



Off-Road Electricity Demand Forecast Update

Jeffrey Lu, California Energy Commission

DAWG Meeting | 14-Sep-2021

Agriculture *new!*

Aviation *new!*

Cargo handling equipment (port)

Commercial harbor craft [via CARB] *new!*

Construction *new!*

Forklifts

Ground support equipment (airport)

Plug-in hybrid work trucks

Shore power (port)

TRU

Truck stops

Changes for 2021

- **New sectors**
- Improved **alignment with CARB**
 - Regulatory actions (truck TRUs, at-berth, commercial harbor craft)
 - Incorporate CARB's electricity demand estimate for commercial harbor craft
 - Updated population inventories
- Factoring in **full electrification** “where feasible” (N-79-20)
 - High scenario
 - What adoption levels are considered reasonable?
- Replaced linear **adoption curves** with “S-curves”

Sector

- ZE =
zero emission

** as an upper bound, this analysis assumes all ZE equipment to be plug-in electric*

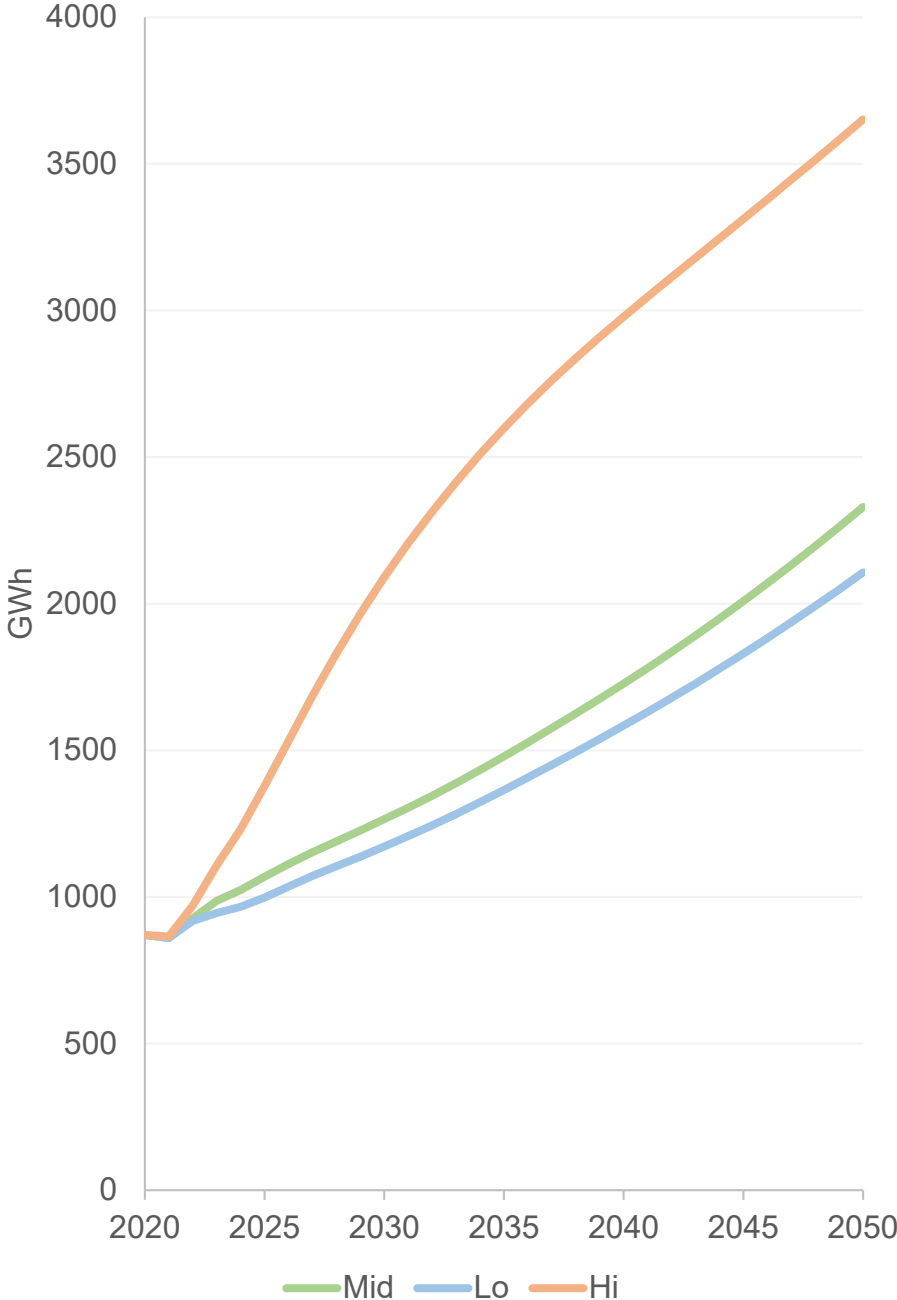
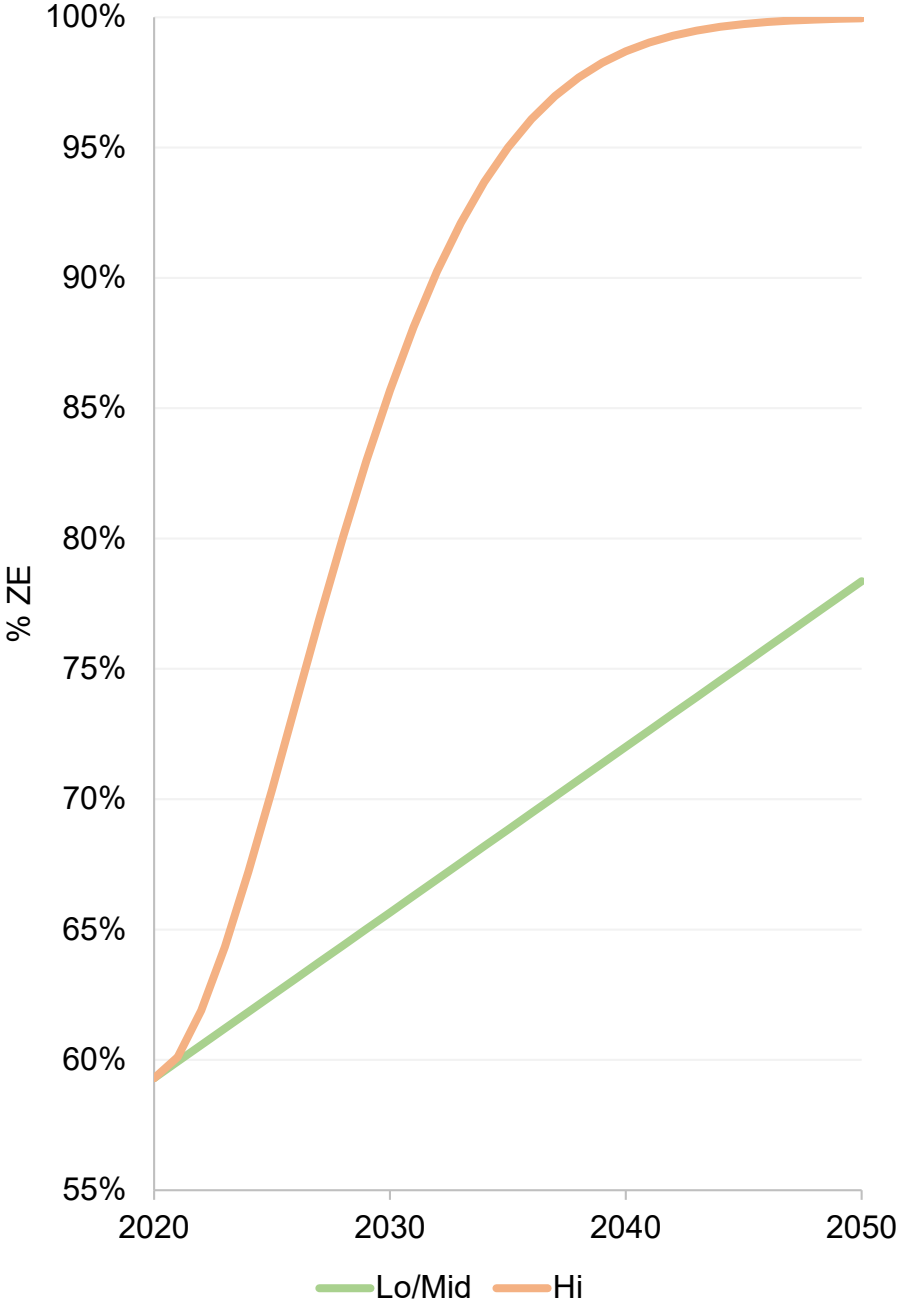
- GSP =
gross state product

Projected **adoption**
(% electrification)

Projected statewide
electricity consumption (GWh)

