ELECTRIFYING PUBLIC TRANSPORTATION

(AND SCHOOL BUSING)

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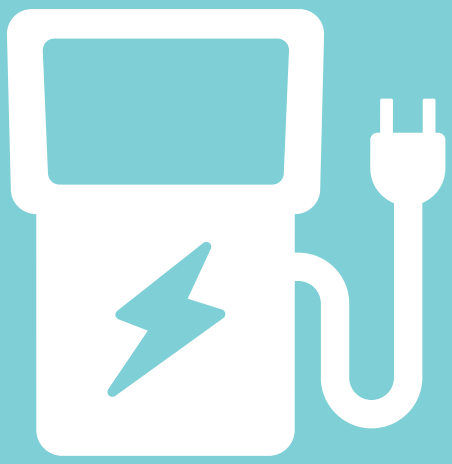

ReImagine Appalachia

IN BRIEF

The coalition to ReImagine Appalachia envisions a sustainable economic future for working people, communities, the land, and public health. Our blueprint for a re-imagined 21st century Appalachia is extensive. It includes expanding clean and efficient manufacturing in the region, repairing damaged lands from more than a century of extractive industry practices, upgrading the region's electrical infrastructure and, as this report will address, building out a more sustainable transportation system.

Modernizing the region's transportation system would not only create a more affordable and efficient way to move people and goods, but also put tens of thousands of people to work upgrading existing freight and passenger rail lines, building out a network of electric vehicle charging infrastructure, reinforcing our electric grid to accommodate electric vehicles of all kinds, and, the focus of this paper, significantly expand and electrify public and school transportation throughout the region.[1] This report looks specifically at the resources needed to electrify those services and also explores how communities can collaborate to accelerate and fully realize the benefits of revitalizing the region's intertwined but separate public transportation and school busing systems.

We recognize that electrifying public transportation is only one piece of the larger puzzle that is creating a complete system of affordable, sustainable transportation options. It is important to understand that we, both as a nation and as a region, have significantly underinvested in alternative modes of transportation for nearly a century, leaving vehicles, rail infrastructure and waterway systems in a state of neglect. As the recent train derailments in Ohio and elsewhere suggest, much work is required just to ensure the safety of our public transit and rail systems, let alone to bring them into the 21st century.

If done well, however, upgrades to our region's transportation system will deliver greater economic, social, environmental, and health benefits that more than recoup the significant upfront investment required. According to an economic impact study of ReImagine Appalachia's blueprint, conducted by the Political Economy Research Institute at University of Massachusetts-Amherst, federal policy makers can create more than 35,000 good jobs in Ohio, Pennsylvania and West Virginia alone by directing $3.5 billion in public funds each year to upgrade and expand zero-emissions transportation, including passenger and freight rail, in the region.[2]

In addition to job creation, the benefits of electrifying public transportation infrastructure would span economic, health, and worker outcomes to include:

- Significantly reducing the 27% of regional carbon emissions that come from the transportation sector, especially if we simultaneously employ a strategy to power these vehicles with renewable energy resources (such as through solar canopies over parking areas).
- Decreasing the average age of the region's bus fleet by replacing old vehicles, many of which are still on the road though their useful life is long past, with new, electric, wifi-equipped, safe, and reliable replacements.
- Saving energy, money, and worry by lowering the cost per mile of providing public transportation while reducing reliance on imported and volatile fossil fuels. Because electricity is cheaper than diesel, and electric buses require less maintenance, electric buses have lower annual operating costs than their diesel counterparts. A study from the National Renewable Energy Laboratory estimates the average payback period of battery-electric buses to be less than four years.
- Improving the health of all people living in our communities. Moving to electrified public transit will eliminate exhaust and its toxic pollutants, which are particularly harmful in more densely-populated communities of color already subject to environmental racism.

We can further maximize the return on sustainable transportation investments by promoting collaboration across transportation providers and state lines. Transit systems, school districts and local governments can leverage their collective purchasing power to reduce the overall cost of both electric vehicles and the clean energy to supply them. A consortium of Appalachian communities equipped with the right procurement strategies can make the most of federal funds and private capital from responsible investors to lower prices; spur new manufacturing opportunities; grow local clean electricity sources; and create good union jobs accessible to all residents, including members of disadvantaged communities.

In 2021 and 2022, Congress passed a series of bills –including, but not limited to, the Bipartisan Infrastructure Law and the Inflation Reduction Act– to which we will collectively refer as the federal climate infrastructure package. Among other measures, that legislation provided a significant down payment towards our sustainable transportation needs, including $17 billion for purchasing electric buses, shuttles, and light-duty vehicles for public transit systems, school busing and other public fleet needs. It also included more than $16 billion for electric vehicle charging infrastructure. More will be needed, but these federal climate infrastructure resources represent the right first step towards creating a 21st century public transportation system.

In May of 2021, on request of Senators Sherrod Brown and Chuck Schumer, the Center for Transportation and the Environment (CTE) estimated that $56-88 billion will be needed to fully transition our national public transit system to zero emissions (A Zero-Emission Transition for the U.S. Transit Fleet).[3] Using a similar methodology, we estimate that the Appalachian portion alone of Ohio, Kentucky, Pennsylvania, and West Virginia will need roughly $315 million annually over a 12-year period (including $175 million to purchase electric buses, shuttles, etc., and $142 million to cover the start-up costs of electric charging infrastructure), or $3.9 billion total, to fully electrify their existing public transportation fleets. Separately, we've estimated that roughly $10 billion would be needed to electrify the region's 20,000 school buses. Collaboration between public transit and school bus systems, to lower costs without sacrificing safety or quality, is then of the utmost importance.

