

Electric Vehicle Transportation and Power Grid Integration



Women in Renewable Energy
Honolulu HI, Jan. 27, 2016

by

Katherine McKenzie

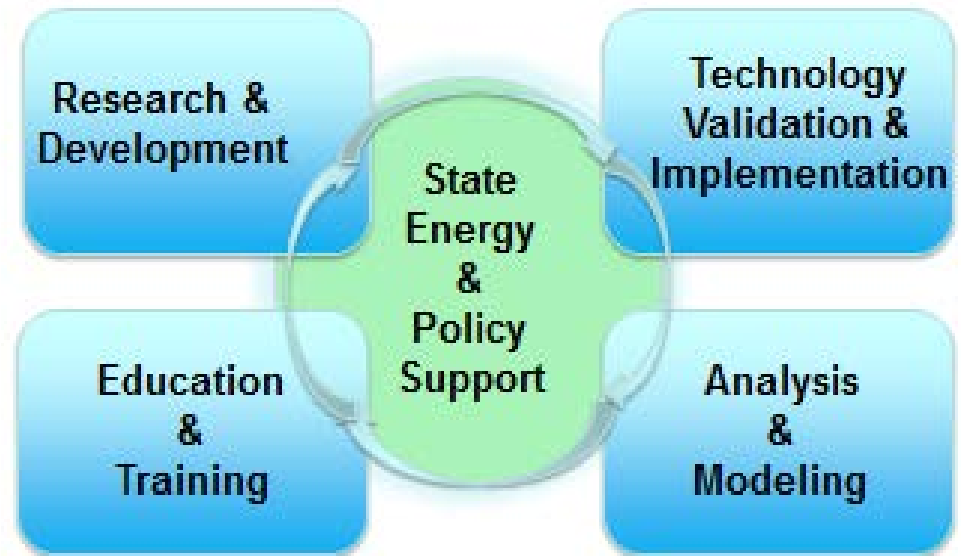
Hawaii Natural Energy Institute
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

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



Electric Vehicle Transportation Center (EVTC)

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.



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 Integration on the Grid



HNEI-GE Modeling



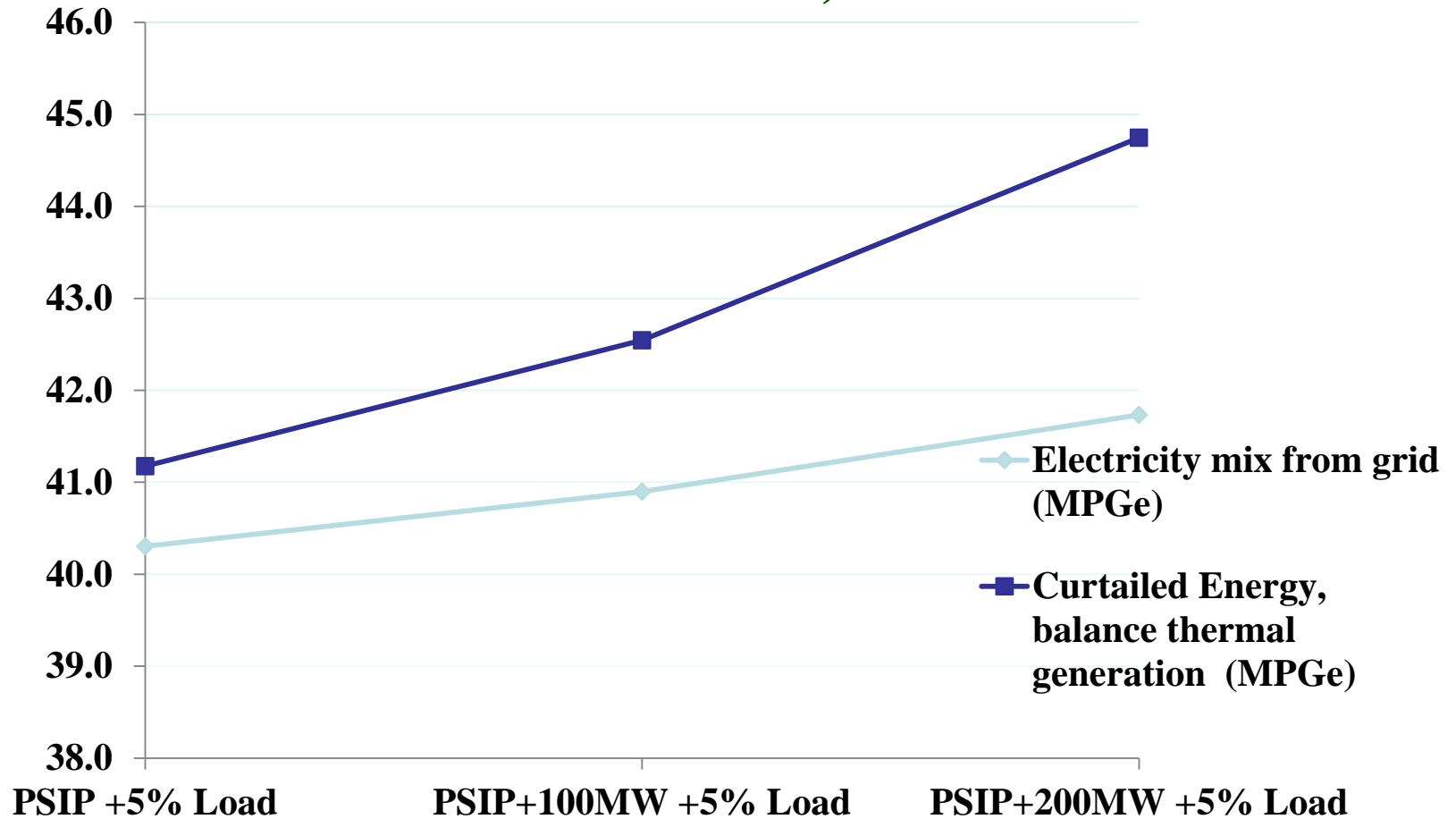
- **GE's Multi Area Production Simulation (GE MAPS) software program was used for the PSIP power grid simulation. Resulting data is then analyzed by HNEI.**
- **HECO's Power Supply Improvement Plan (PSIP) used for the future scenario**
- **Analysis of power grid fuel use, as well as reduction in wind and solar curtailment from HNEI-GE high-fidelity modeling results**

