# Electric Vehicle Transportation and Power Grid Integration



Engineers and Architects of Hawaii
Honolulu HI, Feb. 26, 2016
by
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HNEI
Hawai'i Natural Energy Institute
University of Hawai'i at Mānoa

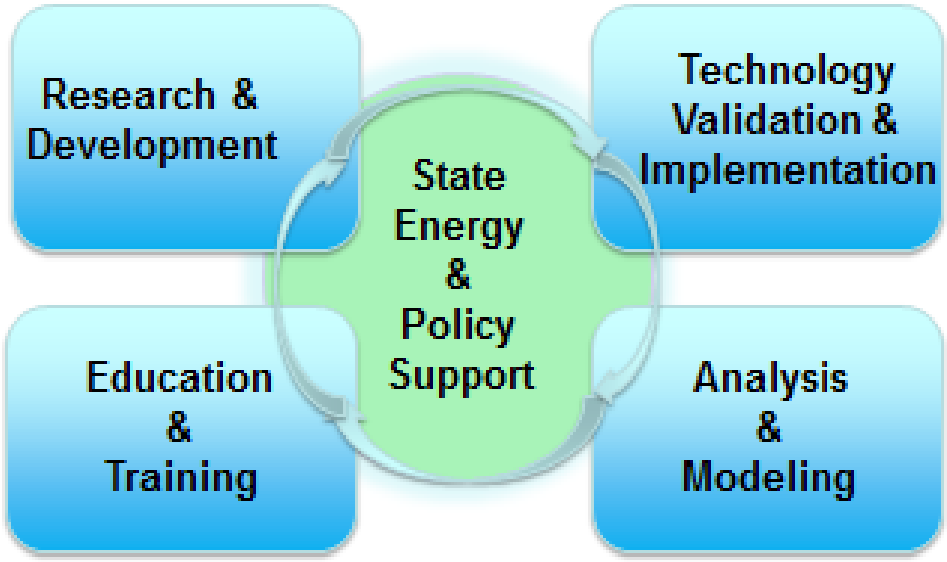
University of Hawai'i Mānoa

# Hawaii Natural Energy Institute

- Organized Research Unit in the School of Ocean and Earth Science and Technology
- Established by the Legislature in 2007
- HNEI leads many significant public-private partnerships focused on the development, testing & evaluation of emerging energy technologies to reduce Hawaii's dependence on fossil fuels

**Programs:**

- Alternate fuels
- Renewable generation
- Fuel cells & batteries
- Energy efficiency & Transportation
- Grid management & enabling technologies

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# EVTC
## Electric Vehicle Transportation Center

**HNEI is partnering with the *Florida Solar Energy Center* on a US DOT program to transform the country's transportation network into a fully integrated 'smart' EV deployment coupled with a 'smart' electric grid.**

**HNEI's focus is the technical and economic benefits and challenges of EVs on an electric grid characterized by high penetration of intermittent renewable energy.**

