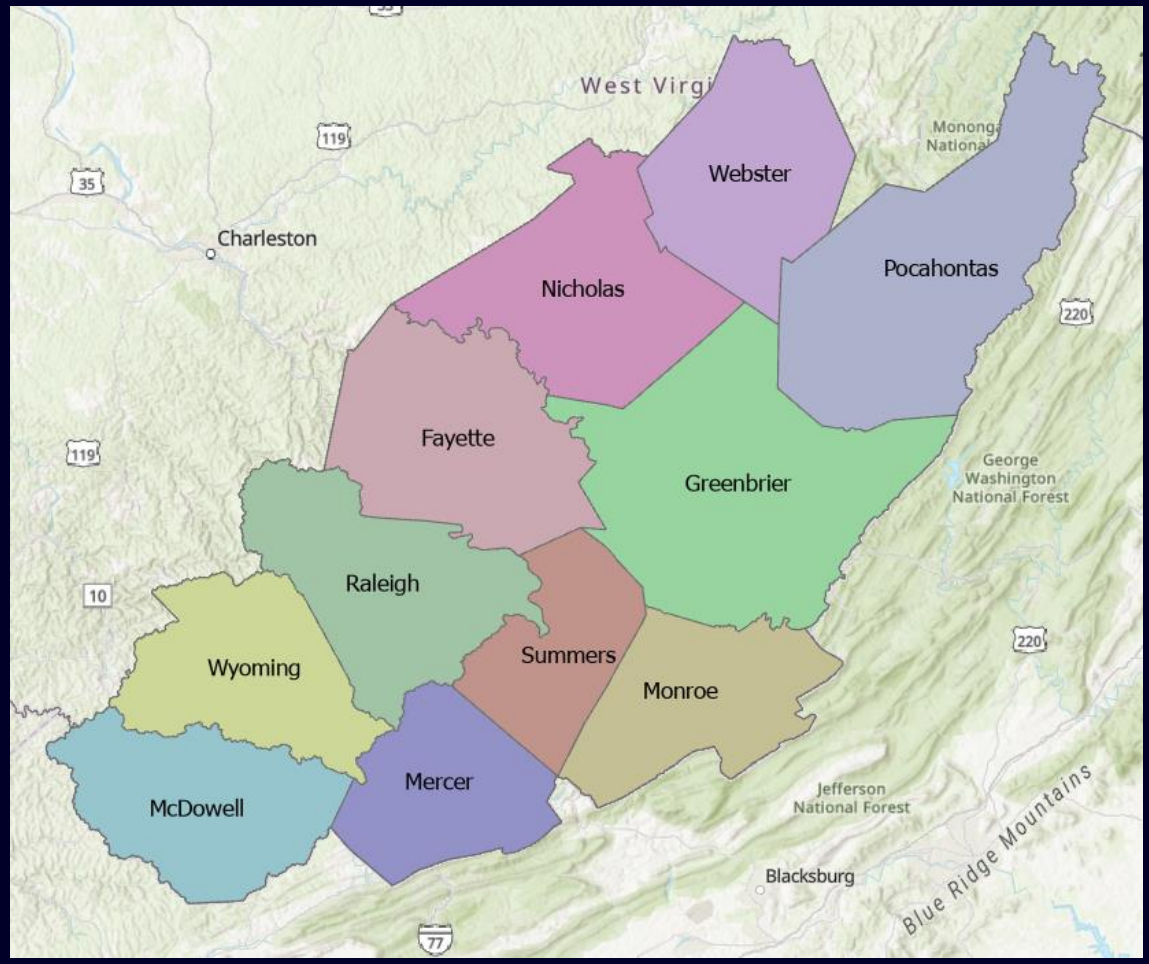
Electric Vehicle and Charging Infrastructure Roadmap for Southeast West Virginia



Final Report

July 2024

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Table of Contents

I. Study Objectives and Scope
II. Executive Summary
III. Current EV Ecosystem
    I. EV Vehicles
    II. EV Charging
    III. Electrification Policies
    IV. Stakeholder Insights
IV. Future EV Ecosystem
    I. EV Vehicle Adoption Forecast
    II. EV Charging Infrastructure Locations
    III. State Park EV Charging Forecast
    IV. Economic and Tourism Impacts
V. E-Bike and Micro-Mobility
VI. EV Charging Feasibility
    I. EV Charging Feasibility
    II. Economic Impacts
VII. Appendix

Study Objectives and Scope

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Charging Plan: Project Scope

Regions 1 & 4 requires a practical and implementable EV Charging Plan to guide charging development

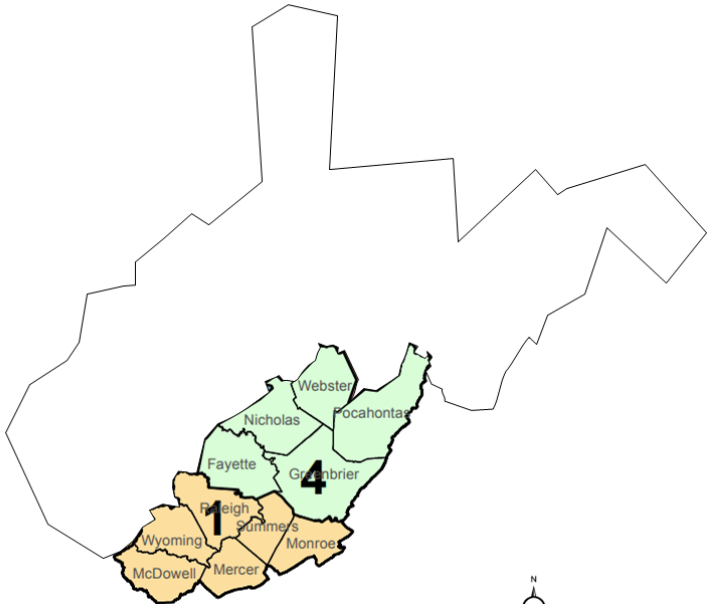
Background

- Siemens PTI understands that the Region 1 and 4 Planning and Development Councils of West Virginia combined their efforts to craft an Electric Vehicle (EV) charging station study across their jurisdictions.
- The Councils seek a comprehensive feasibility and siting study for EV charging stations throughout Regions 1 and 4. The objective of the study is to evaluate the feasibility of siting new EV charging stations in strategic locations throughout each region which would catalyze economic development, support existing businesses, improve quality of life for residents and visitors, and support key tourism destinations.

Objectives

- Assess opportunity for EVs and associated charging to support economic development within the Councils.
- Provide foundational information and support to local entities most likely to consider EVs for fleet operations

WV Regional Planning Councils 1 & 4 County Constituents



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Charging Plan: Original Study Approach

EV Charging plan founded on facts and designed to identify attractive locations, and support business decisions

1 Project Management and Progress Reporting

Provide all project management activities necessary for the performance of the scope of work, including the following:

- Coordinate the work of Siemens PTI's team that are undertaking tasks described in scope of work; ensure control over the project quality, budget and adherence to the project schedule; and provide all project reporting as required.
- Progress meetings with client Project Manager

	2 Project Kick-Off, Plan Confirmation, Data Access	3 Current EV Ecosystem	4 Future EV Ecosystem	5 EV Charging Feasibility Review
Objectives	Establish project foundations and direction	Identify and assess current EV and local economics situation	Forecast EV infrastructure, services, and program needs	Assess EV charging economics and feasibility
Key Tasks	2.1 Confirm Study Plan, Requirements and Schedule 2.2 Conduct Project Kick-Off Meeting 2.3 Identify Data Sources	3.1 Existing Plan(s) Review 3.2 Current EVs, infrastructure, policies, programs, business models, etc. 3.3 Economic development, tourism patterns and economics 3.4 Stakeholder outreach	4.1 Forecast infrastructure needs and locations 4.2 Forecast probable charging sites	5.1 Share EV charging business models 5.2 Develop EV charging station economics 5.3 Economic development impact
Deliverables	1. Project Kick-Off Meeting 2. Study Requirements 3. Data Sources	1. EV Current Ecosystem Chapter 2. Stakeholder Perspective	1. EV Future Ecosystem Chapter 2. Economic and Tourism Impacts	1. EV Charging Feasibility 2. Economic Impacts

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Charging Plan: Added Scope

The Council's elected to add study topics to further enhance the EV plan

1. Regional Stakeholder and Site Information Gathering
2. Electrified School Bus Requirements
3. Electrified Transit Bus Requirements
4. Electrified Fleet Requirements
5. Electrified Bike (eBike) Requirements
6. EV Charging at State and Federal Parks
7. Electrification Policies, County and City
8. Electrification Impacts on Utility Feeders

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Executive Summary

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Summary Results

EV charging both needed and viable to support southeastern WV

- EV charging will need to serve both locals and tourists
  - Local private EV adoption is nascent and forecasted to grow; public charging needed to enable adoption
  - Early commercial EV adopters include schools, transit agencies, and local delivery operators.
  - Tourist with EVs require charging or will vacation elsewhere taking valuable tourism income
  - Strong federal, state, and utility incentives support EV purchase and charging infrastructure development

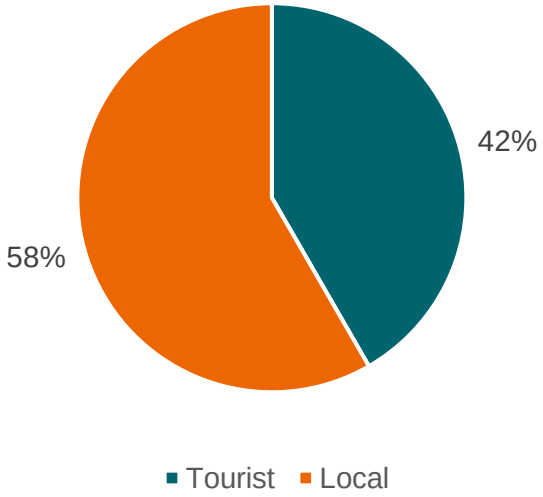
- While some charging needed along major corridors, local points of interest (e.g., hospitals, shopping centers, parks, etc.) offer potential
  - NEVI program will fund interstate corridor charging in Phase 1 and may extend to state roads in Phase 2
  - Some local charging will be provided by fuel stations and national retailers like Walmart and Sams Club
  - Some national fleet owners (e.g., USPS, Fedex, UPS, etc.) will build for their needs
  - Where national fleets pay to upgrade local systems for their needs, adding public charging will be easier and less costly

Summary Results

Development of 113 chargers at perhaps 29 locations through 2035 could bring significant benefits to the Councils

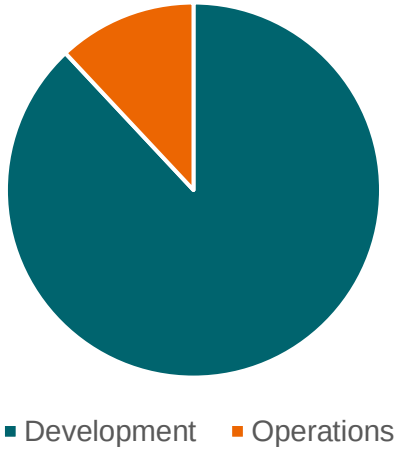
Distribution of Developed Chargers through 2035

∑ = 113



Distribution of Direct Costs through 2035

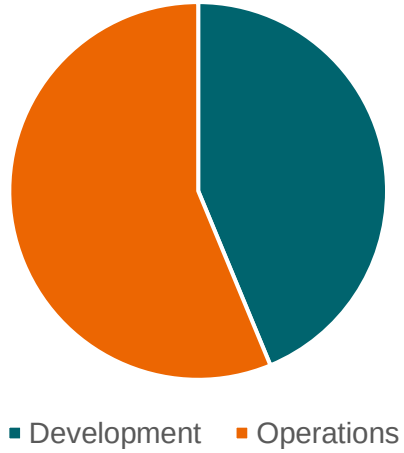
∑ = $33.34 million



- Including induced impacts would add another 22% to the cost impacts.
- Not all costs will be spent in the Councils

Distribution of Charger Employment through 2035

∑ = 64 Jobs



- Including induced impacts would add another 28% to the employment impacts.
- Not all jobs will be added in the Councils

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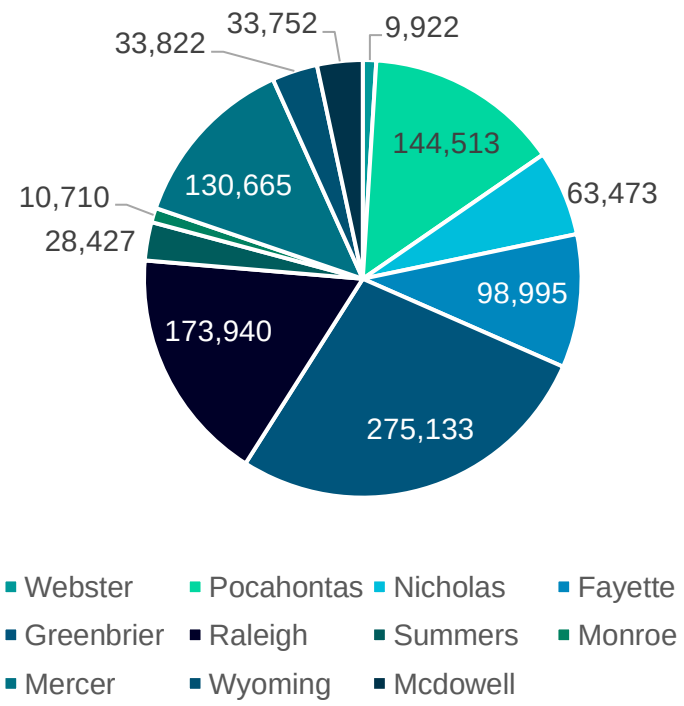
Tourism at Risk

Just over $1 billion in tourist related spending across the Councils will increasingly depend upon charging access

Distribution of Tourism Spending in 2021

Thousands



- Pocahontas, Greenbrier, Raleigh, and Fayette counties comprise more than 60% of tourism spending.
- Available EV charging will become increasingly important as EV adoption accelerates in key neighboring states including Ohio, Pennsylvania, Virginia, and North Carolina
- Considering current spending, and forecasted EV adoption, as much as $100 million per year in tourism spending could be lost by 2035.

