PROTERRA ELECTRIC BUS FLEET AND CHARGING MODELING

Presentation to

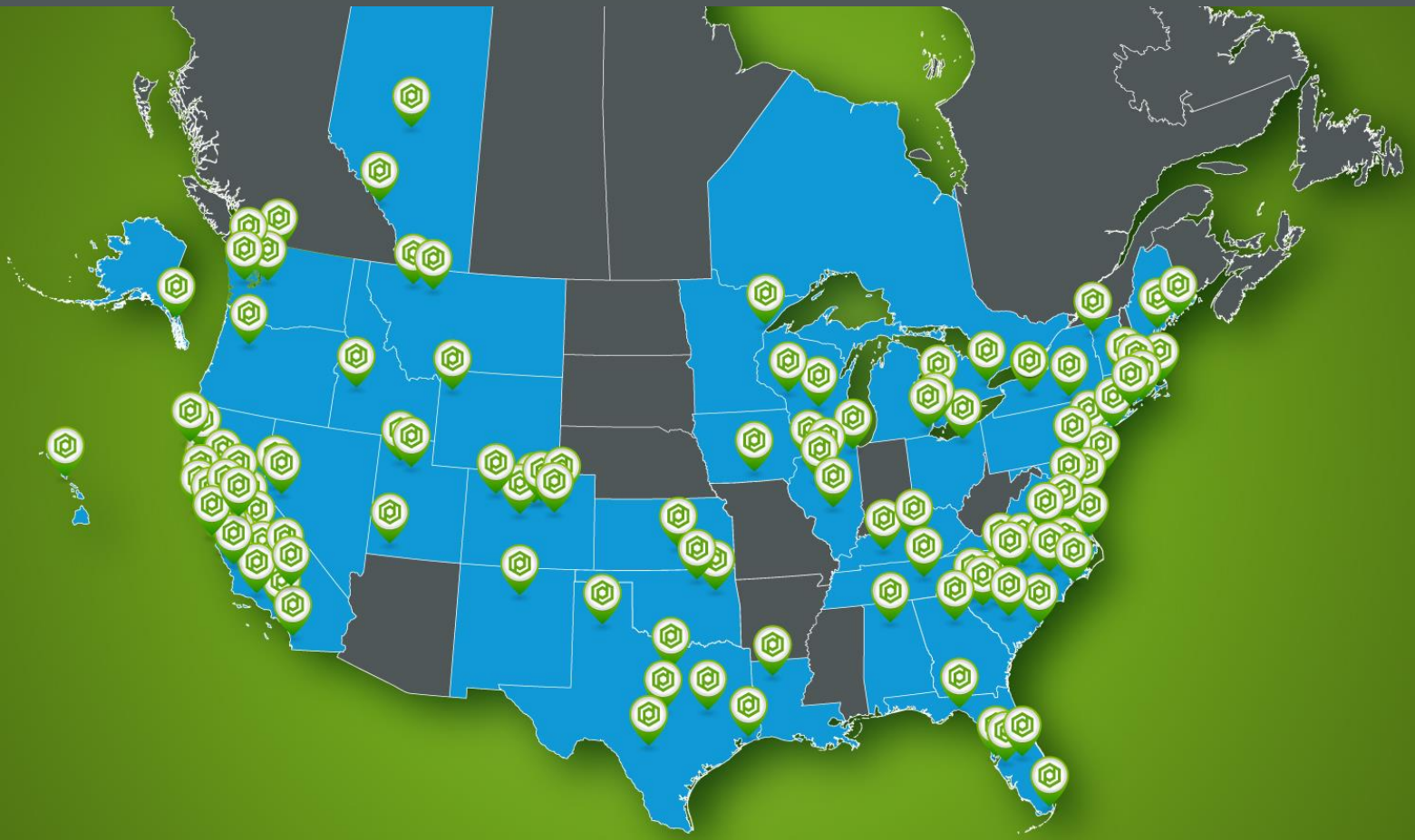
CERV

February 11, 2020

PROTERRA

OUR CUSTOMERS

PROTERRA



>900 buses sold to **>120 customers** across **43 states/provinces**

AL
ALABAMA A&M UNIVERSITY NORMAL

AK
CAPITAL TRANSIT JUNEAU

CA
CITY OF ARVIN
CITY OF DUARTE
FAX FRESNO
FCRTA FRESNO
FAST FAIRFIELD
FOOTHILL TRANSIT WEST COVINA
HUMBOLDT TRANSIT AUTHORITY EUREKA
LADOT TRANSIT LOS ANGELES
MAX MODESTO
RABA REDDING
RTD STOCKTON
SACRAMENTO INTERNATIONAL AIRPORT
SACRAMENTO REGIONAL TRANSIT
SAMTRANS SAN CARLOS
SAN FRANCISCO INTERNATIONAL AIRPORT
SAN JOSE INTERNATIONAL AIRPORT
SCMTD SANTA CRUZ
SFMTA SAN FRANCISCO
TRI DELTA TRANSIT ANTIOCH
VTA SAN JOSE
VISALIA TRANSIT VISALIA
YOLO COUNTY REGIONAL TRANSIT WOODLAND
YOSEMITE NATIONAL PARK

