

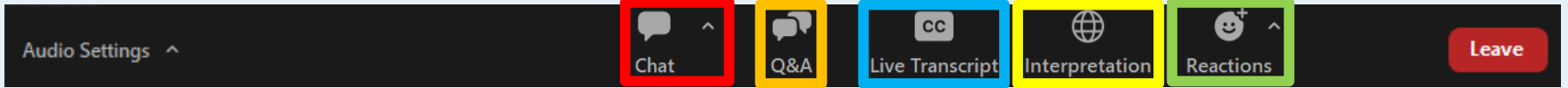


EPA CLEAN SCHOOL BUS

ESB Overview, Maintenance, and Procurement
June 18, 2024 @ 1 PM ET

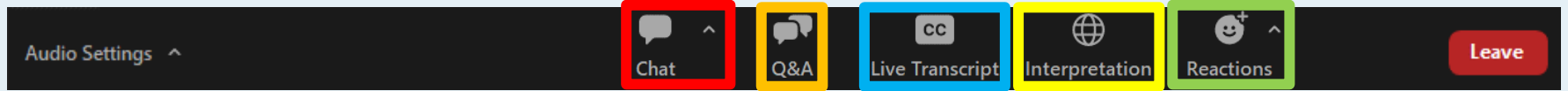
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Zoom Webinar Logistics



- **This presentation is being recorded.** The slides and recording will be posted to epa.gov/cleanschoolbus as soon as they are processed for posting.
- **All attendees are in listen-only mode.** Audio is available through your computer speakers or by phone. The presenter will ask you to come off mute if applicable.
- **Live transcription:** Live captioning is available by clicking the “Live Transcript” icon.
- **Live interpretation:** Live Spanish interpretation is available by clicking the “Interpretation” icon and selecting Spanish. Click “Mute Original Audio” to mute English audio when listening in Spanish.
- **Questions:** Use the Q&A feature to ask questions during the presentation. We will address as many as possible after the presentation. If we are unable to answer your question at this time, we will list all questions and answers in the Q&A document available on our website. You can also submit written questions to the EPA Clean School Bus Program helpline at cleanschoolbus@epa.gov.
- **Chat:** Chat is disabled, but the presenters might share links through the chat feature.
- **Reactions:** Reactions are enabled for you to interact with the presenter.

Logística de seminarios web en Zoom



- **Esta presentación es grabada.** Las diapositivas y la grabación se publicarán en epa.gov/cleanschoolbus tan pronto sean procesadas para su publicación.
- **Todos los asistentes se encuentran solo en modo escucha.** Hay audio disponible a través de los altoparlantes de su computadora o por teléfono. El presentador le pedirá que quite el silencio si corresponde.
- **Transcripción en vivo** Hay subtítulos disponibles haciendo clic en el icono “Live Transcript” [Transcripción en vivo].
- **Interpretación en vivo:** Hay interpretación en español disponible haciendo clic en el icono “Interpreting” [Interpretación] y seleccionando el español. Haga clic en “Mute Original Audio” [Silenciar audio original] para silenciar el audio en inglés al escuchar en español.
- **Preguntas:** Use la función Q&A [preguntas y respuestas] para hacer preguntas durante la presentación. Abordaremos todas las que sea posible después de la presentación. Si no podemos contestar su pregunta en este momento, anotaremos todas las preguntas y respuestas en el documento Q&A correspondiente disponible en nuestro sitio web. Puede también enviar preguntas por escrito a la línea directa de ayuda del Programa de Autobuses Escolares Limpios de la EPA en cleanschoolbus@epa.gov.
- **Chat** Se encuentra inhabilitado el chat, pero los presentadores podrían compartir enlaces a través de la función de chat.
- **Reacciones:** Las reacciones están habilitadas para que usted interactúe con el presentador.

