

Roadmap to 100



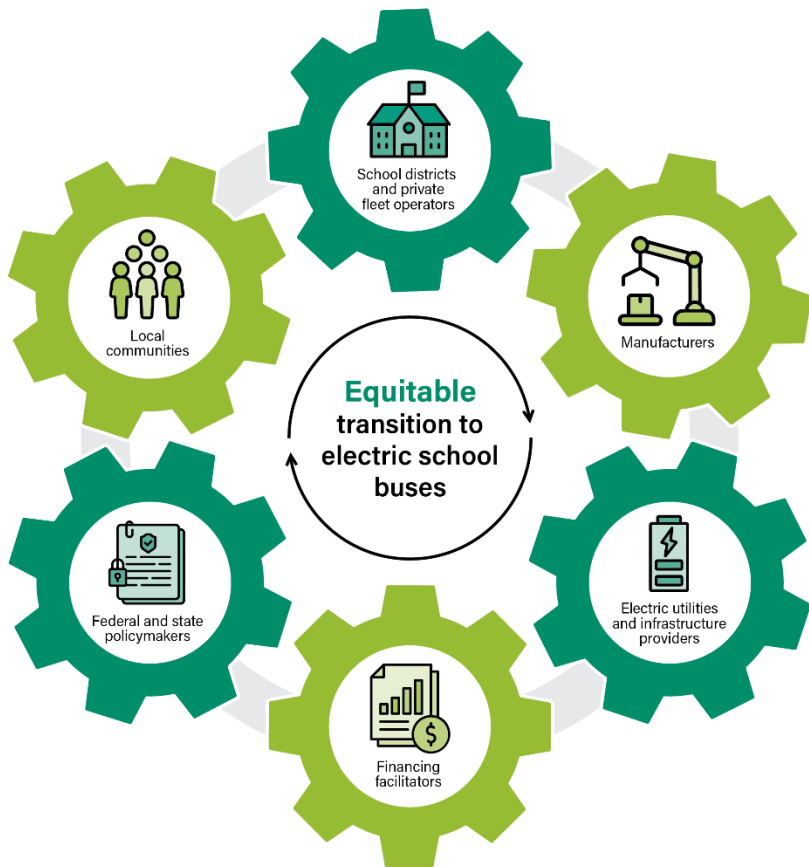
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INSTITUTE

Electric
School Bus

INITIATIVE

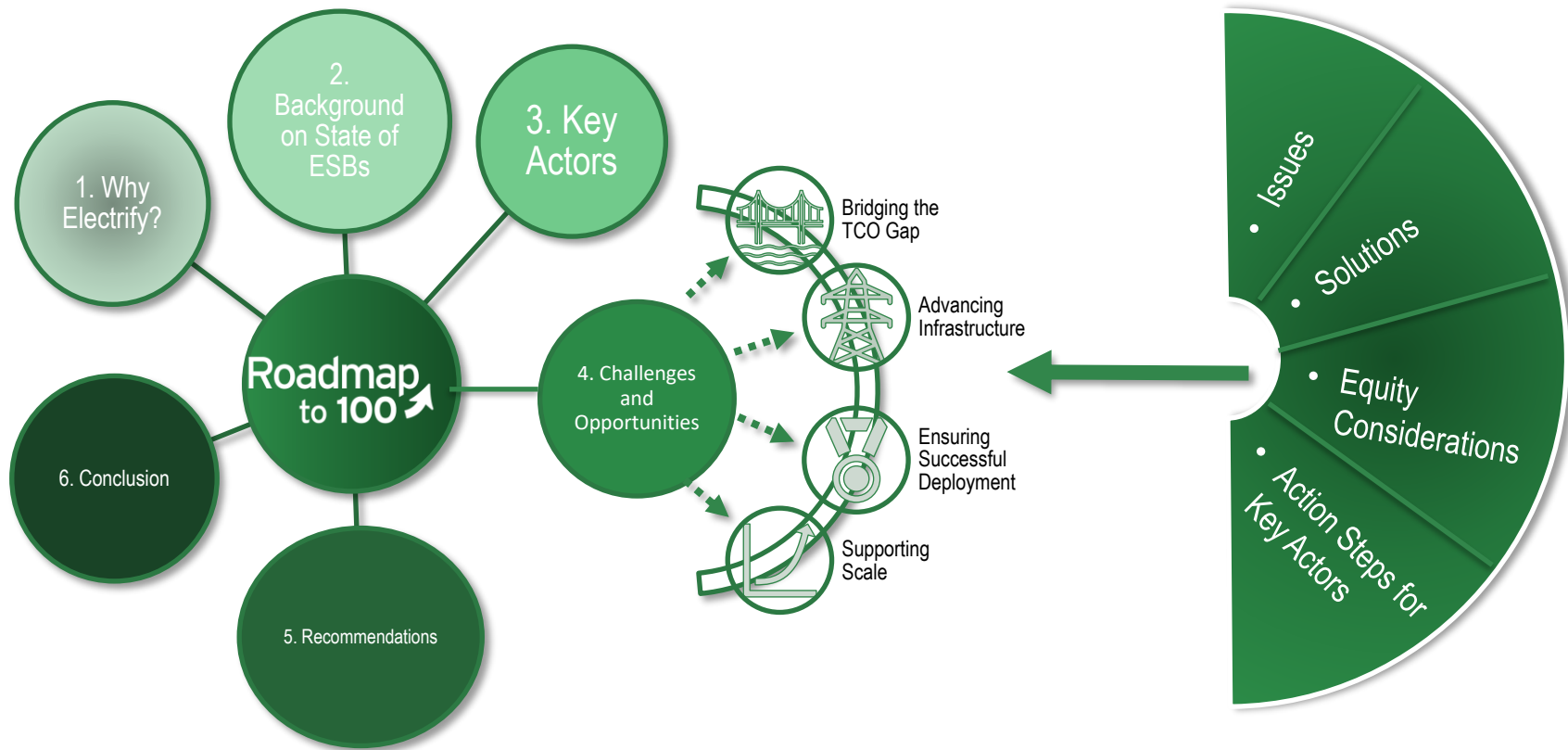


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THE SCHOOL BUS ECOSYSTEM

Roadmap to 100: High Level Outline



Roadmap to 100



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TOPICAL BREAKOUTS: KEY MILESTONES



Bridging the TCO Gap



**Advancing
Infrastructure**



**Ensuring Successful
Deployments**



Supporting Scale



BRIDGING THE TOTAL COST OF OWNERSHIP GAP

Trends And Key Levers To Unlock Savings For All

Alyssa Curran with support from Alejandra Achury

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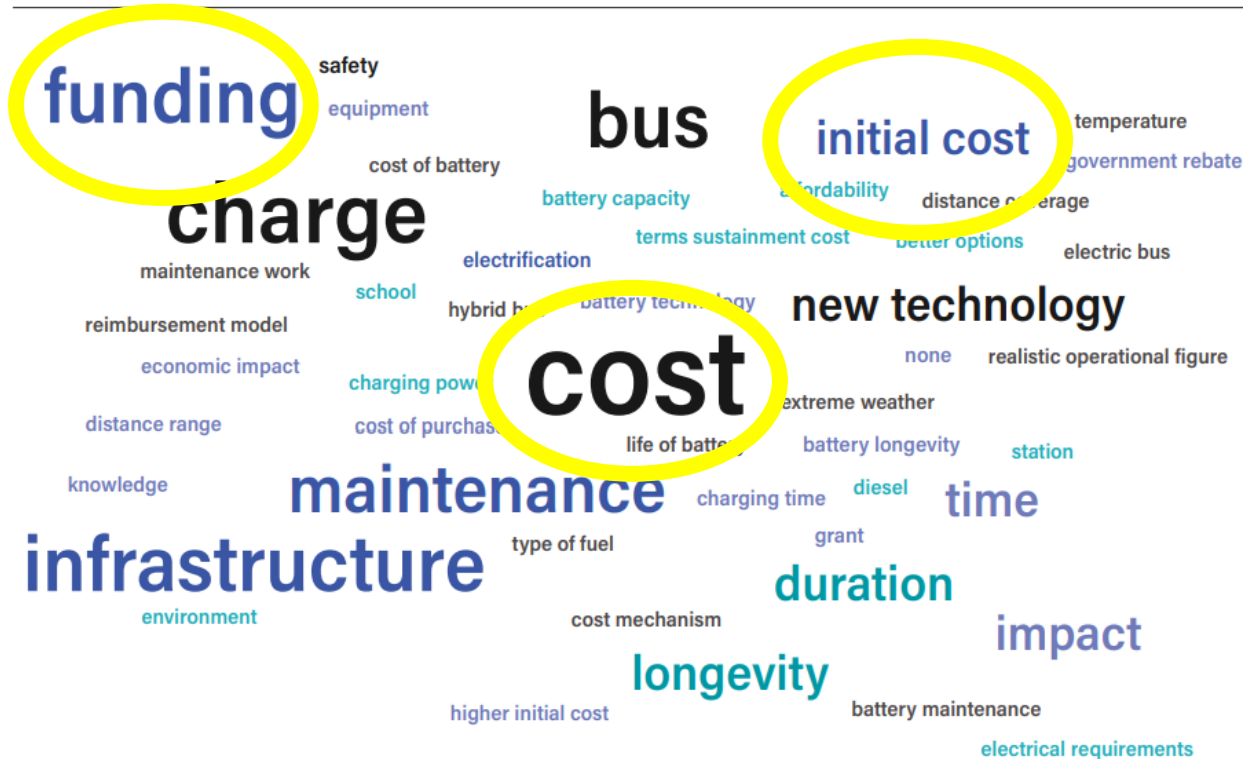
WHO'S IN THE ROOM