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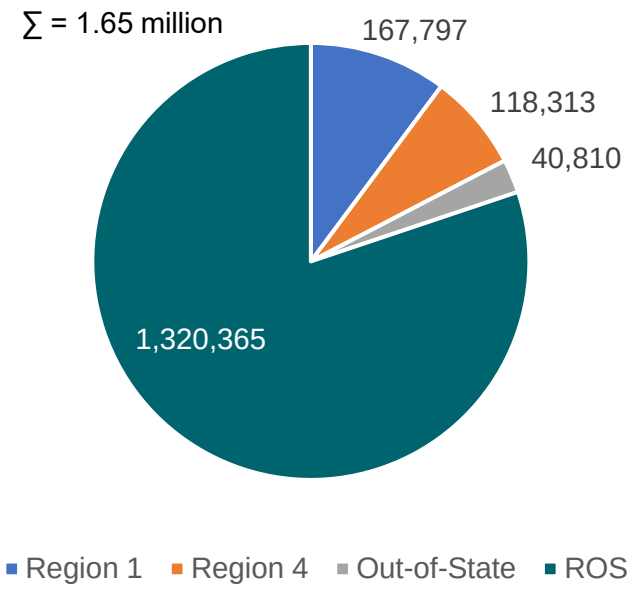
Current EV Ecosystem

Current Vehicle and EV Population

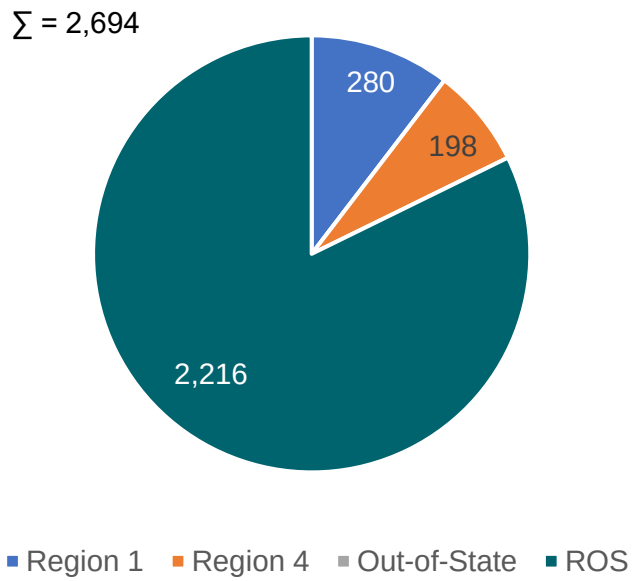
17.4% of WV registered vehicles domiciled in Regions 1 & 4 in 2020; About 0.16% of WV registered vehicles in 2022 were EVs

West Virginia Registered Vehicles,
No. as of 2020



Source: West Virginia Division of Motor Vehicles Annual Report 2020

West Virginia Registered EVs,
No. as of 2022



- According to the American Community Survey, across WV population declined 0.46% p.a. from 2015 to 2021 and the number of households declined 0.64% from 2017 to 2022
- Declining population and number of households suggest the number of registered vehicles will decline in many WV counties

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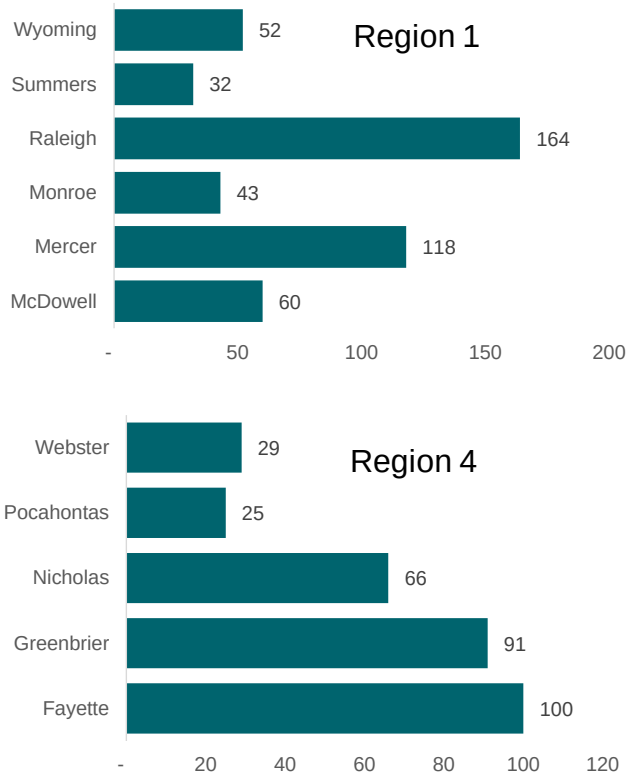
Key Segment Vehicle Population

School buses, transit vehicles, and smaller commercial vehicles will switch to EV first

School Bus Fleet by Region and County,

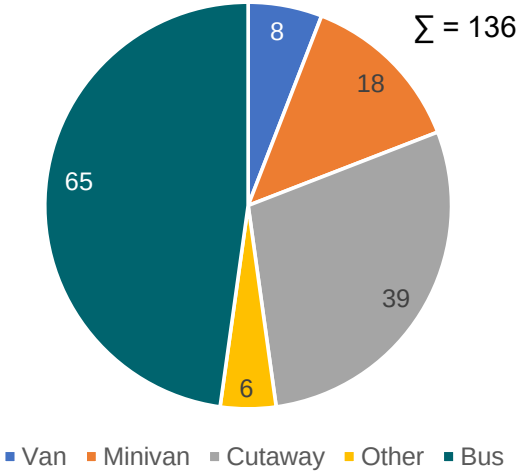
No. of school buses



Source: World Resource Institute

Transit Vehicles Serving Regions 1 and 4,

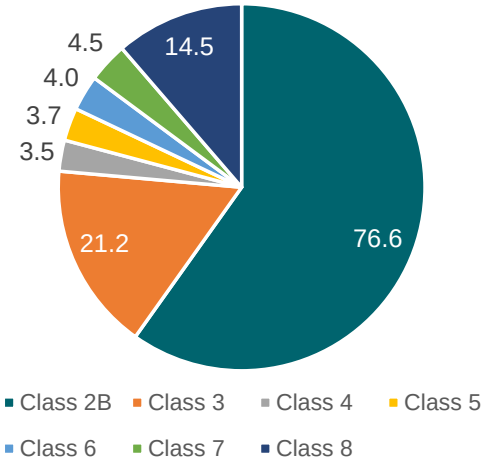
No. of vehicles



- Three public transit agencies serving the Regions
  - Kanawha Valley Regional Transportation Authority
  - Mountain Transit Authority
  - New River Transit Authority
- Bluefield Area Transit is a municipally owned transit department also serving part of the area
- Between them, there are 136 operating vehicles of which most are cutaways or buses

WV Commercial Vehicles by Class,

No. of vehicles



- Most commercial trucks are either relatively small (class 2b and 3) used in local service, tractor trailers (class 8) used for longer larger loads
- For reference, Class 2b tend to be large pickup (i.e., F250/ 350) often used by local contractors

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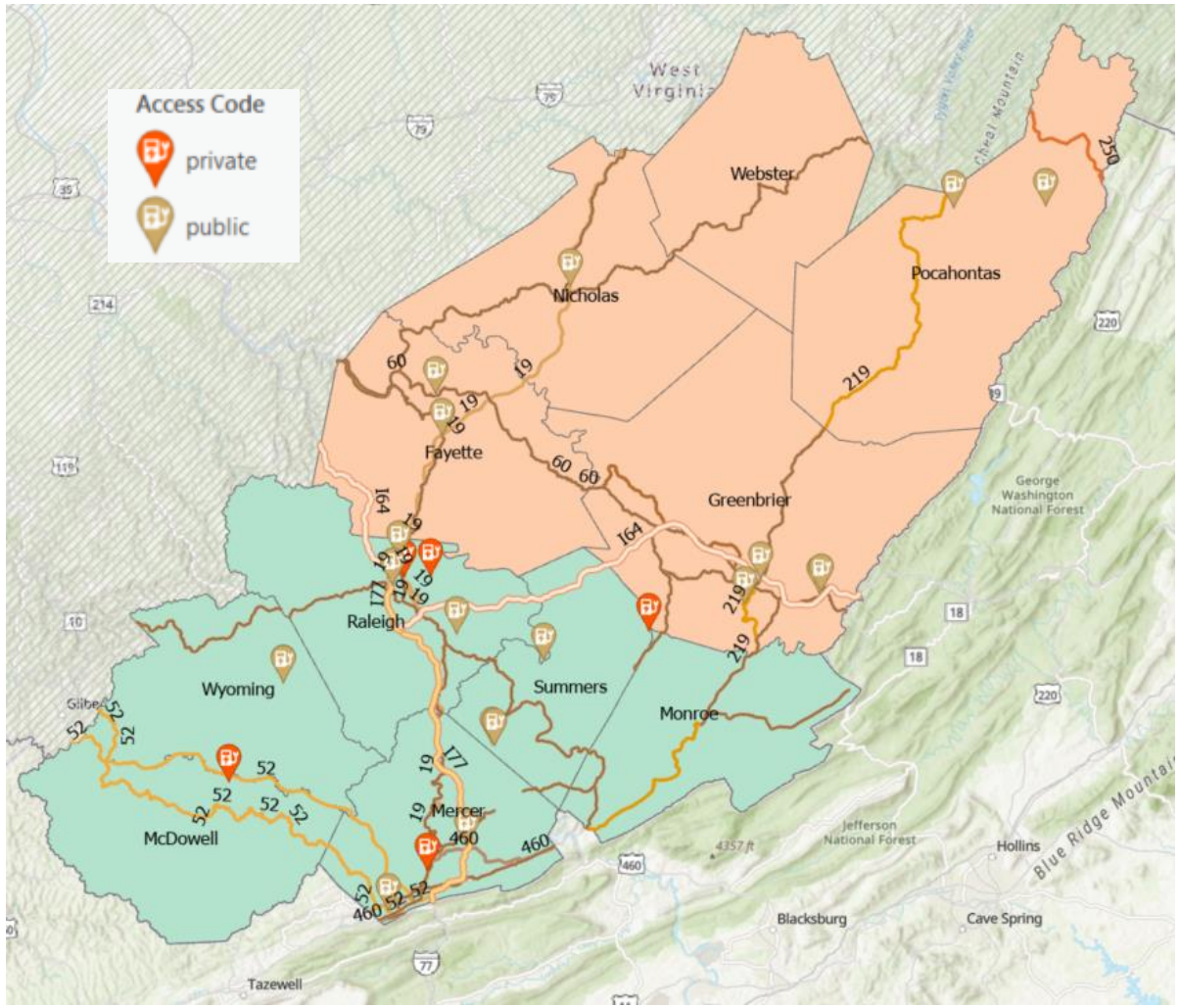
Current EV Charger Locations

Mix of public and private charging concentrated to the South

- 30 Existing EV Charger Locations between Regions 1 & 4
  - Region 1 counties include: 17 Locations
    - 5 Private & 12 Publicly Accessible
  - Region 4 counties include: 13 Locations

Region	Access	EV Network	L1 EVSE Count	L2 EVSE Count	DCFC EVSE Count
1	Private	Non-Tesla	4	2	
	Public	Non-Tesla	1	12	
		Tesla		11	16
4	Public	Non-Tesla		23	1
		Tesla		6	8
Grand Total			5	54	25



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Stakeholder Input

Critical input guiding and supporting charging planning

- Local stakeholder meetings conducted with members of Regions 1 and 4 January 29-30, 2024
- Presented brief project slide deck to inform and elicit feedback
- Stakeholders in a unique position within community to identify attractive locations, partners, and concerns
- Interesting discussions with Mayors, County representatives, and leaders of one of the transit bus fleets amongst others
- Reviewed Tennessee Tech charger offering and recent successes
- Gathered contacts for future conversations

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EV Policies

Substantial EV and charging incentives currently available with more on the way

Over $18 billion in Federal incentives alone

Program	Incentives
National Electric Vehicle Infrastructure (NEVI) Formula Program	$5 billion for states to build a national EV charging network
Community and Fueling Infrastructure (CFI) Grant Program	$2.5 billion for EV charging among other incentives
Low- or Non-Emission Vehicle Program for Transit	$5.6 billion in support of low- and No-Emission transit bus deployments
Clean School Bus Program	$5 billion in support of electric school bus deployments

+

West Virginia EV Incentives

Laws and Incentives

Information in this list is updated throughout the year and comprehensively reviewed annually after West Virginia's legislative session ends.
Last Comprehensive Review: March 2024

State Incentives

- West Virginia's National Electric Vehicle Infrastructure (NEVI) Planning

Utility/Private Incentives

- Residential Electric Vehicle (EV) Charging Station Rebate - Appalachian Power
- Electric Vehicle (EV) Time-Of-Use (TOU) Rate – Appalachian Power Company
- Electric Vehicle (EV) Infrastructure Support

