gradually change and quickly change their appearances and functions within the urban landscape.

Our aspiration is for this Framework and Toolkit to be the baseline research that becomes a catalyst for:

- Internal Perkins&Will discussions and further research on this timely subject;
- Initial dialogue with municipalities, NGOs, business leaders, and developers;
- Conversations with individual owners that show them a vision of a feasible future.

Key words: **Gas Station, Site & Building Adaptation, Spatial Analysis, Climate Change, Renewable Energy, New Mobility, Kit of Parts, Modular Design Thinking, Infrastructure, Carbon Free Economy**

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CLOSED
THIS SALE
GALLONS
ESSO
ESSO EXTRA
CONTAINS LEAD

BACKGROUND & OBJECTIVES

POLICY DRIVERS

TIMELINE

CALIFORNIA

Removal of single wall UST

Achieve 1.5M zero-emission vehicles

2025

2030

NATION-WIDE

A carbon pollution-free power sector

CALIFORNIA

All in-state sales of new passenger cars and trucks are zero-emission

- General Motors announced that it would stop selling vehicles with tailpipe emissions by 2035

2035

2040

CALIFORNIA

All operations of medium- & heavy-duty vehicles shall be 100% zero emission

2045

NATION-WIDE

Net zero economy

NET 0

CO_2

2050

Biden says that his plan “will make the largest-ever investment in clean energy research and innovation,” at an estimated cost of $400 billion over 10 years.

Problem Statement

This research is based on many urban and technological trends but was crystallized after an encounter we had with a gas and service station owner in 2020. The owner needs to replace his single walled storage tanks by 2025 per CA Water Board mandate. It is an expensive endeavor but most importantly — he is unsure what his next business model will be. Should he install gas tanks, add electric charging capacity, or both? His future is so unclear that he is looking to sell his station if he cannot identify a future-proof business strategy.

In California alone, there are still many owners and operators that need to replace their single wall storage tanks by 2025 per state mandate. These costs can reach upwards of $600,000 for removal and replacement. Based on our correspondence with an Engineering Geologist at the State Water Resources Control Board, there are 2,000 plus individual tanks that need to be replaced in CA by 2025.

The questions we investigate are:

1. What can be done between now and 2035, and before 2050?

Gas stations can be phased out as early as 2035. Technological innovations and policy changes may not be quick enough to provide a universal and affordable solution for existing sites. Not all sites are ready for a complete redevelopment. What decisions can owners make that is implementable and tangible ***now***? What adaptations are achievable within a realistic time frame with a reasonable amount of resources?

2. What approach can help individual owners, municipalities, communities, and organizations to understand the adaptation opportunities of gas station sites?

Given the magnitude of the scope, the issue of transforming gas station goes beyond what individual owners can tackle. There should be a ***partnership*** between the private and public sector. This partnership needs to consider the feasibility of adapting a single site and the collective benefit of adapting multiple sites across a region. What tools and processes can support decision making in this partnership?

Objectives

Analyze regional/city scale opportunities

Create a holistic, incremental

Explore sequence of changes and scalable approaches

approach for adaptation & transformation between now and 2050.

THE TRENDS

TAKEAWAYS

VISIONS FROM OTHERS

- Transform into electric vehicle charging stations; use architectural design expressions to celebrate these sites as new icons.
- Complete redevelopment into housing, open space, social infrastructure, and etc.; establish typologies and assign potential uses.
- Tap into future technology and innovations.

LESSONS LEARNED FROM THESE VISIONS

- **Transformation and Adaptation strategies need to consider local community needs.** (i.e. housing, public space). A quantitative, typology-based approach needs to be combined with a qualitative one.
- **There needs to be a clear plan for a realistic business model** that can transition from fossil fuel to electric charging for sole proprietors. There is few vision discussing the process of transition, especially when the existing operation needs to be maintained while other uses and programs are being tested on the site.
- **There needs to be a tool that assess the nuances and site specific attributes.** Rather than assigning potential uses, strategies or typologies, the trade-offs among different uses should be discussed based on specific site and market conditions.
- **Strategies need to be realistic and not based on what if.** Strategies should not be heavily relied on future innovations or technologies that are not yet made affordable.

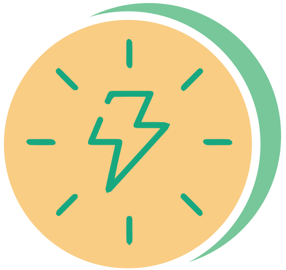

ACCURATE DELIVERY FROM 5GPM TO FULL FLOW AT ANY PRESSURE
THIS
SALE
Gulf
GALLONS
PRICE INCLUDING TAX

FRAMEWORK & APPROACHES

Adaptation Scenarios

MOBILITY SCENARIO

- Support Last Mile Delivery



ENERGY SCENARIO

- Phase 1: Provide Electric Vehicle (EV) Charging Stations
- Phase 2: Support a Clean Energy Microgrid

COMMUNITY SCENARIO

- Phase 1: Catalyze Service & Activity Clusters
- Phase 2: Complete Redevelopment

MOBILITY SCENARIO:

› Support Last Mile Delivery

Existing Gas Stations

Adapted Gas Station Supporting Last Mile Delivery

The Site

- Store and distribute last-mile freight cargo
- Support independent/small businesses
- Support delivery agents traveling using different modes of transportation
- Promote all electric fleet; charge e-bicycles, and e-scooters
- Provide space for social encounters

GOALS ACHIEVED

BETTER CONNECTED

SUSTAINABLE

HEALTHIER

MOBILITY SCENARIO:

› Support Last Mile Delivery

WHY LAST MILE DELIVERY

- Reduce the number of freight delivery trucks on urban streets for environmental, traffic and safety reasons.
- Lower last-mile delivery costs for small businesses.
- Allow participation in last mile delivery for e-cargo-bikes and other micromobility devices.
- Leverage route optimization platforms which makes deliveries more efficient and flexible, attracting more participants.

WHY GAS STATIONS

- Most sites have easy access to the highway and are accessible from freight routes.
- Some sites are located at the edge of commercial corridors or main arterial roads and are within the "last mile" distance to the recipients.
- The existing site design typically optimizes ease of vehicular turning and maneuvering.

LAST MILE DELIVERY

COMPRISES

53%[1]

OF OVERALL SHIPPING COSTS

IS BOTH THE MOST EXPENSIVE AND TIME-CONSUMING PART OF SHIPPING PROCESS

ENERGY SCENARIO:

- › Provide EV Charging Stations
- › Support a Clean Energy Microgrid

Existing Gas Stations

Adapted Gas Station Providing EV Charging

Adapted Gas Station Supporting Clean-Energy Microgrid*

* Concurrent to this, legislation changes are needed to support private microgrid development.

Phase 1

- DC Fast Charging for electric vehicles (EV) at a lower cost
- Vehicle maintenance services

Phase 2

- Energy storage
- Generate solar energy through rooftop Photovoltaic (PV)

Other Properties on the Microgrid

- Generate solar energy through rooftop PV
- Critical facilities and essential businesses leverage the grid resource during an emergency event
- Homes and businesses receive an energy bill reduction

GOALS ACHIEVED

BETTER CONNECTED

SUSTAINABLE

RESILIENT

EQUITABLE

HEALTHIER

ENERGY SCENARIO:

› Provide EV Charging Stations
› Support a Clean-Energy Microgrid

WHY ELECTRIC VEHICLE CHARGING STATION

- Support California's growing zero-emission vehicle (ZEV) refueling needs.
- Serve long-distance drivers and those who do not have access to chargers at home or work.
- Provide DC Fast Charging, which requires more power and more expensive and higher maintenance equipment.

WHY CLEAN-ENERGY MICROGRID

- Increase the resilience of the power grid by adding redundancy in the event of a large system outage.
- Meet increasing energy demand from the electrified transportation sector.
- Serve critical facilities (i.e. hospitals, nursing homes, fire stations, water pumps) on the microgrid during system outages.
- Leverage surrounding properties' rooftop photovoltaic (PV) capacity to generate clean energy.

WHY GAS STATIONS

- Gas stations are located at major junctions and frequently traveled routes.
- Located in a variety of places, some gas stations are adjacent to critical facilities.
- Incorporate EV charging in microgrids helps maintain mobility in an extreme event[2].

2021 TEXAS ENERGY CRISIS

The entire design of the system is based on short-run prices – not reliability[3].

COMMUNITY SCENARIO:

› Catalyze Service & Activity Clusters

› Complete Redevelopment

Existing Gas Stations

Adapted Gas Station Catalyze Service & Activity Clusters

The Site

- Adopt temporary and/or permanent commercial and community programs
- Compact vehicle storage
- DC Fast Charging for electric vehicles (EV) at a lower cost

Other Properties Nearby

- Public uses benefit from transportation services provided
- Other businesses leverage foot traffic generated by people who are charging cars

The Cluster as a Whole

- Build on synergistic uses
- Improve pedestrian environment

Complete Redevelopment

Addressed by researches & visioning done by others

- Affordable housing
- Parks
- Mixed use development
- ...

GOALS ACHIEVED

SUSTAINABLE

HEALTHIER

BETTER CONNECTED

RESILIENT

EQUITABLE

COMMUNITY SCENARIO:

- › Catalyze Service & Activity Clusters
- › Complete Redevelopment

WHY SERVICE & ACTIVITY CLUSTERS

- Provide services for consumers waiting on charging vehicles.
- Introduce consumers to the cluster's economy.
- Make the cluster more attractive for complete redevelopment.

WHY COMPLETE REDEVELOPMENT

- Create urban development for people rather than for cars and adopt uses that have more synergy with surrounding uses.
- Capitalize on the rising land value of some locations.
- Remove any potential hazardous materials remaining on site.

WHY GAS STATIONS

- Some sites are located at places with high visibility and adjacent to other commercial land uses.
- EV charging creates a waiting period for the vehicle owners.
- Gas station sites that are in existing or emerging activity centers are an eyesore.

ADAPTATION SCENARIOS

CALIFORNIA (2025)

Removal of single wall UST

Achieve 1.5M zero-emission vehicles

NATION-WIDE (2035)

A carbon pollution-free power sector

CALIFORNIA (2035)

All in-state sales of new passenger cars and trucks are zero-emission

- General Motors announced that it would stop selling vehicles with tailpipe emissions by 2035

CALIFORNIA (2045)

All operations of medium- & heavy-duty vehicles shall be 100% zero emission

NATION-WIDE (2050)

Net zero economy

NET 0 CO_2

2025 2030 2035 2040 2045 2050

EV CHARGING

SERVICE & ACTIVITY CLUSTERS

LAST-MILE DELIVERY

CLEAN- ENERGY MICROGRID

REDEVELOPMENT

THE FRAMEWORK

Planning & Urban Design Tool:

Adaptation Opportunity Assessment

Assessment Attributes

Gas Station Locations

Spatial Data Input

Spatial Analysis Tool

Negotiate

~~Categorize~~ the level of adaptation potential of each site under each scenario

[Mobility Network
Parcel
Land Use
Zoning
Critical Facility
Low-Median Income
Household
Rooftop PV Capacity
etc.]

[A geoprocessing model that automates and documents the analysis and data management process]

[Mobility Scenario
Energy Scenario
Community Scenario]

Conceptual Architectural Model:

Physical Adaptation Strategy

Adaptation Scenario Defined

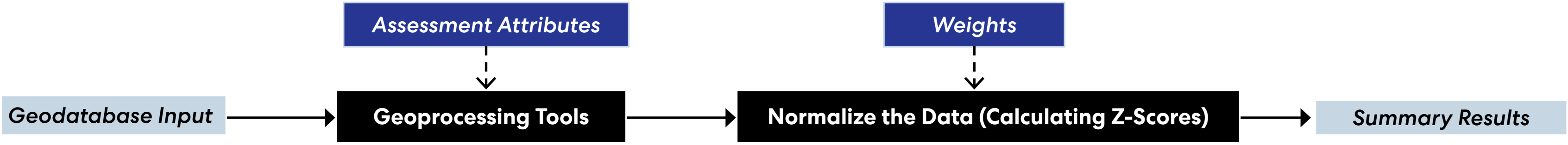
Quantify Spatial requirements for adaptation types

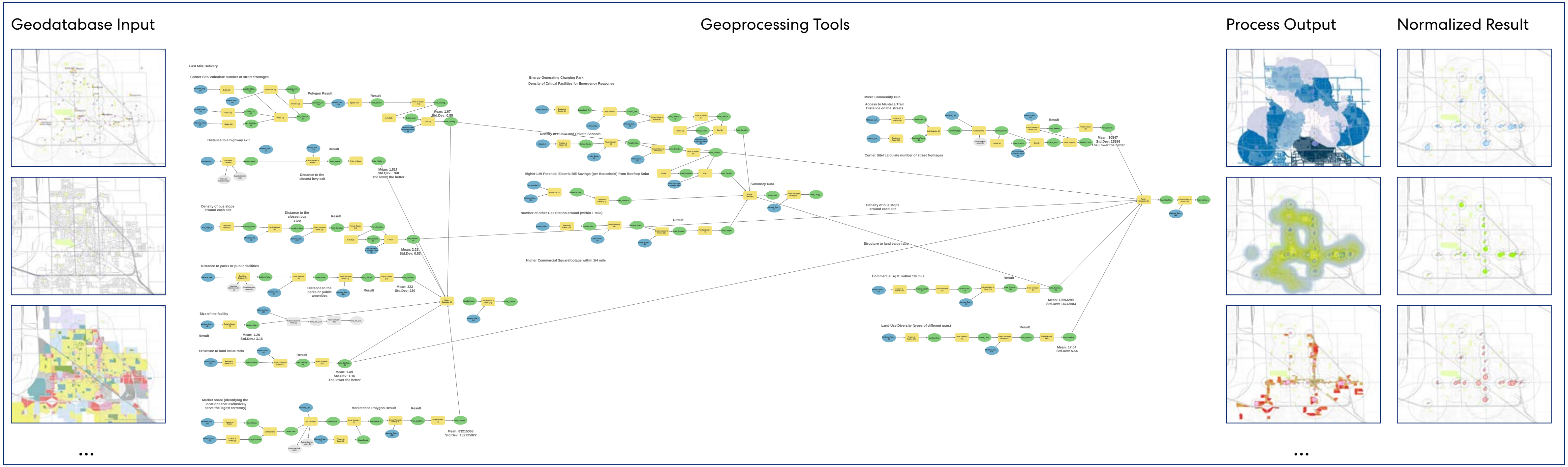
Design full potential of site for defined scenario

Design a phasing strategy to reach full potential in given timeline

Spatial Analysis Tool

The Spatial Analysis Tool is a geoprocessing model that automates and documents the analysis and data management process.



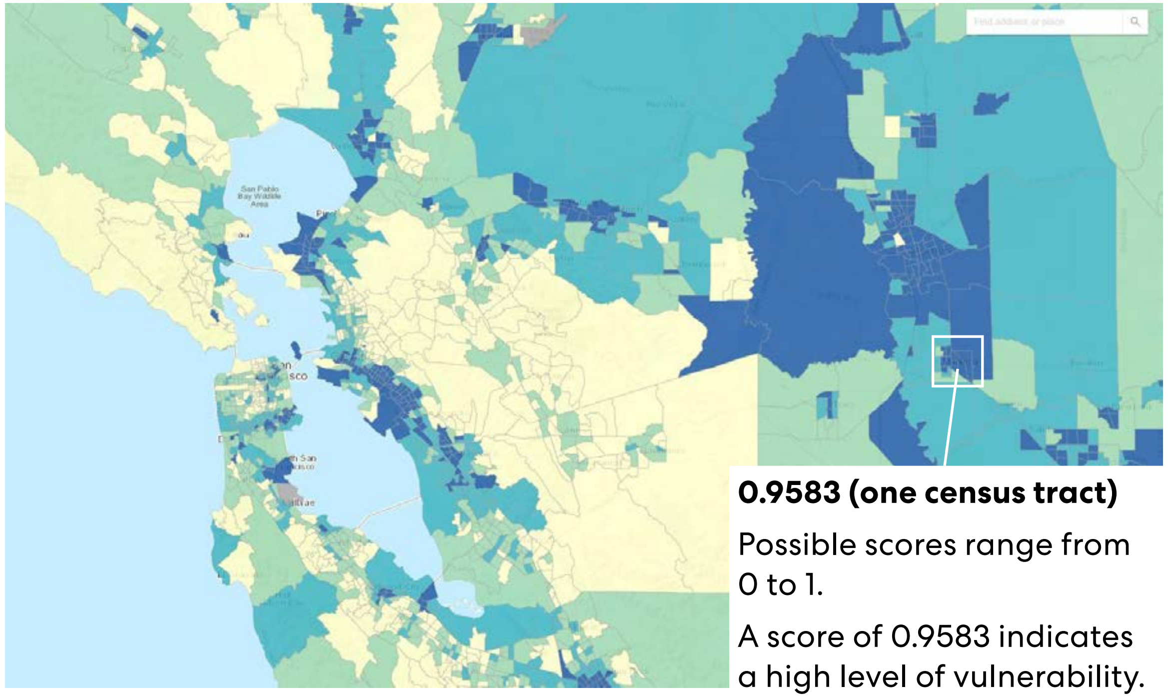



GENERAL
UNLEADED GASOLINE

CASE STUDY: MANTECA

About Manteca

CDC Social Vulnerability Index



0.9583 (one census tract)

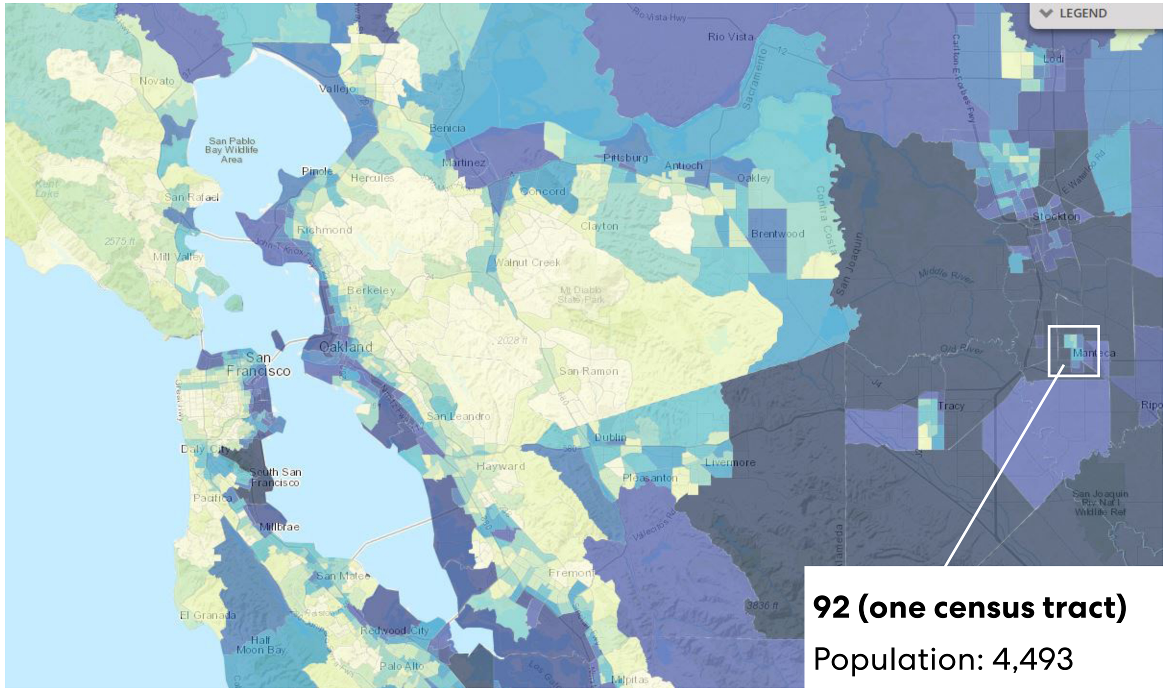
Possible scores range from 0 to 1.

A score of 0.9583 indicates a high level of vulnerability.

