

DOCKETED

Docket Number:	19-IEPR-03
Project Title:	Electricity and Natural Gas Demand Forecast
TN #:	229043
Document Title:	Off-road Transportation Electrification
Description:	Presentation by Marshall Miller of CEC and Aspen Environmental Group
Filer:	Raquel Kravitz
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	7/19/2019 1:29:09 PM
Docketed Date:	7/19/2019

Off-road Transportation Electrification

**2019 IEPR Workshop on Transportation
Energy Demand Forecast**

Marshall Miller

and

Aspen Environmental Group

July 22, 2019

Outline

- Study summary
- Methodology
- General changes from 2015 study
- Preliminary results for categories
 - Inputs
 - Specific changes from 2015
 - Electricity plots

CEC Study Purpose

- Estimate total electricity demand for off-road vehicles and applications from 2019 – 2030
- Add new categories to the 7 old categories
- Produce Low, Medium, and High scenarios for electricity usage for each category for years 2019-2030

2015 Study Off-Road Transportation Categories

- Truck Stop Electrification (TSE)
- Trailer Refrigeration Units (TRUs)
- Industrial Forklifts
- Port Cargo Handling Equipment (CHE)
- Airport Ground Support Equipment (GSE)
- Utility Work Trucks
- Shore Power

New Study Categories

- Locomotives (Class 1)
- Construction, Mining, Industrial
- Commercial Harbor Craft
- Motorcycles (?)
- Likely complete a subset of the above

Methodology: Inputs

- Present fleet stock (# vehicles/applications)
 - Separate category for each vehicle type (e.g. airport baggage tug, airport belt loader, forklift classes)
 - Data from ARB Orion database in most cases
- Estimate population growth through 2030
- Estimate vehicle/application activity (VMT or hours) and fuel economy (mi/kWh, kWh/hour)
 - Data from Orion Database in most cases
- Estimate % of electrified vehicles/applications in fleet
 - Generally assume linear increase through 2030
 - Data from current reports, recent activity, and regulations
 - Discussions with stakeholders

Methodology: Calculations

- Vehicles
 - Electricity usage = $\# \text{ veh}_e * \text{VMT} / (\text{mi/kWh})$
- Applications (Truck stops, shore power, etc.)
 - Electricity usage = $\# \text{ equipment} * \text{hours usage (elec)} * (\text{kWh/hr})$
- Some cases data includes total energy usage (e.g. airport GSE)
- Variation of inputs by year
 - Population increases
 - % electrified increases (dominates)
 - Fuel economy/usage, activity held constant

Scenarios: Low, Medium, High (Range of Estimates)

- Electrification demand mostly determined by % adoption of electrification (dominates range)
- Project Low, Medium, and High scenarios stock growth
 - data from U.S. Bureau of Economic Analysis; Moody's Analytics (CA counties) for projected economic growth from 2019 – 2030
- Low
 - Close to lower bound, extrapolate from 2019 with present regulation
- Medium
 - Best estimate and roughly in middle of Low and High
- High
 - Aggressive assumptions

