Fleet Electrification Feasibility Study
Demo Day Presentation
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Industry Need
Fleet Electrification: Components and Interdependence

Fleets are now responsible for not just purchasing vehicles but building and operating the whole system. System components have extremely complex inter-dependencies.
Opportunity

• Transitioning from traditional to electric mobility is a capital intensive process as electric vehicles are more expensive and need additional investments to develop the required charging infrastructure. These projects are also complicated by the several factors that influence their design, cost and performance.
Solution

EVOPT-Planner models the driving and charging process to determine the optimum size of the vehicle battery, charging infrastructure capacity and operational schedule to minimize capital and operational costs.
Project Scope at-a-Glance

Key Objective: Test technology services and supporting Ameren and their customers with the transition to EVs by potentially lower cost methods of providing fleet electric vehicle feasibility studies.

Key Deliverables:

1. Feasibility Study
2. Zero-Emission Fleet Transition Plan
3. Building a Digital Twin model of the electrical network at the depot.

Example:

DEPOT OF THE FUTURE
Route Energy Analysis

Electric vehicles are extremely sensitive to how and where they are operated. Their performance and longevity depends on several factors. EVOPT Planner takes the existing fossil-fuel based fleet operations data as input and simulates how an electric fleet will operate and perform under the same conditions. First step in this project was to gather telematic information for the Hazelwood School Districts operations and perform detailed Route Energy Analysis, i.e. estimating the energy required on each route by an electric bus.

1. Data Collection
   1. Route Details
   2. Operating Schedule
   3. Fuel consumption
2. Duty Cycle generation
3. Route Modeling, etc.

- Route Energy
- Route Alignment
- Charging Strategy
- Schedule Alignment
Route Energy Analysis

Duty Cycle generation

26 million data points analyzed

Raw Telematic Data as input

Speed vs Time trace for every bus for every day’s operation. Detailed operations data helps in studying the operations.

Operation and performance of an electric bus is dependent on several factors including duty cycle, elevation, ambient temperature, passenger loading, etc.

EVOPT takes all these parameters as input and comes with optimized solution.
Telematic Operations Data and Analysis

Route details shown for one bus on one day.
More than 2800 bus-days analyzed

Each dot represents data being sent by the telematic system.
Each point includes information related to timestamp, location, speed, elevations, etc.

More than 26 million data points analyzed.
Electric school buses available today have about ~130kWh Energy required. Most of the routes, but not all, can be satisfied by Electric buses.
Route Energy Analysis

About 80% of the daily operations can be served by Electric Buses.

341 Routes (20.5%)
Require more energy than existing technology or need Opportunity Charging

1328 Routes (79.5%)
Can be electrified now
Route Energy Analysis

Every route on every day is analyzed and based on that energy requirements are calculated.

Heat map showing energy requirements on a per day basis.

Worst-case (18th Feb) further analyzed in detail.
Charging Infrastructure Sizing
Simplified Single Line Diagram (scenario #3 shown here)

Several Scenarios analyzed in detail.
Scenario with 100x 15kW AC chargers shown here.
Phase-I:
- Upgrade transformer with same feed
- Get new LV panel inside building
- 55 Bus charging with mix of AC and DC

Phase-II:
- Get the new MV feed to the South
- Get new MV transformer (check rating)
- Get new LV panel
- Get step down transformer and 600A panel
- 10 AC Chargers
- Get 2x 50kW DCFC installed

Map Layout and proposed phasing plan for infrastructure upgrade and charger installations. Several options evaluated. One shown here.
Digital Twin of the Charging Depot
OpenDSS model and Digital Twin for power and energy analysis including Power Quality

OpenDSS Modeling – Initial Topology
(section of the whole)

Load Profile (managed charging with DER)
(one node)

Nodes Voltages- Unmanaged v/s Managed

Total Harmonic Distortion

Flicker
Energy Infrastructure Sizing

Solar PV based self generation

Option-I: EV chargers in parking spaces

Option-II: Bus port solar and EV chargers
Energy Infrastructure Sizing

Busport and Carport Solar PV installation provides shade for the vehicles and generate energy in order to reduce operating cost and build resiliency. 

**Hazelwood Schools BEB Charging Scenarios**

(Feb 18 2020)

**System Capacity:** 1571.8 kWdc (10479 m²)

Option-II: Bus port solar and EV chargers
Load Profile and Financial Analysis

Load profile for unmanaged charging, managed charging and charging with onsite Solar PV based production

**Unmanaged Charging**

Hazelwood Schools BEB Charging Scenarios (Feb 18 2020)

Peak Demand **1375kW**

100x Chargers

**Managed Charging**

Hazelwood Schools BEB Charging Scenarios (Feb 18 2020)

Peak Demand **1000kW**

100x Chargers

**Managed Charging**

(with Solar PV and Battery Storage)

Hazelwood Schools BEB Charging Scenarios (Feb 18 2020)

Peak Demand **700kW**

100x Chargers

1.5MW Solar PV + 1MWh BESS

~$6M Capex for PV+BESS
Path Forward and Next Steps

Implementation of Depot Management System in a real-world scenario operating an Electric Vehicle Fleet.
Our Team

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