http://evtc.fsec.ucf.edu/

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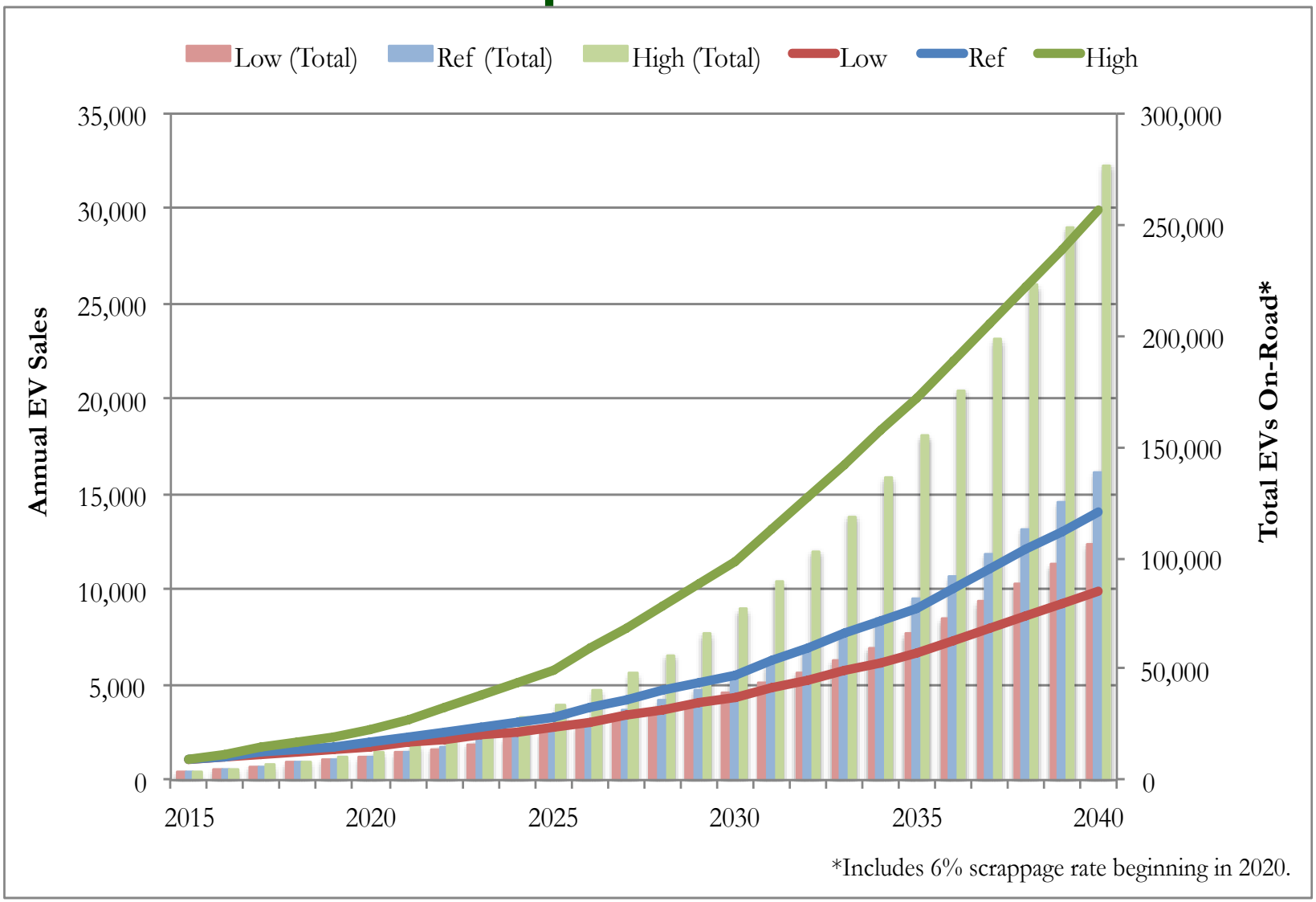
FSEC

# Hawaii EVTC Projects

- **EV Energy Impacts: Reduction of net petroleum use and emissions**
- **Optimization of EV battery durability under grid operations**
- **EV Interaction at the Electrical Circuit (Neighborhood) Level**
- **Effect of EVs on Power System Expansion and Operation**
- **Economic Impacts of Electric Vehicle Adoption**