Laws and Regulations

- Alternative Fuel Vehicle Fee
- Alternative Fuel Production Subsidy Prohibition
- Alternative Fuels Tax
- Public Utility Definition
- Alternative Fuel Use Requirement
- Mid-Atlantic Region Electric Vehicle (EV) Support

Source: AFDC

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West Virginia NEVI Plan Outline and Funding

Program will use federal funds to reinforce current charging corridors and establish new ones

- $45.7 million in NEVI funds will be apportioned to WVDOT over 5 Years
- An estimated 912 new public charging ports will be constructed in total

Phase	Duration	Cost (% of Total NEVI Funds)	Goal	Progress
Phase 1 (Electric AFC Charging)	2 Years	30-37%	• Build-out of NEVI stations along designated AFCs • Chargers will be located within 1 mile of AFCs • 50 miles or less of spacing between chargers	• 15 charging stations have been proposed (60 ports)
Phase 2 (Community-Based Charging)	3 Years	63-70%	• Designed to build out additional charging corridors • Completive and community-based grant process • Chargers may be located on any public road or publicly accessible location	• Site selection process will begin once Phase 1 is complete

*AFC: Alternative Fuel Corridor

Source: https://transportation.wv.gov/highways/programplanning/NEVI/Documents/WV%20NEVI%20PLAN_9-28-23%20Final.pdf

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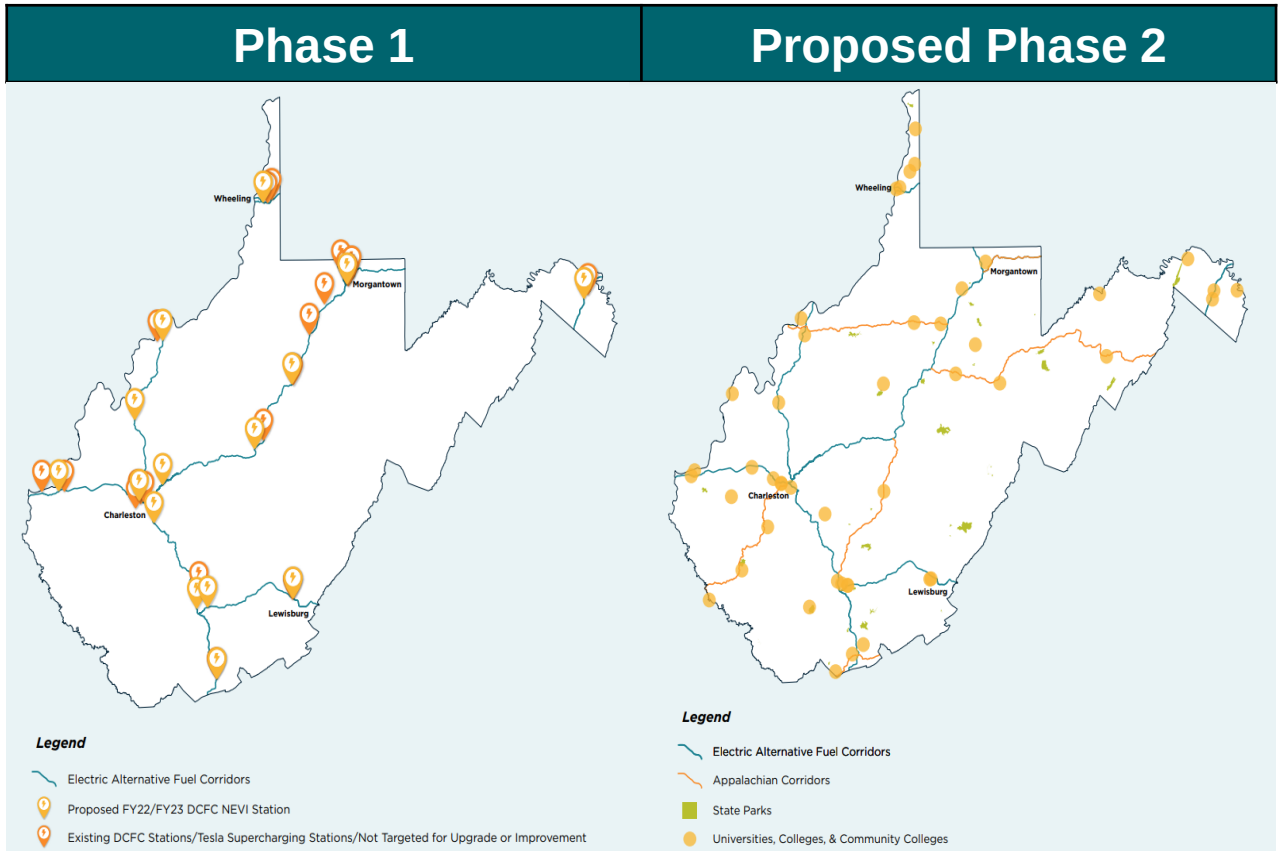
West Virginia NEVI Plan Proposed Charging Locations

Phase 1 locations appear to be set, while Phase 2 locations remain flexible

ID	City Name	Route	Interstate Exit	Number of Ports	NEVI Funding Sources
1	Huntington	I-64	15	4	FY22/FY23
2	South Charleston	I-64	56	4	FY22/FY23
3	Ripley	I-77	138	4	FY22/FY23
4	Parkersburg	I-77	176	4	FY22/FY23
5	**Tamarack**	**I-64**	**42**	**4**	**FY22/FY23**
6	**Princeton**	**I-77**	**9**	**4**	**FY22/FY23**
7	**Lewisburg**	**I-64**	**169**	**4**	**FY22/FY23**
8	Sutton	I-79	62	4	FY22/FY23
9	Weston	I-79	99	4	FY22/FY23
10	Morgantown	I-68	1	4	FY22/FY23
11	Wheeling	I-70	4	4	FY22/FY23
12	Martinsburg	I-81	13	4	FY22/FY23
13	Kanawha City	I-64	89	4	FY22/FY23
14	Elkview	I-79	9	4	FY24
15	**Beaver**	**I-64**	**125**	**4**	**FY24**

- Each station has will cost ~$1,200,000 in NEVI funds
- Estimated year of operation for each station is 2025



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Additional EV Funding Opportunities

Program	Summary Description
Alternative Fuel School Bus Incentive	Any county that uses compressed natural gas (CNG), propane, or electricity for the operation of any portion of its school bus fleet is eligible for a 10% reimbursement from the West Virginia Department of Education to help offset maintenance, operation, and other costs. A county is eligible for an additional 5% reimbursement for the portion of the school bus system that is manufactured within the state of West Virginia.
Electric Vehicle (EV) Time-Of-Use (TOU) Rate – Appalachian Power	Appalachian Power Company offers a TOU rate to residential customers who own an EV. Eligible customers must have a meter that is capable of separately identifying EV usage.
Residential Electric Vehicle (EV) Charging Station Rebate - Appalachian Power	Appalachian Power offers residential customers a rebate of up to $500 for the purchase and installation of an ENERGY STAR certified Level 2 EV charger by an approved contractor.
Alternative Fuel Vehicle Fee	In addition to standard registration fees, owners of vehicles fueled with natural gas, hydrogen, or electricity must pay an annual fee of $200. Plug-in hybrid electric vehicle owners must pay an annual fee of $100.
Alternative Fuel Vehicle Refueling Property Tax Credit	The Alternative Fuel Vehicle Refueling Property Credit will allow individuals to receive a tax credit of 30% of the cost of the EV charging infrastructure, with a maximum amount of $1,000. To be eligible, the individual must be located in a low-income community or a non-urban area.
Discretionary Grant Program for Charging and Fueling Infrastructure	The Discretionary Grant Program for Charging and Fueling Infrastructure consists of $2.5 billion million dollars to complement the build-out of EV charging infrastructure along alternative fuel corridors. States, cities, metropolitan planning organizations, and local governments are eligible recipients and can receive the grant. Of the $2.5 billion, $1.25 billion is set aside for community and corridor grants, with priority given to applications serving rural areas, low- and middle-income areas, and areas with a high ratio of multi-unit dwellings to single-family homes.
Clean School Bus Program	The EPA's Clean School Bus program awards funding to school districts that wish to purchase electric school buses and associated EV charging infrastructure to provide students with a cleaner and healthier ride to school. Technical assistance is also available under this program.
Formula Grants for Rural Areas	The Formula Grants for Rural Areas (5311) provides capital, planning, and operating assistance to states and tribal nations to support public transportation in rural areas with populations of less than 50,000 in regions where the public relies on public transit. This funding can be used for infrastructure planning, technical assistance, workforce development, medium- to heavy-duty EV charging infrastructure, and medium- to heavy-duty EV purchases or leases. The federal share includes 80 percent for capital projects, 50 percent for operating assistance, and 80 percent for Americans with Disabilities Act (ADA) non-fixed route paratransit service.

Additional EV Funding Opportunities

Program	Summary Description
Low or No Emission Vehicle Program	The Low or No Emission vehicle program is focused on lessening emissions from public transit buses and enables eligible applicants to purchase low- or no-emission transit buses. Eligible applicants include states, local governments, and Tribes. 25% of Low-No funding is allocated towards application for low-emission vehicles and 75% is allocated towards zero-emission vehicles. Program funding may also be applied to workforce training and EV charging infrastructure.
Public Works and Economic Adjustment Assistance Program	The Public Works and Economic Adjustment Assistance Program (PWEAA) provides grants to states, nonprofits, tribal entities, local governments, and educational institutions for projects in distressed communities, including those impacted by changes to the coal economy. The financial investment provides resources to meet the construction or infrastructure design needs of communities so they can be more economically competitive. Projects can include the installation of EV charging infrastructure, workforce development for EV projects, and EV infrastructure planning.
Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Program	The Rebuilding American Infrastructure with Sustainability and Equity is for road, rail, transit, and port projects investments that work towards achieving national objectives. The eligibility requirements of RAISE allow state and local level entities to obtain funding for multimodal, multi-jurisdictional projects that are more difficult to support through traditional DOT programs. The program includes funding for light- to heavy-duty charging infrastructure and infrastructure planning. The minimum RAISE grant award for capital grants is $5 million in urban areas and $1 million in rural areas. There is no minimum award amount for planning grants. The maximum grant award for capital and planning grants is $25 million.
Rural Surface Transportation Grant Program	The Rural Surface Transportation Grant Program supports projects that improve and expand our nation's surface transportation infrastructure in rural areas. At least 90% of rural funding must be awarded in $25 million or greater amounts. Eligible projects include light-duty EV charging, transit EV charging, commercial EV charging, infrastructure planning, and workforce development.
Commercial Clean Vehicle Tax Credit (45W)	Businesses that buy a qualified commercial EV may qualify for the Commercial Clean Vehicle Tax Credit of up to $40,000 under Internal Revenue Code 45W. The credit equals the lesser of: • 30% of your basis in the vehicle for EVs, 15% for plug-in hybrid EVs (i.e., PHEVs). • The incremental cost of the vehicle. • The maximum credit is $7,500 for qualified vehicles that weigh under 14,000 pounds (Classes 1–3) and $40,000 for all other vehicles (Classes 4–8). Tax-exempt entities are also eligible for the tax credit via the elective pay (also known as direct pay) option. Individuals leasing a light-duty vehicle may also benefit from this tax credit indirectly. The registered dealership or the automaker can claim the tax credit and pass on the value to the consumer, resulting in a reduced vehicle price.
Community Facilities Direct Loan Program	As part of the Community Facilities Direct Loan and Grant Programs, the Community Facilities Grant Program provides additional funding, along with that for vehicle acquisition for communities in rural areas.

Future EV Ecosystem

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EV Vehicle Adoption Forecast

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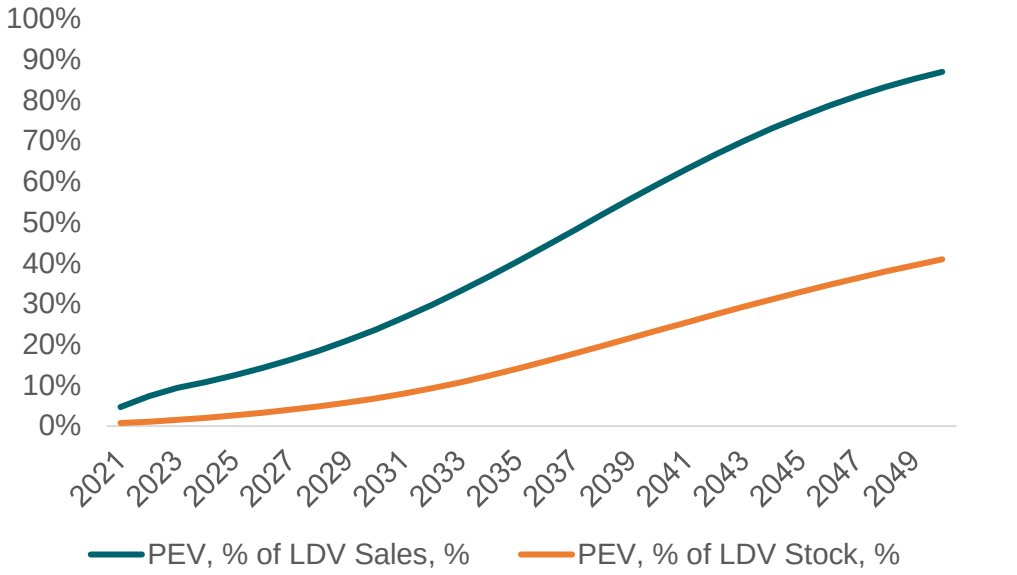
US EV Adoption and Forecast

By 2050 approximately 87% of new LDVs are expected to be EVs, but only 41% of registered vehicles will be EVs