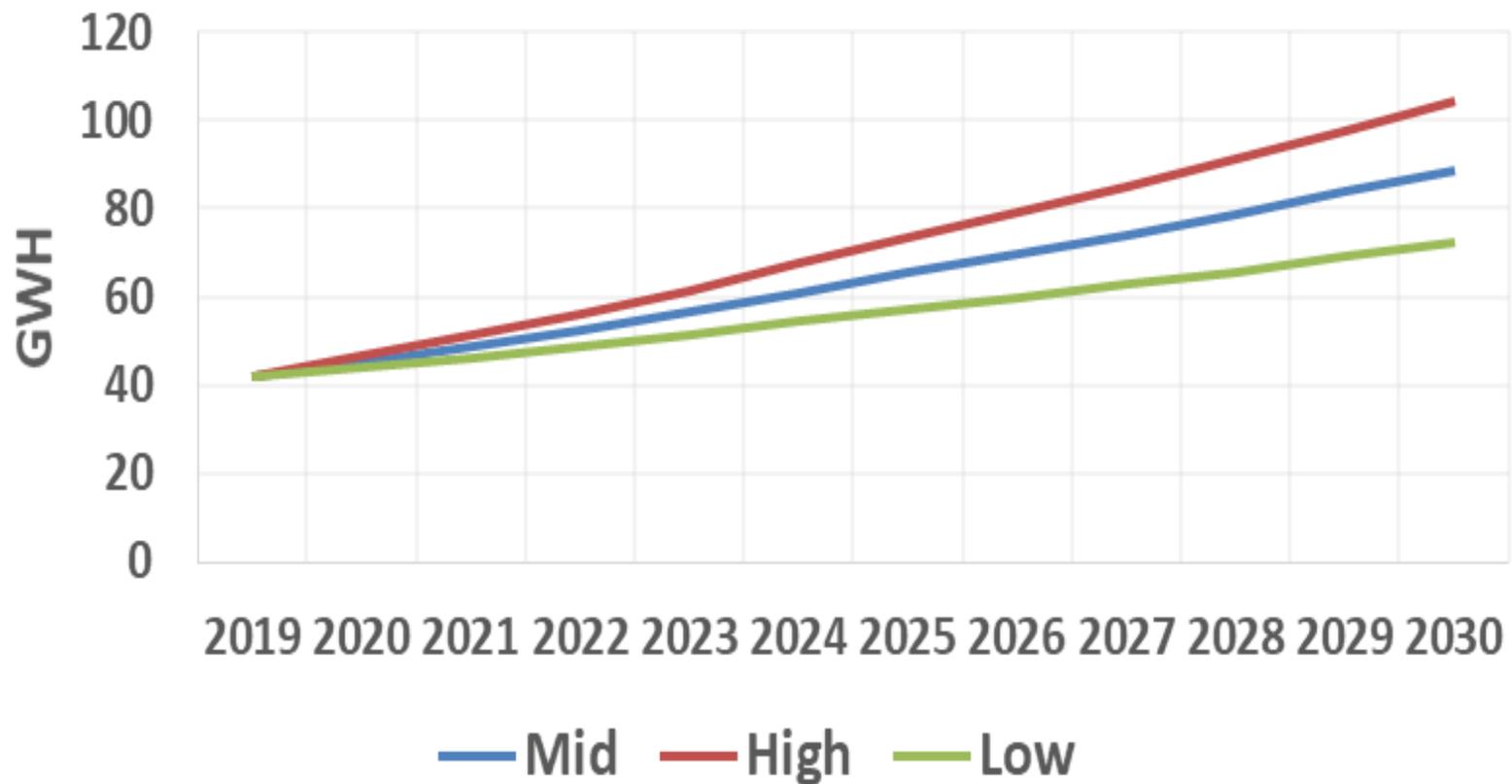
General Changes from 2015

- Orion database
 - Reporting of all vehicles/equipment with emissions
 - No electric vehicles/equipment
 - Assume large difference in accuracy
- ARB regulations
 - 2015 vague planning stage
 - 2019 specific targets

Airport Ground Support Equipment

- LAX study 2013 – economically beneficial
- Airports and airlines push to electrify
- 2019 high percentage of equipment already electrified
- Mid-range of projected electrification
 - A/C wide body tug: 30%
 - Baggage tug, belt loader: 80%