OUTLINE

1. The basics of electrifying public transportation
2. Public transportation in the Ohio River Valley of Appalachia
    a. Table 1: More than a third of our 4-state region's public transit vehicles operate in the Appalachian portion of the state (5,038)
    b. Table 2: Nearly a third of 5,000+ transit vehicles in the Ohio River Valley of Appalachia are buses, another third are shuttles, and one third light-duty vehicles
    c. Table 3: 20,000 school buses in Ohio River Valley of Appalachia

3. Costs and benefits of 100% transit electrification in the region
    a. Benefits far outweigh costs of electrifying public transit
    b. Purchasing electric transit vehicles
        i. Table 4: $2.1 billion needed to replace 5,000+ transit vehicles
    c. Table 3: 20,000 school buses in Ohio River Valley of Appalachia
        i Table 5: $1.7 billion needed for transit vehicle charging infrastructure
    d. Over time, technological innovation will lower costs

4. How the federal climate infrastructure package – including the Bipartisan Infrastructure Law and the Inflation Reduction Act – can support efforts to electrify public transit
    a. Table 6: $17 billion federal investment for purchasing electric buses, shuttles, vehicles
    b. Table 7: $16 billion in federal resources for electric vehicle charging infrastructure
    c. Table 8: $14 billion for carbon planning and projects, technical assistance, R&D for transportation innovation
    d. Table 9: $208 billion in flexible federal transportation funding programs

5. Strategies to minimize costs, maximize benefits
    a. Strategy #1: Planning for 100% electrification of public transit
        i. The federal government should act to reduce duplication across agencies and systems
        ii State or local governments should take the lead on utility collaborations
        iii Clean school buses demonstrate the need for cross-stakeholder collaboration
        iv Story box: S&B Construction - one-stop contractor shop for transit / school bus electrification
    b. Strategy #2: Mapping existing skills of transit workforce to new skills needed
    c. Strategy #3: Increasing purchasing power by building an interstate consortium
    d. Strategy #4: Sourcing local & clean electricity
        i Story box: Examples of school districts and public transit systems using solar canopies to help energize their vehicle fleets
    e. Strategy #5: Financing transit decarbonization
        i Storybox: Greenbanks

6. Conclusion

1. THE BASICS OF ELECTRIFYING PUBLIC AND SCHOOL VEHICLES

Electrifying a personal vehicle is surprisingly simple. If you purchase an electric vehicle and typically drive fewer than 70 miles a day, which is the case for 9 out of 10 households, you can plug into any standard 120V outlet when you get home each day and you'll be good to go in the morning - no fancy charger needed.[4]

An electric bus is not like your electric car.

To start, a standard 40-passenger bus requires **a battery pack that is nearly 10 times larger** than that of a Tesla Model Y in order to go the same distance. Buses must also meet unique and exacting safety, performance, and operational standards developed over decades of transit operations.[5] For electric buses, these requirements include fast charging times - transit vehicles often have only a six-hour window from when they return to the depot to their 'pullout' time - as well as stringent weight and material durability expectations since they travel, on average, 43,000 miles per year.[6] Electric buses require **a charger that delivers six to 12 times more power** than the highest-powered home charger currently available.[7]

And the electricity flowing through such a powerful charger needs to come from somewhere. Unlike upgrading a single circuit for an electric stove or personal car charger, for which personal tax credits are available, powering an entire fleet of buses requires that local utilities **reinforce their electrical grid** beyond the transit agency's depot facilities. This infrastructure improvement necessitates a diverse stakeholder planning process that can involve millions of dollars of potential work in two to three-year timelines. That ordeal can be complex for the largest agencies, much less the smallest school districts.

2. PUBLIC TRANSPORTATION IN THE OHIO RIVER VALLEY OF APPALACHIA

While public transit is often equated with 40-passenger buses and underground subways, the typical vehicle fleet in Appalachia includes a range of vehicles, from buses to airport shuttle-style vehicles (called cutaways) to minivans and even sedans. Of the more than 13,000 public transit vehicles operating in the states of Kentucky, Ohio, Pennsylvania and West Virginia, more than 1/3 operate in the Appalachian portion of these states.

Nearly 150 transit systems serve the Appalachian region of Kentucky, Ohio, Pennsylvania and West Virginia, operating more than 5,000 transit buses, shuttles, and light duty vehicles (see Table 1).

Table 1

More than one third of our four-state region's public transportation vehicles operate in the Appalachian portion of the state

	# OF TRANSIT VEHICLES				
	Kentucky	**Ohio**	**Pennsylvania**	**West Virginia**	**4 State Total**
State as a whole	2,587	4,266	6,208	583	13,644
Appalachian portion of state	922	688	2,845	583	5,038
% transit vehicles in Appalachia part of state	36%	16%	46%	100%	37%

Source: National Transit Database, 2021 Vehicles / Appalachian Regional Commission

Table 2 shows that roughly ⅓ of these vehicles are buses, ⅓ shuttles, and ⅓ light duty vehicles (vans, automobiles, minivans, and sport utility vehicles), highlighting the diversity of transit systems serving diverse and dispersed communities in the region.

Table 2

Of the 5,000+ transit vehicles operating in the Ohio River Valley of Appalachia, one third are buses, a third are shuttles, and a third are light-duty vehicles.

	Appalachian Portion of OH, PA, KY & WV	**Share of Vehicles**
Buses	1,587	31.5%
Shuttles	1,672	33.2%
Light Duty	1,779	35.3%
Transit Total	**5,038**	

Interestingly, there are even more school buses on the road than other forms of public transportation vehicles, including in the Appalachian portion of our 4-state region.