Overall Social Vulnerability Index

- 0.75-1 (Highest Vulnerability)
- 0.5-0.75
- 0.25-0.5
- 0-0.25 (Lowest Vulnerability)

CalEnvironScreen 3.0 - Pollution Burden



92 (one census tract)

Population: 4,493

Pollution Burden Percentile

90-100	30-40
89-90	20-30
70-80	10-20
60-70	0-10
50-60	
40-50	

About Manteca

Located at a crossroads of major highways and railroads, Manteca is a commuter bedroom community for the San Francisco Bay Area. Despite of a four-hour round trip commute, the city has attracted many families and grew over 27% in the past ten years. Mateca has a small downtown and one main commercial corridor, where gas stations, drive-through retail and strip malls lining the street. The rest of the city is predominantly single family homes and farm land.

Population:

85,878 (2020)

Race:

39% WHITE ALONE, 37% HISPANIC, 11% ASIAN ALONE, 6% BLACK ALONE

Commute to Work:

78% DRIVE ALONE, 1.5% PUBLIC TRANSPORTATION

Convenience Stores (with Gas Station):

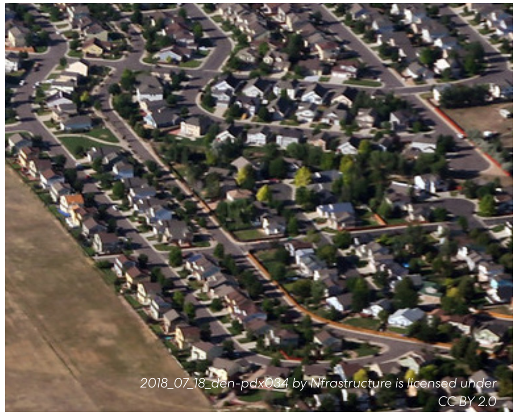
Source: US Census

https://www.census.gov/quickfacts/fact/table/berkeleycitycalifornia,mantecacitycalifornia/PST045219#PST045219

Main Street - Ferndale, California by Tony Webster is licensed under CC BY-SA 2.0

Cars, cars, and more cars by smith is licensed under CC BY 2.0

Playing Bang at the beer garden by northways is licensed under CC BY 2.0



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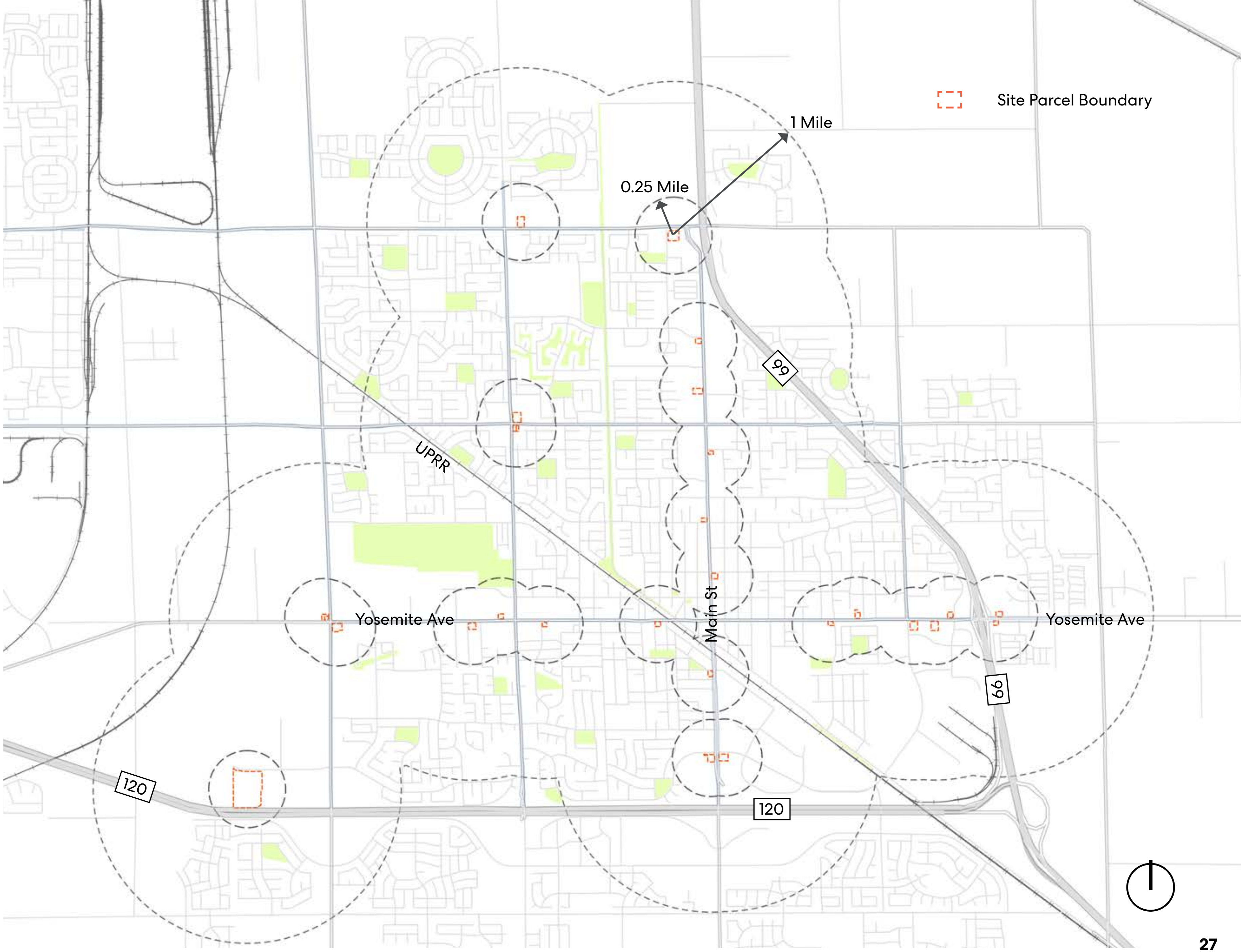
Sonic at Aramingo Crossings2 by Generic Brand Productions is licensed under CC BY-SA 2.0

Old strip mall by Clean Wal-Mart is licensed under CC BY 2.0

Study Area

There are 26 gas station sites in Manteca



Assessment Attributes

	ASSESSMENT ATTRIBUTES	SCENARIOS					
CATEGORY		MOBILITY		ENERGY		COMMUNITY	
		Weight	Notes	Weight	Notes	Weight	Notes
Transportation & Logistics	Distance to nearest highway exist	3	The smaller the distance, the easier access from highway fro long-distance trucks				
	Density of transit stops, bike routes or pedestrian infrastructure within 1/4 mile radius to the gas station sites	2	The higher the density, the easier access by multiple modes of transportation for pickups			3	The higher value, the easier the site is accessible by transit, bike, and on foot
	Distance on streets to Manteca Tidewater Trail					2	The higher the value, the higher potential to leverage foot traffic generated by this regional attraction
	Site has more than one public street access / Whether a site is a corner site at an intersection	3	Having multiple street access points can reduce truck turning and maneuvering on site			2	A corner site provides higher visibility and potential capture pedestrian traffic
Context Land Use, Zoning & Density	The amount of total commercial and residential square feet in a service-shed exclusively served by a gas station site	3	The higher the total square footage, the bigger potential market capacity of a site				
	Total commercial square footage within 1/4 mile to a gas station site			1	The higher total square footage, the higher potential to share backup energy with small businesses	3	The higher total square footage the higher potential to leverage synergistic uses (other commercial/retail uses)
	Distance from a gas station site to surrounding public parks and community assets	1	Distance should be more than 500' to minimize visual impact to the park or community asset				
	Total number of critical facilities within a 1/4-mile radius			3	The higher value, the higher potential to integrate critical facilities identified by General Plan in the mirogrid for emergency response		

Assessment Attributes

	ASSESSMENT ATTRIBUTES	SCENARIOS					
CATEGORY		MOBILITY		ENERGY		COMMUNITY	
		Weight	Notes	Weight	Notes	Weight	Notes
Context Land Use, Zoning, & Density	Total number of schools within a 1/4-mile radius			2	The higher value, the higher potential to integrate school facilities in the mirogrid for emergency response		
	Low to median income (LMI) household potential electric bill savings from rooftop pv			3	The higher value, the higher potential to provide energy bill savings to LMI household through microgrid system		
	Land use diversity					3	The higher level of land use diversity, the higher potential to create a vibrant place leveraging surrounding activities
Site Attributes	Gas Station lot size	3	The higher the lot acreage, the higher storage capacity				
	Grouping of gas station sites			1	The higher level of grouping, the higher potential to strengthen the microgrid capacity through having multiple gas station sites in the same grid for renewable energy generation, storage and distribution		
	Gas Station structure to land value ratio	3	The lower the ratio, the more likely a site can be redeveloped			3	The lower the ratio, the more likely a site can be redeveloped

Mobility Scenario

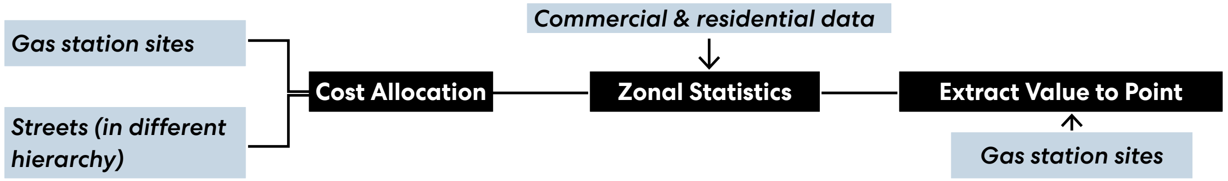
Site Assessment Attributes

Goals:

1. Prioritize site locations with **last-mile delivery cost reduction** potential.
2. Identify the opportunity to leverage **micro-mobility** to conduct last-mile delivery.
3. Identify the market potential (Service Area Capacity).
4. Identify sites that might be more feasible to be redeveloped.

	ASSESSMENT ATTRIBUTES	**SCENARIOS**	
CATEGORY		MOBILITY	
		Weight	Notes
Transportation & Logistics	Distance to nearest highway exist	3	The smaller the distance, less time spent by long-distance trucks navigating city streets
	Density of transit stops, bike routes or pedestrian infrastructure within 1/4 mile radius to the gas station sites	2	The higher the density, the easier access by multiple modes of transportation for pickups
	Site has more than one public street access / Whether a site is a corner site at an intersection	3	Having multiple street access points can reduce truck turning and maneuvering on site
Context Land Use, Zoning & Density	The amount of total commercial and residential square feet in a service-shed exclusively served by a gas station site	3	The higher the total square footage, the bigger potential market capacity of a site
	Distance from a gas station site to surrounding public parks and community assets	1	Distance should be more than 500' to minimize visual impact to the park or community asset
Site Attributes	Gas Station lot size	3	The higher the lot acreage, the higher storage capacity
	Gas Station structure to land value ratio	3	The lower the ratio, the more likely a site can be redeveloped

[Geoprocessing Example - Service Area Capacity]



Mobility Scenario: Support Last Mile Delivery

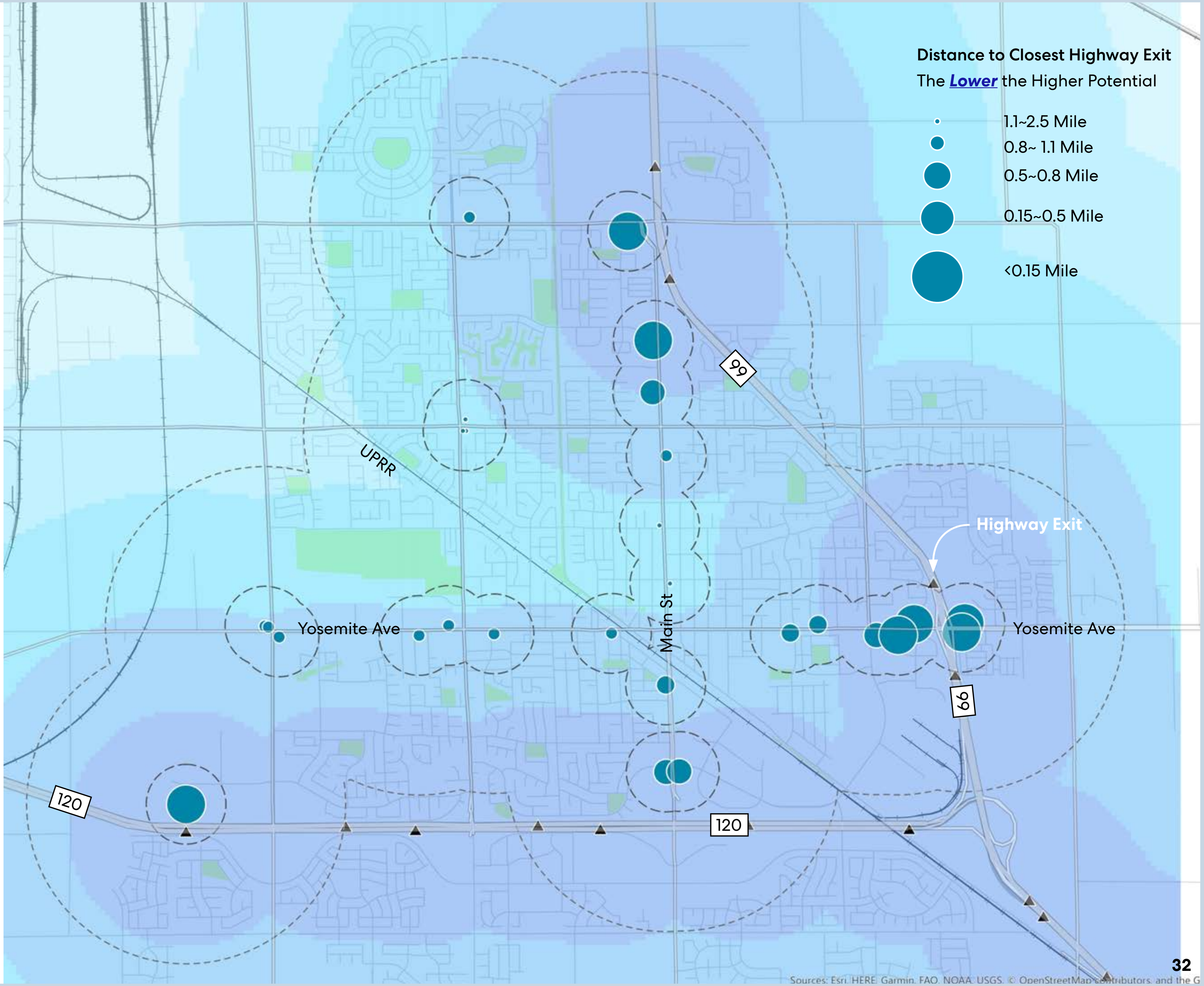
Distance to Highway Exit

Last Mile Delivery Scenarios

- **Distance to Highway Exit**
- Transit Access
- Service Area Capacity
- Site Acreage
- Structure to Land Value Ratio
- Number of Street Frontages
- Distance to Public Amenities

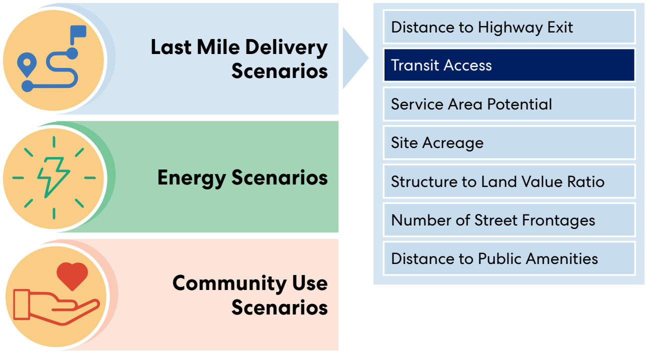
Energy Scenarios

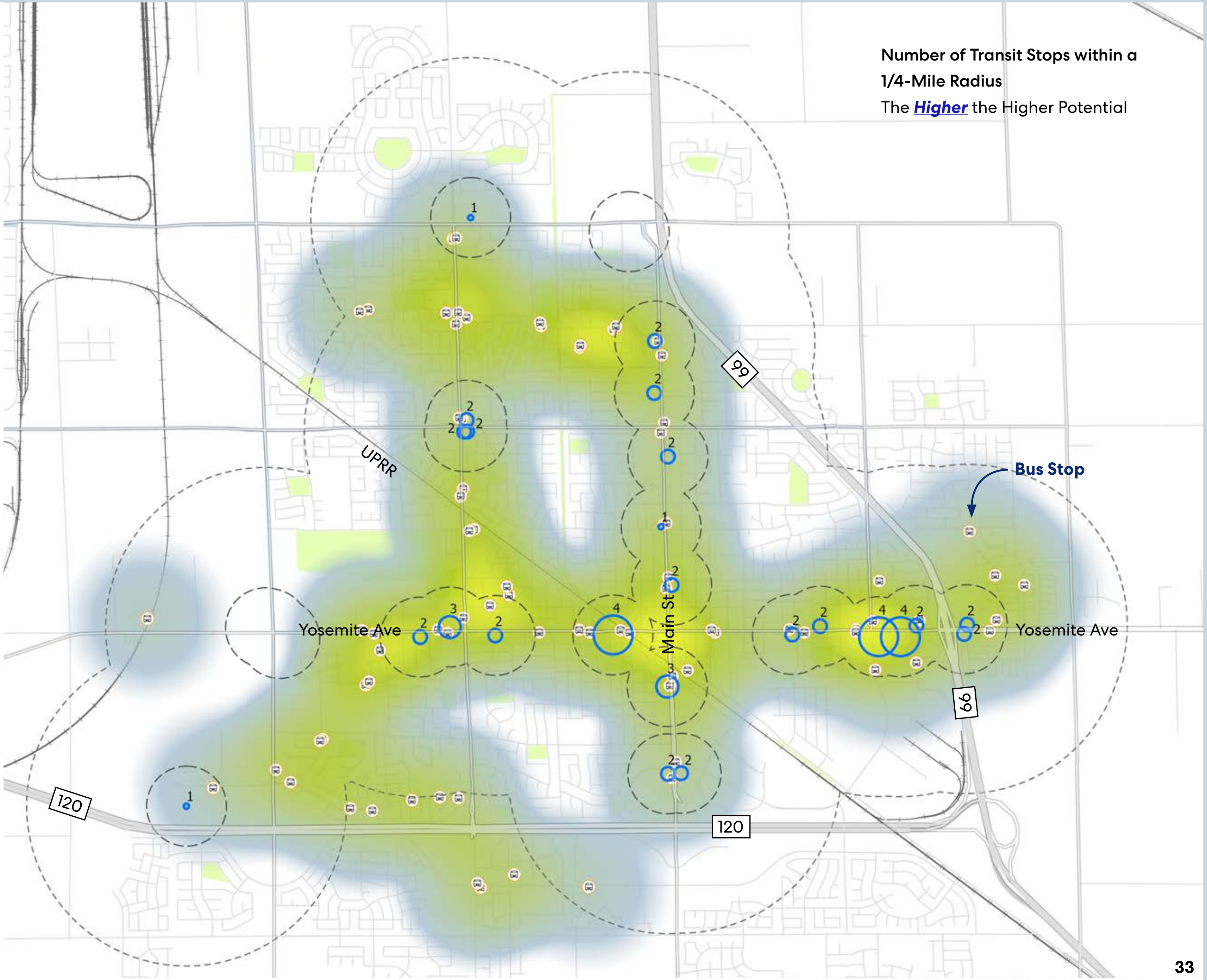
Community Use Scenarios



Mobility Scenario: Support Last Mile Delivery

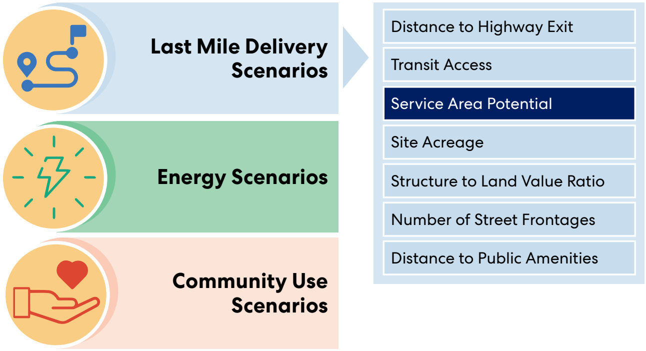
Transit Access
(Number of Bus Stops within 1/4 Mile Radius)