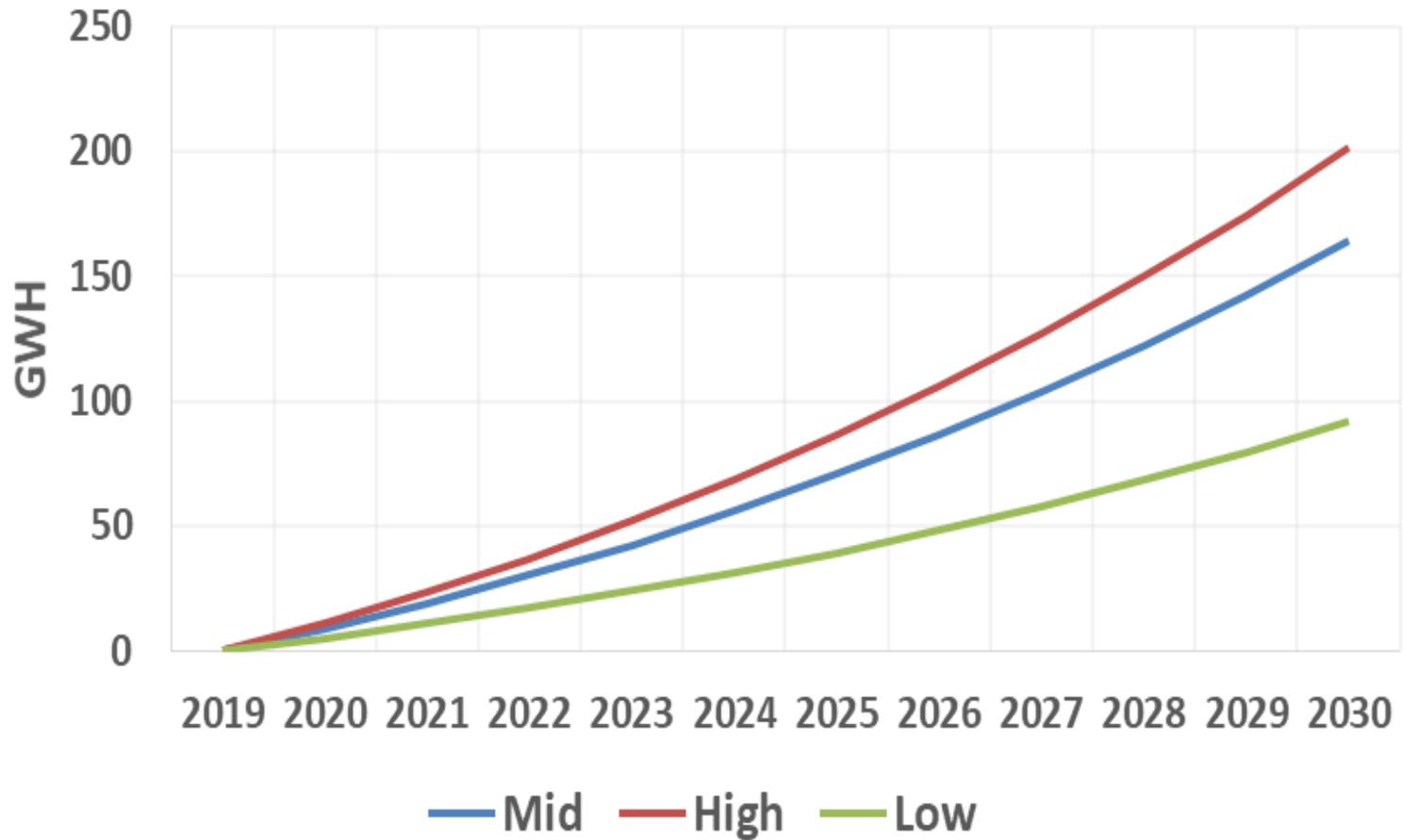
AIRPORT GSE ELECTRICITY DEMAND FORECAST



Port Cargo Handling Equipments

- Lower population from Orion
- ARB might start requirements in 2026
- Port of Long Beach and Port of Los Angeles have goals of being 100% electric on port by 2030
- Significant uncertainty especially in large forklifts (can be electrified soon?)