CO
TOWN OF BRECKENRIDGE
SUMMIT COUNTY FRISCO
ECO TRANSIT GYPSUM

CT
GBT BRIDGEPORT

DC
DC CIRCULATOR WASHINGTON

DE
DART FIRST STATE DOVER

FL
STAR METRO TALLAHASSEE
HART HILLSBOROUGH
LYNX ORLANDO
MIAMI-DADE COUNTY MIAMI

GA
UNIV. OF GEORGIA ATHENS

HI
JTB HAWAII HONOLULU

IA
DART DES MOINES

ID
VALLEY REGIONAL TRANSIT MERIDIAN

IL
QUAD CITIES METROLINK MOLINE
JLL CHICAGO
CHICAGO TRANSIT AUTHORITY
CITYLINK PEORIA

KS
WICHITA TRANSIT WICHITA

KY
TARC LOUISVILLE
LEXTRAN LEXINGTON

LA
SPORTRAN SHREVEPORT

MA
WRTA WORCESTER
PVTA SPRINGFIELD

MD
BGE BALTIMORE
MCDOT ROCKVILLE
THE BUS PRINCE GEORGES COUNTY TRANSIT

ME
SH-ZOOM TRANSIT BIDDEFORD
GREATER PORTLAND METRO PORTLAND

MI
BLUE WATER AREA TRANSIT PORT HURON
DDOT DETROIT
SMART DETROIT

MN
DTA DULUTH

MT
DASH UNIV. OF MONTANA MISSOULA
MOUNTAIN LINE MISSOULA

NC
RALEIGH-DURHAM INTERNATIONAL AIRPORT
ART ASHEVILLE
GTA GREENSBORO
DUKE UNIVERSITY DURHAM
GO TRIANGLE DURHAM
CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

NM
ATOMIC CITY LOS ALAMOS

NV
RTC RENO
TAHOE TRANSPORTATION DISTRICT STATELINE

NY
MTA NEW YORK CITY
TOMPKINS CONSOLIDATED AREA TRANSIT ITHACA
PORT AUTHORITY OF NY & NJ

OH
LAKETRAN PAINESVILLE

OK
THE CHEROKEE NATION

OR
SMART PORTLAND

PA
SEPTA PHILADELPHIA

RI
RIPTA PROVIDENCE

SC
CATBUS CLEMSON
CITY OF SENECA
GREENLINK GREENVILLE
CITY OF ROCK HILL
CARTA CHARLESTON

TN
MTA NASHVILLE

TX
VIA SAN ANTONIO
DART DALLAS
CITIBUS LUBBOCK
PAT PORT ARTHUR
CAPMETRO AUSTIN
BRAZOS TRANSIT DISTRICT BRYAN

UT
PARK CITY TRANSIT PARK CITY
UTA SALT LAKE CITY
ZION NATIONAL PARK

VA
HAMPTON ROADS TRANSIT NORFOLK

VT
GREEN MOUNTAIN TRANSIT BURLINGTON

WA
KING COUNTY METRO SEATTLE
EVERETT TRANSIT EVERETT
KITSAP TRANSIT BREMERTON
PIERCE TRANSIT LAKEWOOD

WI
METRO TRANSIT MADISON
LA CROSSE MTU LA CROSSE

WY
START JACKSON

CANADA

AB
EDMONTON TRANSIT SERVICE
ROAM BANFF

ON
TORONTO TRANSIT COMMISSION

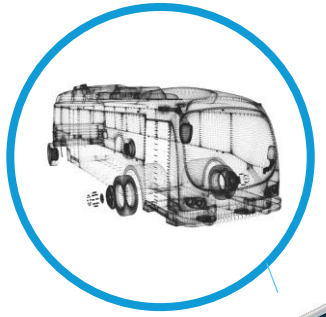
Only announced customer names shown. Updated May 2019

HIGHLY DIFFERENTIATED AND FULLY INTEGRATED
HEAVY DUTY TECHNOLOGY PLATFORM

PROTERRA

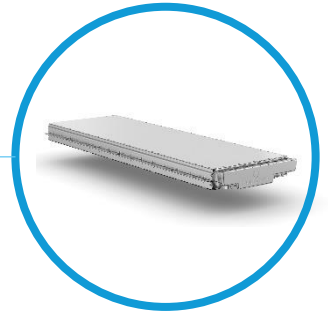
Advanced Composite Body

Lightweight and durable carbon-fiber-reinforced composite



Heavy Duty Battery Pack

High energy density, ruggedized battery packs purpose built for commercial vehicles



High Efficiency Drivetrain

5x efficiency of diesel
Greatest horsepower
Fastest acceleration

Universal Charging

Industry standard plug-in and overhead high power Level 3 charging

SMARTER CHARGING
PROTERRA POWER CONTROL SYSTEMS

60KW
For fleets with longer available charge times.

