THE NETWORK OF *THE REVOLUTION*

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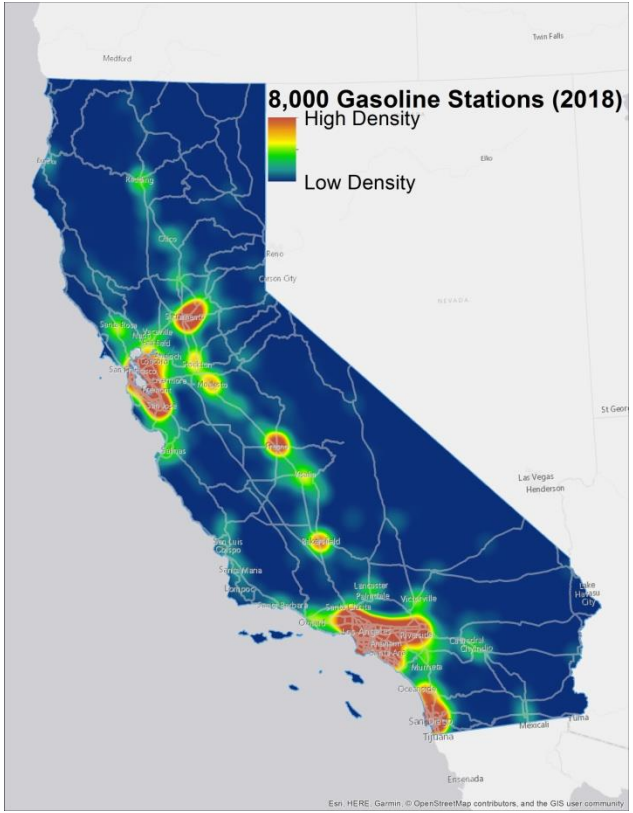
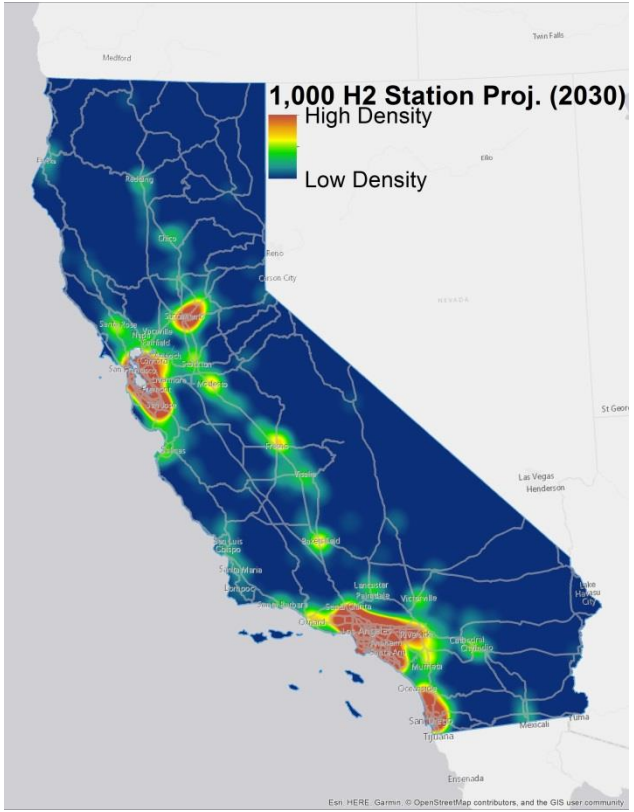
CALIFORNIA
AIR RESOURCES BOARD

The 2030 Network Vision

How did we arrive at the network in *The Revolution*, what does it provide, and how can we get there?

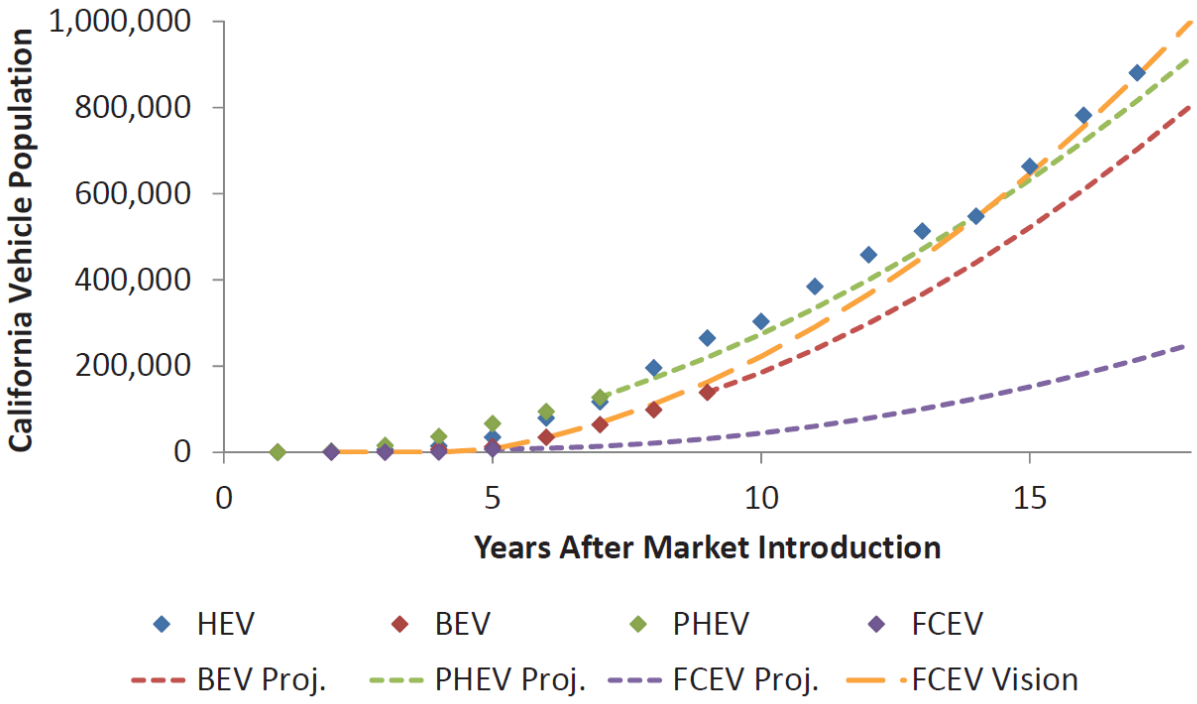




DEFINING THE NETWORK OF *THE REVOLUTION*

Why 1M FCEVs by 2030?

