



Matthews Bus Alliance, Inc.
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Orlando, FL 32808
"Legacy of Trust"
www.matthewsbusesflorida.com



Below are our responses to FAPT questions pertaining to Electric Vehicle (EV) Thomas Saf-T-Liner Jouley School Bus, available on FLDOE ITB:2020-16. Please keep in mind A/C is included with our base price! The difference between the Thomas Jouley and the competition starts with the proven Proterra Battery system and charging infrastructure. This system has been successful with transit districts for over 7 years. The answers below are in direct response to the questions. Technology is evolving as are offerings, thus, please consult with your Team Matthews Account Manager for the most up to date information available at the time.

Questions for Bus Vendors:

- 1. What configurations are you currently offering in the Florida Bid (meeting Florida Specifications) in the Electric bus, type, and capacity?**
 - a. Saf-T-Liner C2 Jouley as bid on FLDOE ITB:2020-16
 - b. 65 passenger with and without lift
 - c. 71 passenger with and without lift
 - d. 77 passenger with and without lift
 - e. Please review the attached detailed information regarding the Saf-T-Liner C2 Jouley and Proterra battery platform
- 2. Based on these configurations, please identify with a fully loaded bus based on capacity of ridership, A/C application, the effective range for each application (bus) before recharge.**
 - a. Effective range of Thomas' Jouley is up to 135 miles
 - b. Effective range is reduced based on several inputs to the vehicle's operation. Rider capacity in terms of loaded weight, has a minimal impact on range. Ambient air temperature does impact the vehicles range by demanding either A/C or heat. Florida's average ambient air temperatures are favorable towards operating an EV school bus. In general, HVAC load may reduce effective range between 10-30% depending on usage. Lastly, driver behavior is very influential on the vehicle performance. It is difficult to provide the impact driver's behavior has on electric buses
 - c. Idle Time is an additional factor that will impact range. On average school buses are 20% and 35%
- 3. Identify the requirements of percent of charge that the bus must have prior to operation.**

Jouley is designed to operate and perform with any SOC (State of Charge) above 18%. Distance of operation will depend on the SOC at the start of the route. Think of SOC similarly to fuel level in an internal combustion engine. If you start out low, the distance of travel will be limited. The reason we state 18% above is because this is the threshold where we begin to conserve power on the bus. As the SOC declines, systems on the bus will begin to reduce performance to protect themselves. Battery manufacturers generally prefer to operate between 30-85% (+/-5%) SOC.
- 4. Identify all charging options and time requirements that each carry to provide a fully charged bus ready for use.**

Thomas Built Buses offers 3 Charging Solutions:

- a. Proterra 60kW DC Charger
- b. ABB & Delta 24kW DC Chargers

c. Graphs below show benefits of the Proterra Charger 60kW

d. Time Rates of charging

ELECTRIC VEHICLE SUPPLY EQUIPMENT	Charge time for full charge of Jouley Bus Note: AC Charging is not available	Fast Charge Time Charging during daytime between routes.	Bi-directional Capability	Fast Discharge of Energy for future potential applications.
		Flexible charging during lowest, off peak times.	Inverter in the charger and not on the bus.	Revenue opportunities for schools with discharge of energy during desired times such as Demand Response Events and reduce loads during peak times for utilities.
		Future use beyond route transportation such as field trips	Vehicle to Grid (V2G) Hardware on the Charger with Firmware	V2G for potential Energy back up and Resiliency applications being considered for the future.
Proterra DC 60 kW Charger	3.3 Hours	Yes	Yes	Yes
DC 24kW Charger w/out bi-directional hardware	8.25 Hours	No	No	No
AC 19.5kW Charger w/out bi-directional hardware	10 Hours	No	No	No
AC 7kW Charger w/out bi-directional hardware	28 Hours	No	No	No

60 kW DC Fast Charger				
Useable kWh	Energy Used %	Energy Needed in kW	DC kW	Time to Charge – Hrs.
194	0	0	60	0
194	10%	19.4	60	0.3
194	20%	38.8	60	0.6
194	30%	58.2	60	1
194	40%	77.6	60	1.3
194	50%	97	60	1.6
194	60%	116.4	60	1.9
94	70%	135.8	60	2.3
194	80%	155.2	60	2.6
194	90%	174.6	60	2.6
194	100%	194	60	3.2

24kW DC Fast Charger				
Useable kWh	Energy Used %	Energy Needed in kW	DC kW	Time to Charge – Hrs.
194	0	0	24	0
194	10%	19.4	24	0.8
194	20%	38.8	24	1.6
194	30%	58.2	24	2.4
194	40%	77.6	24	3.2
194	50%	97	24	4
194	60%	116.4	24	4.9
194	70%	135.8	24	5.7
194	80%	155.2	24	6.5
194	90%	174.6	24	7.3
194	100%	194	24	8.1

1922 kW AC Charger				
Useable kWh	Energy Used %	Energy Needed in kW	DC kW	Time to Charge – Hrs.
124	0	0	19.2	0
124	10%	12.4	19.2	0.6
124	20%	24.8	19.2	1.3
124	30%	37.2	19.2	1.9
124	40%	49.6	19.2	2.6
124	50%	62	19.2	3.2
124	60%	74.4	19.2	3.9
124	70%	86.8	19.2	4.5
124	80%	99.2	19.2	5.2
124	90%	111.6	19.2	5.8
124	100%	124	19.2	6.5

Proterra Powertrain	Cummins Powerdrive
Total Battery Capacity of 220kWh x 88% limited usage = 194kWh of usable battery capacity.	Total Battery Capacity of 155kWh x 80% limited usage = 124kWh of usable battery capacity.

Charger Manufacturer	Est. Cost Range	Est. Installation Cost*
Proterra 60kW DCFC	\$42,500 to \$70,000	\$60,000 to \$95,000
ABB 24kW - DCFC	\$9,000 to \$11,000	\$15,000 to \$20,000
Delta 24kW - DCFC	\$7,000 to \$9,000	\$15,000 to \$20,000
AC 19.2kW Charger	\$1,700 to \$3,000	\$5,000 to \$10,000
*Estimated cost for budgetary purposes only . Cost for installation will vary based on individual facility infrastructure.		



5. **What level of expertise will be required for Districts to provide internal service of these units. Must technicians have specific certifications? What is the current weight of the bus in comparison to a similar configured diesel bus?**
 - a. Customers can Trust that Thomas Built Buses, Proterra, and Matthews Bus Alliance, Inc., will provide Free on-site driver and technician training for Jouley. Therefore, Matthews Bus Alliance employs a full-time and dedicated nationally recognized trainer to support the on-going training needs of all FL School District Customers. Upon delivery of a new Thomas Jouley bus, we will offer two training courses, Jouley 101, and Jouley 201. Jouley 101 target is for any personnel involved in daily operating a Jouley bus. Examples in this category are lead driver, driver trainer, shop foreman, lead technician and others determined by the customer. In Jouley 201, the content is focused on deeper technical operations of the bus, diagnostics, and maintenance schedules. The target audience for this course is the lead technician, technicians, and shop manager. Matthews Bus Alliance, Proterra, and Thomas will work directly with each customer to customize a training approach that best meets your needs
 - b. We require customer technicians to complete Jouley 101 and Jouley 201 training. Completion of these courses enables customer technicians to work on the low voltage bus systems. We will restrict maintenance and repairs on the high voltage systems to the authorized dealer, Matthews Bus Alliance, Inc. Thomas is developing a Jouley 301 course in compliance with Daimler Trucks North American and Thomas Built Buses policies. Once completed, Matthews Bus Alliance, will make the training available to its customers
 - c. Customer can trust Matthews' training will mirror our existing FREE onsite training you have become accustomed to receiving

Thomas C2 Jouley Vehicle Weight Summary			
lbs.	Front	Rear	Total
No Ac	8,393	13,373	21,766
AC	8,794		
Maximum	9,080		
Average	8,638	13,933	22,571
Sample Size	18		

6. What specialty equipment/tools will be required to be purchased from the district to provide routine maintenance of these units?