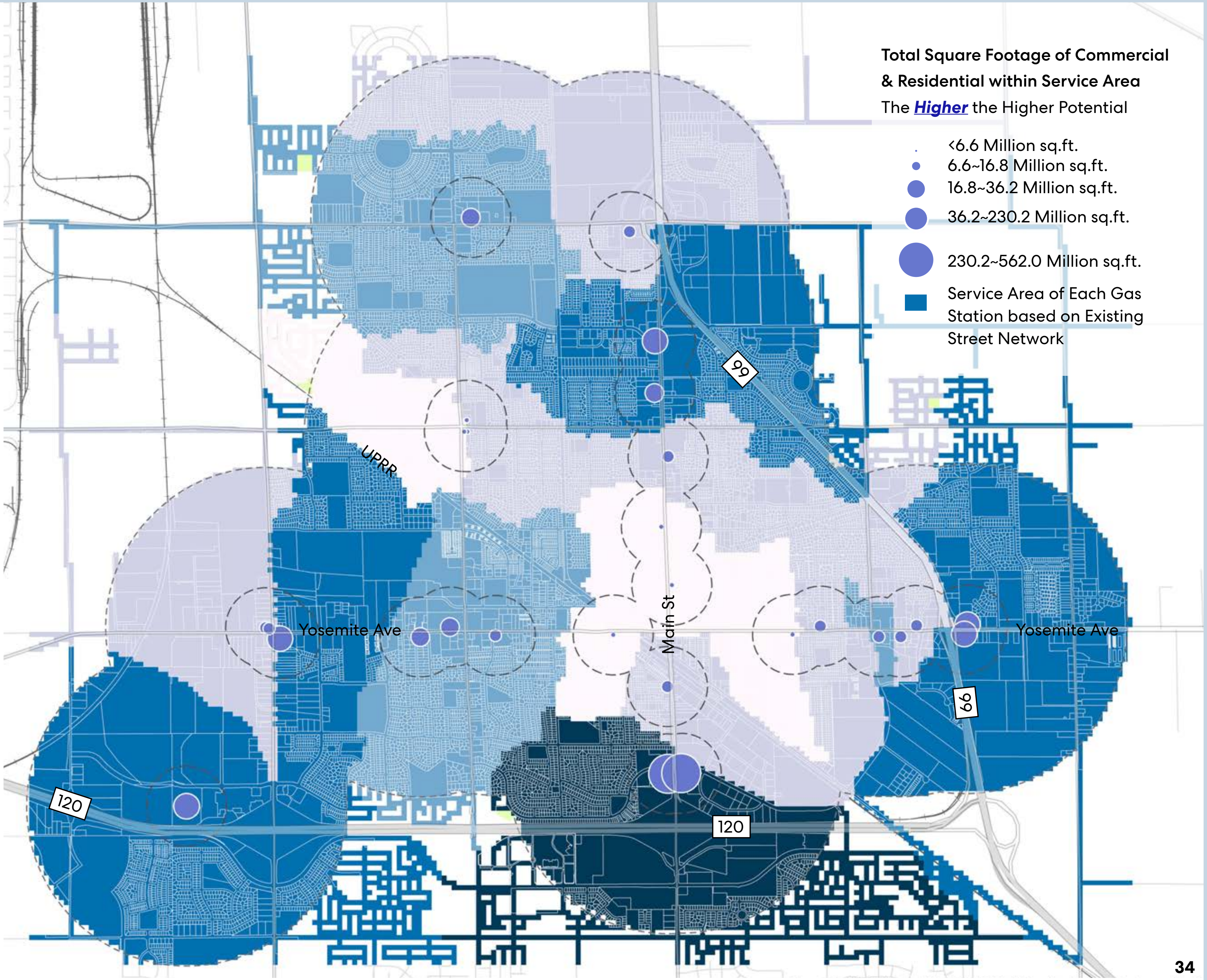




Mobility Scenario: Support Last Mile Delivery

Service Area Potential





Mobility Scenario: Support Last Mile Delivery

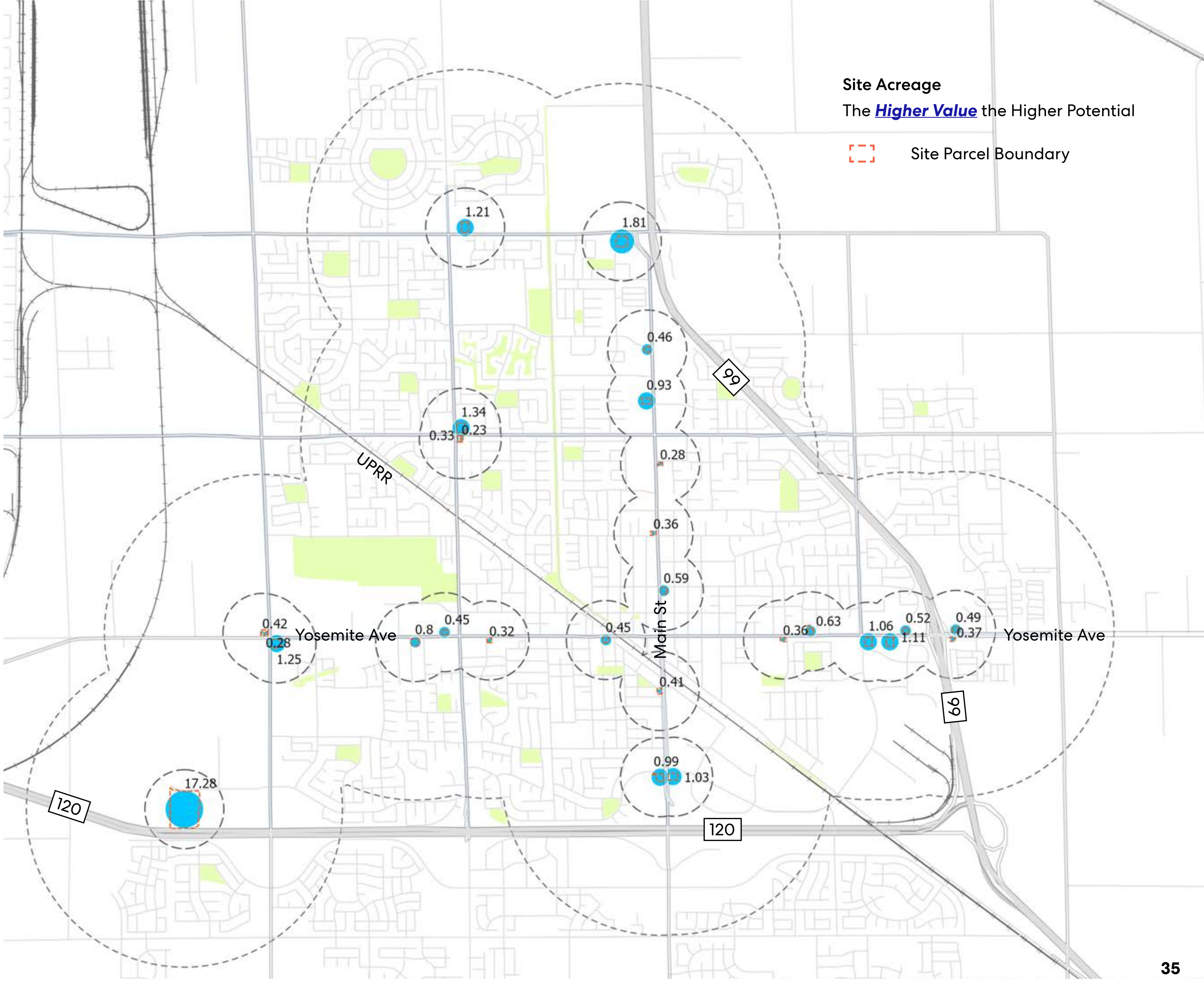
Site Acreage

Last Mile Delivery Scenarios

- Distance to Highway Exit
- Transit Access
- Service Area Potential
- **Site Acreage**
- Structure to Land Value Ratio
- Number of Street Frontages
- Distance to Public Amenities

Energy Scenarios

Community Use Scenarios



Mobility Scenario: Support Last Mile Delivery

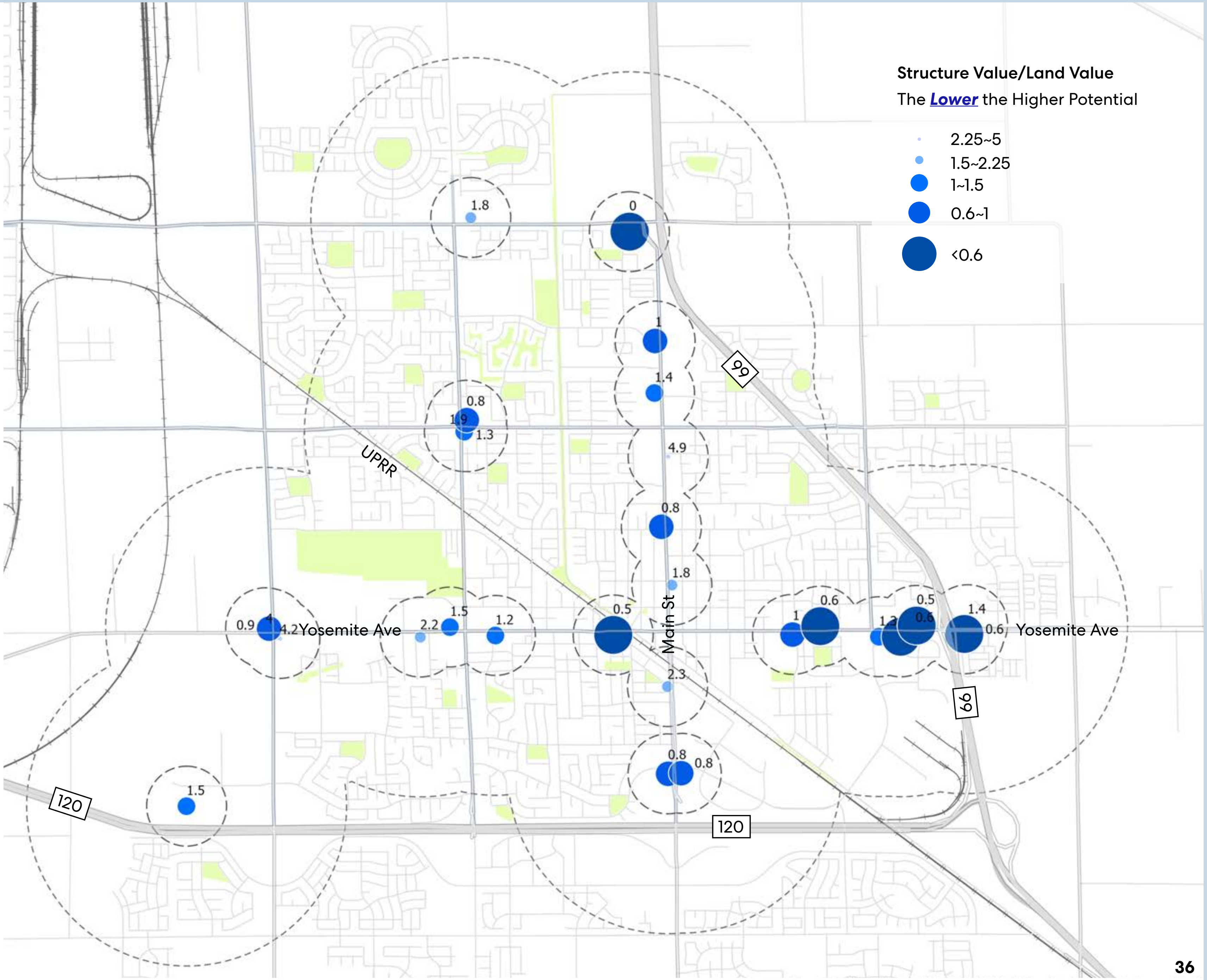
Structure/Land Ratio

Last Mile Delivery Scenarios

- Distance to Highway Exit
- Transit Access
- Service Area Potential
- Site Acreage
- **Structure to Land Value Ratio**
- Number of Street Frontages
- Distance to Public Amenities

Energy Scenarios

Community Use Scenarios



Mobility Scenario: Support Last Mile Delivery

Number of Street Frontages

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Distance to Highway Exit
- Transit Access
- Service Area Potential
- Site Acreage
- Structure to Land Value Ratio
- **Number of Street Frontages**
- Distance to Public Amenities

Mobility Scenario: Support Last Mile Delivery

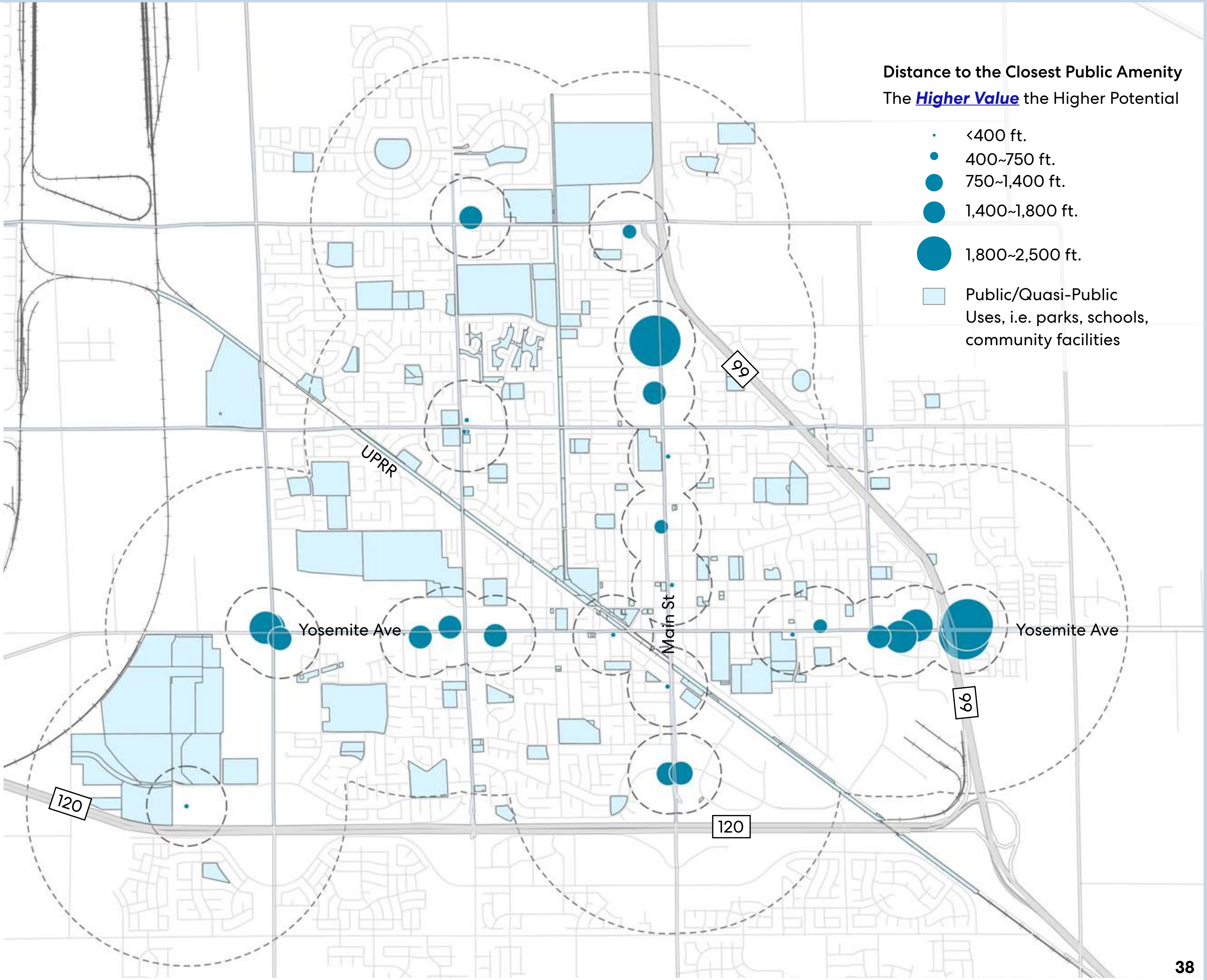
Distance to Public Amenities

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Distance to Highway Exit
- Transit Access
- Service Area Potential
- Site Acreage
- Structure to Land Value Ratio
- Number of Street Frontages
- **Distance to Public Amenities**



Mobility Scenario: Support Last Mile Delivery

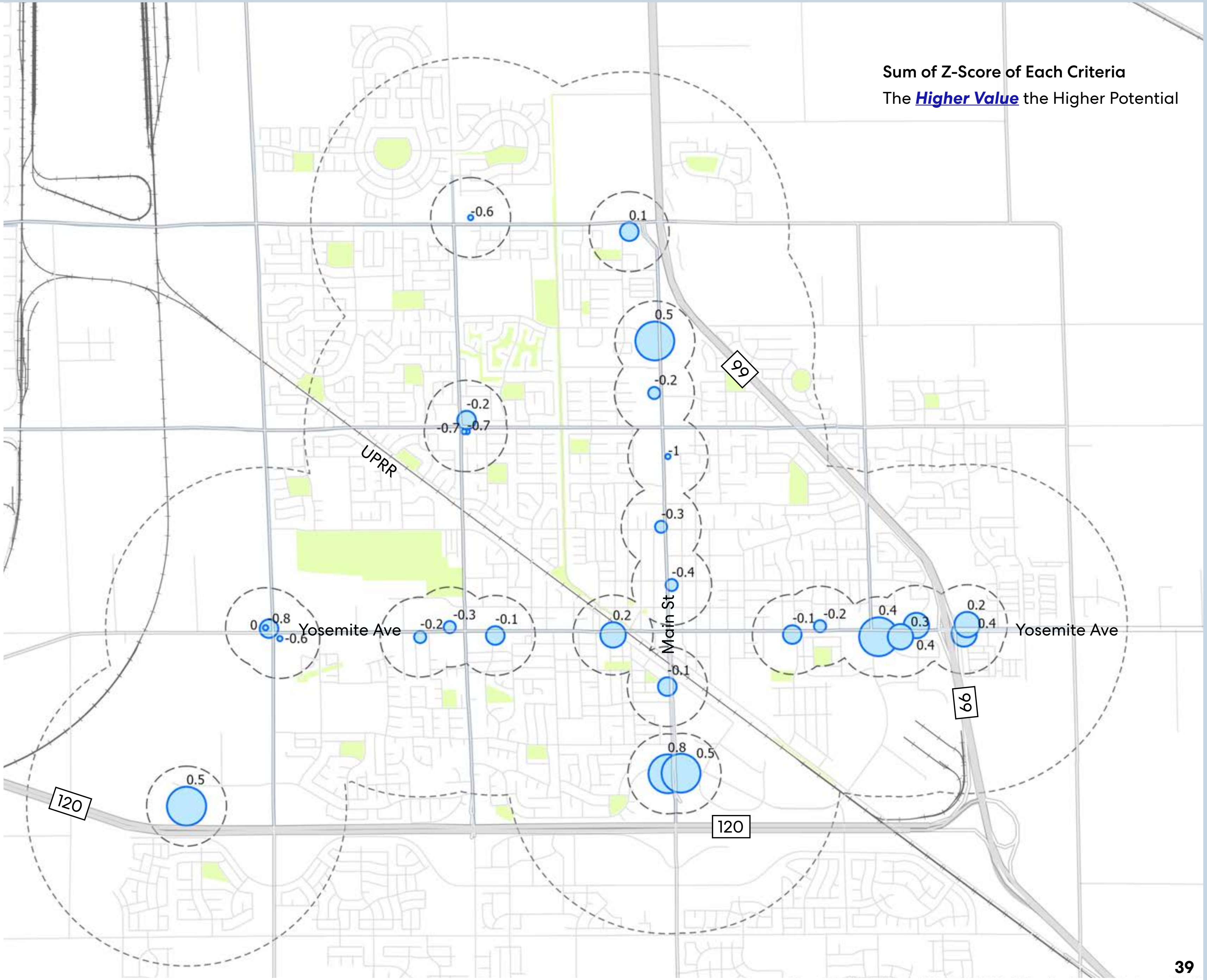
Summary of Normalized Data

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Distance to Highway Exit
- Transit Access
- Service Area Potential
- Site Acreage
- Structure to Land Value Ratio
- Number of Street Frontages
- Distance to Public Amenities

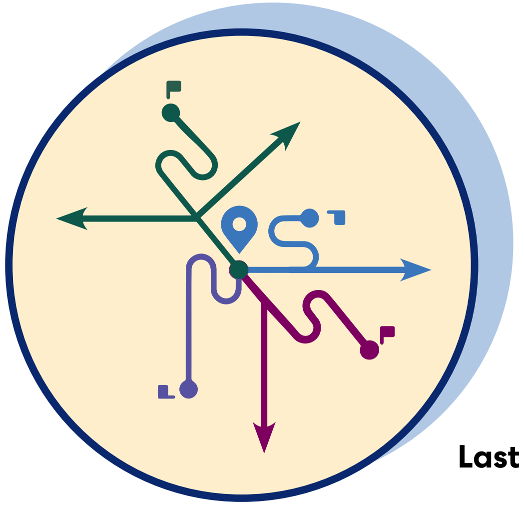


Mobility Scenario: Support Last Mile Delivery

Adaptation Strategy

Sidewalk Labs
The future of last-mile delivery has arrived … in a small Dutch city
Edited by: Eric Jaffe
Quote: Birgit Hendriks

“I was in contact with lots of entrepreneurs, small and bigger, in the city shops,” says Hendriks. “All kinds of retail, restaurants, cafes — they were all annoyed about the number of trucks and the size of the trucks in the city. Nobody enjoys walking and crossing around big trucks, and the noise and everything. That’s not a healthy, livable experience. It’s not a good environment to show to tourists. So we wanted to have a solution.”