EV Energy Impacts Analysis: Assumptions

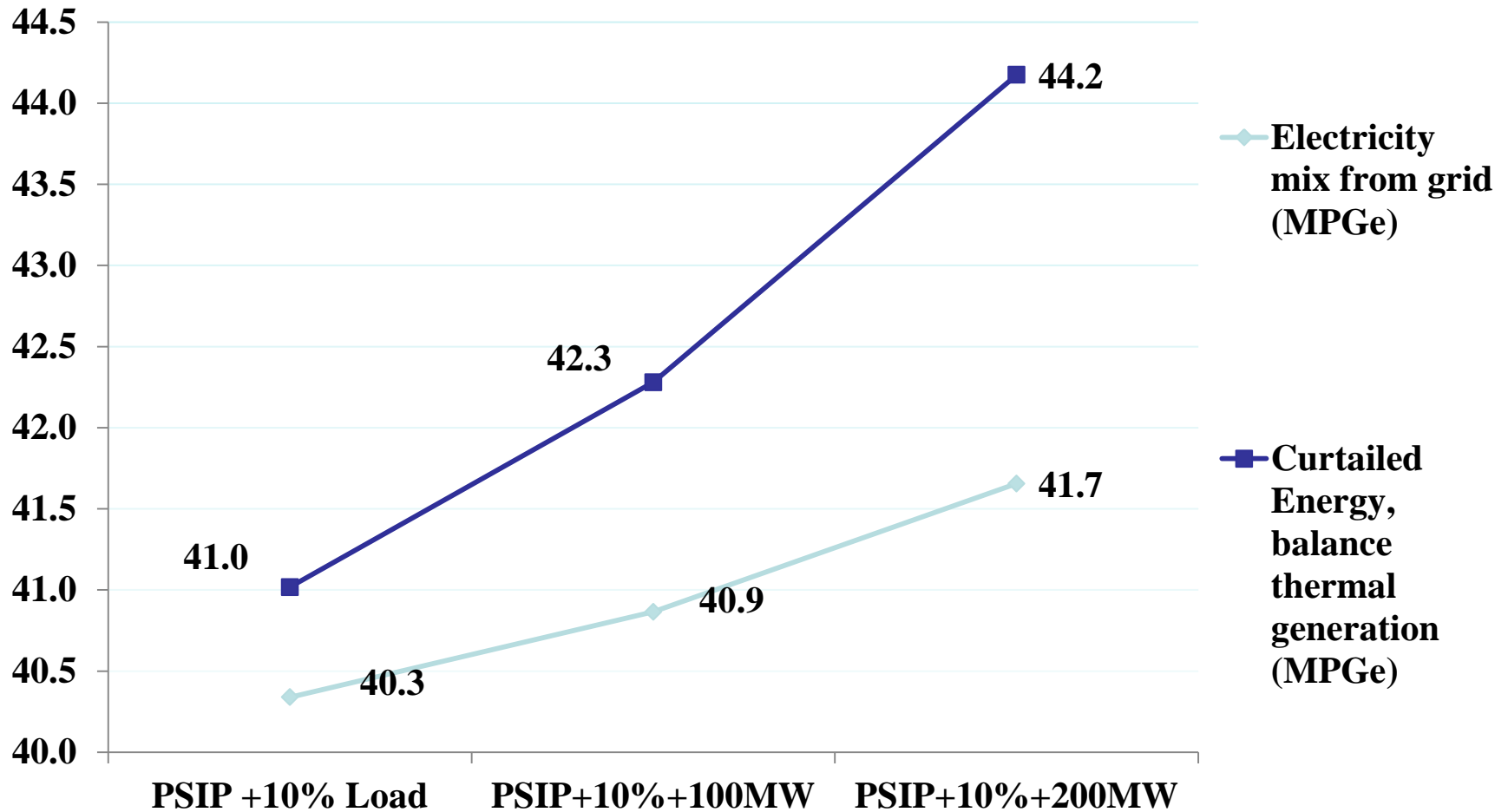
- **Average plug-in EV gets 30 kWh/100mi**
- **11,000 miles traveled per year**
- **Average of 23.4 MPG for all light duty vehicles in the US**
- **101,146 EVs on Oahu by 2040, and 202,147 with EIA high oil price***