Catalyst charge time:
~6 hours

125KW
For fleets with high uptime requirements

Catalyst charge time:
~3 hours

500KW
For fleets with extended operating hours and high mileage requirements

Catalyst charge time:
~30 miles per 10 minutes

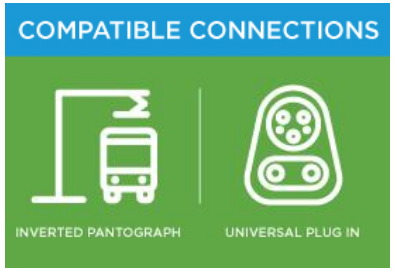
Multiple Dispenser
Sequential charging

Open source communications protocol

V2G Bi-directional V2G capability

Smart grid ready

Telematics-enabled



PROTERRA CHARGING INFRASTRUCTURE
OVER 75 PROJECTS COMPLETED ACROSS 23 STATES

San Jose Airport, CA

Modesto, CA

Wilsonville, OR

Reno, NV

City of Industry, CA

Everett, WA

Stockton, CA

PROTERRA ENERGY FLEET SOLUTIONS
TURNKEY ENERGY DELIVERY FOR ELECTRIC FLEETS

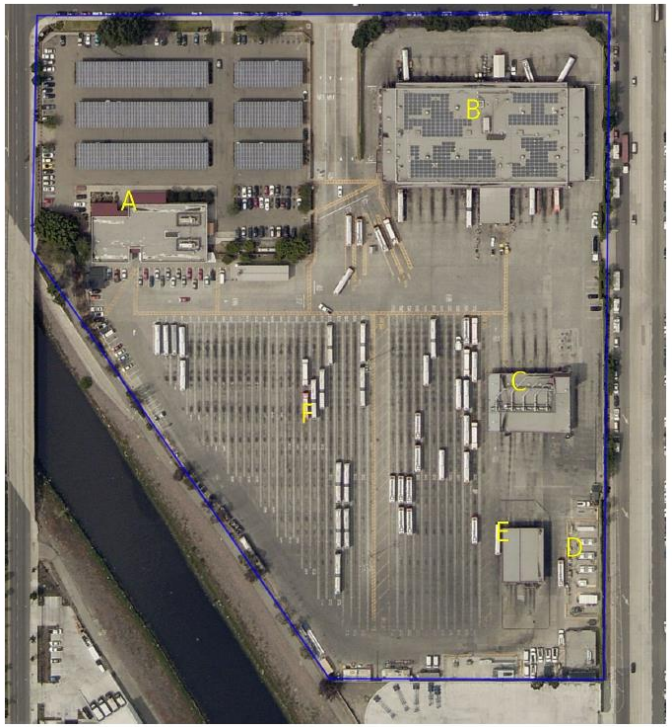
PROTERRA

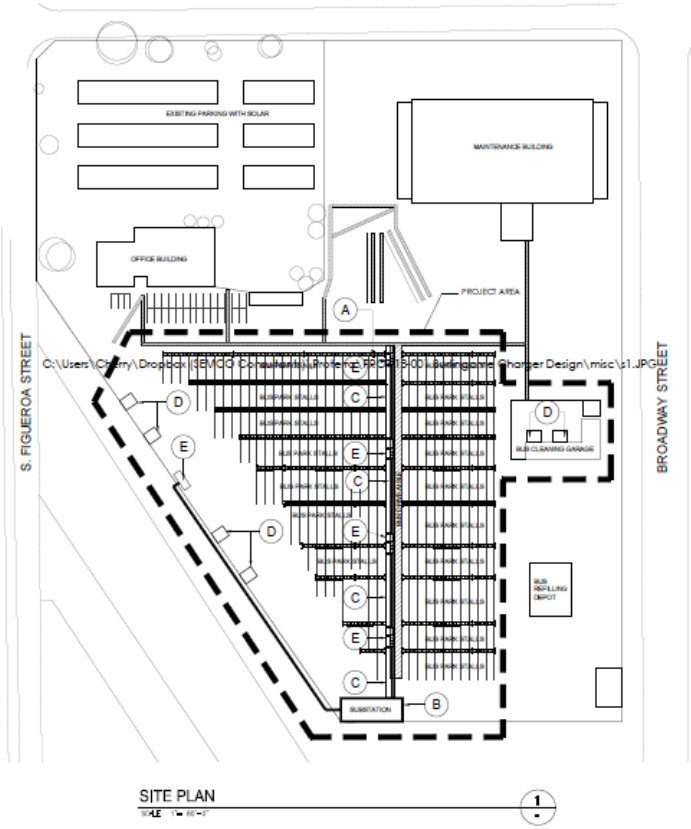
PROTERRA
ENERGY™
FLEET SOLUTIONS

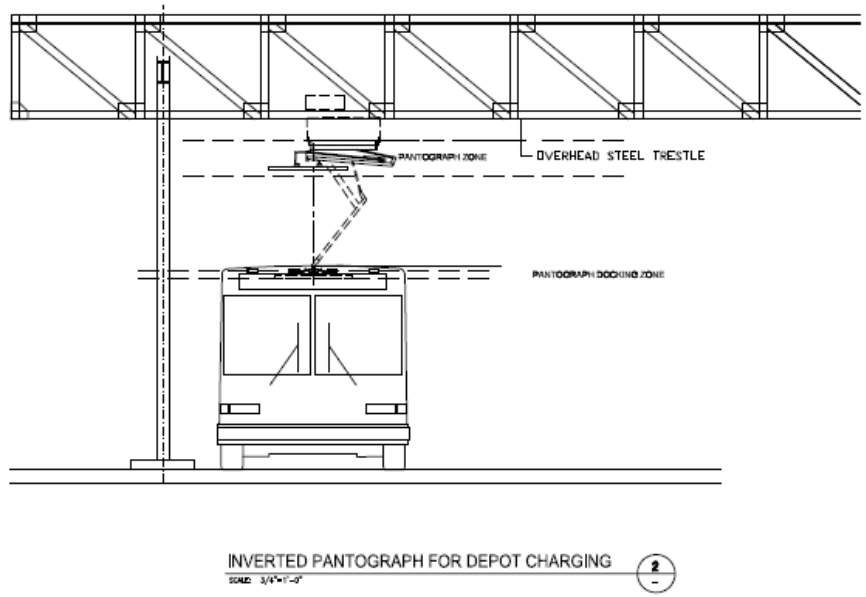
By providing a full suite of Proterra products and services in-house, we offer a **comprehensive solution** to help you meet your electrification goals.

Comprehensive Fleet and Charging Design and Installation

- Basis of Design - Electric buses and charging infrastructure work best when designed as a complete system



