Power A Clean Future Ohio
LOCAL COMMUNITIES LEADING THE WAY

INFRASTRUCTURE GRANT ASSISTANCE PROGRAM

Electric and Clean School Bus Infrastructure
Hosted by the EPA and Joint Office of Energy and Transportation
June 22, 2022 at 1:00PM ET

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Clean School Bus Rebate Program

Overview of the Bipartisan Infrastructure Law Clean School Bus Program

- 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 clean school buses and zero-emission school buses.
- These new clean school bus replacements will produce either zero or low tailpipe emissions compared to their older diesel predecessors.
- School bus upgrades funded under this program will result in cleaner air on the bus, in bus loading areas, and in the communities in which they operate.
- The first funding opportunity under this program is the 2022 Clean School Bus Rebates.

Funding Pools and Number of Applications

- School districts applying directly for funds may only submit one application to replace up to 25 buses.
- EPA will not fund multiple applications for bus replacements that will serve the same school district.
- The application deadline is August 19, 2022

$500 Million in Available Funding for 2022 CSB Rebates	
Zero Emission Funding Pool:	Clean School Bus Funding Pool:
Applications **exclusively requesting zero-emission** buses	Applications requesting **zero-emission, propane, and/or compressed natural gas (CNG)** buses

School Bus Replacement Funding

- The maximum rebate amount per bus is dependent on:

    - Bus Fuel Type
    - Bus Size
    - Whether the school district servedby the buses meets one or more prioritization criteria
- The table (below) displays maximum funding levels. EPA will not disburse rebate funds in excess of the actual cost of the replacement bus and any costs above the maximum funding level are the sole responsibility of the applicant/awardee
    - If the bus costs more than the amount awarded, the awardee must cover the remaining costs
    - Training and shipment of bus can be covered with award funds

Maximum Bus Funding Amount per Replacement School Bus

School District Prioritization Status	Replacement Bus Fuel Type and Size					
	ZE – Class 7+	ZE – Class 3-6	CNG – Class 7+	CNG – Class 3-6	Propane – Class 7+	Propane – Class 3-6
Buses serving school districts that meet one or more prioritization criteria	$375,000	$285,000	$45,000	$30,000	$30,000	$25,000
Buses serving other eligible school districts	$250,000	$190,000	$30,000	$20,000	$20,000	$15,000

https://www.epa.gov/cleanschoolbus/school-bus-rebates-clean-school-bus-program

Infrastructure Funding

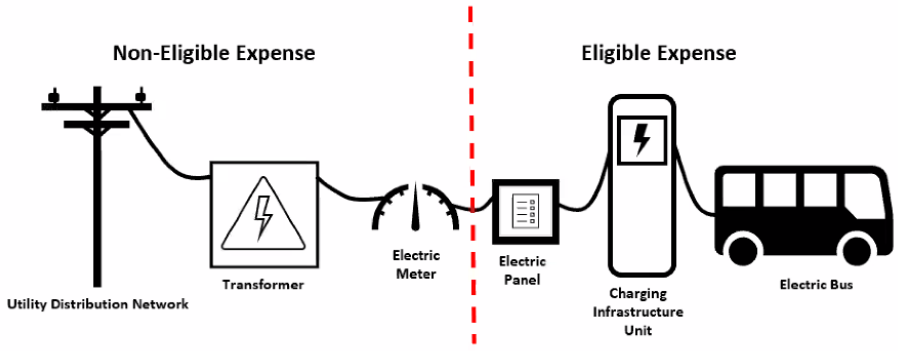
- Talk to your utility now if you are interested in zero-emission, electric buses!

School District Prioritization Status	ZE, Electric – Class 3+ Infrastructure Funding
Buses serving school districts that meet one or more prioritization criteria	$20,000/bus
Buses serving other eligible school districts	$13,000/bus

This table displays the maximum funding levels per ZE, electric bus. EPA will not disburse rebate funds in excess of the actual infrastructure costs.

Infrastructure Funding Restrictions

- EPA funding for infrastructure is limited to the fleet's side of the meter (as shown on the right side of the diagram).
- All Level 2 charging infrastructure purchased under this program must be EPA ENERGY STAR certified chargers
    - EPA strongly recommends that all other charging infrastructure (for example DC Fast-Charge) purchased under this program be listed by a Nationally Recognized Testing Laboratory (NRTL)