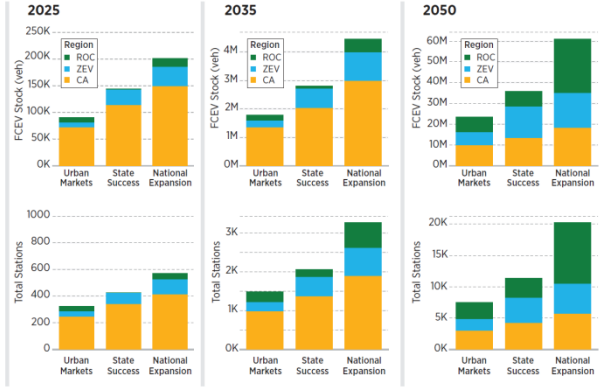
Business-as-Usual projections do not indicate mass-market FCEV entry



Why 1M FCEVs by 2030?

Independent studies confirm 1M FCEVs and 1k stations by 2030 is a reasonable expectation

*From H2USA Locations Roadmap Working Group Publication *National Hydrogen Scenarios (2017)*



*From Hydrogen Council Publication *Hydrogen Scaling Up (2017)*

2030 milestones

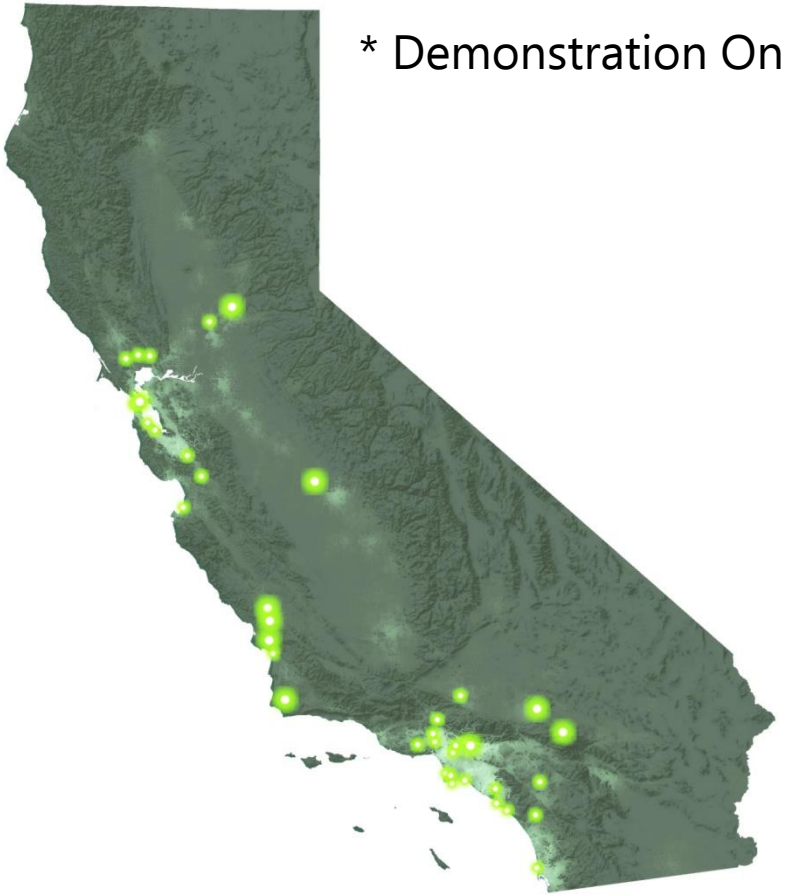
- 1 in 12 cars in Germany, Japan, South Korea, and California powered by hydrogen
- Globally 10 to 15 million cars and 500,000 trucks powered by hydrogen
- Deployment of hydrogen-powered trains and passenger ships

2050 target picture

- Up to 400 million passenger vehicles (~25%), 5 million trucks (~30%), and more than 15 million buses (~25%) running on hydrogen
- 20% of today's diesel trains replaced with hydrogen- powered trains
- 20 million barrels of oil replaced per day, 3.2 Gt CO_2 abated per year

Station Location Method

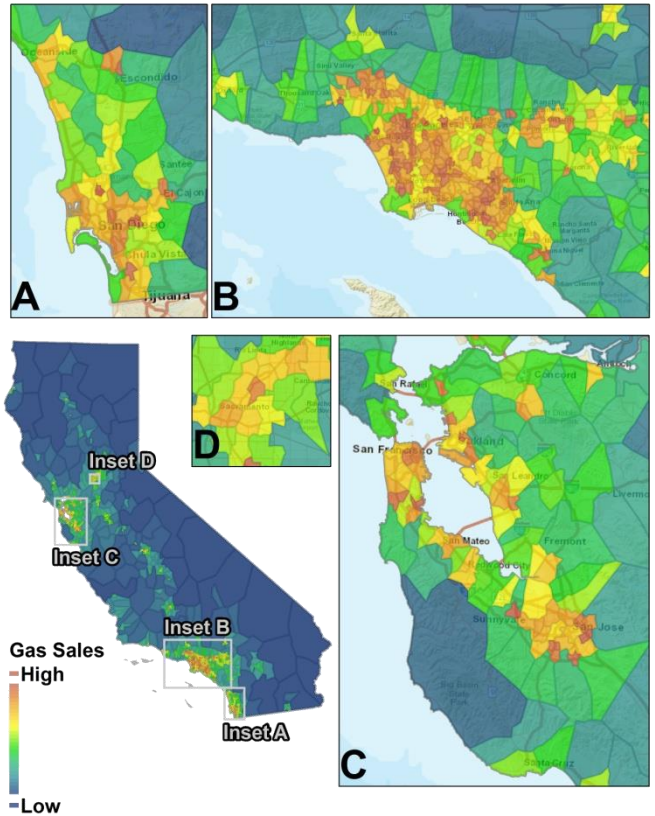
Iterative placement of stations using CHIT based on combined capacity and coverage evaluation



