

Life Without Diesel: Operations Planning for Emerging Vehicle Technologies



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Sustainability & Multimodal Planning Workshop



Today's Presentation



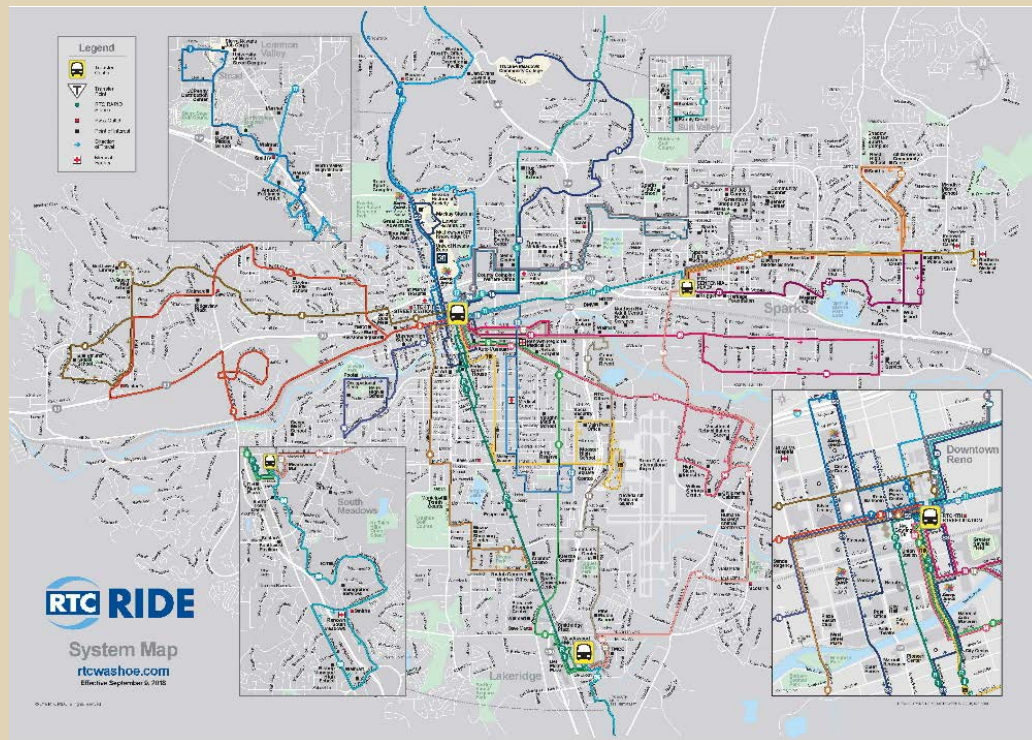
- **Overview of RTC**
- **Current State of Electric Bus Market**
- **Benefits of Electric Buses**
- **Cost of Energy**
- **Challenges / Lessons Learned - Larger Scale Deployment**
- **Route Scheduling Factors**

Overview - Region Transportation Commission of Washoe County



Serving Reno, NV since 1978

- 8 million annual trips
- 26 Routes
- 68 Fixed Route Buses
(21 Electric Buses)
- Two BRT Lines
- 45 CNG Paratransit Vehicles



Overview - Region Transportation Commission of Washoe County



- **Why buy electric buses?**
- **The answer is environmental sustainability, improving the quality of life for our customers and community, and it's the right thing to do for our children and their children.**
- **Potential for cost savings**



Overview - Regional Transportation Commission of Washoe County



- **Proterra BE 35 (2014)**
 - Short range 30 miles
 - 4 minute charge time (about 10%)



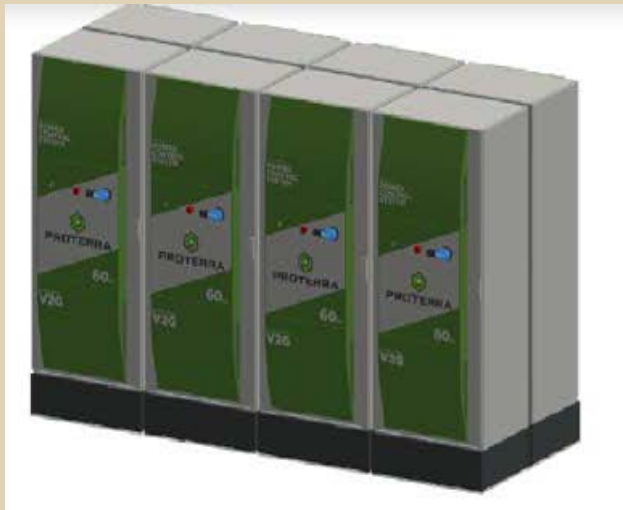
- Overhead fast charger
- Rate of charge 480 kWh

Overview - Regional Transportation Commission of Washoe County



■ Proterra Catalyst (2018)

- Long range 130 miles
- 6 – 7 hours charge time
- Overnight charging
- Rate of charge 60 kWh