- **Alyssa Curran:** *Research Associate, WRI*
- **Kevin Moss:** *Senior Manager, Clean Transportation, Connecticut Green Bank*
- **Adam Ruder:** *Director, Clean Transportation, NYSERDA*
- **Duncan McIntyre:** *CEO & Founder, Highland Electric*
- **Shawn Matlock:** *Director of Capital Programs, Prince George's County Public Schools*



COST IS A UNIVERSAL CHALLENGE

Figure 10 | Top concerns with electric school buses

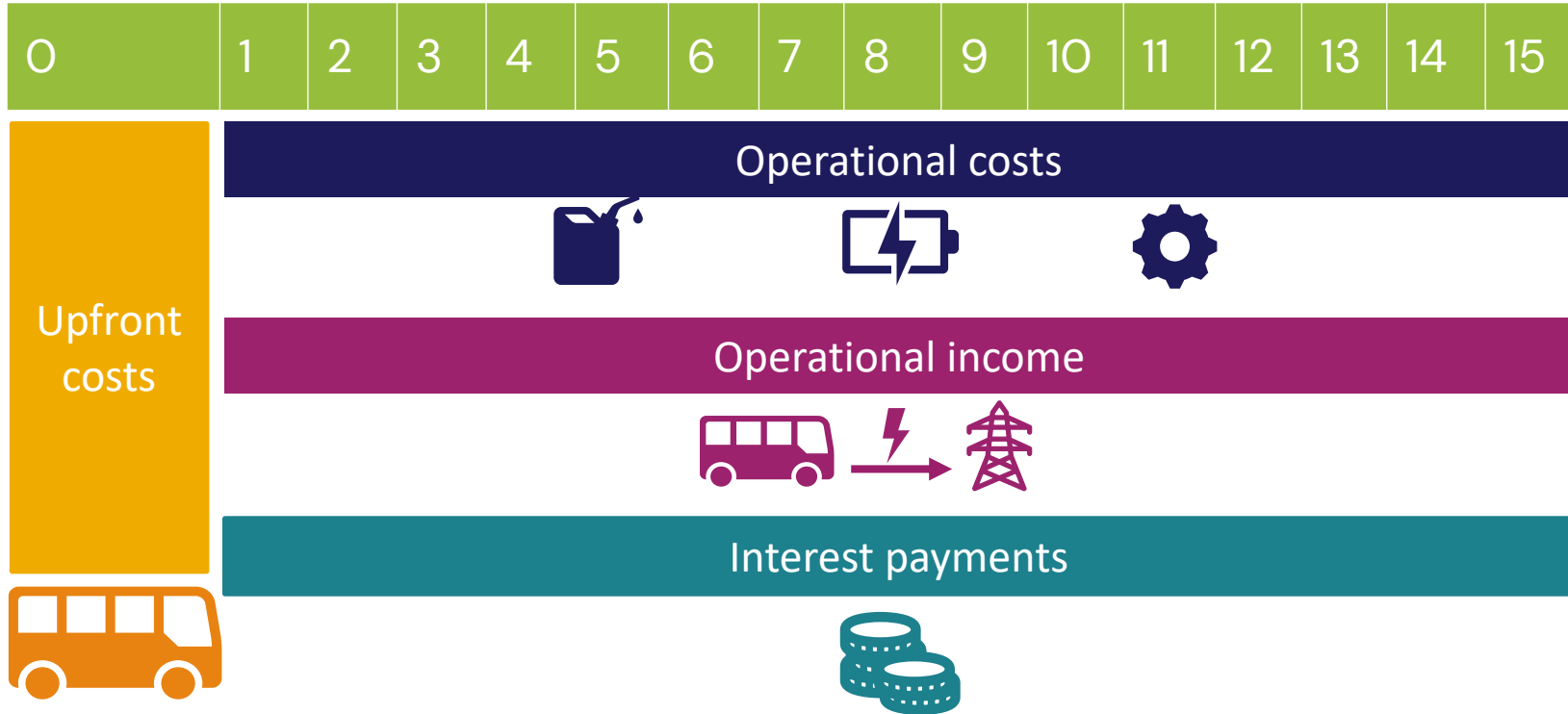


Source: [Needs Assessment for Equitable School Bus Electrification in U.S. School Districts](#) | World Resources Institute

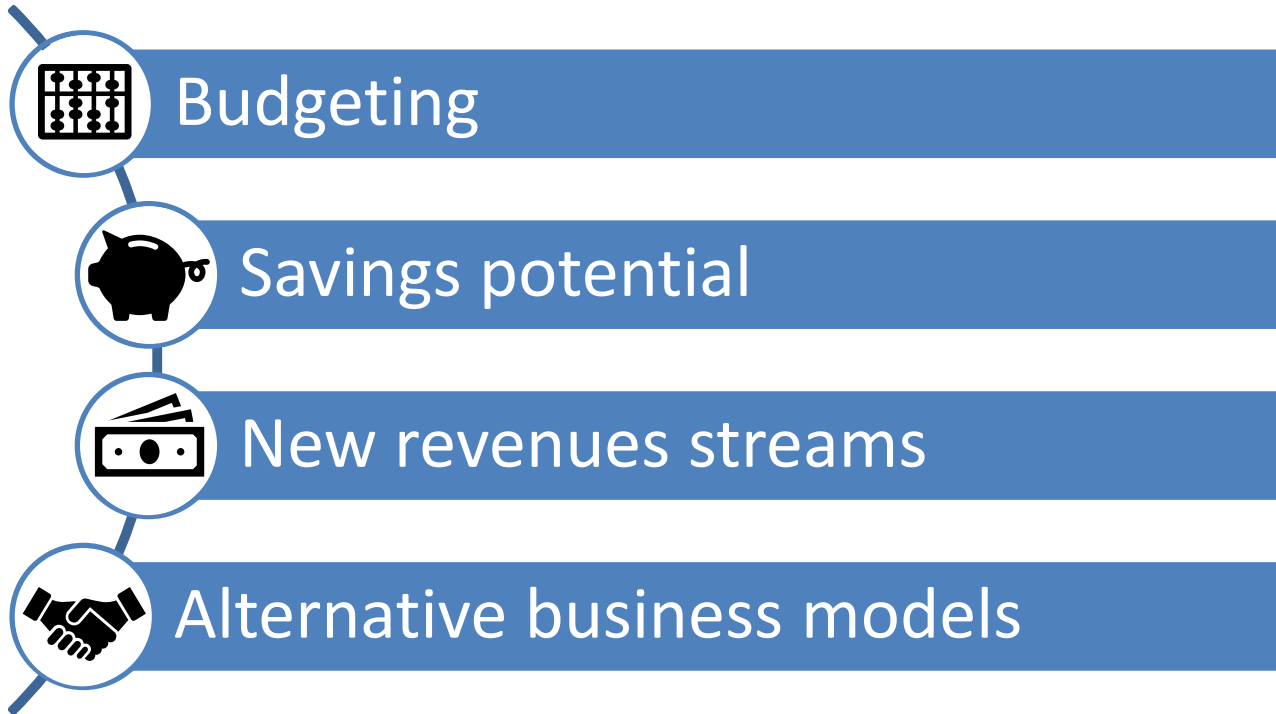


THE TOTAL COST APPROACH

WHAT IS TOTAL COST OF OWNERSHIP?



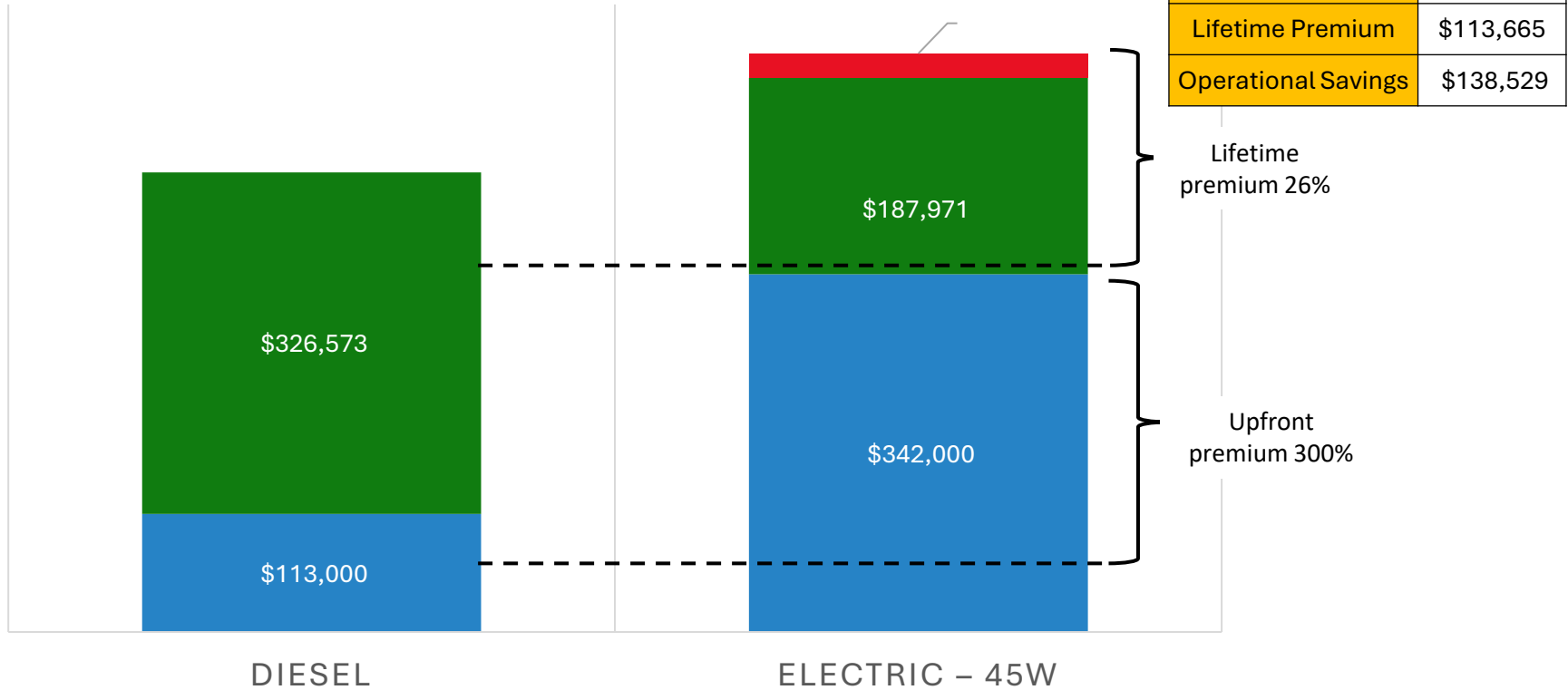
WHY TOTAL COSTS MATTER?