LAST MILE DELIVERY ECOSYSTEM

Freight Carriers
Last Mile Delivery Fleet; Independent drivers
Cargo Bikes
Small Business Owners
Neighborhood Residences

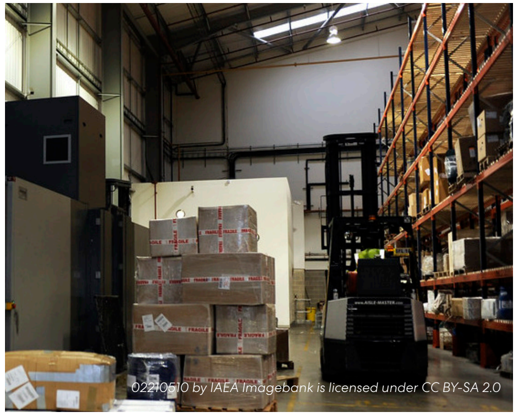

15.11.2017 NRW-Exkursion zur COP 23 - Aachen by EnergieAgentur.NRW is licensed under CC BY 2.0 (2)

Uber eats Holland by dronepicr is licensed under CC BY 2.0

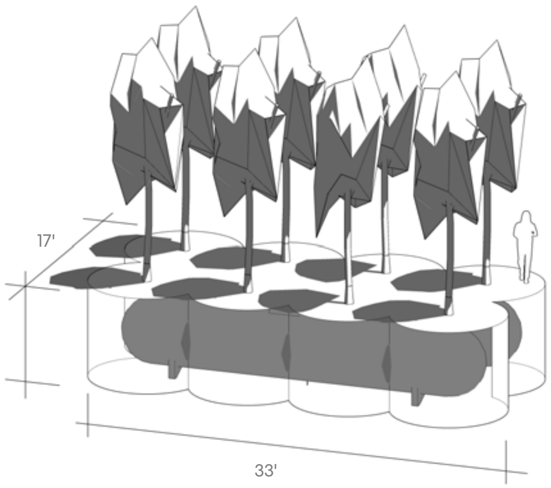

Tonno at the Beer Garden by timquijano is licensed under CC BY 2.0


2 Electric Delivery Van by www.routexl.com is licensed under CC BY 2.0


‘Old Town Goodies’ another charming cafe by shankar s. is licensed under CC BY 2.0


02210510 by IAEA Imagebank is licensed under CC BY-SA 2.0

Kit of Parts

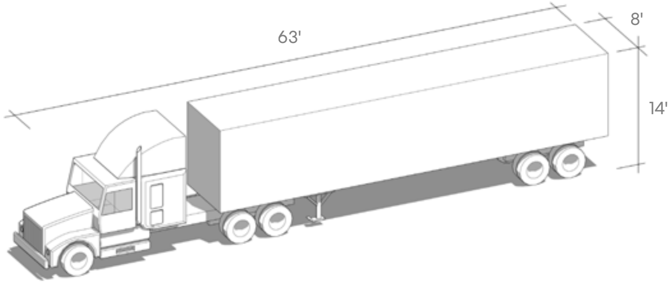


Phytoremediation Tree Cluster

• *One Phytoremediation Tree pulls out 30-40 gallons of toxic water a day*[4]

• *Approx. 350,000 viable fueling stations around the word:*

_ 8 new trees per adaptation =	2,800,000 trees
_ 24 new trees per adaptation =	8,400,000 trees
_ 32 new trees per adaptation =	11,200,000 trees



Freight Delivery

• *Electric Semi Trailers*

• *Diverse Products & Goods*

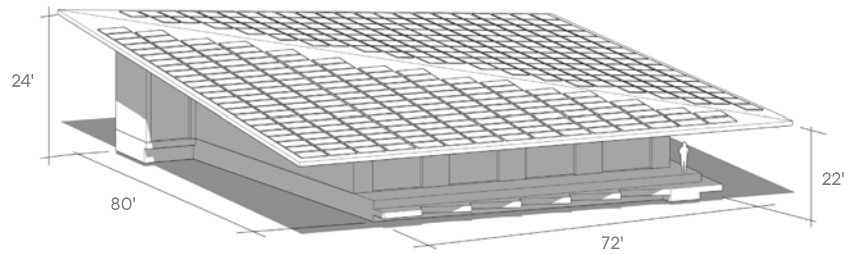
• *Established Supply Chain*

Tree Seating

• *One large tree can provide a day's supply of oxygen for up to four people*

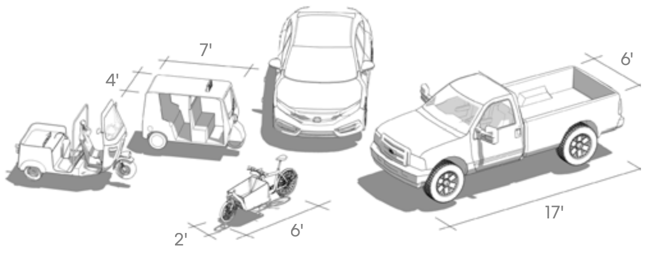
• *One tree one can absorb 48+ pounds of carbon dioxide in one year*

Kit of Parts



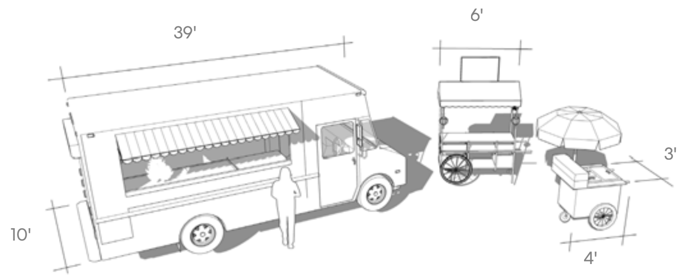
Last Mile Delivery Consolidation Center

- *Store and distribute last-mile freight / cargo*
- *Support independent / small businesses*
- *Space for social encounters*
- *Support Electric Semi Trailers*



Last Mile Delivery Fleet

- *Support independent / small businesses*
- *24-7 Delivery*
- *All Electric Fleet*

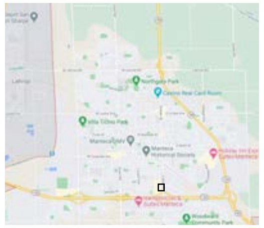


Food & Goods Vendors

- *Support small businesses*
- *Diversity of Foods and Goods*
- *Flexible organization*

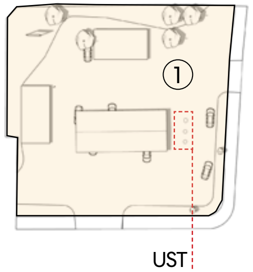
Mobility Scenario: Support Last Mile Delivery

Adaptation Sequence



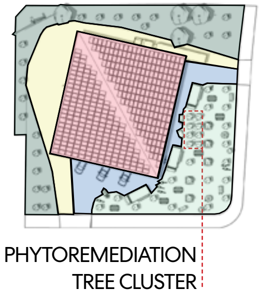
Manteca, CA

Gas Station CS_1



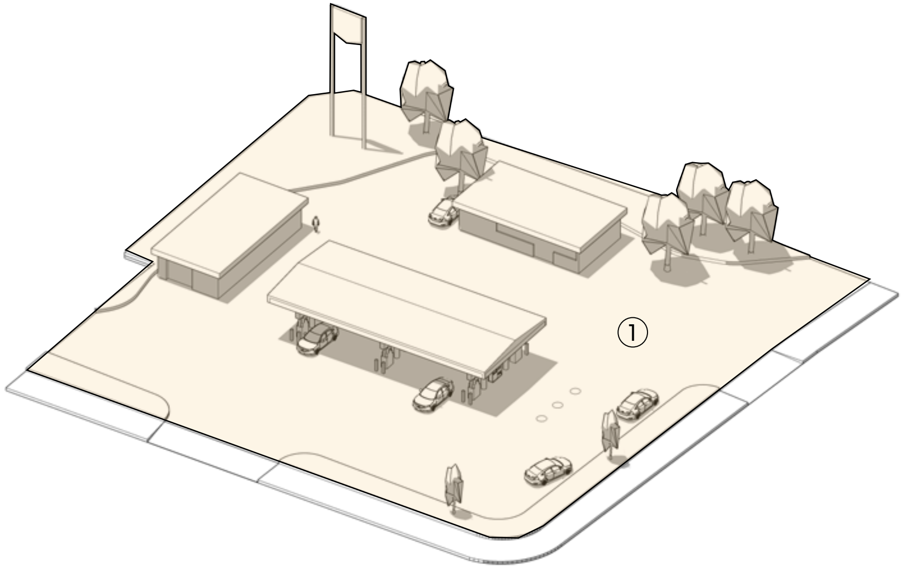
Existing Gas Station

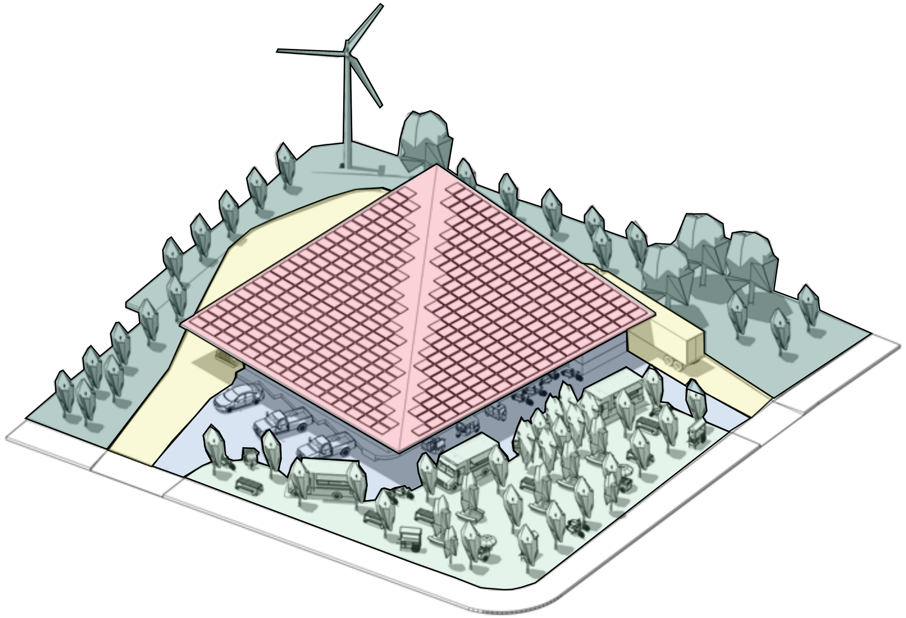
① Transformation Zone



Transformation:

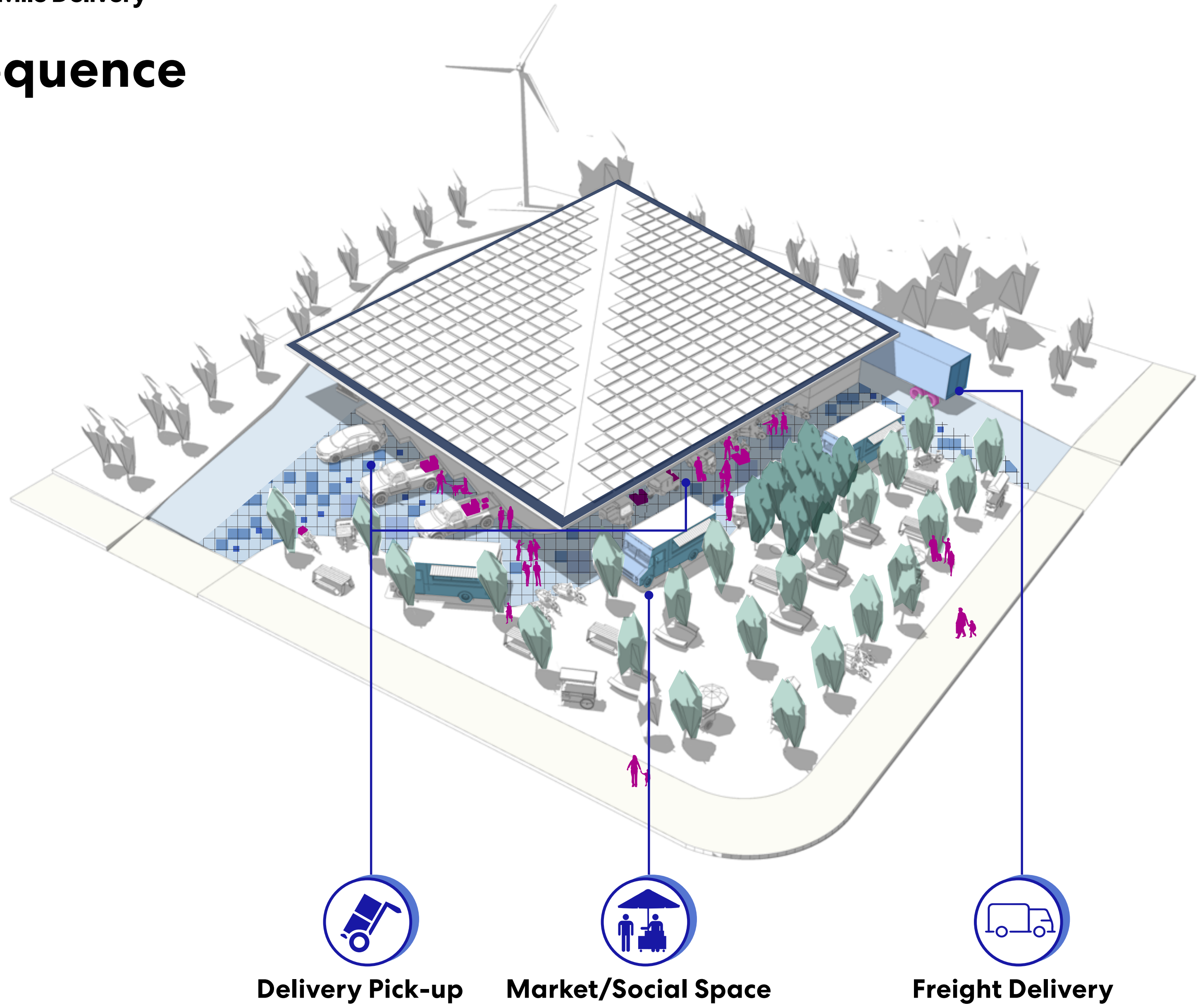
- Public Plaza
- Last Mile Delivery Center
- Semi Trailer Zone
- Last Mile Delivery Fleet Pick Up Zone
- Green Zone





Mobility Scenario: Support Last Mile Delivery

Adaptation Sequence



Energy Scenarios

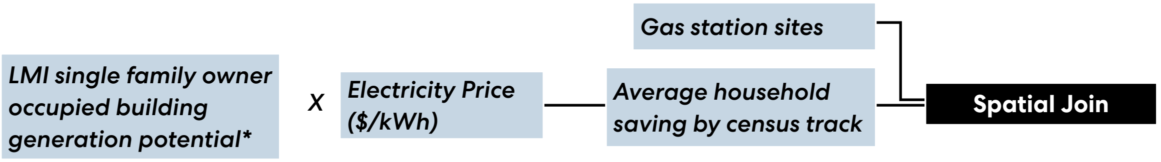
Site Assessment Attributes

Goals:

1. Identify the potential for a microgrid and EV charging station to serve as backup power source for critical public facilities during emergency events.
2. Identify the potential to reduce energy cost burden of low-to-median income household[5] and leverage solar rooftop technical potential of these households.
3. Identify the potential to serve surrounding businesses.
4. Prioritize the gas station sites that are close to each other.

	ASSESSMENT ATTRIBUTES		
CATEGORY		ENERGY	
		Weight	Notes
Context Land Use, Zoning & Density	Total commercial square footage within 1/4 mile to a gas station site	1	The higher total square footage, the higher potential to share backup energy with small businesses
	Total number of critical facilities within a 1/4-mile radius	3	The higher value, the higher potential to integrate critical facilities identified by General Plan in the mirogrid for emergency response
	Total number of schools within a 1/4-mile radius	3	The higher value, the higher potential to integrate school facilities in the mirogrid for emergency response
	Low to median income (LMI) household potential electric bill savings from rooftop pv	3	The higher value, the higher potential to provide energy bill savings to LMI household through microgrid system
Site Attributes	Grouping of gas station sites	3	The higher level of grouping, the higher potential to strengthen the microgrid capacity through having multiple gas station sites in the same grid for renewable energy generation, storage and distribution

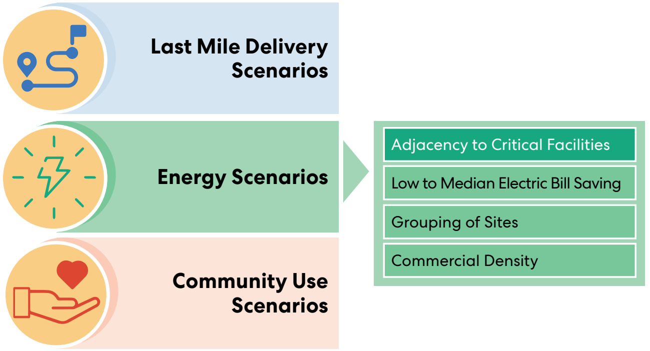
[Geoprocessing Example - Low to Median Income (LMI) Household Electric Bill Saving]