- But – also can charge on fast charger!
- Rate of charge 300 kWh

Current State of Electric Bus Market



- **Buying buses are the easy part!**
 - Almost every manufacturer has an electric bus
 - BYD, New Flyer, Gillig, Nova, etc.
 - Chargers available
 - Overhead
 - In bus
 - Inductive 200 kWh

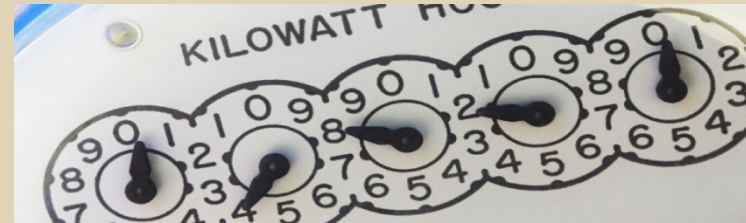


Current State of Electric Bus Market



■ Understanding electric buses Infrastructure

- Industry developments
- Demand Charges and costs
- Learning curve, disruption with new technology



■ Risk

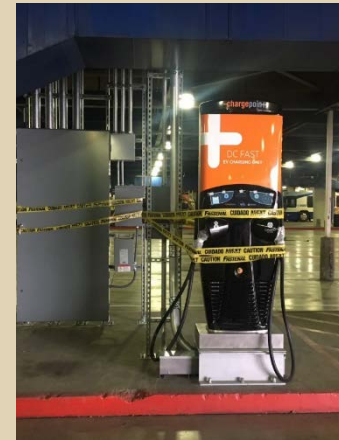
- Diesel price volatility/dependence upon foreign oil/ diversify fuel types
- Reliability of buses/manufacturer
- Technician training and availability



Current State of Electric Bus Market



- **New Technology can be risky**
 - Technology advances quickly
 - Inexperienced manufacturers
 - Smaller scale parts – delays and high costs
 - Technicians hard to find and training materials under development
 - New technology chargers are more complex



Benefits of Electric Buses

- **Benefits**
 - Zero emissions in high density urban area
 - Electricity produced elsewhere
 - Quieter operations
 - Potential for lower maintenance costs
 - Potential for lower fuel costs



Cost of Power

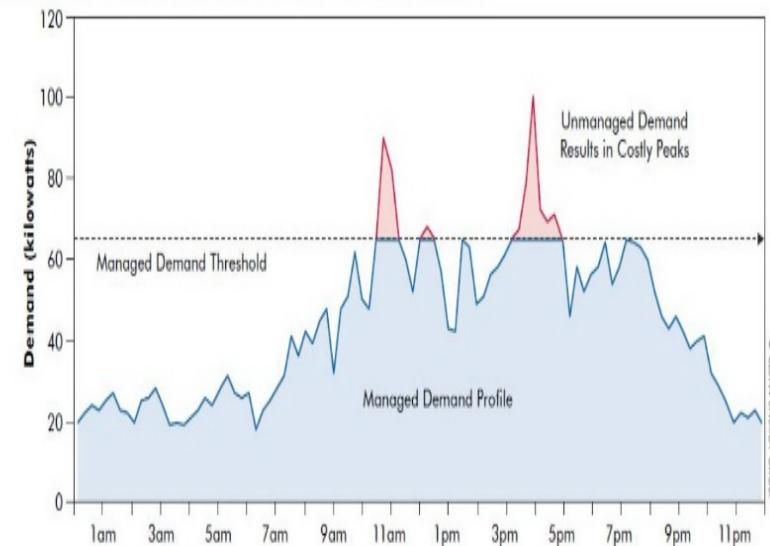
■ Electrical Demand Charges

- Demand charge or peak demand (KW) is highest rate of usage during any 15 minute period during the month.
- Peak demand determines cost for the entire month
- Billed between \$10 and \$30 per KW.

■ Rates

- OGS-HEVRR-NET:
General Service H Electric
Vehicle Recharge Rider – NET.

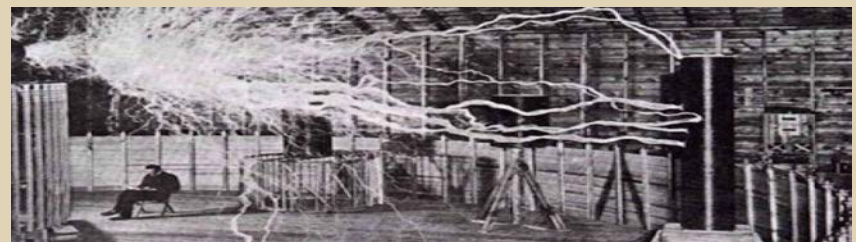
How battery storage can help manage electricity demand over a 24-hour period



Through the deployment of an energy storage system, peak demand can be effectively capped at a specified level—significantly reducing utility demand charges. Assuming a demand charge of \$10 per kilowatt and peak demand reduction from 100 kilowatts to 65 kilowatts each period (as shown here), energy storage could reduce the customer's demand charge by \$350 per billing period, amounting to an annual savings of \$4,200.