Presently with the restricted level of maintenance and repair items, customers do not have any required tooling commitments. We recommend customers use best practices for safe maintenance operations. Items such as high voltage vehicles, caution high voltage, lock-out-tag-out tags and other items are used when performing maintenance. As Jouley 301 level training is implemented, customers will be required to utilize specific high voltage personal protective equipment (PPE) and high voltage tools for maintenance. (See attached HVPPE information).

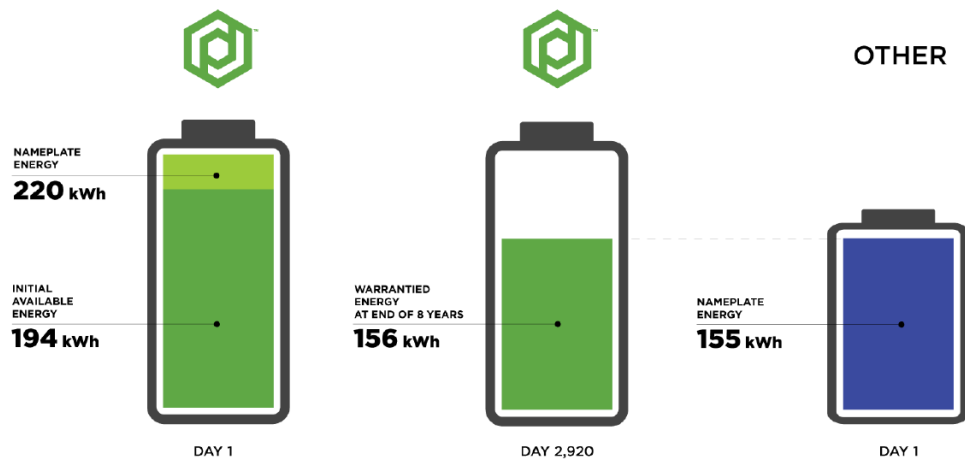
7. Please identify all PM maintenance schedules required along with time expectations to perform.

- a. C2 Maintenance Manual available upon request
- b. Services are predicted by annual mileages and schedules are predicted by type of product uses.
- c. Typical School bus 20,000 miles per year:
 - i. Air compressor filter 4000 mi interval - .50hr
 - ii. Auxiliary Bay desiccant replacement if needed - .25hr
 - iii. Battery pack desiccant replacement yearly - .50hr
 - iv. Proterra transmission service 36-month intervals (drain-replace fluids) - .75hr
 - v. All other inspections are visual checks preformed during standard inspections
 - vi. Anticipated Battery replacement 8-12 years. Cost of exchange will depend on secondary market values of battery packs with residual useful life

8. Please identify all associated warranties with the units being purchased.

System	Type	Coverage	Time (years)	Distance (Miles)	Throughput (kWh/pack)
Battery *Subject to warranty terms and conditions	Base	80% Initial Usable Capacity	8	175,000	200,000
		Materials & Workmanship	8	Unlimited	Unlimited
	10 Year Extended	80% Initial Usable Capacity	10	175,000	200,000
		Materials & Workmanship	10	Unlimited	Unlimited
	12 Year Extended	70% Initial Usable Capacity	12	Unlimited	Unlimited
		Materials & Workmanship	12	Unlimited	Unlimited
	15 Year Extended	70% Initial Usable Capacity	15	N/A	800,000
		Materials & Workmanship	15	Unlimited	Unlimited
Drivetrain *Subject to warranty terms and conditions	Base	Materials & Workmanship	5	100,000	n/a
	Extended	Materials & Workmanship	5	150,000	n/a
	Extended	Materials & Workmanship	8	150,000	n/a
	Extended	Materials & Workmanship	10	150,000	n/a
	Extended	Materials & Workmanship	12	250,000	n/a

**PROTERRA BATTERIES PROVIDE MORE ENERGY AT THE END OF 8 YEARS
THAN SOME OTHERS PROVIDE ON DAY 1**



9. Please identify anticipated costs with battery maintenance, inclusive of replacement costs and disposal costs. Is there a different type of requirement for battery storage than currently being used for current battery applications? Are these batteries available through a general vendor or is there a limited amount of providers? If there is a battery failure, can isolated batteries be replaced or is it an entire section of batteries?
- a. 2 battery desiccant filters, 2 salt plugs
 - b. Battery replacement costs unknown today
 - c. Battery disposal costs not known
 - d. Replacement batteries are unique to the battery management system from Protterra
 - e. After the initial 8 year warranty period, if there is a battery failure, you could replace one entire battery pack, you would not have to replace both packs that are in the Jouley; however, you would not be able to replace one specific module in one of the packs.
 - f. <https://vimeo.com/439334387/a8abbe097c> (Battery Safety Video)
10. Please provide an anticipated build time of these units from time of order to delivery, can you identify a premium time for order based on your factory build schedules.
- a. Build schedule is currently 8-12 months from time order is received. Order timing plays a role in overall lead time based upon factory backlogs at the time of order.
 - b. No premium order period today
11. Please identify the provisions your company has made to ensure warranty service and other service can be preformed on these units once purchase by the districts.
- a. Customers can trust Thomas Built Buses has a very strong partnership with its authorized Florida dealership, Matthews Bus Alliance, Inc. The TBB dealer agreement requires specific dealer performance requirements such as technically trained service staff, on-going staff training requirements, parts inventory requirements, warranty administration and financial structure
 - b. Customers can Trust that Matthews Bus Alliance as a Platinum Support Level Thomas Dealer, 2018 and 2019 Southeast Dealer of the Year, will provide customer support in the same manner we supply support for all

other Thomas Built Buses through our nationally recognized and awarded fleet of 20 road service trucks and certified technicians. Technical support will be available via, txt, phone, email and zoom from our road tech trainer, Dominic Lozano, and Award-Winning Trainer, Ali Rampartab. Matthews Sales staff will be well versed in the operation of the bus(es) and be available to provide driver training



12. Has there been a determination of life expectancy of the electric bus based on all required and recommend services performed?

We do not see a reduction in life expectancy of the electric school bus. It is difficult to present factual data today, our experience leads us to expect that our product will meet or exceed our standard warranties. We see evidence developing that electric buses may last well beyond current expectations. Lower stress and vibration on the chassis, enhanced driver behaviors, and fewer moving parts will lend towards a longer life expectancy. The first 2005 Thomas Saf-T-Liner C2 Diesel models are now 16 years old and many of these units are still operating throughout Florida in daily service. Thus, 15-20-year life should be anticipated from any properly maintained Saf-T-Liner C2.

13. What is the anticipated annual maintenance costs for these units and any milestone services and are they based on time, hours or mileage?

Services are predicted by annual mileages and schedules predicted by type of product uses.

Typical School bus 20,000 miles per year – frequent stops - M1 Schedule of Maintenance

a. Air compressor filter 4000 mile	\$ 21.00 - per year
b. Auxiliary Bay desiccant replacement if needed	\$ 40.00 - per year
c. Battery pack desiccant replacement yearly	\$100.00 - per year
d. Proterra transmission service 36 months intervals	\$ 65.00 - per year
e. Annual average	\$267.00 - per year

All other inspections are visual checks performed during standard inspections.