Live Transcription / Transcripción simultánea

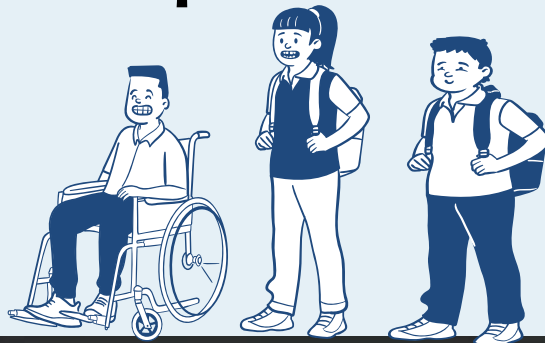


Live transcript is available

CC

Live Transcript

Live Spanish Interpretation / Interpretación simultánea



✓ Off

English

Spanish

Mute Original Audio



Interpretation

AGENDA

Overview of the Clean School Bus
(CSB) Program

CSB Technical Assistance Resources

ESB Overview, Maintenance, and
Procurement w/ JOET

Q&A

Next Steps and Resources

Overview of the Clean School Bus Program

Bipartisan Infrastructure Law

- Under **Title XI: Clean School Buses and Ferries**, the Bipartisan Infrastructure Law (BIL) provides **\$5 billion** over five years (FY22-26) for the replacement of existing school buses with zero-emission and clean school buses.

Future Funding Opportunities

- EPA has offered rebates and grants in past funding opportunities.
- EPA opened the CHDV grant program on April 24, 2024. Applications are due by July 25, 2024.
- EPA *anticipates* opening another round of CSB rebate funding in Fall 2024.



**EPA CLEAN
SCHOOL BUS**



Why Clean School Buses?



Reduced Greenhouse Gas Emissions

CSBs emit zero or low tailpipe emissions.



Cleaner Air

CSBs result in cleaner air on the bus, in bus loading areas, and in the communities in which they operate.




Cost Savings

Replacing older diesel school buses with CSBs often reduces maintenance and fuel costs.



Resiliency

Bidirectional charging capable CSBs can provide power to the grid or buildings during power shutdowns.



Improved Student Attendance & Achievement

The transport of students with CSBs has been linked to student attendance and academic achievement improvements.

CSB Program Technical Assistance Resources



Technical Assistance

- [Clean School Bus Technical Assistance](#)
- [Charging and Fueling Infrastructure Resources](#)
- [Clean School Bus Case Studies](#)
- **NEW** [Tax Credits](#)



Workforce Development

- [Bus Manufacturer Job Quality and Workforce Development Practices](#)
- [Workforce Development and Training Resources](#)



Educational Materials

- [Clean School Bus Reports to Congress](#)
- [Benefits of Clean School Buses](#)
- [Resources to Engage Your Community](#)

Technical Assistance Webinar Playlist



Clean School Bus: JOET - TA Overview & U...

- Introductions
- Technical assistance overview
- Utility interconnection
 - Utility infrastructure
 - Utility rates and solutions
- Working with your utility
 - How to talk with your utility
 - Electric School Bus (ESB) Charging Station Planning Form

Watch on  YouTube

9 2023-10-12 13:13:38

Technical Assistance via the Joint Office of Energy and Transportation



<https://www.epa.gov/cleanschoolbus/clean-school-bus-technical-assistance>



**EPA CLEAN
SCHOOL BUS**



Joint Office of
**Energy and
Transportation**

ESB Overview, Maintenance, and Procurement

Clean School Bus Program Webinar

June 18, 2024

driveelectric.gov

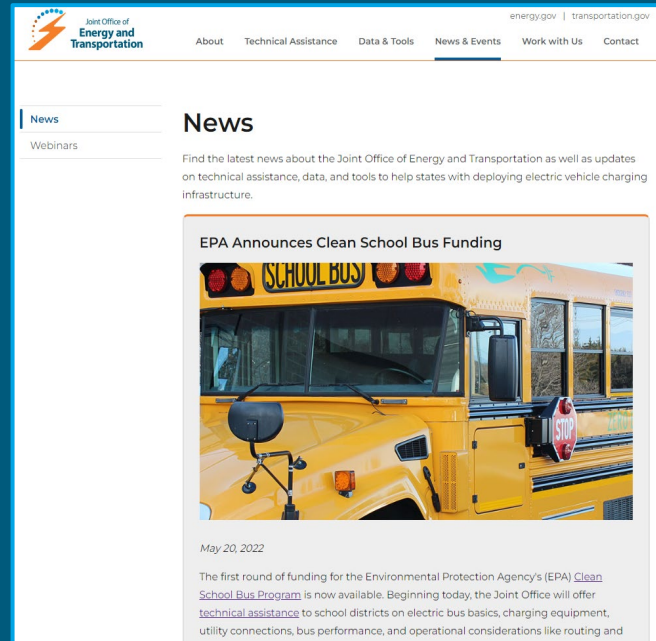
Electric School Bus (ESB) Technical Assistance

NREL and the Joint Office of Energy and Transportation (Joint Office) are partnering with the U.S. Environmental Protection Agency to offer **FREE** clean school bus technical assistance to school districts receiving funds or planning to apply.