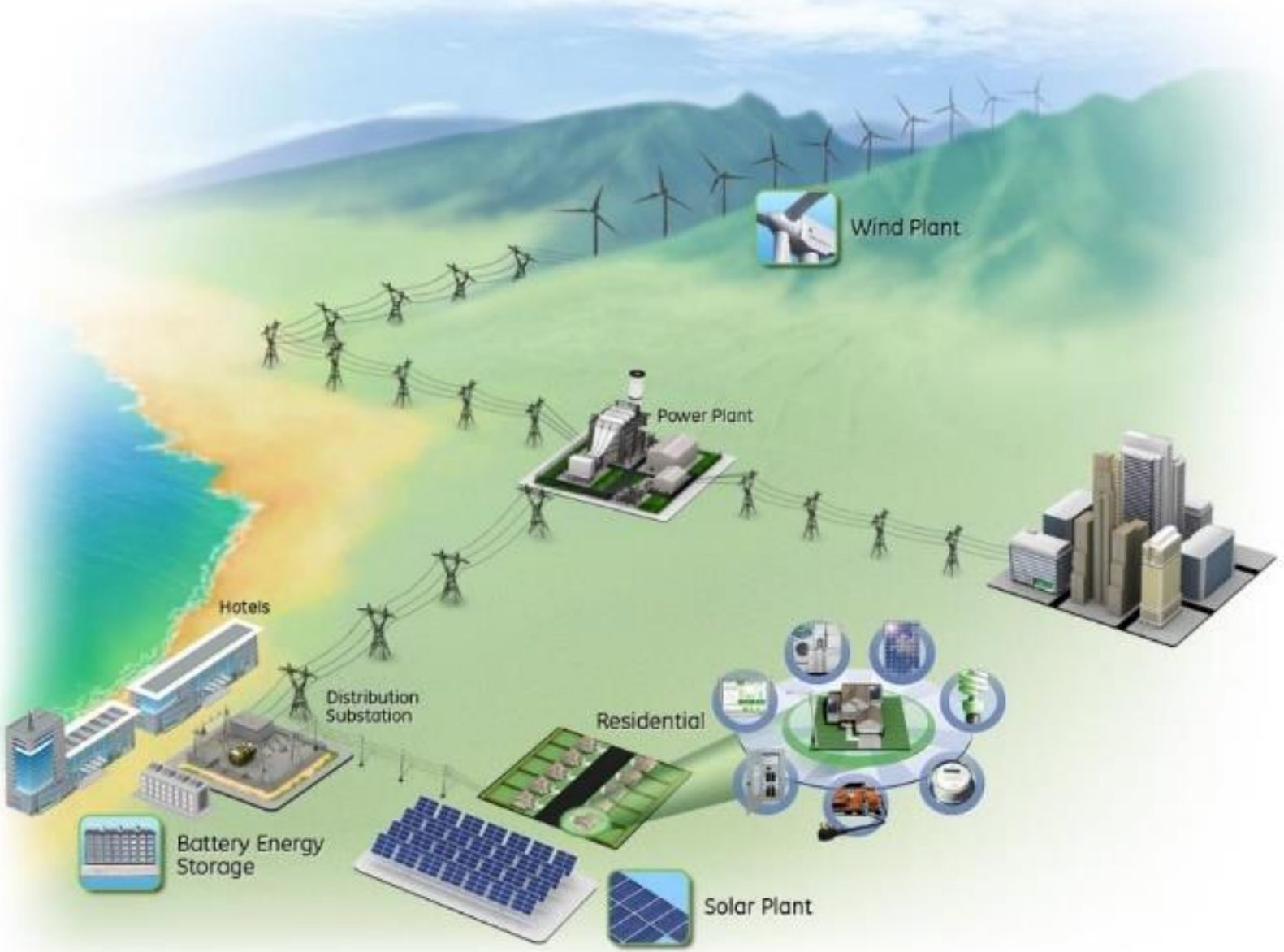
HNEI Battery lab

# EV Adoption in Hawaii



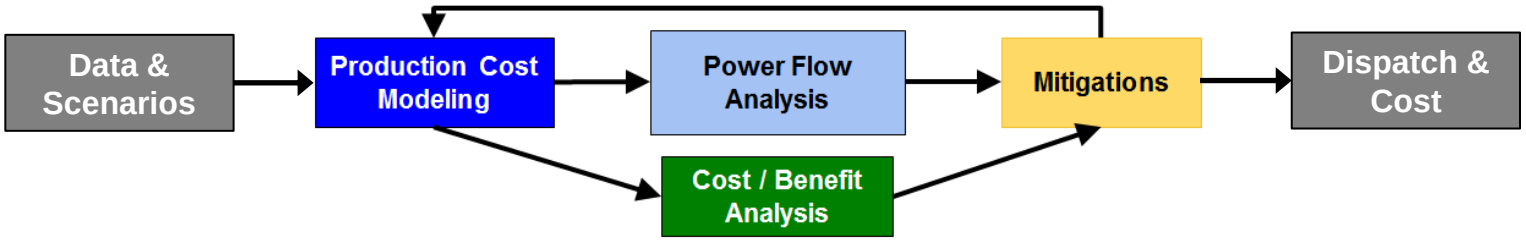

*Factors Affecting EV Adoption: A Literature Review and EV Forecast for Hawaii,* Coffman, M. Bernstein, P. Wee, S. University of Hawaii, Economic Research Organization, March 2015.

