



EVs as a Grid Resource

Community Storage Initiative Leadership Forum
University of MN Law School – Mondale Hall

July 21, 2016

Drive Electric MN Mission



VISION Establish Minnesota as a national leader in adoption of EV technology and charging infrastructure. Promote lower transportation costs, lower emissions, improved air quality and increased energy independence through an electrified transportation system.

Drive Electric MN Partners



Minnesota Plug In
Vehicle Owners Circle



PlugInConnect



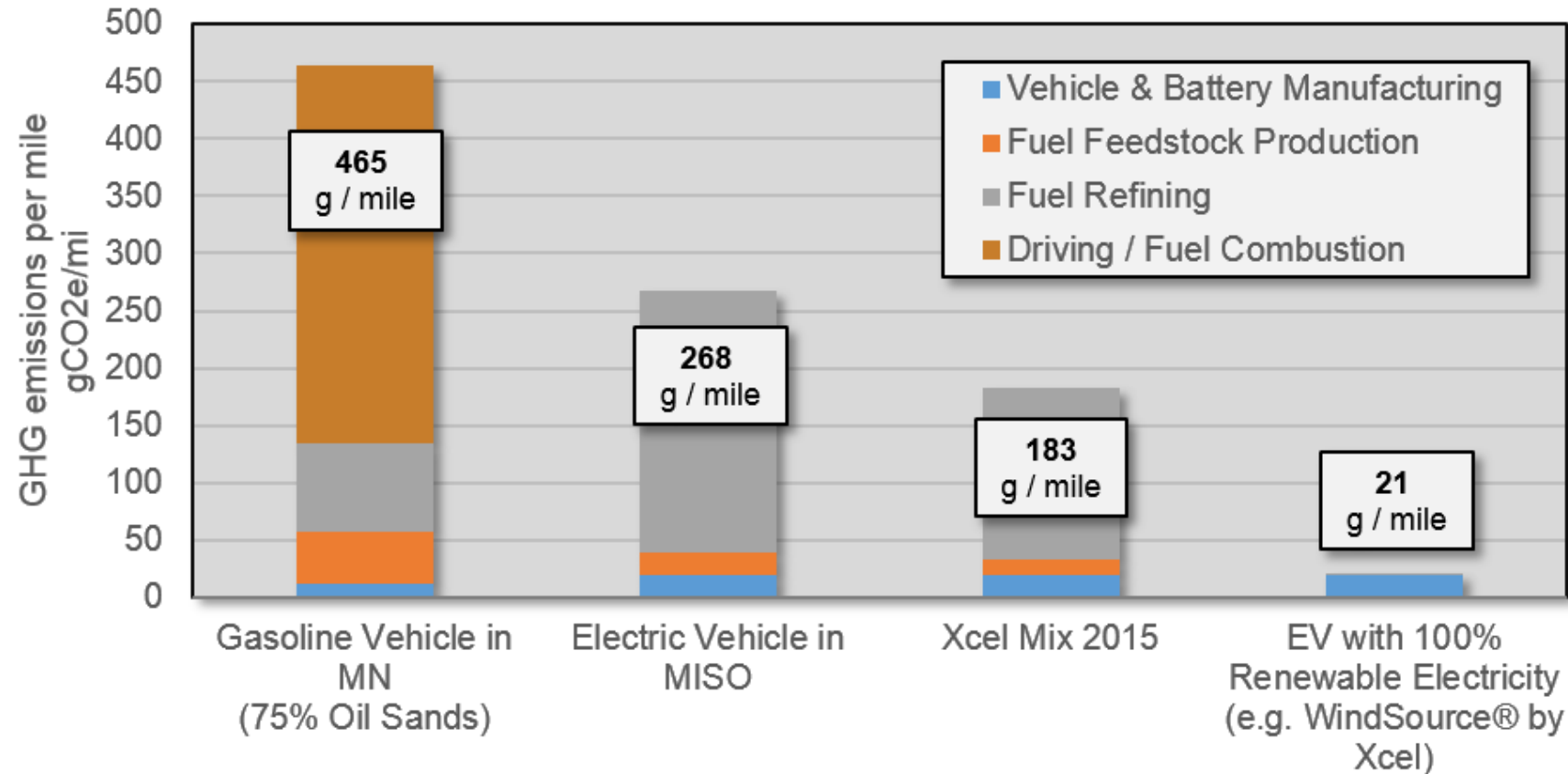
Building a Zero Emissions Future

GENERAL MOTORS

EVs in MN: GHG reduction opportunity



GHG Emissions: Gasoline vs Electric in Minnesota



Economic evaluation: 2MW battery operating in MISO



Present value of revenue* frequency regulation	\$1.51 million (\$377/kW)
Present value of revenue frequency regulation & capacity	\$1.76 million (\$441/kW)