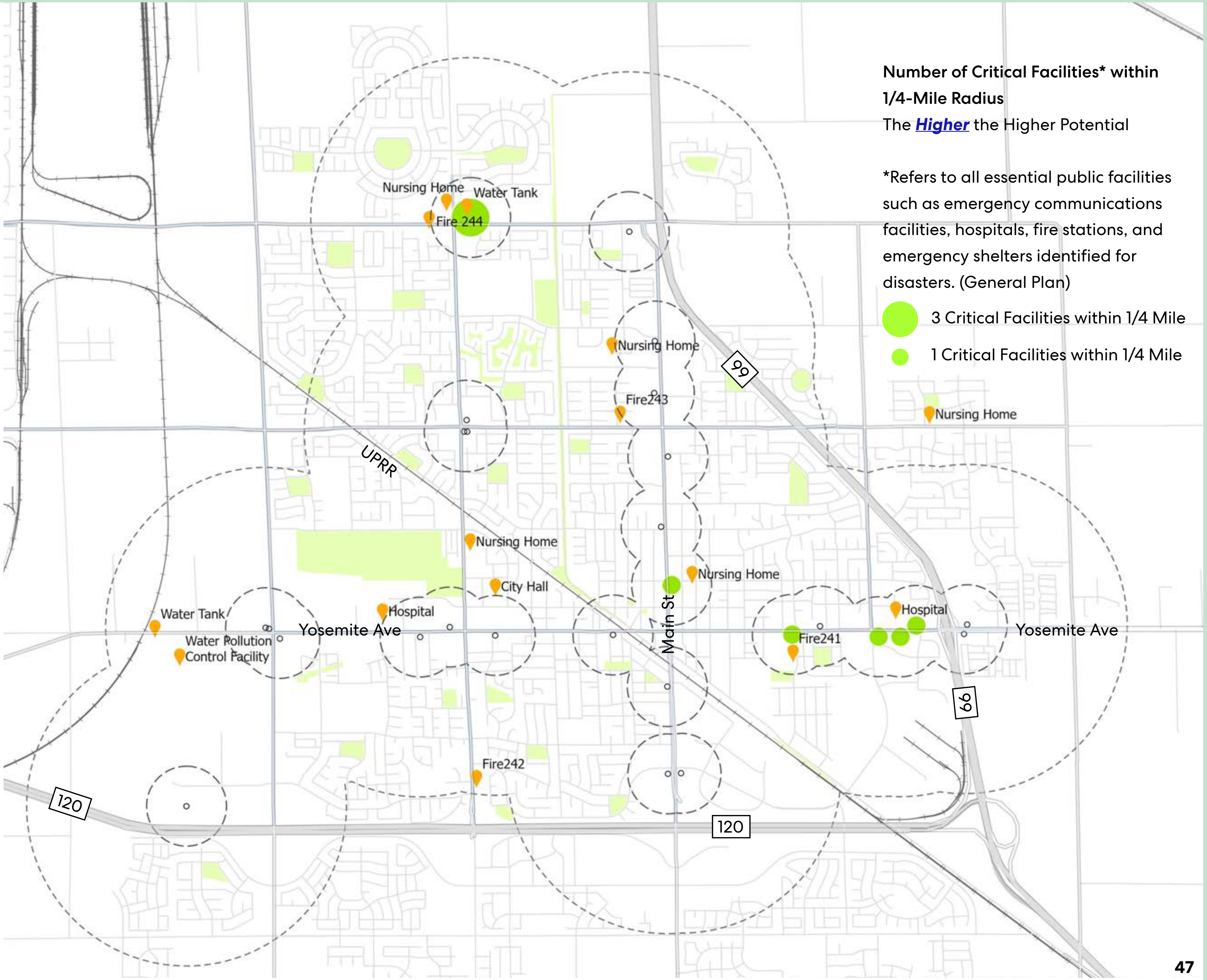


*Source: National Renewable Energy Laboratory (NREL): Solar for All

Energy Scenario: EV Charging & Microgrid

Adjacency to Critical Facilities





Number of Critical Facilities* within 1/4-Mile Radius
The ***Higher*** the Higher Potential

*Refers to all essential public facilities such as emergency communications facilities, hospitals, fire stations, and emergency shelters identified for disasters. (General Plan)

- 3 Critical Facilities within 1/4 Mile
- 1 Critical Facilities within 1/4 Mile

Energy Scenario: EV Charging & Microgrid

Adjacency to Schools

Last Mile Delivery Scenarios

Energy Scenarios

- Adjacency to Critical Facilities
- Low to Median Electric Bill Saving
- Grouping of Sites
- Commercial Density

Community Use Scenarios

Energy Scenario: EV Charging & Microgrid

Low-Median Income Household Potential Electric Bill Saving

Last Mile Delivery Scenarios

Energy Scenarios

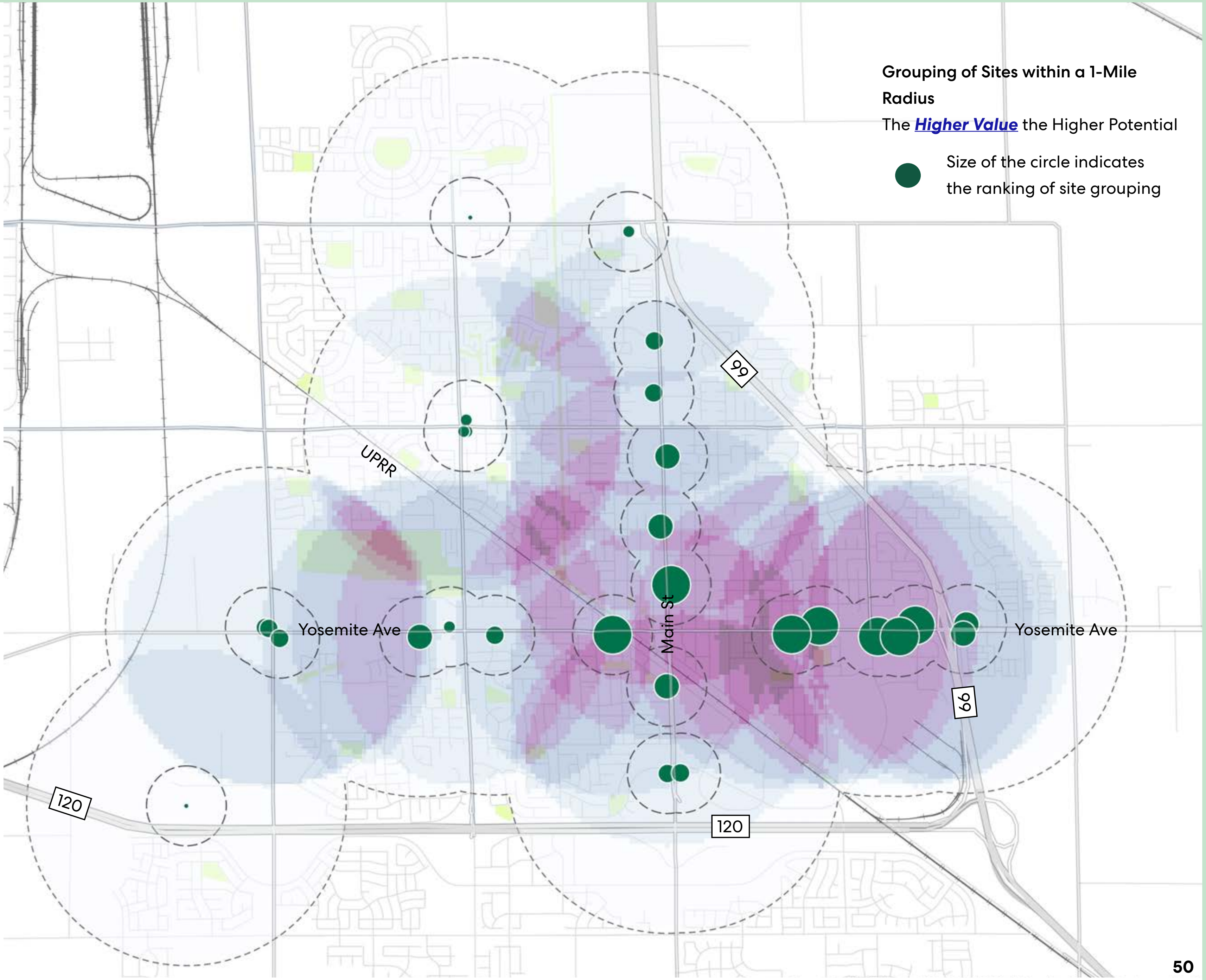
- Adjacency to Critical Facilities
- Low to Median Electric Bill Saving
- Grouping of Sites
- Commercial Density

Community Use Scenarios

Energy Scenario: EV Charging & Microgrid

Grouping of Sites

- Last Mile Delivery Scenarios
- Energy Scenarios
  - Adjacency to Critical Facilities
  - Low to Median Electric Bill Saving
  - **Grouping of Sites**
  - Commercial Density
- Community Use Scenarios



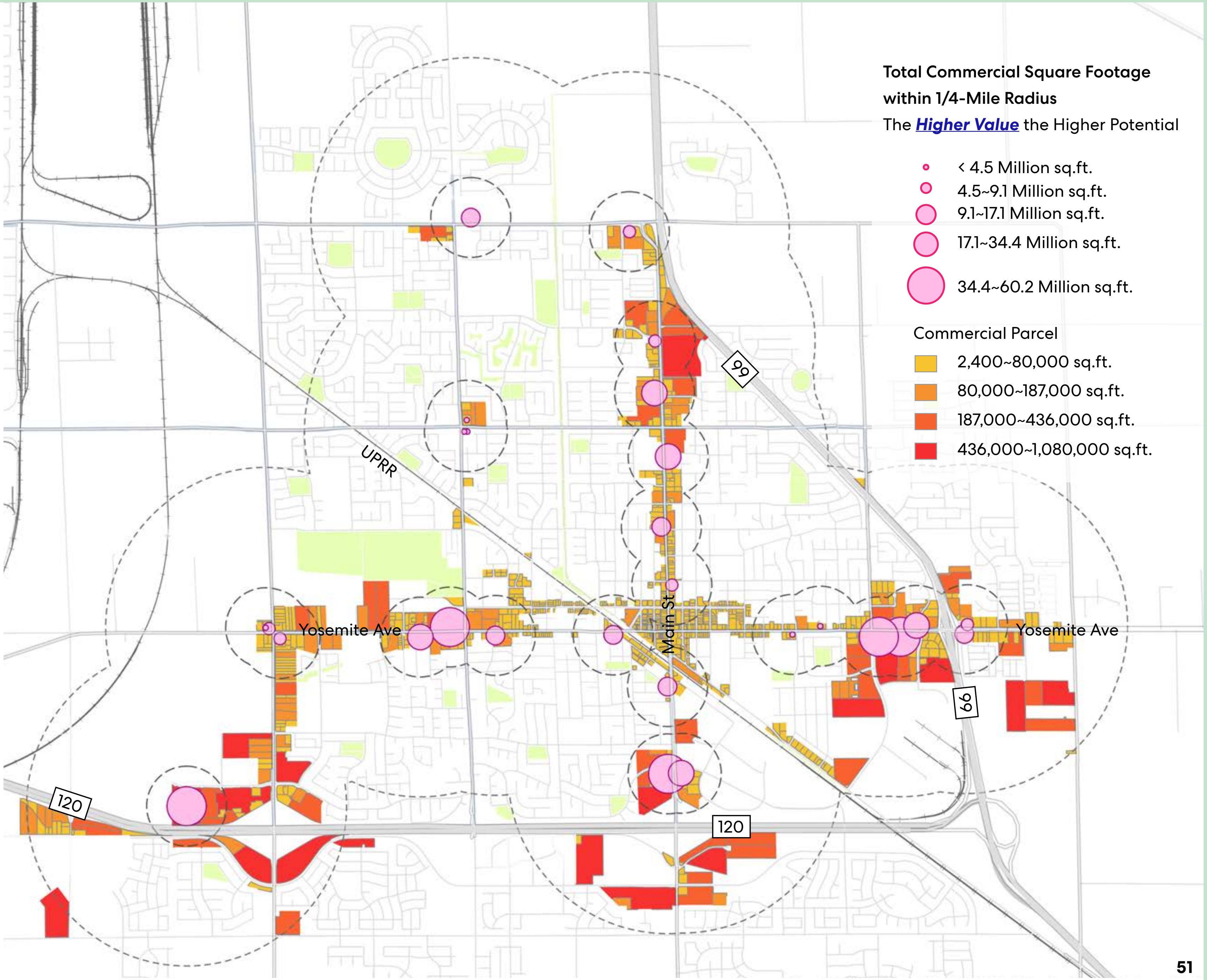
Commercial Density

Last Mile Delivery Scenarios

Energy Scenarios

- Adjacency to Critical Facilities
- Low to Median Electric Bill Saving
- Grouping of Sites
- Commercial Density

Community Use Scenarios



Energy Scenario: EV Charging & Microgrid

Summary of Normalized Data

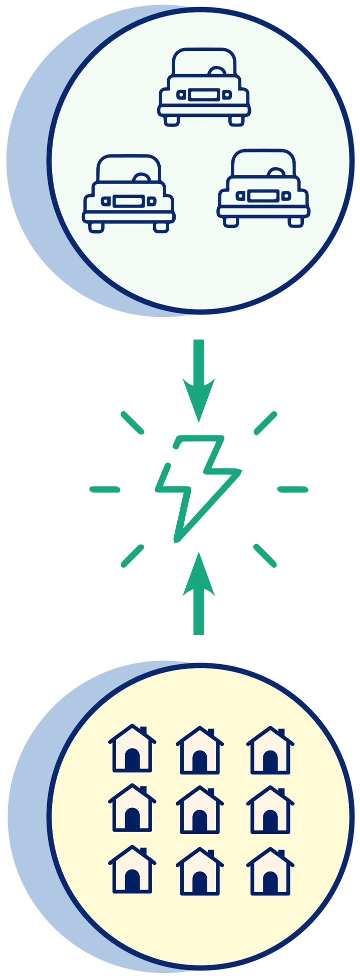
Last Mile Delivery Scenarios

Energy Scenarios

- Adjacency to Critical Facilities
- Low to Median Electric Bill Saving
- Grouping of Sites
- Commercial Density

Community Use Scenarios

Adaptation Strategy



EV CHARGING

GAS STATION ADAPTATION

BLOCK SCALE MICROGRID

West Coast Electric Highway user by OregonDOT is licensed under CC BY 2.0

Tesla Charging Station by pasa47 is licensed under CC BY 2.0

EcoBlock: A Multi-Customer Microgrid Solution

California Energy Commission EPIC project
Phase I (2015-2018) $1.5M
Phase II (2019-2023) $5M

Unique features:
Retrofits of older housing stock on an existing block, combining deep efficiency with 100% solar PV microgrid

Innovative legal and financial structures:
Community ownership and management via nonprofit Co-op or trust; Financing via Community Facilities District (CFD)

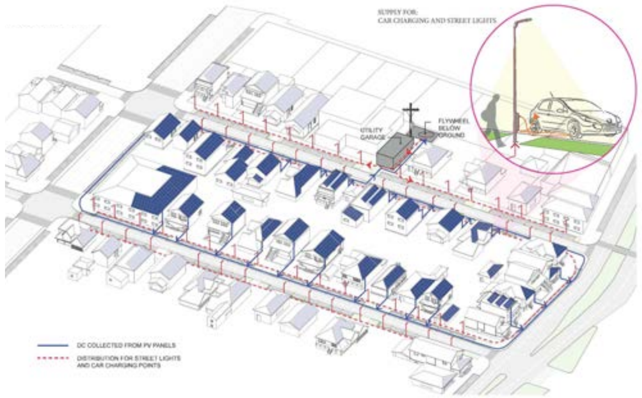
Beneficiaries:
Project aims to prove affordability for low-to-middle income neighborhoods; Scale-up potential is key

EcoBlock Vision: A Multi-Customer Microgrid Solution

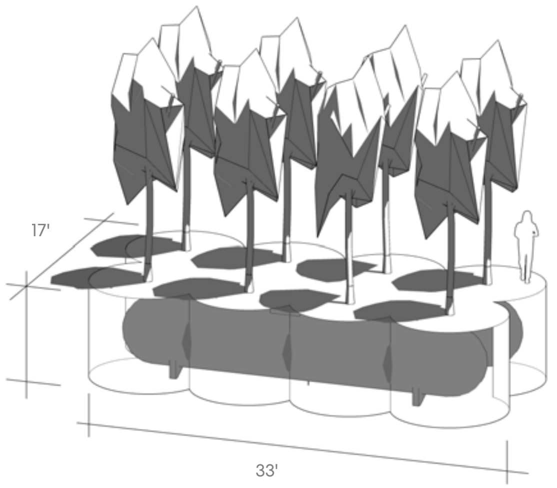
Electrical system combines DER

- Communal rooftop solar PV
- Communal energy storage system (flywheel and/or battery)
- Intelligent loads and electric demand response
- Shared Electric vehicle (EV) charging
- Smart controls in a direct-current (DC) microgrid infrastructure

behind a single interconnection with PG&E



Kit of Parts

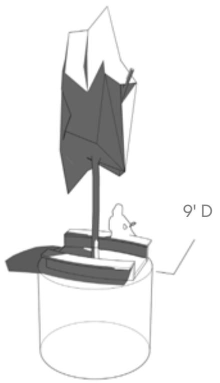


Phytoremediation Tree Cluster

• *One Phytoremediation Tree pulls out 30-40 gallons of toxic water a day*

• *Approx. 350,000 viable fueling stations around the word:*

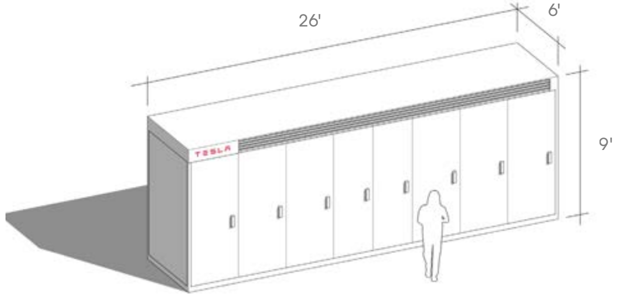
_ 8 new trees per adaptation =	*2,800,000 trees*
_ 24 new trees per adaptation =	*8,400,000 trees*
_ 32 new trees per adaptation =	*11,200,000 trees*



Tree Seating

• *One large tree can provide a day's supply of oxygen for up to four people*

• *One tree one can absorb 48+ pounds of carbon dioxide in one year*



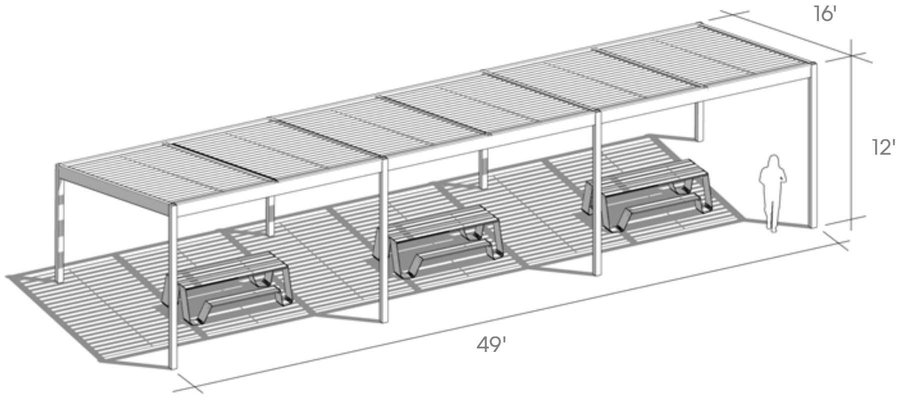
Tesla Megapack

• *1 Unit Stores Approx. 1 day of power for 82 homes*

• *3 MWh max capacity = power for one home for 3.6 months*

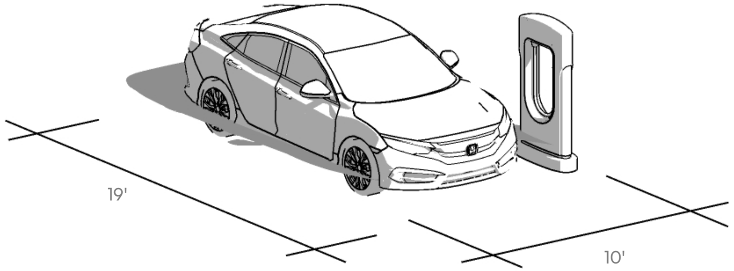
• *Scalable Solution*

Kit of Parts



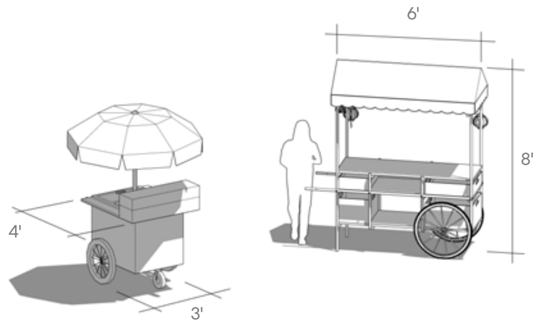
Trellis

- *Supports gathering*
- *Shelter / Shade*
- *PV Panel ready*



EV Charging

- *Parking / EV charging / AV storage*



Food & Goods Vendors

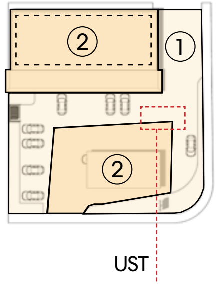
- *Support small businesses*
- *Diversity of Foods and Goods*
- *Flexible organization*