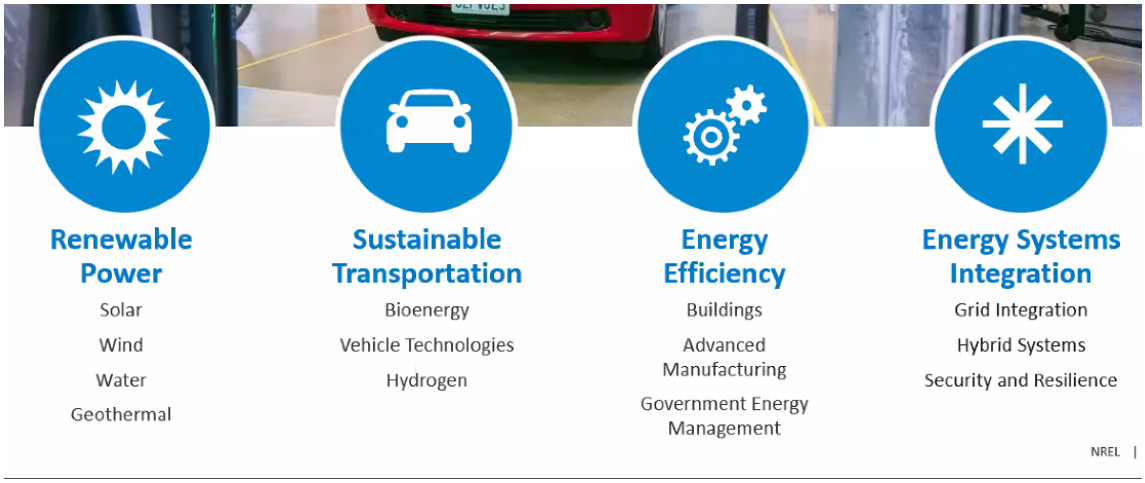
2022 Clean School Bus Rebates

- Sign up for the Clean School Bus Listserv and continue to check www.epa.gov/cleanschoolbus for updated resources and information on additional webinars
- After reviewing the Program Guide, if you still have questions, please contact cleanschoolbus@epa.gov. Questions will be incorporated in an upcoming Q&A document.
- The application deadline is August 19, 2022

Alternative Fueling Infrastructure - National Renewable Energy Laboratory

- Presentations by Jesse Bennett, Abby Brown, John Gonzales, and Lauren Lynch

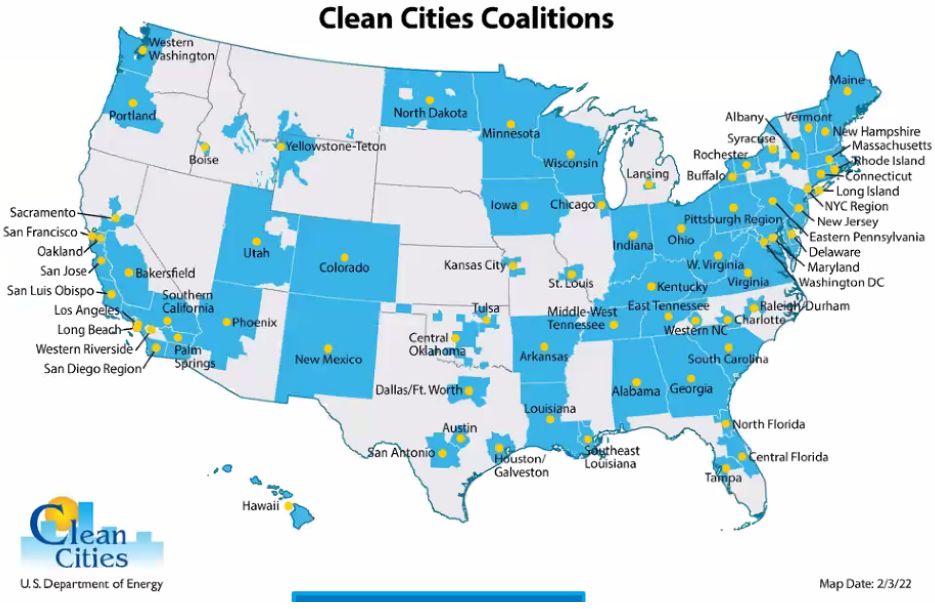
NREL Science Drives Innovation



National Network of Clean Cities Coalitions

https://cleancities.energy.gov/

- More than 75 active coalitions covering nearly every state with more than 20,000 stakeholders
    - Clean Cities is a coordinated group of over 75 coalition groups to support cities in adopting low carbon transportation options
    - Coalition directors serve as education and implementation partners

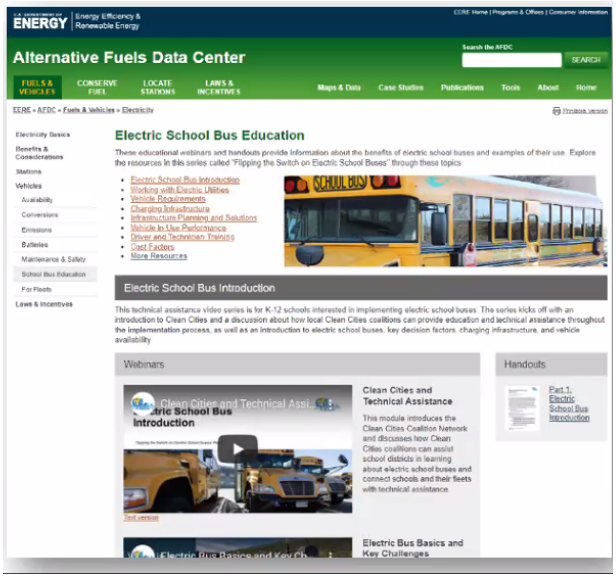


Alternative Fuels Data Center (AFDC)
https://afdc.energy.gov/

- The AFDC is the information source for alternative fuels and advanced vehicles
    - Extensive catalog of resources for a wide variety of alternative fuels

Electric School Bus Education
https://afdc.energy.gov/vehicles/electric_school_buses.html

- "Flipping the Switch on Electric School Buses": This technical assistance video series is for K-12 schools interested in implementing electric school buses
    - Users can watch the videos in order, or pick the topics most interesting or relevant
    - This resource is an 8 part series consisting of videos and handouts to assist school bus fleet managers



