Southern California Zero Emission Truck Infrastructure (ZETI) Study

October 10, 2024

SCAG

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Welcome

Jonathan Raspa

SCAG Project Manager

Re-introducing the Project Team

Re-introducing TAC Member Organizations

SCAG
INNOVATING FOR A BETTER TOMORROW

COMMUNITIES FOR A BETTER ENVIRONMENT
Building Community Power to Achieve Environmental Justice, Clean Energy and Healthy Communities

East Yard Communities for Environmental Justice

MAJESTIC REALTY

Metro

METRANS Transportation Consortium
USC | CSULB

CALSTART

EPRI

South Coast AQMD

sb cta

LACI

CALIFORNIA GOVERNOR'S OFFICE OF BUSINESS AND ECONOMIC DEVELOPMENT

The Port of Hueneme
Oxnard Harbor District

LA THE PORT OF LOS ANGELES

Port of LONG BEACH
THE PORT OF CHOICE

ICTC
IMPERIAL COUNTY TRANSPORTATION COMMISSION

InCharge

PMSA
PACIFIC MERCHANT SHIPPING ASSOCIATION

SoCalGas

Caltrans

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company

LA DWP Los Angeles Department of Water & Power

FE FUEL

TA TravelCenters of America

California Transportation Commission

WattEV

BREATHE SOUTHERN CALIFORNIA

Ventura County Air Pollution Control District

PUBLIC UTILITIES COMMISSION STATE OF CALIFORNIA
EUREKA

VCTC

HTA

CALIFORNIA AIR RESOURCES BOARD

NRDC

STATE OF CALIFORNIA ENERGY COMMISSION

Technical Advisory Committee Meeting #5

Agenda

- Welcome and Introductions
- Project Progress to Date
- Baseline Modeling Results
- Siting Tool & Site Assessment
- Next Steps

PROJECT PROGRESS TO DATE

Project Phase Review, detail

Phase 1	Phase 1	Phase 1 / Phase 2	Phase 2	Phase 2	Phase 3
PROJECT KICKOFF	**INITIAL OUTREACH FINDINGS**	**TRUCK MARKETS AND EXISTING CONDITIONS**	**CHARGING NEEDS**	**DISTRIBUTION OF CHARGING NETWORK**	**ASSESSMENT OF KEY SITES**
Introduce project & begin stakeholder engagement	Truck market and existing conditions	Refined understanding of truck markets, travel patterns, and relevant operational characteristics	Determine adoption scenarios and estimated energy demand	Assess land supply and prioritize station locations	High level site assessments for 24 locations Initial Findings and Wrap-up
JULY 2023	AUG-OCT 2023	NOV-DEC 2023	JAN-FEB 2024	MAR-OCT 2024	OCT-DEC 2024
TAC 1	TAC 2	TAC 3	TAC 4	TAC 5	TAC 6

MEETINGS

We Are Here (TAC 5)

Recap of TAC #4 meeting Next Steps

- Integrate the two technical streams of work – modeling and siting ✓
- Refine the analysis further from preliminary to draft to final ✓
- Develop case studies using siting typologies for the blueprint ⌛
- Start-up second round of engagement using draft results as a means of discussion ⌛

Project Progress to date, Phases

TECHNICAL WORK

- [x] Completed Truck GPS Data Analysis
- [x] Completed Truck Trip Expansion
- [x] Identified Market Segments
- [x] Incorporated Payload Information

PHASE 2 (Stage 1)

TECHNICAL WORK

- [x] Conduct Initial HEVI-LOAD Model Run
- [x] Develop Adoption Scenarios
- [ ] Conduct HEVI-LOAD Model Scenarios Runs
- [ ] Assess Land Supply and Prioritize General Station Locations

PHASE 2 (Stage 2)

MODELING RESULTS

What are we solving for?

We are working to answer three key questions*.

1. Develop an estimate of energy needed to serve the truck travel market in California as it transitions to zero-emission vehicles.
2. Differentiate energy needs between depot and public charging.
3. Where are public charging and refueling facilities needed and how many? Document their load profile and measure peak capacity.

*The modeling effort was carried out statewide to capture long-distance truck travel accurately. The results for the SCAG region are the focus of this study.

Travel Modeling – Recap

- Generated daily truck patterns using truck GPS data – which allows us to model when trucks run out of charge and where
- Developed forecasts for truck travel patterns for future years
  - Three horizon years: 2030, 2035, 2040
  - Ensured consistency with Caltrans statewide travel demand model
- Base electrification scenario matches AATE3 scenario adopted by the state
  - Additional scenario runs under differential rates of adoption are also tested
  - Special scenario for hydrogen

Truck Market Segments - Recap

Truck Market Segment	Port Truck		Truck Type		Total Mileage		Frequent Location	
	Yes	No	Heavy	Medium	0-300 mi	>300 mi	Yes	No
Drayage Heavy-Duty	☑		☑		N/A	N/A	N/A	N/A
Drayage Medium-Duty	☑			☑	N/A	N/A	N/A	N/A
Regional Return-to-Base: HD		☑	☑		☑		☑	
Regional Return-to-Base: MD		☑		☑	☑		☑	
Regional No–Home: HD		☑	☑		☑			☑
Regional No Home: MD		☑		☑	☑			☑
Long-Haul: HD		☑	☑			☑	N/A	N/A
Long-Haul: MD		☑		☑		☑	N/A	N/A

Energy Modeling – Recap

- Enhanced to incorporate truck touring/daily patterns into charging decision-tree
- There are three charging options: private depot charging, public en-route charging, and public destination charging
- The energy modeling modifies the travel data to match AATE3 adoption inputs
- Adopts a simulation approach – multiple runs needed to converge to a consistent and reasonable load profile.

Energy Modeling – Recap

- A preliminary list of 1,000+ public destination and en-route charging sites was created.
- Statewide truck parking locations were used as a starting point. We then filled the gaps on interstates and truck facilities to ensure coverage throughout the SCAG region.
- The energy modeling approach does not limit the amount of charging occurring at any site.

Documenting Results

Results from Baseline scenario, i.e. AATE3 adoption for 2030, 2035, 2040

1. Total energy demands at a county-level
2. Technical approach to transforming model-generated energy measurements into actionable insights
3. Linkage with site prioritization.

TOTAL ENERGY NEEDS

Total Energy Requirements by County – Horizon Years

Counties	**2030**	**2035**	**2040**
Los Angeles	2,440	6,210	9,880
Riverside	1,190	2,200	3,610
San Bernardino	1,710	3,060	4,910
Orange	830	1,950	2,780
Ventura	340	640	1,180
Imperial	170	340	620
Total	**6,680**	**14,400**	**22,980**