* Demonstration Only

Station Location Method

Key input became gas station density template to tune hydrogen station density



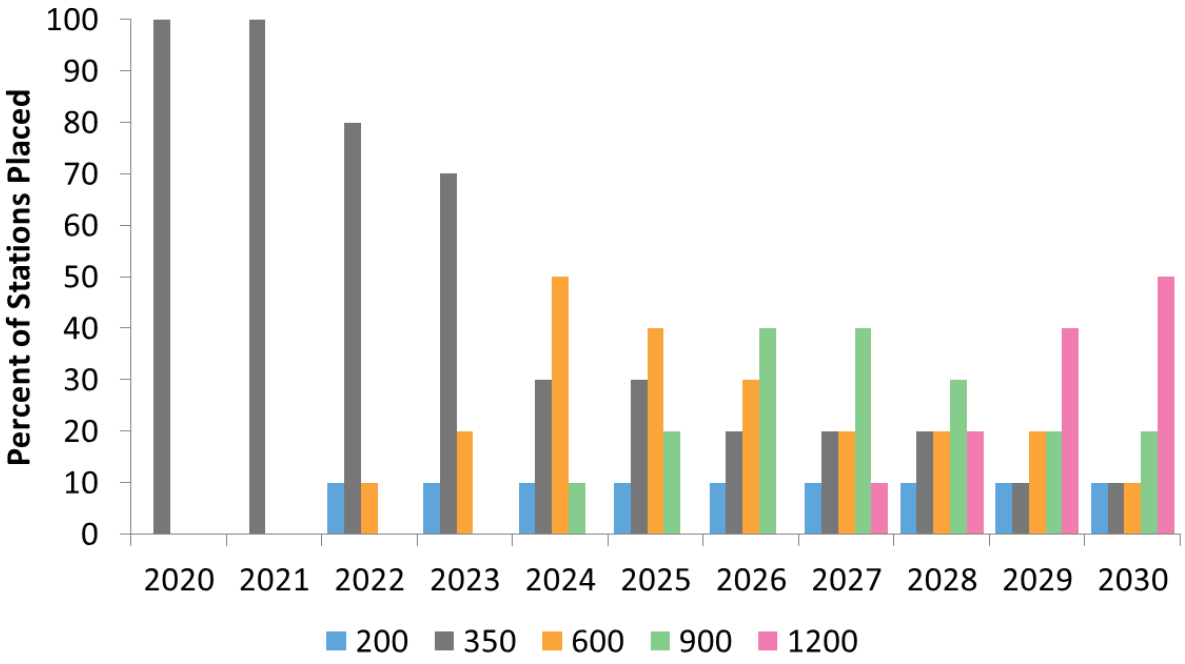
Source: Air Resources Board analysis of Energy Commission PIIRA form CEC-A15 results

- Limited to two hydrogen stations per polygon
- Polygons semi-optimized to contain *at least* 10 gas stations

Network Composition

As Network Develops…

- Average Station Capacity Grows
- Network Becomes More Varied
- Smaller Stations Become Less Common
- Definition of "Small" Increases



Scenario Building Method

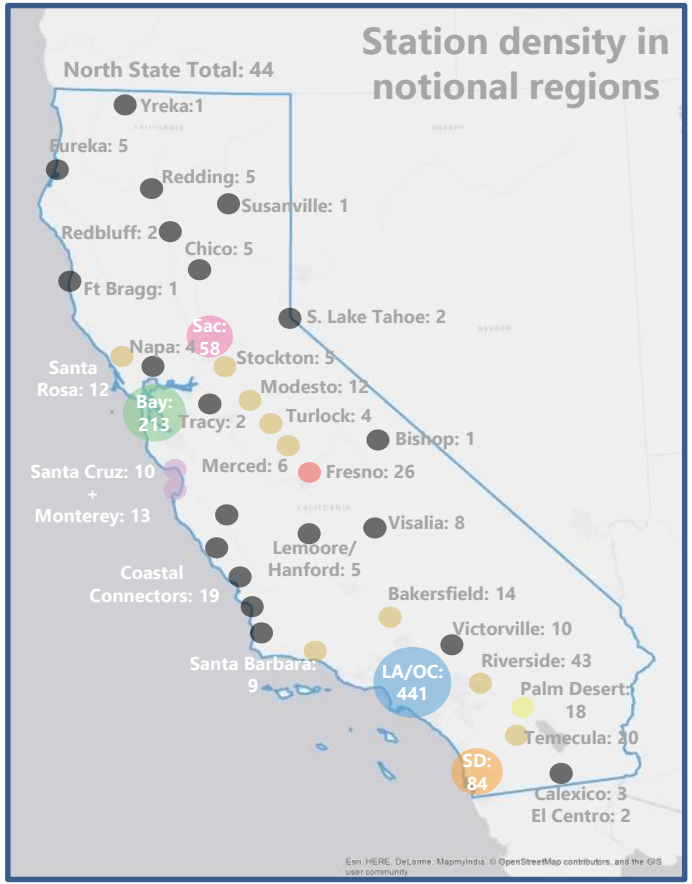
Iterative review of scenario analysis with CaFCP members to define assumptions and parameters