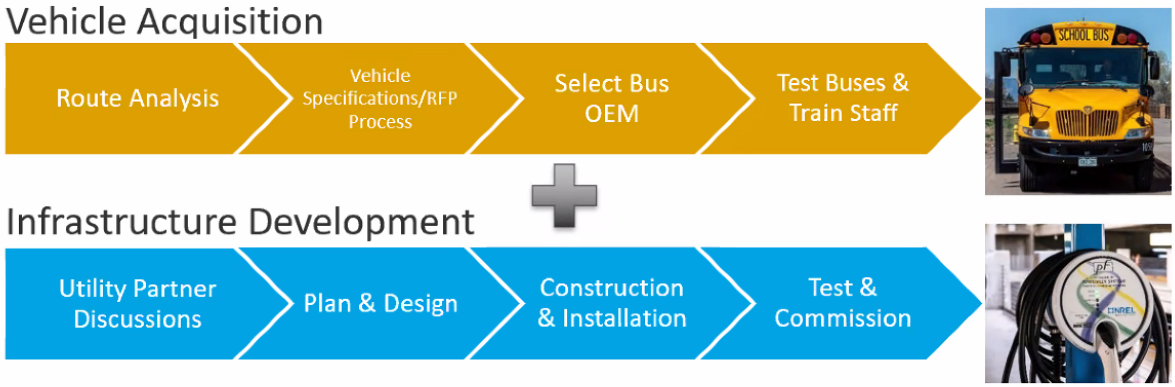
Electric School Bus Technical Assistance

- Clean School Bus Technical Assistance: NREL and the Joint Office of Energy and Transportation are partnering with the EPA to offer clean school bus technical assistance to school districts
- Contact:
    - Email: CleanSchoolBusTA@nrel.gov

- driveelectric.gov/contact

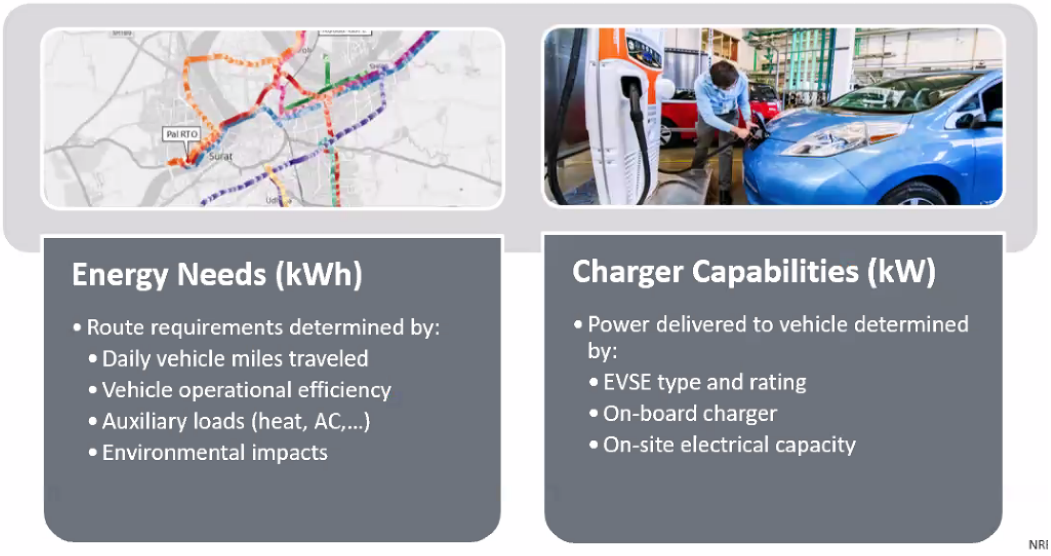
Electric Vehicle Infrastructure Overview

Battery Electric Bus (BEB) Procurement and Infrastructure



- Vehicle acquisition and infrastructure development should be done in tandem when fleet managers are planning a transition to electric vehicles

Energy vs. Power



- Energy needs: Determined by how far it must travel and its operational efficiency
  - How much energy must be recharged at the end of the day to complete the route?
  - This defines the demand side
- Charger capabilities: Determined by how much power can be provided through the charger
  - The greater the power capability of the charger, the less time it will take to charge
  - This defines the supply size

Route Requirements

- Recommend route analysis to quantify the energy needs and power requirements
- In most cases, NREL has found that school buses are a good fit for electrification because:
    - Routes are predictable and consistent
    - Planned downtime
    - Benefit from power technologies like regenerative braking

Power Requirements

- A number of factors contribute to an analysis of power requirements, including:
    - Number of electric buses
    - Average heating & cooling load
    - Average daily miles traveled
    - Number of chargers
    - Dwell time
    - Time needed to fully charge
    - Supplemental charging
    - Future plans for adding to fleet

EV Charger = Electric Vehicle Supply Equipment (EVSE)

- Three types of EVSE:
    - AC Level 1: Portable 120V
    - AC Level 2: 208-240V
    - DC Fast Charging: 50-1,000V
- Electric grid provides electricity in AC power
    - Vehicles store energy in DC power
- AC charging uses the vehicles onboard technology to convert to DC
    - Generally less expensive, but provides less power
- DC charging uses technology in the charging unit to convert to DC
    - Not all buses are DC fast charging capable, so it's important to match buses with the appropriate charging technology