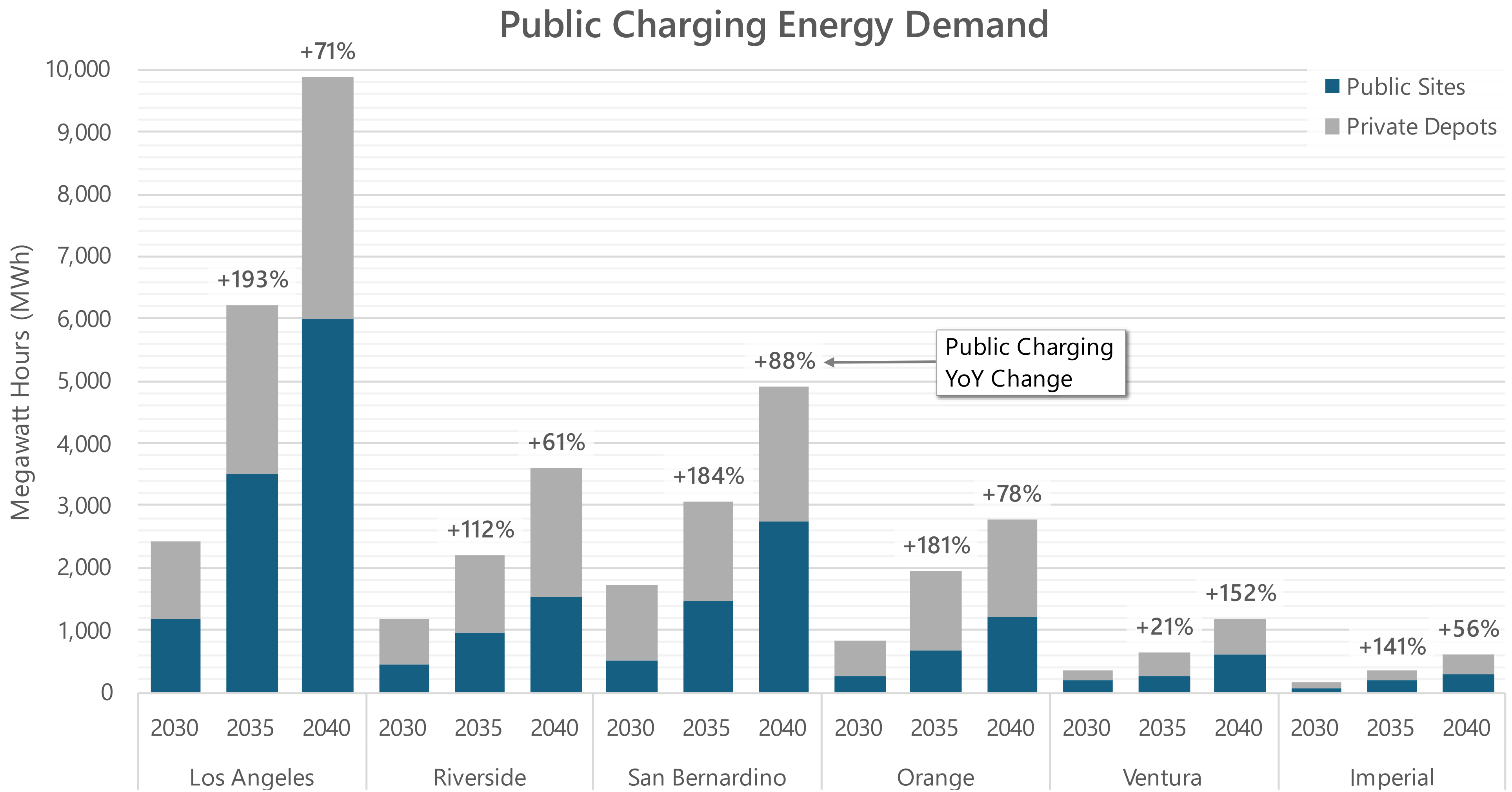
*Daily energy consumption in MW-h

Public Charging Energy Requirements by County – Horizon Years

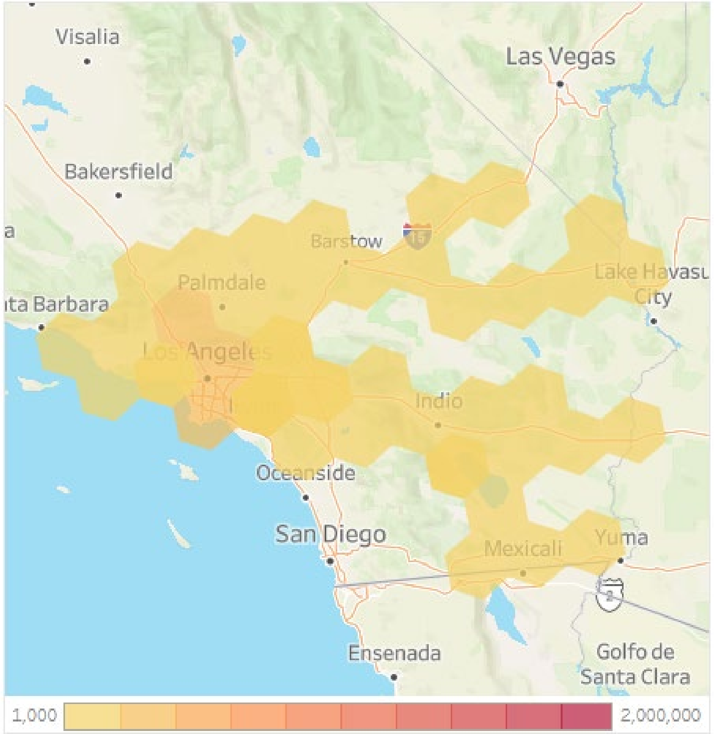
Counties	2030	2035	2040
Los Angeles	1,200(49%)	3,500(56%)	5,990(61%)
Riverside	450(38%)	960(43%)	1,530(42%)
San Bernardino	520(30%)	1,460(48%)	2,750(56%)
Orange	240(29%)	680(35%)	1,220(44%)
Ventura	200(59%)	240(38%)	610(52%)
Imperial	70(43%)	180(53%)	280(45%)
Total	**2,680(40%)**	**7,020(49%)**	**12,370(54%)**

*Daily energy consumption in MW-h (% of total energy demand)

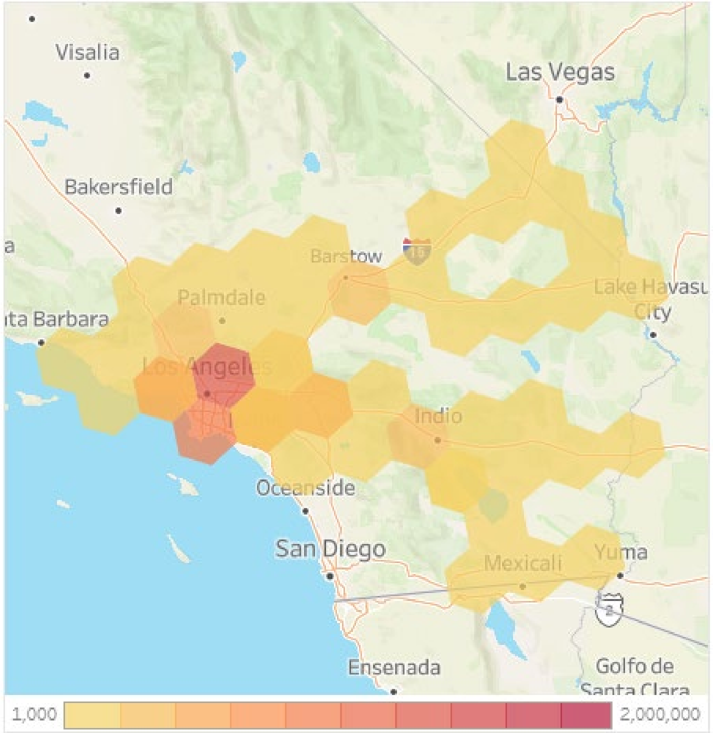
Comparing Public vs Private Total Energy Requirements by County – Horizon Years



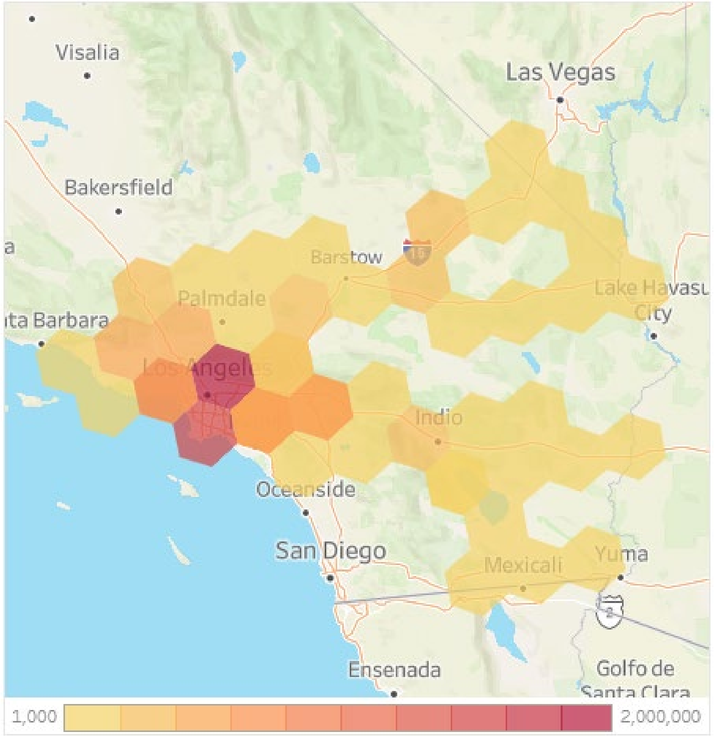
SCAG Public Charging Energy Heat Map



Regional Energy Heat Map
2030



Regional Energy Heat Map
2035



Regional Energy Heat Map
2040

SMOOTHING ENERGY OUTPUTS INTO ACTIONABLE INSIGHTS

Smoothing Techniques

Apply smoothing techniques to convert energy model outputs into practical solutions that quantify number of sites necessary in a sub-area, the number of chargers needed at each site, and the energy capacity.