Energy Scenario: EV Charging & Microgrid

Adaptation Sequence

Manteca, CA

Gas Station CS_2

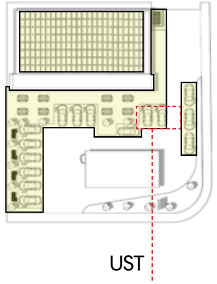


Existing Gas Station

① Adaptation Zone One

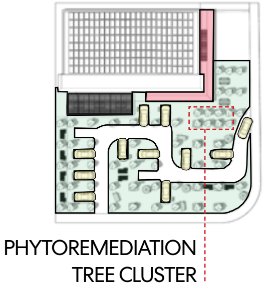
② Adaptation Zone Two

⌜ ⌟ Available Solar Panel Zone



Adaptation 1:

Introduce EV charging



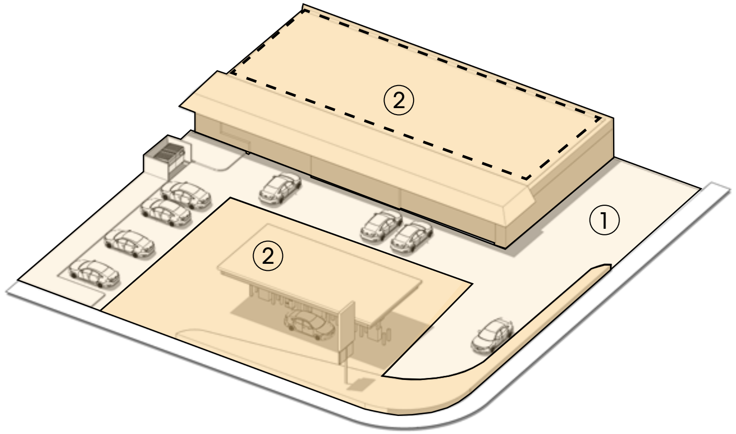
Adaptation 2:

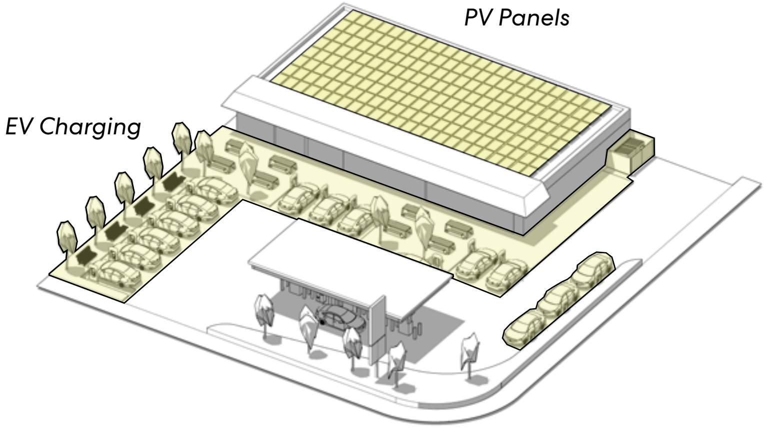
EV Charging Park

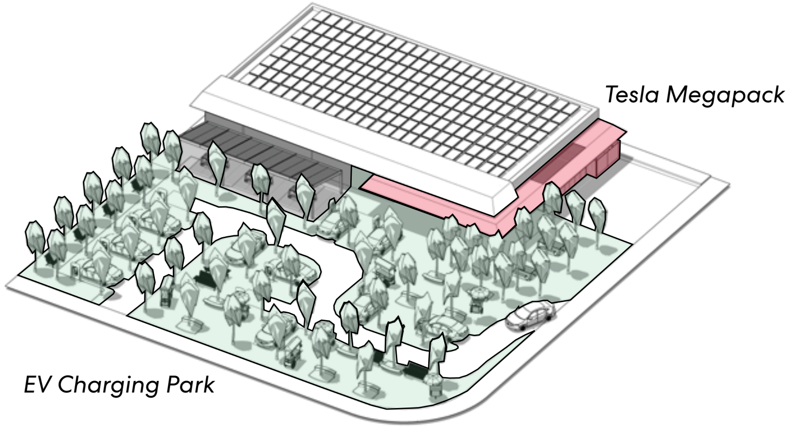
Tesla Megapack

EV Charging Parking

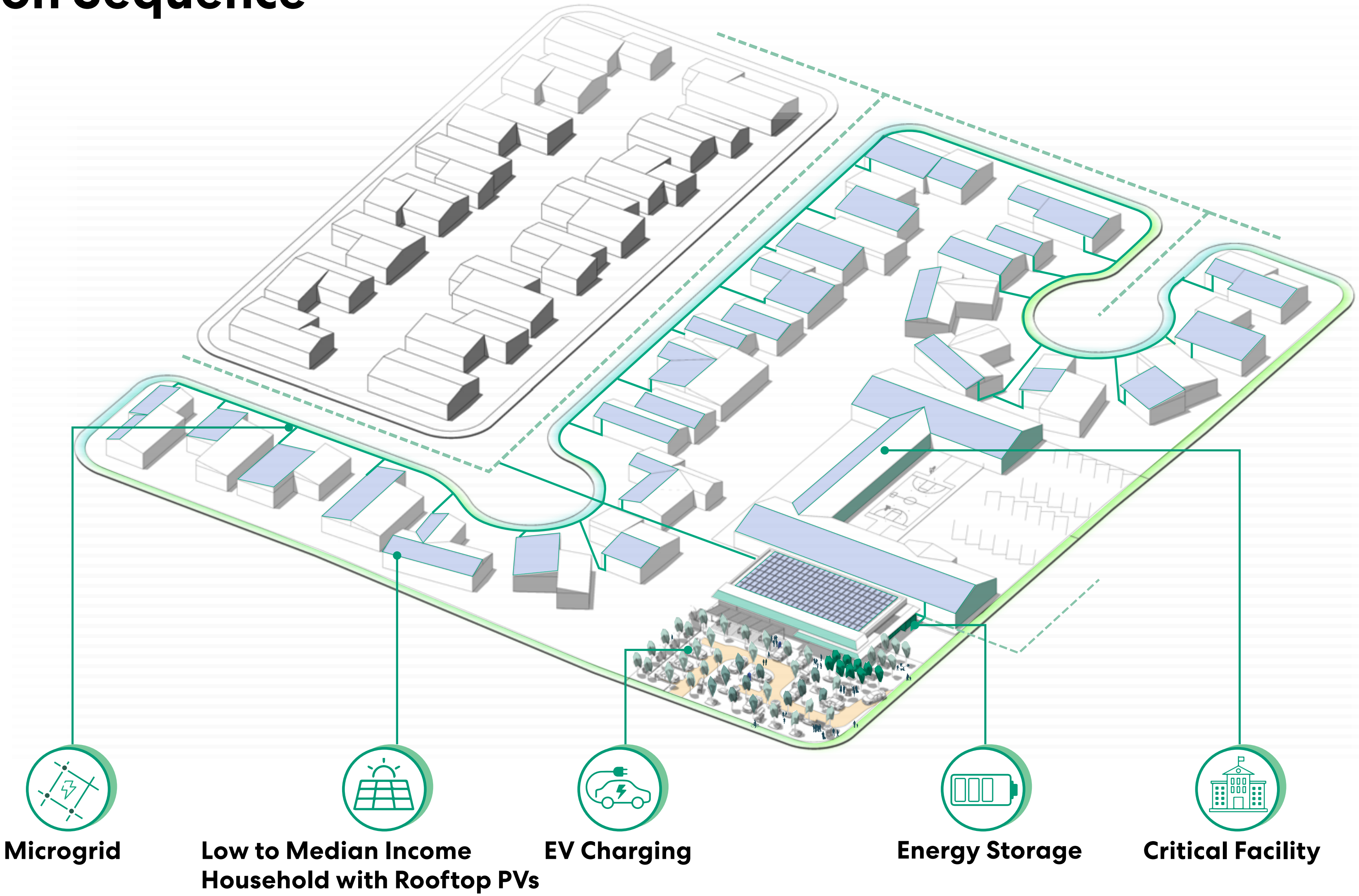
Trellis Gathering







Adaptation Sequence



Community Scenarios

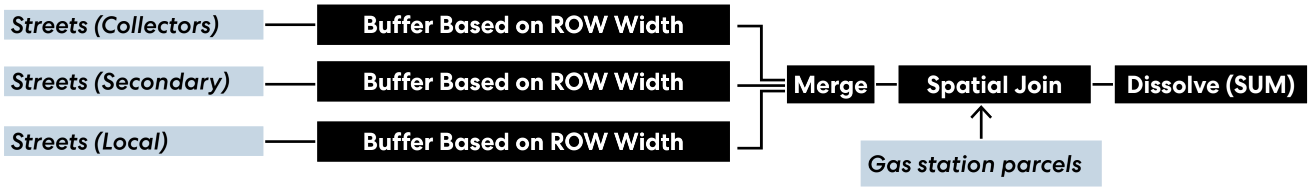
Site Assessment Attributes

Goals:

1. Prioritize sites that can support multi-modal access.
2. Prioritize the connectivity to regional destination (i.e. Manteca Tidewater Trail).
3. Prioritize sites with high visibility, along commercial corridors, and adjacent to a diversity of uses.
4. Identify sites that might be more feasible to be redeveloped.

	ASSESSMENT ATTRIBUTES	**SCENARIO**	
CATEGORY		COMMUNITY	
		Weight	Notes
Transportation & Logistics	Density of transit stops, bike routes or pedestrian infrastructure within 1/4 mile radius to the gas station sites	3	The higher value, the easier the site is accessible by transit, bike, and on foot
	Distance on streets to Manteca Tidewater Trail	2	The higher the value, the higher potential to leverage foot traffic generated by this regional attraction
	Site has more than one public street access / Whether a site is a corner site at an intersection	2	A corner site provides higher visibility and potential capture pedestrian traffic
Context Land Use, Zoning, & Density	Total commercial square footage within 1/4 mile to a gas station site	3	The higher total square footage the higher potential to leverage synergistic uses (other commercial/retail uses)
	Land use diversity	3	The higher level of land use diversity, the higher potential to create a vibrant place leveraging surrounding activities
Site Attributes	Gas Station structure to land value ratio	3	The lower the ratio, the more likely a site can be redeveloped

[Geoprocessing Example - Number of public street frontage]



Community Scenario: Catalyze Service & Activity Centers

Land Use Diversity

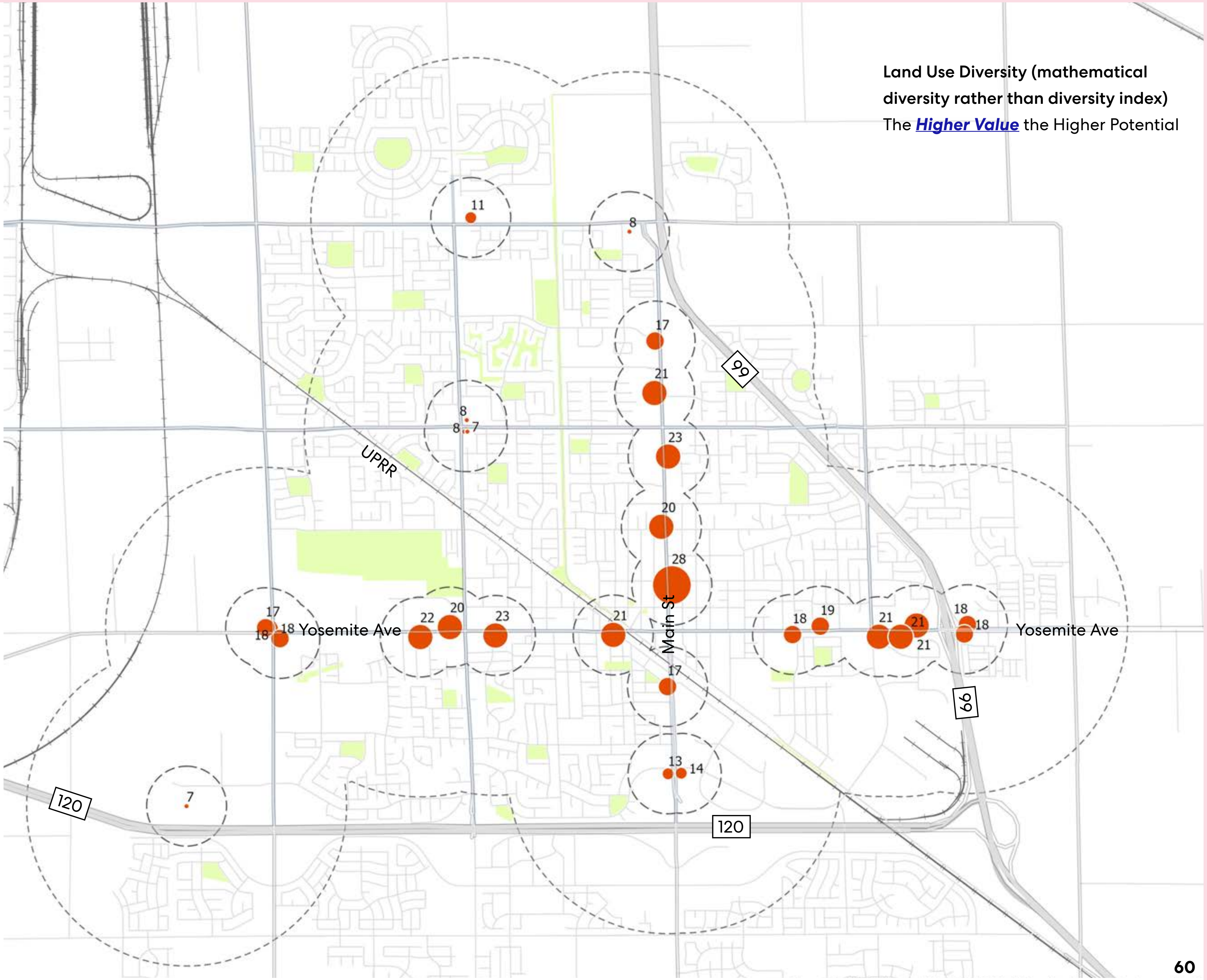
Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Land Use Diversity
- Structure to Land Value Ratio
- Transit Access
- Access to Manteca Trail
- Commercial Density
- Number of Street Frontage

Land Use Diversity (mathematical diversity rather than diversity index)
The ***Higher Value*** the Higher Potential



Community Scenario: Catalyze Service & Activity Centers

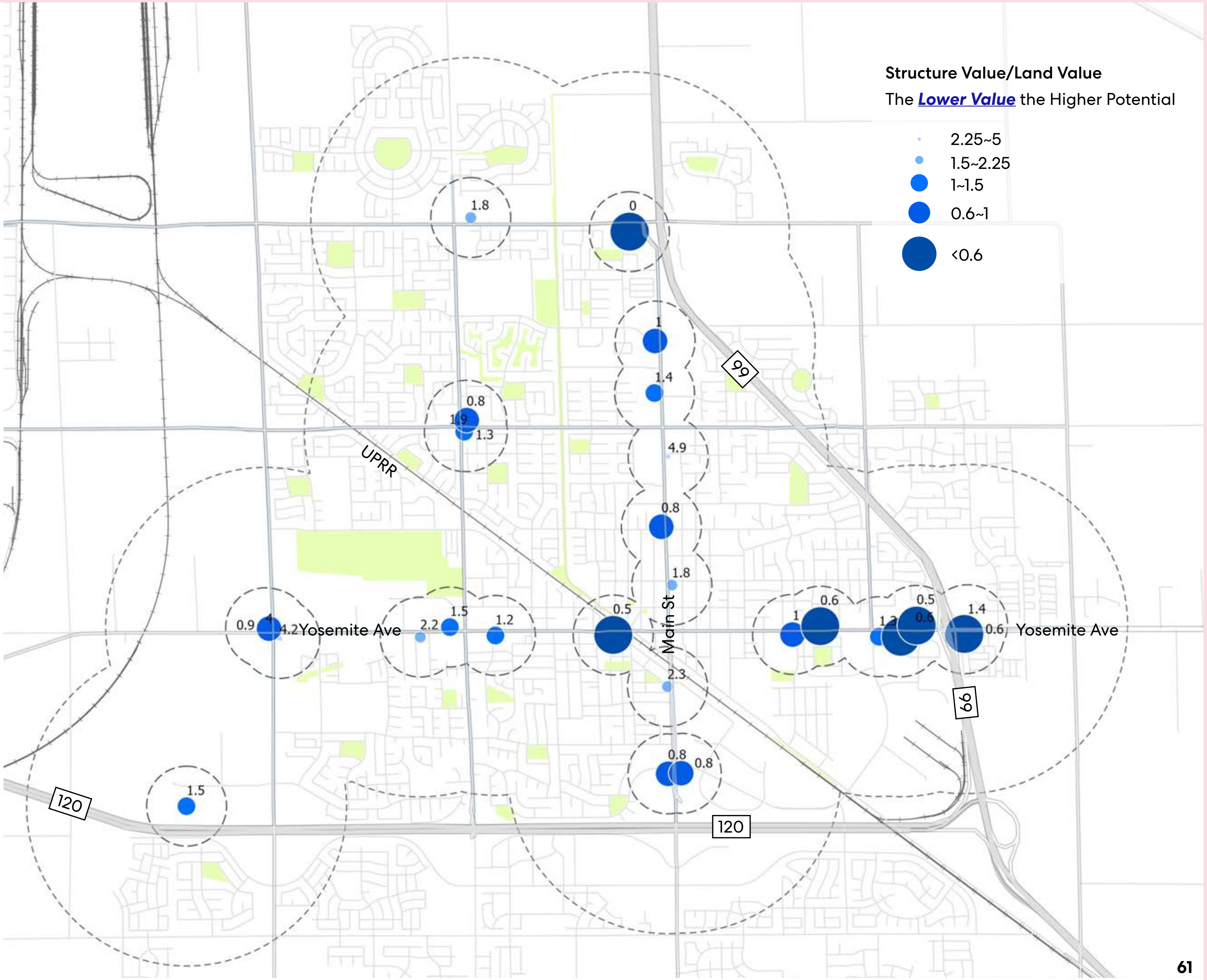
Structure/Land Value Ratio

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Land Use Diversity
- **Structure to Land Value Ratio**
- Transit Access
- Access to Manteca Trail
- Commercial Density
- Number of Street Frontage



Community Scenario: Catalyze Service & Activity Centers

Transit Access

- Last Mile Delivery Scenarios
- Energy Scenarios
- Community Use Scenarios
  - Land Use Diversity
  - Structure to Land Value Ratio
  - **Transit Access**
  - Access to Manteca Trail
  - Commercial Density
  - Number of Street Frontage