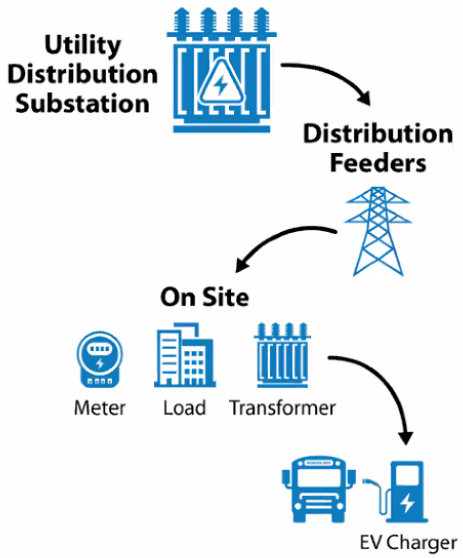
EVSE Unit Costs

- Many factors impact the EVSE unit cost per charger (port)

EVSE	Features	Chargers/Unit	Cost/Charger
Level 1	Non-networked	1	$813
Level 1	Non-networked	2	$596
Level 2	Non-networked max 19.2 kW	1	$1,182
Level 2	Non-networked max 19.2 kW	2	$938
Level 2	Networked max 19.2 kW	1	$3,127
Level 2	Networked max 19.2 kW	2	$2,793
DCFC	Networked 50 kW	1	$28,401
DCFC	Networked 150 kW	1	$75,000
DCFC	Networked 350 kW	1	$140,000

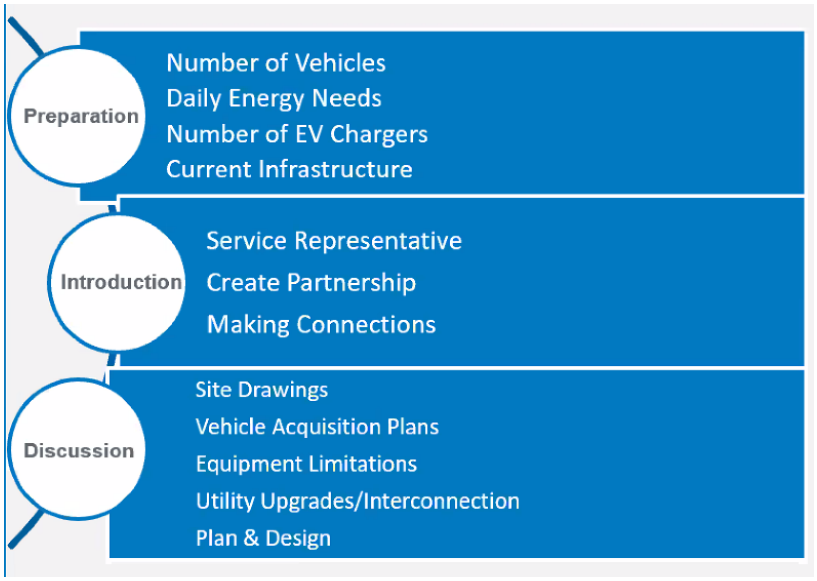
- Level 1 units are similarly priced to Level 2 but provide much less power
- Dual-port units are a more economical unit cost per charger
- Network features more than double the cost
- DCFC provide much more power at a much higher cost than Level 2

Power Distribution System



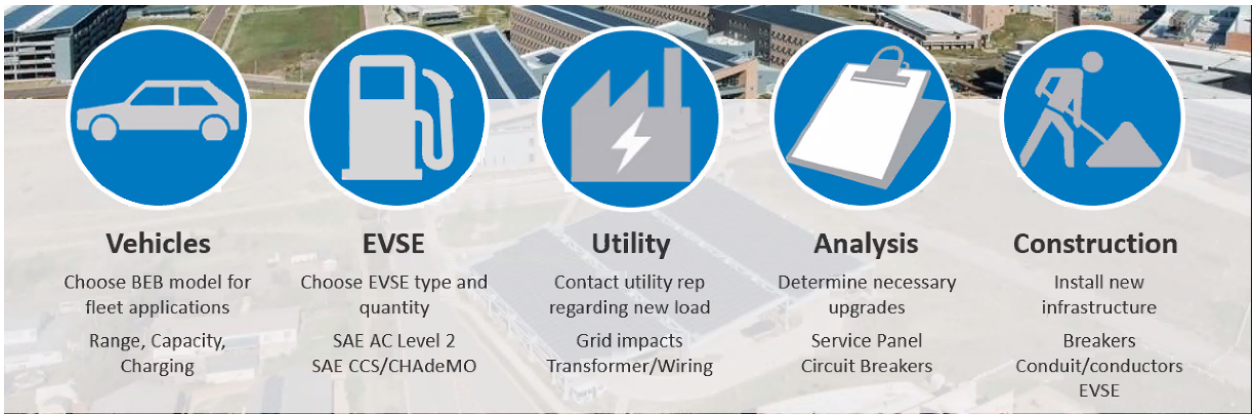
- Equipment upstream of the charger may need to be upgraded to meet the power requirements of the charger
- This is why it's critical to coordinate with your local utility