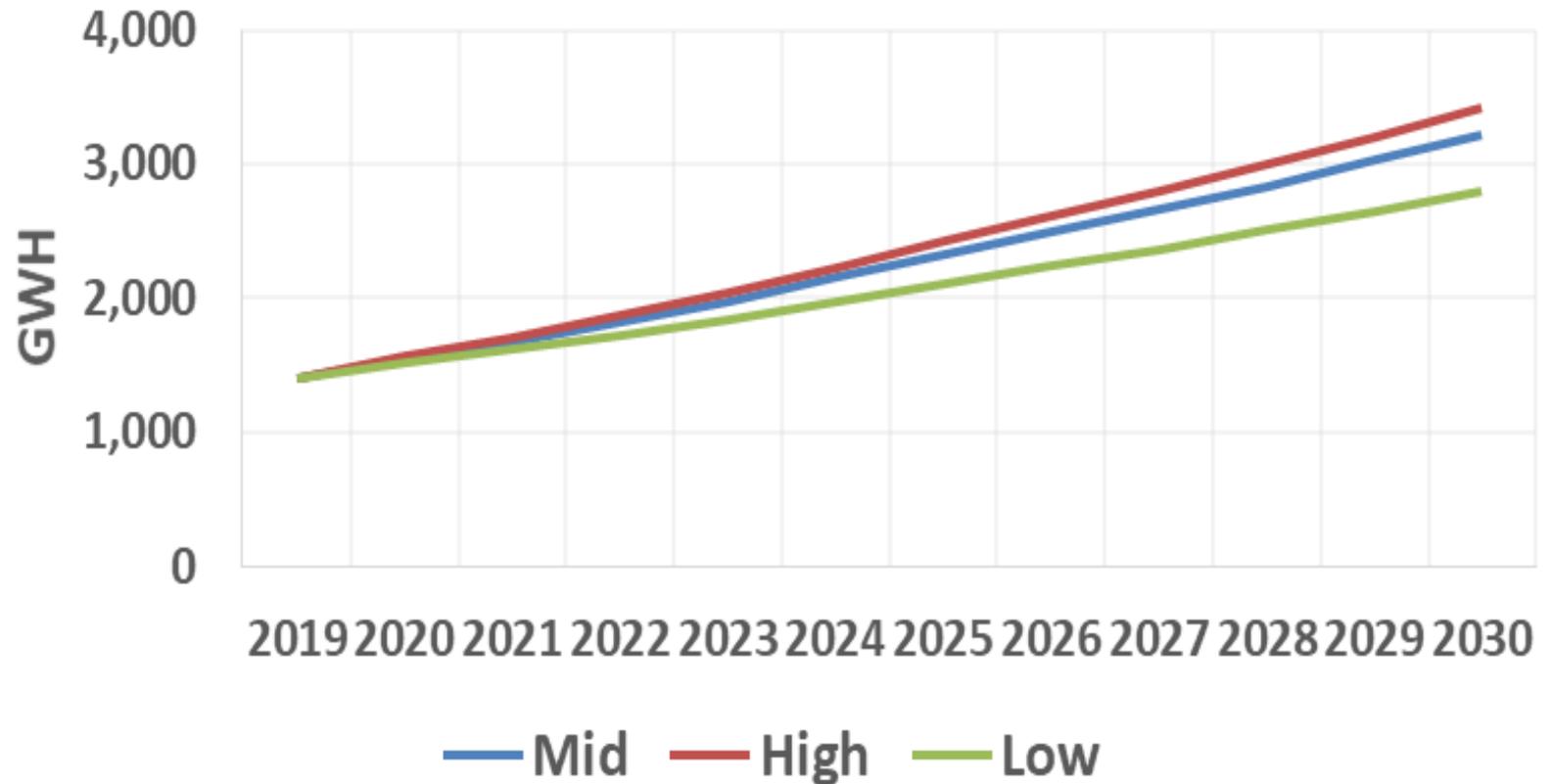
PORT CHE ELECTRICITY DEMAND FORECAST



Industrial Forklifts

- Largest electricity demand category (~2/3 total)
- Class 1-3 electric (~55% of population)
- Class 4-5 fossil fuel (~45% of population)
- ARB may require all < 8000 lb class 4-5 forklifts to be electric by 2035
- Percent electrification class 4-5 (43 – 64% in 2030), some forklifts will be fuel cell
- Higher electricity demand due to ARB regs

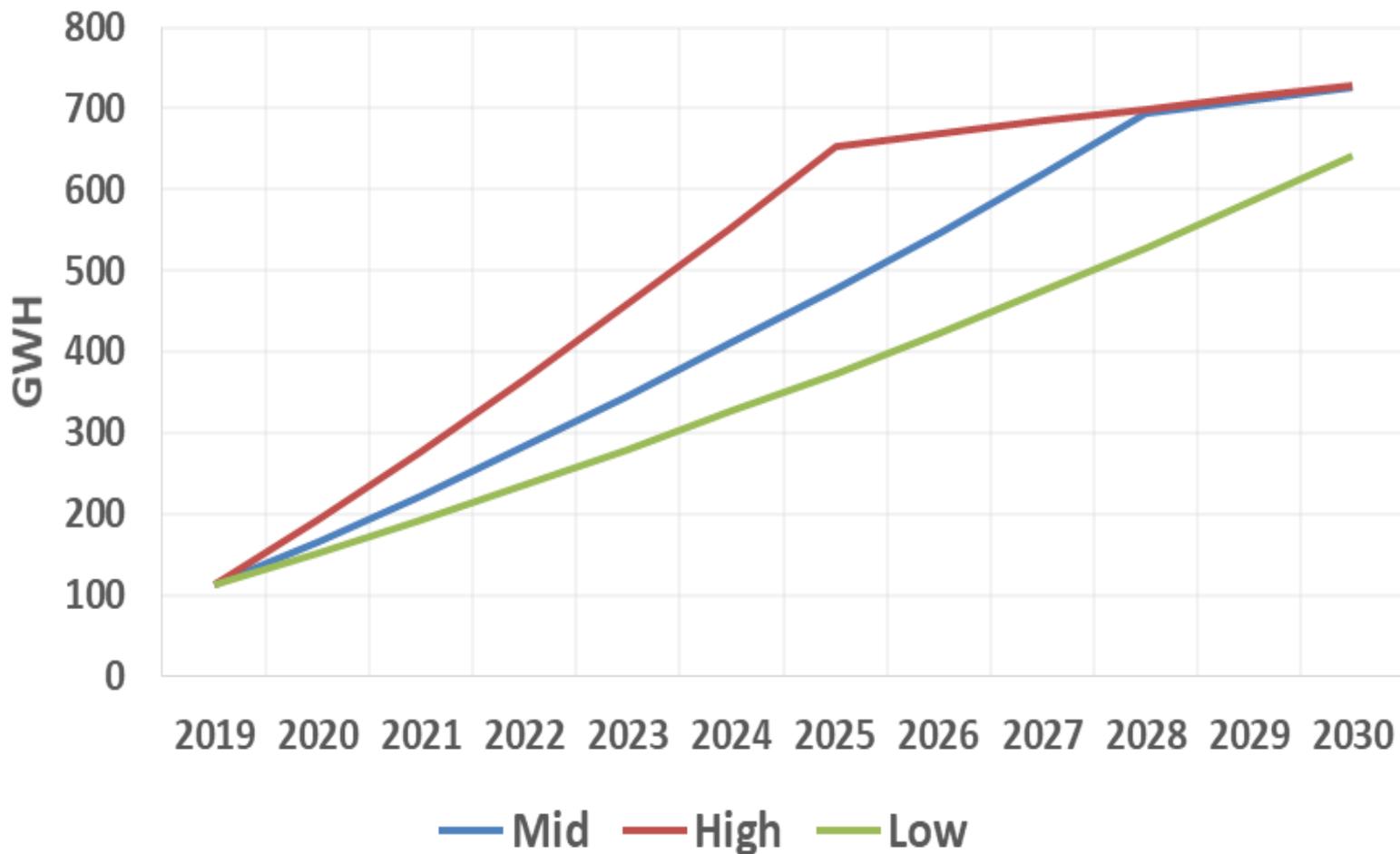
INDUSTRIAL FORKLIFTS ELECTRICITY DEMAND FORECAST