Why is Smoothing Important

Performance Indicator	Model Outputs	We need to account for…
Energy Demand by Geography	Significant variability in energy demand and temporal profiles at adjacent sites due to variation in travel behavior	In real life, load balancing occurs (as in highway travel) and we expect somewhat consistent load profiles to show up in nearby sites
Energy Demand by Time-of-Day	Does not account for electricity rates – charging occurs purely based on travel demand	Over time, especially domiciled trucks, will charge during off-peak hours.
Peak Energy Demand	Unconstrained charging results in spiky peak hours thereby driving up peak capacity.	Significant unused capacity means sites are unlikely to be developed.
Site Sizing	Larger sites need more land and significant investment in utility upgrades	Different combinations of # of chargers and charger capacity can provide more creative solutions

Smoothing Techniques

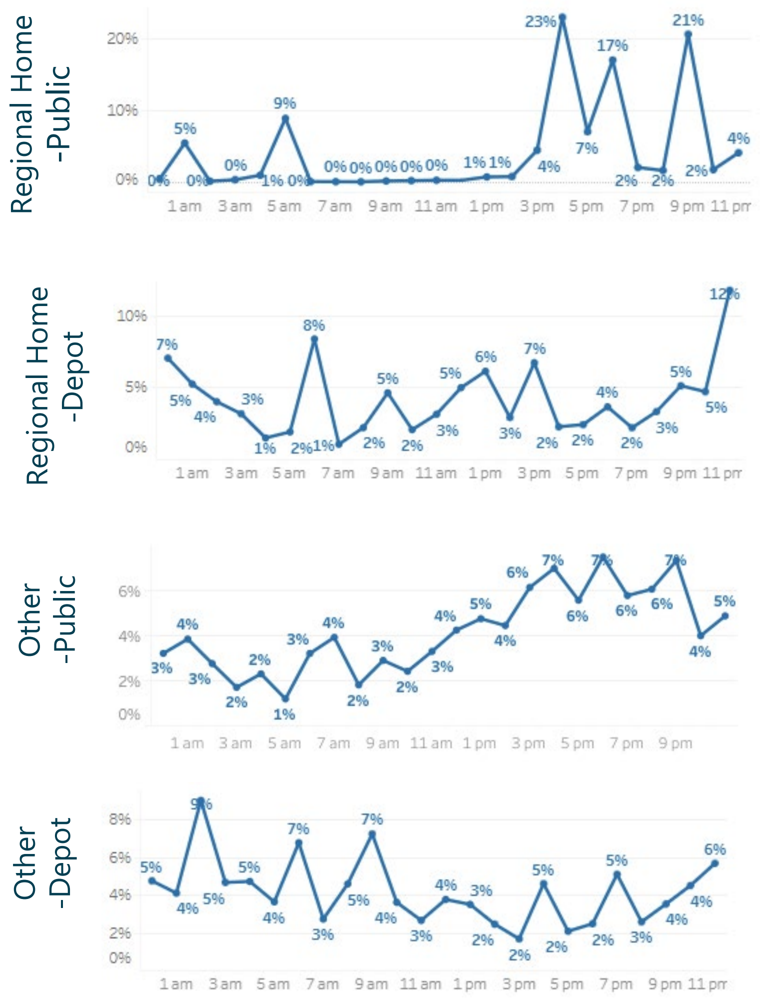
1. Aggregate energy needs at 1,000 public charging sites into 175 statewide zones with public charging needs at hex-bin 4 geography*.
2. Document travel and energy profiles for each hex-bin 4. Cature total energy and peak capacity. Utilize truck travel by market segment and energy needs by time-of-day to adjust energy indicators.
3. Test different combinations of number of sites, chargers, and peak grid capacity that will serve the energy requirements.

*Hex-bin 4 area: approximately 346 square miles (896 square kilometers)

Smoothing Rules

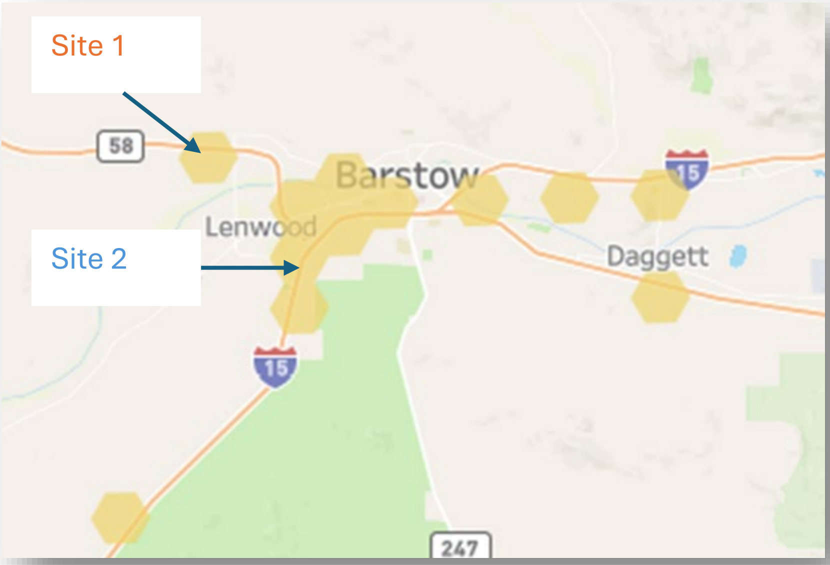
1. **Max. Charge Capacity Calculations:** *No single hour can serve more than 20% of daily energy needs at a site.*
2. **Reallocation for Depot Charging//all market segments & Public Charging//regional-home market segment:** *Distribute excess charging demand between night and early morning (6 pm to 6 am) based on the existing distribution of charging profiles,*
3. **Reallocation for Public Charging for all other market segments:** *Distribute excess charging demand based on the temporal distribution of truck travel.*

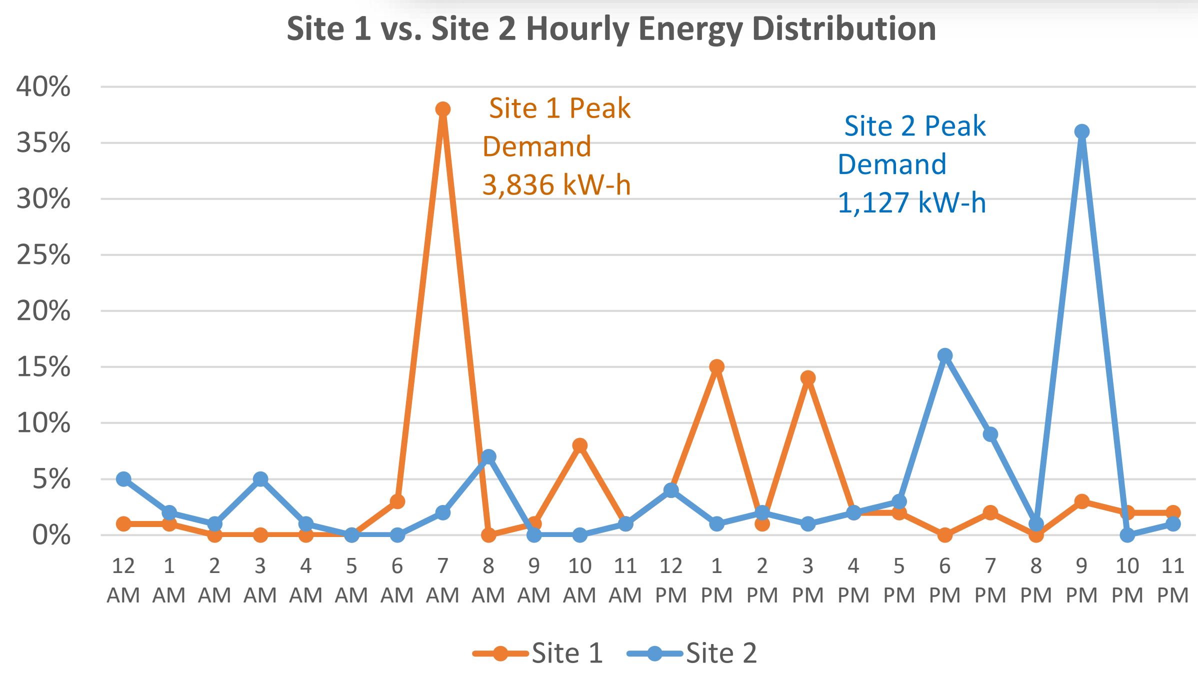
Statewide Hourly Energy Distribution from Model



Case Study from Barstow

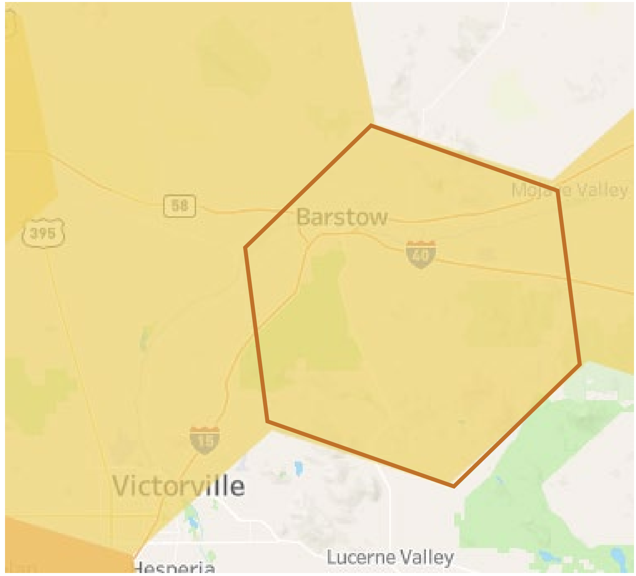
- Public energy consumption occurs at 12 sites with 12 unique energy profiles.
- The grid capacity and hourly energy demand vary dramatically for neighboring sites.
- From a practical/developer perspective, this is not useful information and creates too much uncertainty.