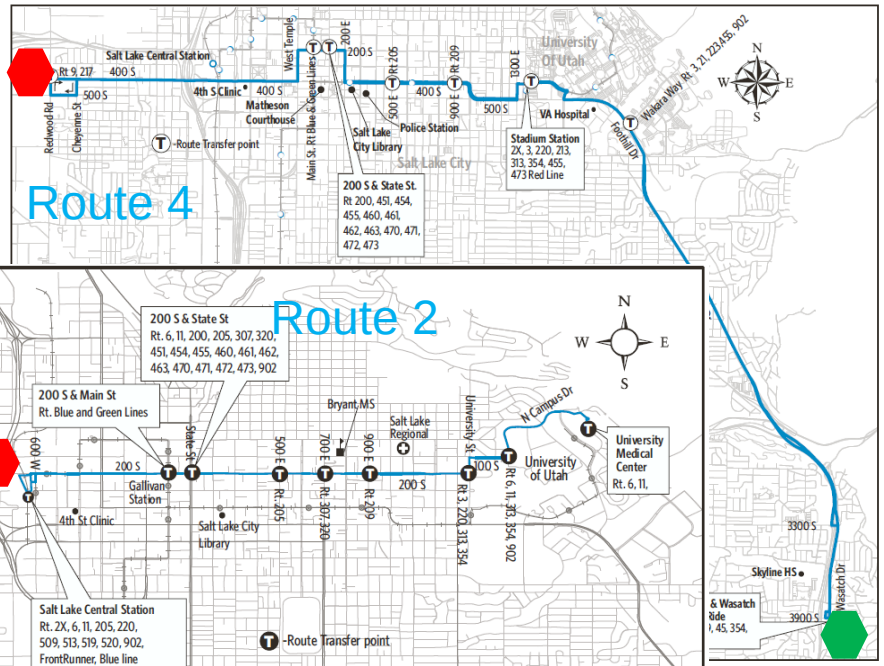


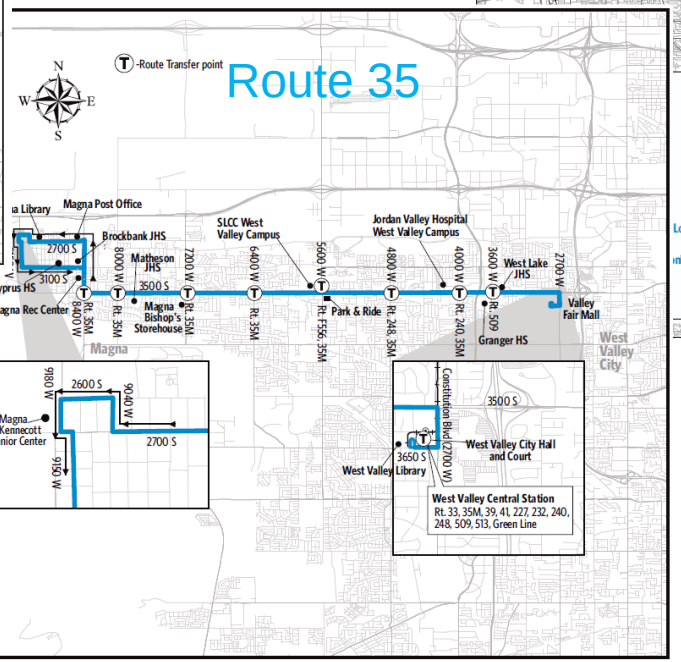


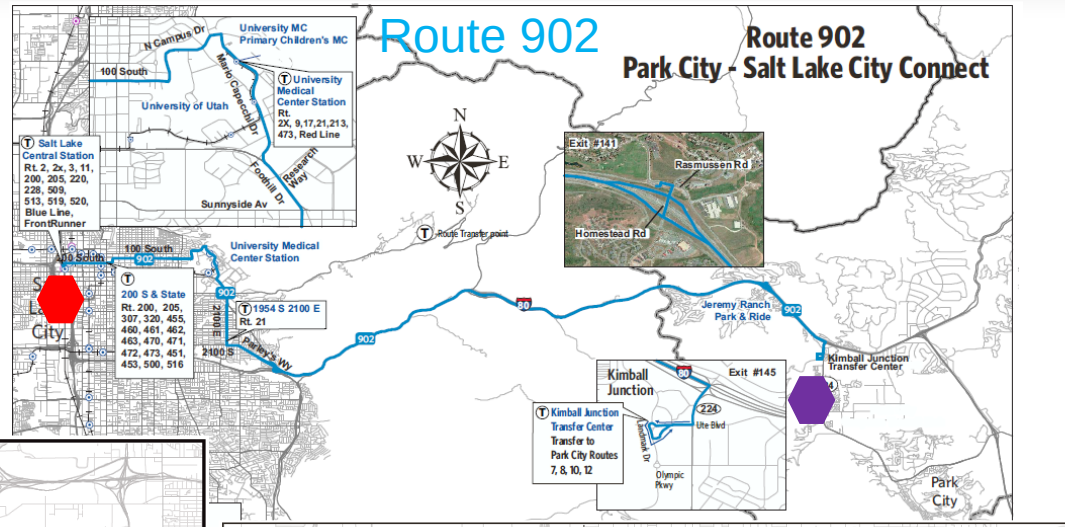
OVERHEAD CHARGING INFRASTRUCTURE

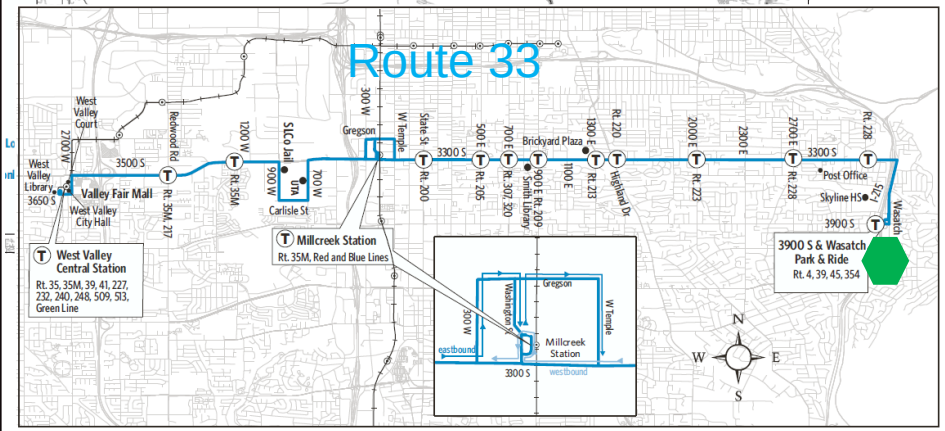
- Proterra designed and installed overhead charging infrastructure at Foothill Transit in Arcadia, CA