HOW ESB INITIATIVE SEES TCO TODAY

ESBS CARRY A MODERATE TCO PREMIUM

■ School Bus Price
 ■ NPV Fuel + O&M
 ■ NPV Infrastructure O&M

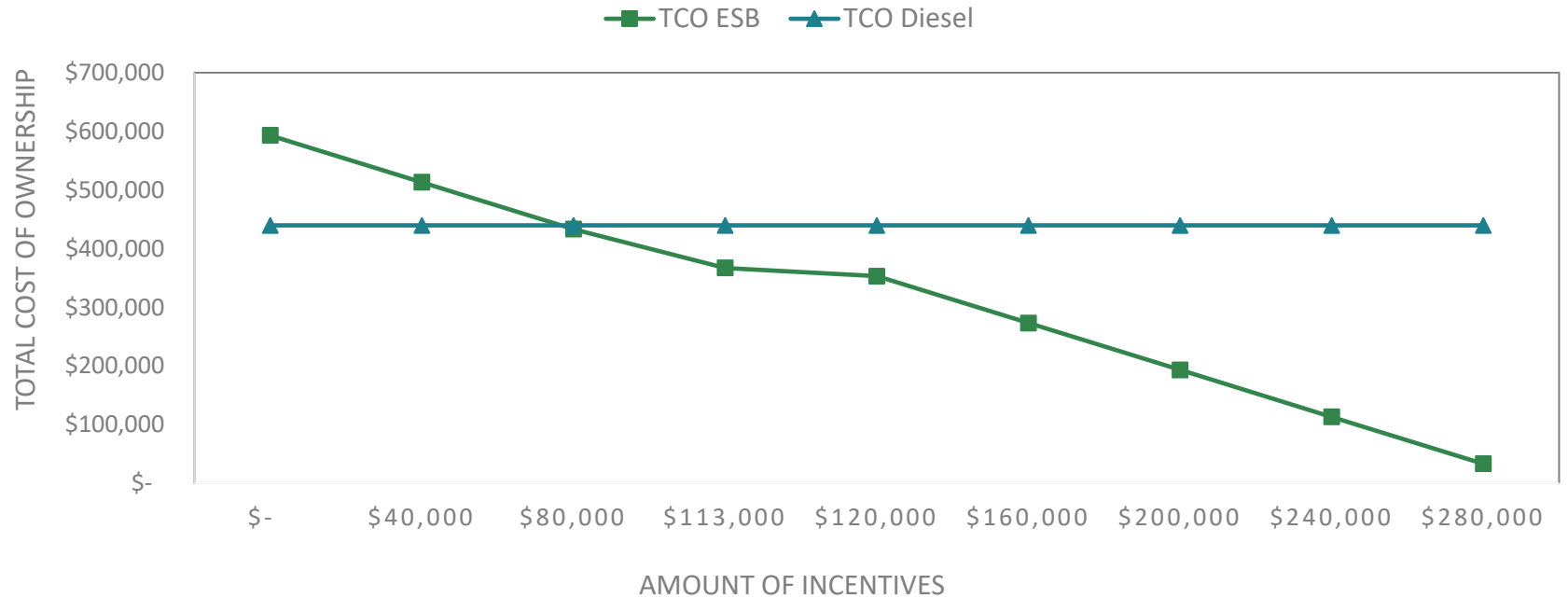


Source: WRI illustrative calculations referencing [TCO Technical Note](#)



INCENTIVES IMPROVE TCO

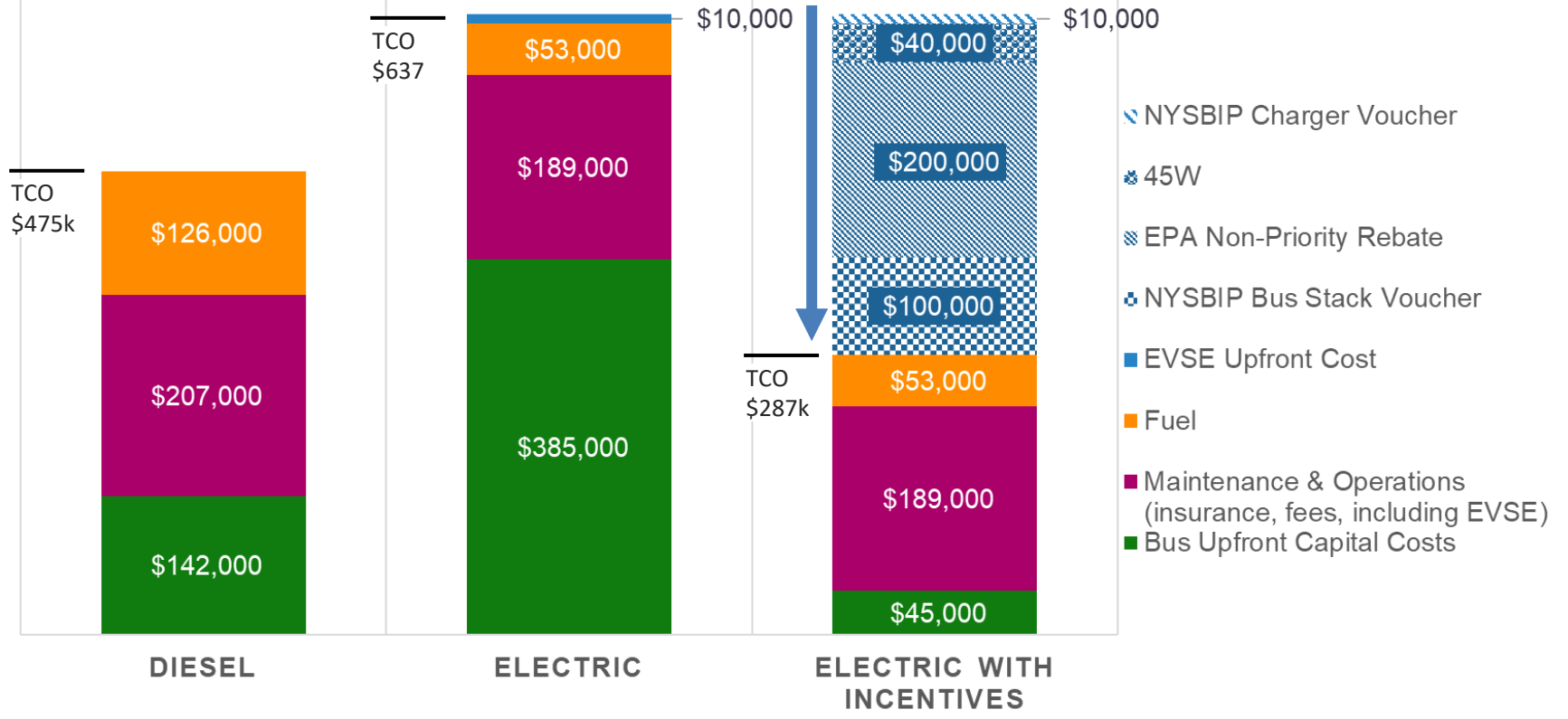
TCO VS. INCENTIVES



Source: WRI illustrative calculations referencing [TCO Technical Note](#)