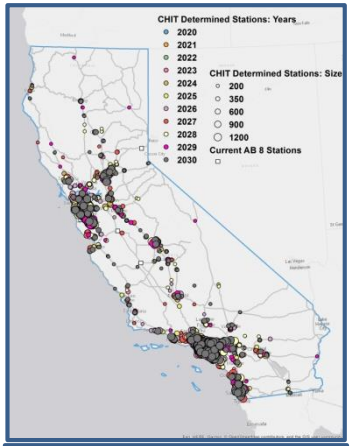
Evaluation	Method	Ratio Coverage: Capacity	Capacity Basis	Lock Out	Priority Areas: Recalculation Frequency	Priority Areas: Minimum Threshold	Available Station Locations	Gas Station Density Following	Evolving Station Size Distribution	Low Through-put Lockout	Early Adopter % Defined	Simulation Guiding Principle
A	1 (Highest Point Basis)	2:1	2030	Station Cell	N/A	N/A	Full State	No	No	No	No	"Where would we put hydrogen stations if we could put them anywhere in the state such that we optimize local capacity and coverage needs? What can we also learn about the order of these stations?"
B	1 (Highest Point Basis)	4:1	2030	Station and Adjacent Cells	N/A	N/A	Full State	No	No	No	No	
C	1 (Highest Point Basis)	4:1	Annually Variable	Station and Adjacent Cells	N/A	N/A	Full State	No	No	No	No	
D	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	Annual	Constant	Full State	No	No	No	No	
E	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	Every 30 stations	Constant	Full State	No	No	No	No	
F	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 3 stations in each	Constant	Full State	No	No	No	No	
G	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time	Full State	No	No	No	No	
H	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time	Restricted Around Gas Stations	Yes	No	No	No	"We have candidates for the optimal locations, but can only choose a subset. Which ones do we choose to optimize coverage and capacity, and in what order ?"
I	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time and starts broader	Restricted Around Gas Stations	Yes	No	No	No	
J	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time and starts broader	Restricted Around Gas Stations	Yes	Yes	No	No	
K	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time and starts broader	Restricted Around Gas Stations	Yes	Yes	Yes	No	
L	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time and starts broader	Restricted Around Gas Stations	Yes	Yes	Yes	Yes	
M	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time	Restricted Around Gas Stations	Yes	Yes	No	Yes	
N	2 (Highest Points within Priority Areas)	2:1	Annually Variable	Station and Adjacent Cells	After 1 station in each	Decreases over time	Restricted Around Gas Stations	Yes	Yes	Reduced	Yes	

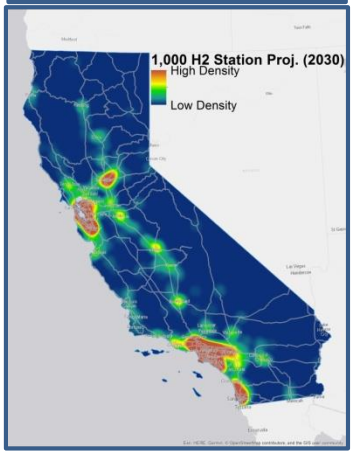
STRUCTURE OF THE NETWORK OF *THE REVOLUTION*

The Network of *The Revolution*

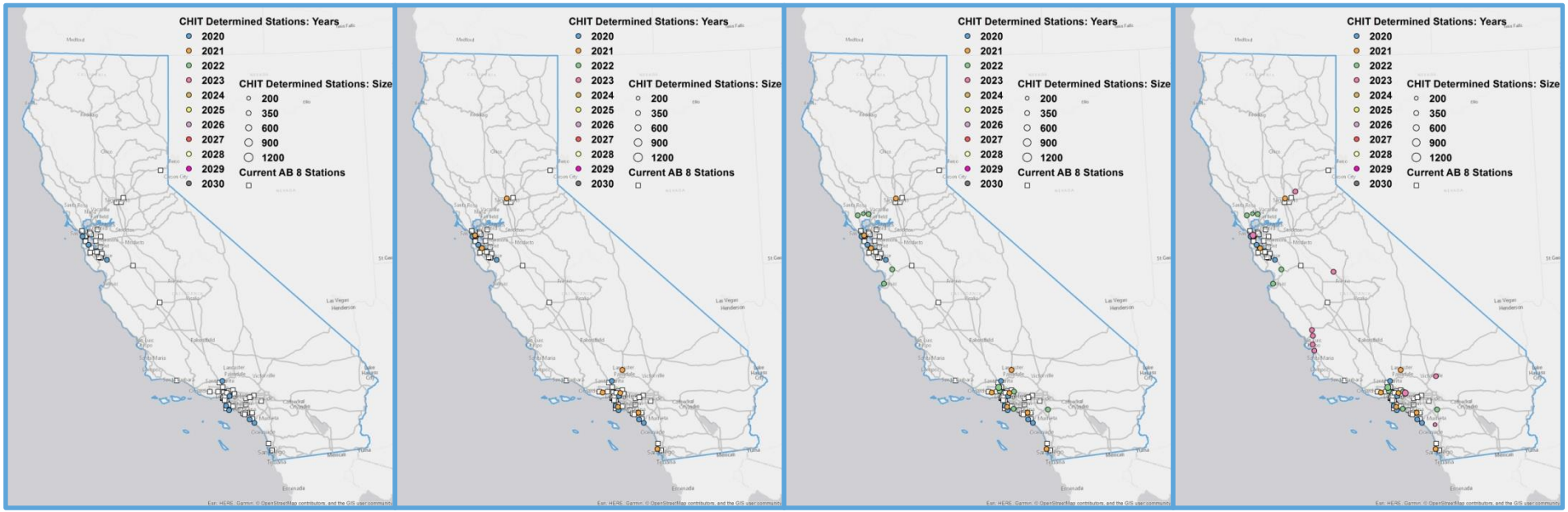
By 2030, the network coverage equivalent to gasoline, with stations densities led by core market demand and expanding market growth