Transport Refrigeration Units (TRUs)

- ARB strong regulations
 - 100% electrification of > 25 hp TRUs by 2025 including out-of-state
 - Potential issue: infrastructure
 - 100% electrification of < 25 hp TRUs by 2031
- 2015 high scenario ~ 50-60% electrification in 2026 (20% out-of-state)
- Much higher electricity demand

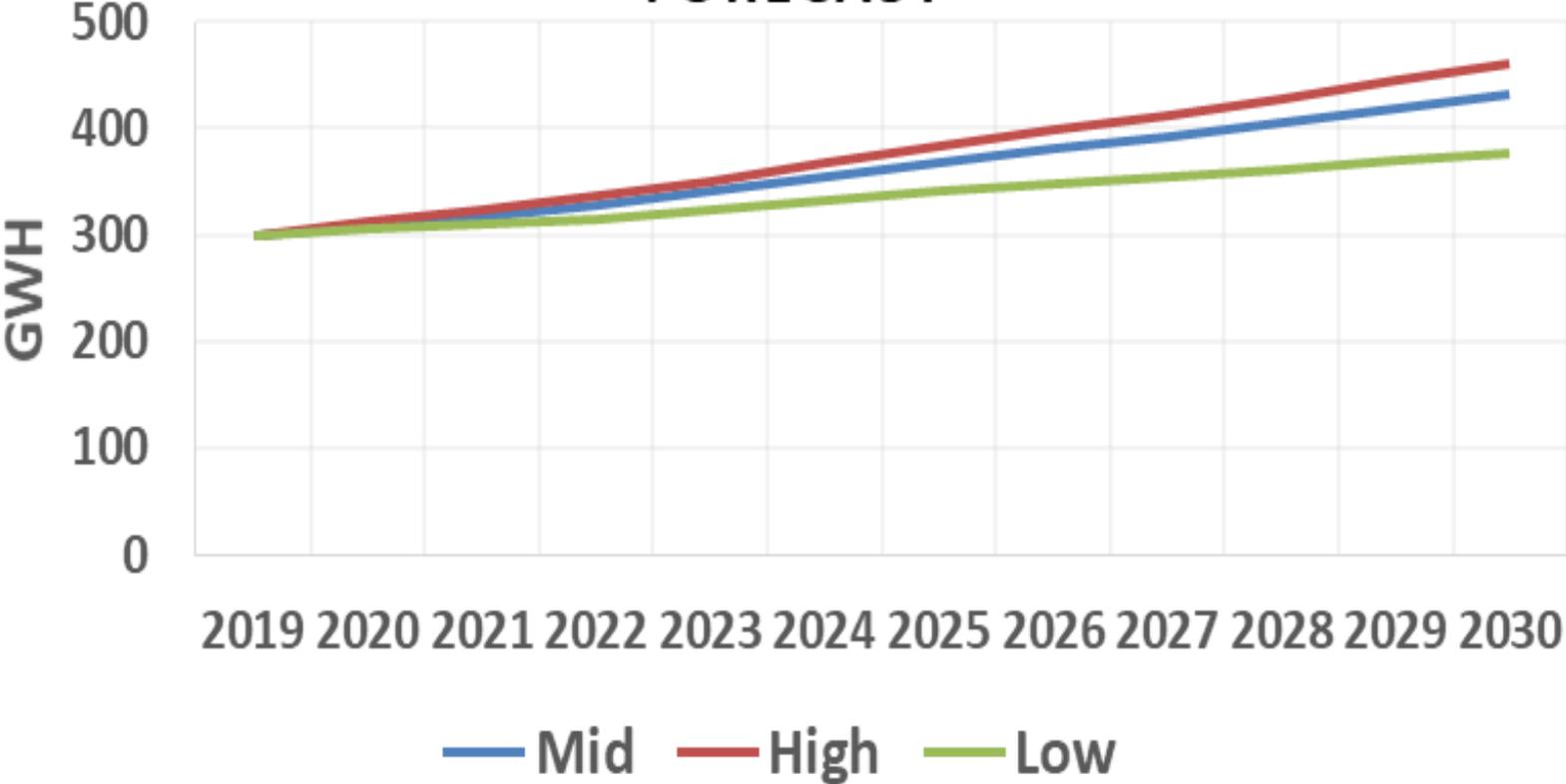
TRU ELECTRICITY DEMAND FORECAST



Shore Power

- ARB Inventory for Ocean-Going Vessels
 - Incredibly detailed data (berthings, hours, kW)
- Added 4 vessel types