Working with Your Utility Partner



Electric Vehicle Infrastructure - Deployment Planning

Implementation Plan for BEB Infrastructure



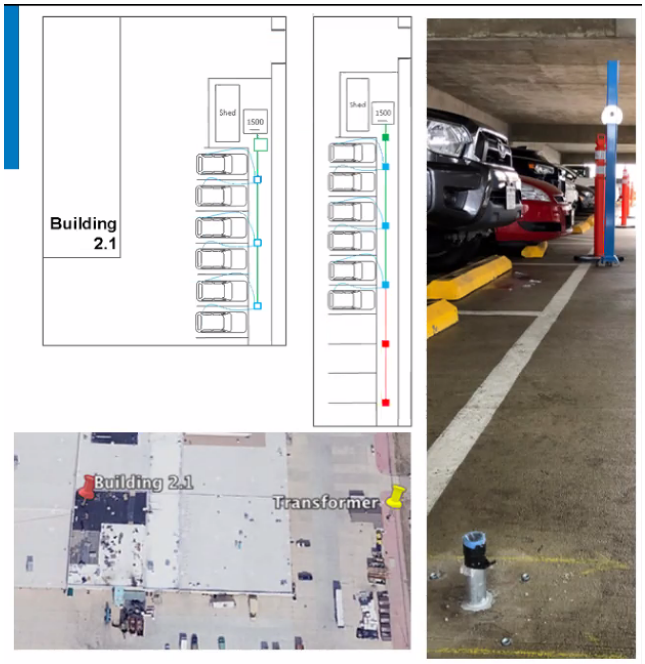
- Upgrades to your buildings or the local electricity infrastructure may be required

Grid and Facility Considerations

- Site Equipment:
    - Circuit Breaker
        - Breaker rating 125% of EVSE current per NEC 625
    - Panel Capacity
        - Space breaker positions must be available
    - Main Breaker
        - Must be sized for all loads in the service panel
    - Transformer Capacity
        - Utility transformer must support total peak demand
- EVSE Requirements

- J1772 AC Level 2
  - Double pole 100A Breaker
  - Up to 19 kW (208-240 V-AC)
- J1772 DC CCS
  - 480V three--phase power
  - 50-350 kW (50-1,000V-DC)

Site Layout



- Determine locations of:
  - Parking, panel, interconnection
- Minimize panel to EVSE distance:
  - Shorter wiring and conduit run
  - Reduce trenching costs (~$100/ft)
- Consider future expansion:
  - Install additional wiring/conduit
  - Stub-outs for future expansion
  - Minimize construction costs over time
- To make material and labor cost more efficient, minimize the panel to EVSE distance and plan for future expansion

EVSE Installation Costs

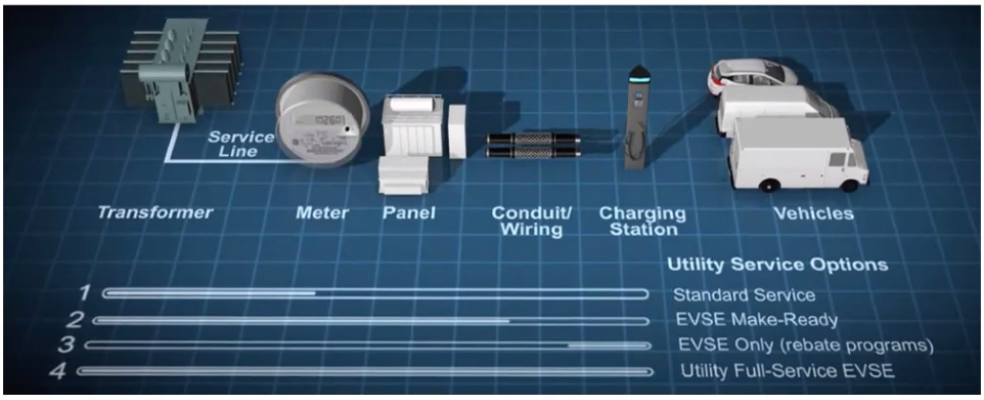
- Installation costs are primarily dependent on EVSE type and power
- L2 pedestal units are common for fleets with a long dwell (8+ hours)
- Installation costs per port decrease as EVSE installations per site increase

	1 Port/Site	2 Port/Site	3-5 Port/Site	6+ Port/Site
Labor	$1,544	$1,827	$1,647	$1,316
Materials	$1,112	$1,039	$1,272	$874
Permit	$82	$62	$59	$38
Tax	$96	$89	$110	$75
Total	**$2,836**	**$3,020**	**$3,090**	**$2,305**