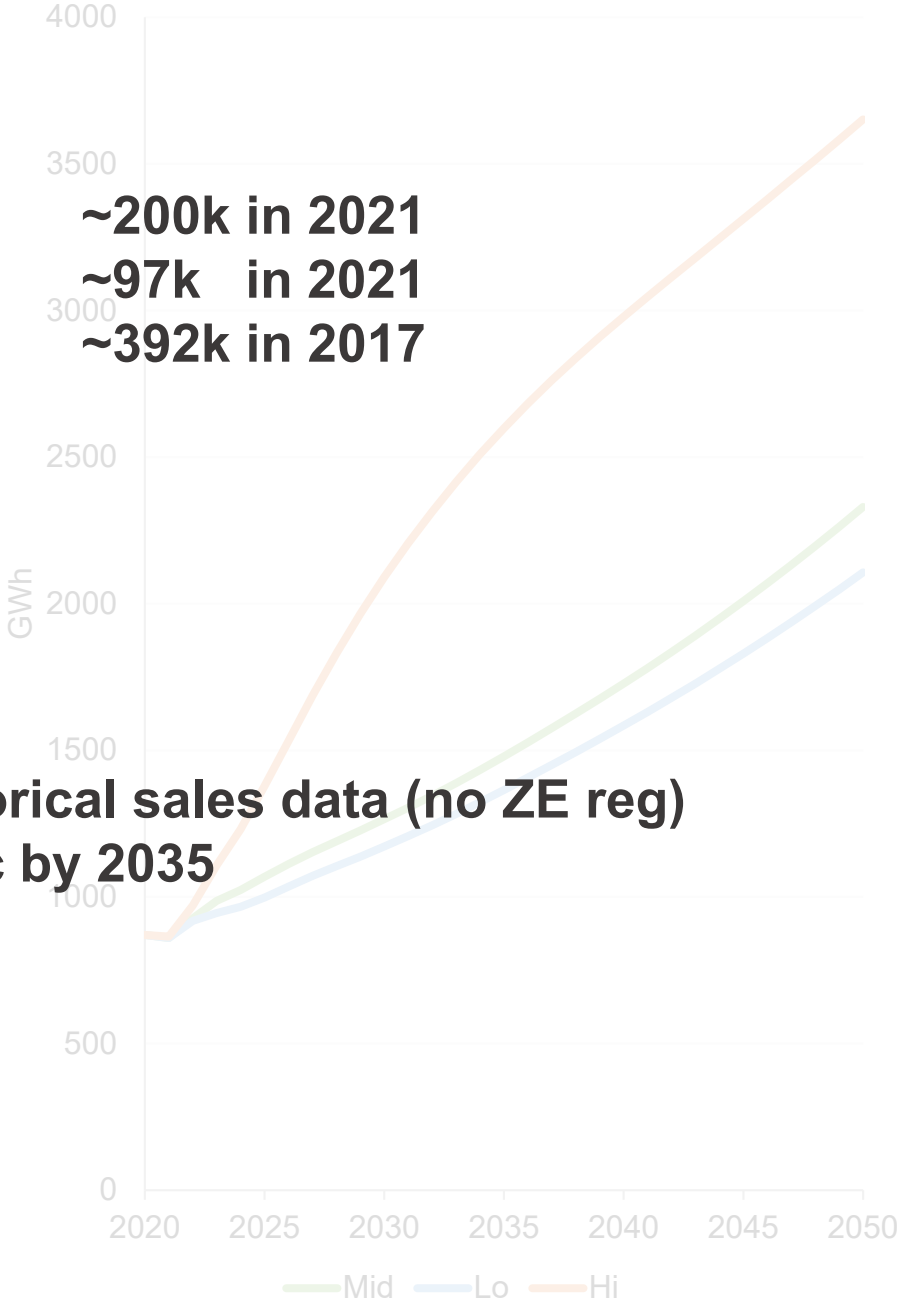
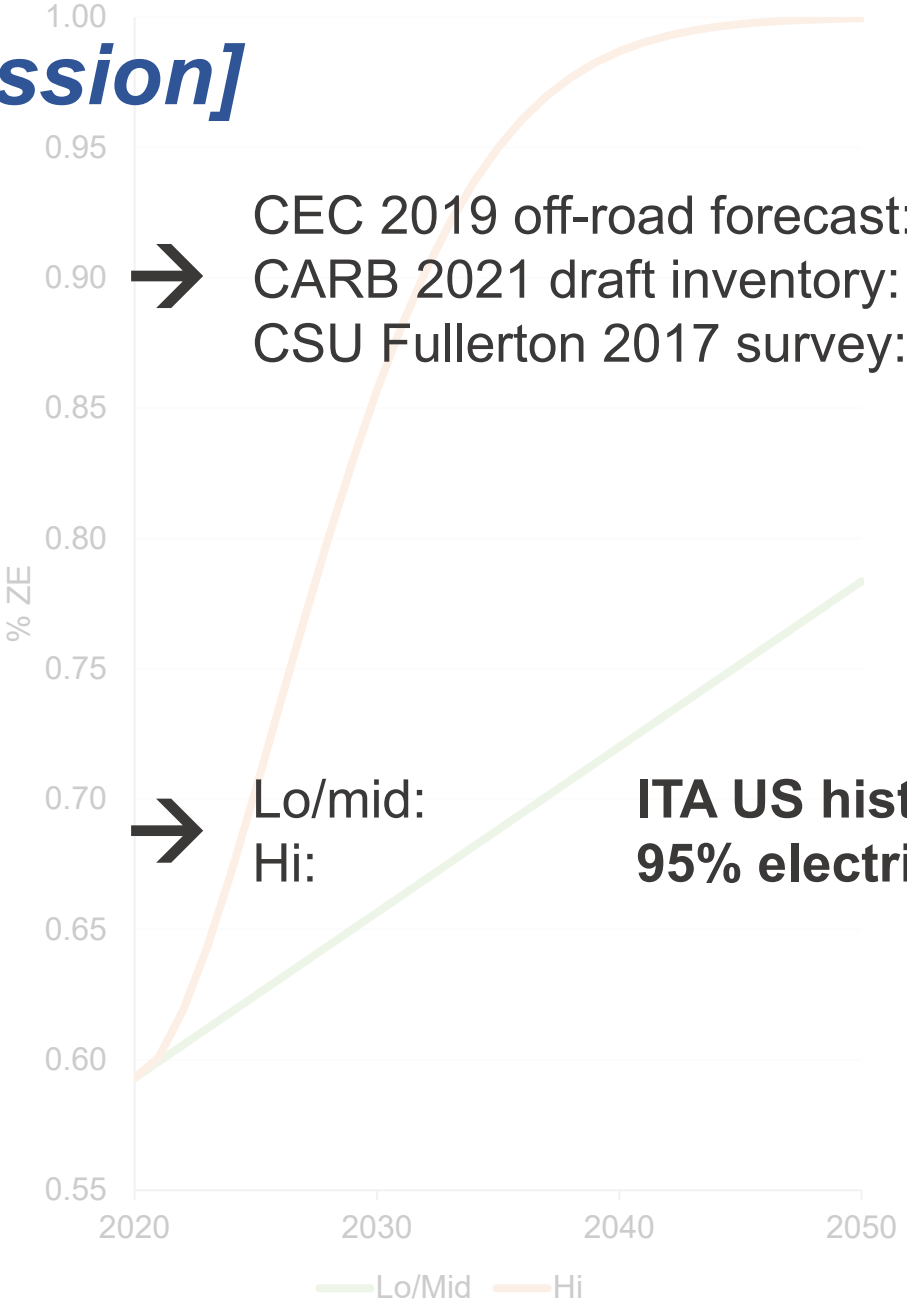
Forklifts

- Mid-case population: 2019 CEC forecast
- Lo and hi population based on GSP spread
- Electrification curves: lo/mid, hi
- Lo/Mid: Based on historical sales data
- Hi: 95% ZE by 2035
- Largest sector in terms of total electricity use



Forklifts *[discussion]*

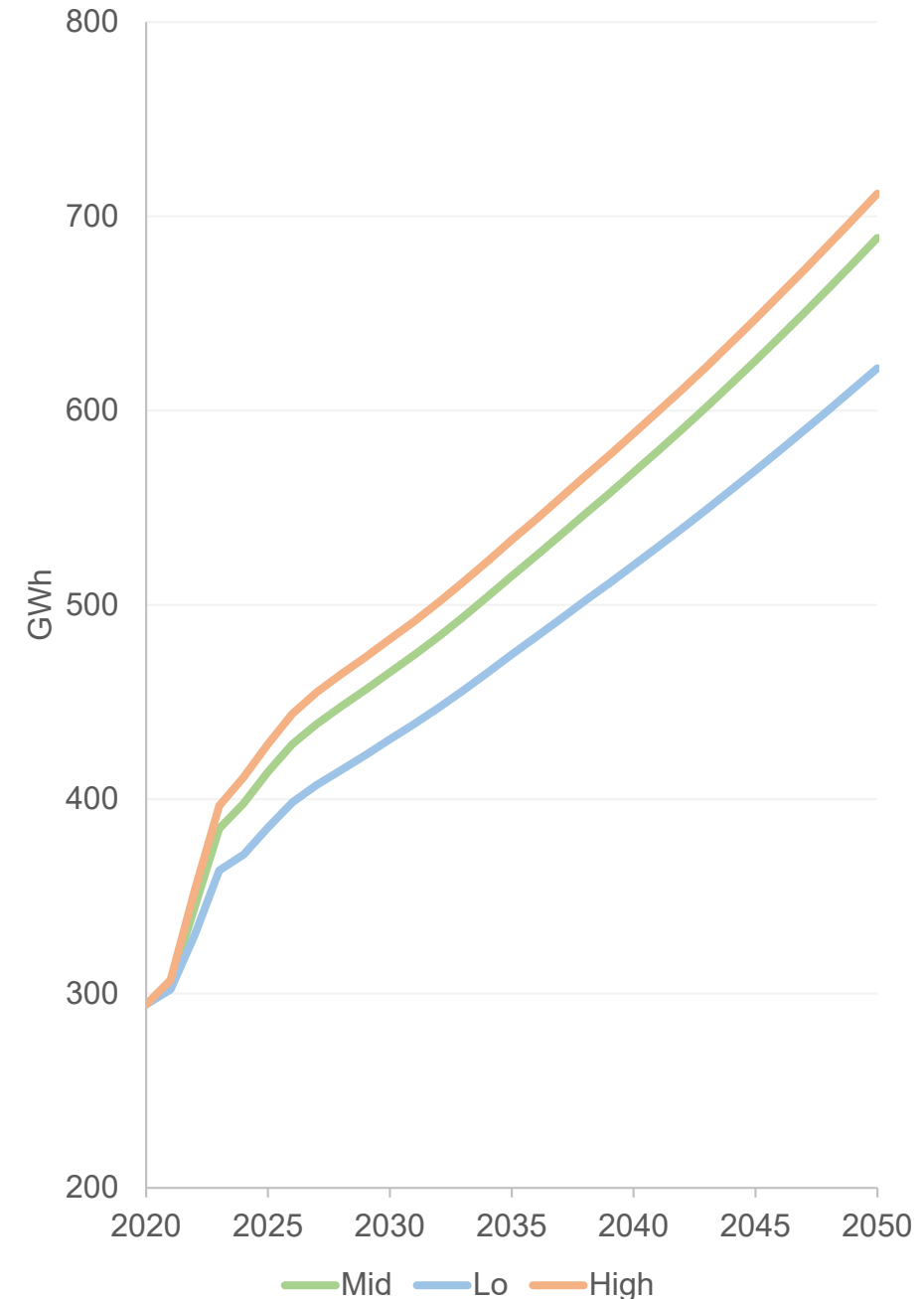
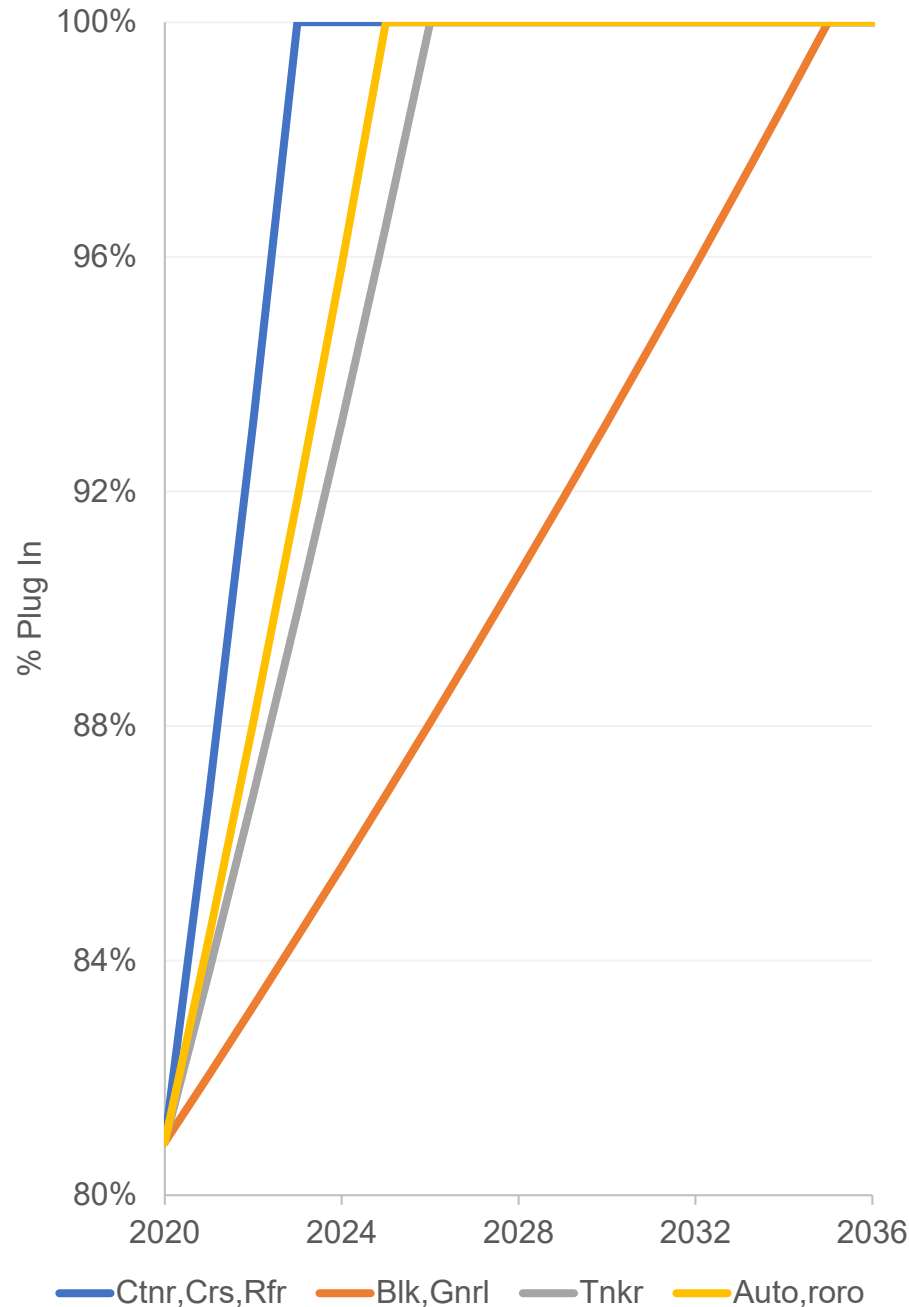
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Shore power