Number of Transit Stops within a 1/4-Mile Radius

The ***Higher Value*** the Higher Potential

Community Scenario: Catalyze Service & Activity Centers

Access to Manteca Cross-City Trail

Last Mile Delivery Scenarios

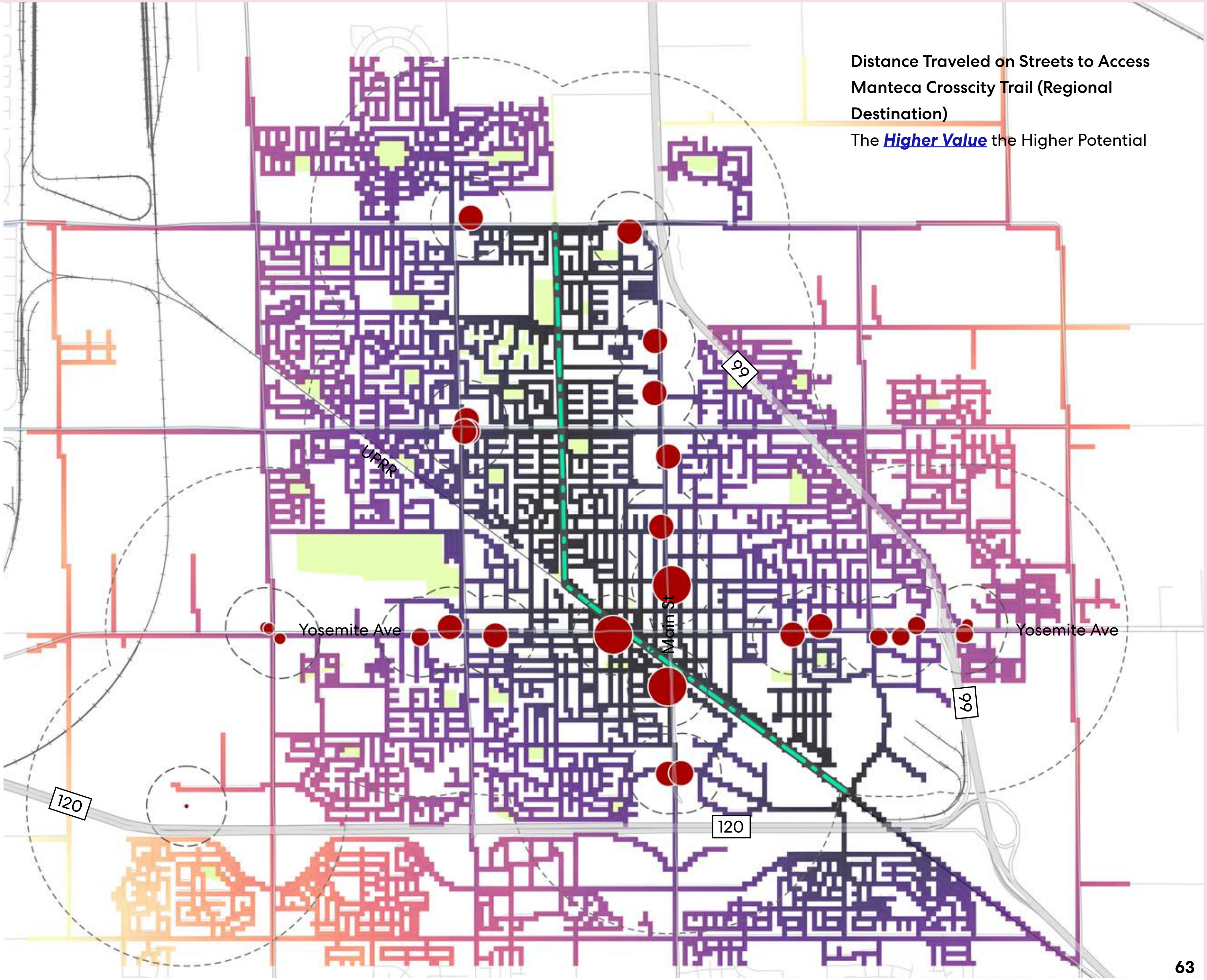
Energy Scenarios

Community Use Scenarios

- Land Use Diversity
- Structure to Land Value Ratio
- Transit Access
- **Access to Manteca Trail**
- Commercial Density
- Number of Street Frontage

Distance Traveled on Streets to Access Manteca Crosscity Trail (Regional Destination)

The ***Higher Value*** the Higher Potential



Community Scenario: Catalyze Service & Activity Centers

Commercial Density

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

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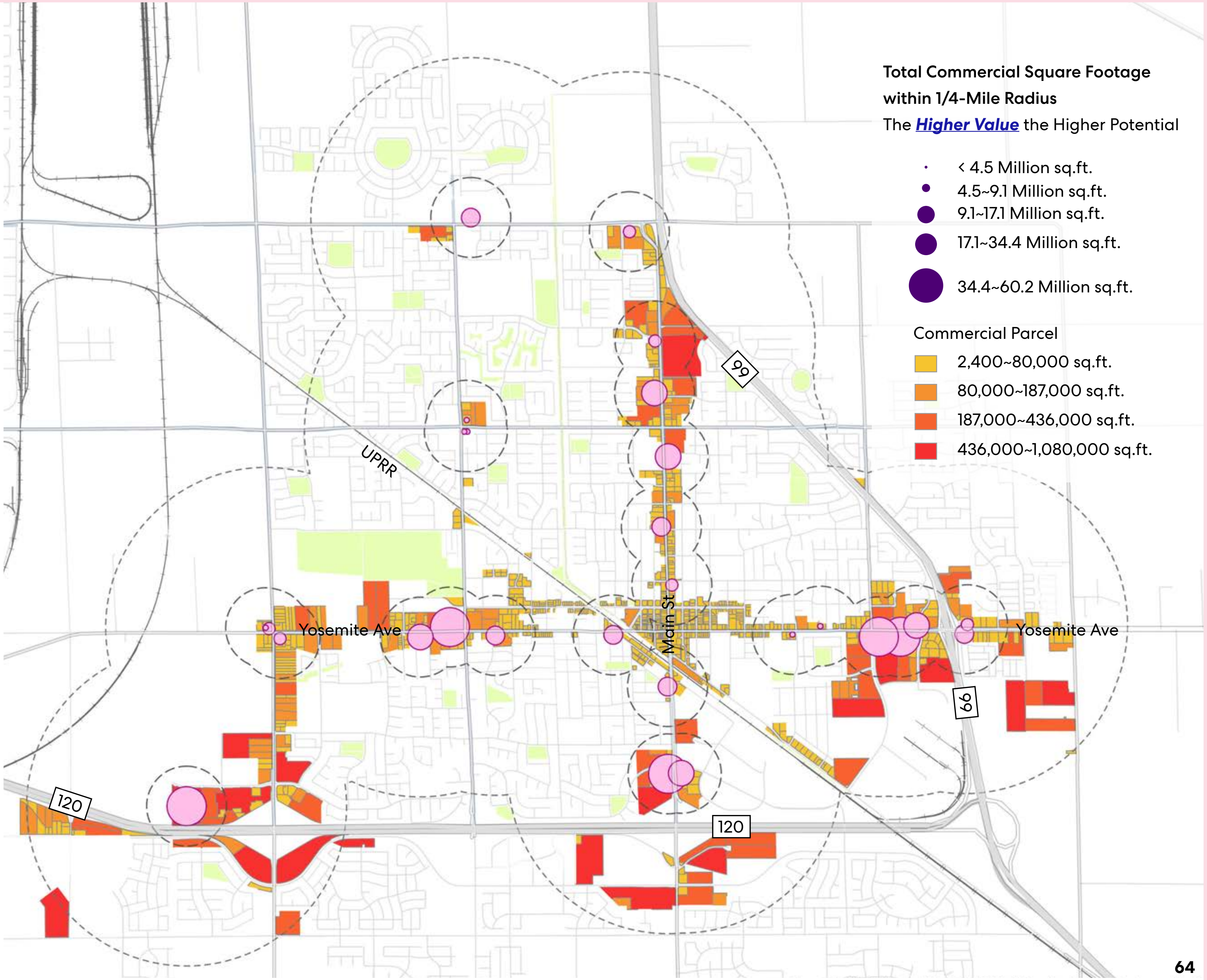

Community Scenario: Catalyze Service & Activity Centers

Number of Street Frontage

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Land Use Diversity
- Structure to Land Value Ratio
- Transit Access
- Access to Manteca Trail
- Commercial Density
- Number of Street Frontage

Community Scenario: Catalyze Service & Activity Centers

Summary of Normalized Data

Last Mile Delivery Scenarios

Energy Scenarios

Community Use Scenarios

- Land Use Diversity
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- Transit Access
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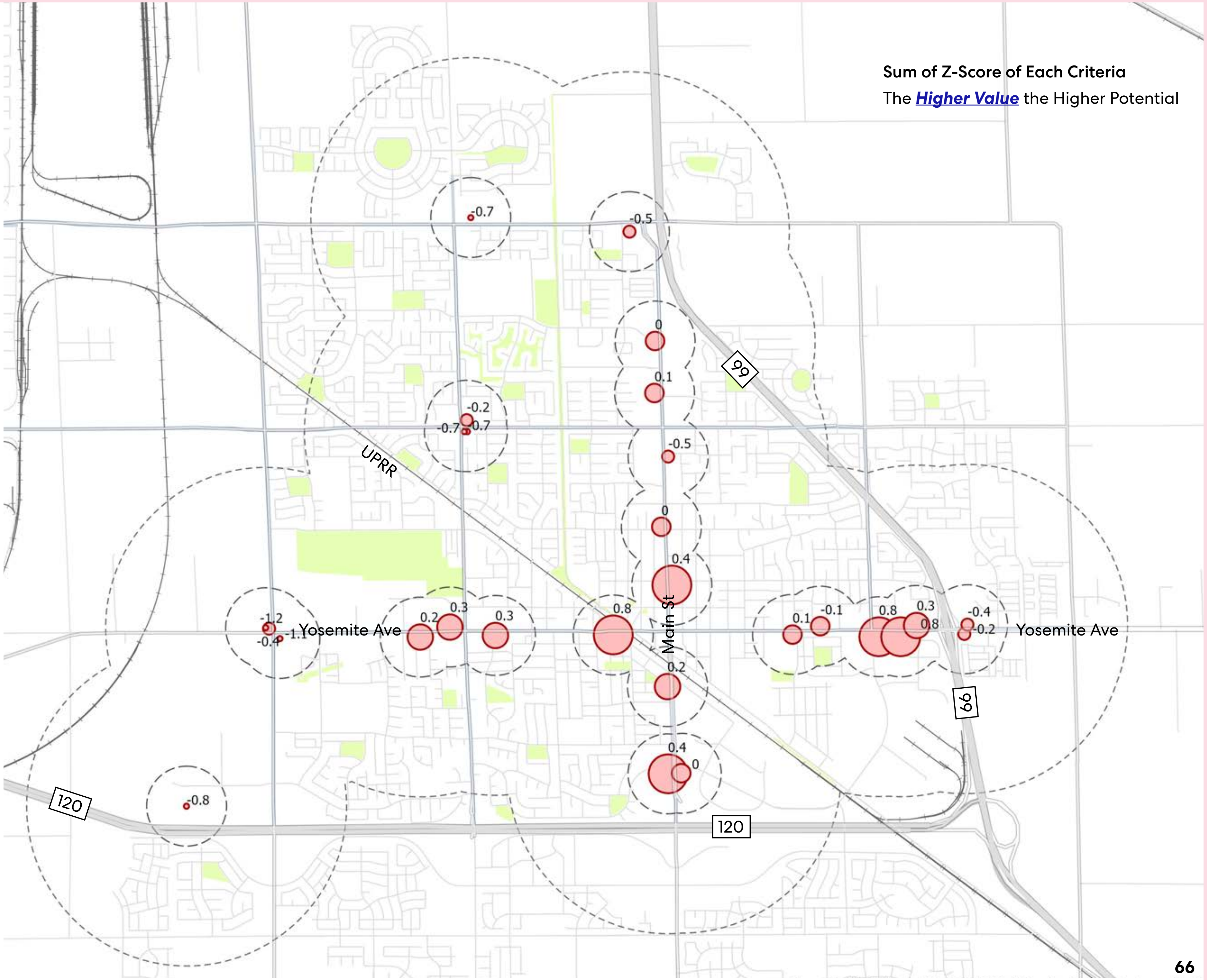
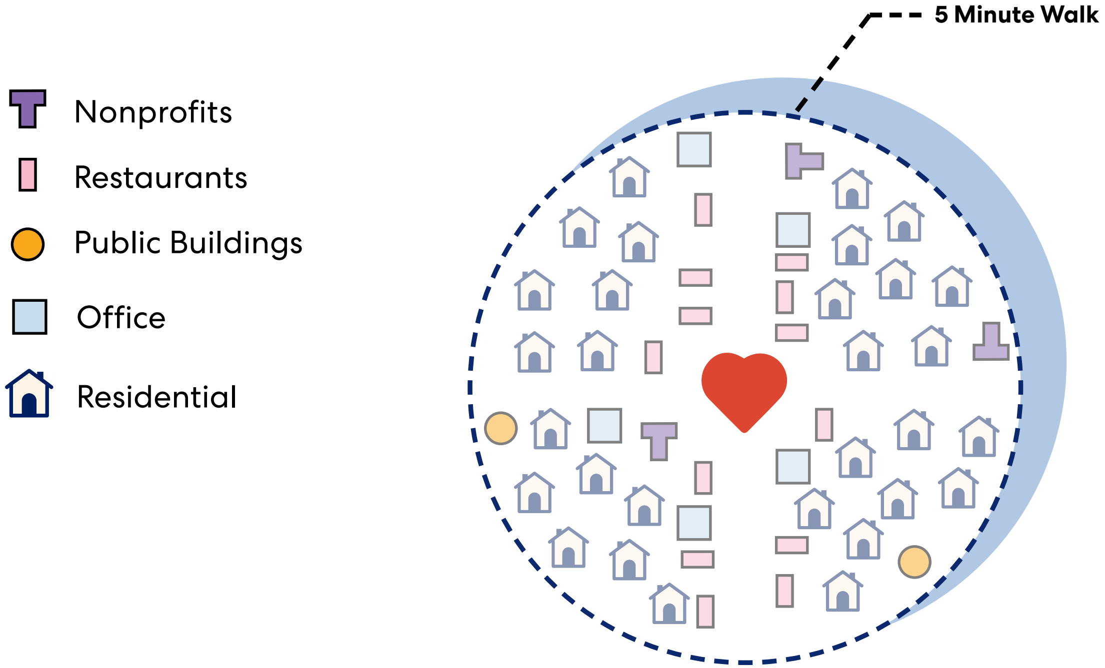


Adaptation Strategy



SYNERGISTIC USES

Outdoor Eating for surrounding restaurants
Catering Venue: Church Functions, Events, etc...
Cultural Food Festivals
Food Trucks / Stalls
Social Heart for Community


West-African Food Stall in Camden by spaztacular is licensed under CC BY 2.0


Tonno at the Beer Garden by timquijano is licensed under CC BY 2.0

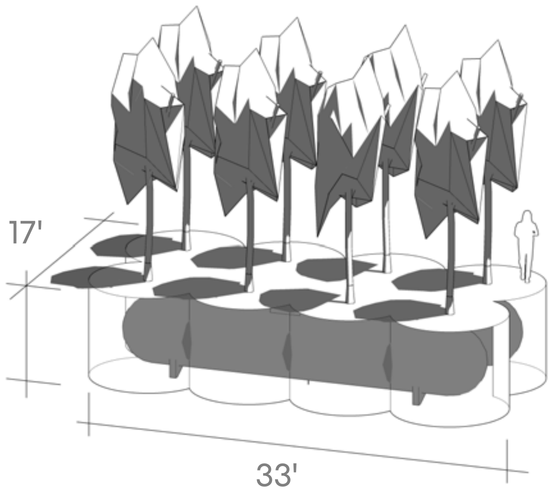

Food stall at South bank Christmas market by Roving-Aye! is licensed under CC BY-SA 2.0


Mobile food trucks at Mobile Food Chowdown in South Lake Union Park by Mayor McGinn is licensed under CC BY 2.0


Food Truck Park by Arthur's Photographs is licensed under CC BY-SA 2.0


Food Stall at the Oaxacan Organic Market by tinyfroglet is licensed under CC BY 2.0

Kit of Parts



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• *Approx. 350,000 viable fueling stations around the word:*

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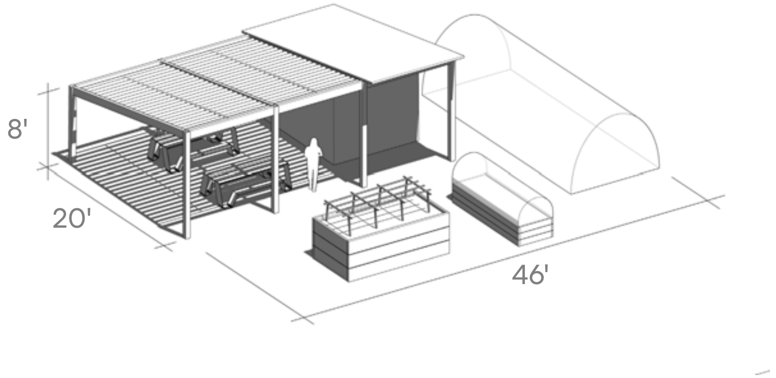
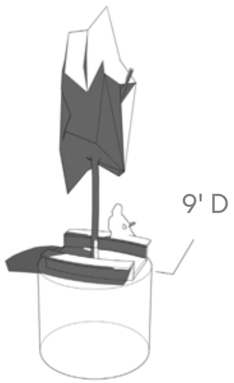


Urban Agriculture

• *Support neighborhood food services*

• *Ecosystem diversity*

• *Culinary / Cultural Education*



Tree Seating

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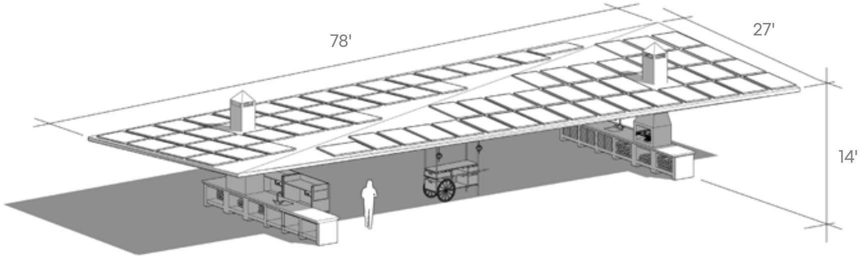
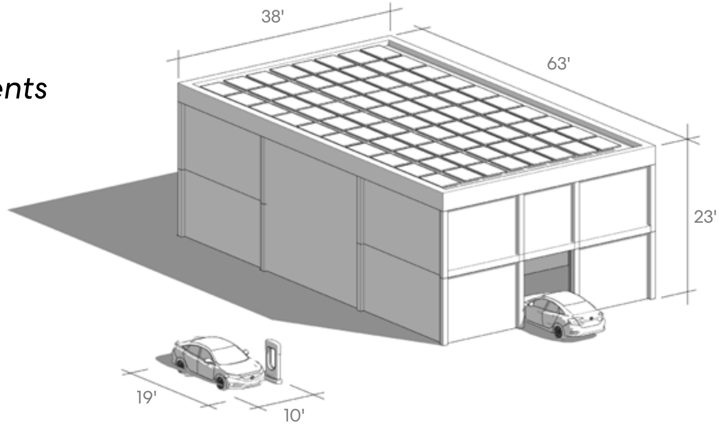
Kit of Parts



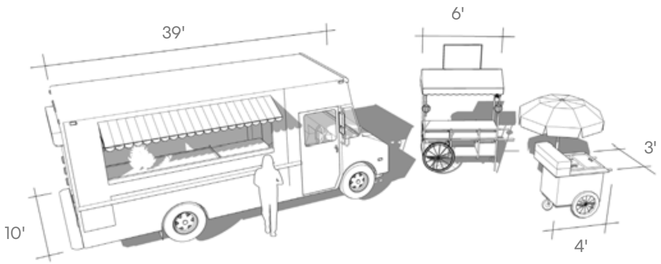
Pop Up Catering Pavilion

- *Support neighborhood / community events*
- *Culinary / Cultural Education*
- *Community Hub*
- *Small Business Platform*



EV Charging & Automated Tower Parking

- *16 parking spots*
- *Parking / EV charging / AV storage*



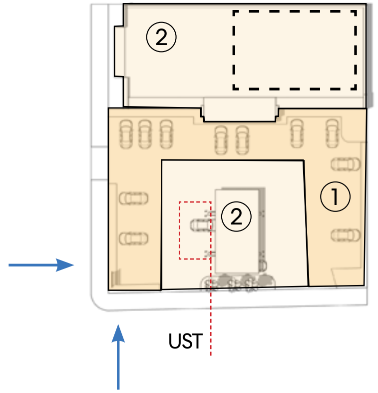
Food & Goods Vendors

- *Support small businesses*
- *Diversity of Foods and Goods*
- *Flexible organization*