Growth in registered EVs…

US LDV EV Growth, 2023-2050,
%

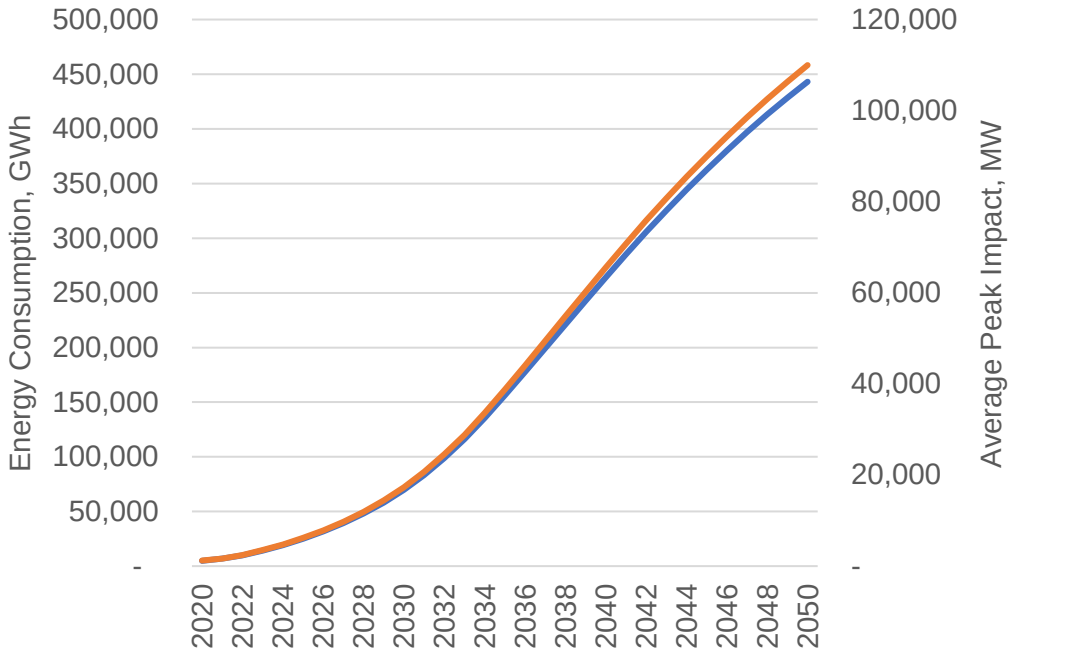


Source: Siemens PTI proprietary model

- While the pace of US EV purchases increases (blue), it takes time to turnover the approximately 260 million LDV stock
- Of course, results vary by state and locality

… Drives energy requirements and infrastructure demand

US LDV EV Electric Requirements,
2023-2050



- In our experience, the actual hourly peak load resulting from EV charging could exceed 2.3x of the average hourly load if unmanaged.
- Charge timing can be managed by vehicle owners, often driven by tariff design, or utilities

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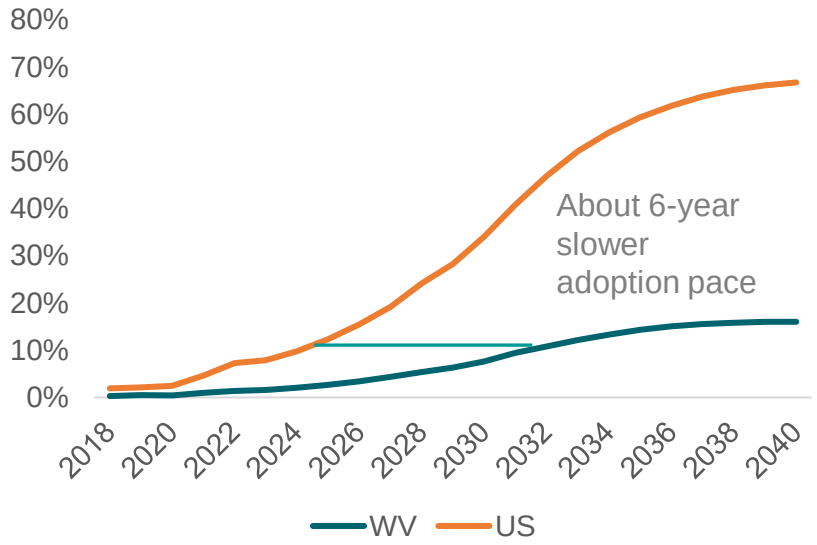
West Virginia EV Adoption and Forecast

EV adoption slower in WV than across the country as a whole

LDV EV Adoption Comparison,

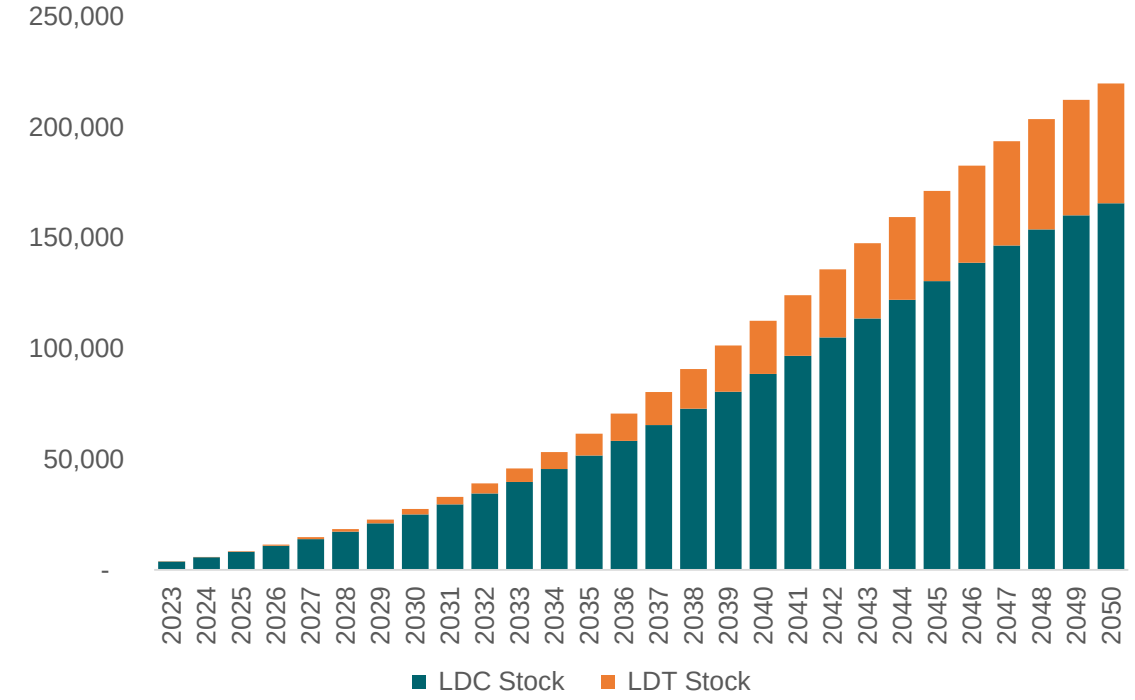
% of LDV Sales



Source: Siemens PTI proprietary model

WV LDV EV Growth, 2023-2050,

No. Registered LDV EVs



Source: Siemens PTI proprietary model

- LDV = light duty vehicles which are comprised of LDC (light duty cars) and LDT (light duty trucks)

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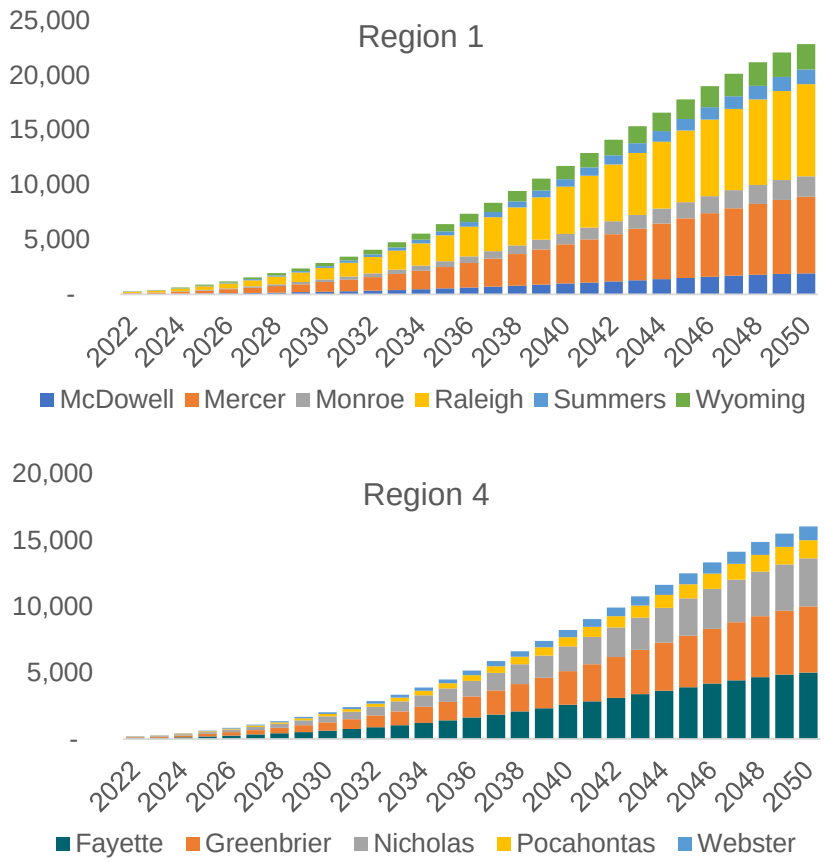
Region & County Private EV Registration Forecast

EV adoption expected to vary by County with growth at somewhat differing rates

LDV EV Registrations by Council and County,

No. of LDV EVs



- State LDV EV forecast segmented to county level based on registered vehicles and recent county population and household growth trends
- Downward trends slow the pace of vehicle purchases and registrations regardless whether vehicles are EV or traditional
  - Top Region 1 counties include: Raleigh and Mercer
  - Top Region 4 counties include: Greenbrier, Fayette, and Nicholas

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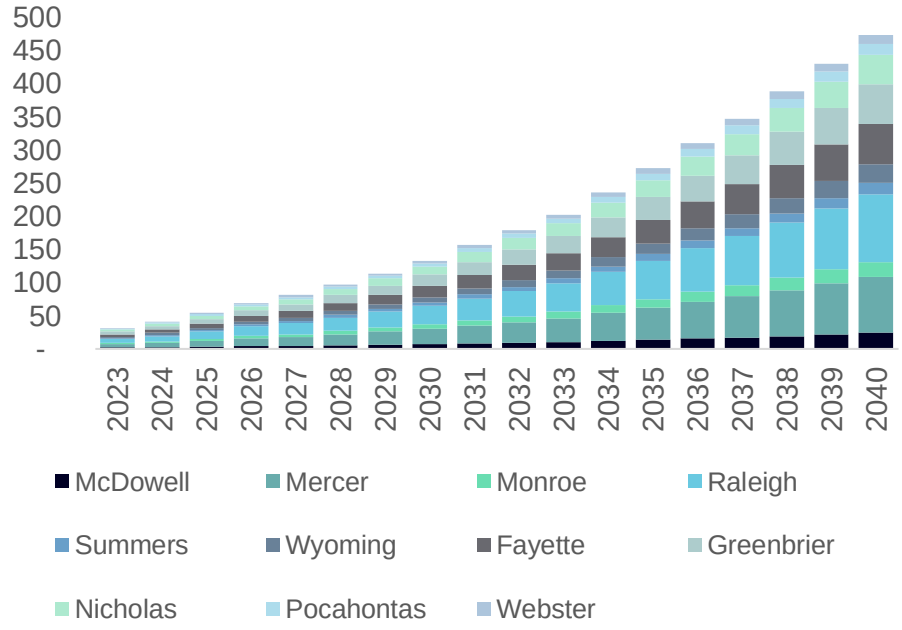
Region & County Public Access Plug Forecast

Public charging stations and the number of plugs will need to grow to keep pace with EV adoption

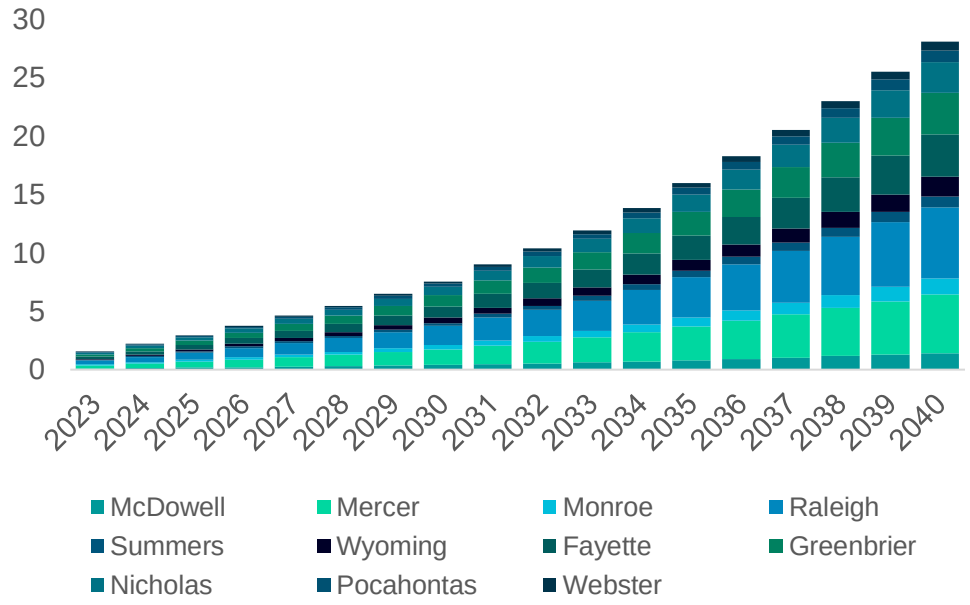
Public L2 Plugs Required by Region and County,