Table 3 shows the Ohio River Valley region has more than 20,000 school buses in operation (the other form of public transportation).

Table 3[8]

The states of Kentucky, Ohio, Pennsylvania and West Virginia have nearly 60,000 school buses on the road, 20,000 of which operate in the Appalachian portion of these states					
	Kentucky	**Ohio**	**Pennsylvania**	**West Virginia**	**Total**
# of School buses currently on the road	9,527	18,606	30,835	3,920	56,524
# of school buses in Appalachian portion of state	3,295	3,947	12,833*	3,920	20,079

Sources: Pennsylvania DMV summary of PA vehicles and World Resource Institute Data summary of KY, OH, and WV vehicles. Appalachian Regional Commission data on counties in scope.
https://www.dmv.pa.gov/pages/pennsylvania-school-bus-statistics.aspx
https://datasets.wri.org/dataset/electric_school_bus_adoption
https://www.arc.gov/appalachian-counties-served-by-arc/
*PA vehicles in region are imputed based on student population ratios.

3. COSTS AND BENEFITS FROM 100% ELECTRIFICATION IN THE REGION

While a wholesale electrification of the region's 5,000 public transit vehicles and 20,000 school buses has significant upfront costs, detailed below, that investment will yield even larger economic, climate, and health benefits in the long run. We estimate 100% electrification of public transit systems in the Appalachian portion of Ohio, West Virginia, Kentucky, and Pennsylvania to cost **roughly $317 million annually over an ambitious 12-year period**. That sum would include 1) roughly **$175 million** for **purchasing** the vehicles, and 2) some **$140 million for upgrading** existing facilities–**amounting to $3.9 billion in total**.[9] Additionally, school bus electrification in the region would cost roughly $10 billion. If spread over a similar 12-year transition period, that amount equates to an additional $830 million per year.

Our calculations mirror that of a national study conducted by the Center for Transportation and the Environment at the request of Senators Brown (D-OH) and Schumer (D-NY) during their budgeting process for the federal climate infrastructure package (A Zero-Emission Transition for the U.S. Transit Fleet, 2021). The Center estimated that an expenditure of $56-88 billion, not including investments needed for utility and generation upgrades, would be required to electrify the nation's transit fleet.

A) BENEFITS OF ELECTRIFYING TRANSPORTATION OUTWEIGH THE COSTS

While electric buses come at a higher initial price tag than their diesel counterparts, they have **significantly lower annual operating costs**. Electricity powers buses more cheaply than diesel[10] and electric buses carry fewer maintenance costs. A study from the National Renewable Energy Laboratory estimates the average payback period for the increased purchase price of a battery-electric bus fleet, over the cost of diesel buses, to be less than four years.[11] Moreover, since 80% of agency capital investments are funded by the federal government, while most operations are not, electrification should allow agencies to save money. At current price levels, a single electric bus saves the agency $200,000 – savings which can be returned to riders through increased service frequency, new routes, lower fares, and/or to improve wages for transit workers.[12] Those investments in convenience are particularly important when they increase ridership, which is the primary metric by which transit agencies measure their impact when appealing for funding.

Thus, the benefits of electric buses reverberate through a community even before we consider the health and climate improvements created by fewer diesel fumes and greenhouse gas emissions, particularly for our youngest school bus riders and users of public transit. Toxic tailpipe emissions from diesel buses are associated with asthma and other chronic conditions, especially in children.[13] A 2015 study from the University of Michigan and the University of Washington found lowering diesel fume levels of school buses improves student health and reduces absenteeism, particularly among asthmatic children.[14] Electric vehicles **eliminate** tailpipe emissions.

Enhanced mobility and affordable transportation options are also good for public health. Cars are expensive to own, operate and maintain. For low-income families, driving can be prohibitively expensive. For the elderly and people with disabilities, driving may not be an option at all. Since we have chronically underinvested in public transportation, many low-income families, elders, and people with disabilities in the region are effectively disconnected from the places they need to go. The resultant inaccessibility of education, job training, job opportunity, grocery stores and doctor's offices perpetuates the cycle of poverty and poor health.[15]

Moreover, the transportation sector accounts for more than one-fourth of all carbon emissions in the Ohio River Valley of Appalachia. Achieving carbon neutrality in the region then requires significant investments to make our transportation system more sustainable. Curbing climate change will help the region reduce flooding, which can damage crops, contaminate public water supplies with bacteria, and attract increasing numbers of mosquitoes and ticks that carry disease.[16]

B) PURCHASING ELECTRIC TRANSIT VEHICLES

Vehicle purchases represent the largest investment required to electrify public transportation systems. Over time, entire fleets will need to be replaced. Replacing all 5,000 transit vehicles in the Appalachian region of the four Ohio River Valley states with their electric equivalents would cost roughly $2.1 billion, or $175 million annually over 12 years. This amount is approximately 30% more than the cost of replacement with new diesel vehicles. Moreover, to electrify the 20,000 school buses in Appalachia would require an additional $6.4 billion in just vehicle purchase costs.[17] Appalachia, like elsewhere, has more school buses than transit vehicles - a consequence of the significant inefficiency that comes with having two bus-based systems serving the same geographies.

Table 4 below represents the number and type of electric transit buses and shuttles needed for purchase throughout the region, as well as the average unit cost for each vehicle type.