TYPE C SCHOOL BUS TCO

Net present value with Non-Priority EPA + NYSBIP + IRS 45W

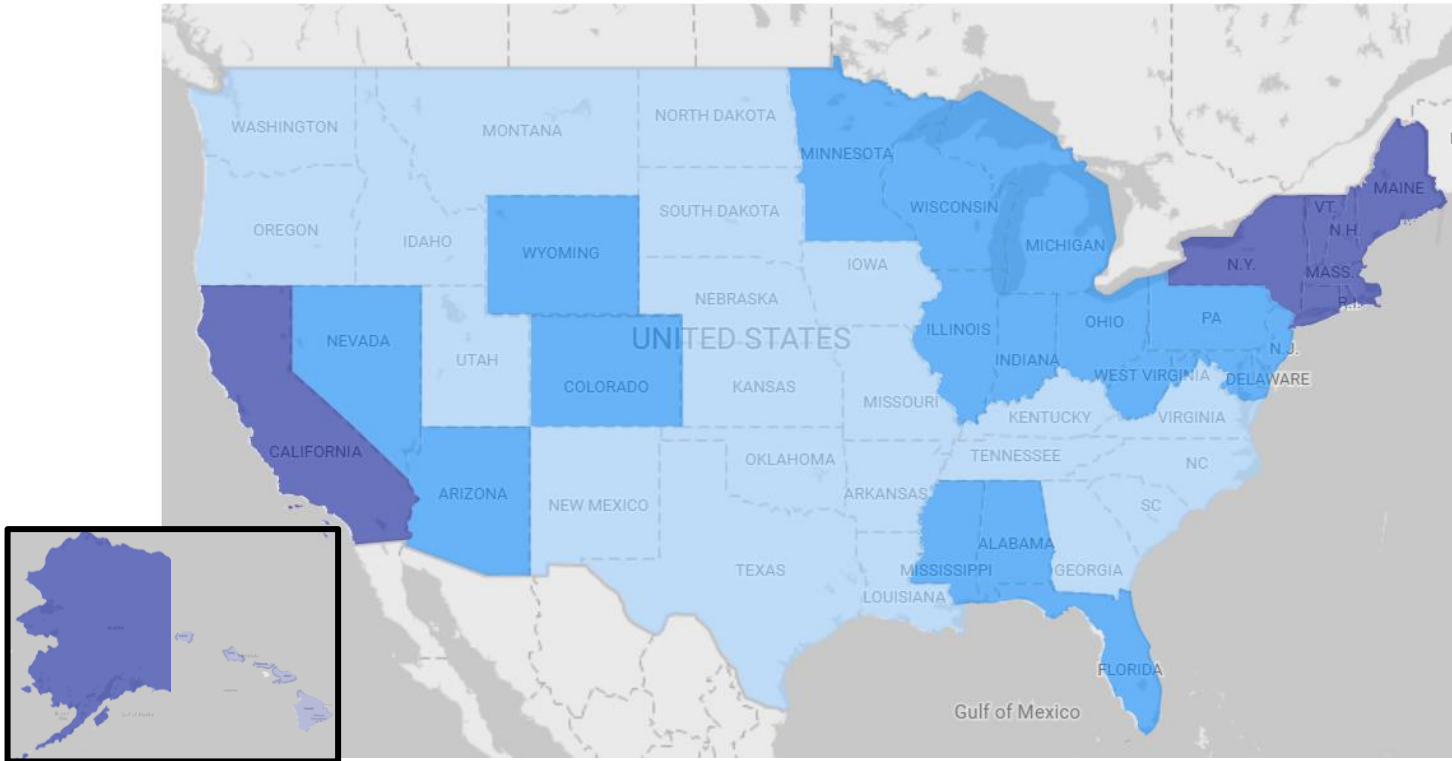


Source: WRI illustrative calculations referencing [TCO Technical Note](#), NYSERDA [Webinar Series](#)

KEY LEVERS SHAPING TCO

AVERAGE ELECTRICITY PRICES ACROSS THE U.S.

Electricity Prices ● Between \$0.09 & \$0.12 ● Between \$0.13 & \$0.16 ● More than 0.19

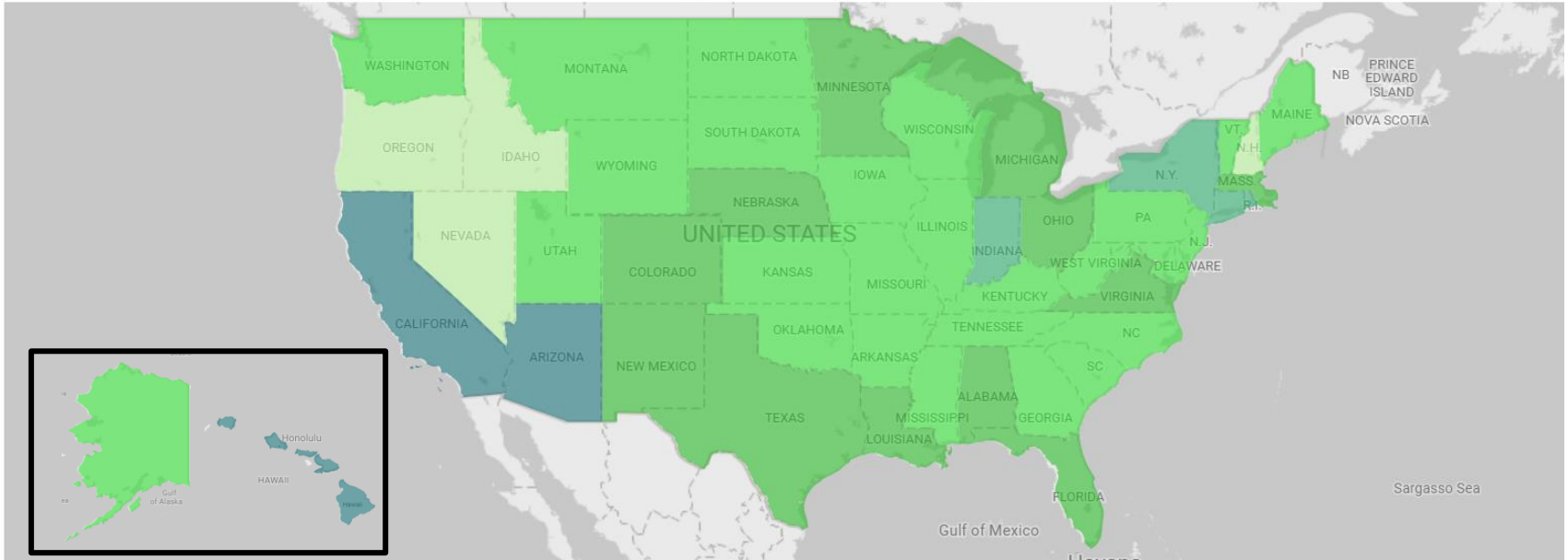


Source: EIA, Commercial Average



ESB TCO PREMIUM RANGE \$87,000 - \$176,000

Lifetime Premium (groups) ● < \$100,000 ● Between \$101,000 - \$120,000 ● Between \$121,000 - \$140,000 ● Between \$141,000 - \$160,000 ● Between \$160,000 - \$180,000

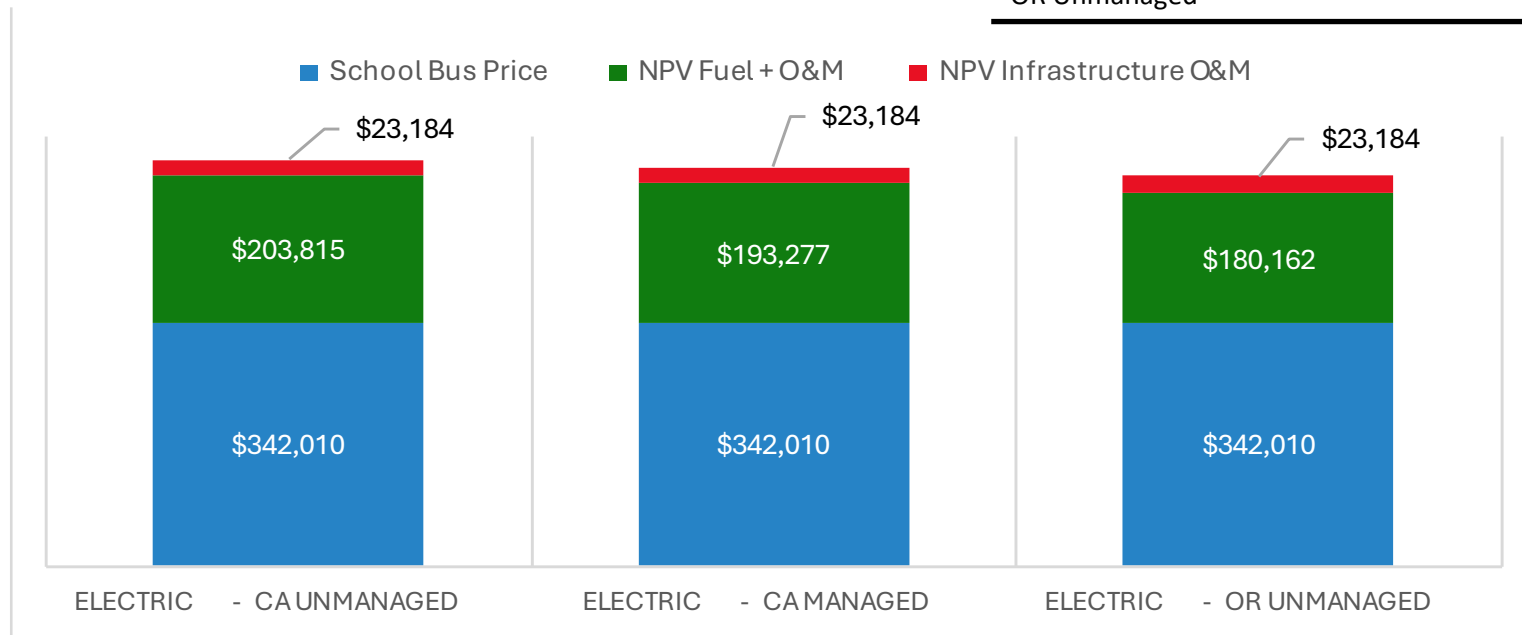


Source: WRI illustrative calculations referencing [TCO Technical Note](#)