UTA Routes 2,4, 33, 35, 902





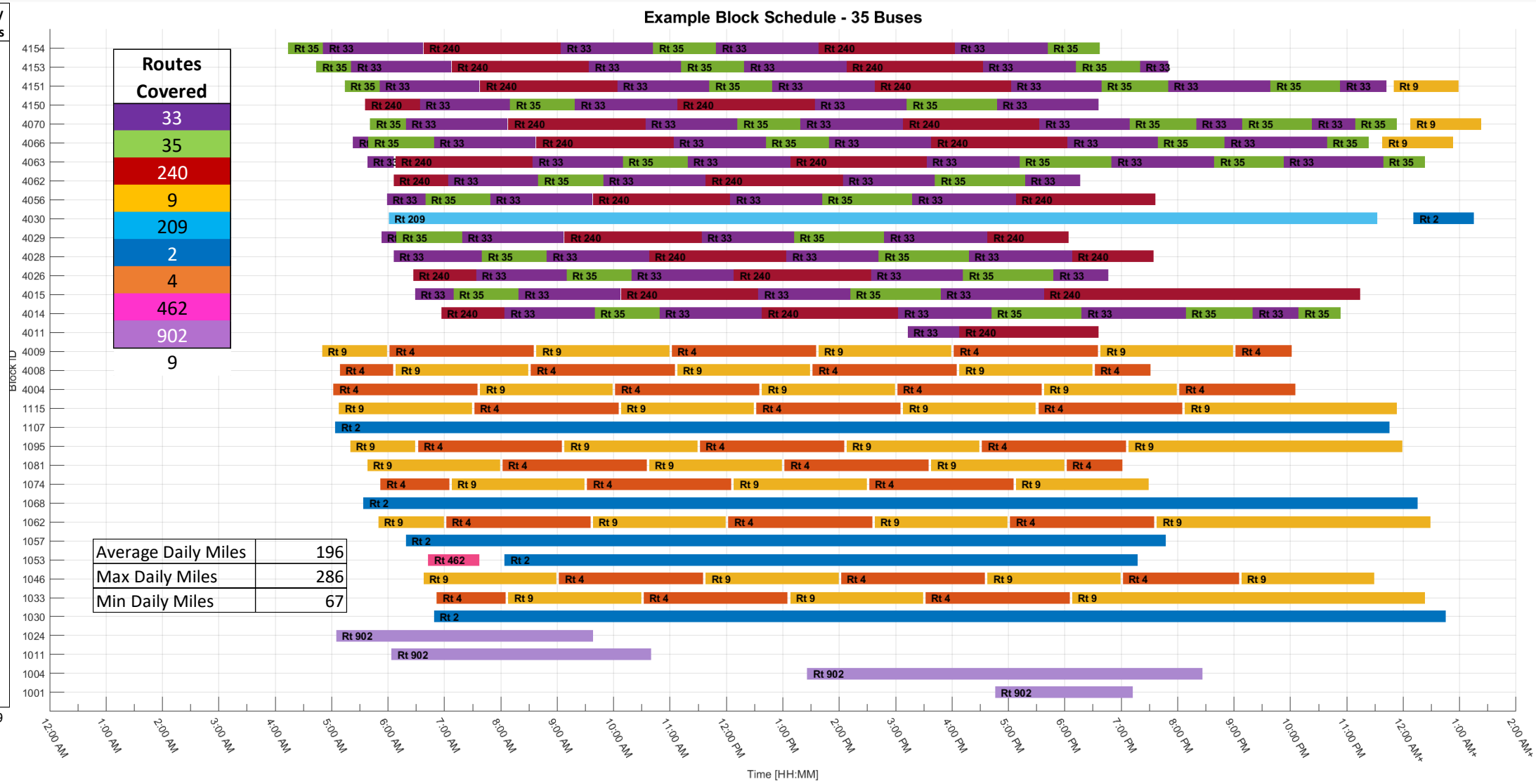




- 39-SWASB On Route Charger (proposed)
- SLCSTATN On Route Charger
- PC Kimball Junction On Route Charger

Fleet Replacement process – Understanding Block Schedules

Buses	Block	Daily Miles
35	4154	67
34	4153	174
33	4151	119
32	4150	119
31	4070	126
30	4066	167
29	4063	159
28	4062	106
27	4056	99
26	4030	171
25	4029	135
24	4028	135
23	4026	135
22	4015	171
21	4014	135
20	4011	171
19	4009	163
18	4008	156
17	4004	171
16	1115	67
15	1107	234
14	1095	237
13	1081	185
12	1074	190
11	1068	170
10	1062	224
9	1057	185
8	1053	185
7	1046	252
6	1033	278
5	1030	286
4	1024	190
3	1011	275
2	1004	210
1	1001	202
35	35	6049



UTA Fleet and Charge Model Results

- 35 Proterra E2 Max (660 kWh) DuoPower Drivetrain Buses
- Charging Analysis
  - On-route charging – 16 buses
    - 1 3900 S/Wasatch Blvd for 409 cumulative charging minutes/day
    - 1 SLC Station for 51 cumulative charging minutes/day
  - Optimized Depot Charging – 35 buses
    - 15 chargers with 35 dispensers