Table 4

$2.1 billion needed to replace 5,000+ vehicles for 147 Ohio River Valley transit systems			
Vehicle	**Quantity Needed**	**Unit Cost**	**Total Cost**
Buses	1,587	$960,000	$1.5 billion
Shuttles	1,672	$285,000	$477 million
Light Duty	1,779	$38,000	$68 million
Transit Vehicle Total	**5,038**		**$2.1 billion**

C) COSTS FOR REINFORCING OUR ELECTRICAL GRID TO SERVE TRANSIT VEHICLES

Just like cars, buses return to a garage when they are not in service. However, unlike your garage, a larger agency's bus garage is often a cavernous warehouse with embedded fueling, cleaning, and maintenance facilities. At smaller agencies, a bus garage resembles a car rental lot, with open air canopies and a dispatch office. Regardless, these facilities will need significant upgrades, like **new charging points, electrical upgrades, and system control technologies to enable vehicle charging** - likely costing an additional 50% of vehicle purchase prices, or **$140 million per year over a 12-year period** (roughly $1.7 billion total) - to maintain or expand existing service levels (see table 5), before they can host electric vehicles.

Table 5

$1.7 billion investment needed for charging infrastructure		
Charging Infrastructure	**Annual Investment**	**Total over 12-year period**
Light and Medium Duty Vehicle Equipment	$31.3 million	$375 million
Bus-Charging Equipment	$33.3 million	$400 million
Additional Fleet Expansion Costs	$75 million	$900 million
Total Cost	**$140 million**	**$1.7 billion**

Our calculations closely mirror that of a national study conducted by the Center for Transportation and the Environment at the request of Senators Brown (D-OH) and Schumer (D-NY) during their budgeting process in May of 2021. The Center estimated a national expenditure of $56-88 billion would be required, not including investments needed for utility and generation upgrades. One key difference is that the CTE effort found that the most cost effective zero-emissions pathway would also include use of fuel cell vehicles - for various reasons, including simplicity, we have assumed only electric vehicles for our purposes.

These Tables allow us to achieve a rough estimate of the costs associated: $3.8 billion in 2021

prices, or $315 annually over a 12-year vehicle replacement period, to achieve 100% transit electrification. For school buses, we estimate a total electrification cost approaching $10 billion.

D) OVER TIME, INNOVATION AND SCALE WILL REDUCE COSTS

In the future, innovation in technologies like battery chemistry and assembly will lower costs and increase efficiency. Moreover, because relatively few electric buses are manufactured currently, economies of scale have yet to be achieved. As we demand more electric buses and begin to achieve greater economies of scale that in turn incentivize further innovation, costs will come down.[18] Light duty electric trucks and passenger cars are already much more comparable in cost to their internal combustion engine counterparts, and we can see that trend accelerating to encompass heavy-duty transport vehicles.

Over the 12-year time horizon anticipated by this study, we expect significant advancements in battery, generation, and mobility technologies, in part due to large federal government and private enterprise investments. To drive costs down now–and get better deals in the future–we can promote economies of scale and grow our purchasing power by building local purchasing consortiums across the Ohio River Valley (see section on minimizing costs, maximizing benefits). Agencies can also tailor route and vehicle assignments to their fleets with a smart mix of 'right-sized' vehicles to provide services appropriate to current frequency and ridership levels, an innovation enabled by better data.

4. HOW THE BIPARTISAN INFRASTRUCTURE LAW AND INFLATION REDUCTION ACT SUPPORT EFFORTS TO ELECTRIFY PUBLIC TRANSPORTATION

In November of 2021, Congress passed the Bipartisan Infrastructure Law (BIL), a down payment on our nation's climate infrastructure needs. Much of these resources went to upgrading our nation's transportation infrastructure, in part through the electrification of public transportation, school buses, ferries, and personal and commercial vehicles. In August of 2022, President Biden signed the Inflation Reduction Act (IRA), another climate infrastructure bill that incorporates even more funding for electrified transportation.

Table 6 below outlines the $17 billion investment from the federal climate package, plus tax credits allocated to purchasing electric buses, shuttles and other vehicles.

Table 7 below outlines the more than $16 billion that can be used for electric vehicle charging infrastructure.

Table 8 outlines roughly $15 billion in federal resources for planning and project development, technical assistance, research and development, and other carbon-reducing projects that include but are not limited to electrification efforts.

Table 9 outlines $208 billion that, though allocated to more traditional federal transportation funding programs, come with enough flexibility to be used to support electrification efforts, among other things.