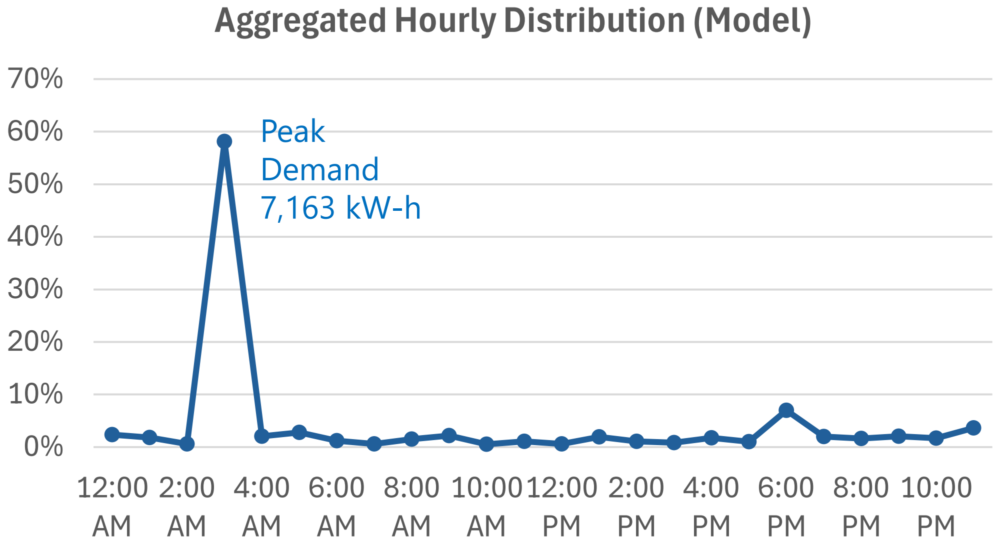




Case Study from Barstow

- We aggregate all 12-sites into a single profile for Barstow
- Understand the total energy needs and the travel markets that are operating in Barstow.





Profile:

- **Total daily energy consumption:** 123.5 MW-h
- **Public daily energy consumption:** 35 MW-h
- Primarily serves **Heavy-Duty Trucks**:
  - > 90% of charging events & energy consumption
  - 65% long haul, 25% drayage

Case Study from Barstow

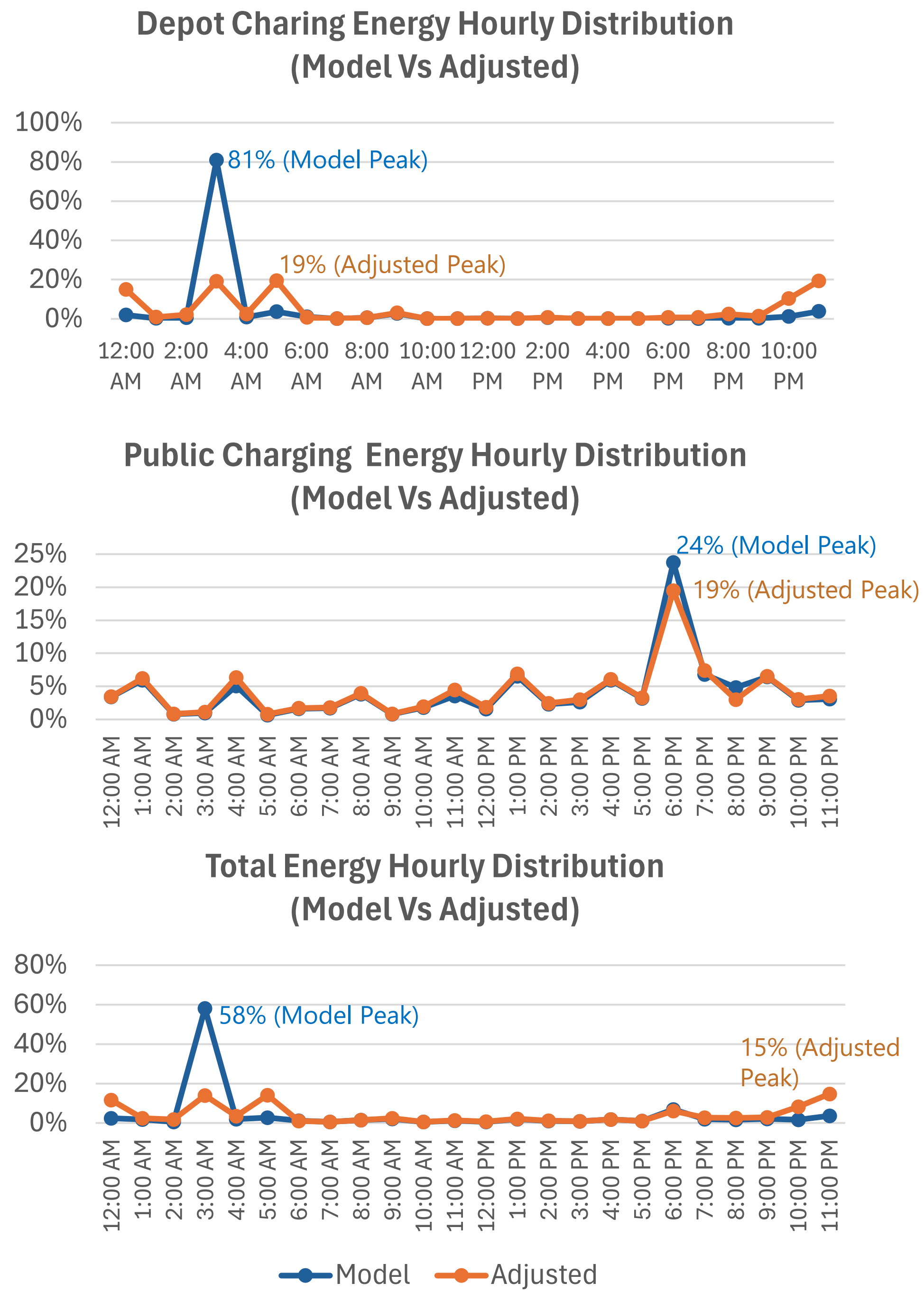
- Energy reallocations to smooth the time-of-day load curve.

Original Profile

- **Grid Capacity for Public Site** 8.3 MW-h (24% of daily public energy demand)
- **Can be served by** 11-17 750 kwh or 24-36 350 kwh chargers

Adjusted Profile

- **Grid Capacity for Public Site** 7 MW-h (19% of daily public energy demand)
- **Can be served by** 10-15 750 kwh or 20-30 350 kwh chargers