Challenges / Lessons Learned

- **Infrastructure**
 - for a few buses - relatively simple – tie into building system
 - for a large number of buses - can be costly and complex
- **Availability and impact to grid**
- **Upgraded transformers, switch gear, distribution panels**
- **Number / geographical distribution and type of chargers**



Challenges / Lessons Learned

- **“Your mileage may vary”**
 - Less predictable range and performance than diesel
 - Test buses in actual conditions to get true experience
 - When routes matched properly, bus operates entire day with enough charge
- **Fuel cost per mile (FEB 2018)**
 - Diesel \$0.49
 - Hybrid \$0.37
 - Electric \$0.31



Challenges / Lessons Learned

- **Short range buses work well on fixed routes of short duration**
- **Predictable range and performance**
- **Short range buses fast charge at 480kWh during the peak rate period, longer range buses charge at CPU rate**
- **Power outages and charger issue may put vehicles out of service**



Challenges / Lessons Learned

- Long range buses (120 – 130 mile range) are expected to be more flexible
- Less predictable range and performance
- Long range buses charge at 60 - 300 kWh during the off peak rate periods
- Power outages and charger issue may not put vehicles out of service



Challenges / Lessons Learned

- **Drivers**
 - Range Anxiety 120 – 130 mile range
 - Regen, acceleration, reliability, efficiency
 - Understanding charging difference
- **Technicians**
 - Wanted to be trained but under warranty
 - Union supports training
- **Passengers**
 - Like quieter buses
 - Wifi, USB's, etc..



- **Electric Buses are Disruptive**
- **Introduce more variables**
 - Equipment limitations
 - Geography / Environmental Conditions / Traffic
 - Passenger loads
- **Limited Range**
 - electric vs 300 miles diesel



- **Electric Buses may require different scheduling process**
- **Schedule impacts - Cost of operations**
 - **Range is shorter than diesel**
 - **Vehicle types**
 - **Energy costs vary with time and kWh needed**
 - **Opportunity Charging – Gaps in schedule**

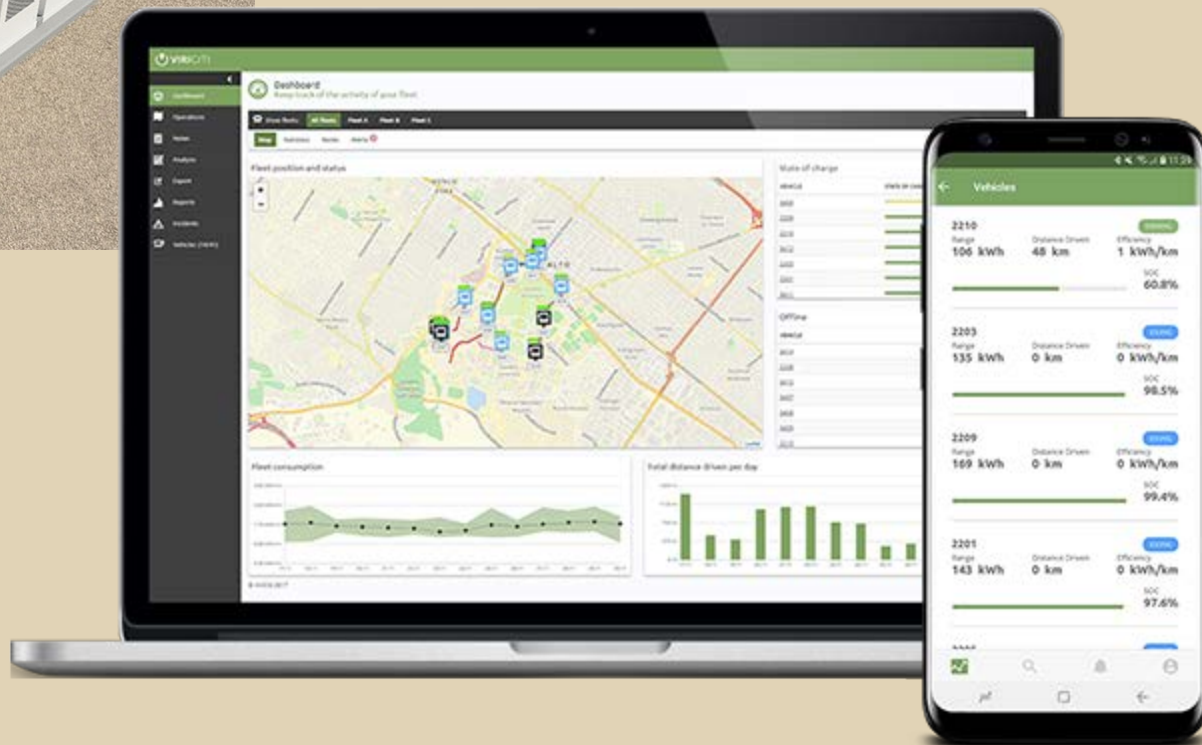


Technology Solutions



Data Collection / Analysis

Battery storage



Conclusions

- **Fledgling industry is improving**
- **More factors to consider requires more complex analysis**
- **Understand vehicle performance, energy costs, operational and customer needs**
- **Build out expandable and flexible infrastructure**
- **Battery storage may be critical success factor**
- **Integration of technology and data are key to solving the electric bus equation**

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