Table 6

$17 billion in BIL & IRA programs can be used to purchase electric vehicles

PROGRAM	AMOUNT	FUNDING TYPE	ELIGIBLE PROJECTS	ELIGIBLE RECIPIENT
Low- and No Emission	$5.6 bil	Competitive grant	Purchase or lease of no- or low-emission transit buses; acquisition, construction, or leasing of supporting facilities and equipment	States, local government authorities, Indigenous nations
Bus and Bus Facilities	$5.13 bil	Formula and competitive grant	Buy, replace, repair, or lease buses, bus-related equipment, and facilities	Designated entities, state or local governmental entities connected to fixed route bus service
Electric or Low-Emitting Ferry Program	$250 mil	Competitive grant	Provides grants for the purchase of electric or low-emitting ferries and the electric and low-emitting upgrade of existing ferries	States, Indian Tribes and recipients designated by a Governor or other public official
Clean School Bus Program	$5 bil	Competitive grant/ rebate; cooperative agreement	Grants and rebates for zero-emission and alternative fuel school buses; priority for rural and low-income communities	States, local government, eligible contractors, eligible nonprofits, and Indian Tribes
Clean Heavy-Duty Vehicle Investments	$1 bil	Competitive grant/ rebate	Purchasing clean heavy-duty vehicles like school buses, transit buses, and garbage trucks	States, municipalities, Indian Tribes, nonprofit school transportation association
Die sel Emission Reduction	$60 mil	Competitive grant	Replace legacy diesel equipment, including school buses, with cleaner versions in low-income disadvantaged communities	Regional, state, local, or Tribal agency or port authority with jurisdiction over transportation or air quality; Nonprofits, Institutions, or Individuals associated with diesel fleets
Commercial Clean Vehicle Tax Credit	n/a	Tax credit	Commercial tax credit for qualified commercial clean vehicles. Amount of credit is the lesser of (a) 15% of the vehicle's basis (i.e. its cost to the purchaser) or 30% for vehicles without internal combustion engines, or (b) amount the purchase price exceeds the price of a comparable internal combustion vehicle. The credit is capped at $7,500 for vehicles < 14,000 lbs and $40,000 for all other clean vehicles.	Businesses that acquire commercial clean motor vehicles or mobile machinery for use or lease; tax-exempt entities that acquire them for use
Overall IRA/ BIL funding	**$17B+ tax credits**			

Table 7

More than $16 billion in federal resources for electric vehicles charging infrastructure

PROGRAM	AMOUNT	FUNDING TYPE	ELIGIBLE PROJECTS	ELIGIBLE RECIPIENT
EV Charging/ Alternative Fuels Tax Credit	n/a	Tax credit	Property tax credit for alternative fueling or charging; fueling equipment funded in rural, low-income communities. Base credit 6% of the cost for businesses, limited to a $100,000 credit per item of property for businesses. 30% for individuals, limited to $1,000. Bonus credit of 30% for businesses meeting prevailing wage and registered apprenticeship requirements.	For clean- burning fuels, as defined in the statute, and must be located in low-income or rural areas.
National EV Infrastructure/ Charging and Fueling Infrastructure	$7.5 bil	Competitive grant	Charging and fueling infrastructure for alternative sources of vehicle power, including electric, hydrogen, propane, and natural gas	States/state subdivision, metropolitan planning organization, local government, special purpose district or public authority with a transportation function, Indian Tribe
Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants	$7.5 bil	Competitive grant	Transportation projects of local or regional significance, including public transit and the electrification thereof	States, local government, Indian Tribes, special purpose district/public authority connected to transportation
Transportation Infrastructure Finance and Innovation	$1.25 bil	Loan	Federal credit assistance for a wide variety of transportation projects, including the electrification of fixed guideway public transit systems, e.g., bus rapid transit	States, local government, other public authorities, private entities undertaking projects sponsored by public authorities
Overall IRA/ BIL funding	**$16B**			

Table 8

$14 billion in federal resources for carbon planning and projects, technical assistance, R&D for transportation innovation

PROGRAM	AMOUNT	FUNDING TYPE	ELIGIBLE PROJECTS	ELIGIBLE RECIPIENT
Joint Development Program		Formula and competitive grant	Coordinates development of transit facilities with non-transit commercial and residential projects; can now be used for EV infrastructure. Funds come from several FTA grants programs	FTA grant recipients, such as State and local government agencies, including transit agencies
Technical Assistance and Workforce Development	$27 mil	Cooperative agreement; technical agreement	Support public transit agencies to provide employment training and outreach, including training on low- or no-emission vehicles	Urban/rural transit agencies, state dept. of transportation, metropolitan planning organization, Indian Tribes, nonprofits, higher ed institutions
Public Transportation Innovation	$132 mil	Competitive grant	Research, development, and implementation of projects that will improve public transportation, including low- or no-emission bus testing and evaluation	Federal government entities, State and local government, public transit providers, private or nonprofit organizations, higher ed institutions
Carbon Reduction Program	$6.4 bil	Formula grant	Projects that reduce transportation-related carbon emissions, potentially including transit electrification	States
EPA Climate Pollution Reduction Grant	$5 bil	Formula and competitive grant	Develop and implement comprehensive and wide ranging plans for reducing greenhouse gas emissions and other harmful air pollution.	States, municipalities, Indian Tribes, air pollution control agencies
Neighborhood Access and Equity Grants Program	$3 bil	Competitive grant	Supports access to affordable and equitable transportation, including improvements to public transit that reduce greenhouse gas emissions	States, municipalities, higher ed institutions, nonprofits
Overall IRA/ BIL funding	**$14B**			

Table 9

Other BIL/IRA transportation funding programs with flexibility to support electrification efforts