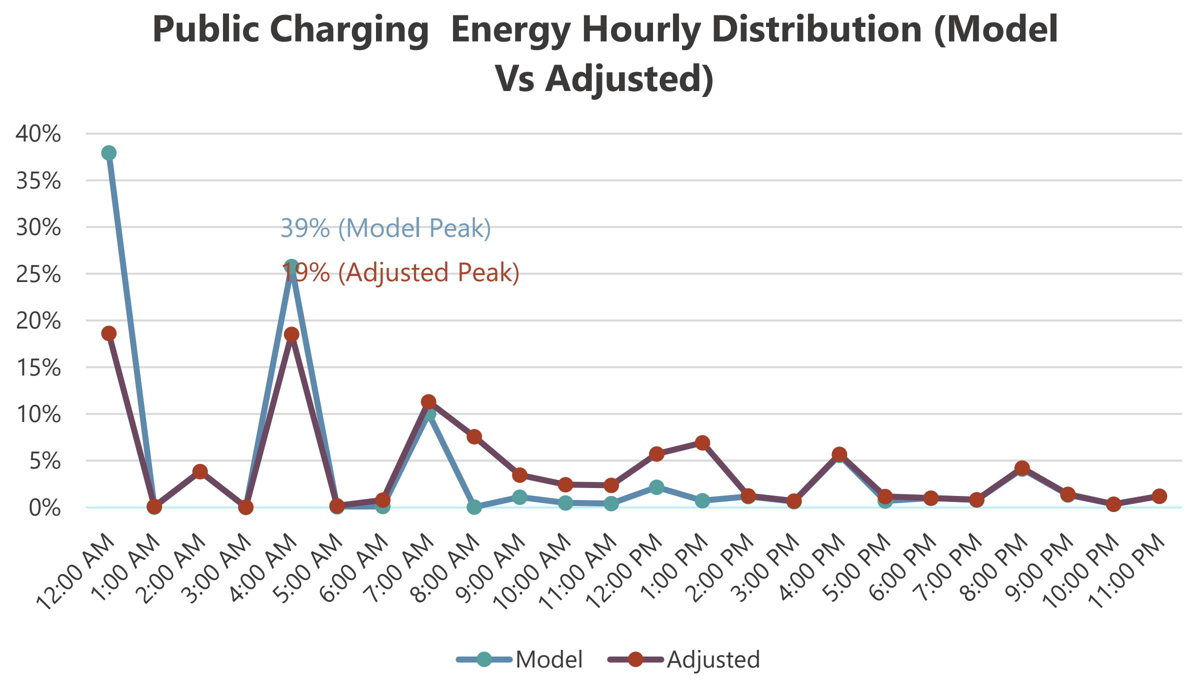
Sites Needs Example

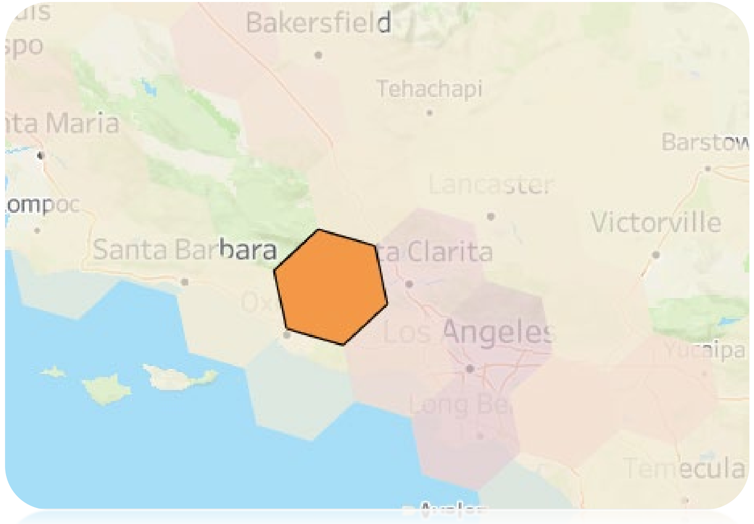
Original Requirements

- **Grid Capacity** 42 MW-h

Number of chargers:
120-180 350kW or 57-85 750 kW

1 large Site or 4-6 medium sites





Adjusted Requirements

- **Grid Capacity** 21 MW-h
- **Number of Chargers:**
  60-90 350kW or 30-52 750kW
- **Better load profile and greater utilization throughout the day**

Q&A and General Comments

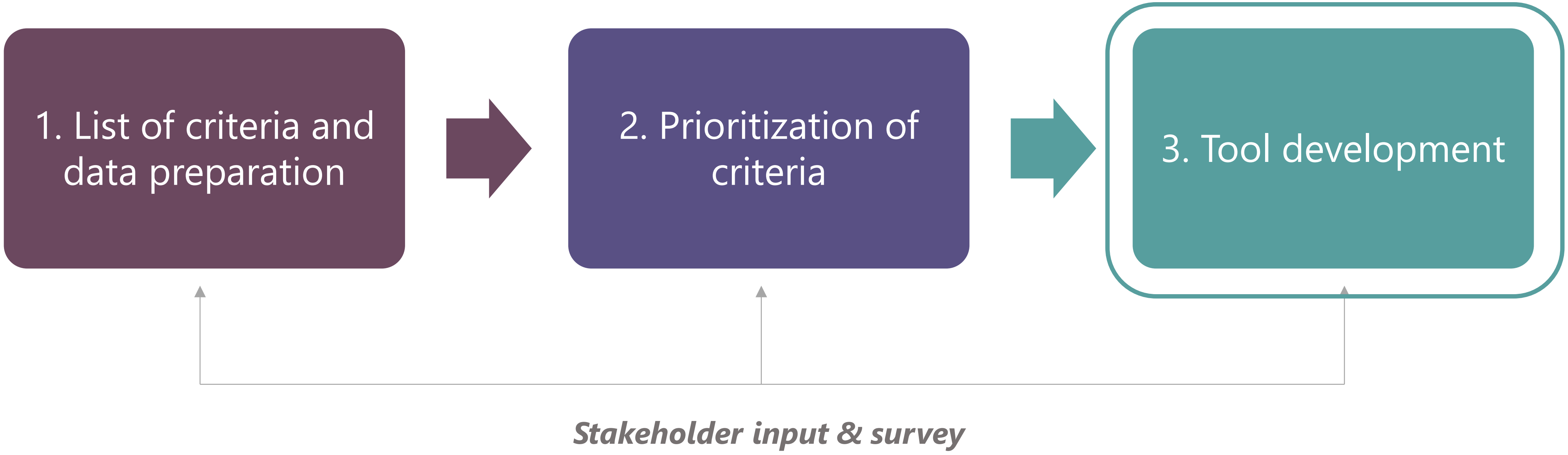
Do you have specific questions about any of the processes discussed?

What are your thoughts regarding the preliminary results?

SITING TOOL AND SITE ASSESSMENTS CONTINUED

Siting Analysis – Recap

- The siting tool is designed to enable stakeholders to assess different scenarios for prioritizing locations for the development of electric vehicle (EV) charging and hydrogen (H2) refueling infrastructure.
- Multi-criteria decision making analysis (MCDA) approach to prioritize sites



Location Criteria & Site Typologies Recap

Utilization

Land

Equity

Grid capacity

Environmental

Electric

Small Facilities	10 dual port chargers
	Minimum of 20 parking spots
	Land Space: 60,000 sq. ft. *(3,000 sq.ft. per spot)*
	Grid Capacity: 3 MW
	500 truck trips a day *(assuming each truck stops for 1 hr and charging facilities are operational 24 hrs)*
Medium Facilities	25 dual port chargers
	Minimum of 50 parking spots
	Land Space: 150,000 sq. ft.
	Grid Capacity: 7.5 MW
	1,200 truck trips a day
Large Facilities	40 dual port chargers
	Minimum of 80 parking spots
	Land Space: 240,000 sq. ft.
	Grid Capacity: 12 MW
	2,000 truck trips a day

Hydrogen

Small Facilities	1,000 kg/day
	2 dispenser units
	32 trucks per day *(assuming hydrogen tank capacity of 31 kg)*
	10,000 sq.ft.
Medium Facilities	3,000 kg/day
	6 dispenser units
	96 trucks per day
	30,000 sq.ft.
Large Facilities	6,000 kg/day
	12 dispenser units
	193 trucks per day
	60,000 sq.ft.

Siting Tool

Site Assessments

- Select a sample of sites and conduct detailed site assessments, capturing variations in the typologies and use cases (24 site assessments)

Note: These sites are used solely for analysis and case study purposes and should not be interpreted as recommendations for ZEV infrastructure deployment

Two zero-emission vehicle infrastructure

- Electric
- Hydrogen

Three typologies

- Small
- Medium
- Large

Four use cases

- En-Route
- Site
- Urban
- Mixed

Use Cases

En-Route refueling

- Along highways
- Pull-through configurations
- Megawatt charging system
- Larger H2 storage tanks

Site refueling

- Near destinations
- Pull-in configurations
- Moderate charger power level
- Moderate to large H2 storage tanks

Urban refueling

- Shorter routes/near delivery routes in urban areas
- Pull-in configurations
- Moderate charger power level
- Moderate H2 storage tanks

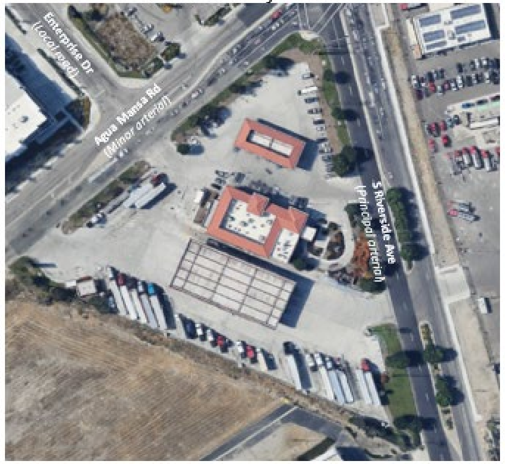
Mixed

Combine aspects of highway, destination and/or urban use cases

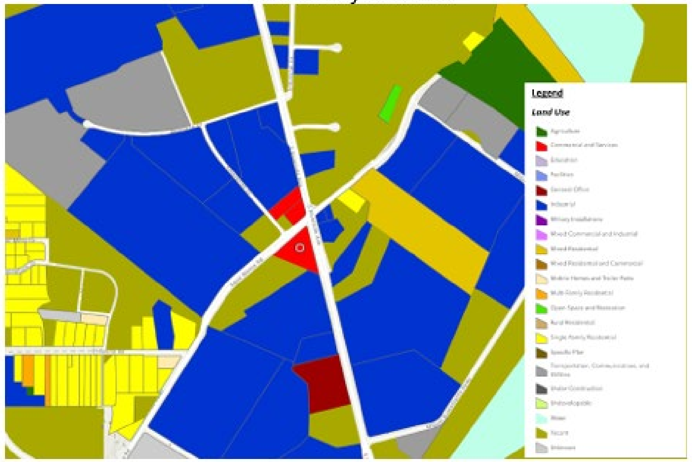
Site Assessments- Preliminary Example

Medium Facility: Mixed Use Case

Aerial view of location



Land use information



Facilities General Characteristics

- Existing Truc Parking? **Yes**
- Parcel size: **151,589 sq. ft**
- Truck parking spaces: **30**
- Urban/Rural: **Urban**
- Property Ownership: **Private**
- Site lane use: **Commercial and services**
- Site primary neighborhood land use(s): **Industrial, Mixed residential and commercial**
- Estimated daily truck visits: **144-720**
- Available load capacity (SCE): **0.77MW**