# EV Integration on the Grid



# Renewables/Grid Integration Modeling

- **Well qualified team with Hawaii experience**
- **Models, procedures, and data vetted by broad range of stakeholders (HPUC, DBEDT, HECO Companies, energy developers and independent energy experts)**

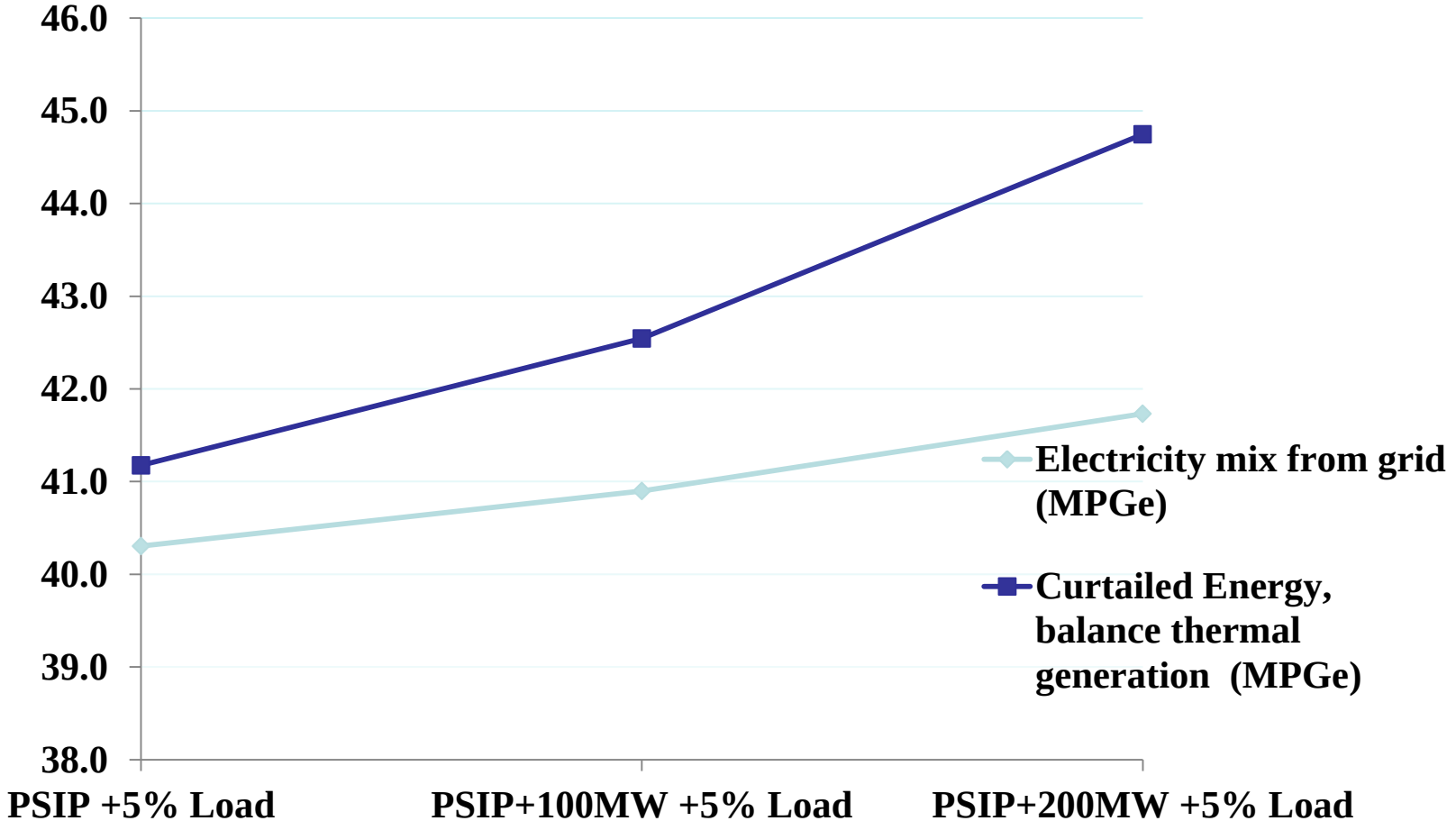



- **Potential, cost effective pathways to 40% wind plus solar identified**
  - Requires substantial changes to generator and grid operations including more flexible gen fleet, deeper turn-down, faster ramping, and baseload cycling
  - Utility implementing changes to accommodate intermittent renewables
- **"Advanced" mitigations needed for higher penetrations**
  - Load shifting (usage and storage), demand response, new reserves (storage and controllable renewables, resource forecasting, and new technologies)
  - Capacity reliability, transient stability and power quality must be addressed - ongoing