PROGRAM	AMOUNT	FUNDING TYPE	ELIGIBLE PROJECTS	ELIGIBLE RECIPIENT
Capital Investment Grants	$23 bil	Competitive grant	Funds fixed guideway investments including new and expanded rapid rail, commuter rail, light rail, streetcars, bus rapid transit, and ferries, as well as corridor-based bus rapid transit investments. Finances the Expedited Project Delivery Pilot Program	State and local government agencies, including transit agencies
State of Good Repair and Rail Vehicle Replacement Program	$45 bil	Formula and competitive grant	Provides support to transit agencies that operate fixed-guideway and high-intensity bus systems for the maintenance, replacement, and rehabilitation of assets.	State and local governmental authorities
Bus Testing Program	$25 mil		Funds bus testing facility (at Penn State U in Altoona, PA) for testing new bus models (including rapid expansion of eBuses) for required reliability, safety, performance, structural integrity, fuel economy, emissions, and noise tests.	Activities relating to the testing of new bus models and the operation and maintenance of the bus testing facility
Formula Grant for Rural Areas	$4.1 bil	Formula grant	Provides capital, planning, and operating assistance to states to support public transportation in rural areas; $138 mil specifically for Appalachian Development Public Transportation Assistance Program	States, Indian Tribes
Surface Transportation Block Grant	$72 bil	Formula grant	Can be used for a wide variety of transportation-related projects, including electrification and the deployment of low- or no-emission vehicles and related infrastructure in public transit	States
Urbanized Area Formula Grants	$36.5 bil	Formula grant	Provides support to urbanized areas and states for transit capital and operating assistance in urbanized areas and for transportation-related planning, including the replacement of polluting buses with eBuses.	States, counties, cities/townships, special districts, Tribal Governments
Rural Surface Transportation Program	$2 bil	Competitive	A wide variety of transportation-related projects (mostly highway), including electrification and the deployment of low- or no-emission vehicles and related infrastructure in public transit in rural areas	States, regional transportation planning organization, unit of local government, Indian Tribes
Overall IRA/ BIL funding	**$207B**			

5. STRATEGIES TO MINIMIZE COSTS, MAXIMIZE BENEFITS

As detailed above, to achieve 100% electrification of public transportation over a 12-year period, the four Ohio River Valley states will need roughly $325 million annually through 2035 for both vehicle purchases and facility electrification in Appalachia. This funding can include existing federal allocations from new programs specifically designed for low/no emissions vehicle purchases (see table 4 and 5 above detailing federal transportation program allocations from the climate infrastructure package), as well as those obtained by expanding existing programs like the Grants for Buses and Bus Facilities Competitive Program (49 U.S.C. 5339(b)) to cover electric transit vehicles. Below we articulate five strategies to help lower costs and maximize benefits from efforts to electrify public transportation.

A) STRATEGY #1: PLANNING FOR 100% ELECTRIFICATION OF PUBLIC TRANSIT WITH OTHER SECTORS OF TRANSPORTATION ALSO IN PROCESS OF ELECTRIFYING

Significant similarities exist between all types of fleet electrification - from public transit and school buses to corporate and government fleets. Thus, planning for fleet electrification should take place through a 'whole of government' approach, spanning cities, counties, and traditional agency or system boundaries to achieve standardization and efficiency. This collaboration is particularly important in light of the EPA's Clean School Bus grant program, which may provide opportunities for public transit agencies to enact cross-agency electrification efforts with school districts to increase efficiency in the electrification process. Below, we've indicated three recommended actions to accelerate eBus deployment:

1. The **federal government** should act to reduce duplication and friction in current eBus deployment by:
    a. Assembling a **fleet electrification playbook** for transit systems to use as a starting point, including comprehensive checklists and sample deployment roadmaps across operational and non-operational departments. The results of planning efforts could then be shared efficiently in a standardized format between actors and agencies.
    b. Providing standardized schematics and facilities-upgrade guidance for government-owned charging locations, presenting options based on climate, terrain, fleet size, and vehicle type.
    c. Supporting multi-agency consortia and existing regional transportation planning organizations by expanding eligible uses of metropolitan and non-metropolitan planning funds available through the Bipartisan Infrastructure Law to promote inter-agency collaboration across metropolitan regions, as well as expanding energy conservation and environmental outcomes within pre-existing programs.

2. **State or local governments should take the lead on utility collaborations to mitigate delays in grid reinforcement**. This work includes moving to comprehensively understand the grid implications of transportation electrification and to develop consistent funding mechanisms for grid upgrades in support of fleet activities. This support should expand beyond public transit systems to other major fleet operators such as school districts, delivery facilities, universities, and hospitals.

3. **Clean school buses and the need for additional cross-stakeholder collaboration.** In addition to resources for electrifying public transit previously mentioned in this report, Congress also allocated $5 billion in federal resources for a new Clean School Bus Program as part of the Bipartisan Infrastructure Law. Over the next five years, the federal government will allocate resources to replace existing diesel school buses with no- or low-emission vehicles, including battery-electric buses, to improve children's health. President Biden's Environmental Protection Agency is now in the process of awarding the second round of available funding, $400 million in school bus grants (taking applications through August 22, 2023). Applicants are encouraged to buy products largely made in the United States. Resources from this program must be used to replace older diesel buses and/or to acquire necessary charging equipment (except they cannot be used for grid reinforcement beyond the utility's side of the meter).[19]

   Undertaking a significant change, like that brought on by a shift to electric transit vehicles, alone, carries the potential for missteps or inefficiencies. Public transportation providers and school districts should work together, sharing best practices, experiences, creative solutions and infrastructure, as they transition towards electric vehicles. Electrifying the yellow school bus itself just scratches the surface of the changes needed, which include new vehicle maintenance procedures, updated operating manuals, expanded databases, altered purchasing contracts, and additional public outreach campaigns. These can be developed across agencies to spread the workload and then tailored for local nuance by individual systems.

STORY BOX:
SIMPLIFYING ELECTRIFICATION WITH PARTNERS AND COLLABORATIVES

Fleet electrification is complicated, especially for smaller districts that may not be able to achieve a sufficient economy of scale independently. S&B Construction is a Pittsburgh-based infrastructure development company working on fleet electrification efforts. S&B's goal is to provide holistic fleet electrification solutions for every step from bus purchasing to construction and project finance to ensuring energy needs are met for electrification. S&B Construction works on electrification for small and light-duty fleets as well as school bus and public transit systems. They are also interested in electrifying off-road and on-road construction vehicles and have been working with partners to deliver electrification infrastructure. To amplify the community benefits of transition, S&B also works with GreenPower Motor Company, a school bus manufacturer based in West Virginia, while operating and developing renewable energy and storage projects in Ohio, Pennsylvania, and West Virginia.