- As you increase the number of ports, the per port installation costs decrease

Grid and Facility Considerations

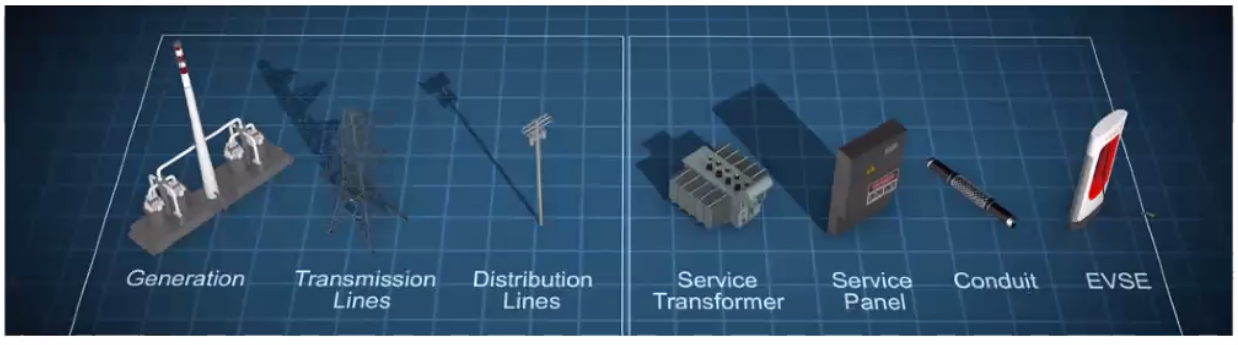
- Utilities are beginning to offer customers new and innovative service options to meet the energy needs of electric vehicles
- These different programs (displayed below) can help support the installation of EVSE through infrastructure development or financial support



- Utility Full-Service EVSE is essentially charging as a service

- The electric utility company is most interested in building the grid instructure needed to supply to energy of your new EVSE will require

- Grid Upgrade Considerations (left)
  - New Service Line
  - New Interconnection
  - Distribution Transformer Upgrade
- Facility Upgrade Considerations (right)
  - Additional Branch Circuits
  - Service Panel or Main Breaker Upgrade
  - Distribution Transformer Upgrade



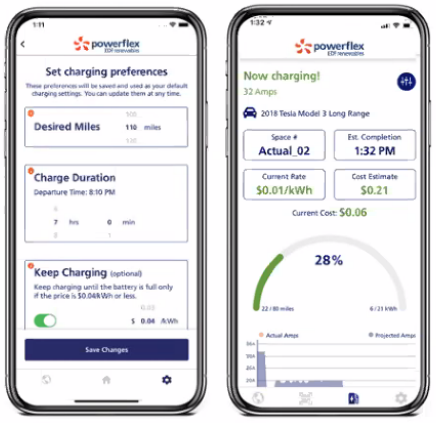
- Depending on the existing power infrastructure and the charging demand, upgrades may need to be made further to the left of the image

Managed Charging Solutions

- How to mitigate equipment upgrades and reduce the cost to charge
    - Equipment upgrade mitigation
        - Set a power ceiling for site-wide EVSE and coordinate charging to reduce equipment upgrades
    - Reduce electricity costs
        - Shift EV charging to periods with lower TOU rates
        - Coordinate EV charging loads to reduce peak demand
- Power ceiling features can help you avoid overburdening the distribution transformer or other equipment

NREL Managed Charging Solution - Case Study

- Challenges to the NREL garage workplace and fleet charging installations:
    - 108 Level 2 EVSE with total charging capacity of 720 kW
    - Total EVSE power exceeds transformer capacity
    - Charging peak could increase demand charges
- Managed charging solution:
    - Drivers input desired mileage and dwell
    - Energy need and charging duration calculated
    - Monitor building loads and PV generation
    - Shift charging away from net building peak



Propane & Natural Gas Infrastructure

What is Natural Gas: Natural Gas Properties

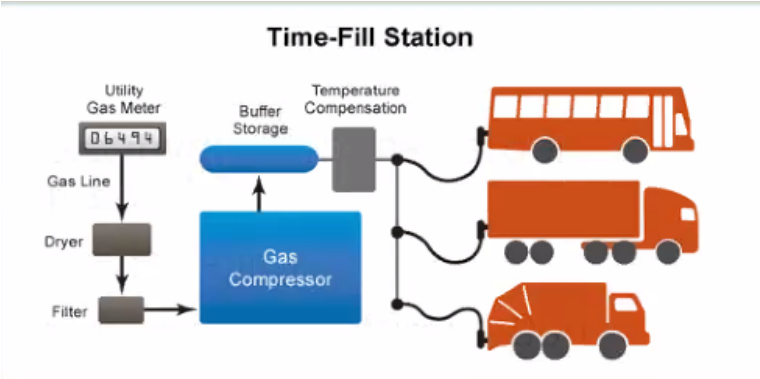
- Mixture of hydrocarbons, largely methane (CH4)
- High octane rating
- High ignition temperature: 1000-1100F
- Available as Compressed Natural Gas (CNG) and LNG
    - CNG is the most common type used by buses

- RNG is essentially biogas processed to purity standards, like conventional natural gas

Infrastructure: CNG Fueling

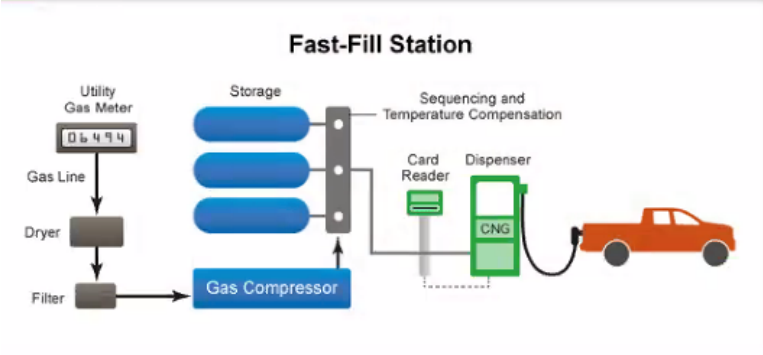
Time-Fill Station

- Good for centrally based fleets with consistent schedules
- CNG is dispensed slowly, often overnight
- Lower cost investment
- Best for fleets that return to a central lot with regularly scheduled downtime