No. of Plugs



Public L3 Plugs Required by Region and County,

No. of Plugs



- Detailed County plug forecasts provide planning basis

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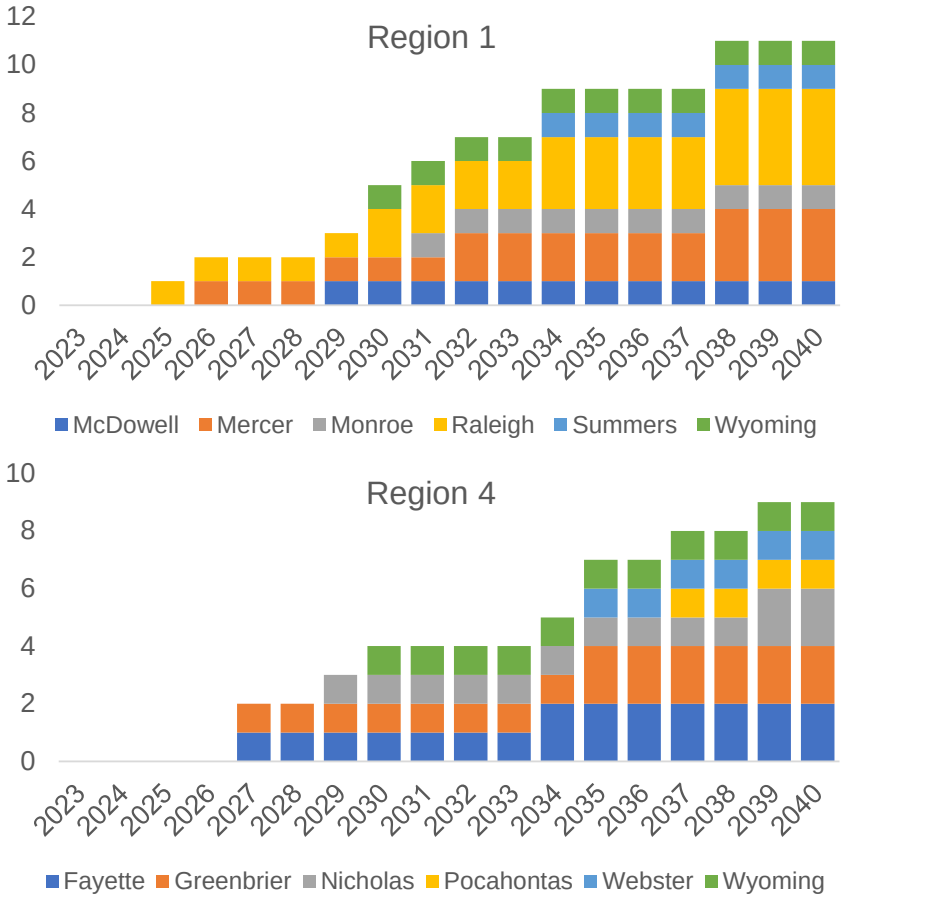
Region & County School Bus EV Registration Forecast

EV school buses expected to begin appearing in 2025

- Electrification of school buses expected to accelerate rapidly nationwide
- Federal funds available via the Clean School Bus Program which provides $5 billion in support of electric school bus deployments
- Some states adding more funding to support bus and charger acquisition
- Across WV, there are 3,832 operating school buses. In Region 1 there are 469 and in Region 4 there are 311.
- WV purchased 41 all-electric GreenPower school buses; the first 4 Type A Nano BEAST school buses were delivered to Cabell, Clay, Monongalia and Kanawha counties
  - Kanawha County is set to receive another in 2024
  - Manufactured all-electric school buses from the company's South Charleston manufacturing facility

EV School Buses Required by Region and County,

No. of EV school buses



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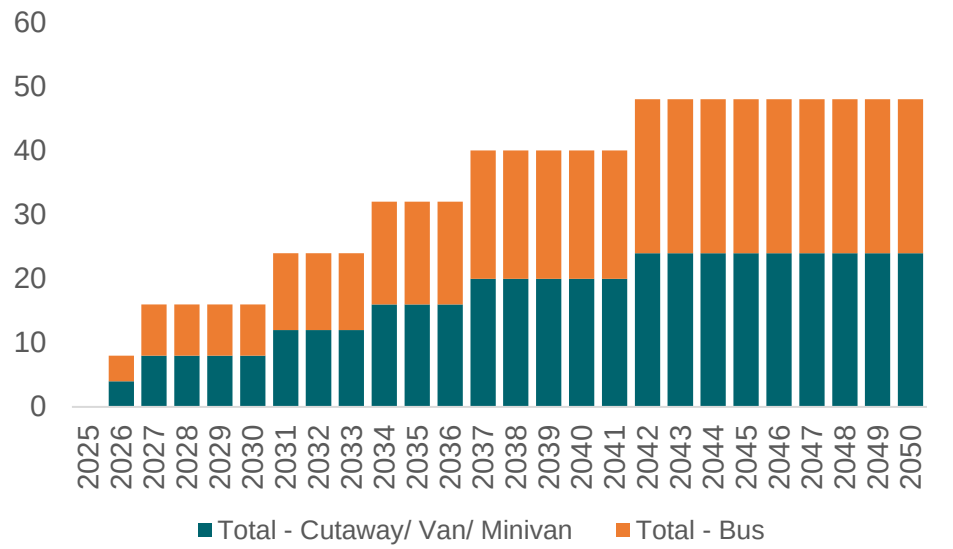
Region & County Transit Bus EV Registration Forecast

EV transit buses strongly supported by the FTA expected in the Regions

EV Transit Buses Required in Regions 1 & 4,

No. of EVs



Source: American Public Transit Association, BTA website

- As of 2021, more than 1,300 zero-emission transit buses were delivered or awarded to U.S. transit agencies
- If four vans/ cutaways and four buses are operating across the four transit agencies by 2026, a total of 50 total could be operating by the early-mid 2040s

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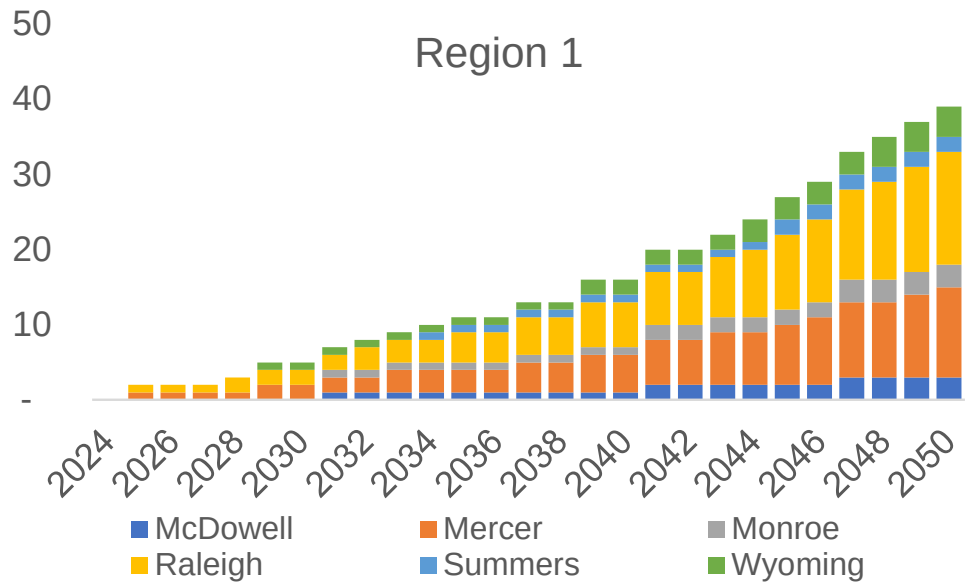
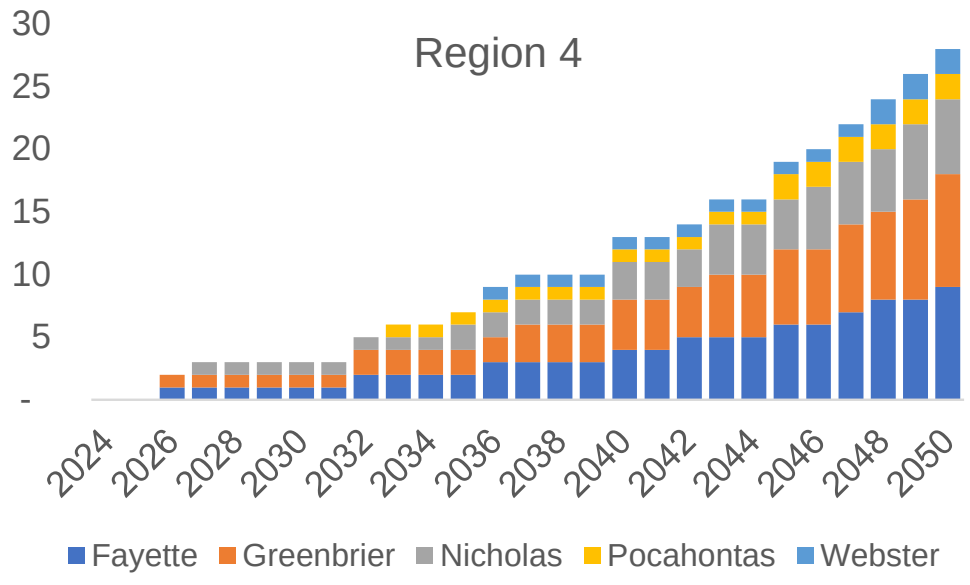
Region & County Commercial Truck EV Registration Forecast

EV adoption to grow more slowly than other segments

EV Commercial Trucks by Region and County,

No. of EVs





- Electric truck offerings arrived first for local delivery and regional delivery (back to base operations)

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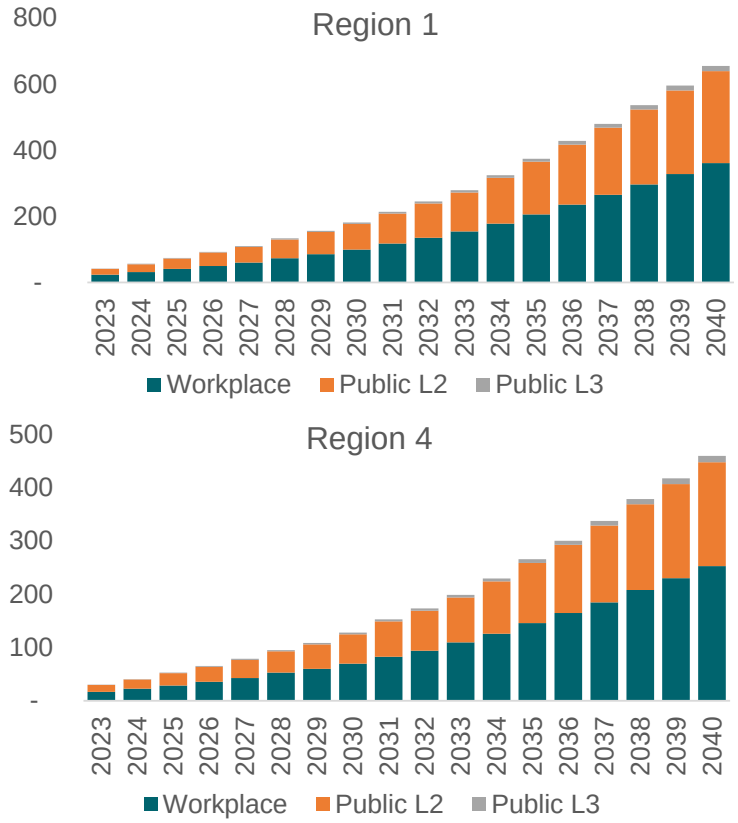
Private Workplace and Public Charge Equipment Requirements

Required charging equipment determined from local forecast of EV demands

Charge Plug Requirements Region and County,

No. of Plugs



- Number of plugs required per registered EV sourced from NREL study provides estimate for workplace, public L2 and public L3 plugs needed to serve EVs forecasted for each county in the two regions
- One charger may contain from one to four plugs depending upon the model
- Not all L2 or L3 chargers are the same; equipment ratings and ultimately the speed of charging varies between vendors
  - For example, one two port 50 amp L2 charger will charge at 50 amps per plug and another will charge at 50 amps for each plug
  - This is particularly important for fleet vehicles that need to charge within a specified timeframe
- Additional charging plugs required for tourists will be discussed later in this report

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EV Charging Infrastructure Locations

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Charging Readiness Review: Public Charging/Public Site Selection

Site competitiveness, attractiveness and readiness are key

Key Factors	Examples
Charging Alternatives	A given base of registered vehicles requires a certain number of workplace, public L2 and L3 plugs to support and existing charging infrastructure and that under development provide part of that need
Points of Interest (POIs)	Since L2 charge rates are relatively slow, EVs must be connected for 1 to 2 hours at least to add appreciable charge to any EV. Owners will need a reason to park for a few hours (e.g., shopping, tourist attractions, museums, hotels, marinas, etc.).
Available Parking	Existing parking lots or decks are natural targets for EV charging.
Traffic	EV owners will want to charge in relatively convenient locations. Hwy X will prove attractive for L3 charging, and key routed in the city are obvious potential choices for L2 charging.
Residential Mix	Share of occupied residences, owner-occupied homes, single-family detached residences, multifamily residences
Workplace Locations	Private vehicles are stationary for the longest periods of time at home or work providing ideal L2 charging opportunities and potentially diminishing public access demand
Relative Strength of Electric Service	Sites with known substation or feeder limits will likely be more costly and time-consuming to upgrade making them less attractive.
Appropriate Zoning	Re-zoning property can be time consuming and costly. Developers seeking quick returns with low costs and risks will avoid difficult site, so appropriate commercial zoning is highly preferred.
Disadvantaged Communities	While the recent IIJA and IRA laws provided economic support for EV charging, additional funding support is available for charging stations in disadvantaged communities, which eases the economic burdens of station development and ownership.
Amenable Site Owners	While EV charging make seems sensible in a given area, if nearby site owners are uninterested for whatever reason, alternate locations may prove easier to develop.
Stakeholder Insight	Local residents may be in a position to add insight about specific installation locations and potential owners.