MINOR TCO SAVINGS FROM MANAGED CHARGING

vs. CA Unmanaged	Electricity price	TCO
CA Managed	-22%	-2%
OR Unmanaged	-49%	-4%

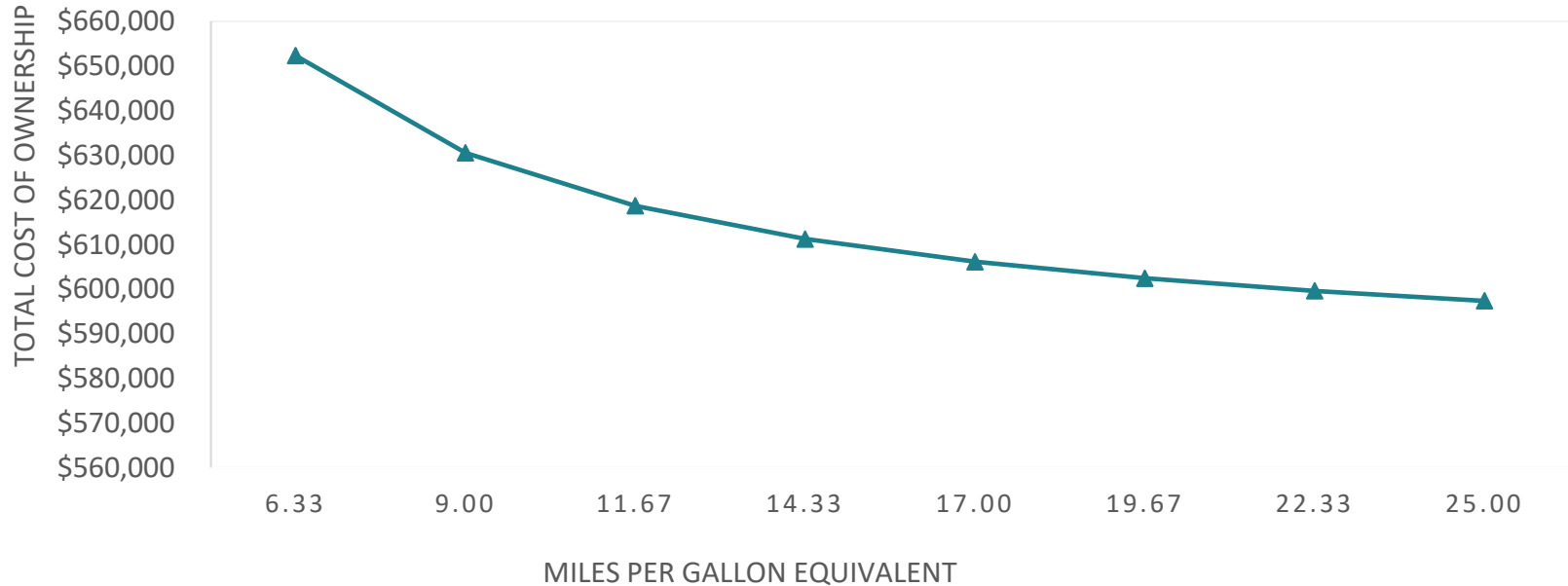


TCO	\$	569,009	\$	558,472	\$	545,357
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Source: WRI illustrative calculations referencing [TCO Technical Note](#)

WEATHER AFFECTS FUEL ECONOMY BUT DOES NOT SIGNIFICANTLY HARM TCO

FUEL ECONOMY ON TCO



Source: WRI illustrative calculations

KEY UNKNOWNNS

- Insurance cost for ESB
- ESB-specific revenues
 - *V2G payments*
 - *LCFS credit payments*
- Battery replacement cost
- Residual value of ESB
 - *Battery 2nd life & scrap value*

Bridging the TCO Gap – Roadmap Actions

1

Refine design of government grant programs

2

Centralized entities for aggregated procurements

3

Educate on managed charging & engage electric regulators to ensure appropriate rates



ADVANCING INFRASTRUCTURE

IMAGE CREDIT: GILBERT ROSAS

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ISSUES DISCUSSION

Co-Leads:

- **Robert Stafford**, *Research Associate*, WRI Electric School Bus Initiative
- **Tracy Warren**, *Electric School Bus Team Lead*, Beneficial Electrification League

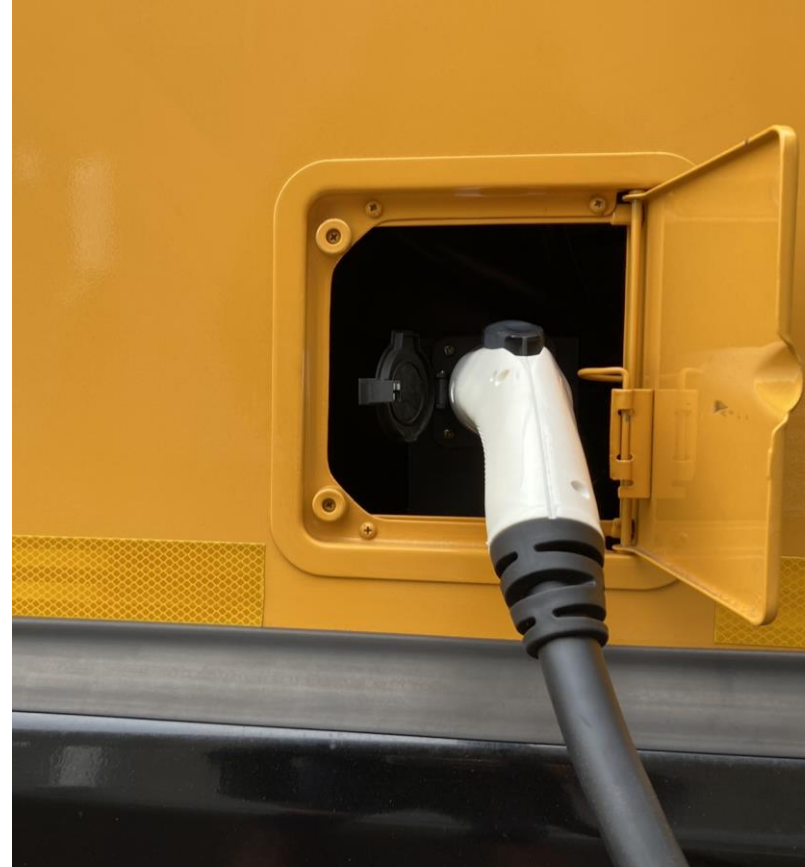
Discussants:

- **Sam DuPont**, *Principal for Strategic Programs*, Baltimore Gas and Electric (BGE)
- **John Walsh**, *Chief Commercial Officer*, EO Charging
- **Kevin Swiat**, *Utility Engagement Consultant*, IC Bus
- **Pallav Prakash**, *Director Electrification Program Management*, Zum



TOPIC OVERVIEW

- Ability of distribution grid to meet new demand
- Relative merits of deployment size and strategy
- Coordinating new and existing actors
- Working within the regulatory paradigm
- Technology readiness for management and bidirectional power



Advancing Infrastructure – Roadmap Actions

1

EQUIPMENT STANDARDIZATION

2

BUILDING TRUSTED COMMUNICATION NETWORKS

3

PREEMPTIVE SITE IDENTIFICATION AND DISTRIBUTION UPGRADES



ENSURING SUCCESSFUL DEPLOYMENTS

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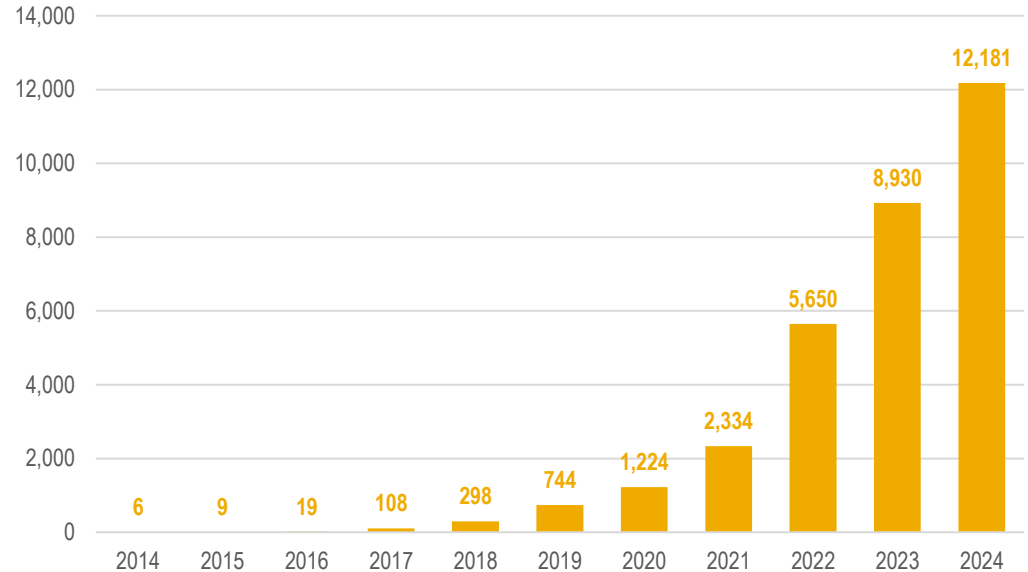
- **Brittany Barrett:** *Deputy Director Operations and Implementation, WRI*
- **Cian Fields:** *School Bus Fleet Electrification Manager, Boston Public Schools*
- **Brad Beauchamp:** *EV Product Segment Leader, Blue Bird Corporation*
- **Jacinta Hughs:** *Director Transportation Services, Baltimore City Schools*
- **Kevin L. Matthews:** *Head of Electrification, First Student*



TOTAL COMMITTED ELECTRIC SCHOOL BUSES

- 12,181 committed electric school buses as of 7/18/24
- 2.5% of the total U.S. school bus fleet
- In 2023, electric school buses accounted for 5% of all U.S. school bus sales