    - 1600 kW
    - No depot charging during high TOU/Demand charge periods
- Net Results
  - 660 kWh bus minimizes on-route charging events
  - Reduce number of chargers from 35 to 15
  - Lower energy needs from 2300 kW to 1600 kW
  - Avoid Time of Use & Demand Charges for depot chargers

Sample Fleet and Energy Calculations

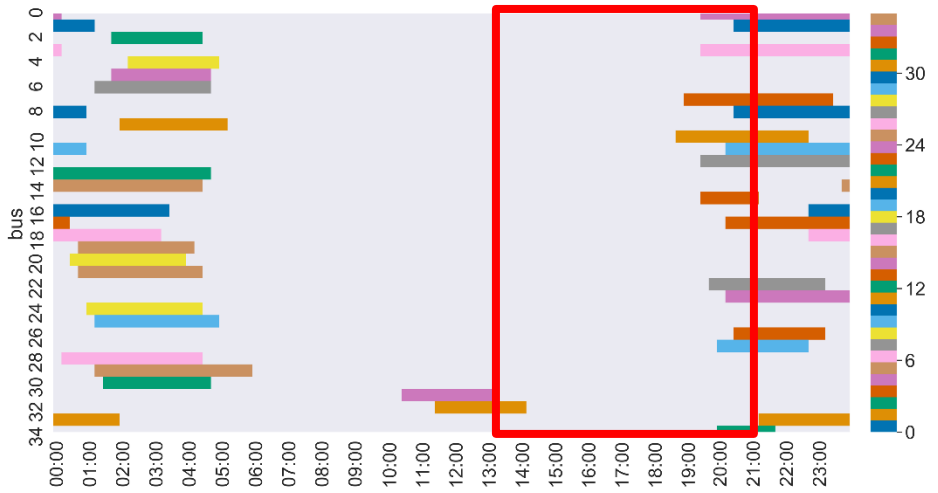
BusID	Efficiency [kWh/mi]	Dash SOC [%]	ORC Time Required [min]
1001	2.981	66	20
1004	2.519	30	25
1011	2.695	69	92
1024	3.165	27	15
1030	3.135	0	94
1033	2.512	79	87
1046	2.195	70	62
1053	2.208	24	13
1057	2.968	74	14
1062	2.905	28	82
1068	2.307	61	4
1074	2.149	77	17
1081	2.635	69	14
1095	3.419	19	40
1107	3.195	32	39
1115	2.808	24	0
4004	2.181	64	22
4008	2.784	22	14
4009	3.475	20	17
4011	2.583	66	37
4014	2.405	15	0
4015	3.095	64	36
4026	2.341	35	0
4028	2.690	66	1
4029	3.240	30	0
4030	2.711	30	36
4056	2.147	48	0
4062	2.826	65	0
4063	3.161	54	15
4066	3.231	10	19
4070	3.044	46	0
4150	2.841	57	0
4151	2.790	68	0
4153	3.002	37	11
4154	3.283	12	0