Provides school districts with the knowledge, tools, and information needed to successfully plan for and deploy clean school buses.

Clean School Bus Technical Assistance

CleanSchoolBusTA@nrel.gov
driveelectric.gov/contact



Examples of How We Can Help

Coordinating
with electric
utilities

Identifying
available
funding and
incentives

Analyzing
charging
infrastructure
needs

Conducting
route analysis
and planning

Conducting
training and
workforce
development

Opportunities
for resiliency
(V2X)

Analyzing
energy needs
and grid
impact

Identifying
solar and
battery storage
opportunities

Electric School Bus Forum

- Online forum available to school bus operators
- Communicate with peers on all things pertaining to electric school buses

Joint Office of Energy and Transportation

Electric School Bus Forum

categories ▾ tags ▾ Latest Top + New Topic

Topic	Replies	Views	Activity
★ Welcome to Electric School Bus Forum! 🤖 ■ General	0	6	Mar 4

<https://electric-school-bus-forum.nrel.gov/>



Electric vs Conventional

- The main difference is the powertrain
- Bodies, chassis, interiors, driving experience are all very similar
- Select a model that meets existing safety regulations, size, and other requirements

ESB Benefits



Zero tailpipe emissions



Quieter



Less maintenance



Eliminate diesel fuel and engine oil



Utilize high voltage (HV) batteries for resilience or to lower peak demand from utilities

ESB Powertrain

Electric Motor

Converts electrical energy to mechanical energy

Should be maintenance free

No aftertreatment or diesel exhaust fluid (DEF)

High-Voltage Battery

Stores energy to run the motor

80 - 315 kilowatt-hour (kWh)

Understand State-of-Charge (SOC)

HV awareness is essential

Charging Port

Level 2 AC and/or DC Fast Charge

Level 2 AC compatible buses will have an on-board charger

Other components

Control units

Converters

Battery management system

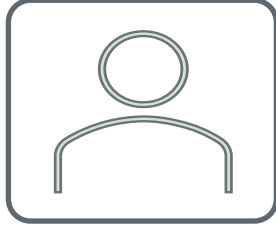
Thermal management system

Bus Range



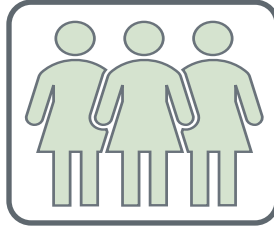
Duty Cycle

- Traffic, average speed, number of stops, terrain



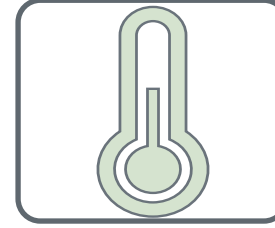
Driver Style

- Aggressive drivers will lower range



Bus Loading

- More weight/riders = less range



Ambient Temp.

- HVAC affects efficiency



Adverse Weather Conditions

- Snow and rain

- ESB Range Impacts

- Best Case
 - 60-70°F day
 - Little/no HVAC usage
 - Perform pre-trip while charging
 - Efficient regenerative braking capture (20%-30%)
 - These days you can experience at or within 10%-15% of OEM rated efficiency

- Worst Case
 - Extreme cold/heat
 - Forget to pre-condition while charging
 - Traffic/long stops
 - Poor regenerative braking/aggressive driving
 - These days MAY cause range to be reduced by 50%-60%

Regenerative Braking

The regenerative braking system will activate when the throttle pedal is released.

It works by slowing the bus to a stop.

Efficient driving can return 20-30% of the energy used on route back to the battery.

At full or high SOC charge regen will be disabled or limited.

Talk to your OEM about regen settings in your bus.

The system extends the life of the braking system components.

Air or hydraulic brakes are both options on ESBs.

Charging

J1772 AC Plug



J1772 AC Port



Level 2

- Shorter routes
- Long dwell times
- High demand rates

CCS DC Plug



DC Fast Charging

- Longer routes
- Minimal dwell time
- Time-of-use rates
- Extreme weather

CCS DC Port



ESB Charging Considerations

- Perform a route analysis and understand what size chargers fit your needs
 - [ESB Route Analysis Tool](#)
- Confirm that your bus offers the desired charging level
- Understand your buses max kW acceptance rate

ESB Maintenance

Electric motor and HV batteries should be maintenance free.