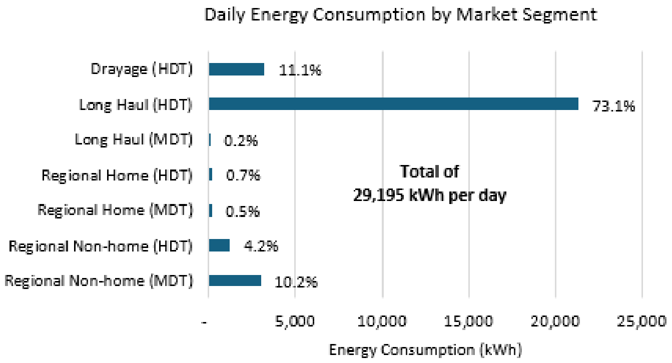
Site Suitability Scoring

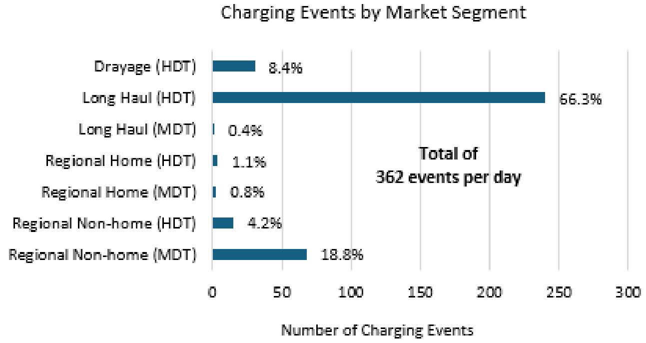
Overall Score: X

Detailed Score (0-10):

8	ZEV Volume
6	Daily Mileage
9	Existing Truck Parking
2	Scalability
5	Land Price
9	Amenities
9	Access, Congestion, Safety
0	Proximity to Other ZEV Infrastructure
8	Load Capacity
6	Ability to Integrate DERs
0	Proximity to Disadvantaged Communities
5	Direct Benefit to Disadvantaged Communities
9	Flood Risk
9	Brownfields

Charging Demand Within Two Mile Radius in 2030



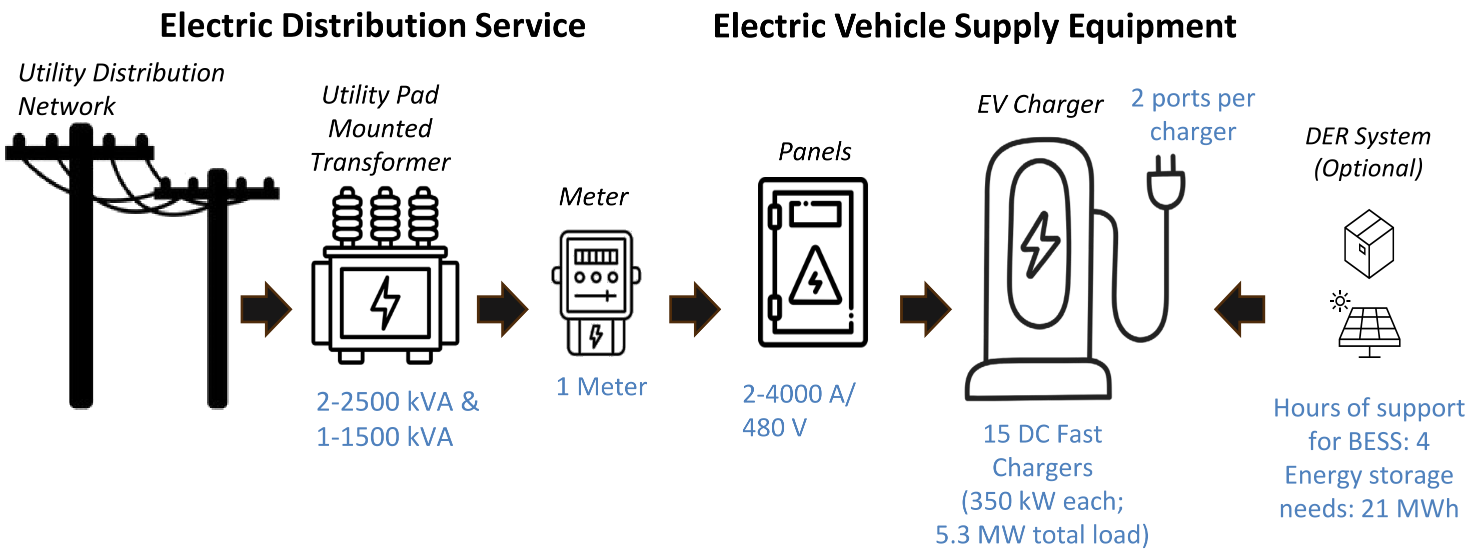


Similar information reported for electric and hydrogen infrastructure

Site Assessments- Example (EV)

Medium facility, mixed use case

Proposed EV charging infrastructure characteristics



EV charging infrastructure costs

EV Charger

Hardware & Installation: $3,383,611

Operation & Maintenance (O&M) Costs (5 years): $1,403,363

Total: $4.8 M

Facility Electrical Infrastructure

Panel Cost: $138,000

Panel Installation: $27,600

Electric Meters: $2,500

Conduit/Trenching: $69,375

Permitting: $3,562

Total: $241,037

Land Acquisition Cost

Sales price per sq. ft: $37.34 per sq.ft

Total: $ 5.7 M

Utility Electrical Infrastructure

Transformer Cost: $447,079

Transformer Installation: $89,416

Reconductoring: $123,000

Total: $659,495

Distributed Energy Resources (DER) Integration

Battery Energy Storage System Cost: $5,670,000

PV cost: $6,300,000

Total: $ 11,970,000

Total Investment (minus DER integration): $ 11.3 M

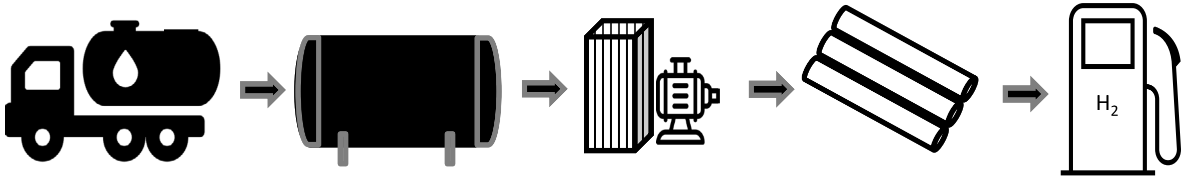
Notes: All dollar amounts are presented in 2023 USD

Site Assessments-Example (H_2)

Medium facility, urban use case

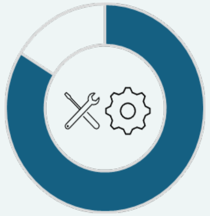
Proposed Hydrogen Infrastructure Characteristics

Liquid Truck Delivery



Truck and liquid trailer	Liquid hydrogen storage tank	Liquid hydrogen pump and vaporizer	Compressed hydrogen storage tanks	Dispenser
	Storage capacity: 3,000 kg/day			6 dispensers, 2 nozzles per dispenser