Depot Charge Energy Model – 35 buses
Scenario 1 – First Come, First Serve

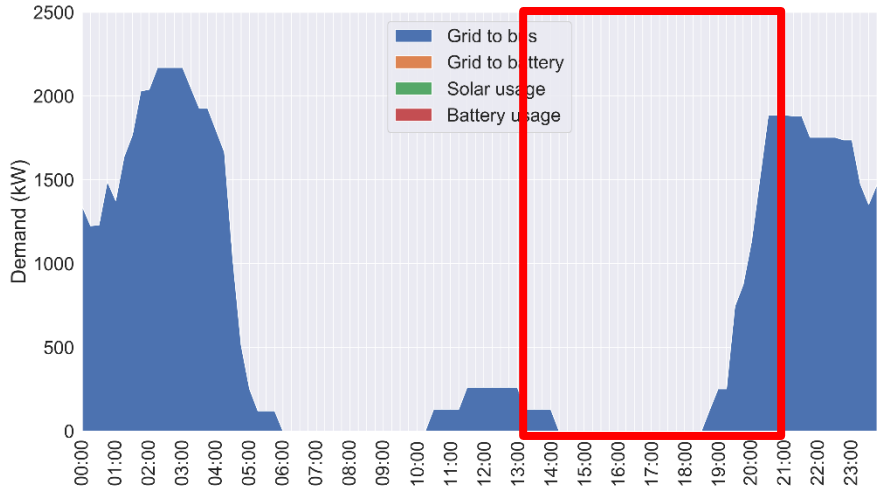
PROTERRA

35 buses

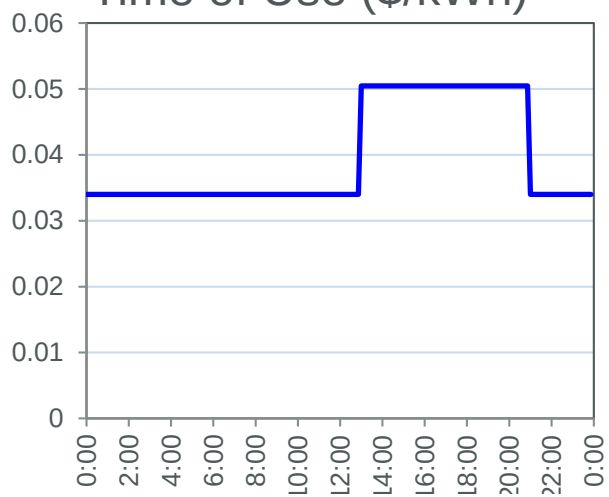
35 chargers, 35 dispensers



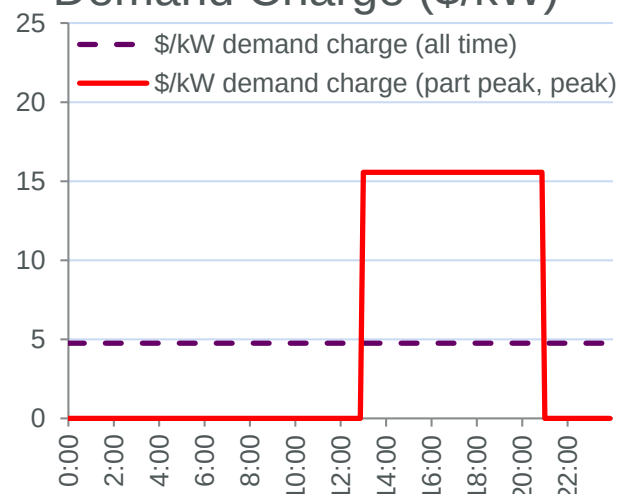
~2300 kW demand



Time of Use ($/kWh)