Station Deployment by Year



2020
9 stations

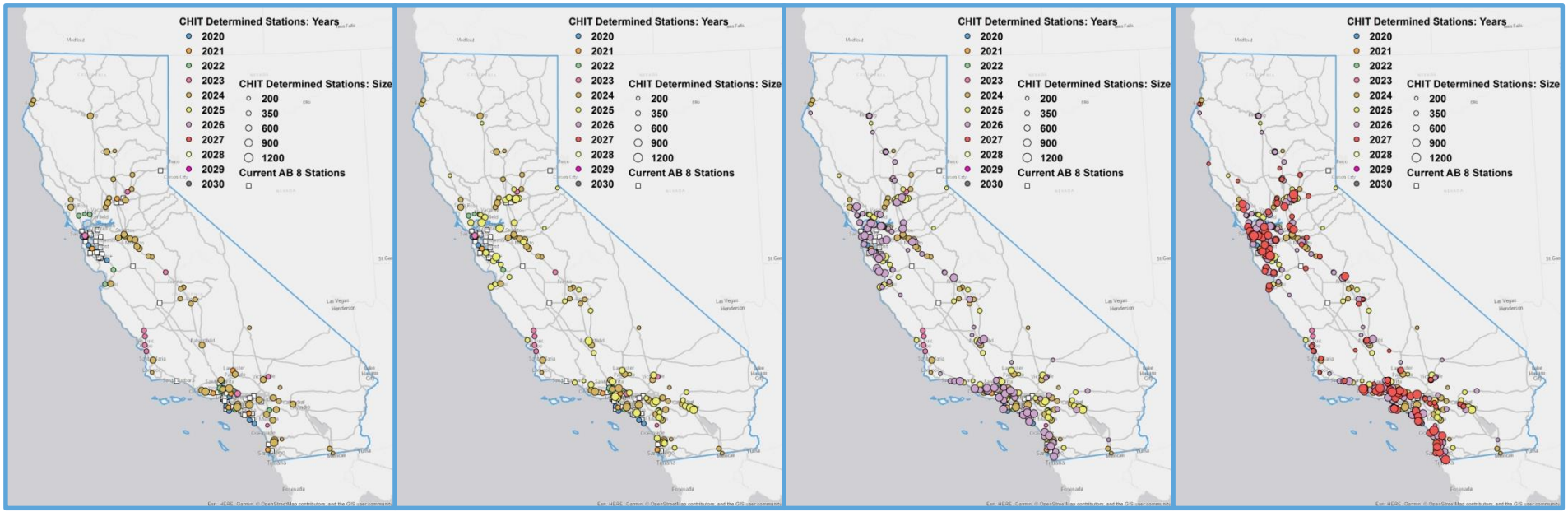
2021
9 stations

2022
10 stations

2023
10 stations

Within the timeline of AB 8, focusing on core markets with room for expansion to some fast-following markets

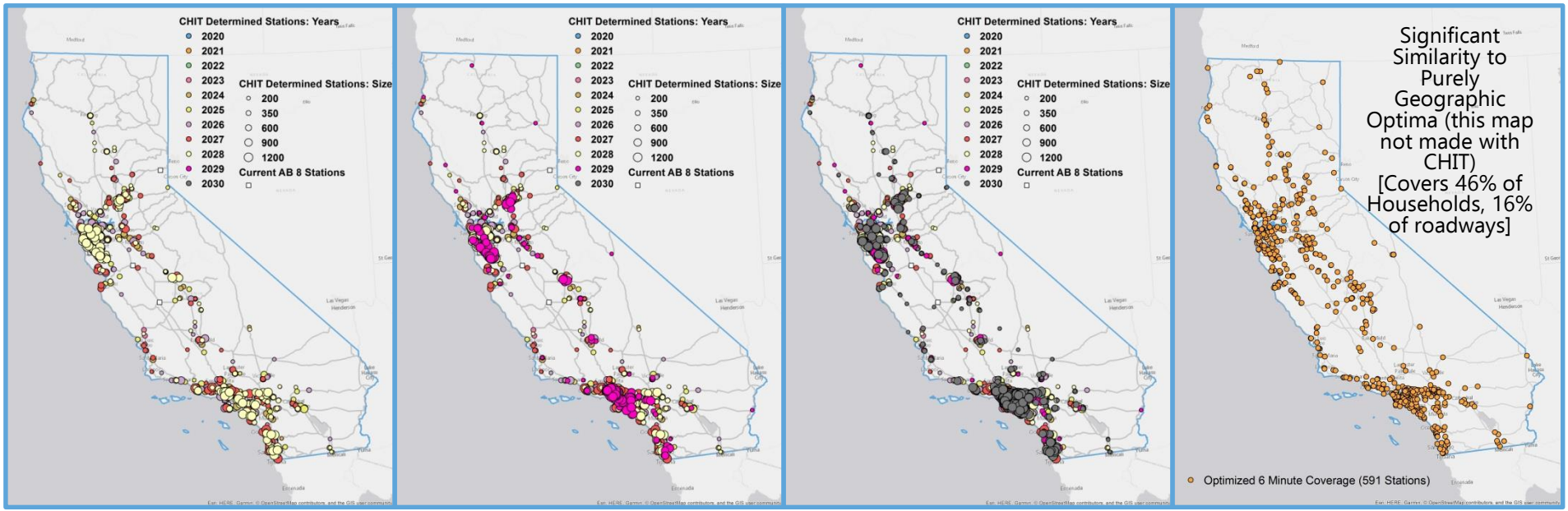
Station Deployment by Year



56 stations | **56 stations** | **100 stations** | **100 stations**

Between AB 8 and EO B-48-18, begin densifying fast-following markets;
After B-48-18, truly accelerate statewide growth

Station Deployment by Year



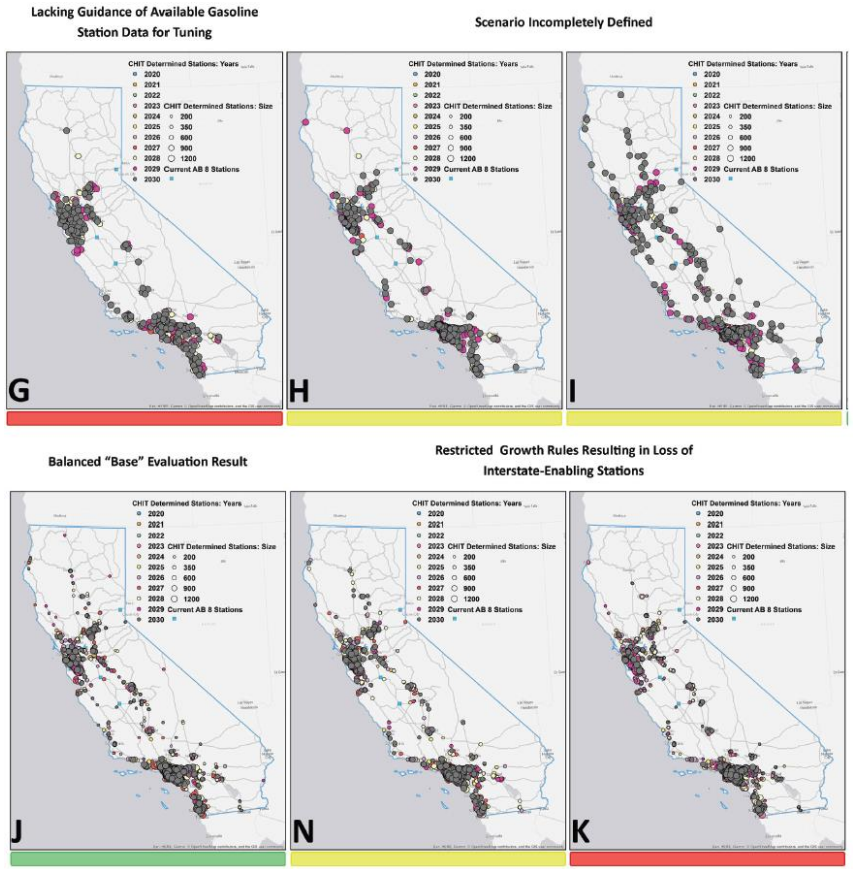
200 stations | **150 stations** | **300 stations** | **Optimum to Cover 800 City Centers w/in 6 Minute Drive**