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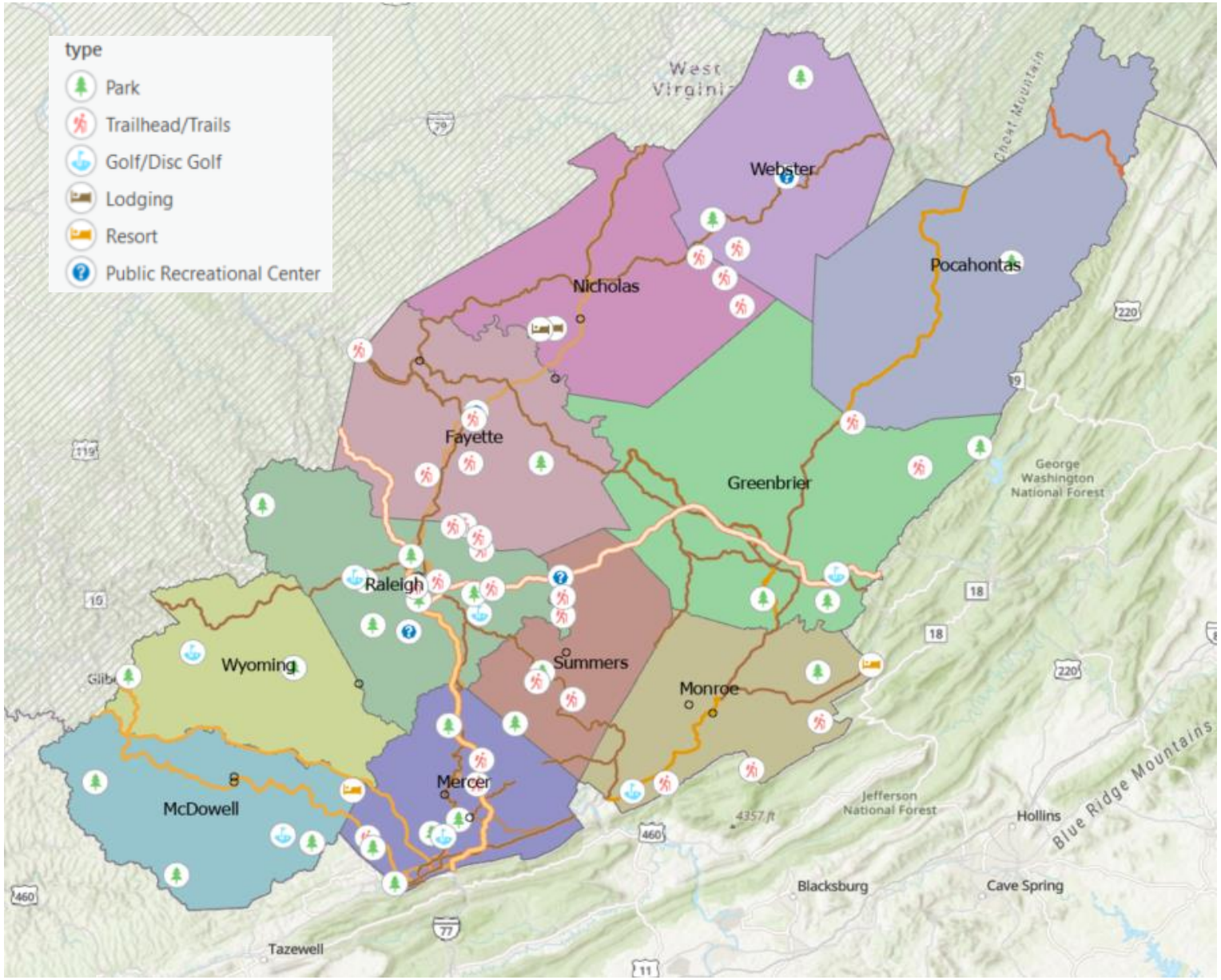
Public Sites: Potential Sites Map

- Southern West Virginia is in a unique position where there is a lot of untapped potential for EV infrastructure expansion
  - Locals & Tourists can benefit from strategically placed chargers
    - Universities, Army Facilities, Municipal Infrastructure, Conference Centers, Libraries, Recreational Centers, Lodges/Hotels, Parks, Trailheads, Golf Courses
- National Campaigns Collaborations
  - Walmart/Sam's Clubs – announced all locations will have EV charging infrastructure
  - USPS – electrification of the Postal Service delivery fleet (E-Transit parcel delivery van)



Public Sites: Potential Sites Map

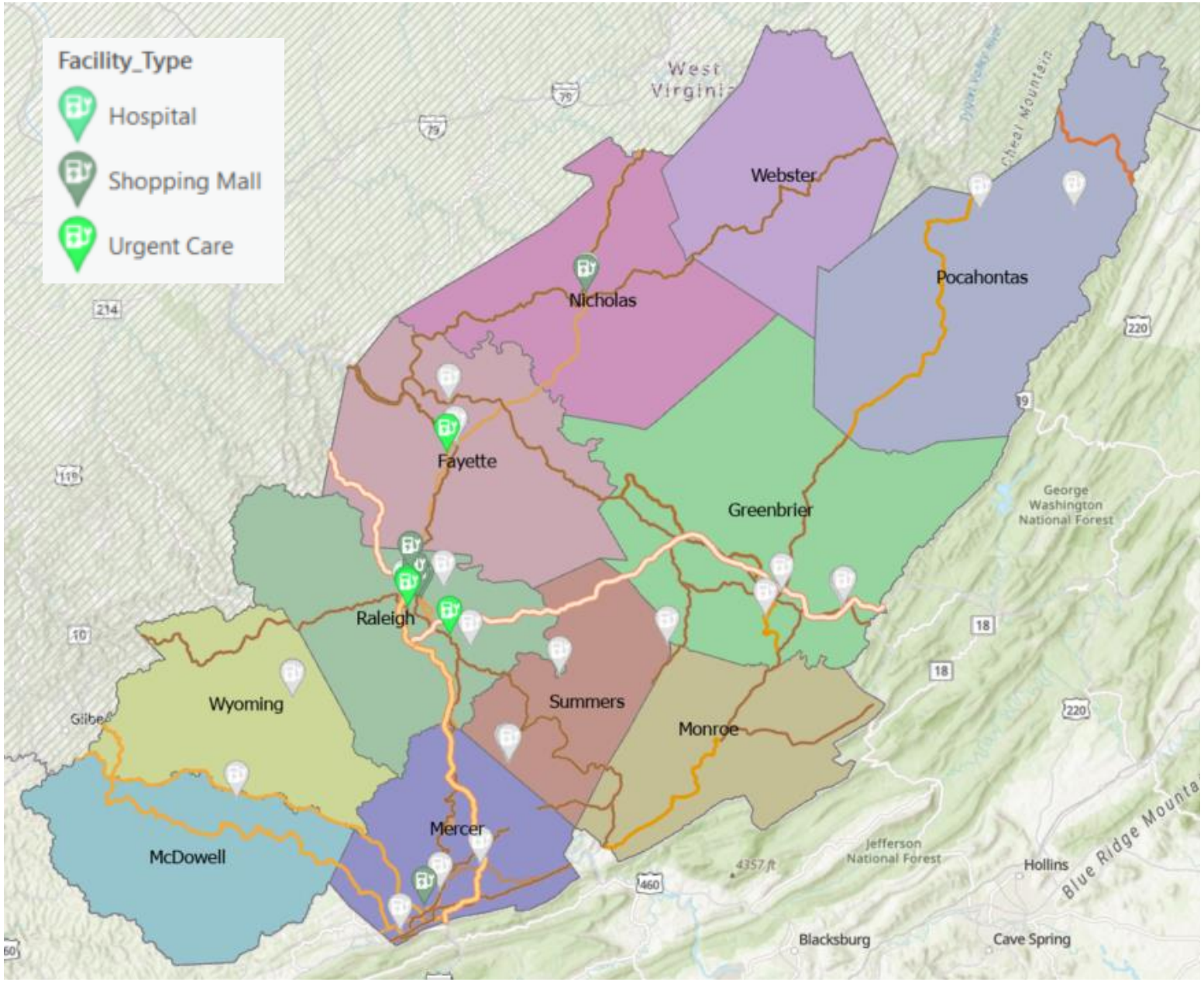
Identified several high traction areas where EV chargers are sensible

- Shopping Malls
- Hospitals
- Urgent Cares

Upgrade or expand existing sites

- 5 L1 chargers can be upgraded to L2
- Additional L2 and DCFC chargers can be installed in existing locations

Region	Access	L2 EVSE Loc	DCFC EVSE Loc
1	Public	9	
4	Public	2	3
Grand Total		11	3



Electric Utility Limitations

Discussions with utility planning engineers revealed few concerns

- Appalachian Power and Mon Power provide electric service across Regions 1 and 4.
- Siemens PTI's energy and distribution planning engineers met with distribution planning counterparts in each utility to discuss potential grid limitations in general and at the potential charging locations identified.
- Both utilities indicated they maintain adequate capacity in each area to support the level of proposed charging development and that no capacity upgrades were anticipated.
- Further, they indicated that single phase power is available everywhere and is sufficient for level 2 charging, and that three-phase power is only available in more populated locations and is required for level 3 charging.
- Thus, were we considering potential level 3 sites in more rural locations (e.g., parks), system upgrades would likely be required, but since we only identified level 2 charging for parks, no grid upgrades are anticipated.

State Park EV Charging Forecast

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State Park Characteristics

Most tourism from within West Virginia itself

Overall Characteristics 2018-2023					
State Parks	**WV Tourism**	**Avg. Growth**	**Camping Sites**	**WV Tourism**	**Avg. Growth**
Avg. Non-Resident attendance	85,926	-3%	Avg. Non-Resident Overnight stays	4,973	4%
Avg. Resident attendance	121,570	-3%	Avg. Resident Overnight stays	6,541	4%
Avg. Total Attendance	207,495	-3%	Avg. Total Overnight stays	11,514	3.21%
Lodging Sites	**WV Tourism**		**Charger Requirements**	**NREL Study Derivation**	
Avg. Non-Resident Overnight stays	3,033	-6%	State Public L2	0.028571429	
Avg. Resident Overnight stays	1,392	9%			
Avg. Total Overnight stays	4,425	-2.34%	**County Overnight Visitors**	**WV Tourism**	
			Persons/ Trip	2	
Cabin Sites	**WV Tourism**				
Avg. Non-Resident Overnight stays	4,976	-9%	**Visit Location Origin**	**WV Tourism**	
Avg. Resident Overnight stays	2,913	12%	Non-Resident	41%	
Avg. Total Overnight stays	7,889	-5.31%	Resident	59%	

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State Park Characteristics

Key Findings

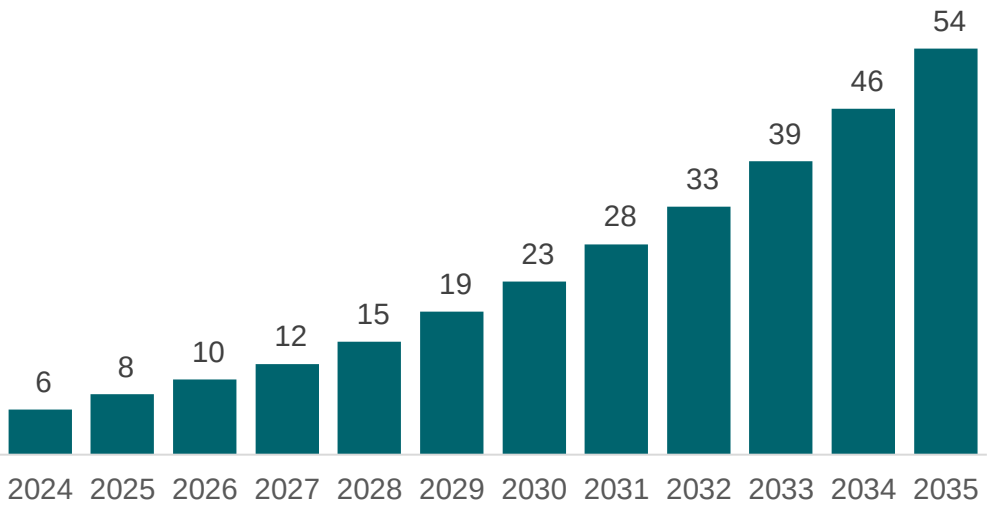
- Most visitors travel from within WV
- Attendance is well distributed among the parks but shows decreasing attendance in recent years.
- Camping, lodging and cabin stays are increasingly popular led by WV residents.
- More residents are going to said activities, while outside visitors are finding other recreation spots.
- A couple of State Parks were identified as needing a charging infrastructure plan based on tourism trends, others experienced relatively low demand, needing only 3 to 4 plugs by 2035.
- These parks are as follows:
  - Bluestone
  - Hawks Nest
  - Pipestem
  - Twin Falls
  - Watoga

State Park EV Chargers

Forecast suggests about 54 chargers will be required in the 16 studied state parks by 2035

Charger Requirements

No. of Chargers



- Analysis suggests about 6 chargers are needed currently to support EV traffic in the state parks.
- Chargers denoted are L2 charging stations with 2 plugs each.
- These numbers consider an approximate of 20% of EV trips needing charging, if consumer behavior changes, more chargers might be needed.

