Transportation Energy Demand Scenarios for SB 100

Quentin Gee, Ph.D.
Manager, Advanced Electrification Analysis Branch
August 7, 2024

Acronyms and Initialisms

ACC2 – Advanced Clean Cars II Regulation

ACF – Advanced Clean Fleets Regulation

BECCS – Bioenergy with Carbon Capture and Storage

CAISO – California Independent System Operator

CARB – California Air Resources Board

CEC – California Energy Commission

H2 – Hydrogen

IEPR – Integrated Energy Policy Report

MDHD – Medium- and Heavy-Duty

OGV – Ocean-Going Vessel

OOS – Out of State (aviation)

PA – Planning Area

PCM – Production Cost Model

SB 100 – Senate Bill 100

TE – Transportation Electrification

TOU – Time of Use

ZE – Zero-Emission

Framework for Demand Scenarios in Transportation

Existing Policies (mostly captured in the IEPR forecast)

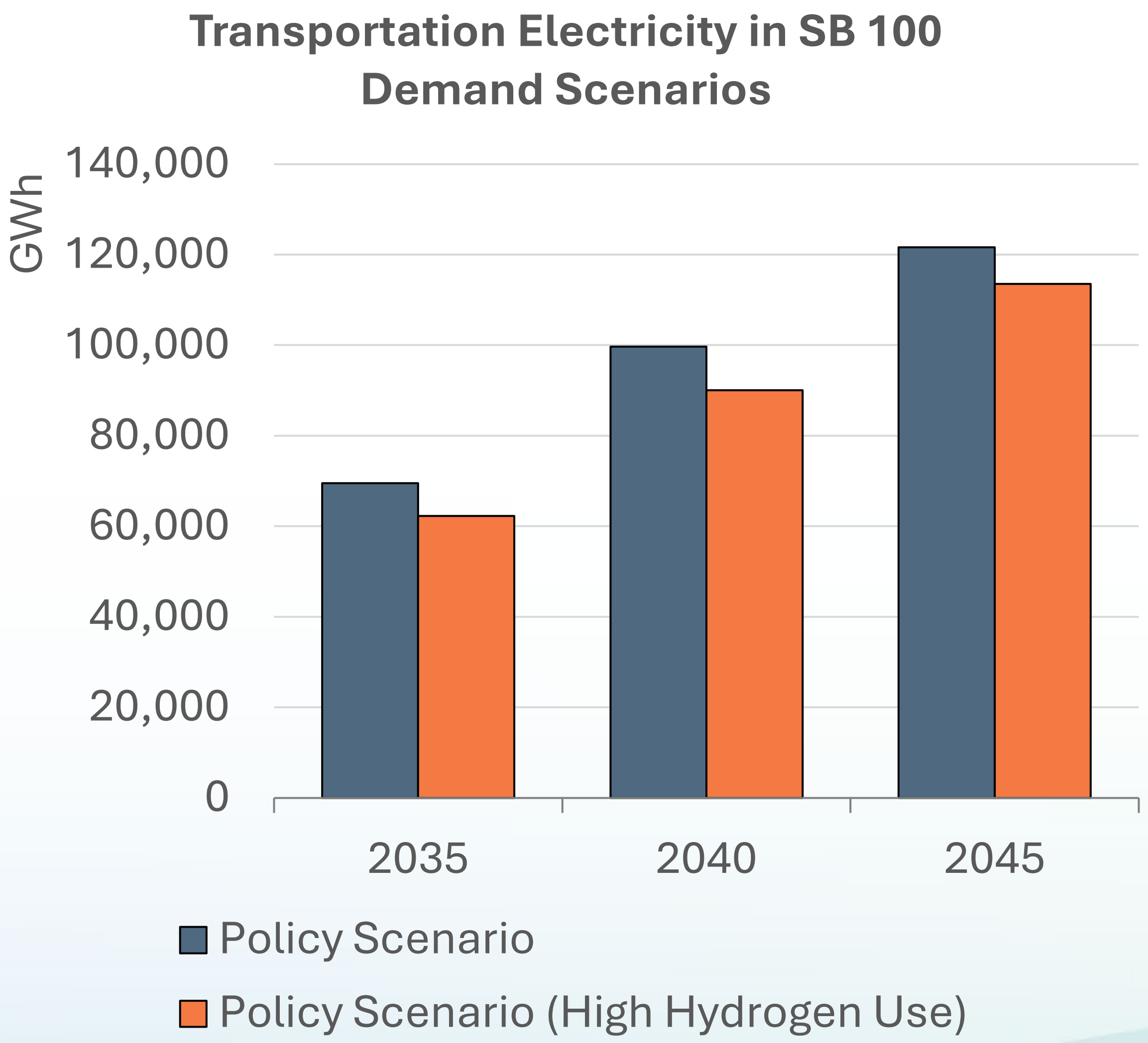
Near-term policies recently or expected to be adopted