New electric school buses, by year, cumulative

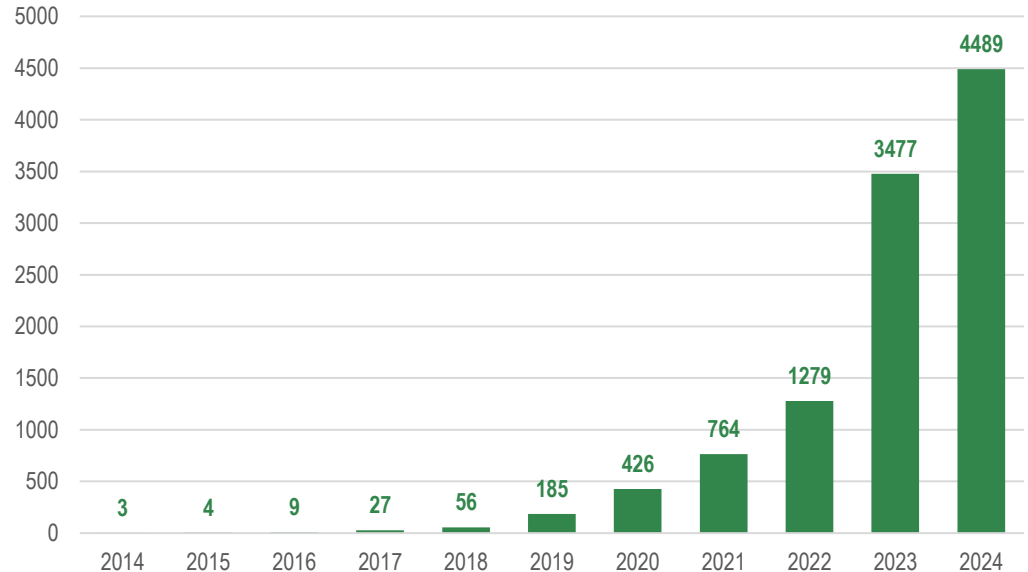


First round of Clean School Bus Program Awards

TOTAL ELECTRIC SCHOOL BUSES ON THE ROAD

- Of all committed electric school buses, 4,489 are on the road as of 7/18/24
- Approximately 235,000 students riding electric school buses across the country

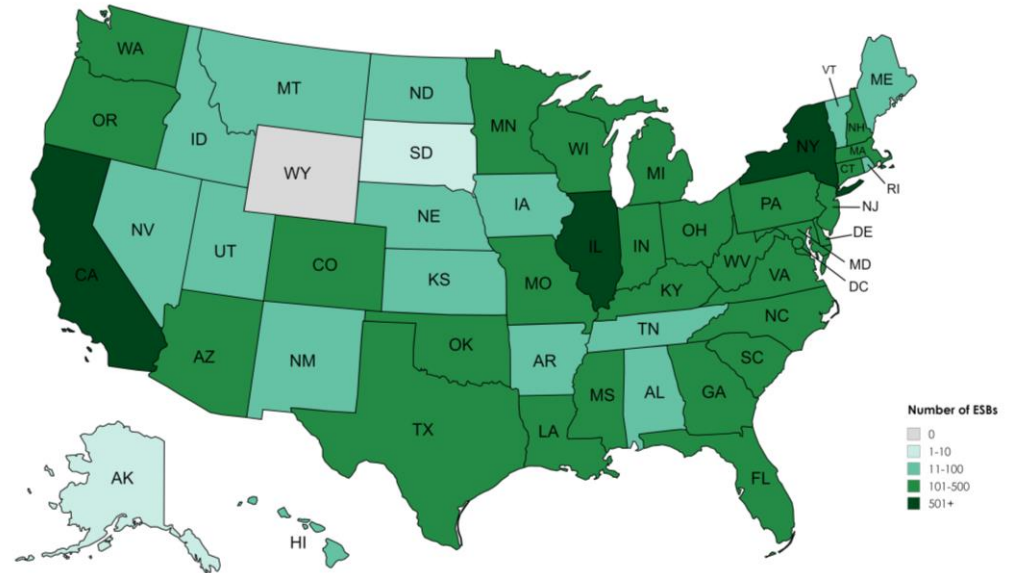
New electric school buses on the road, by year, cumulative



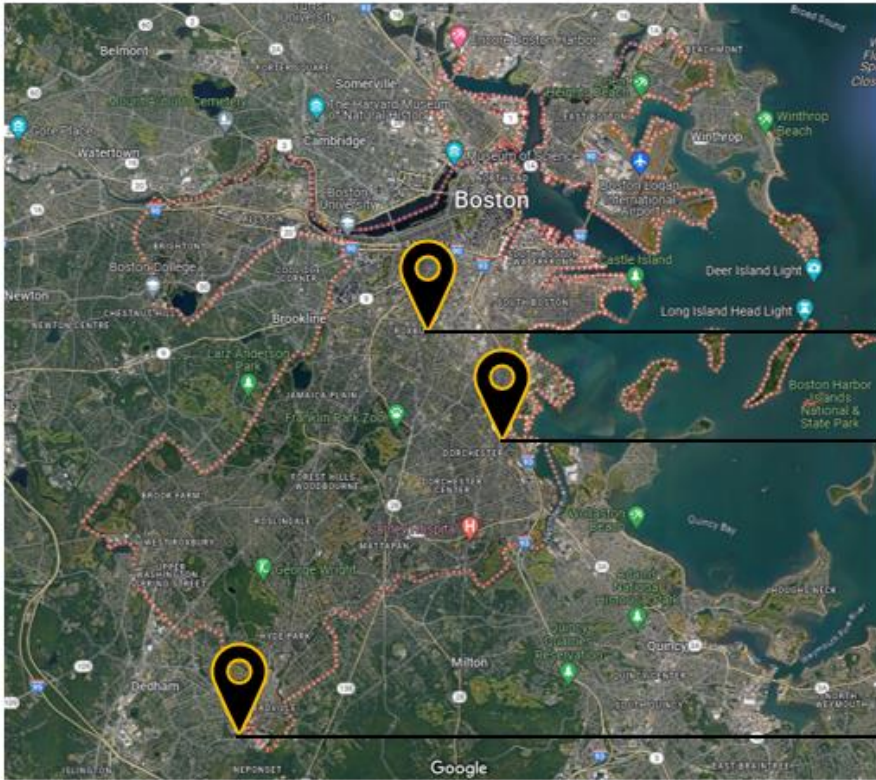
COMMITTED ELECTRIC SCHOOL BUSES BY STATE

- 49 states, DC, four territories, and several tribal nations have committed ESBs
 - Wyoming is the only state without committed ESBs.
- 49 states, DC, American Samoa, the Lower Brule Sioux Tribe, Mississippi Band of Choctaw Indians, Morongo Band of Mission Indians, and the Soboba Band of Luiseño Indians have buses on the road.
- California (3,110), New York (764), and Illinois (609) have the most committed ESBs
 - Followed by Florida (467), Pennsylvania (460), and Maryland (439)
- Around two thirds of ESBs are concentrated in the West (34%) and South (30%).
 - Northeast (20%), Midwest (15%)

Committed electric school buses by state



Boston leases three school bus yards, and owns 750 buses



Small

Medium

Large

**Washington
(Roxbury)**



161

**Freeport
(Dorchester)**



63



158



56

Readville

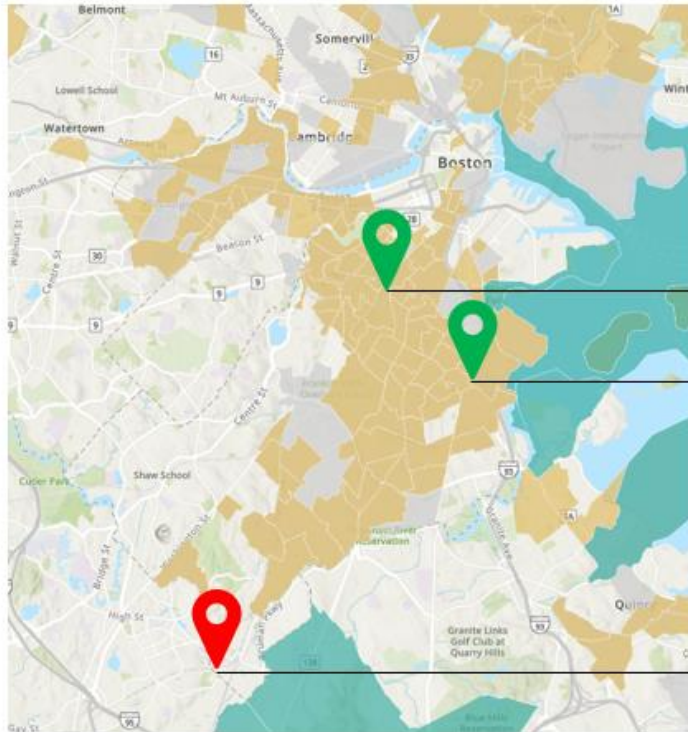


196



116

Two BPS bus yards are eligible for IRS 30c tax rebate, worth 30% of EV charger infrastructure



Washington
(Roxbury)

Freeport
(Dorchester)

Readville

**YES, eligible for
30c IRS tax
rebate**

NOT eligible

Detailed Key

Eligible tract through 2024 (2011-2015 NMTC tracts)



Eligible tract through 2029 (2016-2020 NMTC tracts)

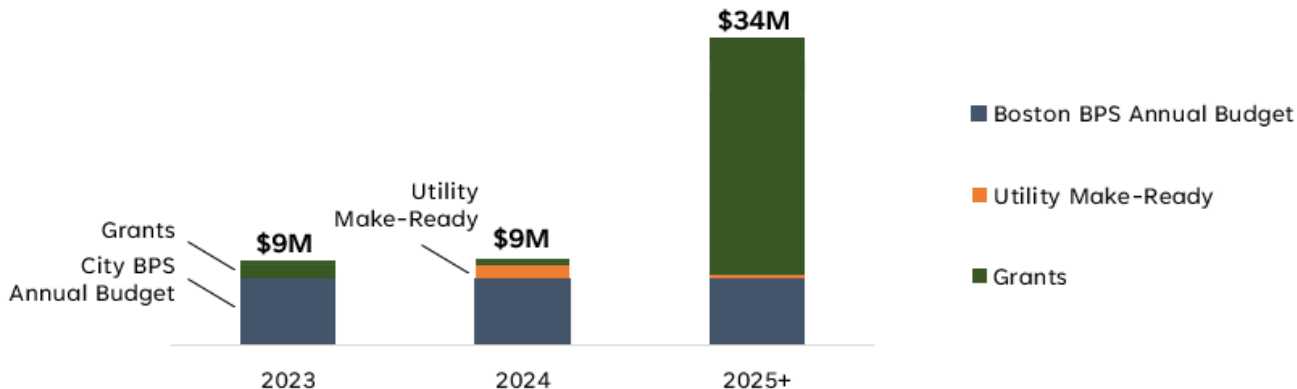


Eligible tract through 2030 (2020 Non-Urban tracts)



Boston is stacking federal, state, and private funds to accelerate fleet and infrastructure upgrades

How are we paying?