Final years of *The Revolution* focus on capacity growth and extend the farthest reaches of the network

BENEFITS OF THE NETWORK OF *THE REVOLUTION*

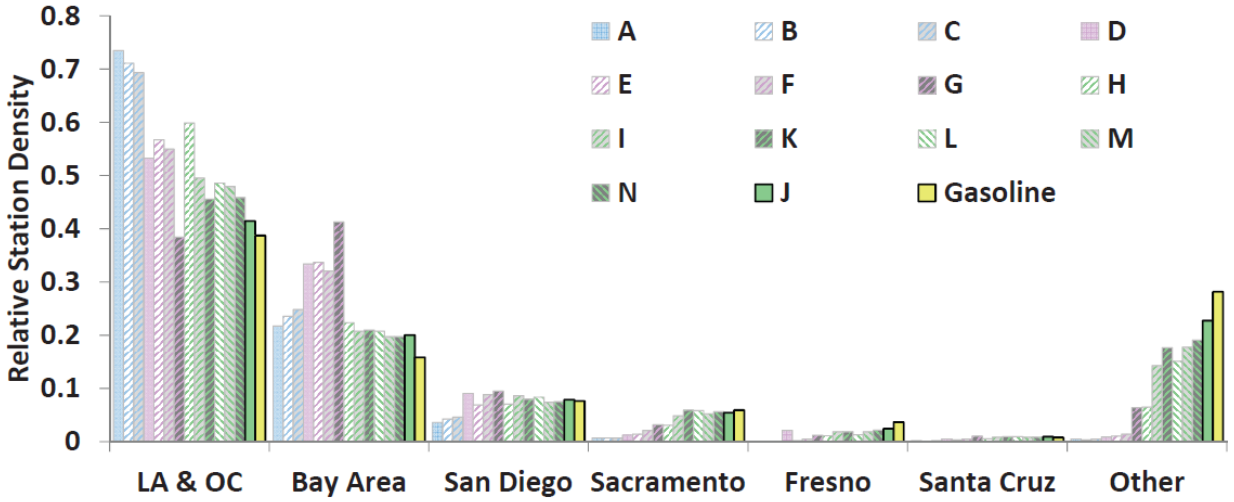
Scenario Evaluation

Balanced growth that prioritizes overall network health rather than singular core area focus



Scenario Evaluation

Geographic distribution of stations balanced and similar to gasoline



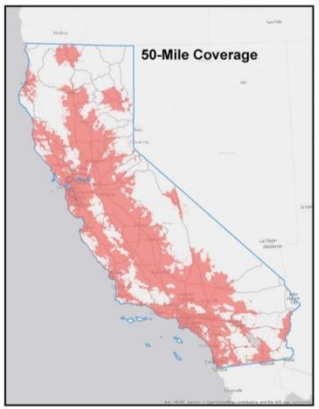
Scenario Evaluation

- Balanced spatial optimization and market needs
- Equitable baseline coverage
- Convenience in core markets
- Long-distance travel

Spatial Optimization ONLY

Optima (for Covering Demand Points)	Drive Distance		
	25	50	100
Minimum # of Stations	90	40	17
% of ZIP Codes Crossed	85.2%	90.5%	96.3%
% of Census Blockgroups Contained	89.8%	94.0%	96.3%
% of Population Covered	95.6%	98.1%	99.4%
% of Households Covered	95.5%	97.9%	99.3%
% of Mileage Contained	55.6%	69.1%	86.9%

Balanced *Revolution* Network



Roadmap 2030 Coverage Metrics	6-Minute Drive	15-Minute Drive	50-Mile Drive
% of ZIP Codes Crossed	62.6%	73.9%	93.1%
% of Census Blockgroups Contained	49.6%	86.3%	94.5%
% of Population Covered	62.8%	94.1%	99.1%
% of Households Covered	64.2%	93.9%	99.0%
% of Mileage Contained	19.4%	41.4%	77.6%

Equitable Opportunity Across California

The network of *The Revolution* ensures fueling opportunities are equitably available across full geography and all demographics

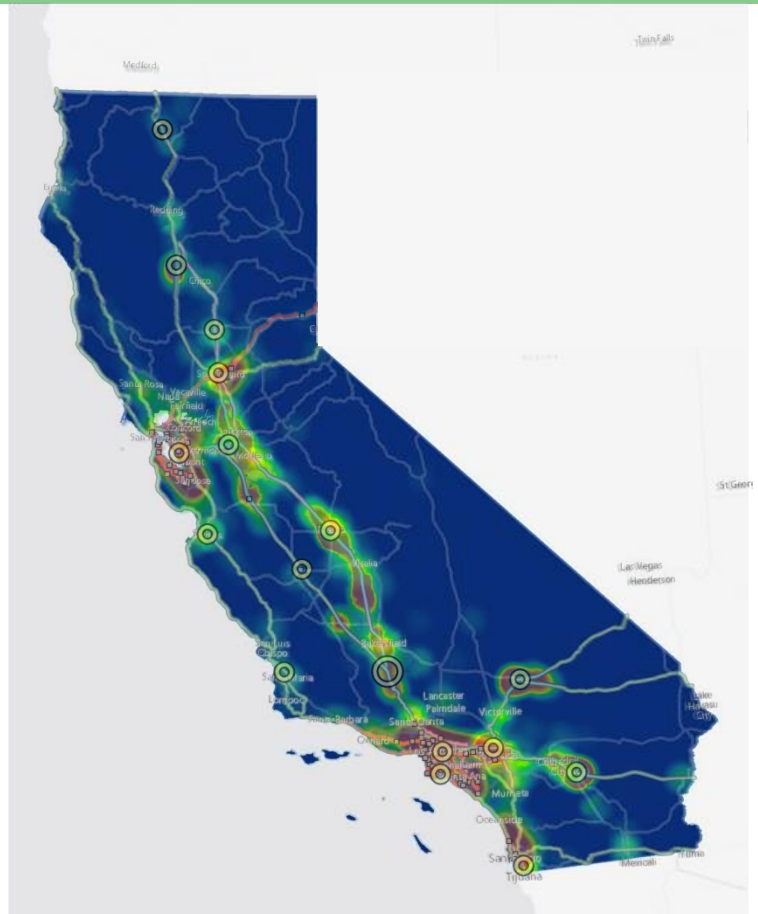
64 Stations CalEnviroScreen Score	Count of Stations	Population in Station Home Tract	Population in 15-Minute Coverage	Percent of CA Population in 15-Minute Coverage	Percent of Covered Population
Non-DAC Subtotals:	52	262,415	12,118,311	32.5%	79%
DAC Subtotals:	12	46,604 (~1% of all DAC)	3,238,482 (~35% of all DAC)	8.7%	21%
Totals	**64**	**309,019**	**15,356,793**	**41.2%**	**100%**
For Reference: CalEnviroScreen Indicates 9,152,024 Residents Living in Disadvantaged Communities					