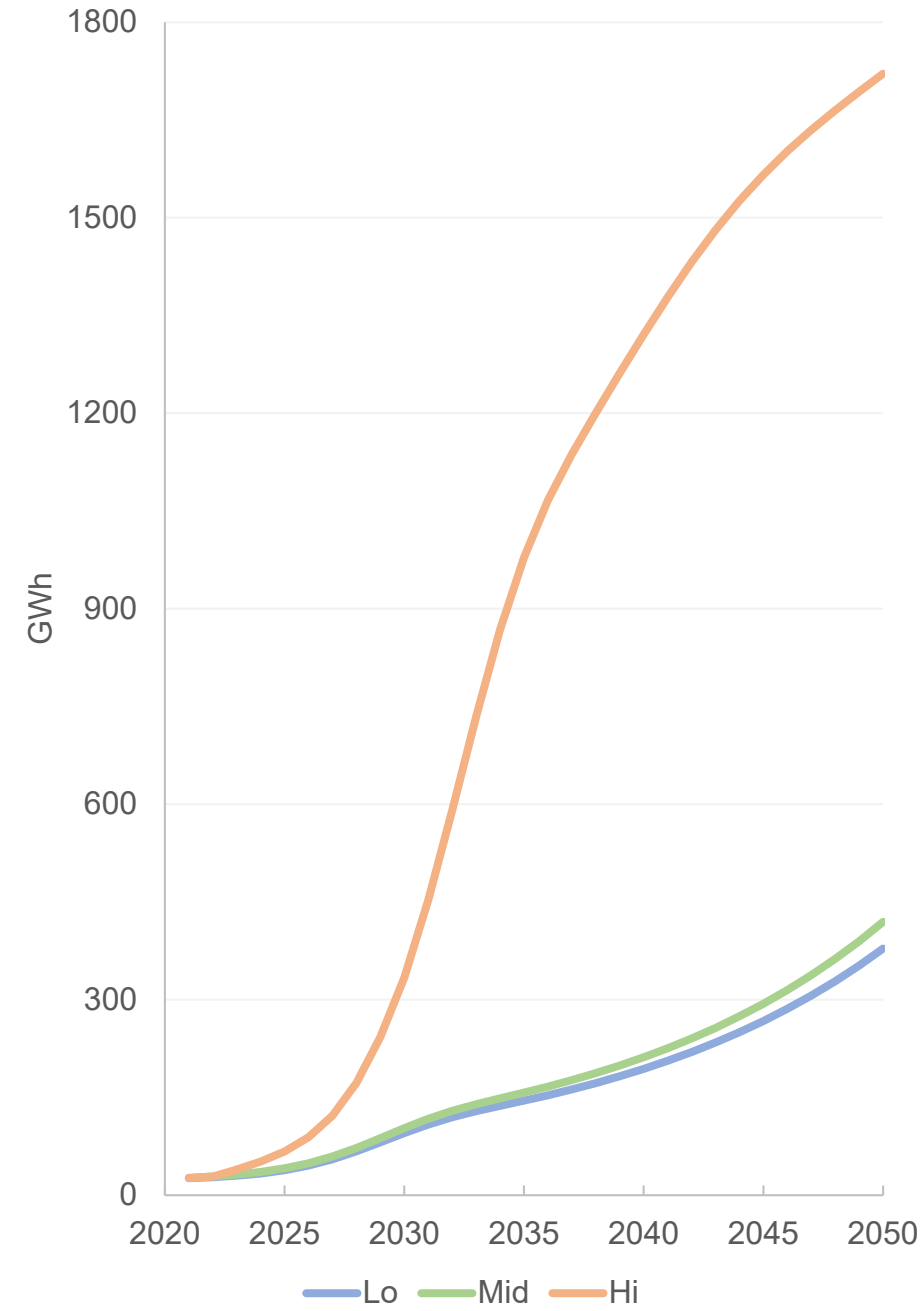
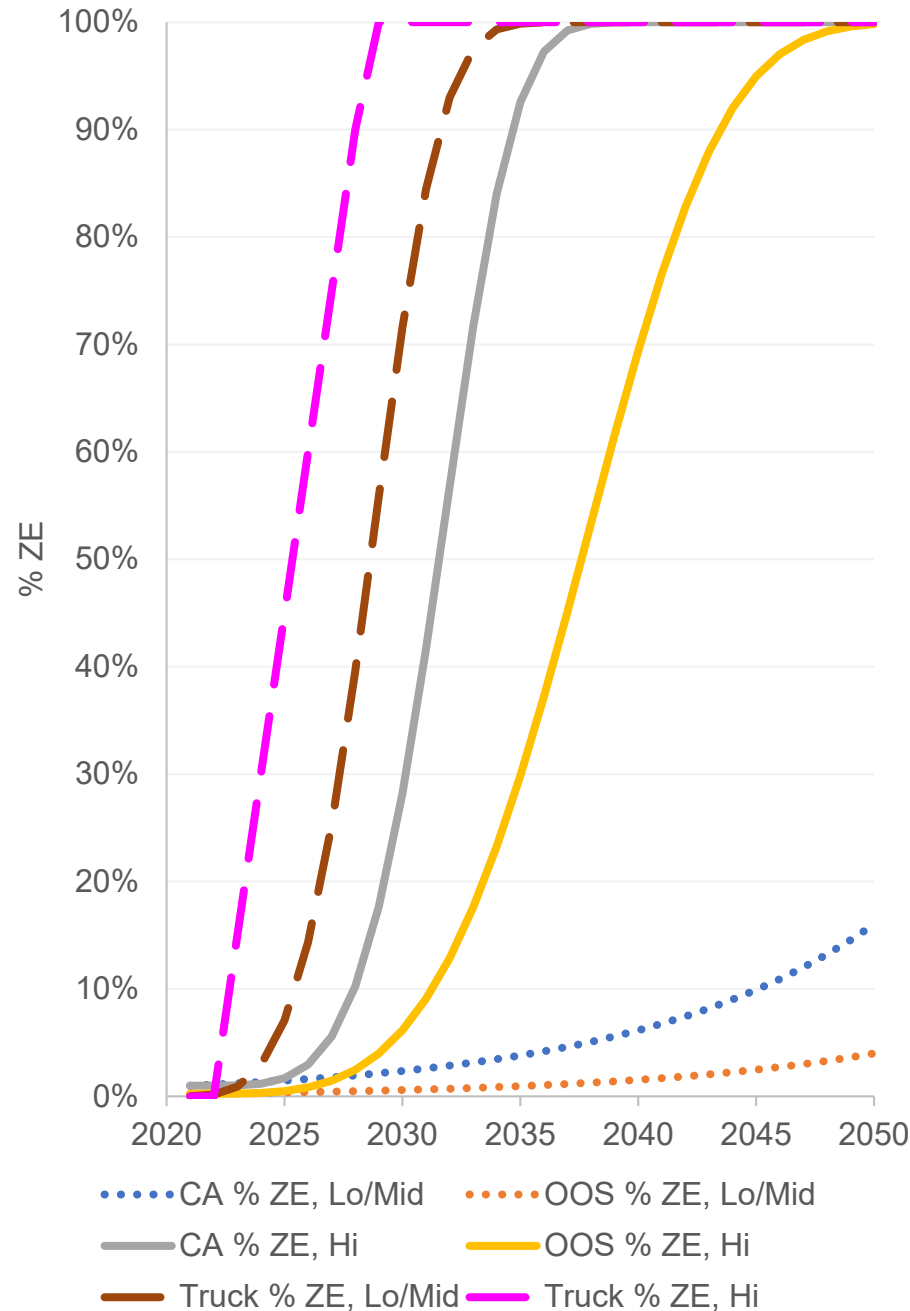
- Mid-case # visits: 2019 CEC forecast
- Lo and hi # visits based on GSP spread
- One electrification curve, based on latest CARB shore power regulation

* Bulk, general vessels are not part of latest CARB at-berth reg, but are assumed to achieve 100% plug-in rate by 2035



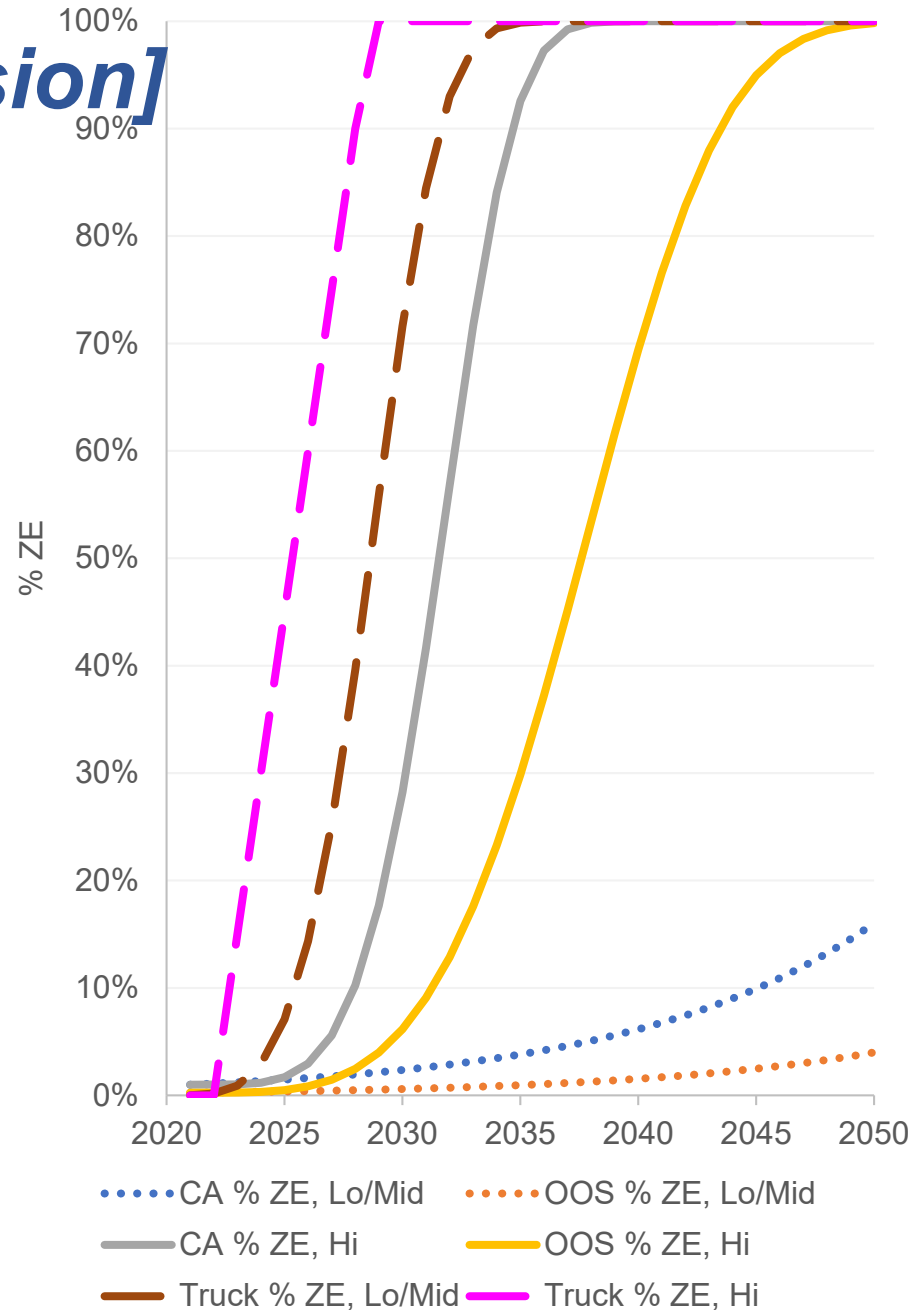
TRUs

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- Electricity use includes “chargers” (for ZE TRUs) and “plugs” (for elec standby)
- Includes CARB proposed truck TRU regulation



