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October 2, 2018

MEMORANDUM

TO: Council Members

FROM: Steven Simmons

SUBJECT: Transportation Electrification Panel

BACKGROUND:

Presenter: Richard DeRock, General Manager with Link Transit, James White, Senior Engineer with Chelan PUD, Steven Simmons Council Staff

Summary: Personal light duty electric vehicles offer higher efficiency and emit less pollution than tradition gasoline powered vehicles, while mass transit can move more people with a smaller overall footprint than personal vehicles and relieve traffic congestion. Municipal bus fleets can also significantly reduce air pollution by transitioning from older, diesel powered buses to new battery electric bus technologies. However, for wide spread electrification to take hold, new charging technologies and infrastructure must be developed and installed.

Representatives from Link Transit and Chelan PUD will discuss efforts underway at their organizations to electrify transportation in the Northwest. Link Transit was a very early adopter of battery electric buses in the region and have a long working history with cutting edge transportation and charging technology. Chelan PUD has also been pursuing the electrification of the transportation sector and has extensive experience with vehicle charging.

Relevance: Though demand for electricity from the transportation sector is fairly limited in the Northwest currently, the increasing sales and operation of personal electric vehicles and electric buses will result in growing electrical load for the region's utilities. As more fully electric car and bus models are made available for purchase or lease, along with charging infrastructure build out, the resulting long-term electricity load in the region could become significant.

Workplan: ANLYS 5 Enhance modeling of electrification of transportation system

Background: Link Transit provides public transportation service for seventeen communities in Chelan and Douglas Counties. Chelan County PUD owns and operations three hydro-electric projects in the region and serves over 48,000 retail electric customers.

Panel on Transportation Electrification

Jim White – Chelan County PUD

Richard DeRock – LinkTransit

Steven Simmons – Northwest Power &
Conservation Council

October 9, 2018

Presenters

Jim White from Chelan County PUD

Dr. White is a Senior Energy Efficiency Engineer where he designs and implements energy efficiency programs.

Jim also serves as a technical advisor for solar power systems and electric vehicles.

Dr. White earned a Doctorate of Engineering in Energy Management from Texas A&M University and a Bachelor of Science in Mechanical Engineering from the University of Alaska Fairbanks.

Presenters

Richard DeRock from Link Transit

Richard is the General Manager of Link Transit where he directs the public transit system for Chelan and Douglas Counties. Link Transit serves 115,000 people across a 3,000 square mile service area.

Richard has been a leader in the driving the use of propane powered light and medium duty vehicles and fast-charged electric transit coaches.

Richard has degrees in Geology and History from the University of California Davis

Transportation Electrification

1. **28 %** of the energy consumption in the U.S. is for Transportation and **92 %** of that is petroleum based
2. Nationwide GHG emissions from transportation have reached parity with the power generation sector
3. In the Northwest, electricity demand from electric cars is not significant now – but it's growing
4. Electrification of transportation could be a source of growing electric load for the region's utilities

Transportation Electrification

1. Council is working on enhancements of the load forecast for transportation
2. Electrification of mass transit is expected to be a growing trend
3. TriMet – the mass transit agency in Portland metropolitan –just announced plans to phase out it's diesel bus fleet and replace with electric buses over time



Link Transit's Battery Electric Bus and Fast Charger Projects



October 2018



Federal Grants to Link Transit

- \$2.95 mil. “ARRA” TIGGER I Grant (2009)
- \$2.5 mil TIGGER III Grant (2011)
- \$3.77 mil. Lo/No Grant (2016)



Ebus 22' Trolleys (Generation 1)



www.linktransit.com

EBus with China Aviation Lithium Batteries

- LiFePO₄ batteries
- 188 – 3.2 v batteries
- Air cooled
- 601 volt
- 90 KW
- 90 mile range