Battery replacement will be dictated by the range needed for the bus to travel, as the batteries degrade over time and lose charge capacity. See Proterra Chart listed under question 8. Cost of exchange will depend on secondary market values of battery packs with residual useful life.

14. What level of interaction will the dealer provide in working with power companies in providing the appropriate hook up platforms for the connection between bus and charging station? Is there an industry standard for hook-up and charging line? Is it based on the level of charging station?

- f. Customers can trust that Thomas Built Buses, Matthews Bus Alliance, and Proterra will work closely with your local power companies regarding infrastructure and support. A customer's vendor selection for a charger will play a very important role for determining infrastructure specifications and overall success of the operation. Likewise, a customer's existing electrical infrastructure will have a significant impact on requirements. For example, Dominion Energy chose Thomas Jouley, Proterra, and the local Virginia Thomas Dealer (Sonny Merryman, Inc.) as the best solution to implement a successful EV School Bus program. For more information concerning Dominion's Choice, contact Kate Staples at (804) 771-4720 or Kathleen.D.Staples@dominionenergy.com
- g. We also partner with companies like <https://www.highlandet.com/> to provide a financing solution that includes charging infrastructure and maintenance in one simple payment, making it easier for districts to participate. Highland is wishing to work with us based upon the Proterra, Thomas, Daimler Jouley Product and infrastructure solution paired with Trusted Matthews Support. <https://www.proterra.com/press-release/beverly-unveils-electric-school-bus/>

15. What will be the methodology in ensuring the fire and rescue will be trained in emergency procedures in bus emergencies?

- a. In our Jouley training courses, we will welcome and invite local emergency responders to attend training at no cost. We find training for many first responders is already in place on EV vehicles, specifically passenger cars. First responders' immediate need is to be aware of new electric school buses in operation and a product orientation.

16. Will there be any additional requirements for bus evacuation procedure in case of an emergency?

- a. None from OEM
- b. Bus meets all FMVSS requirements
- c. Bus meets Florida State DOE requirements

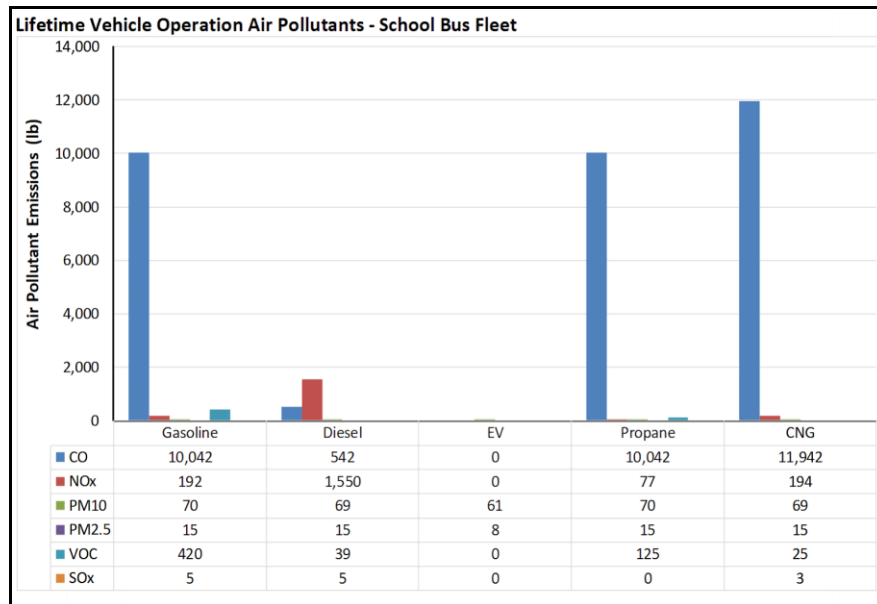
17. What provisions has your company taken to create an upgradable bus as new technologies emerge to enhance this generations of buses being purchased?

- a. Current vehicle design is specific to the technology available today from vendors
- b. Thomas Built Buses along with its parent company, Daimler Trucks North America, bring tremendous EV engineering resources and are constantly developing and looking at new technologies. Daimler is a global family with design, testing, and implementation of new technology to improve safety and efficiency. As a result of such engineering, Thomas recently introduced a new safety feature, auto-reversing service door. This feature senses objects in a closing service door and automatically opens the door. This option is currently available on FLDOE: ITB: 2020-16
- c. New EV battery technology will be integrated in our on-going product road map. A recent example is the new battery cell technology from our supplier to increase our total battery capacity from 220 to 226 kw of storage.

18. Has your company researched the amount of power consumed in charging your electric bus?

ELECTRICAL INPUT	
Nominal Power – Continuous	66 kVA (kilovolt amps)

19. Please provide across your platform the comparisons on emissions for the Electric Bus, Propane Bus, CNG Bus, Diesel Bus and Gasoline Bus. All based on the newest emission standards.



In closing, Matthews Bus Alliance, Thomas, and Proterra are interested in forming a long-term relationship that ensures the success of EV within your district. There is a lot of information provided here that will require further explanation. Thus, we encourage meeting(s) with all involved parties to ensure the infrastructure is planned properly to fit your specific operational needs. Based upon the success of the Proterra battery solutions currently in use by transit districts and schools, with Matthews Bus Alliance, Service, Parts, Warranty and Customer Service, we are confident the Thomas Jouley Saf-T-Liner C2 represents the best long term solution for Florida districts. This will take a complete partnership between all parties for it to be successful long term. The only way to accurately put a cost to everything is to get with your bus supplier, battery and infrastructure provider, local power company, and finance company.

https://www.youtube.com/watch?v=DZnMXtNCfzo&feature=emb_logo – Take a Ride on Jouley, the Electric Bus

**Additional Questions
School Bus Fleet Electrification
General Considerations and Questions**

Buses:

1. What is the maximum battery system kWh capacity?

220kWh

a. Is usable capacity different?

Yes - 88% - 194 kWh

2. What is the maximum kW input the battery system will accept for recharging?

60kWh

3. What is the estimated recharge time based on charging equipment outputs (in kW)?

Please reference the table listed in question 4.

4. What is the rating for miles-per-charge (or kWh-per-mile) under normal bus operation?

a. With air-conditioning?

b. With heating?

Please see question 2

Currently - 1.474 kWh/mile

10%-30% - 1.64kWh/mile low end - 2.1kWh/mile

5. What is the idle time included in the miles-per-kWh rating?

a. With air-conditioning?

2 low - 4kWh high for dash at idle and 4 low - 8kWh high for body AC at idle

b. With heating?

10-30kWh for both battery and heater

c. How does this compare to actual idle time for the fleet?

Needs to be calculated per district policy per individualized fleet

6. Where is the charge port located?

a. Front, rear, option for both?

Front behind entrance door on curbside

Rear - optional curbside behind rear axle - approx. 40 inches from rear bumper

*Can only select front or rear - cannot have both

b. May influence where buses can park for recharging

Charging Equipment (often referred to as Electric Vehicle Supply Equipment or EVSE):

1. What is the maximum kW output?

60kW

2. What footprint is required per unit?

a. Bollards, wheel stops, both?