Grant programs you should consider:

Clean School Bus

Diesel Emission Reduction Act (DERA)
State and National

Clean Heavy-Duty Vehicles Program

Renew America's Schools

Your state's environment/
energy teams



FIRST STUDENT'S VISION AND GOAL

OUR VISION

To transport students in a zero-emissions environment providing cleaner, healthier air for students and the communities in which they operate

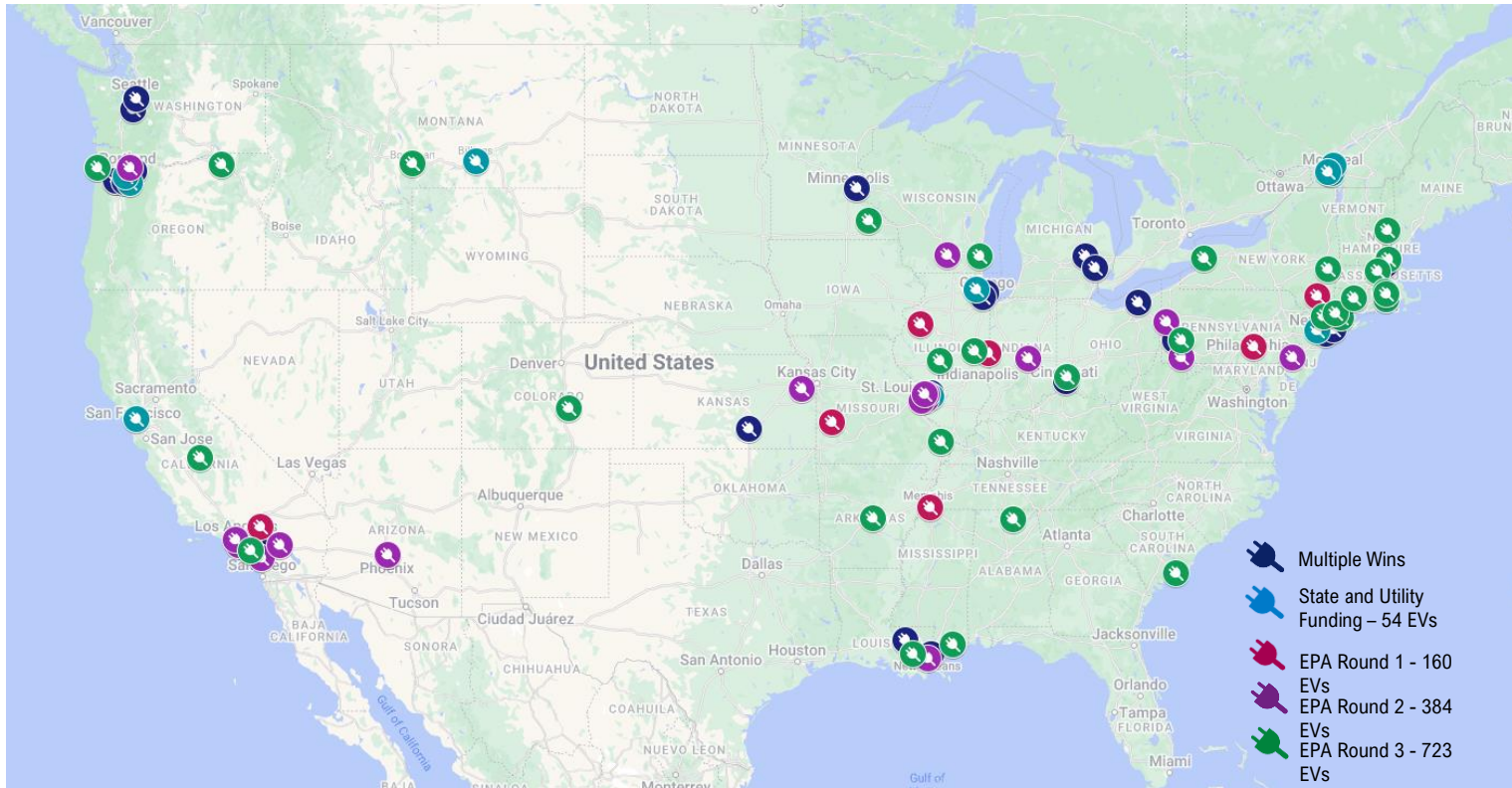
OUR GOAL

Electrify 30,000 school buses by 2035

FIRST STUDENT ELECTRIFICATION STATISTICS

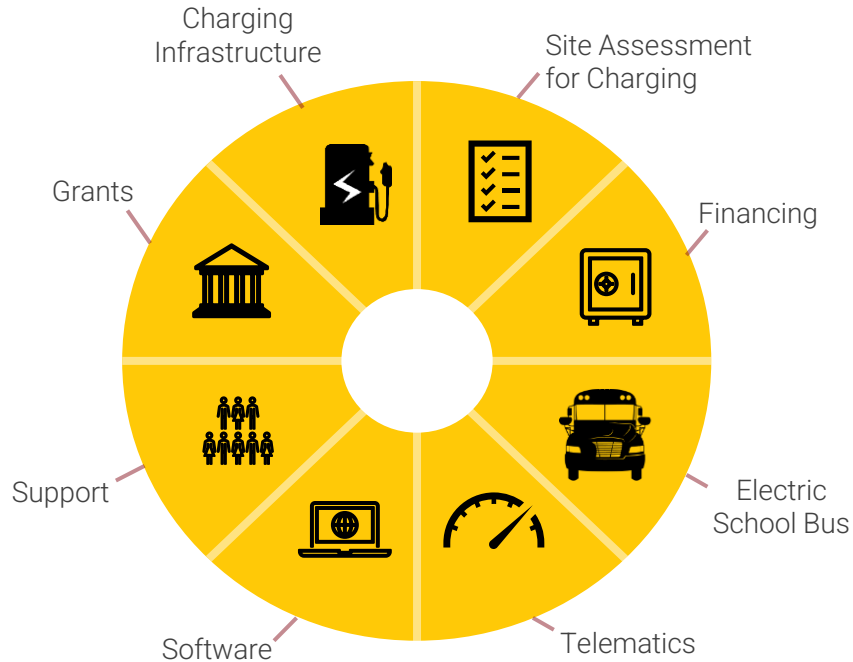
EV Deployment Report	
Total Planned EVs	2154
Total Miles Driven	3,522,481
Total EVs on Order	166
EVs being Ordered	910
EVs recently Awarded	723
Total Active Projects	61
Total Pending Projects	74
Total EVs in Operation	353
Total Grant Dollars Accepted	\$491,966,995
Total States/Provinces with EVs Operating	9
Total States/Provinces with EVs Planned	28
Total School Districts Served Today	22 (+99 more planned with ZETF, EPA Round 2, EPA Round 3, Utility, and State funding)

ELECTRIFICATION SITES – 353 EVs DEPLOYED



Providing Full Support for all the Pieces of the Puzzle

Important Facets of The Road to 100



Ensuring Successful Deployments– Roadmap Actions

1

Funding agencies need to provide funding for pre-planning that includes community input prior to procurement

2

Manufacturers need to aggressively streamline the maintenance process including robust testing prior to delivery and creating local maintenance facilities to support districts

3

An organization needs to create an interoperability testing center that leads to the development of standardization of buses and chargers.



SUPPORTING SCALE

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WHO'S IN THE ROOM

- **Amy Todd:** *Monitoring, Evaluation, Learning and Research Lead* WRI
- **Susan Mudd:** *Senior Policy Advocate*, Environmental Law & Policy Center
- **Aaron Mintzes:** *Senior Policy Counsel*, Earthworks
- **Katherine Stainken:** *Technical Leader III*, EPRI
- **Ian Elder:** *National Director*, Jobs to Move America
- **Kirsten Stasio:** *CEO*, Nevada Clean Energy Fund



AGENDA



- **Why are we here?**
 - Accelerating ESB adoption to reach the full electrification of the US school bus fleet will bring about new challenges and new opportunities. This session will focus on large scale challenges and equity-oriented approaches to tackling them, including expanding grid capacity and access, workforce needs at scale, establishing supply chain responsibility, and deploying financing solutions.
- **What are we doing?**
 - Introduction: 5 Min
 - Moderated Discussion: 10 min
 - Tabling Exercise: 45 min
 - Table Share Out: 15 min
- **What are we leaving with?**
 - 3 Roadmap Actions

US SCHOOL BUS LANDSCAPE

21 million

Students served by the U.S. school bus fleet every day

7 billion

Combined trips taken by vehicles in the U.S. school bus fleet each year

480,000

Total vehicles in the U.S. school bus fleet

300,000

Total drivers in the U.S. school bus fleet

US SCHOOL BUS LANDSCAPE

16,000

School districts (decision node for most purchases)

1,500

School bus contractors
2/3 of buses are district owned or leased
1/3 are owned by private contractors

26

Companies in electric school bus manufacturing space

3,000

Electric utilities
2/3 are publicly operated
Others are cooperatives or investor owned

Supporting Scale – Roadmap Actions

1

Training of regulators and utilities, technicians via OEMS/dealers from procurement requirements

2

Standards for extended producer responsibility on batteries, and aggregation for financing and procurement

3

Fund clean grid buildout equitably, battery passports, community college training for ESB technicians

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ROADMAP ACTION IDEAS

Bridging the TCO Gap

- 1 Refine design of government grant programs
- 2 Centralized entities for aggregated procurements
- 3 Educate on managed charging & engage electric regulators to ensure appropriate rates

Ensuring Successful Deployment

- 1 Funding agencies need to provide funding for pre-planning that includes community input prior to procurement
- 2 Manufacturers need to aggressively streamline the maintenance process including robust testing prior to delivery and creating local maintenance facilities to support districts
- 3 An organization needs to create an interoperability testing center that leads to the development of standardization of buses and chargers.