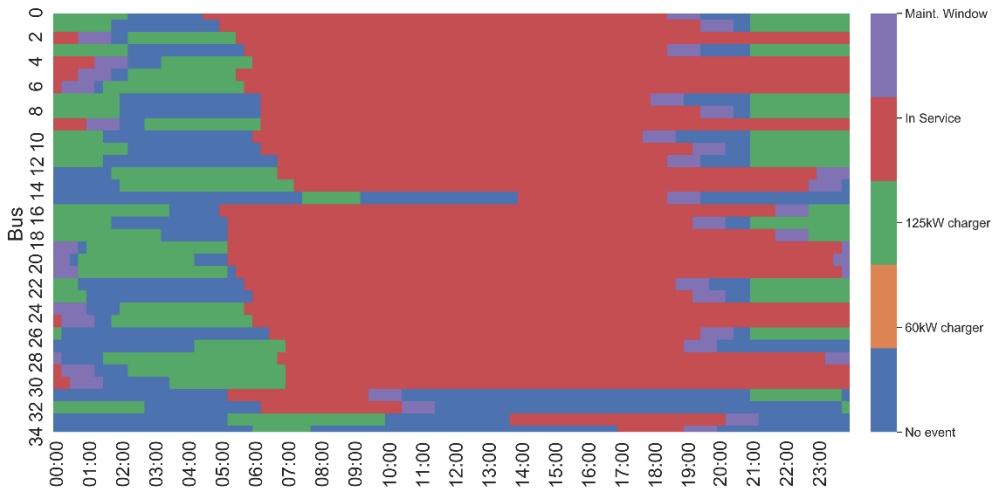
Demand Charge ($/kW)



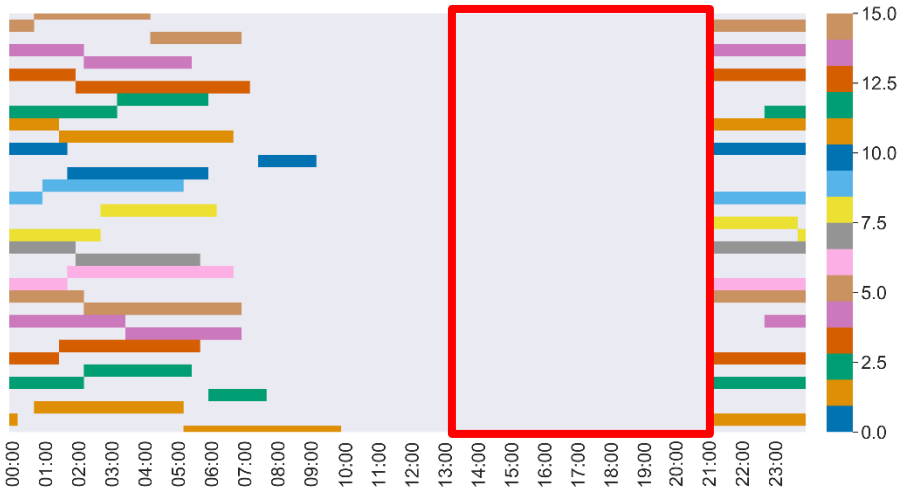
Fleet Replacement and Energy Model – 35 buses
Scenario 2 – Optimized Charger and Energy Model

PROTERRA

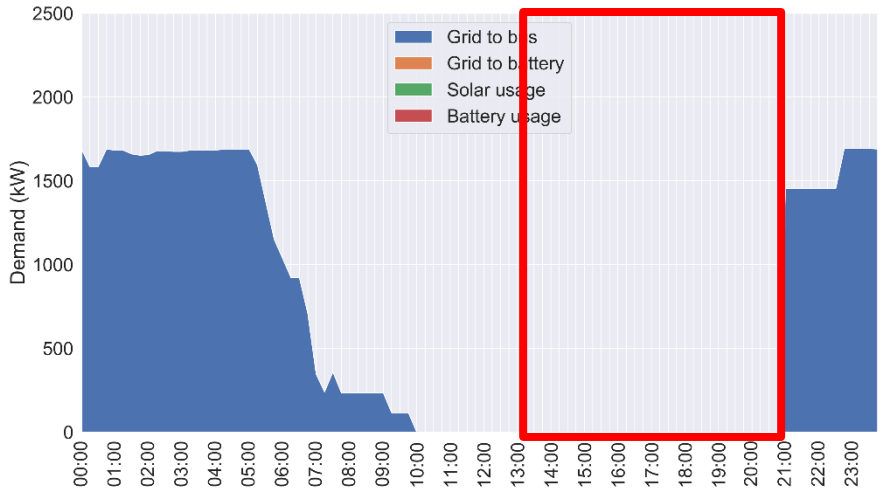
35 buses



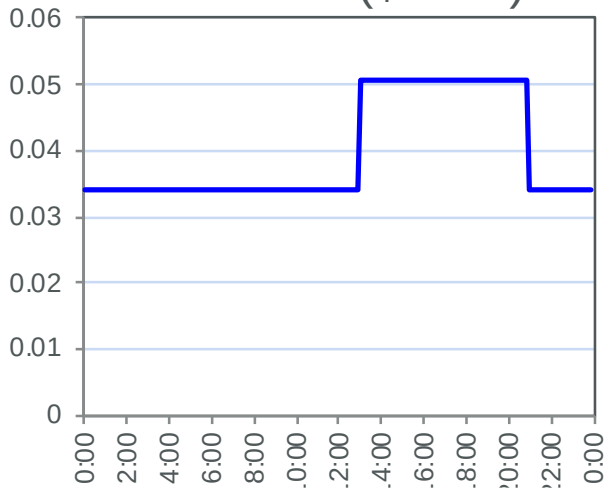
15 chargers, 35 dispensers



~1600 kW demand



Time of Use ($/kWh)



Demand Charge ($/kW)