Ebus 50kW Slow Charger



www.linktransit.com

Ebus Robotic Fast Charger



www.linktransit.com

Trolley Fast Charge



Ebus Robotic Charger Issues

- Exceedingly complicated design
- Many moving parts needing constant maintenance
- Time for deployment and retraction limits functionality of charger
- Charger a strike hazard
- Very moisture sensitive



Ebus Challenges

- Poor reliability – Weekly Circuit Board failures
- Fragile suspension – inadequate durability
- Unique buses and chargers (ours are only ones in existence)
- Temperature challenges – Both high heat and low temperature impacted batteries



Ebus Current Situation

- Fast Chargers de-energized pending FTA disposition decision
- Buses parked pending FTA disposition decision
- Batteries showing excessive degradation



BYD 35' Bus (Generation 2)



BYD Bus with BYD Lithium-ion Iron Phosphate Batteries

- LiPO₄ Battery
- 160 - 3.2 v cells
- Air cooled
- 512 volt
- 270 Kwh
- 165 mile range
145 practical range

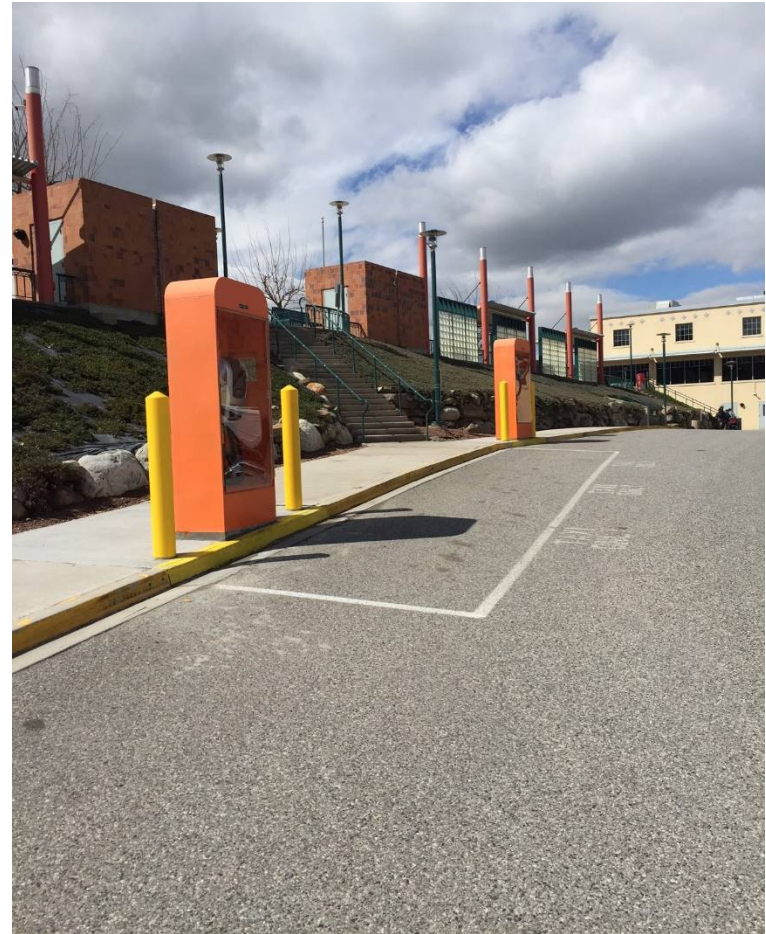


BYD Gen 2 Issues

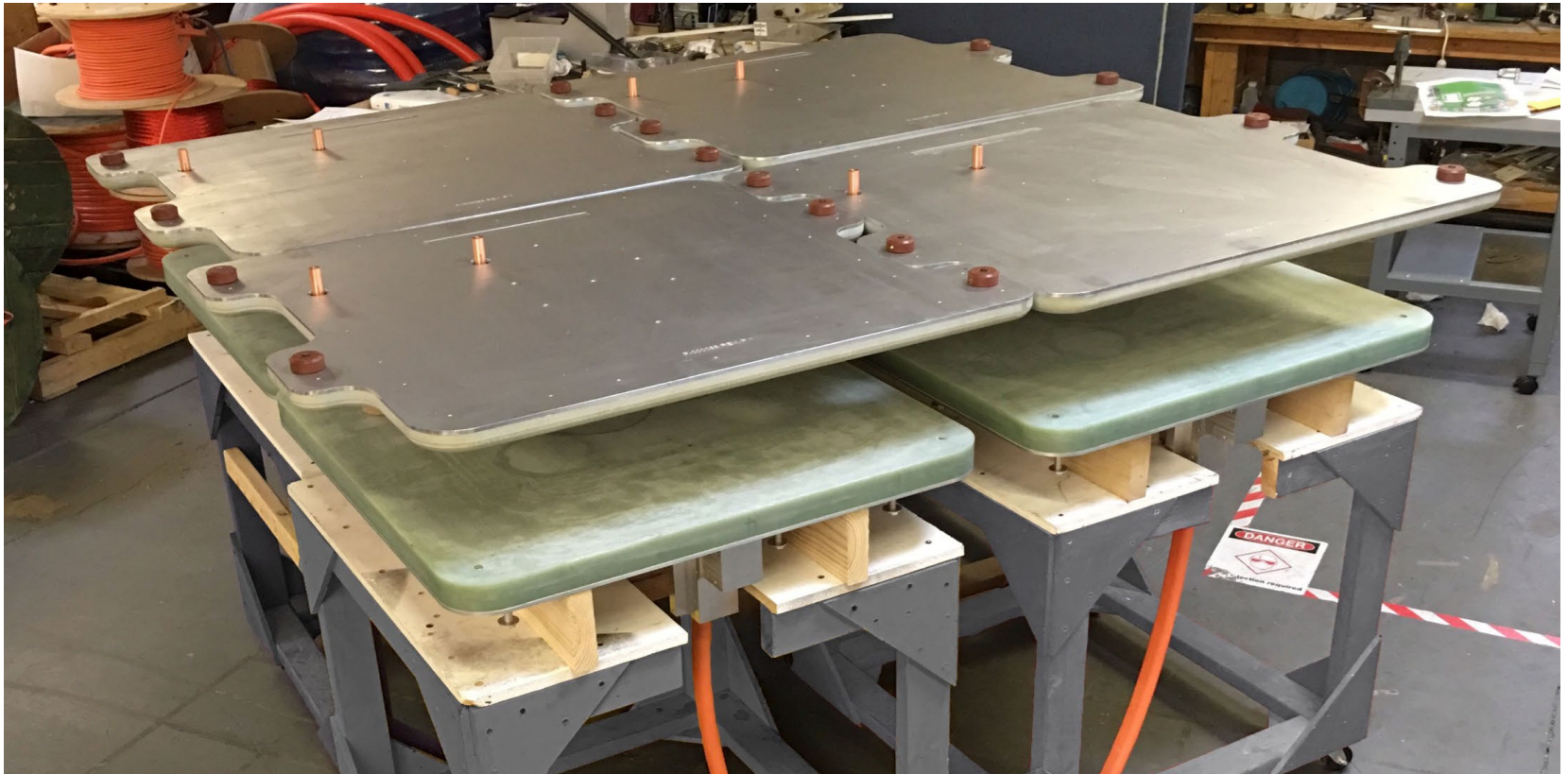
- Temperatures below 35 degrees reduce battery capacity 50%
- Above 90 degrees, battery management software prohibits fast charge, reducing range of vehicle
- Quality of build was lacking