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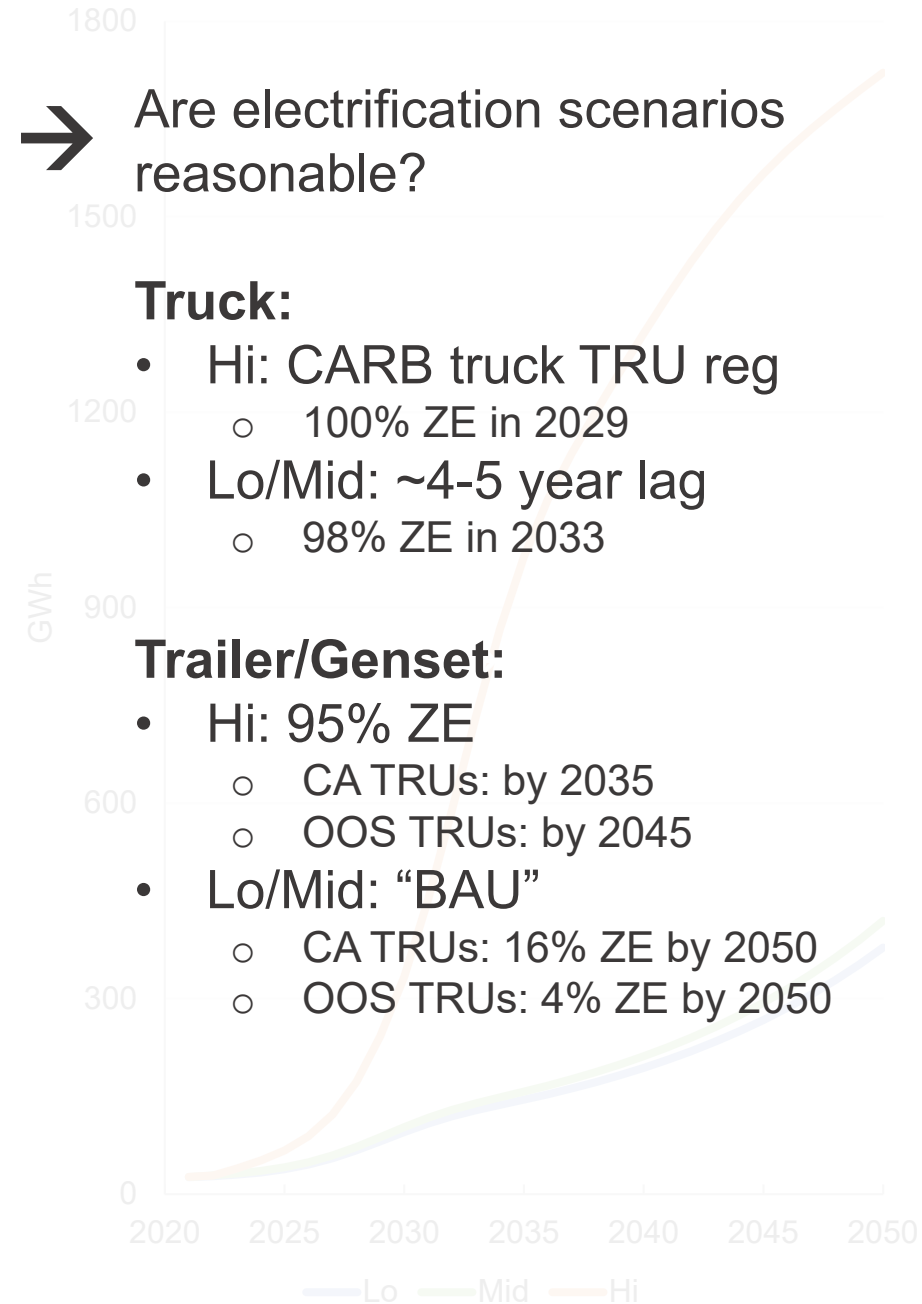
Are electrification scenarios reasonable?

Truck:

- Hi: CARB truck TRU reg
 - 100% ZE in 2029
- Lo/Mid: ~4-5 year lag
 - 98% ZE in 2033

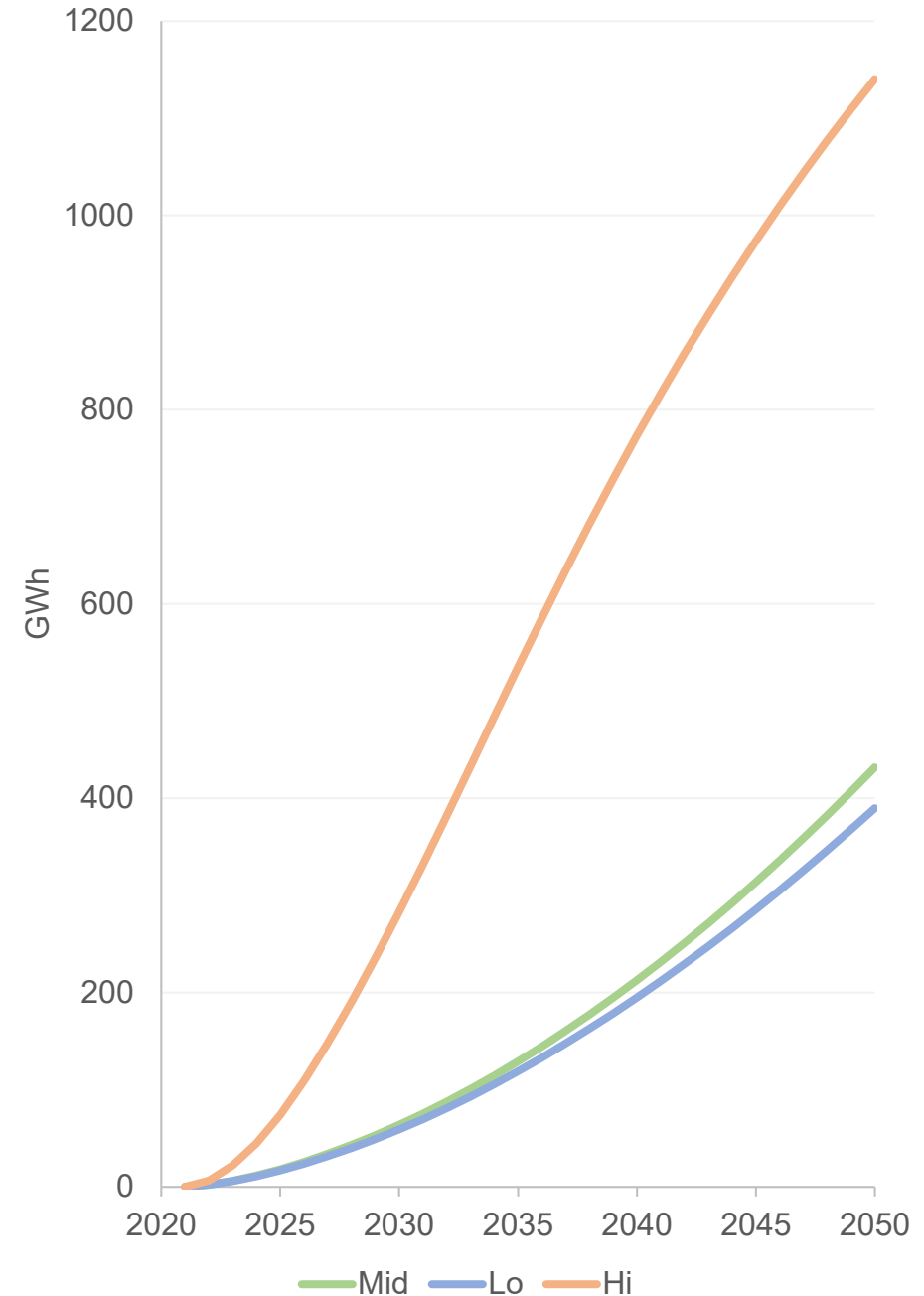
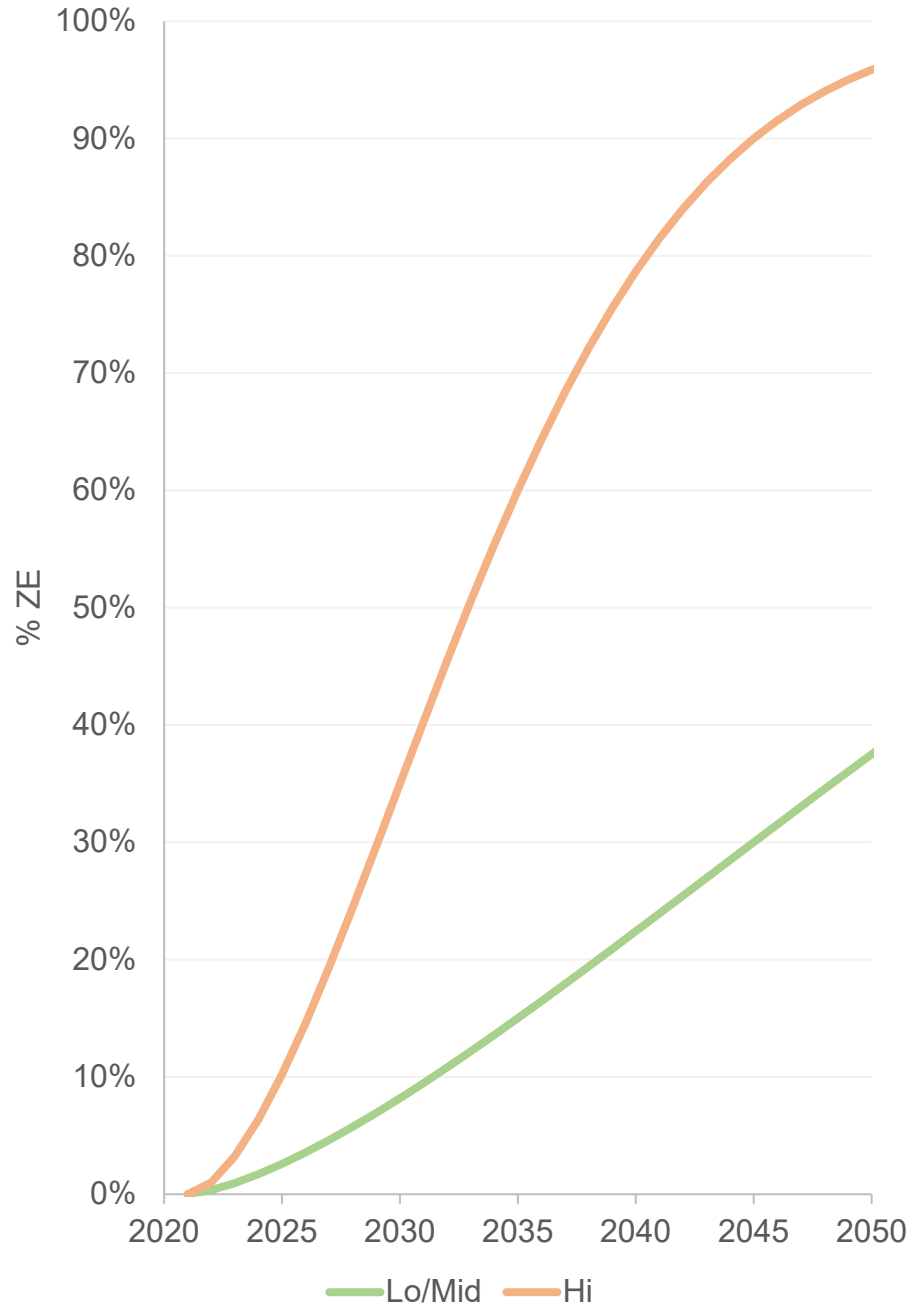
Trailer/Genset:

- Hi: 95% ZE
 - CA TRUs: by 2035
 - OOS TRUs: by 2045
- Lo/Mid: “BAU”
 - CA TRUs: 16% ZE by 2050
 - OOS TRUs: 4% ZE by 2050