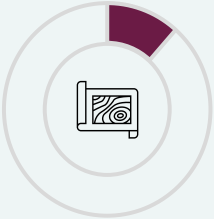
Hydrogen infrastructure key costs



Capital Cost

Cost per kg: $5,000 per kg/day

Total: $ 15 M



Land Acquisition Cost

Sales price per sq. ft: $46.02 per sq.ft

Total: $ 2.4 M

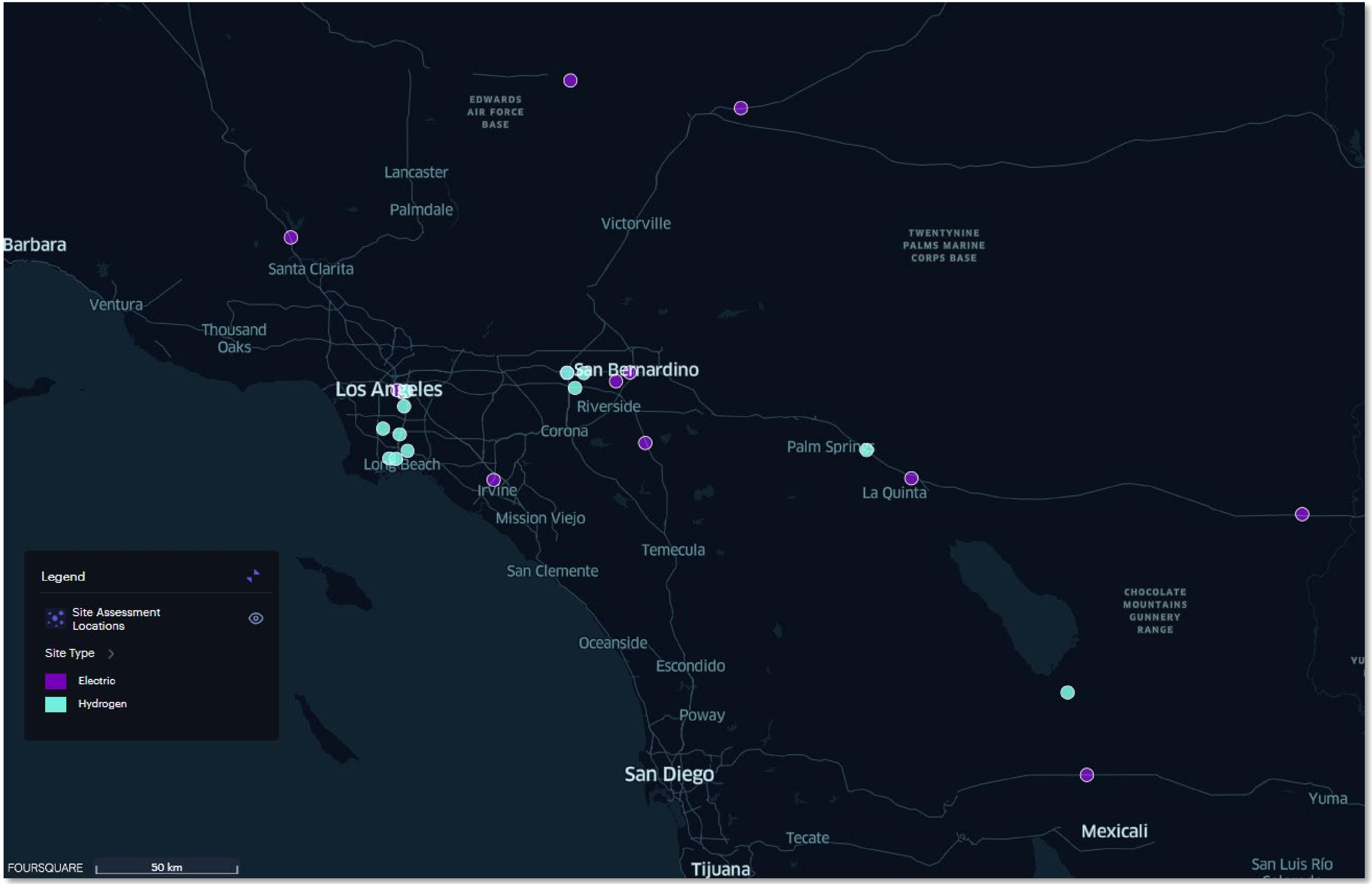
Total Investment: $ 17.4 M

Notes: All dollar amounts are presented in 2023 USD

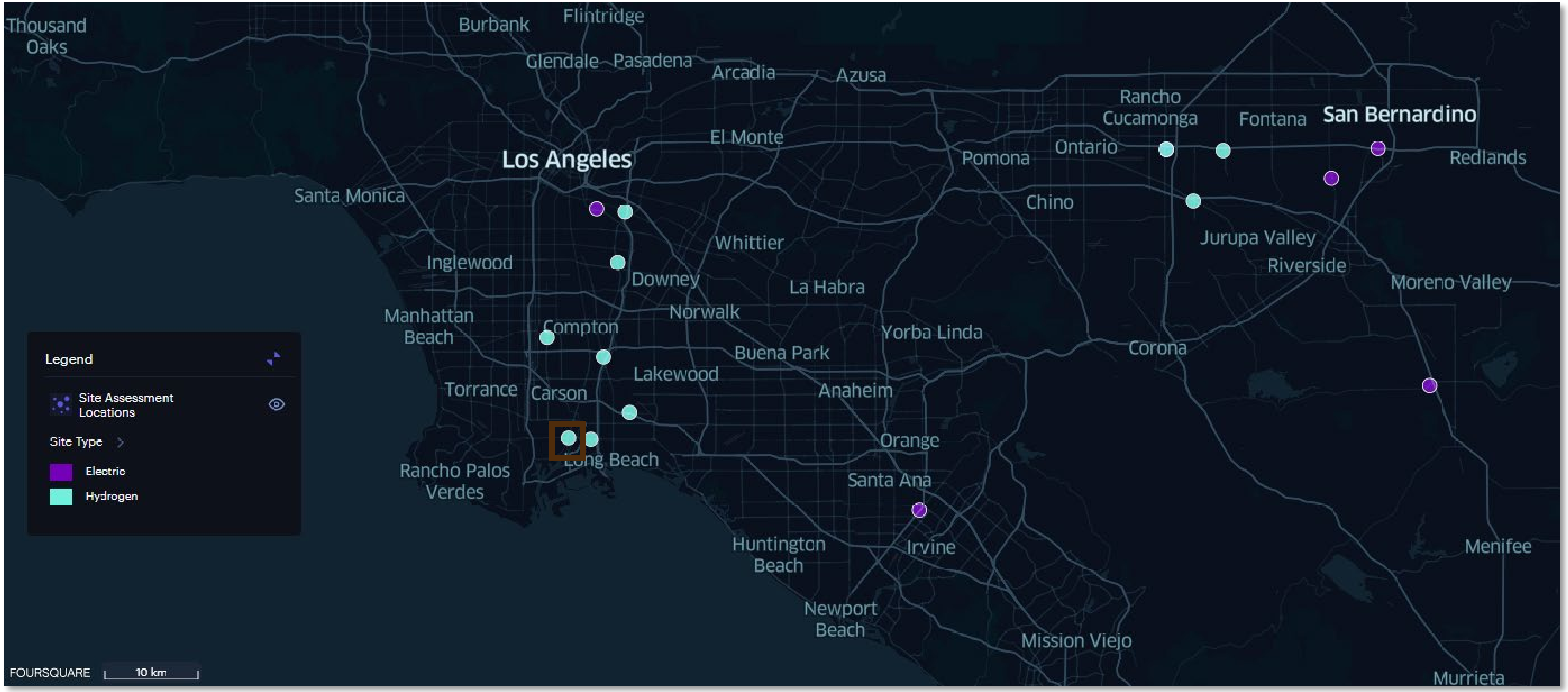
Site Assessments- Maps

24 sites

- 12 EV infrastructure
- 12 Hydrogen infrastructure

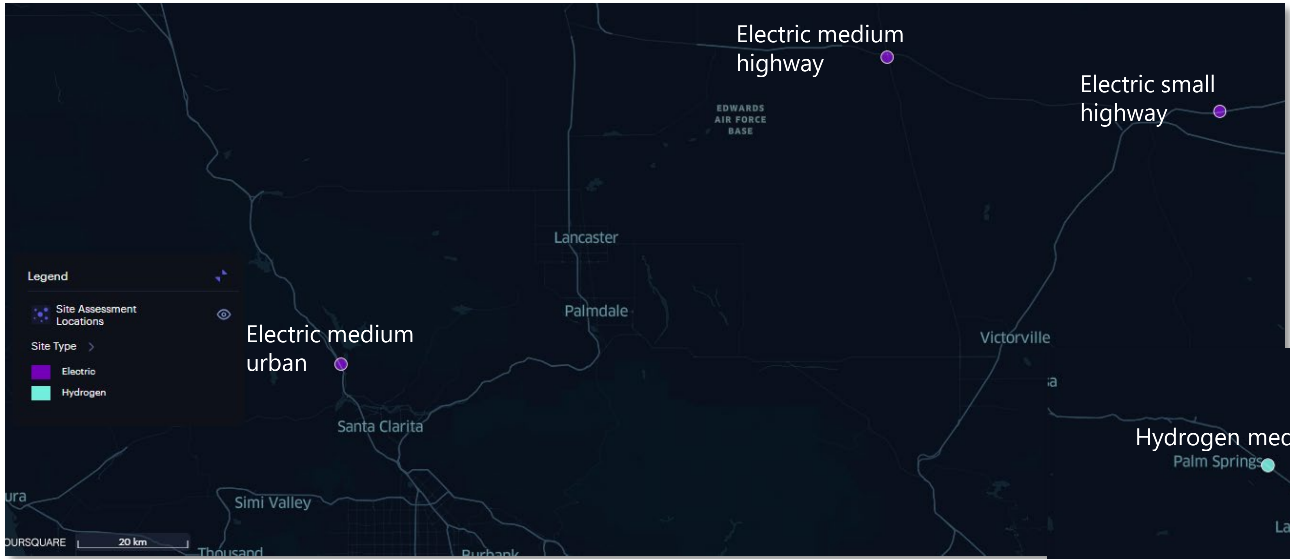


Site Assessments-Maps



Example:
-Hydrogen medium destination

Site Assessments-Maps



Example:
-Electric large highway

Q&A and General Comments

Do you have specific questions about any of the processes discussed?