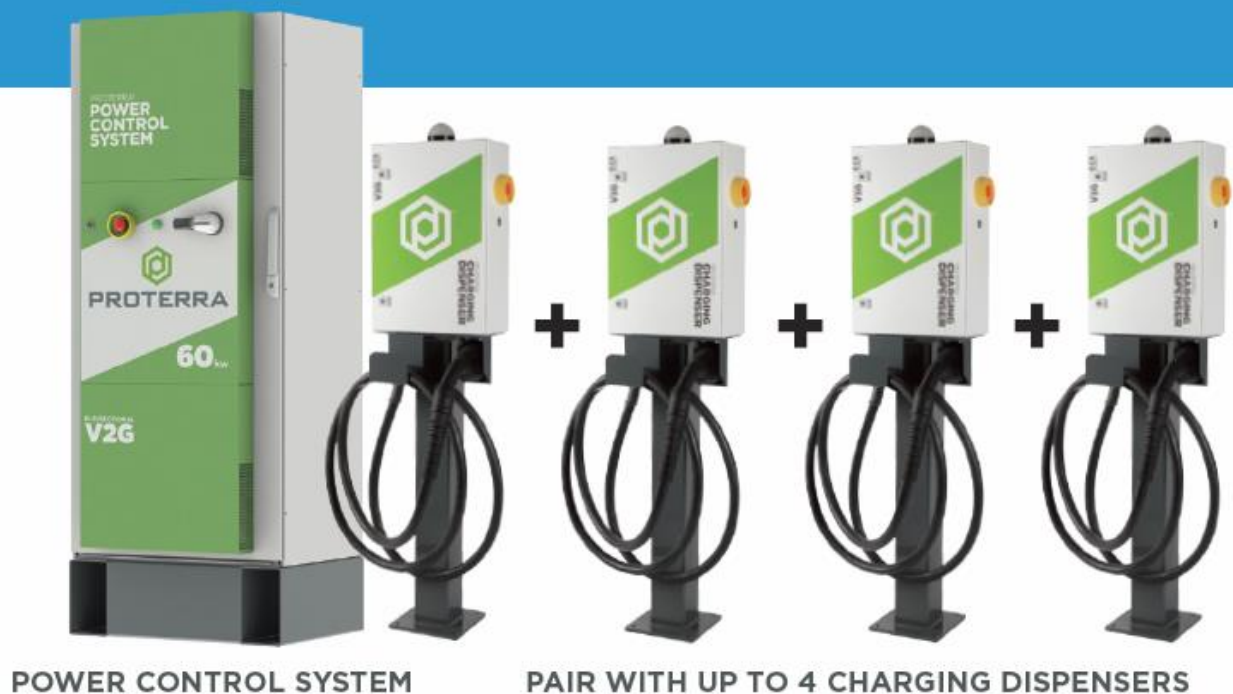
District preference - recommended

3. Is each unit stand-alone or is it 'mother-daughter' system that is easier to expand?

1 - 1 relationship with the AC charger and the 25kW charger (one charger per bus).

Also requires 8 hours to charge - not effective V2G

Proterra - 1 to 4 relationship, meaning you have one power control system (PCS) and 4 dispensers. Charging strategy is sequential. Future is simultaneous with Proterra in 2021. With effective V2G capability and 3.3 hours of recharge.



60_{kW}
**PROTERRA®
CHARGING
SYSTEM**
**PROTERRA
ENERGY™**
FLEET SOLUTIONS

TECHNICAL SPECIFICATIONS

ELECTRICAL INPUT

Nominal Power – Continuous	66 kVA
Input Voltage	480VAC, 5-Wire WYE (L1, L2, L3, Neutral, Ground)
Input Current	79A @ 480VAC, 60Hz
Input Frequency	60 Hz
Power Factor	>0.995
Maximum Efficiency	>91% @ 800 V (DC output voltage dependent)
THD - Full Power	<3%

ELECTRICAL OUTPUT

Output Power Capability – Continuous	60 kW
Output Voltage	270 – 870 VDC
Output Current	± 200ADC
Charging Module	Remote dispenser with vehicle interface
Max Number of Dispensers	4 dispensers for automated, sequential charging
Max Distance - PCS to Dispenser	500 ft 152 m

MECHANICAL

Cooling	Air cooling
Weight	1400 lb 635 kg
Dimensions (W x D x H)	31.5 in x 23.6 in x 70.8 in 80 cm x 60 cm x 180 cm
Environmental Rating	NEMA 3R
Wall Clearance (Side, Back)	6 in, 1 in 15.24 cm, 2.54 cm
Adjacent Unit Clearance (Side, Back)	1 in, 1 in 2.54 cm, 2.54 cm
Door Clearance	Facing open space: 36 in 91.4 cm
	Facing open door: 48 in 121.9 cm

DISPENSER SPECIFICATIONS

Dimensions - wall-mounted (W x D x H)	15.75 in x 8.5 in x 26.5 in 40 cm x 21.6 cm x 67.3 cm
Dimensions - pedestal-mounted (W x D x H)	15.75 in x 8.5 in x 58 in 40 cm x 21.6 cm x 147.3 cm
Weight (wall-mounted)	42 lb 19 kg
Weight (pedestal-mounted)	112 lbs 50.8 kg
Dispenser Installation	Wall or pedestal-mounted
Charging Cord Length	10 ft, 18 ft or 25 ft 3 m, 5.5 m, or 7.6 m
Wall Clearance (Side, Back)	0 in, 0 in 0 cm, 0 cm
Door Clearance (Facing open space, Facing another door)	36 in, 48 in 91.44 cm, 121.92 cm

ENVIRONMENTAL

Operational Temperature Range	-4°F to 113°F -20°C to 45°C
Humidity	0% to 95%
Altitude	De-rates over 2000m above sea level

COMMUNICATIONS PROTOCOLS

Remote Management	OCPP 1.6 via 4G Cellular
Compatible Charging Connections	J1772 CCS Type 1 universal plug-in

CERTIFICATIONS

UL	2202, 2231, 1741 SA
Warranty	2 Years

▪ Standardized and Interoperable

▪ Modular and Scalable

▪ Multi-dispenser Capable

▪ Intelligent and Automated

Proterra is a leader in the design and manufacture of zero-emission electric transit vehicles and EV technology solutions for commercial applications. We provide a suite of products, services and financing options for a seamless transition to clean, quiet, battery-electric fleets. Proven through more than 11 million miles in service and rigorous U.S. independent testing, Proterra technology is designed for durability, safety and energy efficiency.



MADE IN THE USA

Distributed in partnership with:



proterra.com/contact-us

4. What are the capabilities for data collection and reporting?

- a. Charge duration?
- b. kWh dispensed?
- c. Etc.

All EV System reporting will come thru Proterra's APEX Telematics software

5. What are the capabilities for managed charging?

- a. Scheduling? Provided thru Proterra's APEX Telematics software
- b. kW Ramp-up/ramp-down? Yes

Site Location for bus parking/charging:

1. Identify the location(s) where the buses will park to charge

- a. Utility service to an existing facility may not be adequate and may require a new service
- b. Additional time for design, permitting, and construction of utility service may be needed
- c. Bus/charger specs, and charging schedules will influence power requirements
- d. Weigh option to use more than one location based on current power availability and potential for expansion at each location

Good questions to be answered for each individual district

2. What are the expansion considerations?

- a. Lead times on buses, EVSE, and utility service may warrant expansion considerations in the initial project scope
- b. How many additional buses can EVSE control panel(s) support?
- c. Can additional equipment be avoided using managed charging or based on route schedules?

References:

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Additional References available per request. Please contact your Matthews Account Manager for additional information.

THE SAF-T-LINER® C2 JOULEY ELECTRIC SCHOOL BUS POWERED BY PROTERRA® EV TECHNOLOGY



THE SAF-T-LINER C2 JOULEY ELECTRIC SCHOOL BUS POWERED BY PROTERRA EV TECHNOLOGY



Proterra has partnered with Thomas Built Buses to electrify their most popular vehicle, creating a 100% battery-electric bus designed to meet the needs of school bus fleets.