Monitor for cable issues and fluid leaks on a regular basis.

Maintenance intervals – air compressor, coolant system, power steering system, mounting hardware.

ESBs share most chassis and body components with conventional buses.

Confirm access to local ESB certified technicians with your dealer or manufacturer

Understand warranty coverage and include response and/or repair times in contract service level agreements



ESB Maintenance Pros and Cons

Pro	Con
No aftertreatment systems	Accelerated tire wear
No oil	Educational curve
Fewer moving components	Update some tools and personal protective equipment (PPE)
Ease of access to components	
Reduced use of braking system	
Reduced labor costs	
Reduced regular maintenance	

Recommended Training

- Component overview – HV battery, battery thermal management system (BTMS), air compressor, etc.
- PPE
- Lockout/Tagout procedures
- HV disconnect and measurement
- Preventive maintenance task and schedule
- Troubleshooting and diagnostic codes

Manufacturer Training



Resources

- [NFPA 70E](#) – Standard for Electrical Safety in the Workplace
- Automotive Service Excellence (ASE) xEV, [Level 1 & 2 xEV Standards and Certifications](#)
- SAE, [Course Catalog](#)
- [Axle Mobility](#) free online EV training for safety, electrical awareness
- Local technical colleges
- Clean Cities and Communities <https://cleancities.energy.gov/>

Electric School Bus Familiarization Webinar Series

Brought to you by:

- Joint Office
- NREL
- International Transportation Learning Center (ITLC)
- School bus manufacturers

- Four-part module-based series for operators, technicians, and other school bus fleet members.
- Learn fundamentals of electric school bus technology.
- Live Q&A during each session.
- Recordings with testing materials for internal training programs.



Register for ESB Familiarization Webinars

Register at:
driveelectric.gov/webinars



Webinar topics:

- Operator Overview (April 10, 2024)

- Electric School Bus Technology Overview
- High Voltage Safety Considerations
- Charging Considerations

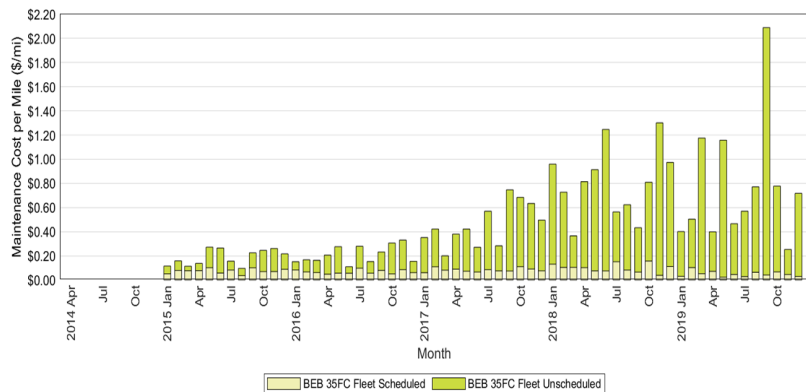
Technician Focused

Maintenance Costs

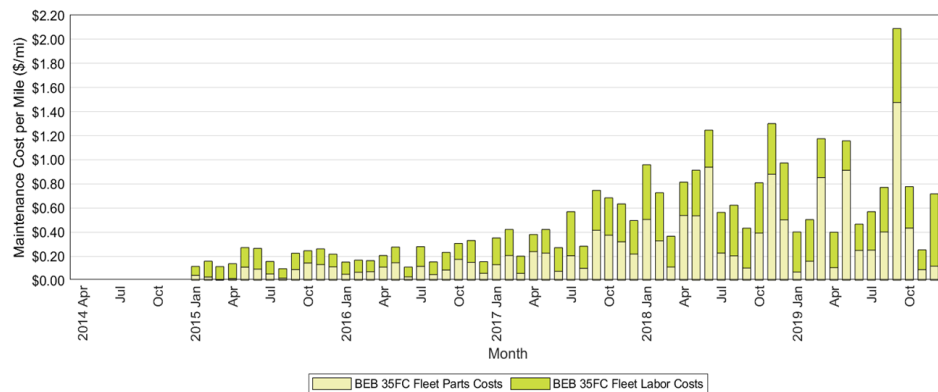
Foothill Transit BEB Progress Report

<https://www.nrel.gov/docs/fy20osti/75581.pdf>

Scheduled and Unscheduled Maintenance



Parts and Labor



- The Joint Office is planning a similar study on ESB maintenance costs
- Contact us at cleanschoolbusTA@nrel.gov if interested in participating