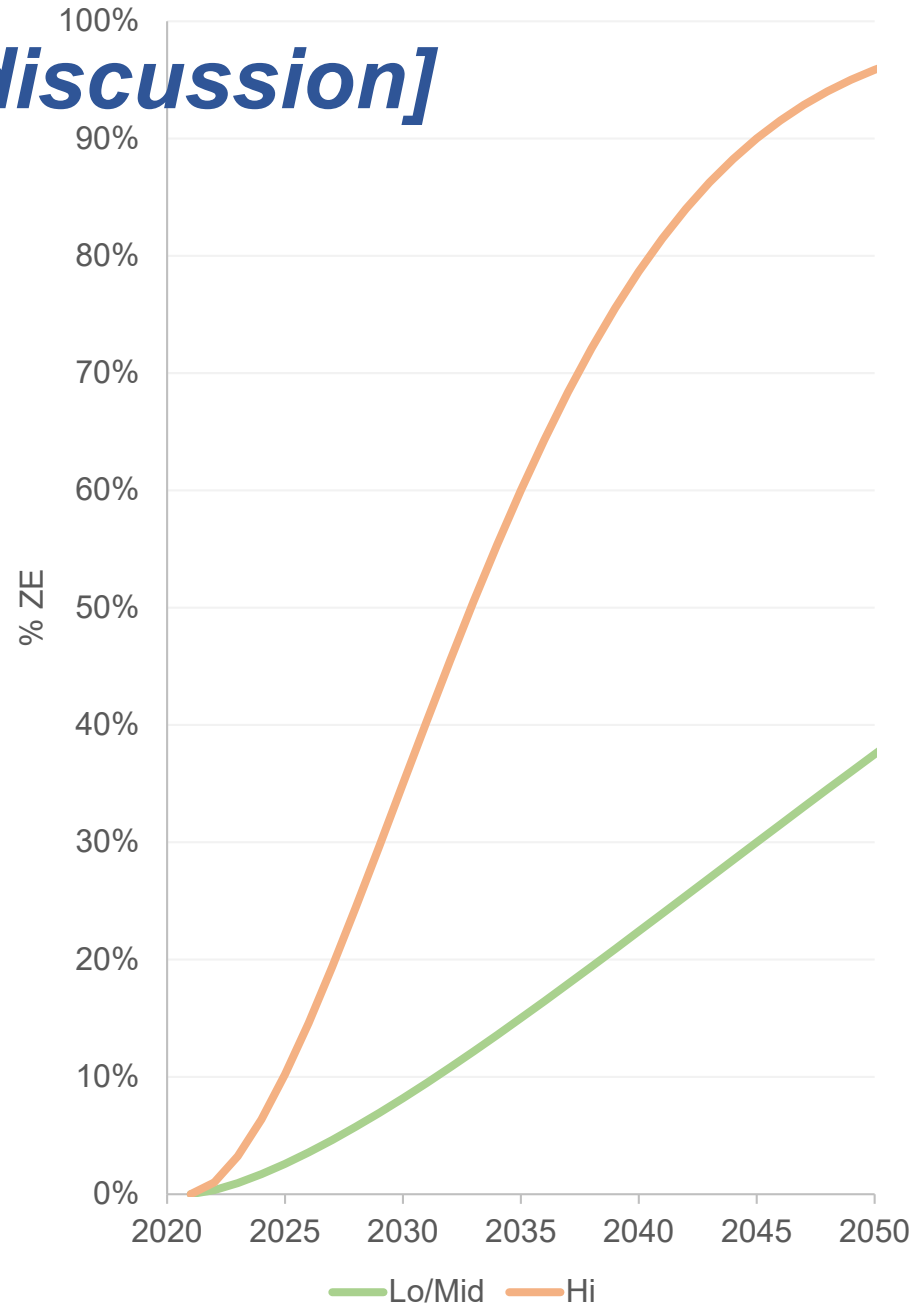
Construction

- Excavators, tractor-loader-backhoes, rubber tired loaders
- Mid-case population: 2021 CARB draft inventory
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- Lo/Mid: 30% ZE by 2045
- Hi: 90% ZE by 2045

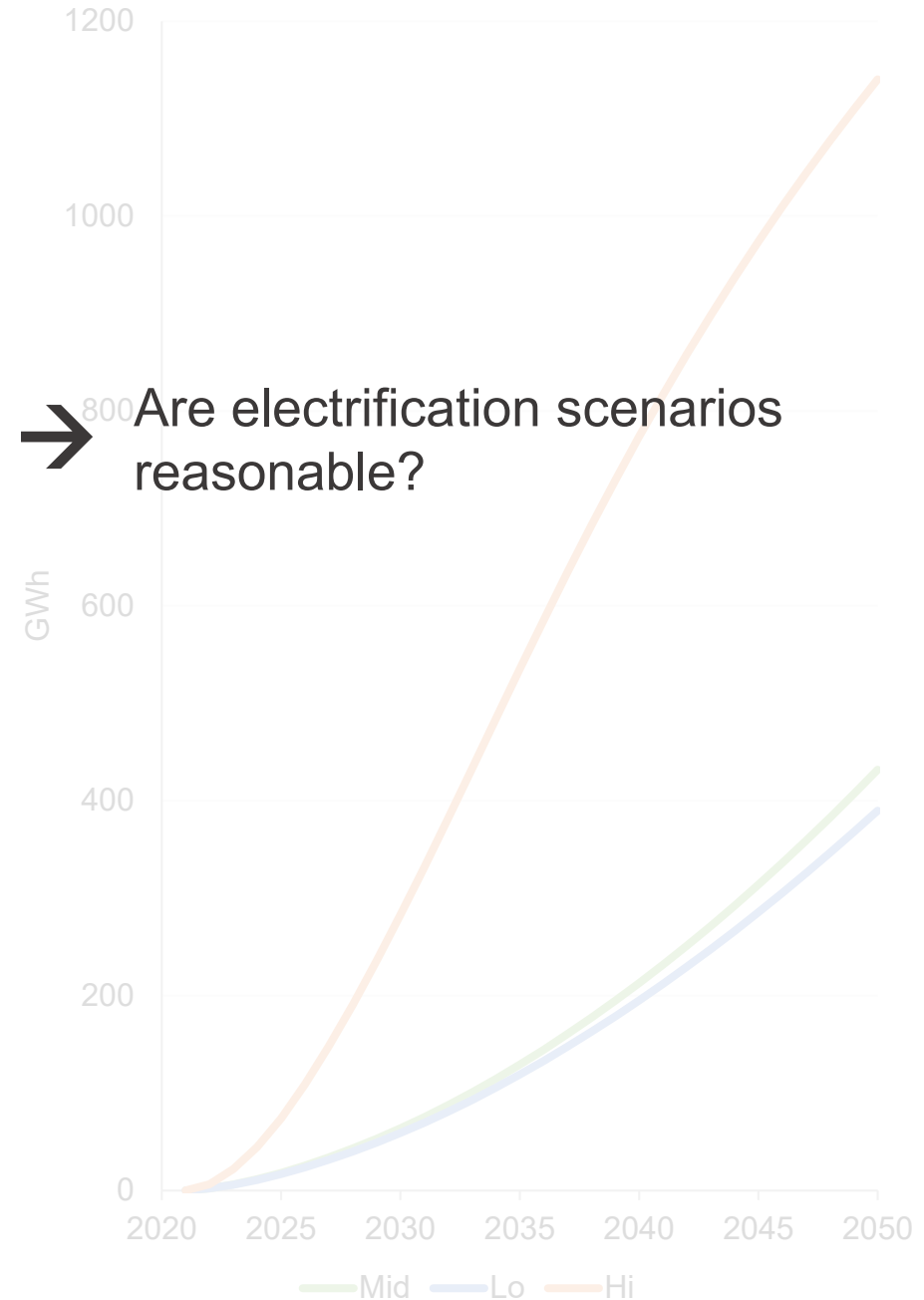


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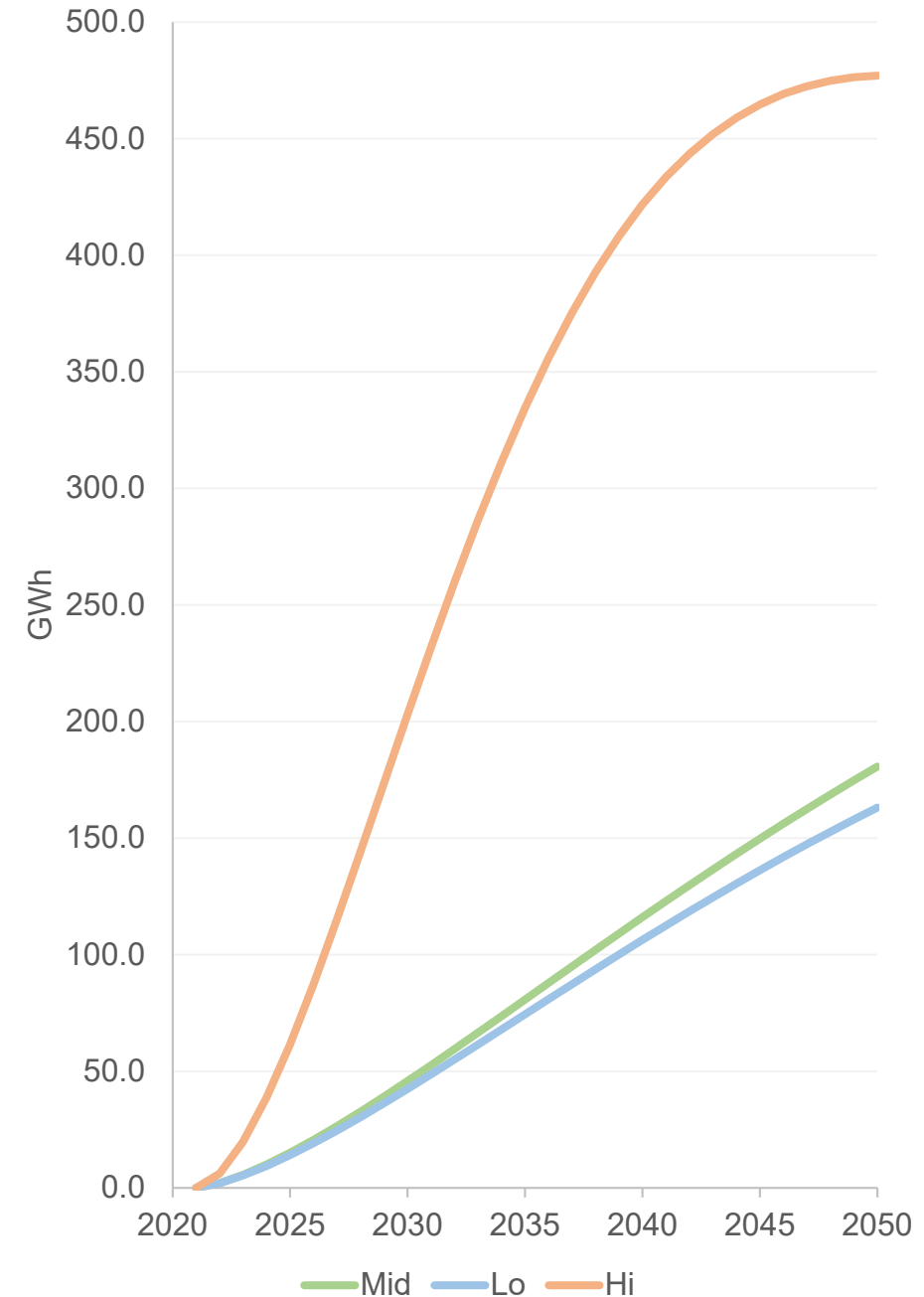
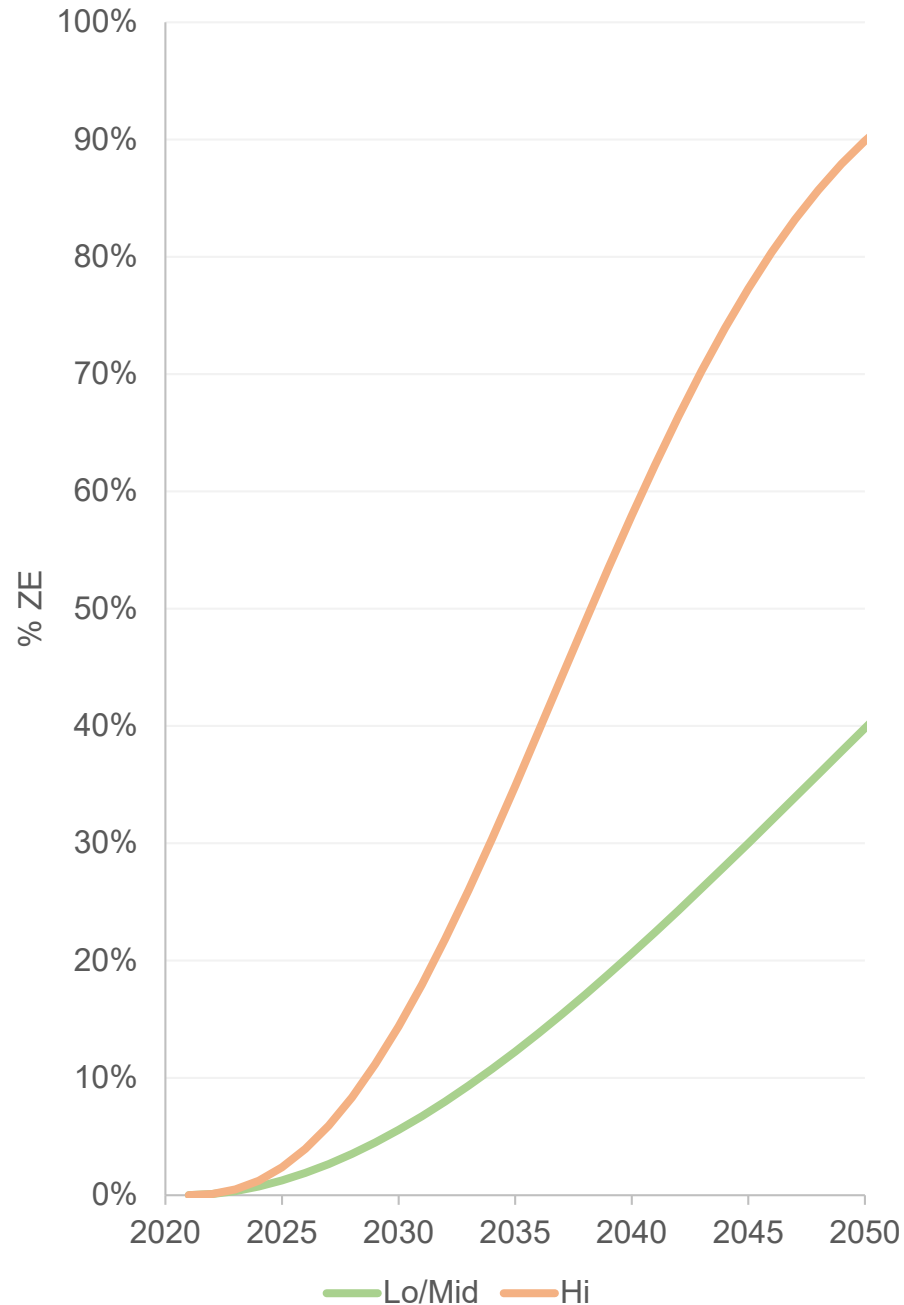