1,000 Stations CalEnviroScreen Score	Count of Stations in Future Priority Areas*	Population in Priority Areas	Population in 15-Minute Coverage	Percent of CA Population in 15-Minute Coverage	Percent of Covered Population
Non-DAC Subtotals:	403	17,704,848	26,199,288	70.3%	75%
DAC Subtotals:	597	7,663,418 (~84% of all DAC)	8,883,966 (~97% of all DAC)	23.8%	25%
Totals	**1,000**	**25,368,266**	**35,083,254**	**94.1%**	**100%**
For Reference: CalEnviroScreen Indicates 9,152,024 Residents Living in Disadvantaged Communities					

* Counts for Priority Areas include all Priority Areas that partially or wholly overlap a DAC. Data for populations in Priority Areas and 15-Minute Coverage are exact and only include population wholly contained within both the DACs and either Priority Areas or 15-Minute Coverage.

Link to Other Sectors

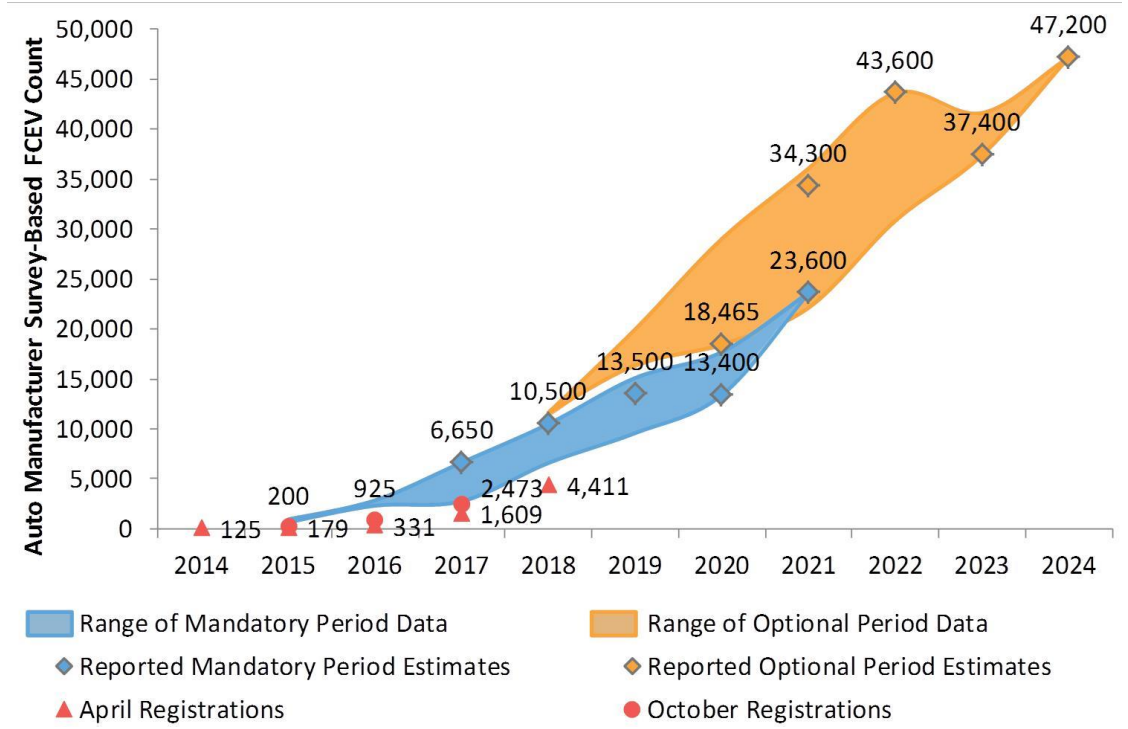
The light duty-centric network of *The Revolution* presents opportunities for co-location with fueling for other transportation sectors