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State Park EV Chargers

Key Takeaways

- Around 50 Chargers are needed for the most popular sites.
- Installation can be exponential, as nearby sites can “share” infrastructure in early years.
- Charger use will be distributed between Resident and Non-Resident use, however near-term state incentives might change how this looks in the upcoming years.
- As EV adoption grows, consumer behavior might change and out-from-home charging habits might become more popular, pushing the need for infrastructure.

Economic and Tourism Impacts

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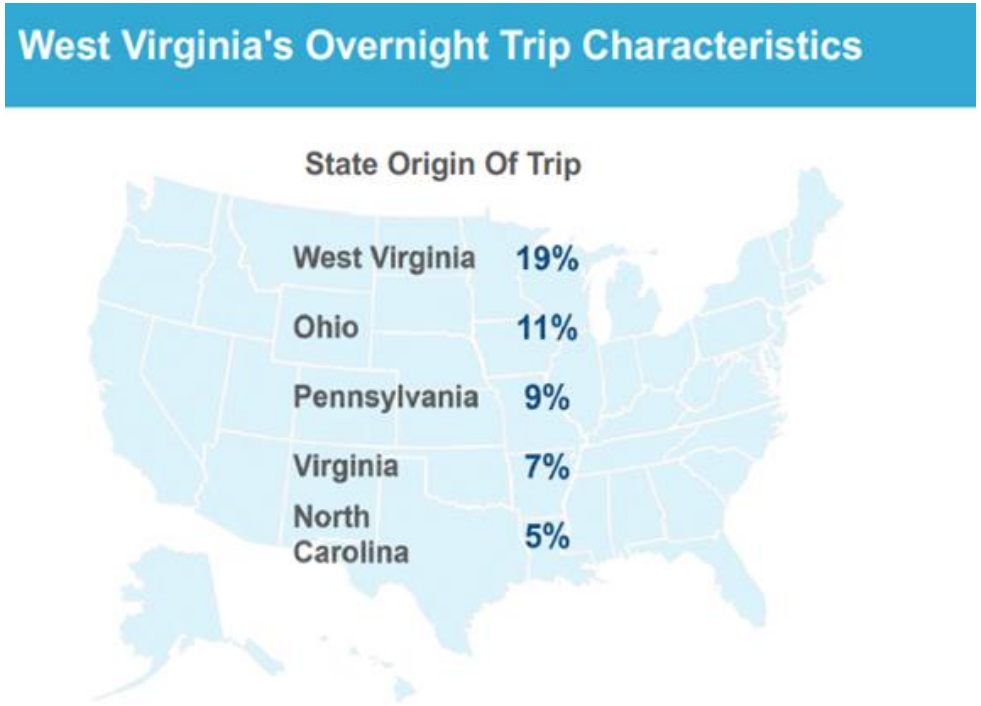
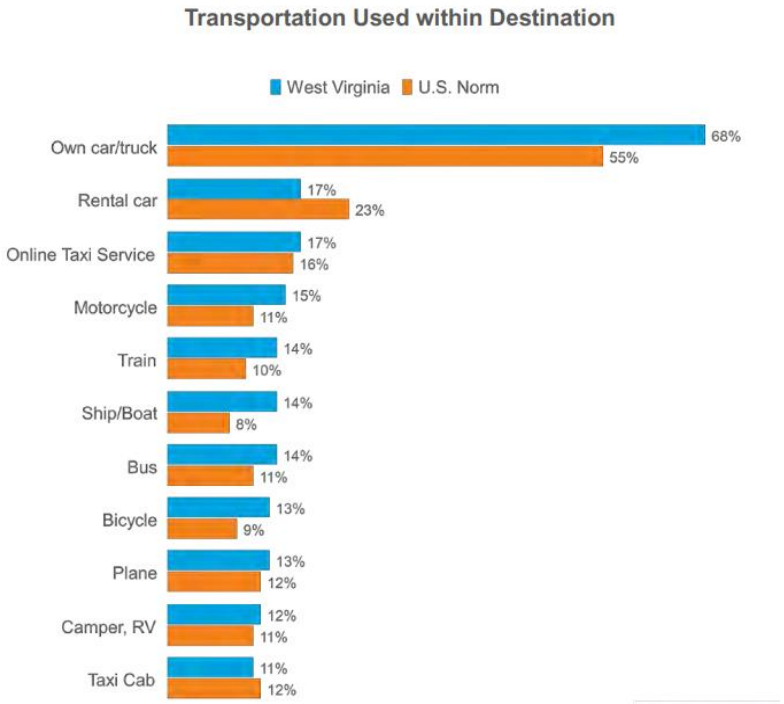
Technical Impacts Tourism: State Characteristics

Most tourism from within WV itself

State Details



Tourism Transportation Characteristics



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Economic Impacts Tourism: New River/Greenbriar Valley

Large differences in individual county tourism trends

New River/Greenbrier Valley Region

Year	Total Direct Travel Spending (Thousands)	Visitor Spending by Type of Accommodation (Thousands)	Visitor Spending by Commodity Purchased (Thousands)	Industry Earnings Generated by Travel Spending (Thousands)	Industry Employment Generated by Travel Spending	Tax Receipts Generated by Travel Spending (Thousands)	Average Overnight Spending (PP)	Overnight Visitor Volume
2014	$ 672,042	$ 664,398	$ 664,398	$ 196,317	6,951	$ 52,150	$ 207	2,474,727
2015	$ 603,842	$ 595,518	$ 595,518	$ 197,028	6,659	$ 50,857	$ 193	2,415,805
2016	$ 586,273	$ 577,395	$ 577,395	$ 197,071	6,717	$ 49,441	$ 188	2,424,771
2017	$ 620,271	$ 610,948	$ 610,948	$ 203,494	6,860	$ 51,404	$ 197	2,466,884
2018	$ 671,416	$ 661,071	$ 661,071	$ 218,913	7,156	$ 55,184	$ 203	2,557,421
2019	$ 704,120	$ 693,334	$ 693,334	$ 236,587	7,677	$ 57,513	NA	2,648,095
2020	$ 591,163	$ 583,182	$ 583,182	$ 198,880	6,330	$ 46,044	NA	2,355,516
2021	$ 785,443	$ 778,524	$ 778,524	$ 235,715	7,118	$ 58,837	NA	2,795,580

County Tourism Spending (Thousands)

Year	Webster	Pocahontas	Nicholas	Fayette	Greenbrier	Raleigh	Summers	Monroe	Mercer	Wyoming	Mcdowell
2014	$ 9,748	$ 88,562	$ 61,883	$ 75,494	$ 225,522	$ 171,071	$ 18,773	$ 10,369	$ 111,536	$ 33,733	$ 25,544
2015	$ 8,054	$ 80,154	$ 52,575	$ 65,495	$ 215,313	$ 150,862	$ 16,950	$ 9,764	$ 97,352	$ 27,364	$ 20,742
2016	$ 7,603	$ 87,388	$ 49,724	$ 64,975	$ 199,399	$ 156,651	$ 16,631	$ 9,575	$ 93,814	$ 25,706	$ 19,477
2017	$ 8,007	$ 92,860	$ 53,552	$ 69,012	$ 211,737	$ 157,903	$ 17,400	$ 9,771	$ 105,510	$ 27,135	$ 20,265
2018	$ 7,953	$ 115,681	$ 55,674	$ 71,638	$ 238,314	$ 168,677	$ 19,783	$ 10,017	$ 113,494	$ 27,939	$ 20,937
2019	$ 8,600	$ 119,168	$ 62,578	$ 78,901	$ 240,142	$ 183,028	$ 19,971	$ 10,232	$ 115,392	$ 28,248	$ 28,206
2020	$ 7,527	$ 123,303	$ 49,852	$ 71,041	$ 214,350	$ 136,529	$ 19,796	$ 10,181	$ 88,609	$ 25,320	$ 25,337
2021	$ 9,922	$ 144,513	$ 63,473	$ 98,995	$ 275,133	$ 173,940	$ 28,427	$ 10,710	$ 130,665	$ 33,822	$ 33,752

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Economic Impacts Tourism

New River Gorge and Bluestone Data

New River Gorge

	Recreation Visitors	Non-Recreation Visitors	Concession Lodging	Tent Campers	RV Campers	Concession Camping	Backcountry Campers	Misc Campers	Total Overnight Stays
				2022					
January	31,656	200	0	85	65	0	79	0	229
February	39,219	200	0	195	178	0	147	0	520
March	69,767	200	0	390	167	0	263	97	917
April	117,824	200	0	1,365	750	0	1,050	45	3,210
May	174,882	200	0	1,291	897	0	1,085	298	3,571
June	203,538	200	0	1,938	897	0	1,575	997	5,407
July	273,494	200	0	3,746	1,447	0	2,713	406	8,312
August	215,254	200	0	2,641	1,792	0	2,170	181	6,784
September	180,086	200	0	1,947	1,523	0	1,575	233	5,278
October	168,930	200	0	1,427	1,302	0	1,085	750	4,564
November	79,143	200	0	690	630	0	525	0	1,845
December	39,730	200	0	346	315	0	263	0	924
2022 Totals	1,593,523	2,400	0	16,061	9,963	0	12,530	3,007	41,561
Report Totals	1,593,523	2,400	0	16,061	9,963	0	12,530	3,007	41,561

Bluestone

	Recreation Visitors
2022	
January	0
February	0
March	0
April	0
May	809
June	3,080
July	3,519
August	3,368
September	2,270
October	1,067
November	0
December	0
2022 Totals	14,113
Report Totals	14,113

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Economic Impacts Tourism

New River Gorge and Bluestone Data

Recreation Visits by Month

New River Gorge NP & PRES

Current year data are preliminary and subject to change. Data will be finalized by the end of the first quarter of next calendar year.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2023	38,149	42,210	74,879	126,494	197,509	233,909	286,821	235,837	190,817	141,544	100,314	38,740	1,707,223
2022	31,656	39,219	69,767	117,824	174,882	203,538	273,494	215,254	180,086	168,930	79,143	39,730	1,593,523
2021	33,856	36,361	103,151	126,454	151,995	220,558	288,827	212,484	178,614	173,459	110,368	46,593	1,682,720
2020	30,180	31,358	56,577	52,875	109,036	155,085	170,593	145,611	108,306	111,263	50,939	32,551	1,054,374

Recreation Visits by Month

Bluestone NSR

Current year data are preliminary and subject to change. Data will be finalized by the end of the first quarter of next calendar year.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2023	182	281	377	469	1,393	4,150	5,956	3,702	3,084	1,511	188	300	21,593
2022	0	0	0	0	809	3,080	3,519	3,368	2,270	1,067	0	0	14,113
2021	0	0	0	0	843	3,619	8,892	6,282	3,530	3,544	0	0	26,710
2020	0	0	0	0	0	0	8,890	7,036	4,857	4,424	0	0	25,207
2019	75	84	218	375	3,800	6,659	9,530	6,939	5,299	4,684	0	0	37,663
2018	60	87	100	200	350	6,500	8,500	6,500	4,694	4,000	200	125	31,316

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E-Bike and Micro-Mobility

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Micro-Mobility: E-Bikes

Key Findings

- Micro-mobility refers to lightweight, often single person modes for transportation designed for short distances. These vehicles are typically smaller, more agile, and can complement existing public and private transportation methods. Common vehicles include scooters, bicycles, skateboards, and mopeds.

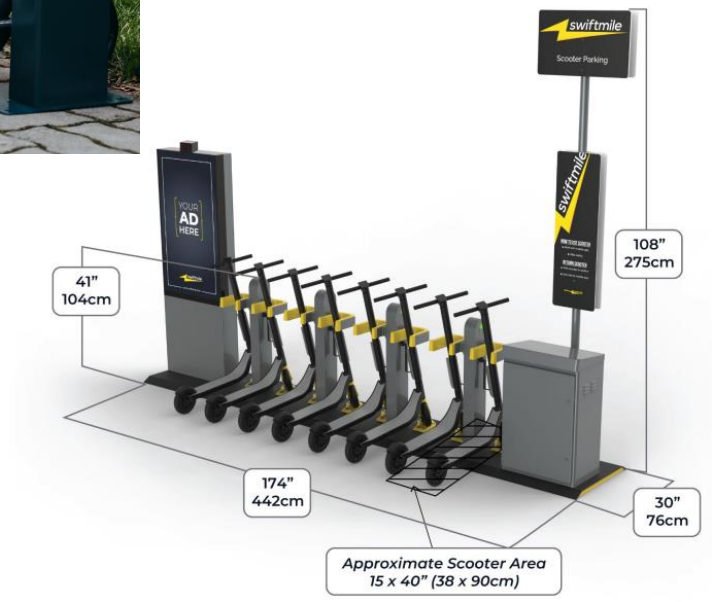
- E-micromobility site selection focuses less on areas such as university campuses and commercial districts, since they are ideal because they attract higher utilization across areas that are designed for walking.

- Micromobility introduces new safety concerns, but the National Fire Protection Association has released several standards which can help address the safety requirements pertinent to the development of remote and at home micromobility charging

- Each vendor has a slightly different design for their docking station, but all designs are compatible for outdoor installation. Siemens PTI notes these vendors are not ideally suited for outdoor recreational activities such as using an e-bike for trail rides.