Good Guidance: About 98% of routes in the US can be completed with the current electric technology. Introducing electrification with "low hanging fruit"– routes that are relatively flat or short, and/or routes that consist mostly of city driving –is a good way to break into the electrification of school buses and public transit systems with the encouragement of early success. Advance route planning can factor in the time and space needed to charge.

S&B facilitates conversations with school districts in order to increase comfort with electric vehicle technology and demystify charging infrastructure. The company then helps fleet operators plan their transition from beginning to end. Districts, systems and organizations that own and operate their own fleet, or have begun the electrification conversation with their transportation provider, are better positioned to take advantage of federal funding opportunities.

S&B also helps these districts figure out what energy solutions can work for them. Some districts and systems install solar canopies as part of their charging infrastructure in order to help meet some of the fleet's electricity needs. This means utility companies are important collaborators during the electrification process. S&B has developed relationships with a number of utility companies so that already-overburdened school districts do not have to assume that task. They also help school districts find financing options to fill the gap left by federal funding, which typically doesn't cover the entirety of the costs associated with electrification.

B) STRATEGY #2: MAPPING EXISTING SKILLS OF TRANSIT WORKFORCE TO NEW SKILLS NEEDED

Transit systems cannot operate without a workforce dedicated to safely delivering people to their destinations. Transit systems employ up to five types of workers:

1. Operators - who drive vehicles,
2. Hostlers - who clean and fuel vehicles,
3. Mechanics - who conduct preventive or heavy maintenance,
4. Dispatchers & schedulers - who allocate operators to vehicles to routes, and
5. Clerical and administrative staff - who ensure everything works seamlessly.

Large urban public transit agencies typically employ well-paid union members, whose day-to-day activities are governed by multi-year contracts. While clerical and administrative staff in agencies will largely be spared disturbances from electric vehicles, the first three job classifications listed – operators, hostlers, and mechanics – will see their career pathways and training programs affected by electrification. Thus, agencies must begin their assessments of skill shifts now and be proactive with outreach to union members regarding retraining preferences and needs.

Operators and hostlers' core duties will see subtle operational changes, such as replacing fueling duties with charging and executing different troubleshooting processes for operational errors. And, if vehicle counts increase, transit agencies will likely need to hire more operators and hostlers to drive, clean, and charge the additional buses. However, as electric vehicles contain fewer parts and more computers, there is a high likelihood of decline in the need for mechanics.[20] Transit agencies must consider prioritizing these workers for new opportunities.[21]

Planning agencies, workforce development entities, and transit systems can support the transition for impacted employees by:

:

1. Convening a multi-state working group of agencies, transit and building trades unions, and training partners across the Ohio River Valley to jointly plan for the allocation of $275 million of funding available for workforce training and development.
2. Identifying the skills and competencies needed for electrified transportation and mapping those to existing talent pools and skills, taking a holistic view of the broader competencies attached to specific domains of technical knowledge.
3. Designing standard curriculum modules for new skills associated with alternative career paths. Curriculum developers in state departments of transportation and individual agencies can use those modules to accelerate retraining for the 97% of workers who do not have eBus skills.
4. Prioritizing displaced workers when assigning new roles and training within transit systems by providing paid on-the-job training opportunities to acquire new skills.[22]
5. Including union members and leaders in undertaking the workforce analyses submitted with 'Zero Emissions Transition Plans' in applications for eBuses.

C) STRATEGY #3: INCREASE PURCHASING POWER BY BUILDING A CONSORTIUM AND FORM AN EBUS MANUFACTURING CLUSTER IN THE REGION

If the region's transportation systems, local governments, school districts and anchor institutions combine forces to fulfill their electric vehicle needs, we can **use the region's collective bargaining power to reduce the costs** of electric buses, shuttles and vans **while also encouraging** the **manufacturing** of those vehicles and/or their pieces and parts **in Appalachia**. Smart and targeted investments that lead to the creation of new eMobility manufacturing clusters can create economically sustainable opportunities for future generations. This region has a history of strong economic clusters where businesses in similar industries locate near one another to reap the benefits of strong labor markets, professional networking, transportation linkages, and knowledge spillovers, all of which benefit not only firms but also workers and communities.[23]

These manufacturing clusters can build the foundation for a more prosperous shared economy as the electric vehicle supply chain is reinforced.[24] To create this wealth, local governments and anchor institutions can act now to:

1. **Form one or more purchasing collaboratives to aggregate vehicle and infrastructure purchases**. This expanded buying power could help Appalachian communities to lower the upfront costs of vehicle purchases and coordinate delivery schedules amongst partner agencies.
2. **Partner with economic development organizations and regional academic institutions to identify and market sites to eBus assemblers and parts manufacturers**. Advertising Appalachia's potential as a regional core of advanced manufacturing, hosting technological expertise as well as shuttered manufacturing and coal plant facilities capable of industrial production at the requisite scale[25], will help purchasing collaboratives build the leverage to demand "made in Appalachia" labor and community standards. .
3. **Bring a federally-sponsored or other equivalent 'innovation hub' to the region**. Many available sites and forthcoming investments in new cluster development can be targeted toward creating an eBus hub across the four states that build on existing efforts, like the existing Federal Transit Administration bus proving ground in Altoona, PA.

