



## Public & Home Charging for PHEV and its Impact on Infrastructure

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### Eaton

Fluid Power



Electrical



Automotive



Truck

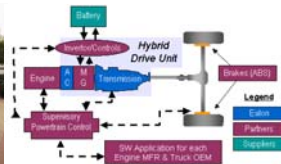


- A global diversified industrial manufacturer (approx. 78,000 employees)
- A leader in:
  - Fluid Power & Aero Space Systems
  - Electrical power quality and control
  - Automotive engine air management systems & components
  - Intelligent drivetrain and safety systems for medium & heavy duty trucks (Hybrid & Plug-in Hybrid Drive Trains)



## Eaton Truck Hybrid Activities

- Hybrid Utility Bucket Truck
- Utility F550 Hybrid Trouble Truck
- Utility F550 Plug-in Hybrid Trouble Truck
- Class 8 Hybrid – Idle Reduction Platform
- Pickup & Delivery Hybrid Program
  - Federal Express, UPS, Coke....



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## Eaton Grid Connected Transportation Activities

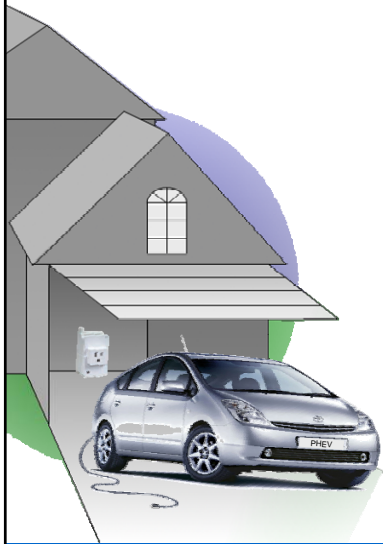
- Truck Stop Electrification
  - EPRI/Eaton White Paper Established Framework
  - Codes & Standards Activities (NEC 626)
  - National Deployment Program (7 year process)
- IdleAire 133 Sites, 33 States, >7,500 spaces
- Port Electrification
- Global Codes & Standards Activities (IEC)
- Up to 10MW / 11.6KV power supply systems
- Eaton Marina Power Systems
- Eaton RV Power Systems



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## Eaton In-Home Charging



### Least Impact On Existing Home

120V / 20 circuit for charging

15 KWH PHEV Battery

40 Mile electric target range

6 hour estimated charge time

In-home charging will be first adopters

Slow charging is sufficient (Over night)

### Potential Metering/Control Methods

Distributed Smart Outlet

Centralized Intelligent Load Center

### Higher Current Charging Could

Require Loadcenter Upgrade (200A to 400A)

Require Upgraded Service Drop

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## Charging vs. Fueling

Capacity = 15KWH

Mileage  $\approx$  40 mpg

Fill Rate  $\approx$  6 hrs

Cost  $\approx$  \$1.50 / 40 mi\*

(\*assumes \$0.10/kwh @ 15 kwh)