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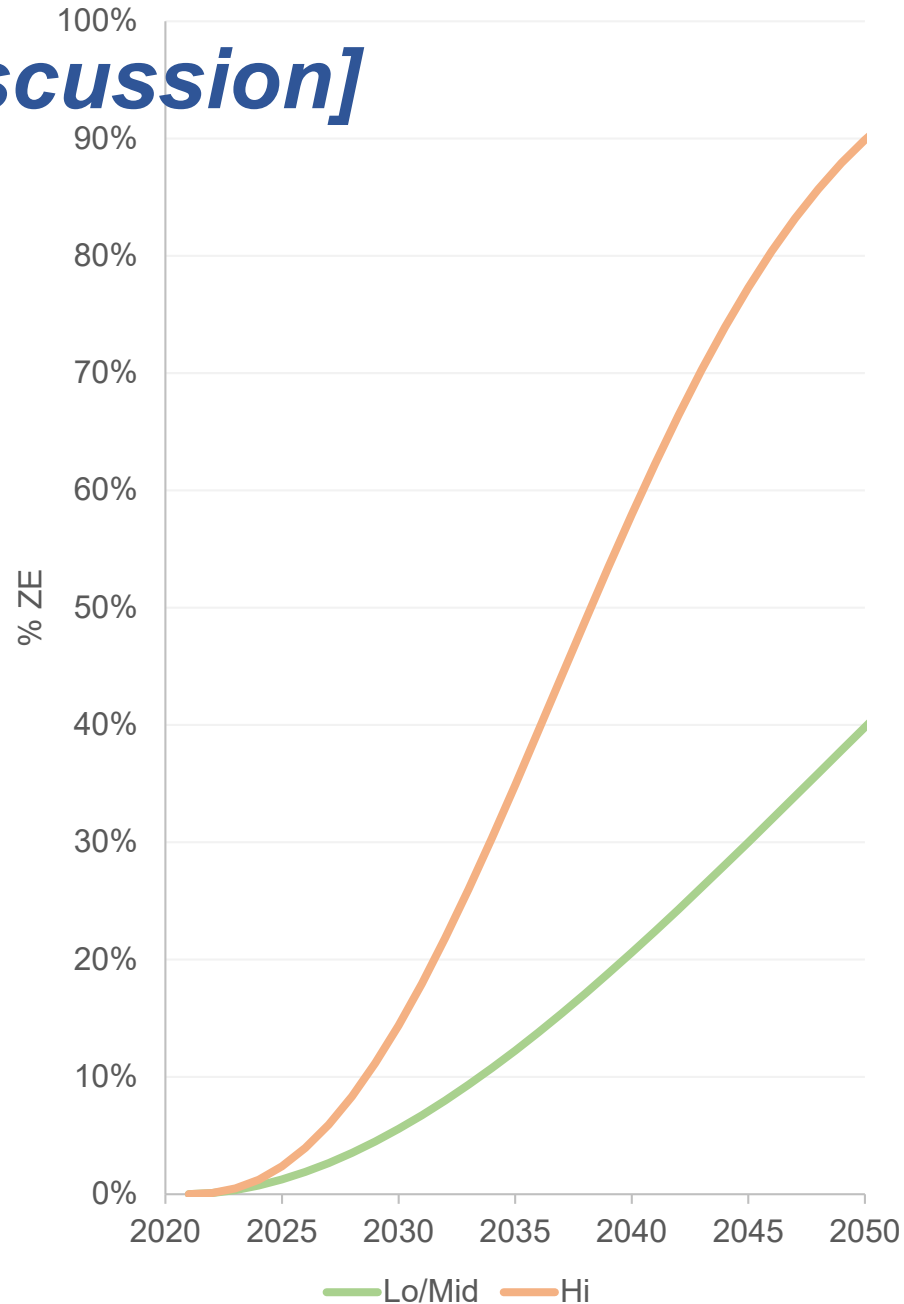
Agriculture

- Tractors ≤ 100 hp, construction equip ≤ 100 hp, ATVs ≤ 50 hp
- Mid-case population: 2021 CARB ag inventory
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- Electrification curves: lo/mid, hi
- Lo/Mid: 30% ZE by 2045
- Hi: 80% ZE by 2045
- Only sector with assumed population decline