The Saf-T-Liner C2 Jouley powered by Proterra technology brings Proterra's **proven battery and drivetrain technologies** to the North American school bus market, the next frontier for zero-emission commercial fleets.





**Burlingame,
California**

*Battery
Manufacturing*

Company HQ



**Los Angeles,
California**

*Bus
Manufacturing*

*West Coast
Operation*



**Greenville,
South Carolina**

*Bus
Manufacturing*

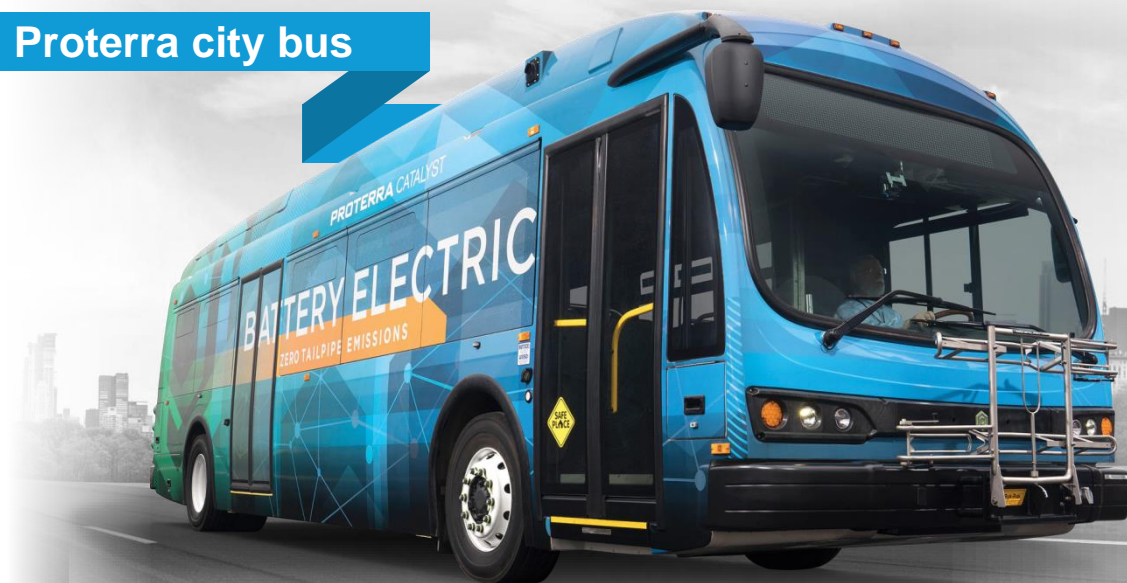
*East Coast
Operation*

Proterra is a leader in the design and manufacture of zero-emission, heavy-duty EVs and charging systems.

- Founded in 2004
- >9,000,000 service miles
- Over 300 vehicles on the road
- Over 700 vehicles sold
- 90+ customers
- >45,000,000 pounds of CO2 emissions avoided
- Engineering team with deep automotive expertise and experience with ground-up EV design and platform adaptation

Leading provider of commercial electric vehicles and technology for fleets

Proterra city bus



Powered by Proterra



Thomas school bus

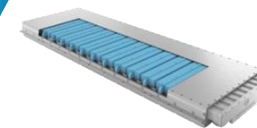


Van Hool coach bus

Commercial electric fleet technology



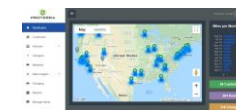
High power charging



Energy-dense battery pack



High efficiency drivetrain



Connected vehicle platform

Proterra Battery Engineering Team

- Core engineering team of 25+ members with deep automotive and heavy-duty experience
- Experience with both ground-up EV design as well as platform adaptation
- Fully outfitted R&D facility and pilot battery factory are co-located in Silicon Valley to enable rapid development cycles and oversight

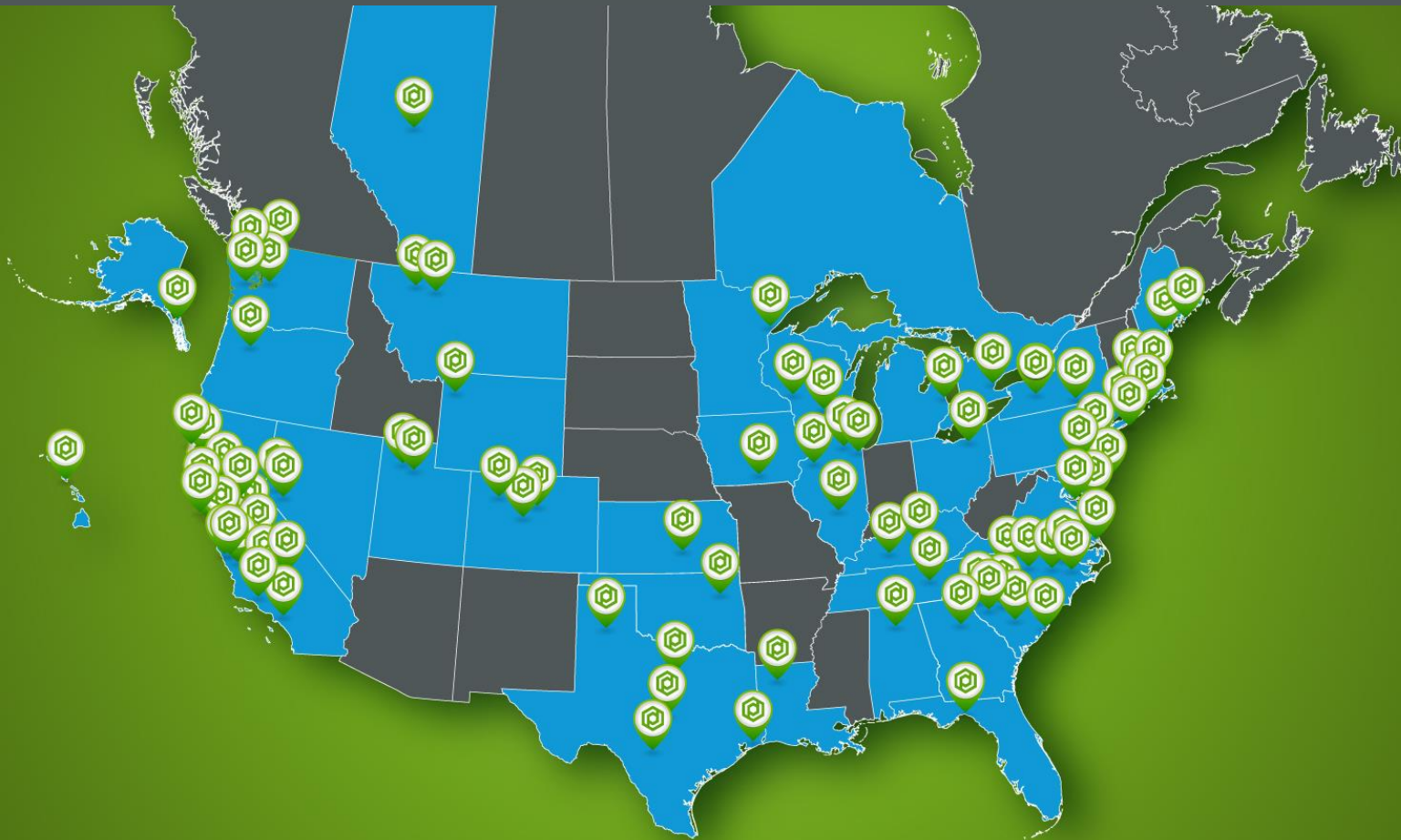
Product Development Experience



Professional Background

**BOSCH****Bloomenergy®**

PROTERRA CUSTOMERS



>700 buses sold to >90 customers across 41 states/provinces

AL

ALABAMA A&M UNIVERSITY
NORMAL

AK

CAPITAL TRANSIT JUNEAU

CA

CITY OF ARVIN
CITY OF DUARTE
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
SAMTRANS SAN CARLOS
SAN FRANCISCO INTERNATIONAL AIRPORT
SAN JOSE INTERNATIONAL AIRPORT
TRI DELTA TRANSIT ANTIOCH
VTA SAN JOSE
VISALIA TRANSIT VISALIA
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