Capacity = 2 Gallons

Mileage  $\approx$  40 mpg

Fill Rate  $\approx$  25 secs

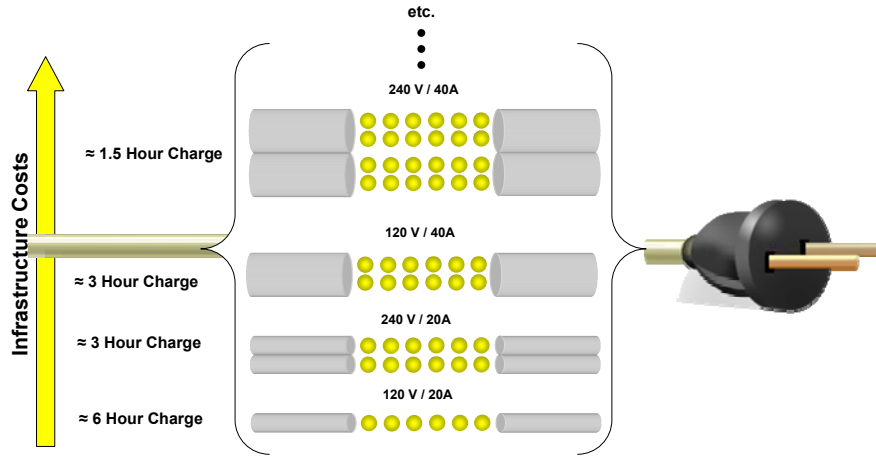
Cost  $\approx$  \$8.00 / 40 mi



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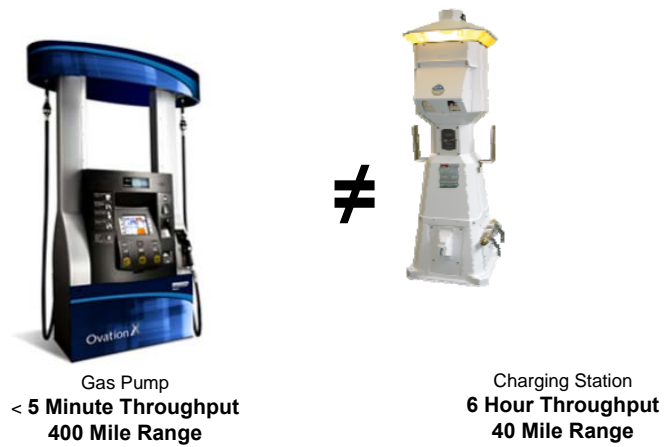
## Different Rates, Different Connections



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## Infrastructure Impact



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## Infrastructure Impact



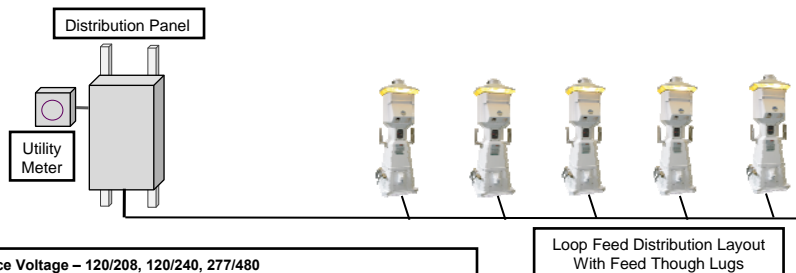
Gas Pump  
**< 5 Minute Throughput**  
**400 Mile Range**

=



Charging Station  
**6 Hour Throughput**  
**40 Mile Range**

## Public Charging Considerations



- Service Voltage – 120/208, 120/240, 277/480
- Power Distribution Panel Sizing & Mounting Location
- Utility Metering Requirements (Service Drop)
- Charging Pedestal Configurations (single circuit or multi circuit)
- Loop Feed or Dedicated Branch Circuit Feeds to Pedestals
- Charging Pedestal GFI protection & trip reset methods
- Charging Pedestal Overload protection & trip reset methods
- Charging Pedestal Short Circuit protection & trip reset methods
- UL Listings on all products to address NEC and AHJ requirements
- Comprehensive System Designs showing load diversity, arc flash, and voltage drop calculations
- Pedestals are targets for vehicles so a lot of care should be taken in details in the system design as to where each unit should be mounted
- Drive away considerations must be considered in pedestal design
- Underground work necessary for branch circuits

Design must meet  
 NFPA70(NEC) and  
 NFPA70E requirements

## Public Charging Considerations

- 20 Amp 120V Circuits are very slow charging
  - Most likely have one shot at getting infrastructure right...
  - Can the \$\$/hour rate convert a profit for anyone or would 240V be a better value proposition?
- Higher currents and voltages will...
  - Charge batteries quicker (drive better infrastructure utilization)
  - May better prepared us for next generation batteries that could have greater charging density – thus move on board KWH's
  - Drive the infrastructure costs up quickly (higher first cost)
- Food for thought...



Thanks....