Advancing Infrastructure

- 1 Equipment standardization
- 2 Building trusted communication networks
- 3 Preemptive site identification and distribution upgrades

Supporting Scale

- 1 Training of regulators and utilities, technicians via OEMs/dealers from procurement requirements
- 2 Standards for extended producer responsibility on batteries, and aggregation for financing and procurement
- 3 Fund clean grid buildout equitably, battery passports, community college training for ESB technicians

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SECTOR BREAKOUTS



**Bus Owners &
Operators**



**Bus & Charger
OEMs**



Utilities



**Advocates &
Community
Representatives**



**Financing
Entities**



**Policymakers &
Regulators**

OBJECTIVE: Define Top ROLES for Each SECTOR



INTRODUCTIONS: Who is in the room? (Name, Org, Pronouns)

5 mins



STEP 1: Review the **Roadmap Action Items** from the four previous breakouts

15 mins



STEP 2: Provide feedback via MENTI

Identify **TOP 3 ACTION ITEMS** for sector to champion

15 mins



STEP 3: Map out **key considerations** for each of the top three action items

How is your sector positioned to act?

How do we center equity?

Who else needs to be involved to be successful?

What are key milestones for maintaining momentum?

30 mins

KEY CONSIDERATIONS FOR TOP 3 CHOICES

- How is your sector positioned to act?
- How do we center equity?
- Who else needs to be involved to be successful?
- What are key milestones for maintaining momentum?

RAPPORTEURS: CLOSING REFLECTIONS



Bus Owners & Operators

Kenni Jean Schrader
Transportation Supervisor

Three Rivers (MI)
Community Schools



Bus & Charger OEMs

Rachel Chard
Deputy Director Electric School Buses

CALSTART



Utilities

Leslie Vishwanath
EV Project Management Commercial and Industrial Portfolio Delivery

National Grid



Advocates & Community Representatives

Katherine García
Director, Clean Transportation for All Campaign

Sierra Club



Financing Entities

Michael Grossman
Chief Investment Officer

Climate United



Policymakers & Regulators

Christine Koester
Clean School Bus Program+

U.S. EPA

Diana Friedrich
Supervisor

California Energy Commission



BUS OWNERS AND OPERATORS



Top action items:

- 1** OEMs: streamline the maint. process including robust testing prior to delivery and creating local maint. facilities to support districts
- 2** Create an interoperability testing center = the development of standardization of buses and chargers
- 3** Educate on managed charging & engage electric regulators to ensure appropriate rates



Key considerations:

- 1** Needed for both charger and bus. District mechanics want to be able to do the work. Can technical (high)schools be connected to the solution? OEMs need to service what they sell, OEMs need to train districts. Demand occupation list to qualify for DOL subsidy.
- 2** Who pays? Funding for certification center. Charge Mgmt companies are in the middle so what is their role?
- 3** Analysis Paralysis. Many options make it difficult to complete due diligence. Get into the minutia on how to manage it. What's the TCO on buying larger battery capacity vs. paying mid-day charges. Can microgrids and stationary storage help avoid?

BUS AND CHARGER OEMS



Top action items:

- 1 Interoperability testing center that leads to the development of standardization of buses and chargers.
- 2 Manufacturers need to streamline the maintenance process including robust testing prior to delivery and creating local maintenance facilities to support districts
- 3 Equipment standardization



Key considerations:

- 1 OEMs have to meet the unique maintenance needs for every school
- 2 Need for collaboration and communication between bus and charger OEMs on interoperability
- 3 Structuring incentive programs to promote standardization

UTILITIES



Top action items:

- 1 Educate on managed charging & engage electric regulators to ensure appropriate rates
- 2 Proactive site identification and distribution upgrades
- 3 Fund clean grid buildout equitably, battery passports, community college training for ESB technicians



Key considerations:

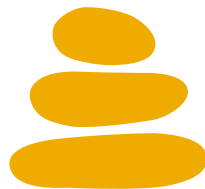
- 1 Fleet advisory services, regulator approval, trusted advisor/partner
- 2 Proactive utility outreach, regulator direction, certainty on process
- 3 Utility programs for carbon reduction from energy generation, fed/state grid funding
Vehicle grid integration

FINANCING ENTITIES



Top action items:

- 1 Centralized entities for aggregated procurement - support Quarterback approach
- 2 Refine design of gov't programs – coordinated voice
- 3 Right-sizing investments in buses & charging – finance can bring rigor to purchase decisions



Key considerations:

- 1 Role of green/public banks vs private
- 2 Fragmented programs
- 3 Uncertainties on residual value & potential revenue opportunities

POLICY MAKERS AND REGULATORS



Top action items:

- 1 Preemptive site identification and distribution upgrades
- 2 Refine design of government grant programs
- 3 Building trusted communication networks



Key considerations:

- 1 Engage utilities early, ID depot sites and capacity needs with equity considerations in mind
- 2 Coordinate and explain multiple funding streams & how they can be stacked with support for disadvantaged communities
- 3 Be transparent and avoid overselling, use nontraditional messengers

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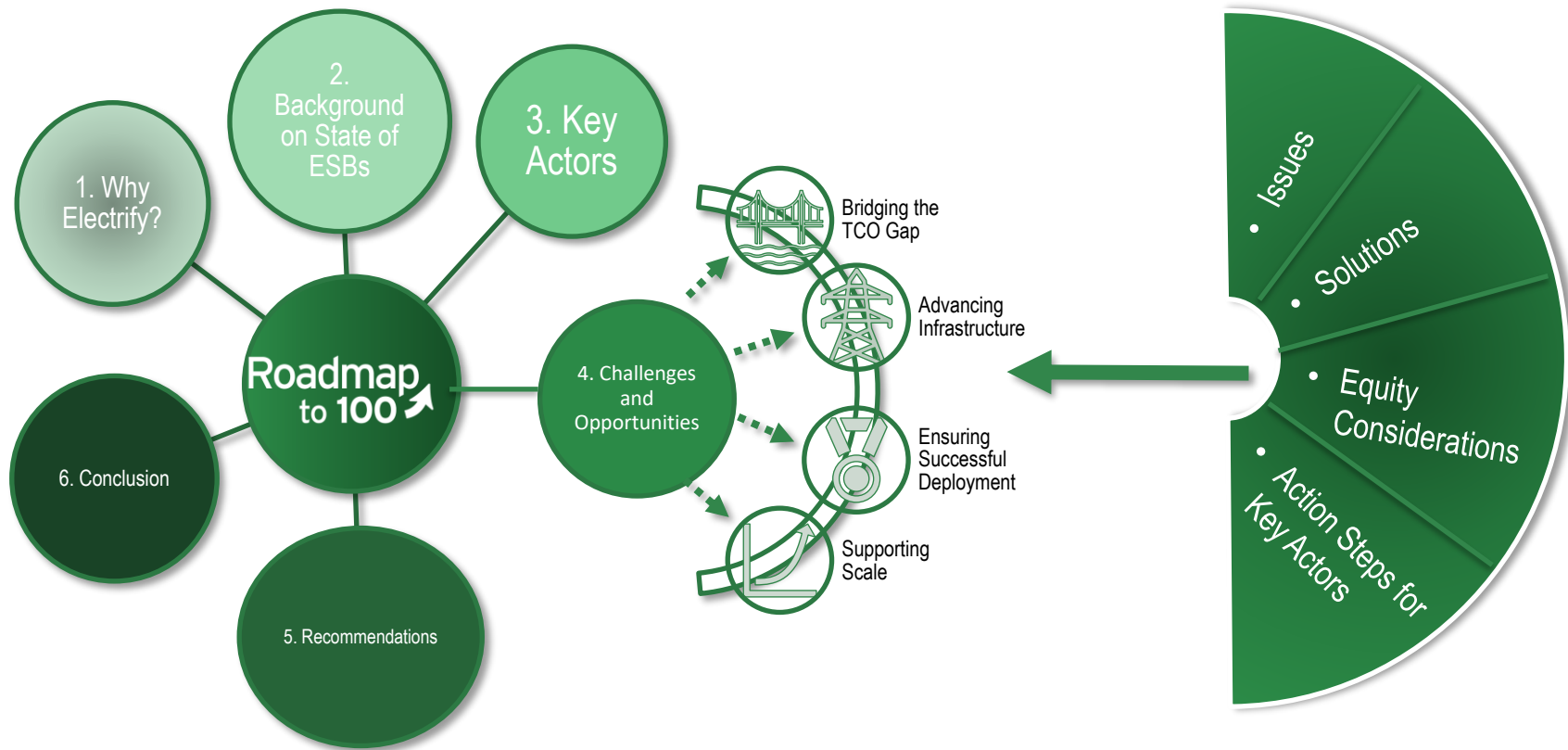
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