GA

UNIV. OF GEORGIA ATHENS

HI

JTB HAWAII HONOLULU

IA

DART DES MOINES

IL

QUAD CITIES METROLINK MOLINE
JLL CHICAGO
CONNECT TRANSIT BLOOMINGTON - NORMAL
CHICAGO TRANSIT AUTHORITY

KS

WICHITA TRANSIT WICHITA

KY

TARC LOUISVILLE
LEXTRAN LEXINGTON

LA

SPORTRAN SHREVEPORT

MA

WRTA WORCESTER
PVTA SPRINGFIELD

MD

BGE BALTIMORE
MCDOT ROCKVILLE

ME

SH-ZOOM TRANSIT BIDDEFORD
GREATER PORTLAND METRO PORTLAND

MI

BLUE WATER AREA TRANSIT
PORT HURON

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

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

UT

PARK CITY TRANSIT PARK CITY
UTA SALT LAKE CITY

VA

HAMPTON ROADS TRANSIT NORFOLK

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

ON

TORONTO TRANSIT COMMISSION

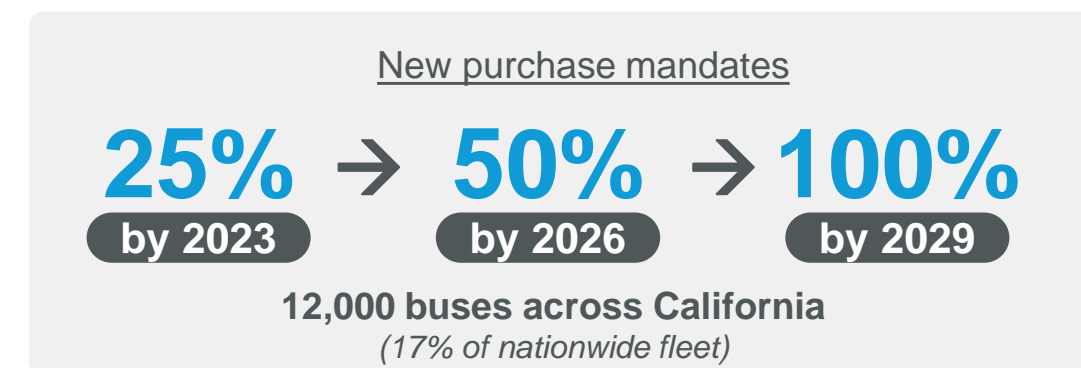
Only announced customer names shown. Updated May 2019

THE TRANSIT MARKET IS RAPIDLY SHIFTING TO EV

- Battery-electric transit vehicles are moving toward **widespread industry adoption**
- Major cities making commitments to zero-emission transportation
 - Emissions reduction targets
 - Improving air quality
 - Cost savings
- **Purchase barriers eliminated** due to:
 - Improved range
 - Sharp decline in battery costs
 - Service-proven performance
 - Increased funding opportunities



California mandates 100% electric by 2040



Source: National Transit Database; agency websites; 2017 American Public Transportation Association Fact Book



Proterra

- EV Bus Deployment know how
- Battery Technology & Charging Infrastructure
- Design and Manufacturing
- Burlingame, CA and Greenville, SC



Freightliner Custom Chassis Company (FCCC)

- C2 Chassis Manufacturing
- Service expertise
- Gaffney, SC



Thomas Built Buses

- Dealer sales and service network throughout the U.S.
- School Bus Design and Manufacturing
- High Point, NC

Close proximity of design and manufacturing facilities enables close collaboration and efficient production.

THE SAF-T-LINER C2 JOULEY ELECTRIC SCHOOL BUS POWERED BY PROTERRA EV TECHNOLOGY



ZERO EMISSIONS

- 100% battery-electric with no tailpipe emissions

FAST CHARGING

- DC charging enables a full charge in less than 3 hours

HIGH PERFORMANCE

- Efficient, smart, safe drivetrain technology for optimal performance in any climate

PROVEN TECHNOLOGY

- Proterra batteries and drivetrains proven in more than 8,000,000 service miles on transit buses

LOWER OPERATING COSTS

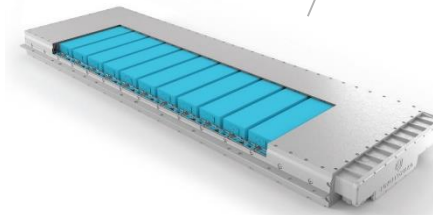
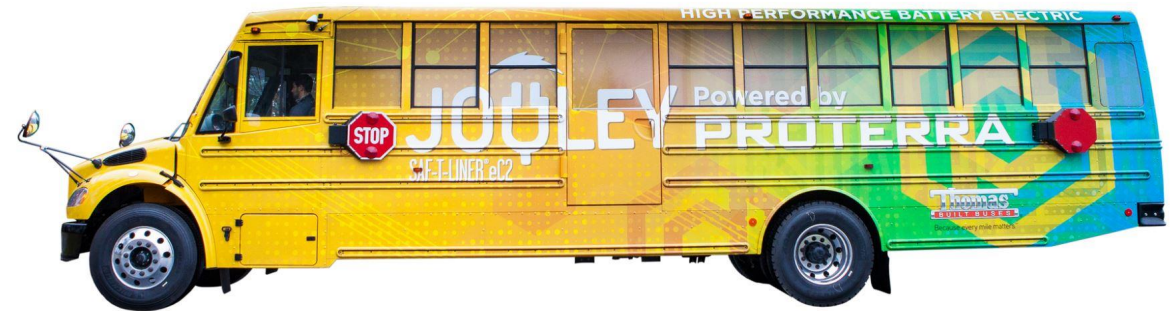
- More efficient EV technology enables simplified maintenance and better MPGe for greater savings

GREATER EFFICIENCY

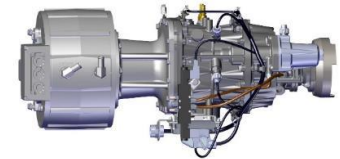
- Proterra drivetrains deliver unparalleled performance and greater fuel economy

REGENERATIVE BRAKING

- Regenerative braking provides additional energy to the batteries while driving for maximum range.



Proterra® battery



Proterra® drivetrain



- School buses are perfectly **suited for electrification**
 - Low daily mileage
 - Predictable, planned routes
 - Health benefits for children & community
 - Downtime between routes allows for midday charging if needed
 - Ability to provide power back to grid during peak times

THE PROTERRA® BATTERY

SMART. SAFE. EFFICIENT. PROVEN.