** Factors Affecting EV Adoption: A Literature Review and EV Forecast for Hawaii, Coffman, M., Bernstein, P. & Wee, S., (2015)*

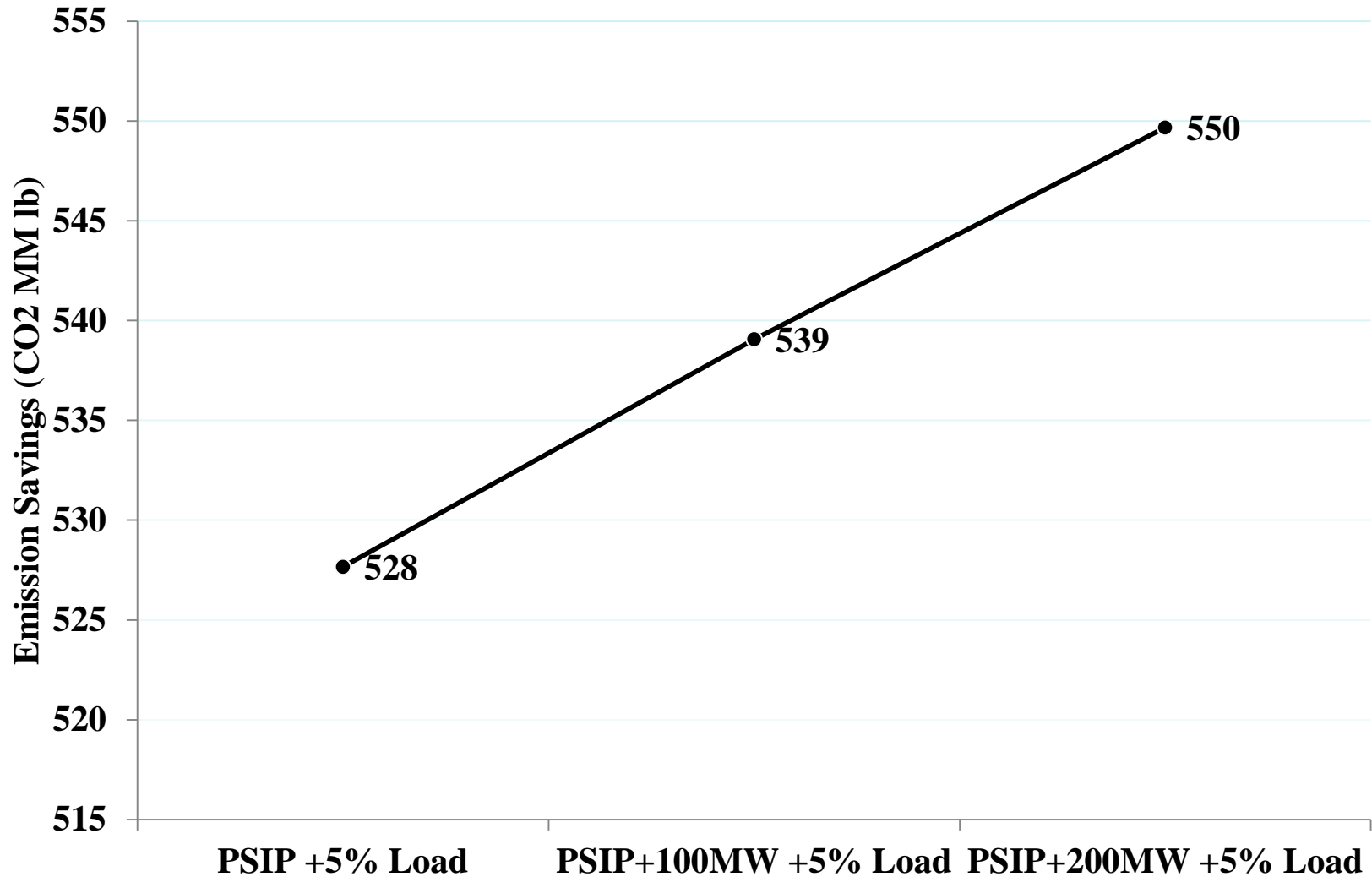
EV Mileage in MPGe for PSIP Scenarios: 5% Load = 122,121 EVs



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



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 massive infrastructure development is needed for workplace charging



MAHALO

For more information, contact:

Katherine McKenzie

Hawaii Natural Energy Institute

1680 East-West Road, POST 109

Honolulu, Hawaii 96822 “Electric Vehicle Energy Impacts” project is the

Office: (808) 956-5337

E-mail: kamckenz@hawaii.edu

Website: www.hnei.hawaii.edu