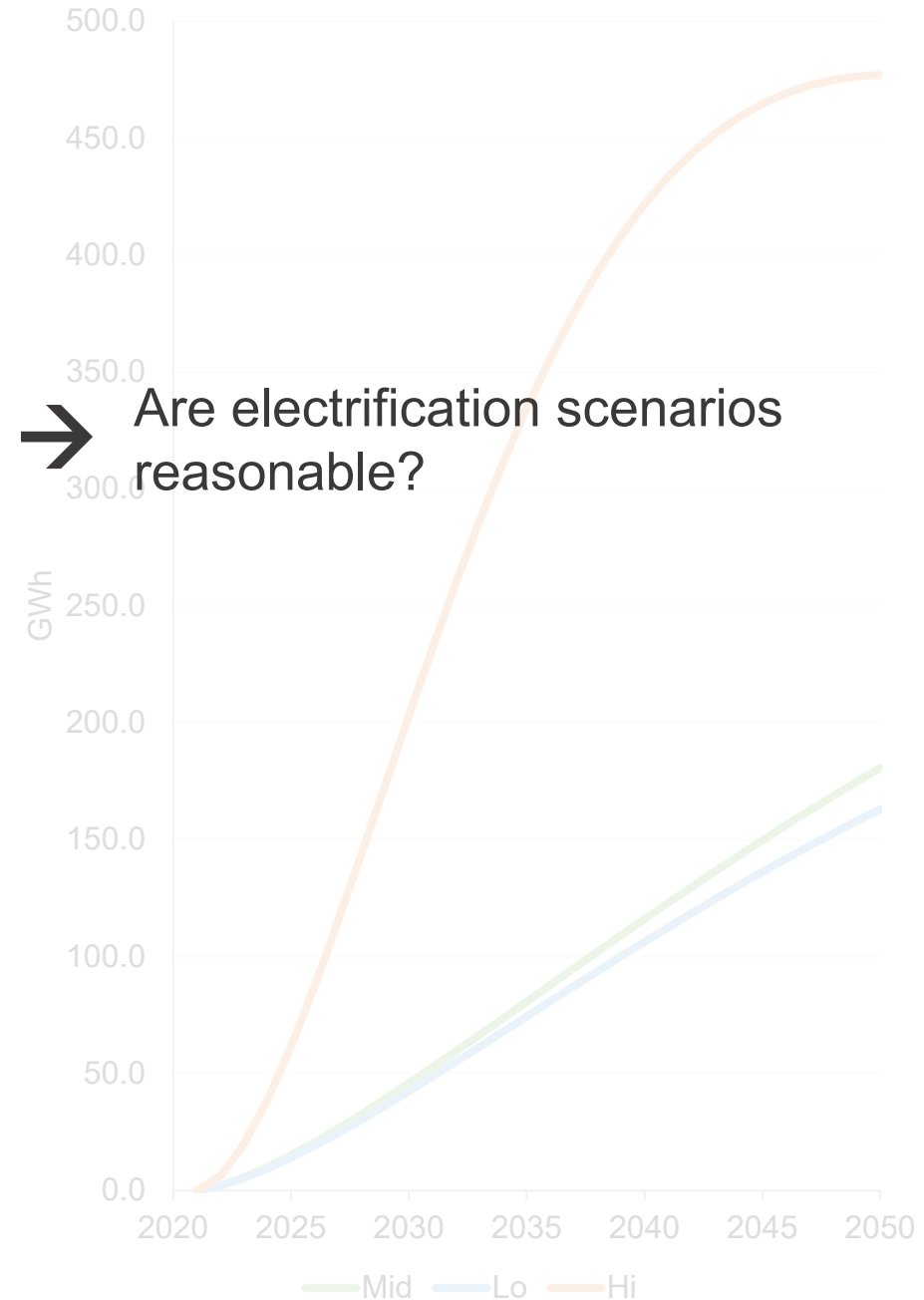


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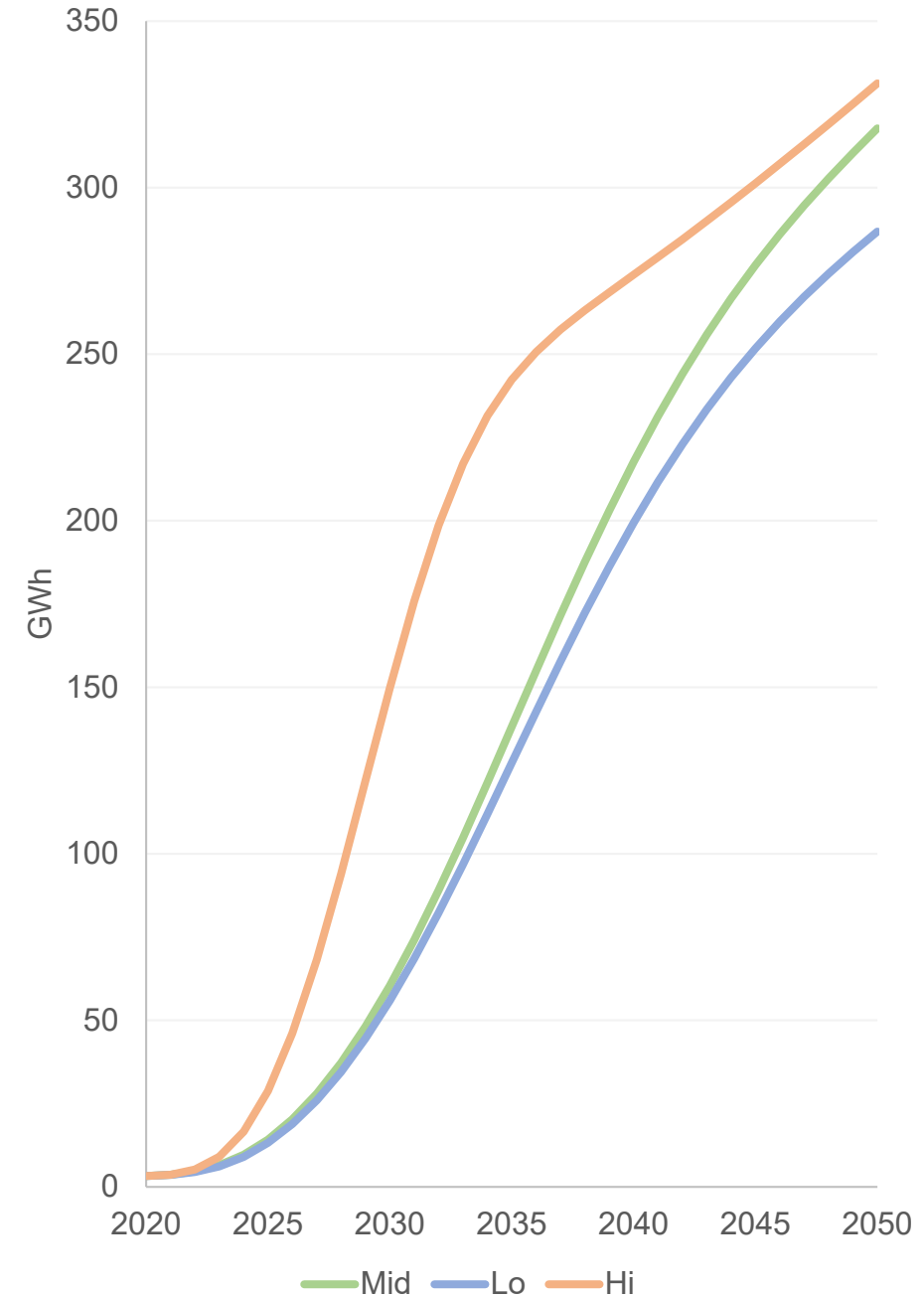
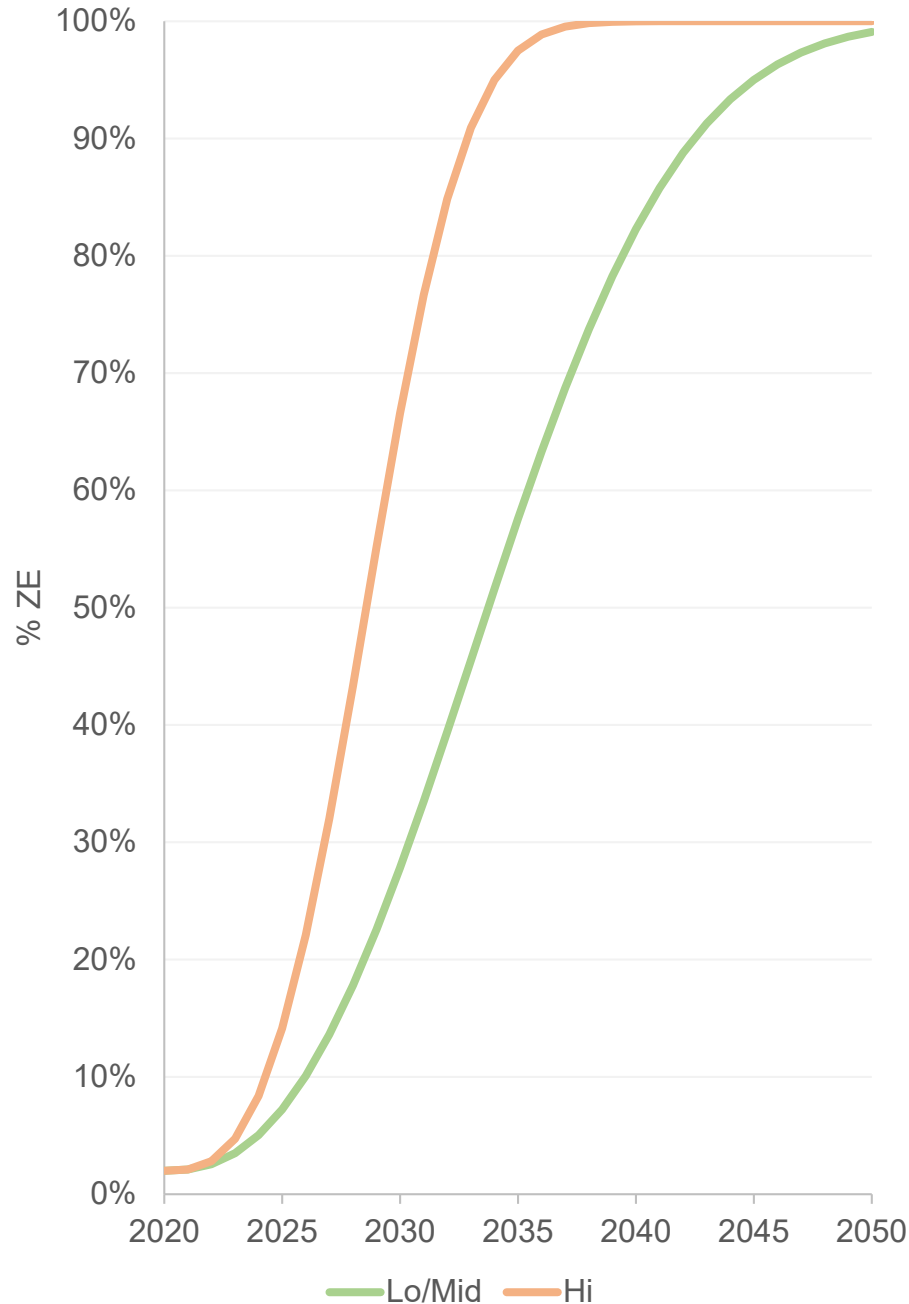


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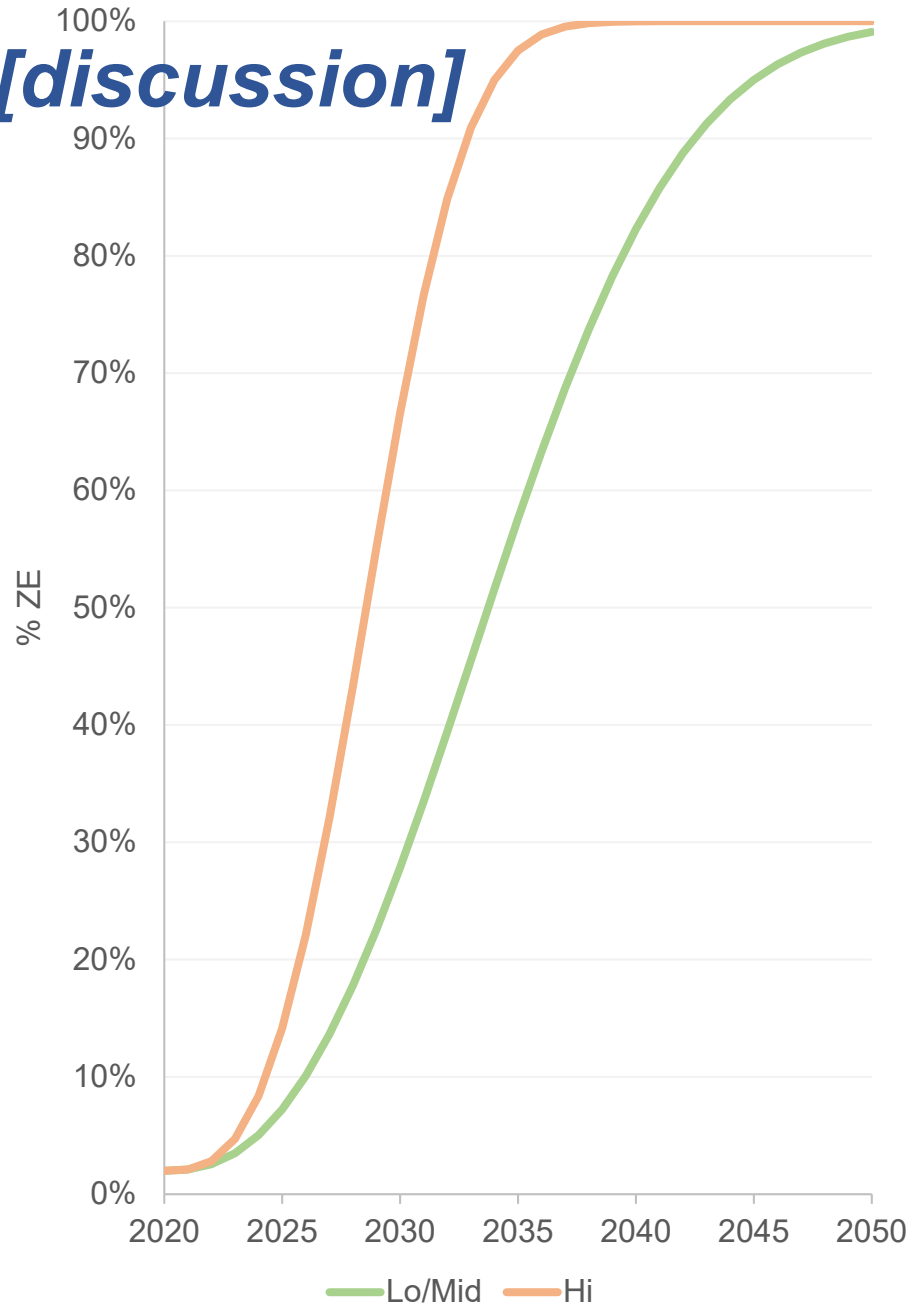
Cargo handling