Cost estimate**	\$2.42 million (\$606/kWh)

*Assumes a 10-year project life, constant prices, and a 2.5% discount rate

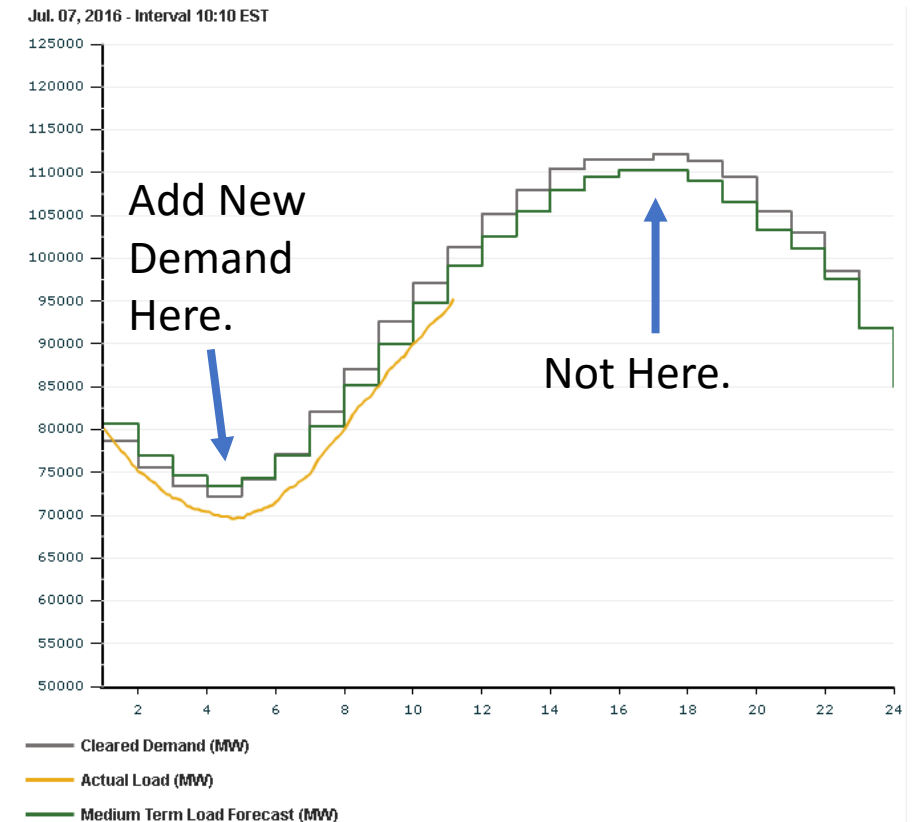
**Based off quote for a 2 MW / 4 MWh Tesla PowerPack grid-connected battery system, excludes installation costs.

Suppliers have projected future costs that would make this project economic, for example \$200/kW by 2020

Opportunity for grid integration: simplest to hardest



- **EV charging** increases loads (no change required – just promote EVs)
- **EV charging off-peak** (TOU rates required)
- **Vehicle-to-home** (inverter, creativity, multiple trips to a fast charger)
- **Dispatchable/curtailable EV charging** (rate design, metering innovation, change MISO rules, 2 way communication)
- **Vehicle-to-grid** (changes to vehicles, upgraded metering, 2 way communication)





THANK YOU