BYD 85KW Wired Charger



Momentum Dynamics 200KW Magnetic Inductive Charger



Wireless High Power Charging

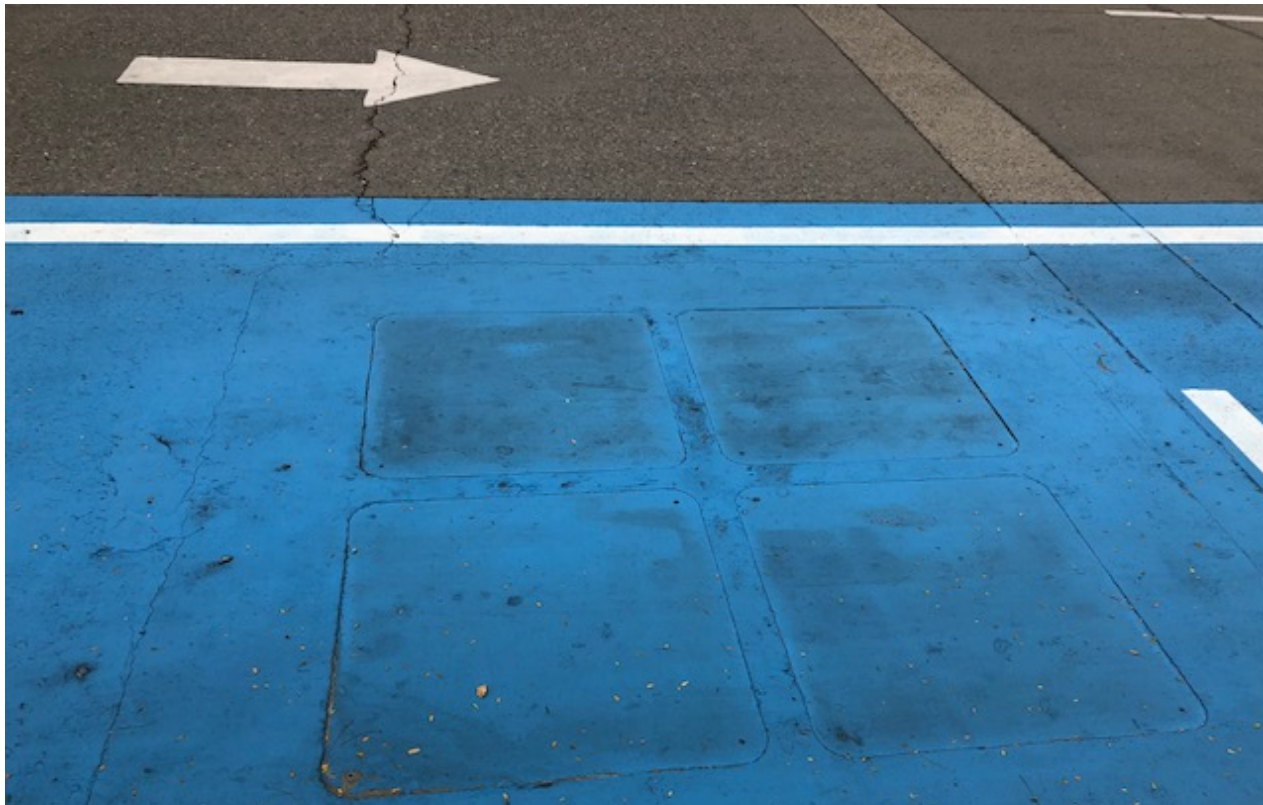
- 207 Kilowatts
- 3.3 Kilowatts transferred per minute
- Full bus recharge 81 minutes
- Power needs – 455 amps at 440 volts
- Safe – very low magnetic field penetration
- 95 – 97% efficiency of power transfer



MD Charger Installed



MD Charger Plates



MD Charger Cabinet



35' BYD Bus (Generation 3)

- 10 BYD Coaches
- LiPO4 Batteries
- Liquid Temperature Managed
- 160 3.2 volt batteries
- 512 volt operations
- 350 KW
- Delivery – Winter 19



Monthly Energy Cost Comparisons

Electric:

\$285 per month

2530 KW @ \$0.11/kwh

Diesel:

\$1,381 per month

429 gallons @ \$3.22 per gal