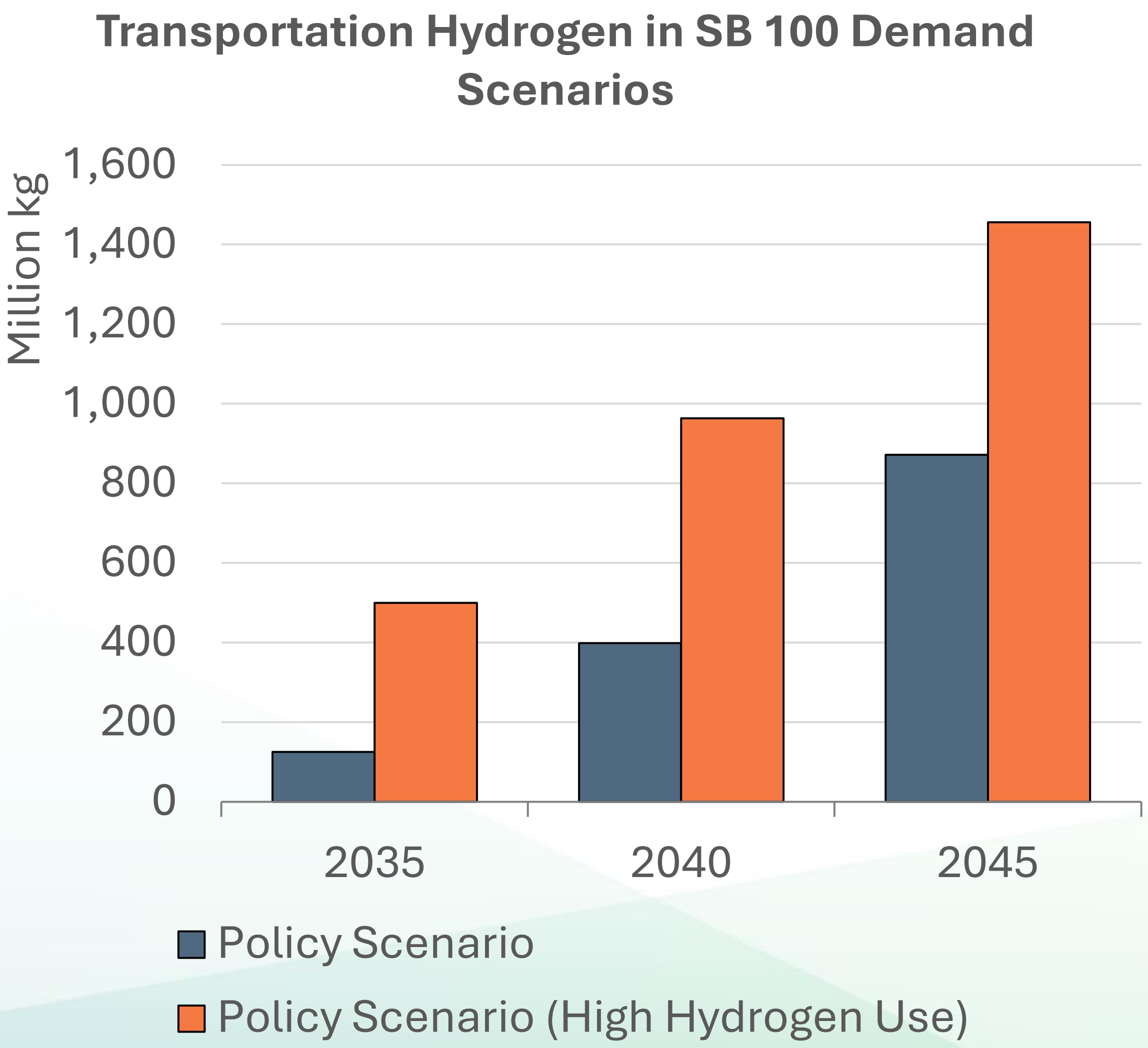
Goals with clear technological pathways informed by market analysis