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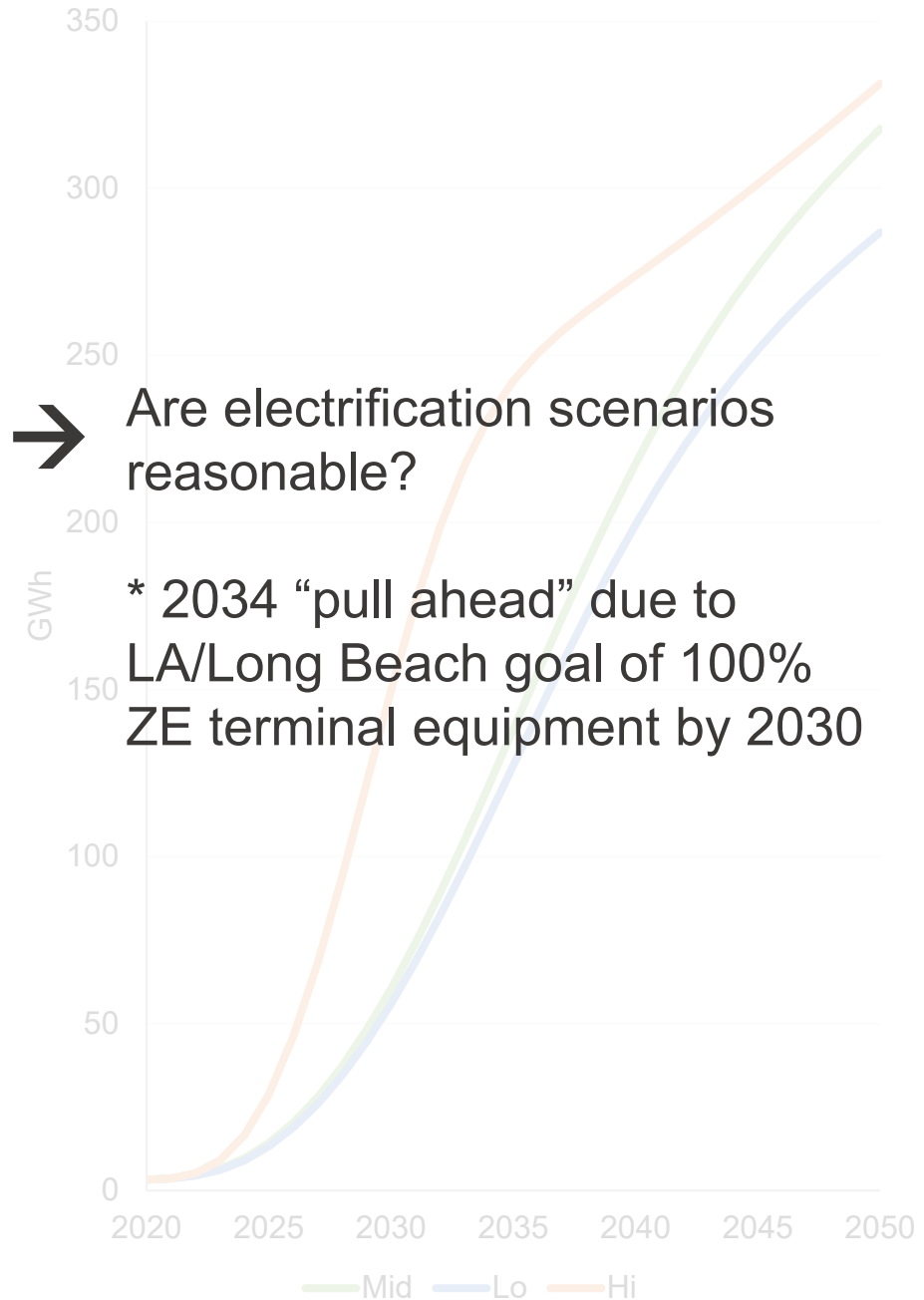
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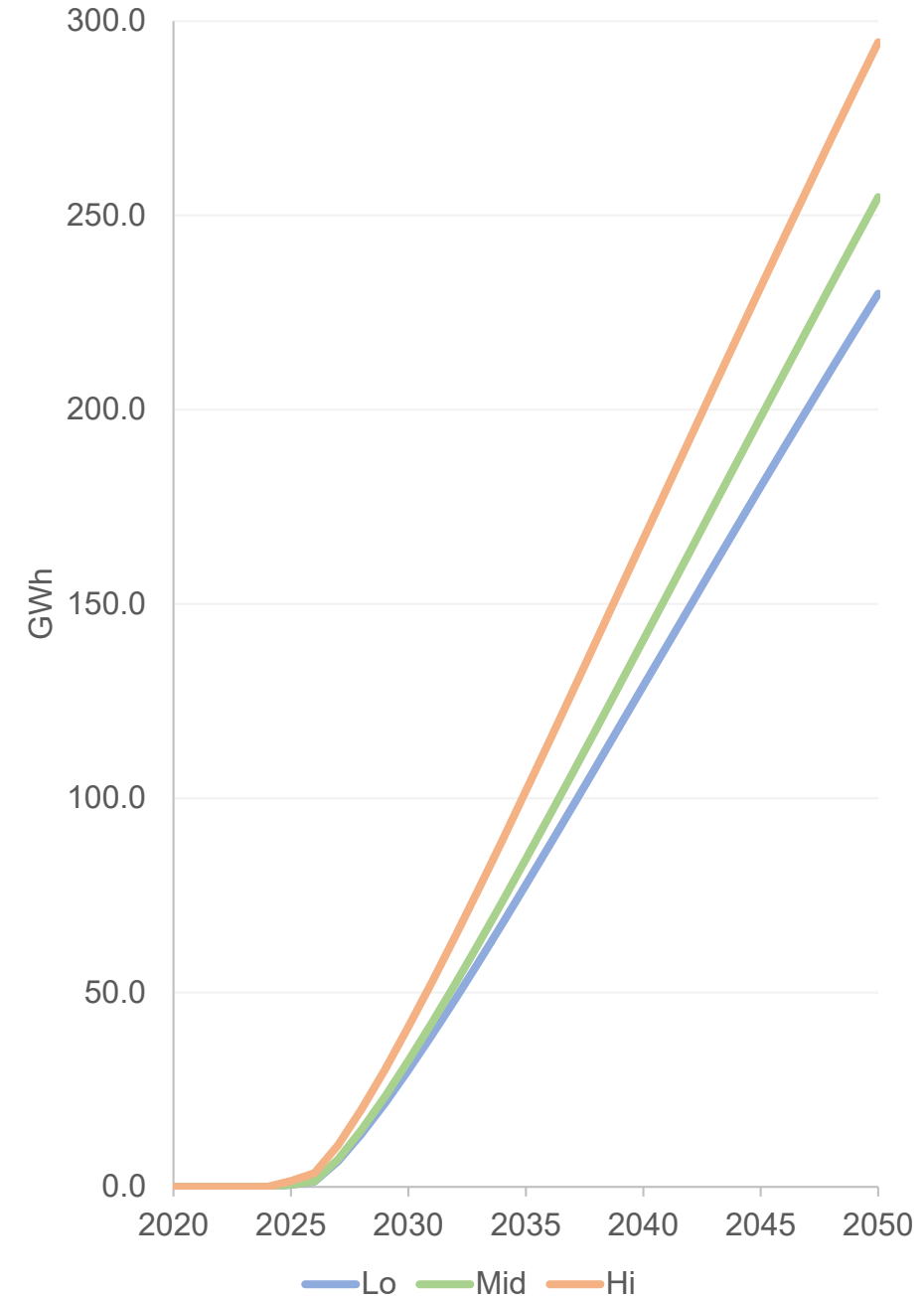
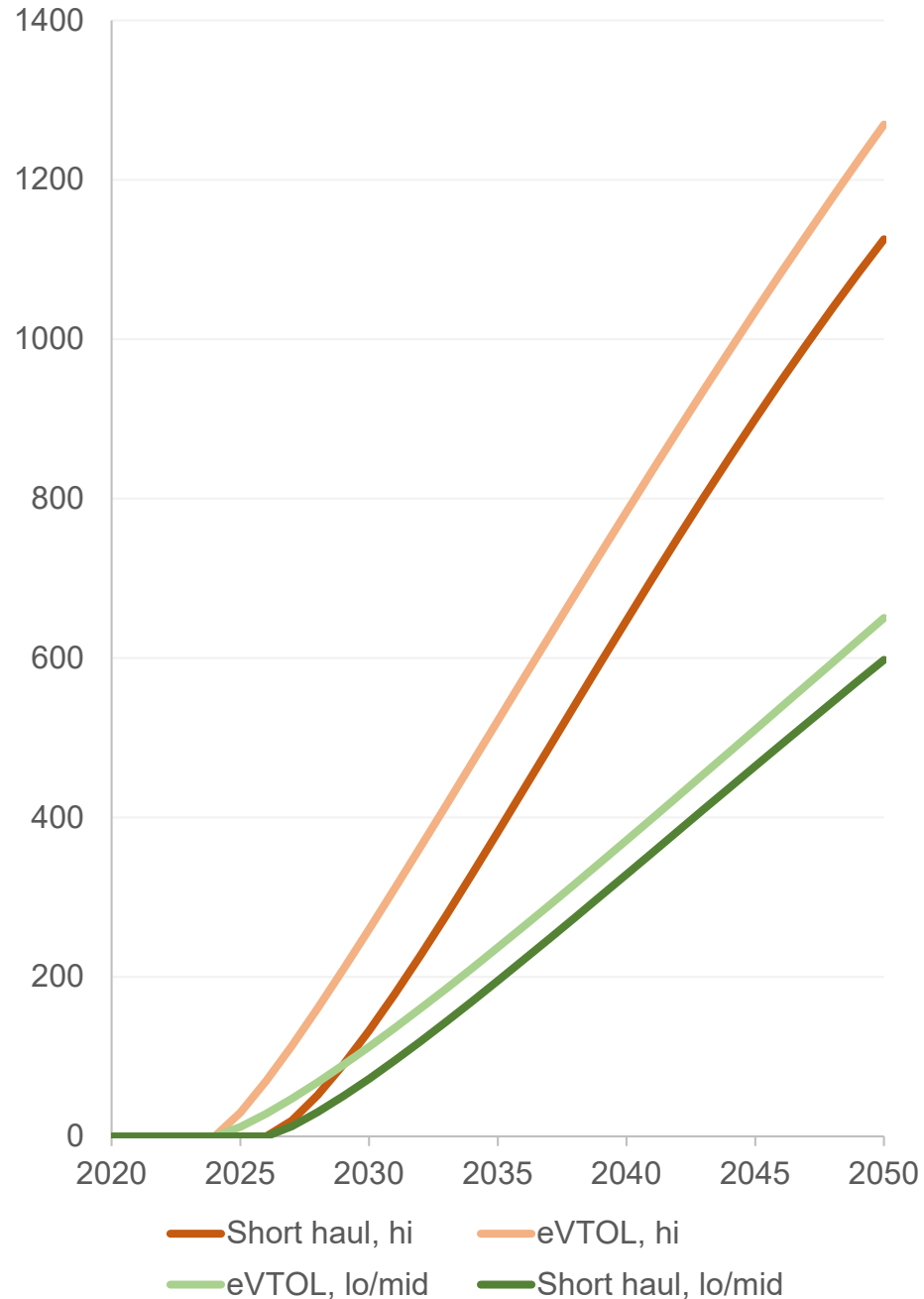
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* 2034 “pull ahead” due to LA/Long Beach goal of 100% ZE terminal equipment by 2030



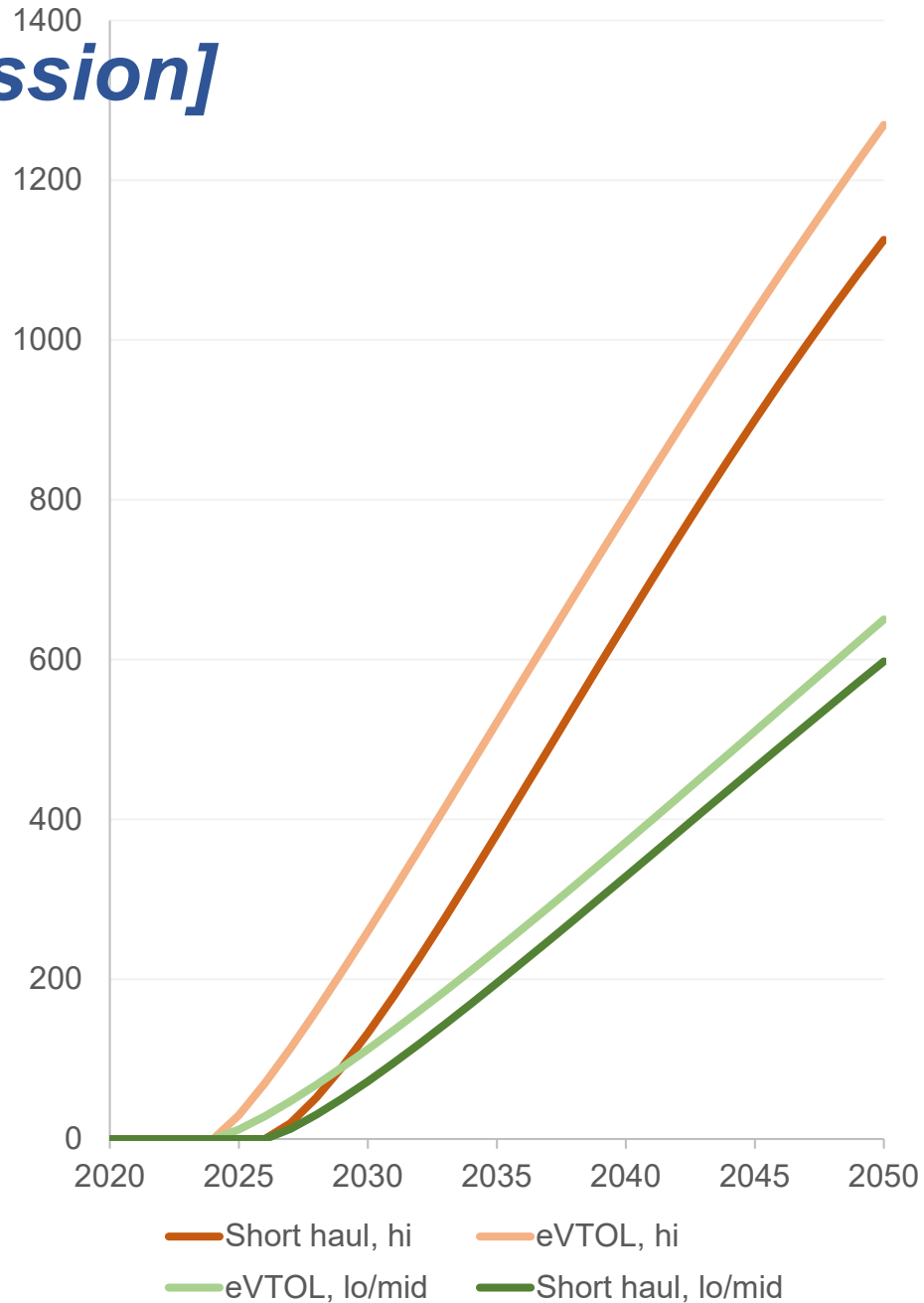
Aviation

- Short haul aircraft and eVTOL
- Hi population target:
 - 489 short haul, 592 eVTOL by 2035
 - Based on ICF analysis (short haul) and MDPI paper (“advanced air mobility”), scaled to CA by GDP contribution
- Mid population target: 40% of hi
- Lo population target: Same as mid, scaled down by GSP growth spread



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Are population scenarios reasonable?

ICF estimates 3,300 short haul aircraft nationwide serving sub-regional airport-airport trips in 2035 (e.g., SFO-MOD)

MDPI paper estimates ~4k aircraft nationwide serving 55k advanced air mobility trips daily (urban air taxi and airport “shuttles”)

Initial passenger service currently planned for 2024-2026



Thank you

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