D) STRATEGY #4: SOURCING LOCAL AND CLEAN ELECTRICITY

The climate and health benefits of decreased pollution and toxicity from tailpipes are a major boon for communities that use electrified transit. However, to avoid outsourcing this pollution to power-plant communities, transit agencies must use green and renewable electricity.

Whether through agency-owned generation or contractual agreements with for-profit partners, local generation can create good jobs in communities while growing wealth. Transit agencies are already investing in new and innovative power generation. For example, Philadelphia's SEPTA is now purchasing 20% of its electricity from a South Central Pennsylvania solar project.[26] Appalachian transit agencies can achieve similar cost and pollution benefits by:

1. **Combining forces with other transit systems, local governments and/or anchor institutions to launch large clean energy projects** while lowering costs, reducing risks associated with financing the project, and creating local jobs (more on that below).

2. **Sharing expertise around renewable power purchasing to ease transition, whether to agency-owned assets** like solar canopies with new vehicle charging capacity for parking areas or to externally supplied energy provided through Power Purchase Agreements like the SEPTA example above.

The story box below provides examples of school bus systems that have proactively incorporated the use of solar canopies as they work to electrify their school bus fleets.

STORY BOX: EXAMPLES OF SCHOOL DISTRICTS AND PUBLIC TRANSIT SYSTEMS USING SOLAR CANOPIES TO HELP ENERGIZE THEIR VEHICLE FLEETS.

In addition to electrifying their fleets, some forward-thinking school districts and public transit systems have also invested in solar charging stations in the form of solar canopies. Some states have established public funding especially for the construction of solar canopies. Solar canopies provide a self-sustaining and green method of charging electric school buses, and these school districts' results are well worth replicating elsewhere.

- The **Oconomowoc Transport Company in Wisconsin** started the electrification process back in 2010 with resources from the American Rescue and Recovery Administration during the Obama Administration. Their school buses charge up with a solar canopy that was manufactured in Memphis, Tennessee.[28]
- With resources from the Volkswagen Settlement and funds from the Utah Clean Diesel Grant program, the **Salt Lake City School District in Utah** was able to purchase 8 electric buses in 2021.[29] The district then worked to secure additional funds from the Rocky Mountain Blue Sky program to expand their existing solar canopy.
- Since 2014, the Maryland Energy Administration has awarded funds for public transit solar canopies under its **Solar Canopy Grant Program**. Additionally, the program stipulates the installation of at least four EV charging stations per solar canopy.[30] In 2021, the grant program funded eight solar canopies and 35 accompanying EV charging stations.

E) STRATEGY #5: FINANCING TRANSIT DECARBONIZATION

With an estimated $70 billion needed for transit decarbonization alone in the United States, existing and future federal funding programs will likely not provide enough money to achieve an ambitious 12-year decarbonization timeline. Thus, moving decisively and rapidly to electrify will require reinventing the public financing playbook to move beyond traditional federal grant expenditures and bond issuances and bring private capital into the fold. The Environmental Defense Fund highlighted some of these private financing opportunities in 2020. To replicate the benefits and avoid the shortfalls of Appalachia's past public-private partnerships, we can employ the following best practices:

1. **Establish local programs, modeled after successful examples in New York and elsewhere** (see Table 8), **that leverage public capital** to secure additional private capital at significant and favorable ratios while keeping Appalachians at the decision making table.
2. **Support local agencies in developing sophisticated funding mechanisms**, such as by providing templates for green bond issuances or convening summits that bring together governments and financiers.

Green banks: a public-private partnership to facilitate climate investment

A green bank is a financial institution that leverages public money to secure and supplement private investment in projects that reduce carbon emissions and promote climate change mitigation.[33] These projects are often seen as risky due to their reliance on emerging technologies or their relative lack of prior investors. Green banks strategically use public money to lend security to these projects, thus attracting private capital and helping eliminate perceived barriers to investment.

A number of cities, counties, states, and countries have established their own green banks; while these institutions vary in exact mechanics, they share the same basic functions and commitment to funding climate infrastructure. The largest green bank in the United States is the New York Green Bank, which committed $437.8 million of capital across 17 transactions during the 2021-2022 fiscal year.[34] Other states with green banks include Connecticut, Rhode Island, Hawaii, and California. On the local level, Maryland's Montgomery County operates its own green bank.[35]

The Inflation Reduction Act, passed in August 2022, includes $27 billion for the establishment of a National Climate Bank, with $8 billion specifically allocated for disadvantaged communities.[36] A federal green bank will facilitate investment in climate infrastructure on a massive scale, making private financing, especially when utilized strategically in conjunction with existing and forthcoming public funds, far more accessible to projects such as public transit electrification.

CONCLUSION

This report's focus has been the potential for transit electrification. Many households cannot afford the expenses of owning, operating, and maintaining a vehicle. As personal vehicle technology advances, the trend in automobile prices is expected to keep increasing. The number of households who cannot afford to drive will also likely increase. Additionally, an aging population and COVID-19-induced increases in the rates of disability will add to the numbers of people for whom individual automobile transportation is not accessible. Those changes, coupled with the ease of using mobility-as-a-service offerings like ride-shares, car-shares, and last-mile services as well as the climate impact of mass automobile dependency, means that public transportation will become even more important in the future.

Ultimately, electrifying transportation is not easy - it requires the confluence of local, state, and federal intent, coupled with a rapid scaling of manufacturing capacity and workforce knowledge, and a willingness to replace not only buses but also mindsets about mobility and transportation. Taking on that change requires strong action from our elected officials and community leaders, but it also invests those people with the once-in-a-generation opportunity to contribute to massive environmental and social progress.

END NOTES

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