What are your thoughts regarding the presented information?

NEXT STEPS

Next Steps: Modeling Refinement/Scenarios

- Run Additional Modeling Scenarios
  - *ZEV adoption – vary by truck market segment*
  - *ZEV adoption – pivot off AATE3 adoption rates as plausible alternative futures*
  - *Incorporate Hydrogen*
- Run for multiple future years in the 2030, 2035, & 2040 horizon year
- The modeling results will help us understand where we need to build ZE charging and refueling sites and help prioritize sites

Next Steps: Siting Tool and Site Assessments

- Incorporate feedback
- Conduct QA/QC
- Develop user guide & metadata requirements
- Complete site assessments

Next Steps: Project Overall

- Integrate the two technical streams of work – modeling and siting
- Run Final Scenarios to help inform the Blueprint
- Finalize all Site Assessments for the Blueprint
- Develop draft of Blueprint & Regional Action Plan

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THANK YOU!

For more information, please visit:

https://scag.ca.gov/socalzeti

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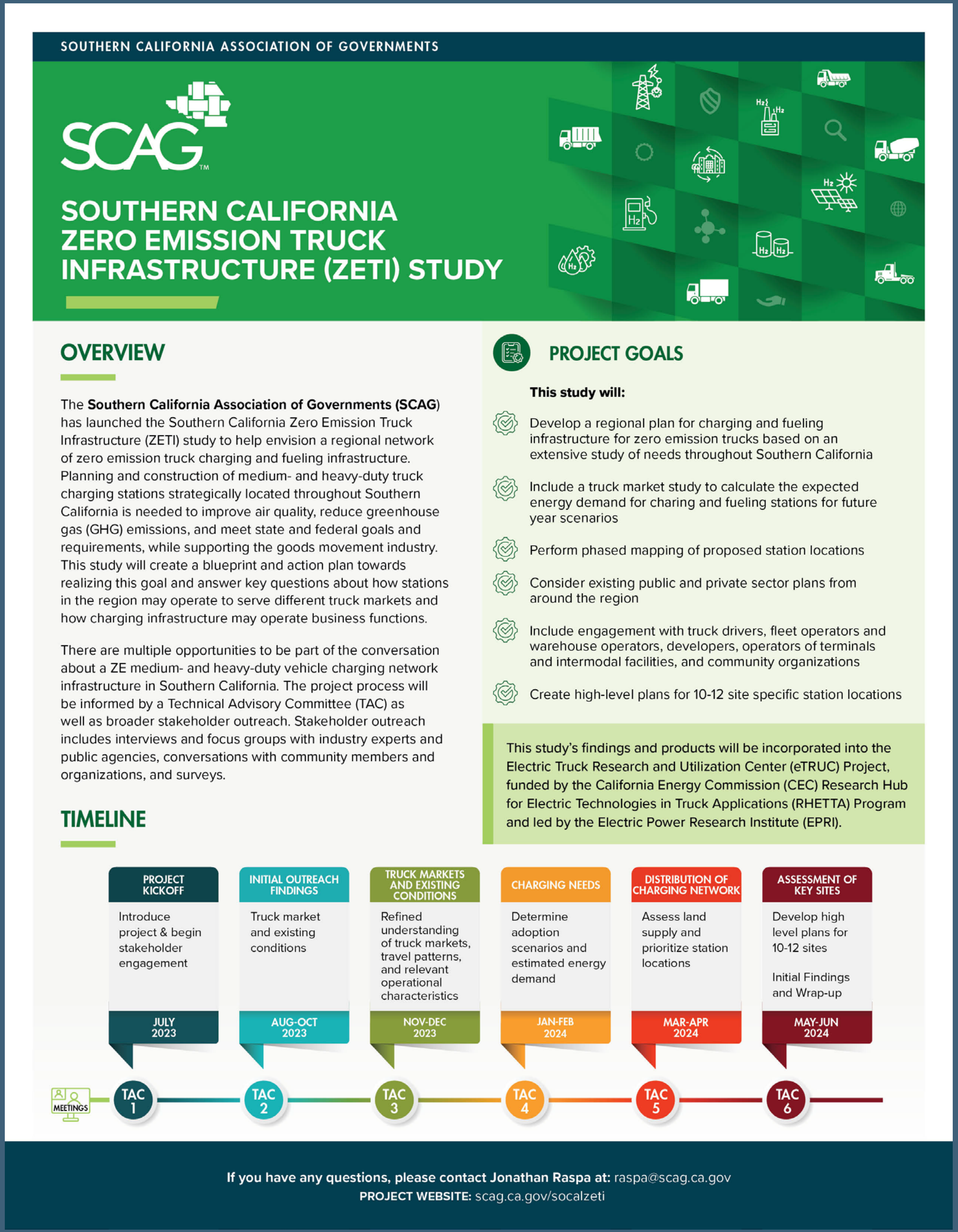

SOUTHERN CALIFORNIA ASSOCIATION OF GOVERNMENTS

SCAG

SOUTHERN CALIFORNIA ZERO EMISSION TRUCK INFRASTRUCTURE (ZETI) STUDY

OVERVIEW

The **Southern California Association of Governments (SCAG)** has launched the Southern California Zero Emission Truck Infrastructure (ZETI) study to help envision a regional network of zero emission truck charging and fueling infrastructure. Planning and construction of medium- and heavy-duty truck charging stations strategically located throughout Southern California is needed to improve air quality, reduce greenhouse gas (GHG) emissions, and meet state and federal goals and requirements, while supporting the goods movement industry. This study will create a blueprint and action plan towards realizing this goal and answer key questions about how stations in the region may operate to serve different truck markets and how charging infrastructure may operate business functions.

There are multiple opportunities to be part of the conversation about a ZE medium- and heavy-duty vehicle charging network infrastructure in Southern California. The project process will be informed by a Technical Advisory Committee (TAC) as well as broader stakeholder outreach. Stakeholder outreach includes interviews and focus groups with industry experts and public agencies, conversations with community members and organizations, and surveys.

PROJECT GOALS

This study will:

- Develop a regional plan for charging and fueling infrastructure for zero emission trucks based on an extensive study of needs throughout Southern California
- Include a truck market study to calculate the expected energy demand for charing and fueling stations for future year scenarios
- Perform phased mapping of proposed station locations
- Consider existing public and private sector plans from around the region
- Include engagement with truck drivers, fleet operators and warehouse operators, developers, operators of terminals and intermodal facilities, and community organizations
- Create high-level plans for 10-12 site specific station locations

This study's findings and products will be incorporated into the Electric Truck Research and Utilization Center (eTRUC) Project, funded by the California Energy Commission (CEC) Research Hub for Electric Technologies in Truck Applications (RHETTA) Program and led by the Electric Power Research Institute (EPRI).

TIMELINE

PROJECT KICKOFF	INITIAL OUTREACH FINDINGS	TRUCK MARKETS AND EXISTING CONDITIONS	CHARGING NEEDS	DISTRIBUTION OF CHARGING NETWORK	ASSESSMENT OF KEY SITES
Introduce project & begin stakeholder engagement	Truck market and existing conditions	Refined understanding of truck markets, travel patterns, and relevant operational characteristics	Determine adoption scenarios and estimated energy demand	Assess land supply and prioritize station locations	Develop high level plans for 10-12 sites Initial Findings and Wrap-up
JULY 2023	AUG-OCT 2023	NOV-DEC 2023	JAN-FEB 2024	MAR-APR 2024	MAY-JUN 2024
TAC 1	TAC 2	TAC 3	TAC 4	TAC 5	TAC 6

MEETINGS

If you have any questions, please contact Jonathan Raspa at: raspa@scag.ca.gov
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