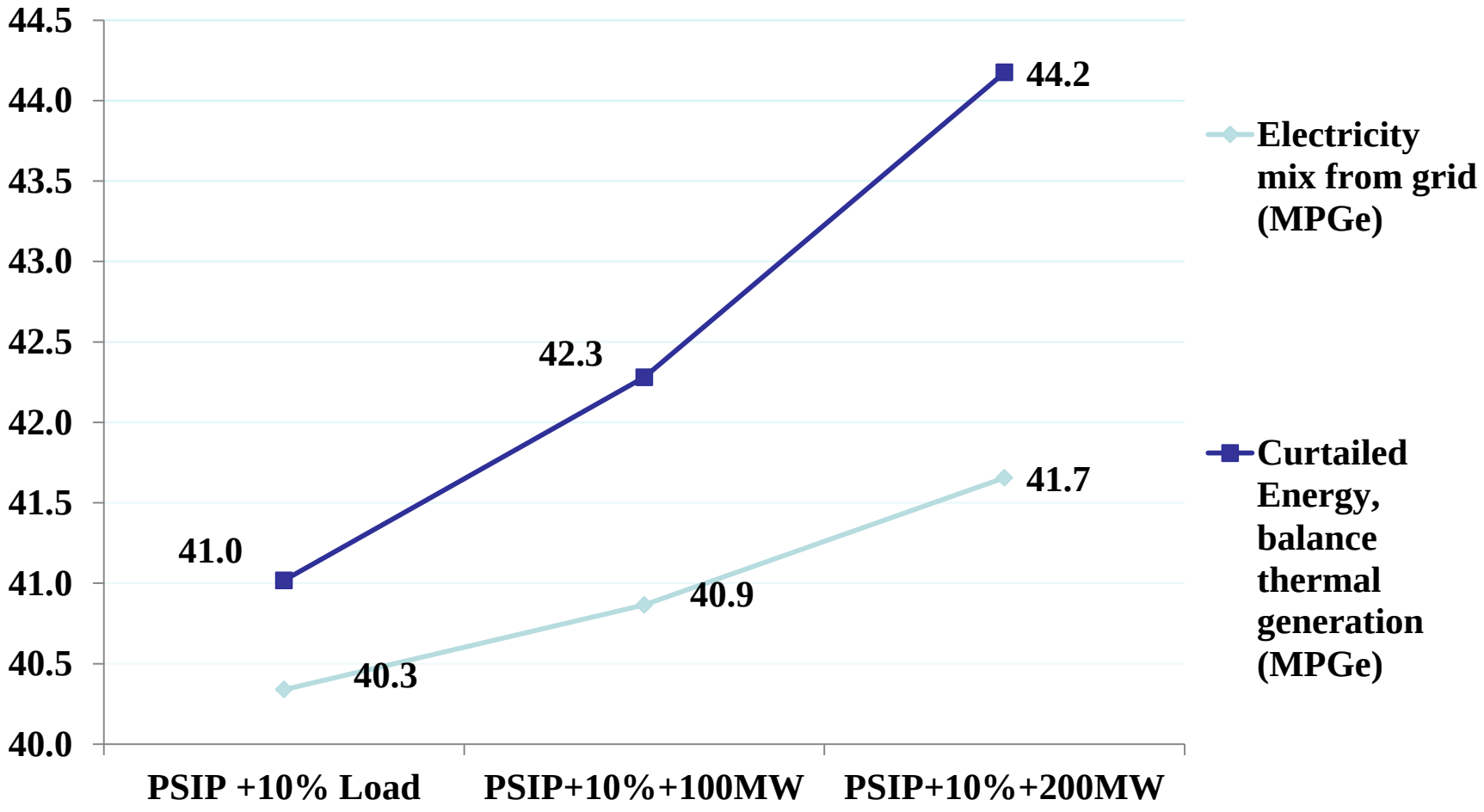
# EV Energy Impacts Analysis: Assumptions

- **Average plug-in EV gets 30 kWh/100mi**
- **11,000 miles traveled per year**
- **Average of 23.4 MPG for all light duty vehicles in the US**
- **121,288 EVs on Oahu by 2040 and 266,412 by 2045 with EIA high oil price**