SMART

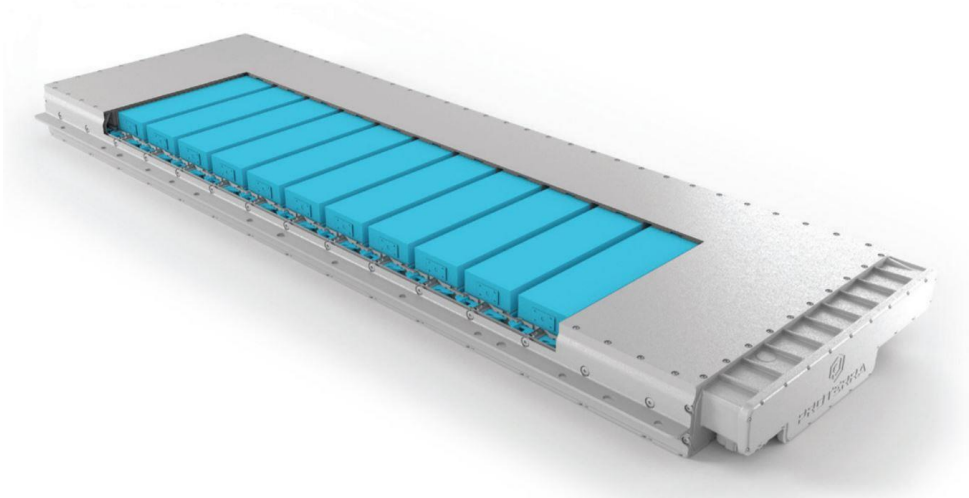
- Active thermal management ensures optimal charging in any climate
- Multiple sensors enable continuous monitoring
- Dynamically adjusts over time for maximum performance

EFFICIENT

- Compact design delivers industry-leading energy density
- Highest efficiency, with industry-leading range

PROVEN

- 9,000,000+ service miles on transit buses across North America
- Achieved record-breaking range for heavy-duty vehicles



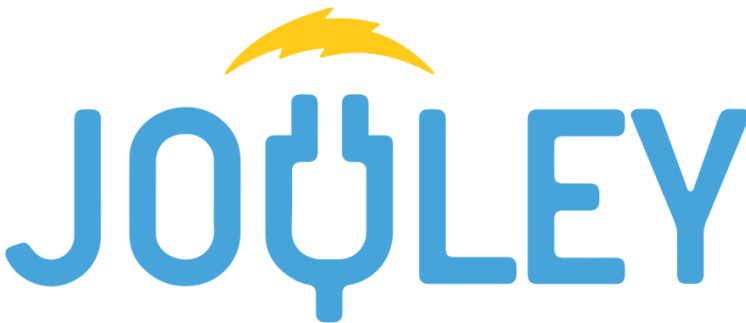
Designed and manufactured in-house in Silicon Valley by the best minds in battery engineering, Proterra battery systems are lightweight, compact, safe and powerful.

Proterra battery packs are designed specifically for safe operation in heavy-duty transportation.



- Protective, **ruggedized enclosure** made with ballistic-grade materials that can withstand the toughest conditions
- Pack design ensures service technicians and operators are protected from high voltage components
- Liquid cooling for **active thermal management** to ensure optimal operation in any climate
- More than **70 sensors** throughout each pack delivers continuous monitoring and diagnostics, enabling faster service
- If a single cell within the battery fails, the pack is designed such that the defective cell will be isolated to a small region of the pack and not cause complications throughout the entire pack.
- Rigorously tested and 3rd party validated