Fast-Fill Station

- Fueling in minutes
- Necessary for public access
- Good for vehicles with little downtime
- Fast-Fill Station: Better for vehicles with little or unpredictable downtown



- Stations can also have combo-fill capabilities

https://afdc.energy.gov/fuels/natural_gas_cng_stations.html

CNG Station Cost

Size	Approx. Fuel Use	Cost*
Small Station	100–200 gge/day	Fast-fill: **$450K–$600K** (15–25 delivery vans) Time-fill: **$250K–$500K** (5–10 refuse trucks; 10–20 school buses)
Medium Station	500–800 gge/day	Fast-fill: **$750K–$900K** (50–80 light/medium duty vehicles) Time-fill: **$550K–$850K** (25–40 refuse trucks; 50–80 school buses)
Large Station	1,500–2,000 gge/day	Fast-fill: **$1.2M–$1.5M**

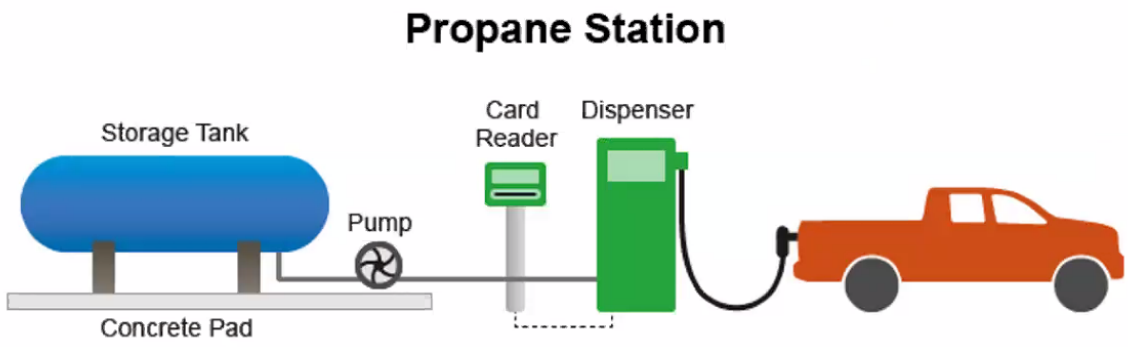
- CNG stations should be designed for modularity to expand as the fleet expands

https://afdc.energy.gov/files/u/publication/cng_infrastructure_costs.pdf

What is Propane: Propane Properties

- Also known as:
  - LPG
  - Propane Autogas
- Three-carbon alkane gas (C3H8)
- Colorless, odorless, non-toxic
- Stored at about 150 psi as a liquid
- Renewable propane is a non-fossil fuel that is produced from 100% renewable raw materials

Infrastructure: Propane Fueling



Propane Station Costs

- Daily fuel use can vary substantially; refills are scheduled to meet station needs
- https://afdc.energy.gov/files/u/publication/propane_costs.pdf

Tank (gal.)	Approx. Fuel Use*	Cost
Small 1,000	100–400 gal/day	**$45K–$60K** (Leasing Initial Cost: $3K-$10K)
Medium 18,000	900–2,400 gal/day	**$150K–$220K** (Leasing Initial Cost $15K-$50K)
Large 30,000	900–3,000 gal/day	**$225K–$300K** (Leasing Initial Cost: $15K-$50K)

- Many school districts start with small stations and expand as the fleet transitions

Useful Links

- Clean Cities: cleancities.energy.gov
- Alternative Fuels Data Center: afdc.energy.gov
- "Flipping the Switch" Educational Series: afdc.energy.gov/electric-school-buses
- Clean School Bus Technical Assistance: DriveElectric.gov/bus
    - CleanSchoolBusTA@nrel.gov

Questions & Answer

Program Eligibility

- Are you seeing scenarios when school systems work with private bus contractors to secure new buses and charging stations?
    - Yes. School districts can enter into a contractual arrangement with a private fleet that owns and operates buses to replace buses that serve a public school district.
- Electric buses have to stay with the district for 5 years. if a school district's electric buses are in a third-party's fleet, but the district decides to go with a second third party for a new contract, what happens to the ebus in the first third-party's fleet?
    - If the replacement school bus fails to meet the requirements the program requirements (i.g. serve the school district listed on the application for at least five years), the selectee may be required to return up to the full amount of the rebate award to EPA. The amount required to be returned is at the discretion of EPA and will be determined on a case-by-case basis.
- if an application is selected and alloted funding to purchase x buses, could the applicant choose to actually purchase fewer buses? or does the applicant have to purchase all of the buses to get any funding?
    - Yes. If the bus and eligible charging infrastructure costs are lower than the amount of funds EPA has reserved for the selectee, EPA will reduce the rebate funding amount to the actual costs. EPA will also lower the funding amount if the replacement bus size falls into a lower funding tier.