 - Old: container, reefer, cruise, tanker
 - New: auto, bulk, Ro-Ro, general
- Percent electrification similar 2015 to 2019
- Slightly lower electricity demand due to lower population of some vessel types

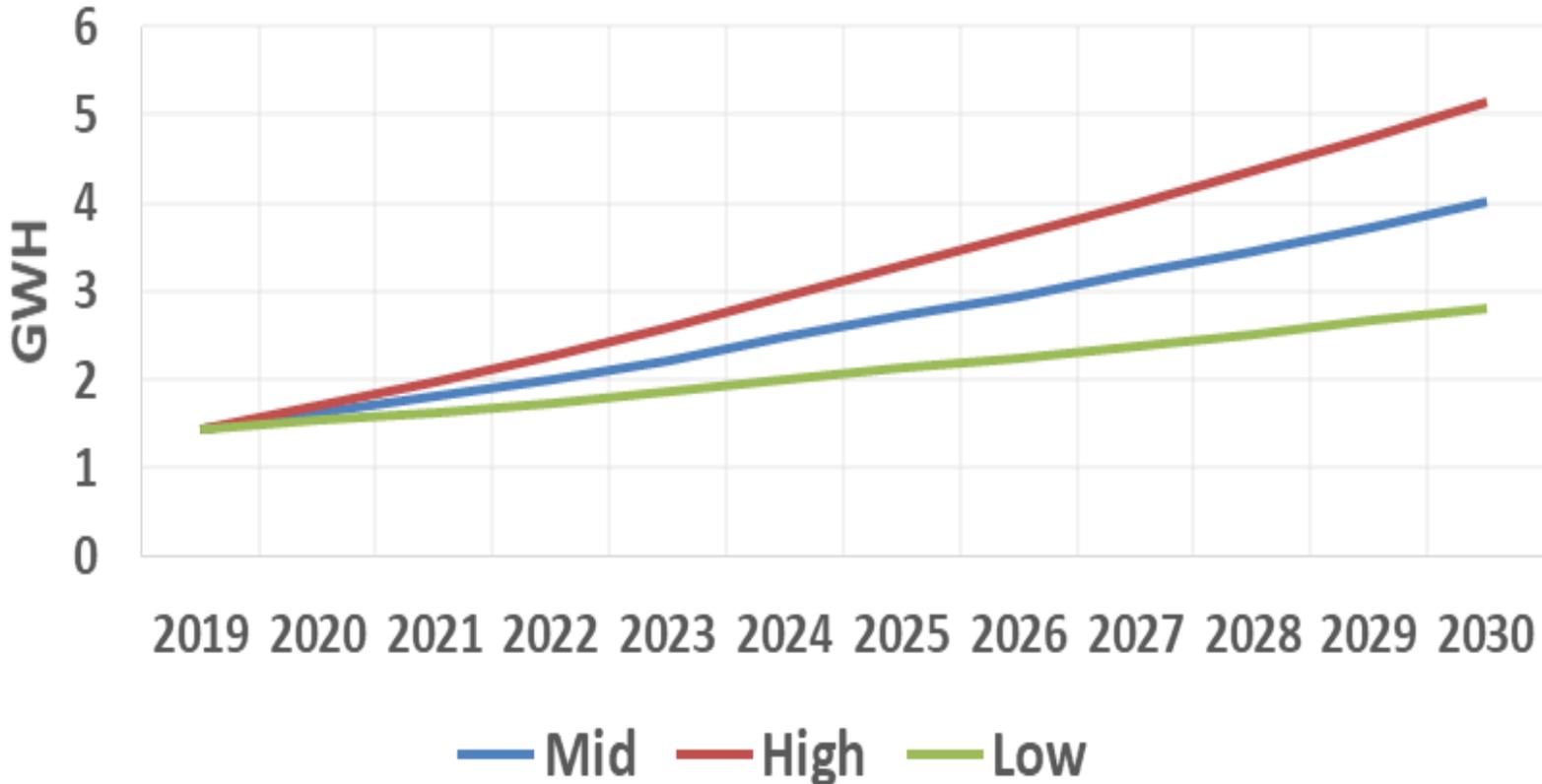
SHORE POWER ELECTRICITY DEMAND FORECAST



Utility Work Trucks

- Battery provides power at work site through PTO
- Edison Electric Institute study
 - Electricity demand
- California utilities
 - Bucket truck populations
 - Percent electrification
- 2015 and 2019 results similar