Specifications Overview



up to 120

Miles
Range

220

kWh
Total
Battery
Capacity

295

Peak
Horsepower

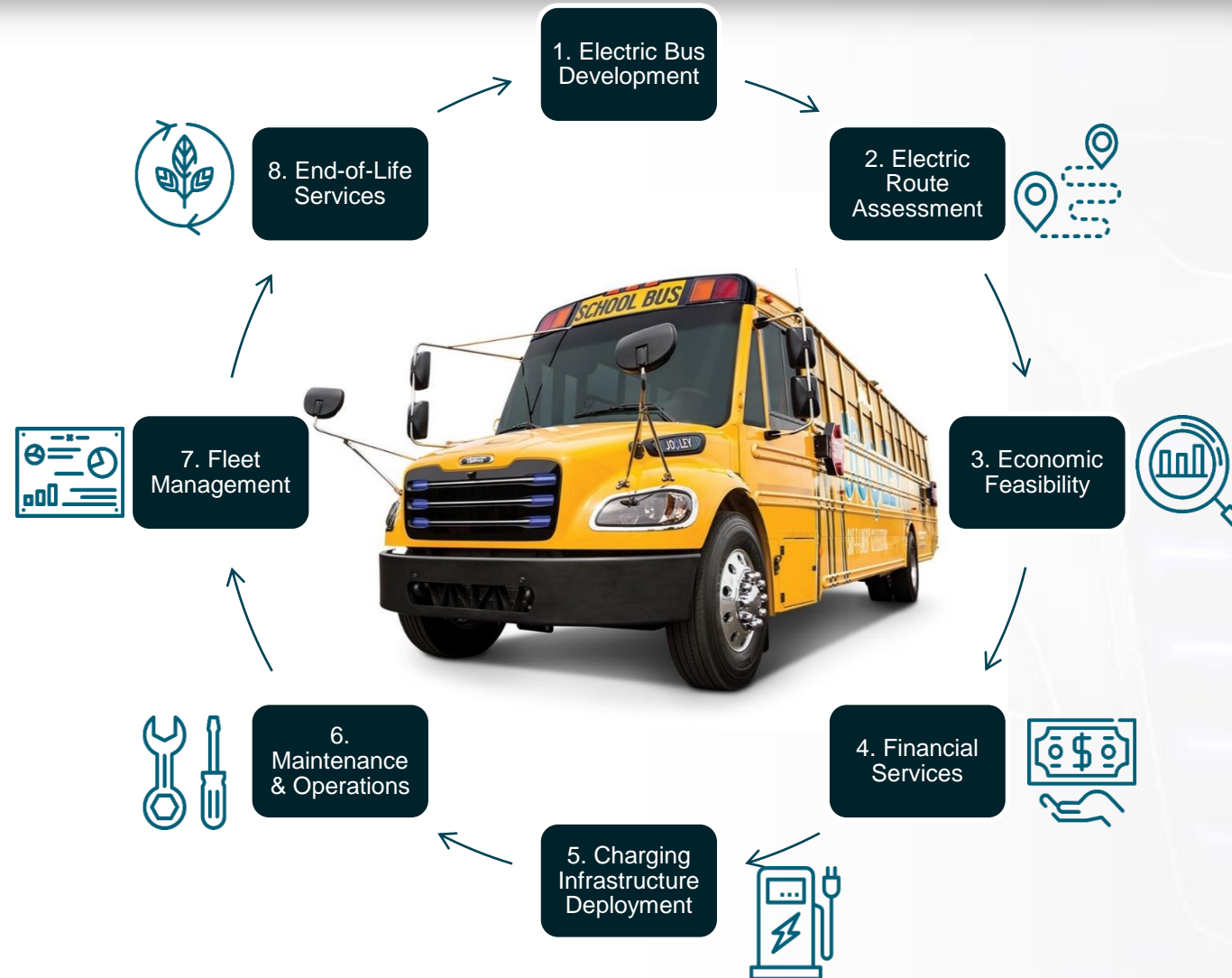
2

Speed
Transmission

100

% Charge
< 3 hours

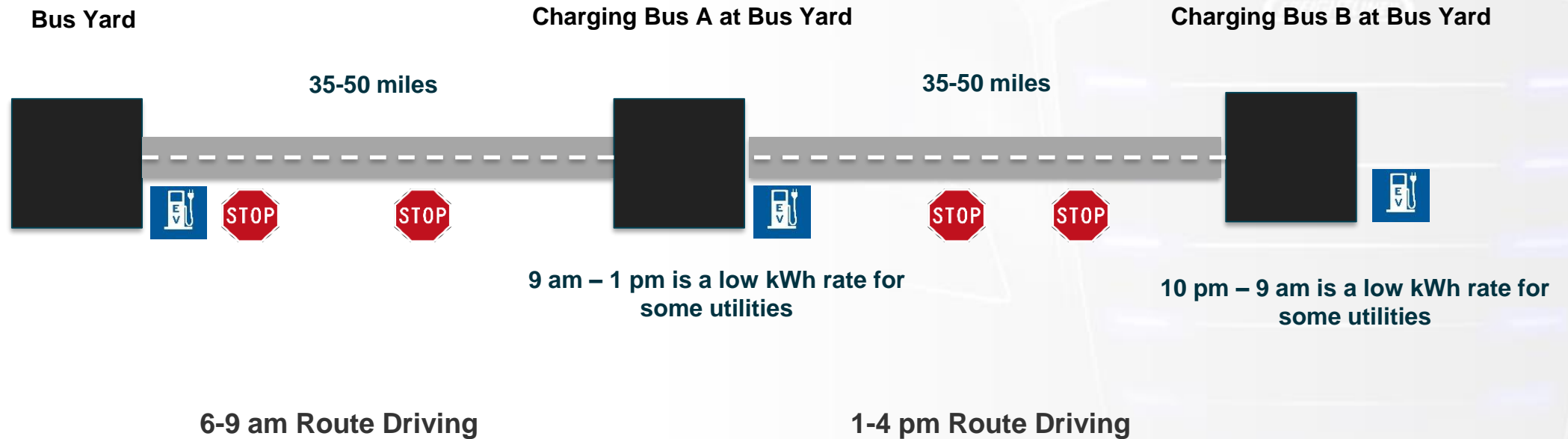
Ecosystem Support for School Buses





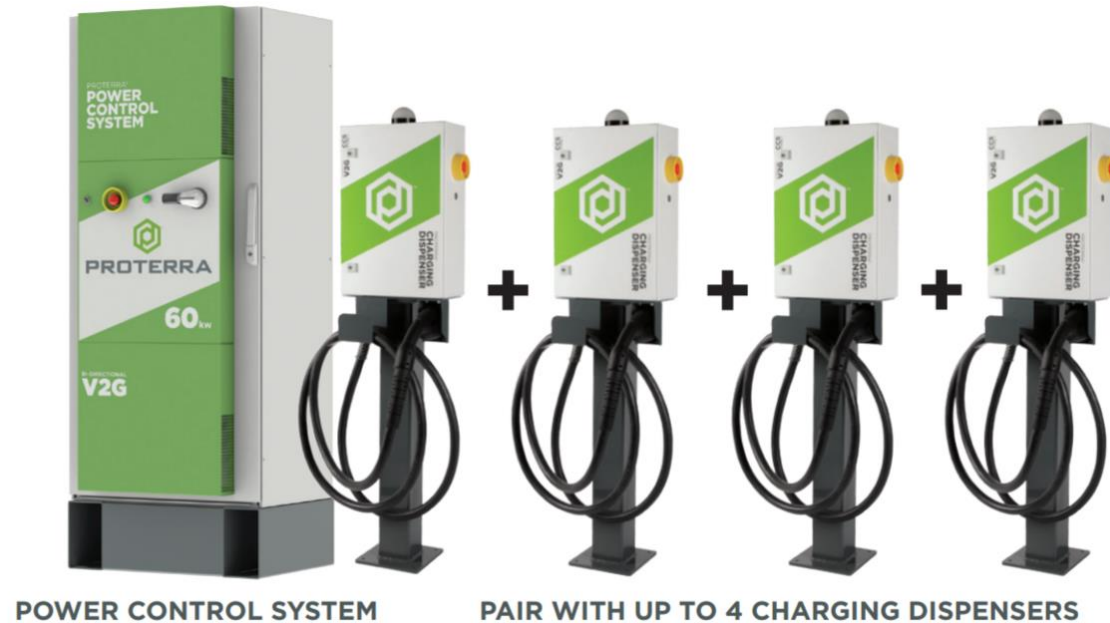
With the Saf-T-Liner C2 Jouley electric school bus, Proterra charging systems, and turn-key infrastructure installation, Thomas Built Buses and Proterra provide a **comprehensive solution** to electrify your school bus fleet.

Day in the Life of an Electric School Bus



SMARTER CHARGING FOR ELECTRIC SCHOOL BUSES

PROTERRA 60kW CHARGING SYSTEM



- **STANDARDIZED TECHNOLOGY**

Industry-standard charging technology seamlessly connects with your electric buses and other EVs.

- **FAST CHARGING**

DC charging enables a full charge in less than 3 hours. With additional dispensers, up to 4 buses can be charged in automated sequence in less than 12 hours.

- **VEHICLE TO GRID (V2G) CAPABLE**

Proterra's utility-preferred DC charging solution is optimized for bi-directional power flow, with inverters integrated into the charger rather than on the bus.

- **TURNKEY INFRASTRUCTURE**

Proterra offers turnkey installation of your charging infrastructure to simplify your transition to an electric fleet.



Open source
communications
protocol



Bi-directional
V2G capability



Smart grid ready

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.

PROTERRA SCHOOL BUS DC FAST CHARGER PRICING



Upgrades for Fleet Expansion

Price to upgrade 1 dispenser charging station to 2, 3 and 4 bus charging stations is \$12,500, \$18,000, and \$23,500 respectively. Price includes the Junction Box.

Optional Accessories:

-Pedestal Mount with cord rack
\$750

-Charge cord 18' with CCS1 plug
\$300

-Charge cord 25' with CCS1 plug
\$550

Proterra Charging Station Models	Power of the Power Control System	# of Dispensers	Pricing incl. shipping	Commissioning bus to charger
4 Dispenser Charging Station	60kW	4	\$66,000	\$3,400
3 Dispenser Charging Station	60kW	3	\$60,500	\$2,600
2 Dispenser Charging Station	60kW	2	\$55,000	\$1,800
1 Dispenser Charging Station	60kW	1	\$42,500	\$1,000



Greensboro Transit Authority, North Carolina

- Charges the Jouley school bus in around 3 hours with Proterra 60 kW Charging System
- Utilize **industry-standard** J1772-CCS Type 1 connectors
- Electric buses, utility vehicles and cars can share the same standardized chargers
- Power Control System can be installed up to 500 feet from dispenser for **space optimization**

Our experienced engineering and project management team works with you to design and implement the best infrastructure installation for your depot, managing the whole process from start to finish and providing a scalable, turnkey solution.

- **ONE STOP SHOP**
- **IN-HOUSE EXPERTISE**
- **CLEAN, RELIABLE ENERGY**
- **PURPOSE-BUILT CHARGING HARDWARE**



FIRST VW SETTLEMENT GRANT AWARDED IN THE COUNTY FOR AN ELECTRIC SCHOOL BUS PILOT WITH A VEHICLE TO GRID STUDY



- MICHIGAN VW Settlement Funding announced on 5/30/2019

- **Project Partners:**

- Ann Arbor School district
 - 4 Jouley buses and Proterra chargers
- Roseville School district
 - 2 Jouley buses and Proterra chargers
- DTE Energy
- Proterra
- Thomas Built Buses
- Hoekstra Transportation

VW Settlement Trust Administrators:



- **Project Scope:**

- 5 year Pilot Project
- Reduced emissions for students and community with zero emission school buses
- Cleaner, quieter pupil transportation
- School bus as a learning laboratory for STEM education in the classroom
- Vehicle to Grid discharge of energy back to the grid
- School Bus as a mobile energy source

Utility Partner:



THANK YOU



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