ESB Specifications

Battery Size/Range

- [Electric School Bus Route Analysis Tool](#)

Charging Method

HVAC Options

- Understand what options work best for you
- Use the [ESB Forum](#)

Maintenance and Support

- Require local service and SLAs

Warranties

- HV Battery, traction motors, other components

Training

- [ITLC - Training for ZEBs: Recommended RFP Language](#)



ESB Procurement Resources

[ESBI: ESB Price Tracker](#)

[ESBI: ESB and Charger Procurement RFP Template](#)

Specs/Search Tools

- [ESBI: US Buyers Guide](#)
- [AFDC Vehicle Search Tool: School Buses](#)
- [STN 2024 Buyers Guide](#)
- [CALSTART: ZETI Tool](#)

Cooperative Purchasing

- [Climate Mayors Purchasing Collaborative](#)
- [Sourcewell: School Buses](#)

ESB Procurement



Your chargers must be installed before your buses arrive.



Talk to your utility early and understand any required upgrades.



Understand your complete costs for infrastructure before committing to bus procurement.



Ensure your bus and charger models are compatible.



Understand who will maintain your buses.

General Best Practices/Advice

Don't be afraid to start a pilot

Take advantage of unprecedented funding

Size your bus batteries to fit your routes

[ESB Route Analysis Tool](#)

Join the ESB Forum and connect with peers

<https://electric-school-bus-forum.nrel.gov/>

Reach out to cleanschoolbusTA@nrel.gov





Joint Office of
**Energy and
Transportation**

Thank you

June 18, 2024

CleanSchoolBusTA@nrel.gov

driveelectric.gov

Question & Answer Session



Upvote and comment on questions similar to your own.
Type your full thought so we can follow-up with an answer.
Speak slowly and clearly for the captioner/interpreter.

cleanschoolbus@epa.gov

epa.gov/cleanschoolbus

Upcoming JOET TA Webinars

July 24, 2024	Battery Overview, Recycling/End-of-Life Options, and Warranties
August 28, 2024	Building a Case For ESBs in your Fleet including Benefits, Total Cost Of Ownership (TCO), and Emissions Calculators
September 25, 2024	Electrification Process including a Step-by-Step Guide for New Adopters



To view the most up-to-date list of CSB webinars and register, please visit:
www.epa.gov/cleanschoolbus/events-related-clean-school-bus-program



**EPA CLEAN
SCHOOL BUS**

Clean Bus Planning Awards (CBPA) Program

- In addition to the free technical assistance provided by NREL for CSB applicants and selectees, **the \$5M Clean Bus Planning Awards Program provides FREE technical assistance** to create comprehensive and customized bus electrification plans for fleets across the United States.
- **Applications for assistance are open on a rolling basis through Sept. 30, 2024**, giving fleets an opportunity to fully understand their needs before applying for support. **This new program will reduce the burden of electrification by helping fleet managers create a step-by-step plan to transition their bus fleet.**
- Learn more at <https://driveelectric.gov/clean-bus-planning-awards> and <https://www.nrel.gov/news/program/2024/clean-bus-planning-awards-support-fleet-electrification-with-custom-transition-plans.html>

Current Funding Opportunities

- EPA has begun announcing 2023 Rebate selections.
- Applications for the CHDV grant program are due by July 25, 2024, at 11:59 PM ET.

Future Funding Opportunities

- EPA encourages school districts to consider which competition structure (grants or rebates) best suits their needs.
- EPA *anticipates* opening another round of CSB rebate funding in Fall 2024.

Resources

- The Joint Office of Energy and Transportation (cleanschoolbusTA@nrel.gov)
- The CSB helpline (cleanschoolbus@epa.gov)

35

Stay in Touch

- Learn more about the EPA Clean School Bus Program at epa.gov/cleanschoolbus
 - Learn more about the JOET Clean Bus Planning Awards Program at driveelectric.gov/clean-bus-planning-awards
 - Sign up for the CSB listserv at <https://lp.constantcontactpages.com/su/dgrhRed/cleanschoolbus>
-



**EPA CLEAN
SCHOOL BUS**

cleanschoolbus@epa.gov
epa.gov/cleanschoolbus