CREATING THE NETWORK OF *THE REVOLUTION*

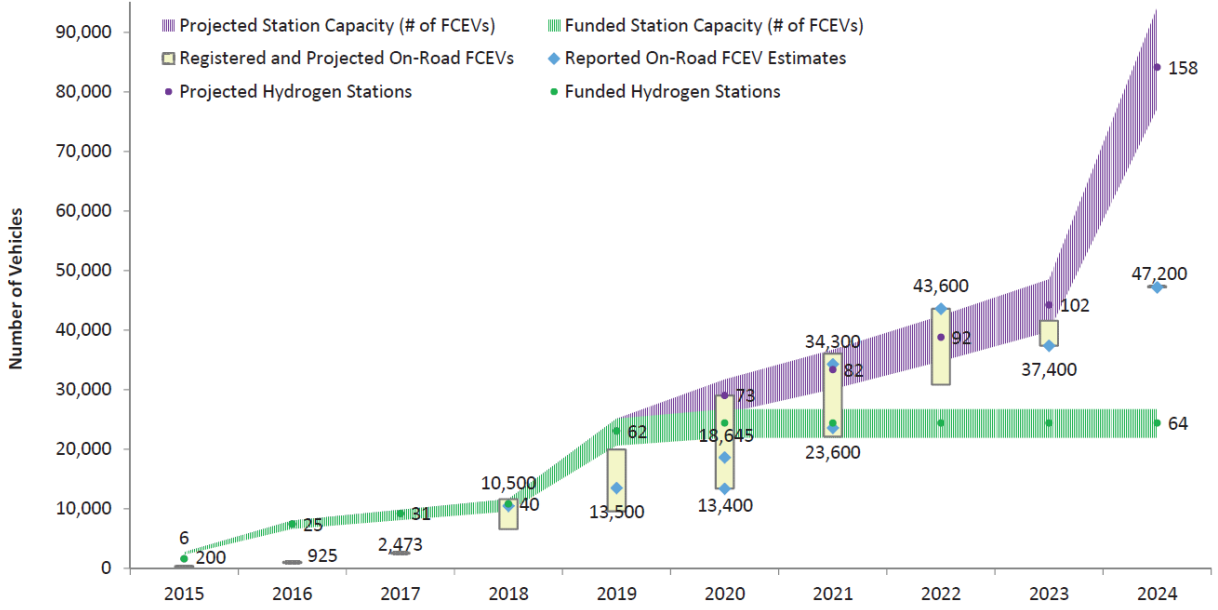
Today's Picture

Latest auto manufacturer projections for future FCEV releases show acceleration, but…



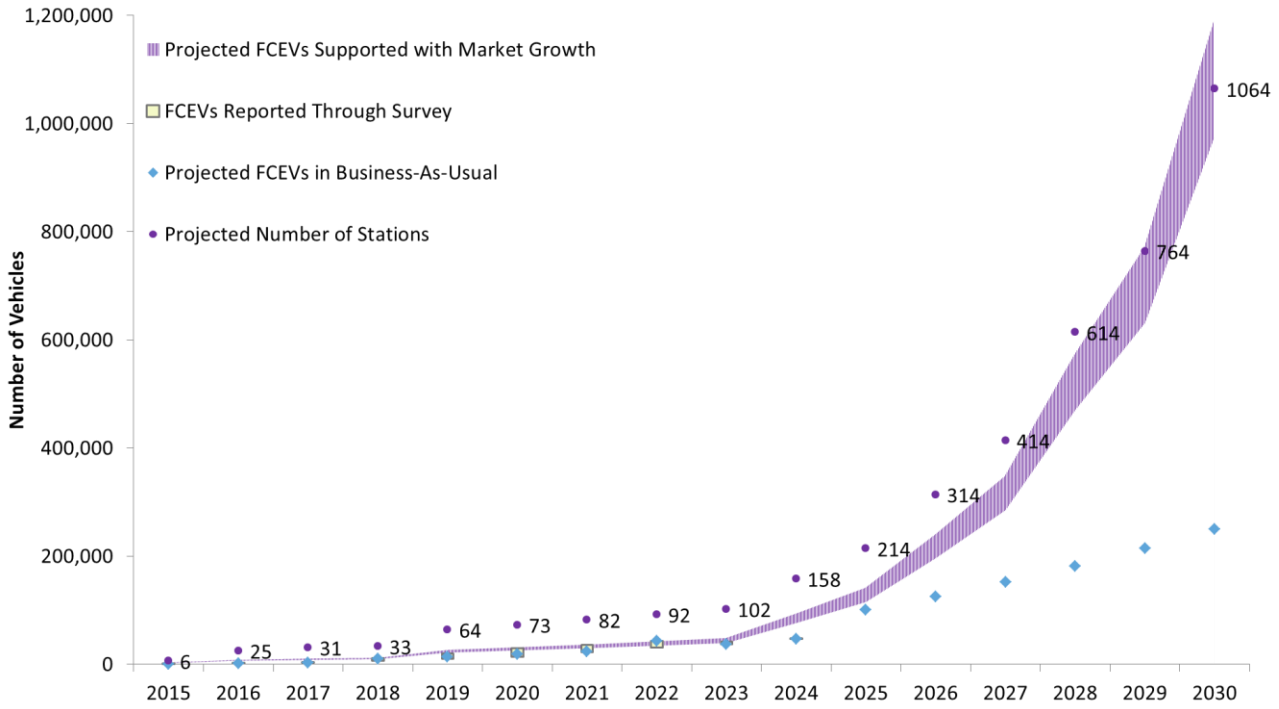
Our Current And Aspirational Trajectories

A path that meets the goals of EO B-48-18 and *The Revolution* enables two to three times greater FCEV deployment than currently planned



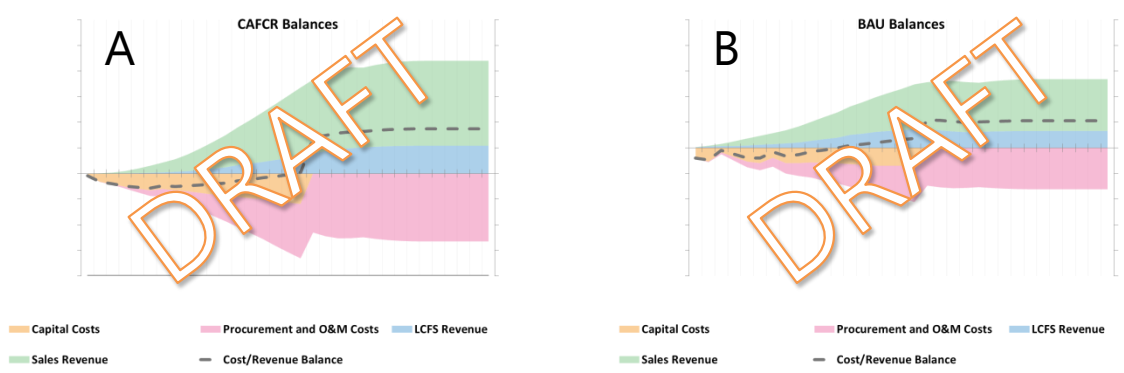
Our Current And Aspirational Trajectories

The network of *The Revolution* requires different strategies than what enabled market initiation



What Support Does the Network Need?

Success and the support strategies and timing required can vary with the network buildout scenario



DISCUSSION