# EV Mileage on Oahu in MPGe for PSIP Scenarios: 5% Load = 122,121 EVs



# EV Mileage on Oahu in MPGe for PSIP Scenarios: 10% Load = 243,939 EVs

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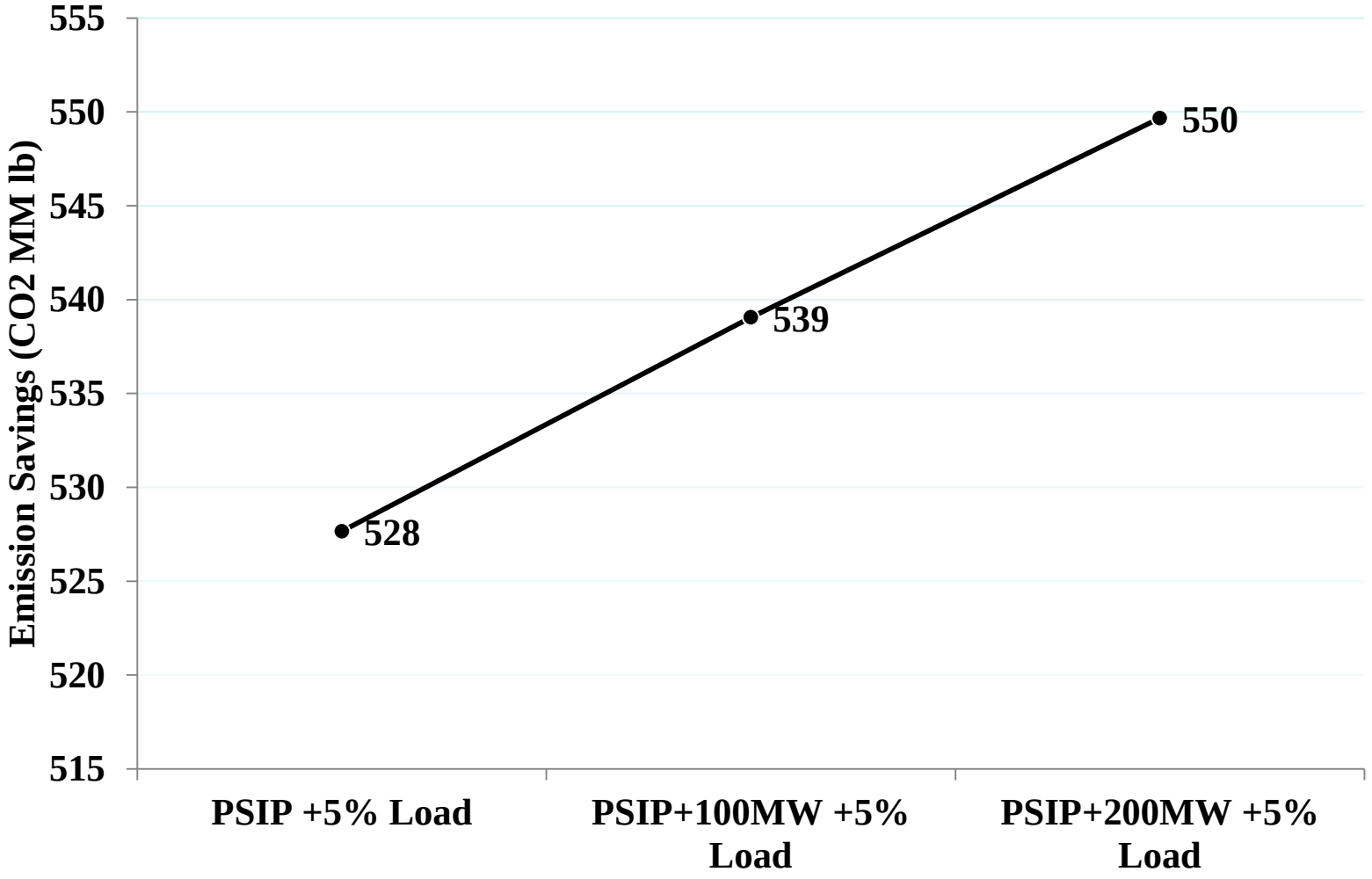
# EV Emission Savings Compared with Gasoline Vehicles (23.4 MPG):



# EV Analysis – Further Results

- 2 to 5 MPG – what it would take for similar fuel savings by reducing Oahu's entire passenger vehicle fleet's fuel economy

- 39% and 62% reduction in curtailed wind and solar energy when 5% load and 10% loads are added to the PSIP grid, but curtailed energy only 2.4% and 4.2%

- Beyond ~40% renewables on Oahu, EVs can be especially helpful to reduce daytime curtailment of PV, but significant infrastructure development is needed for workplace charging

# MAHALO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