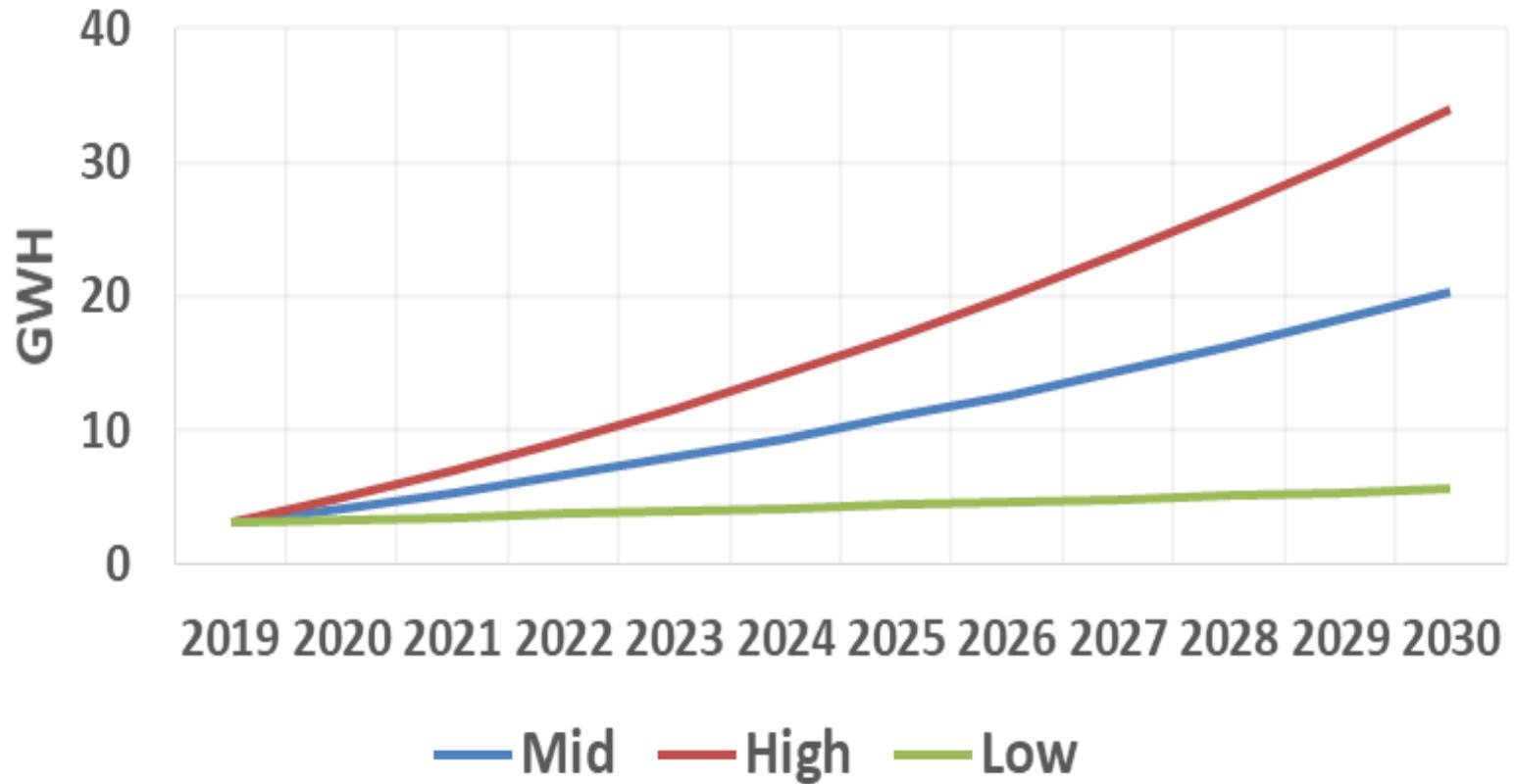
WORK TRUCKS ELECTRICITY DEMAND FORECAST



Truck Stop Electrification

- Electrify cabin and connect to grid at truck stop parking space
- Estimate percent of trucks with cabin electrified
- Estimate capacity factor (% time parking space is utilized for electricity)
- 2015 and 2019 results similar

TRUCK STOPS ELECTRICITY DEMAND FORECAST



Harbor Craft

- ARB has no present plans to require electrification in regs
- Possible vessel type suitable for ZEV operation is ferries
- Norway has commercial ZEV ferries – fuel cell rather than battery electric
- Some companies want to skip Tier 4 regulation and move to lower emissions