- If you don't have the Old Bus information at time of submission can it be submitted after you've been selected?
    - The old bus information needs to be submitted with the application. Information that needs to be included for each old bus is VIN, manufacturer, model, model year, average annual mileage, average annual fuel consumption, fuel type, GVWR and you need to attach the title and registration (if required in your state).
- After grants are submitted, what is the timing to know if the school district is awarded the funds? Bus order? Bus delivery to school? Also, are buses available in stock, or will it be years like the delay in EVs?
    - I assume your referring to the rebate program. For the rebate program, EPA anticipates notifying applicants of their selection status within approximately 60 days of the application deadline.
    - Applicants need to submit a purchase order and request for payment within 6 months of notification of selection.
    - Selectees must submit an online Close Out Form demonstrating that they have received their new buses and eligible charging infrastructure and have replaced their old buses. The Close Out Form must be submitted within two years of the date of the selection notification
- Can entities other than school districts apply? We are a federally funded Head Start program that transports 90% of our students. Do we qualify?
    - Unfortunately, Head Start is not an eligible applicant.
- We cannot apply for infrastructure funding until we know if we have been awarded a Clean School Bus Rebate? Correct?
    - If you are applying for electric school buses, we will add the infrastructure funding to the total funding available when we send you the selection letter. Please refer to the Program Guide (page 6) for details.
- Can the rebate be applied to the site preparation and installation of distributed solar installed on school campus to recharge BEB?
    - EPA funding for infrastructure is limited to installations between the electrical meter and the charging port.
    - This can include, but is not limited to, charging equipment (such as AC Level 2 charging equipment or direct-current fast charging equipment), design and engineering, and installation costs such as trenching, wiring and electrical upgrades, labor, and permitting. EPA funds must not be used for any infrastructure costs associated with work on the utility's side of the electrical meter.

Electric Vehicle Infrastructure

- In our area it takes a significant amount of time to get the local utility to set up an electric bus charging station. Meanwhile - electric buses must be recharged. The school district has found an interim solution in a Fuel Cell (FC) based Refueling station that is available from Toyota and Kohler. The electric buses will plug into the FC recharger and be put on routes in disadvantaged communities within a year. Can this EPA program fund this FC recharging station?

    - EPA funding for infrastructure is limited to installations between the electrical meter and the charging port. This can include, but is not limited to, charging equipment (such as AC Level 2 charging equipment or direct-current fast charging equipment), design and engineering, and installation costs such as trenching, wiring and electrical upgrades, labor, and permitting. EPA funds must not be used for any infrastructure costs associated with work on the utility's side of the electrical meter.
- We are a school district with a contractor doing the transportation. We will be looking into setting up the charging station. I have contacted Con Edison because we are on a PRIVATE road. they have not gotten back to me.. if i am correct this is the 1st step in the planning
    - Correct, speaking with your utility is a key first step. If you are having trouble connecting with your utility, your local Clean Cities coalition may be able to help. Please also contact CleanSchoolBusTA@nrel.gov and we would be happy to assist with an introduction to your coalition if you do not already have a relationship.
- Is there a certain point where a higher power charger won't get you a faster charge? Also, don't higher power chargers damage the battery faster than a level 2 charger?
    - The level of charging power a vehicle will receive is dependent on both the BEB and EVSE capabilities. These capabilities will vary by BEB and EVSE manufacturers. It should also be noted that some BEBs are unable to use AC charging and must use DC fast charging.
- Limited in power and in range? How many miles can an electric bus travel at one time?
    - This depends on many factors, including the range of the bus and the route/duty cycle. See the Flipping the Switch series for some more detailed explanations on this topics (specifically, the charging infrastructure and vehicle requirements modules: https://afdc.energy.gov/vehicles/electric_school_buses.html)
- Sometimes dual port DCFC is a CCS and a CHaDeMo, so 2 CCS or 2 CHaDeMo cars can't both charge at the same time. another layer of complexity
    - Correct, typically dual port DC fast charging infrastructure can only charge one vehicle at a time.
- And if it's not enough, how expensive is it typically to get your electrical provider to increase that power?
    - The two key limitations that should be considered are the service panel capabilities at your site, as well as the spare capacity remaining in the utility service and transformer. You will need to ensure existing service panels have capacity for the circuit breakers the EVSE will require and if the power (in kW) can be supported by the utility service. If there is insufficient capacity, your site may require equipment upgrades. Additional details can be found here: afdc.energy.gov/electric-school-buses
- Aren't energy demand for a vehicle similar between an EV bus and other fueled bus? (e.g., diesel consumption would increase if an aggressive driver, lots of stops, bad weather, route design and length (e.g., road grade), etc.?) It seems the big issue is the infrastructure like charger choices, demand needs to utility and involving utility in the

whole process? BTW great explanations Lauren of some of the more complicated logistical concepts (and why AC is cheaper but slower than DC).
    - That is correct, energy demands impact the fuel efficiency regardless of the fuel type! It is best to engage with the utility throughout the entire process. There may be limitations from the utility (such as supply chain issues) that may impact your infrastructure plans. There are some organizations that may be able to assist with engagement, such as DOE Clean Cities Coalitions.
- Any special consideration for V2G?
    - Yes, there certainly are! We did not cover today, as it's meant to be an introductory webinar. That said, we do cover this in the Flipping the Switch series: https://afdc.energy.gov/vehicles/electric_school_buses.html. See the infrastructure planning and solutions section videos