Transportation Scenario Comparisons

	Policy Scenario	Policy Scenario (High Hydrogen Use)
Light-Duty Vehicles	ACC2 as modeled in the 2023 IEPR, extended to 2050	Same as Policy Scenario
Aviation	ZE fuel substitution of jet fuel for in-state aviation starting 2030, 10 percent electricity and 10 percent H2 by 2045 (5 percent for OOS Aviation)	Same as Policy Scenario
In-Use Locomotive Regulation	ZE fuel substitution starting in 2027, diffusion to 100% by 2058	Same as Policy Scenario
Freight Trucks	ACF + ZE Truck Measure (faster adoption of ZE trucks than ACF)	ZE Truck Measure, higher adoption of fuel cell trucks in lieu of BEVs
Off-Road (non-rail)	Enhanced Electrification to align with 100% ZE port operations by 2045	Same as Policy Scenario
OGVs	5% OGV energy demand replaced by hydrogen by 2045	25% OGV Energy Demand replaced by hydrogen by 2045

Comparing Transportation Energy Demand Differences

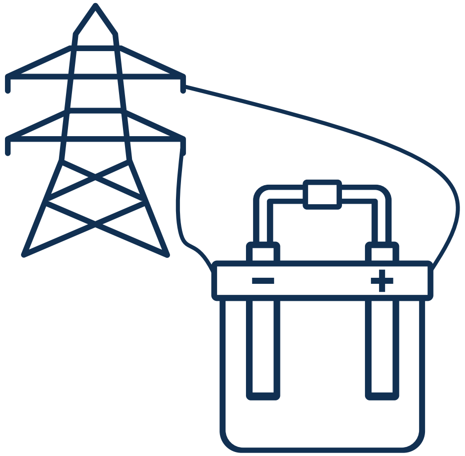


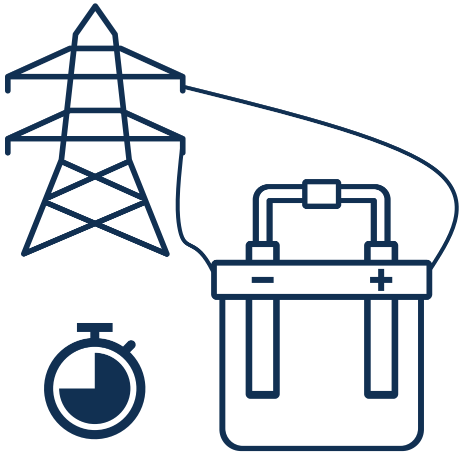


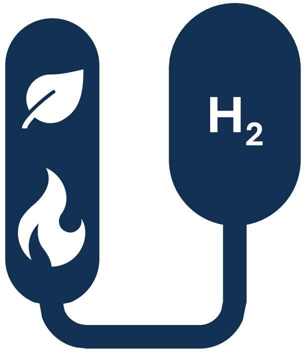
Note: Does not include electricity demand from hydrogen production