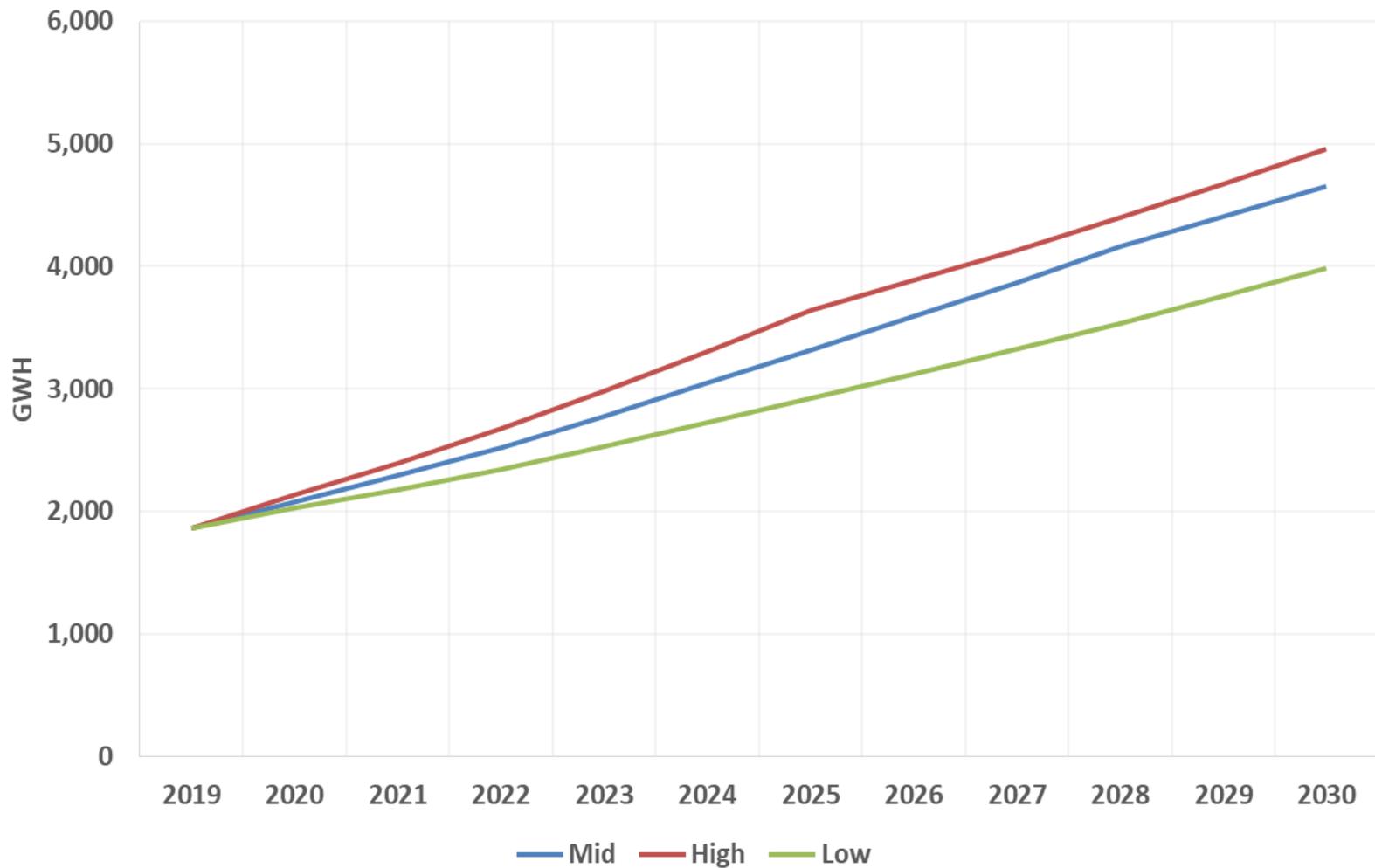
Construction and Mining

- ARB has no present plans to require electrification in regs
- Demo projects
 - High capacity forklift Port of Stockton
 - Mobile charging for Agricultural tractors
- Possible electrification of rough terrain forklifts
- Australia has fully electric mines
- Mining depends strongly on operations

Locomotives (Class 1)

- ARB has no authority to regulate rail (US regulations)
- Class 1 – freight
- Some demonstrations scheduled
 - GE/BNSF Stockton/Barstow demo late 2020
 - Battery powered paired with diesel locomotives
 - Operating strategy TBD
 - Port of Los Angeles switcher locomotive 2019-2020
- Unlikely to see electricity demand

OFF-ROAD ELECTRICITY DEMAND FORECAST



Thank You

mmiller@ucdavis.edu