Adaptation Sequence


Manteca, CA


Gas Station CS_3



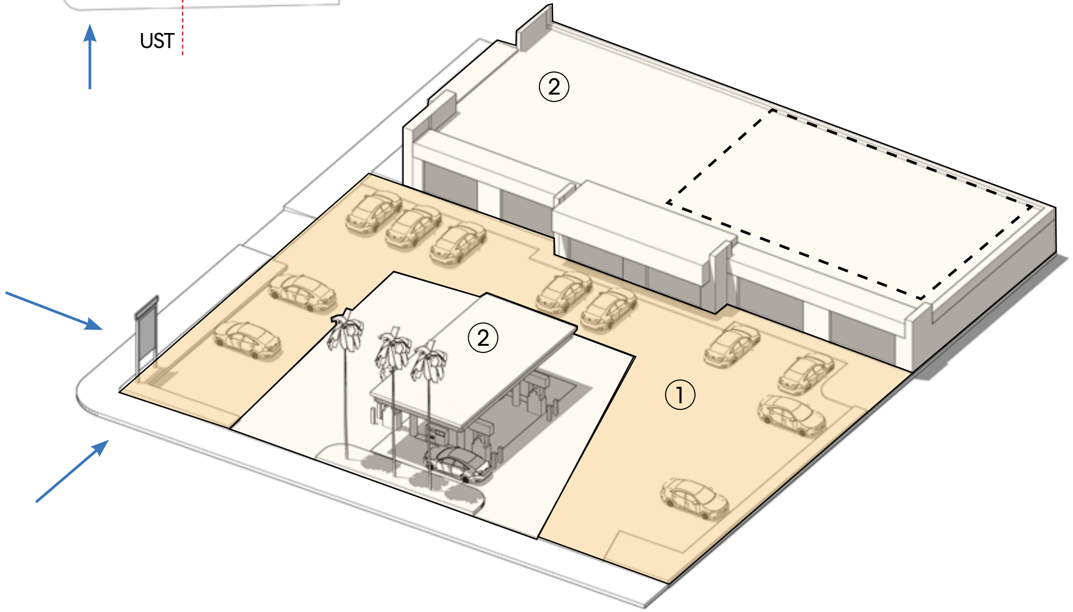
Existing Gas Station

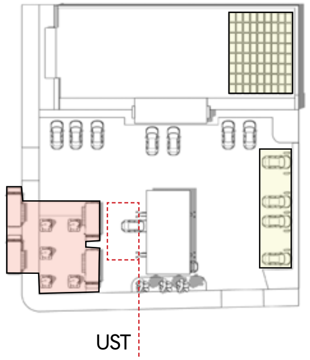
① Adaptation Zone One

② Adaptation Zone Two

[ ] Available Solar Panel Zone

→ Prime Pedestrian Access

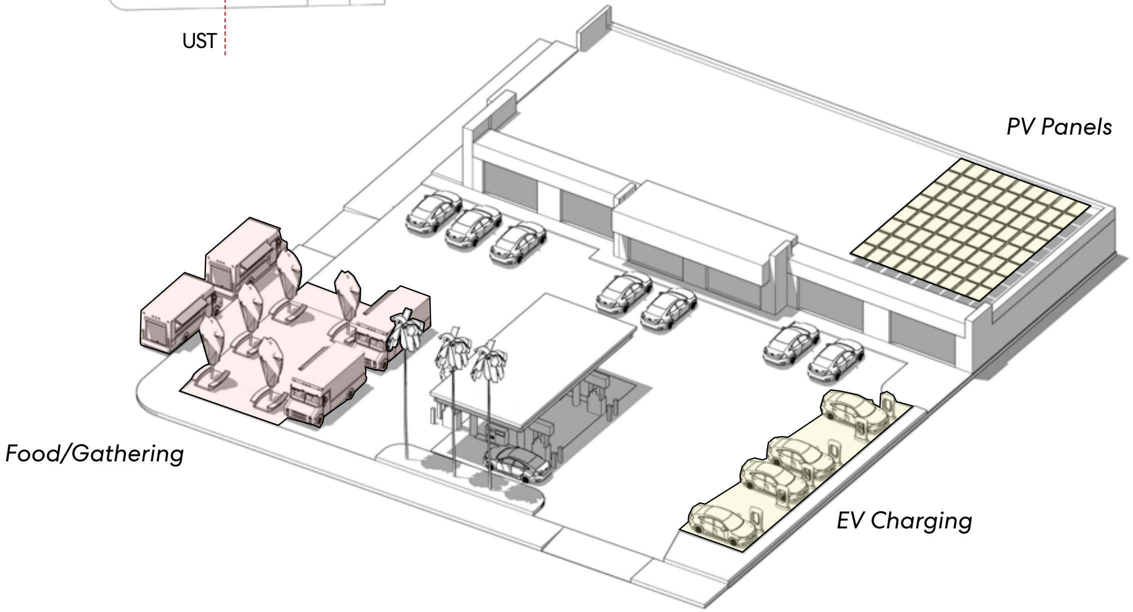




Adaptation 1:

Introduce synergistic use at prominent corner.

Introduce EV charging



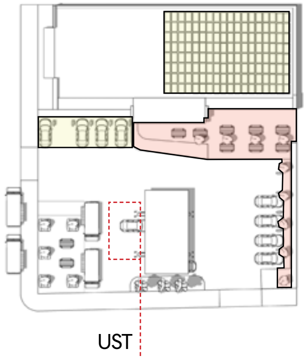
Adaptation Sequence

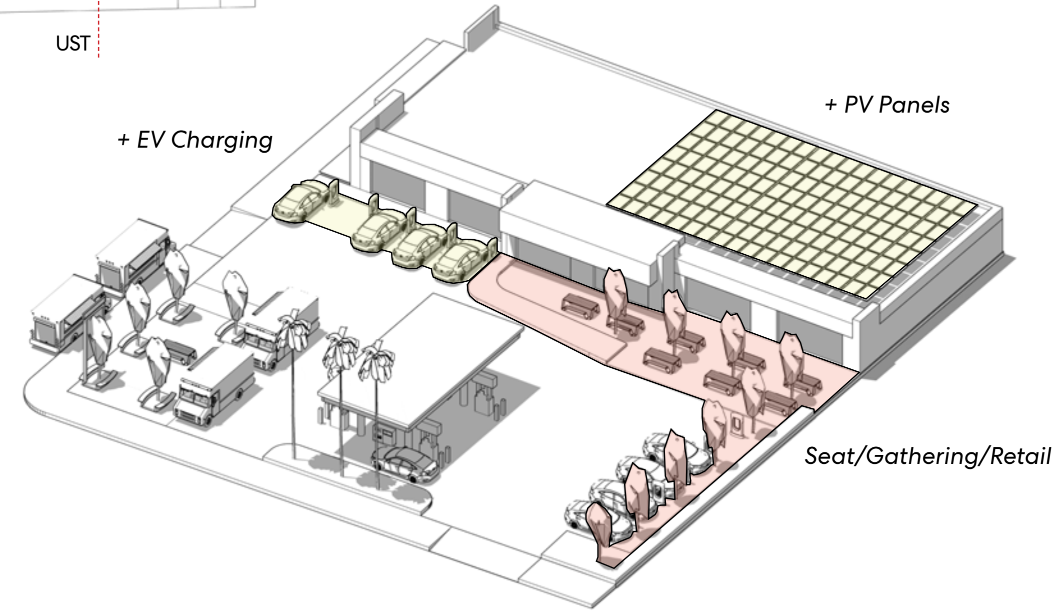
Manteca, CA

Gas Station CS_3

Adaptation 2:

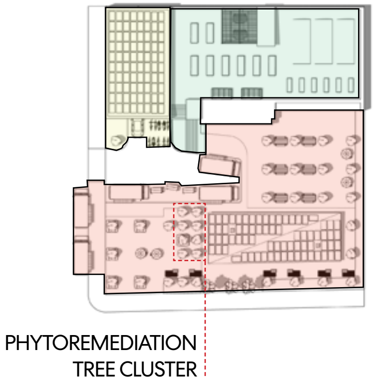
- Provide more seating for adjacent Synergistic Uses and on site Services
- EV charging and fueling equalize

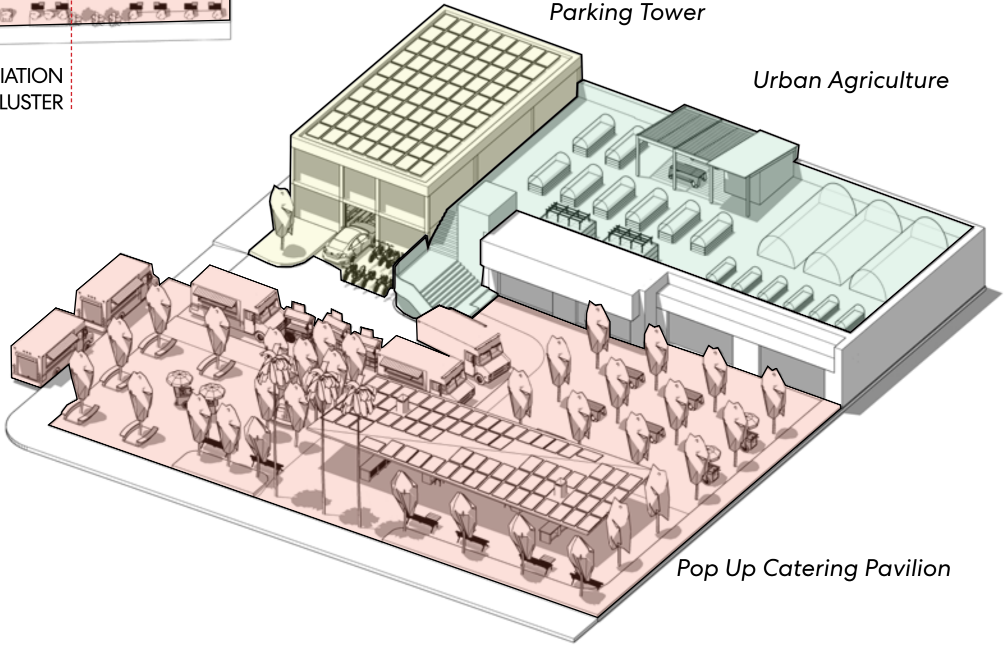




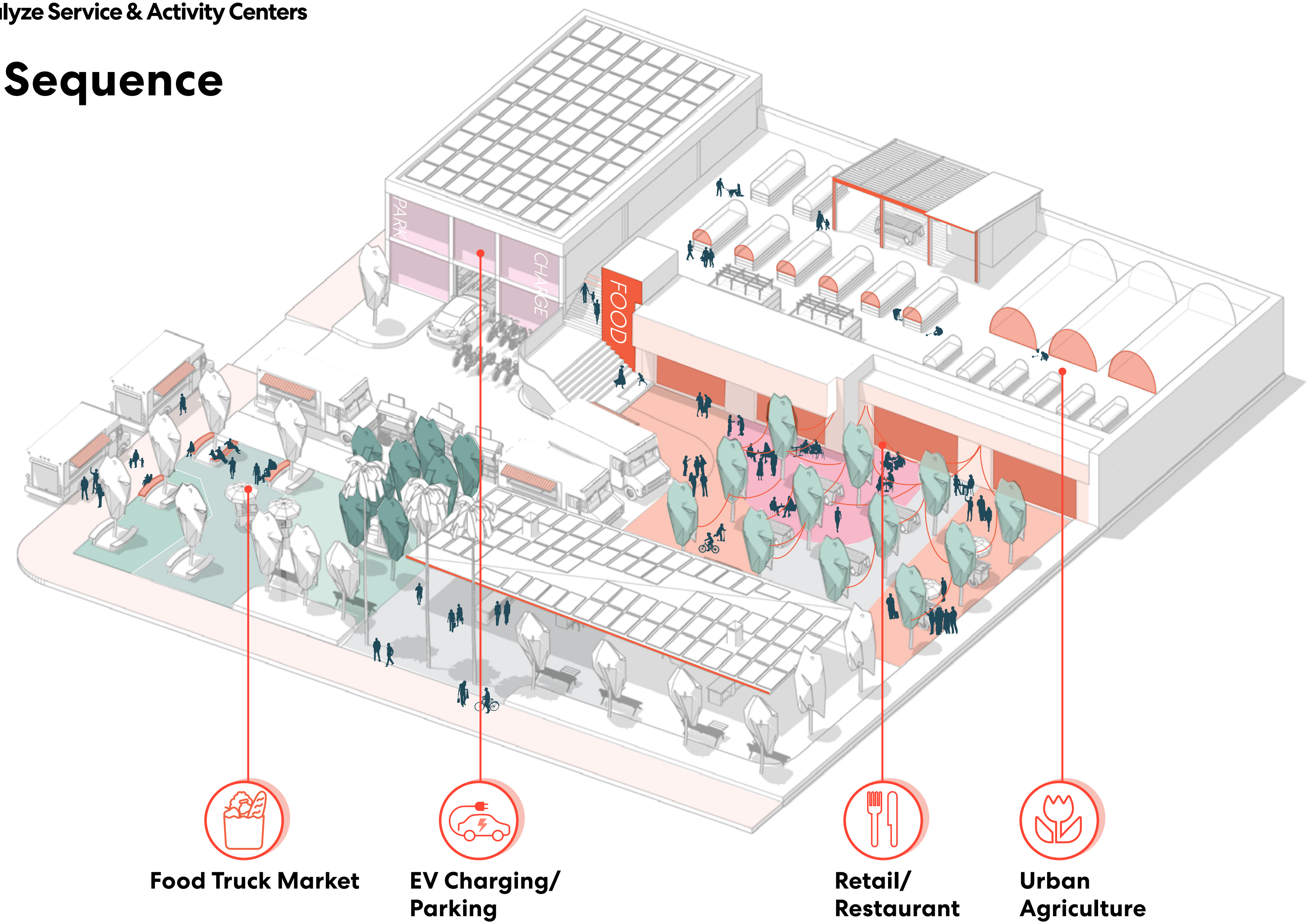
Adaptation 3:

- Complete vision a private and public place for synergistic uses
- Fully optimized parking
- Sustainable food production





Adaptation Sequence



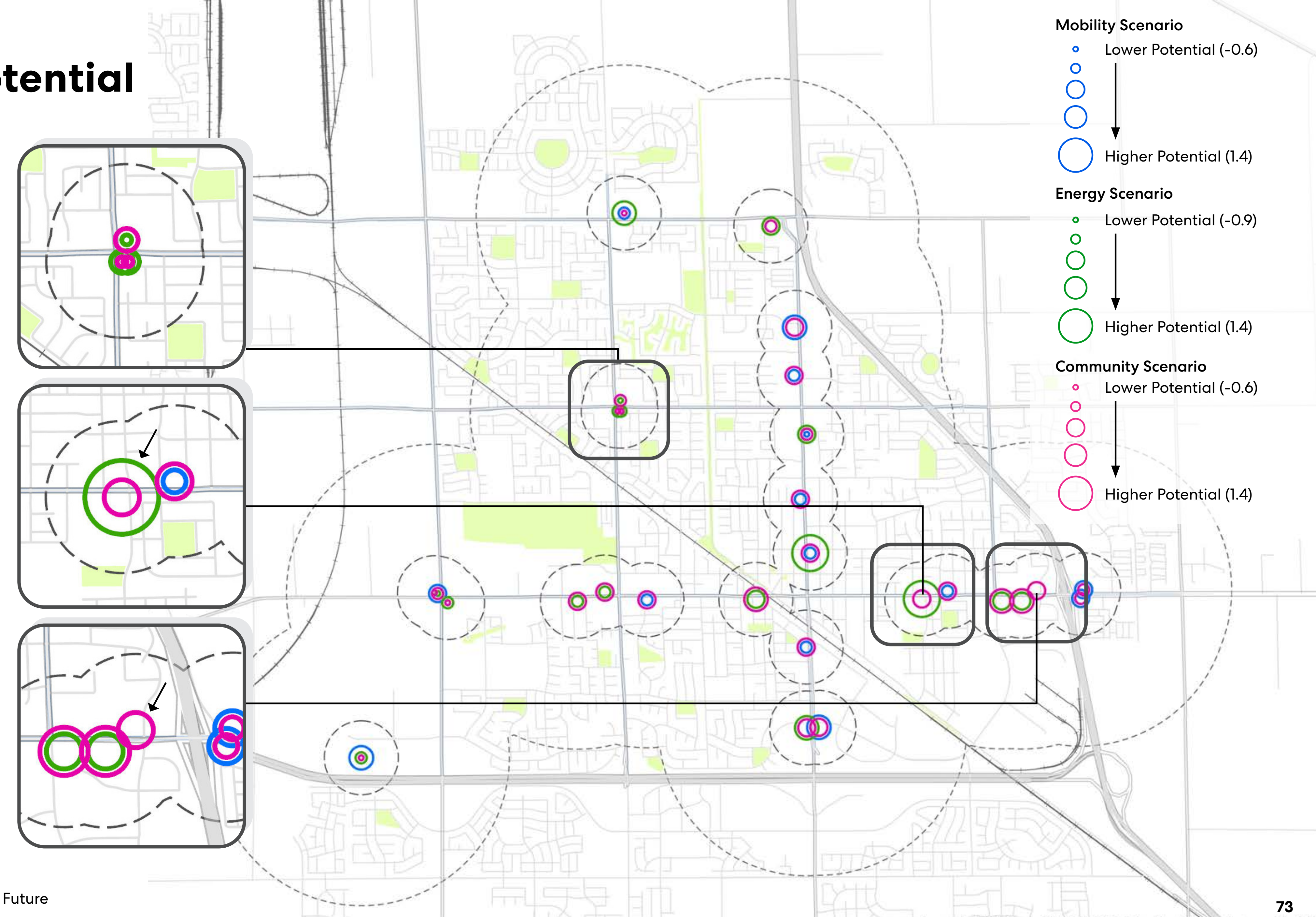
Adaptation Potential

These sites have **low levels of potential** for all scenarios.

This site has significantly **higher potential for Energy Scenario**.

This location concentrates critical facilities, schools and low to median income households with high rooftop pv potentials.

This site has **similar levels of potential** for all 3 scenarios. Negotiation of best use scenario can be done through further studies of the site.



PATH FORWARD

Next Steps

REFINE THE TOOL

- Further refine the spatial analysis tool and add assessment attributes based on stakeholder input.

INTERNAL PARTNERSHIP

- Work with existing research programs (such as the Mobility Lab and Resilience Lab) to continue the research.
- Develop a new strategic working group in collaboration with firm-wide experts in mobility and energy, Nelson Nygaard and Dar Group.

EXTERNAL PARTNERSHIP

- Join the EcoBlock Project Team in the effort to establish the next 3-5 sites for adaptation and develop strategies for this framework to be deployed at scale.
  [The Oakland EcoBlock project aims to demonstrate technical, social, legal, and financial methods for radically reducing the environmental footprint of buildings through cost-effective retrofits at the block scale. The project is led by UC Berkeley and primarily funded by the California Energy Commission to support California legal mandates.]
- Explore opportunities for working with developers, legislators, and contractors to develop a design-build project delivery framework.

THOUGHT LEADERSHIP

- Create a set of marketing assets.
- Attend symposia and conferences.

Endnotes

1 Business Insider. The challenges of last mile delivery logistics and the tech solutions. https://www.businessinsider.com/last-mile-delivery-shipping-explained

2 Microgrid Knowledge. Can a microgrid be a resilient superhero? https://microgridknowledge.com/microgrid-energy-resilience/

3 Forbes. Texas Energy Crisis Is An Epic Resilience And Leadership Failure . https://www.forbes.com/sites/arielcohen/2021/02/19/texas-energy-crisis-is-an-epic-resilience-and-leadership-failure/?sh=6097a0256eee

4 https://www.mv-voice.com/news/2017/10/20/a-pollution-solution-thats-growing-on-trees#:~:text=the%20area's%20groundwater.-,On%20any%20given%20day%2C%20his%20trees%20are%20sucking%20up%20about,to%20help%20clean%20up%20pollution.

5 NREL. Solar for All Data Query: https://maps.nrel.gov/solar-for-all/?aL=Z0HxR8%255Bv%255D%3Dt&bL=clight&cE=0&lR=0&mC=37.801103690609615%2C-121.1974811553955&zL=14

Reference Materials

Decision 21-01-018. Decision Adopting Rates, Tariffs, And Rules Facilitating The Commercialization Of Microgrids Pursuant To Senate Bill 1339 And Resiliency Strategies https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M361/K442/361442167.PDF.

CA Clean Transportation Program (Alternative and Renewable Fuel and Vehicle Technology Program). https://cecgis-caenergy.opendata.arcgis.com/app/clean-transportation-program-app-formerly-arfvtp.

Energy Equity Indicators. https://nelsonnygaard.maps.arcgis.com/apps/MapJournal/index.html?appid=d081a369a0044d77ba8e80d2ff671c93.

Noack, M. (2017) A pollution solution that's growing on trees.New research at Moffett Field finds poplars can rid groundwater of TCE. https://www.mv-voice.com/news/2017/10/20/a-pollution-solution-thats-growing-on-trees#:~:text=the%20area's%20groundwater.-,On%20any%20given%20day%2C%20his%20trees%20are%20sucking%20up%20about,to%20help%20clean%20up%20pollution.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