Hydrogen Production

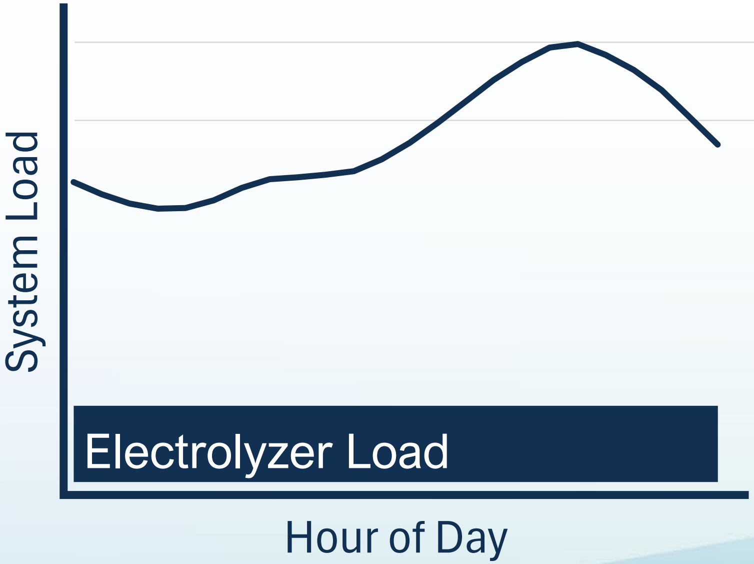
Options for Hydrogen Production



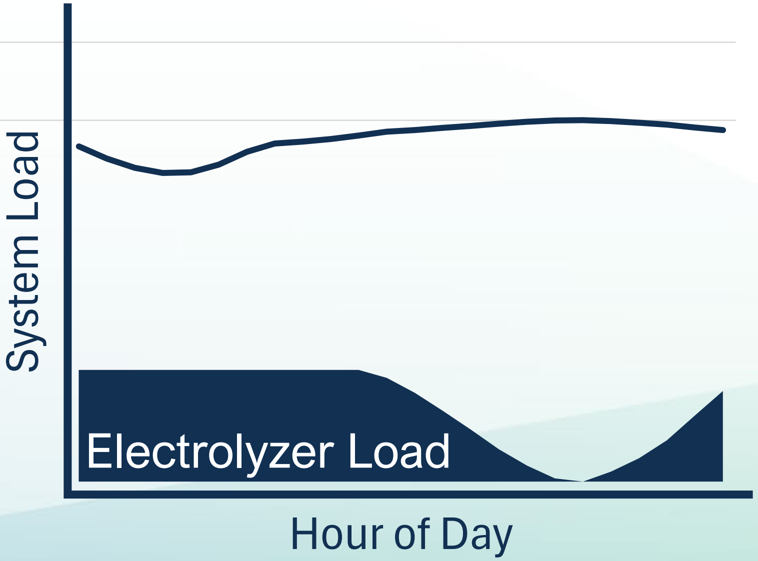




Base Grid-Tied



Flexible Grid-Tied



Biological Sources

Small amount of electricity demand from Biomethane and BECCS Operations

Hydrogen Production Considerations

- Proportion of electrolyzer/biological sources
- Energy for electrolysis
- Other energy demand (compression, facilities, etc.)
- Geographic distribution
- Electrolyzer capacity factor
- Electrolyzer efficiencies
- Efficiency associated with electrolyzer ramping

Hydrogen Production Framework

Geographical Assignment	Hydrogen production assigned to existing MDHD electricity demand
Minimum Electricity Adder	All production requires electricity for compression and other operations
Biological Sourcing	Align with CARB Scoping Plan biological/electrolysis proportions
Electrolyzer Operations Parameters and Assumptions	Consideration of multiple electrolyzer factors to develop a planning area assignment of load associated with electrolyzer operations, and for transportation, with seasonal fuel demand
Use Parameters in PCM	Use parameters to interact with the PCM

Parameter Characterizations

	Temporal Operation Characterization	Capacity Factor Characterization	Efficiency from Ramping Characterization
Super Flex	Can drop to zero load to maximize against price signals	Lowest capacity factor to capture maximum flexibility	Consistent ramping means lowest efficiency
Flexible	Can drop to very low levels to represent high flexibility	Lower capacity factor to capture some flexibility	Regular ramping causes relatively large reductions in efficiency
TOU	Regularly drops to low levels to approximate TOU optimization schedules	Moderate capacity factor to approximate likely TOU scheduling	Some ramping causes some reductions in efficiency
Baseload	Maintains high operational capacity	Near 100 percent capacity factor to prioritize production	Baseload operation maintains ideal efficiency

Parameters and Assumptions

	Percent Share of Electrolyzer System	Minimum Load Draw	Maximum Load Draw	Target Annual Capacity Factor	Multiplier for Ramping Efficiency
Super Flex	16.7%	0%	70%	40%	0.7
Flexible	16.7%	10%	77.5%	55%	0.8
TOU	16.7%	20%	87.5%	75%	0.9
Baseload	50%	92.5%	97.5%	95%	1.0

Standard Electricity for Electrolysis	52,500 MWh per 1M kg
Electricity for Biological Sourcing	0 MWh per 1M kg
Electricity for Compression/Operations for Both System Types	5,000 MWh per 1M kg

With geographical PA assignments and seasonal demand for transportation, target monthly electricity demand is assigned with the above parameters. Resulting values are used as inputs into the PCM.

Thank You!