Micro-Mobility: E-Bikes

Leading Vendors



Vendor Name	Docking Station Options	Contact
KUHMUTE	Charging Port	Sanji Alwis Chief Commercial Officer (CCO) sanji@kuhmute.com (617) 480-5292
	2 Charging Port Hub	
	4 Charging Port Hub	
	6 Charging Port Hub	
City Dock	Charging Port	Musat Marian Chief Executive Officer (CEO) marian@citydock.ro +40727360354
	6 Charging Port Hub	
Swiftmile	Charging Port	Colin Roche Chief Executive Officer (CEO) colin@swiftmile.com (650) 346 – 0541
	Parking + Charging	
	Parking + Charging with Digital Screen	

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EV Charging Feasibility

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EV Charging Feasibility

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Qualitative Charging Infrastructure Program Rationale

Evaluate the financial and non-financial benefits and costs of EV charging business

	Benefits	Costs

Non-Financial	• Gather tangible charging behavior data
	  • Utilization
	  • Time of day, Day of month, Weekend v. weekday
	  • Energy & load requirements
	  • Grid impacts
	• Evaluate charging rates
	  • Energy - $/kWh
	  • Time - $/hour
	• Positive image impacts
	• Proof of concept
		• Equipment reliability/ availability
		• Remote reset capabilities
		• Spare parts requirements and use
		• Service requirements

Financial	• Revenues • Margins • IRR/ NPV	• Capital costs • O&M costs • Working capital requirements

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Charging Capability & Design

Goals, EV forecast, resiliency needs, and existing electric infrastructure drive charging capabilities needed

To determine necessary charging capability:

- Quantify L2/ L3 station* economics
- Optimize L2/L3 station portfolio economics
- Identify and quantify portfolio risks and mitigants
- Estimate the number of chargers required in each year, accounting for existing EV charging ports
- Determine any resilient supply needs for critical assets

* Level 2 charging stations charge at a rate of 12 to 80 miles per hour of charging, charging most EV's from empty in about 4.5 hours. Level 3 charging stations charge at a rate of 75 to 1,200 miles per hour of charging, charging most EV's from empty in about 30 minutes.

Charge Station Economic Drivers

Category	Information
Utilization	• Current known measures • Peak potential at each site • Recently reported/ studied national utilization trends • Forecast EV growth indicating pace of change
Availability	• Current charge program and site experience • Recently reported/ studied national observance • Availability guarantees
Charge Rate	• Current rates • Local competitive charge rates and structures establishing local expectation • Location convenience and access premium, perhaps by site
Capital Costs	• Requirement for and to pay for utility necessary upgrades • "Make-ready" infrastructure cost – largely defined by distance • Site service upgrades

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Additional EV Charging Program Considerations

Key charging program efforts and decisions

Charging Station Development

- Decision - Ownership structure necessary regulatory and internal pilot approvals
- Program Scope - Final program composition/ site selection
- Site Partners - identification, screening, term sheets, and contracting
- Construction approach – EPC, self build?
- Make ready infrastructure – requirements, planning, procurement, install
- Notice to proceed
- Equipment purchase and install
- Commissioning

Charging Ownership

- Ongoing remote monitoring - quickly identify outages and remote reset
- Charger data analytics - requirements, access, storage, and analysis
- Equipment Support - Required local spare parts and access to additional spares
- Staff training - support field repairs/ replacement

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Charging Station Readiness, Siting & Specifications

Site selection readiness review differs for fleet owners with distinct sites and charge station siting for public access

Fleet Site(s) Readiness Review:

- Forecast EVs expected to operate from site(s)
- Identify preferred charging windows, parking locations, etc.
- Forecast specific EV energy consumption & determine charge frequency
- Determine charge patterns & charge plug number and mix for site
- Forecast site energy & peak load
- Consider means to reduce peak impacts/ costs (i.e., schedule, load balancing, etc.)

Public Site(s) Readiness Review:

- Evaluate local competition – equipment, locations, charge rates, competitive position
- Consider local residential, workplace and commercial charging requirements
- Identify additional attractive public charging locations
- Traffic study
- Determine charge patterns & charge plug number and mix for site
- Map energy and load projections to sites and neighborhoods
- Consider means to reduce peak impacts/ costs (i.e., BESS, etc.)

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Charging Station Development

Developing economically successful charging at scale requires objectives driven planning

Typical EV Charging Development Process

1	Project Specific EV Forecast and Charger Requirement
2	Electric Service, Charger Locations, Levels, and Plugs
3	Conceptual Technical and Operating Design
4	Financial and Business Model Options and Selection
5	Develop/ Evaluate Design, Operations, etc. Scenarios
6	Utility Load Connection Request
7	Utility Interconnection Review/ Study
8	EPC Design/Detailed Cost
9	Design Review/Approval
10	Resolve Code/ Permit Issues
11	Financial Negotiations/ Approvals
12	Long Lead Time Orders (NTP)
13	Site and Grid Upgrade Construction
14	Testing and Commercial Operations

Pilot EV charging stations/ programs often fail

- **Low utilization** – little to no knowledge of local traffic and parking, poor siting
- **Low availability** – neglected maintenance and software upgrades, stolen cords
- **High costs** – site selected without considering electrical connection or utility requirements, maintenance

- One academic study found only 72.5% of 657 public fast chargers in the San Francisco Bay area are working.
- EV owners continue to be highly satisfied with their vehicles, while frustrated with the state of our public charging infrastructure.

Source: Autoweek, July 11, 2022

Economic Impacts

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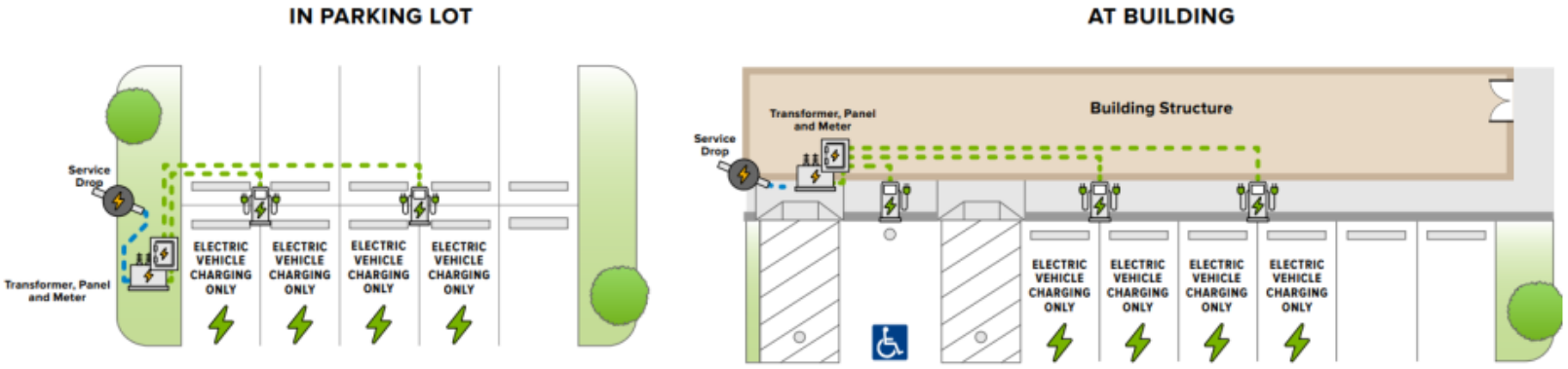
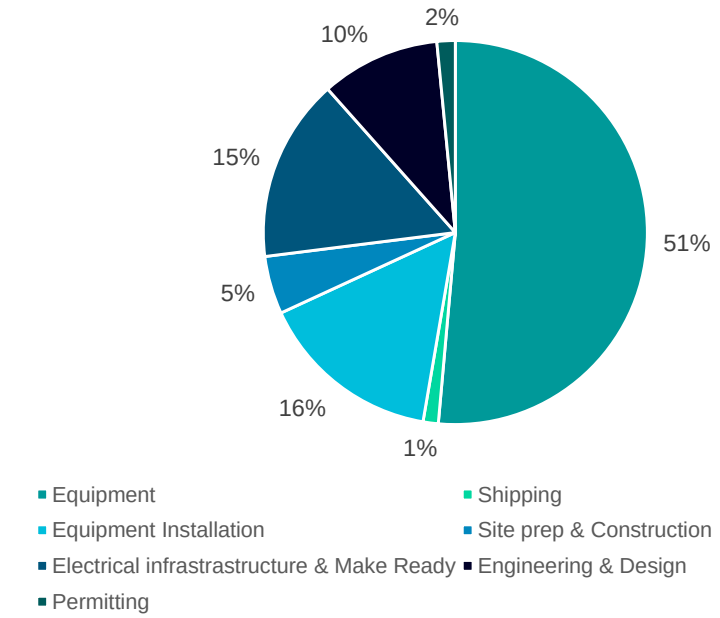
Station Development: Generic L2 Station

Generic L2 station used to determine economic and jobs impacts

Generic L2 EV Station Concept and Capital Cost Breakdown



- **Existing service assumed unable to handle increased load. Transformer upgrade to 90% of charger maximum power.**
- **No future proofing assumed in default case. User input required.**
- **3 chargers (2 ports/cords per charger).**
- **Trenching/boring from transformer to cabinet to chargers. Default assumes 75 ft at $80/ft.**
- **ADA compliance, retractable cords, signage, bollards/curbs and striping/sidewalks.**



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Economic Impact Definitions

Applied Argonne National Labs JOBS EVSE 2.6 model

Term	Definition
Development	Station Development expenditures include up-front costs required to develop stations. Station development expenditures are grouped into six main categories: station equipment, site preparation, engineering & design, installation, permitting and project contingency.
Operations	Stations in Operation characterizes activities required to operate stations. Both new and pre-existing stations may be modeled. Includes value of electricity.
Supply chain impacts	These are impacts directly associated with expenditures on EVSE station development, construction, and operation. They include manufacturing of the necessary equipment, installation of that equipment, and operation and maintenance (O&M) of the station itself. Impacts also include the upstream purchases made by those industries, such as raw and prefabricated materials for production of equipment. In this analysis, industry supply chain impacts are equivalent to what are often referred to as direct plus indirect impacts of initial expenditures. Industry supply chain impacts are equivalent to what Bureau of Economic Analysis (BEA) refers to as RIMS Type I impact.
Induced Impacts	These impacts are induced by supply chain impacts. They account for the additional impacts from expenditures (on housing, meals, entertainment, etc.) by individuals and households that earn income due to supply chain impacts and then re-spend it elsewhere in the economy.
Combined Impacts	Includes both development and operations impacts
Total Impacts	Supply chain impacts plus induced impacts equal total impacts and are equivalent to what BEA refers to as RIMS Type II impacts.
Employment	Employment is reported in number of jobs. A job is defined as one year of work for one person and includes both full-time and part-time work.
Earnings	Earnings consist of wages, salaries, and proprietors' income. The latter is defined as the difference between revenue and explicit production costs in owner-operated businesses.
Output	Output represents the total value of sales by producing enterprises including the value of intermediate goods used in production. Gross domestic product is different from gross economic output because it does not include the value of the intermediate goods used in production.

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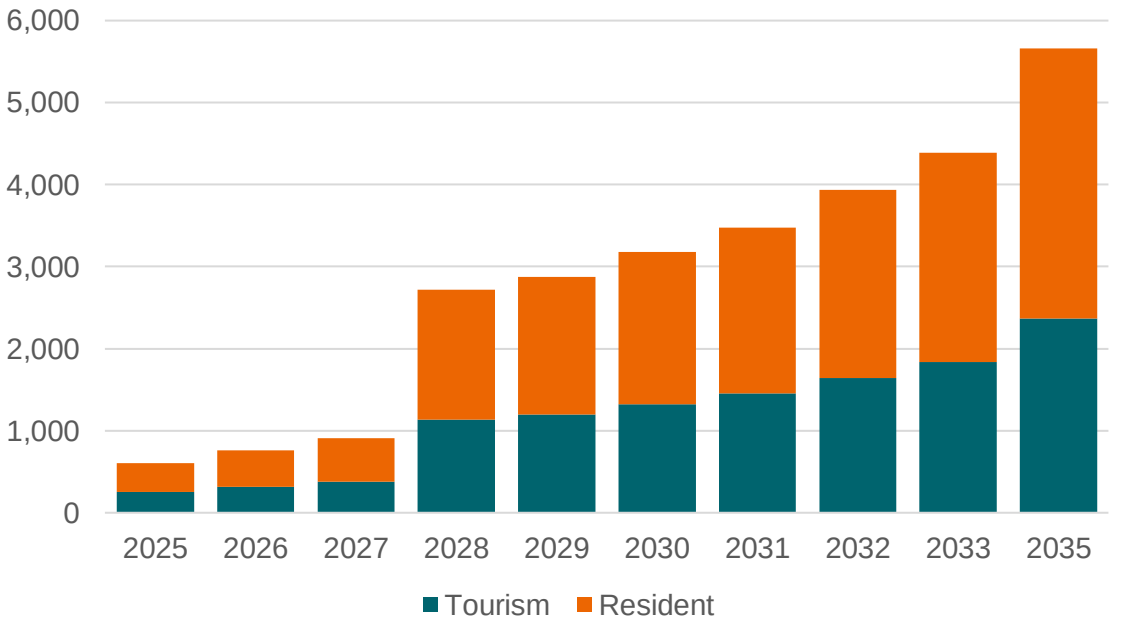
Direct Economic Impacts

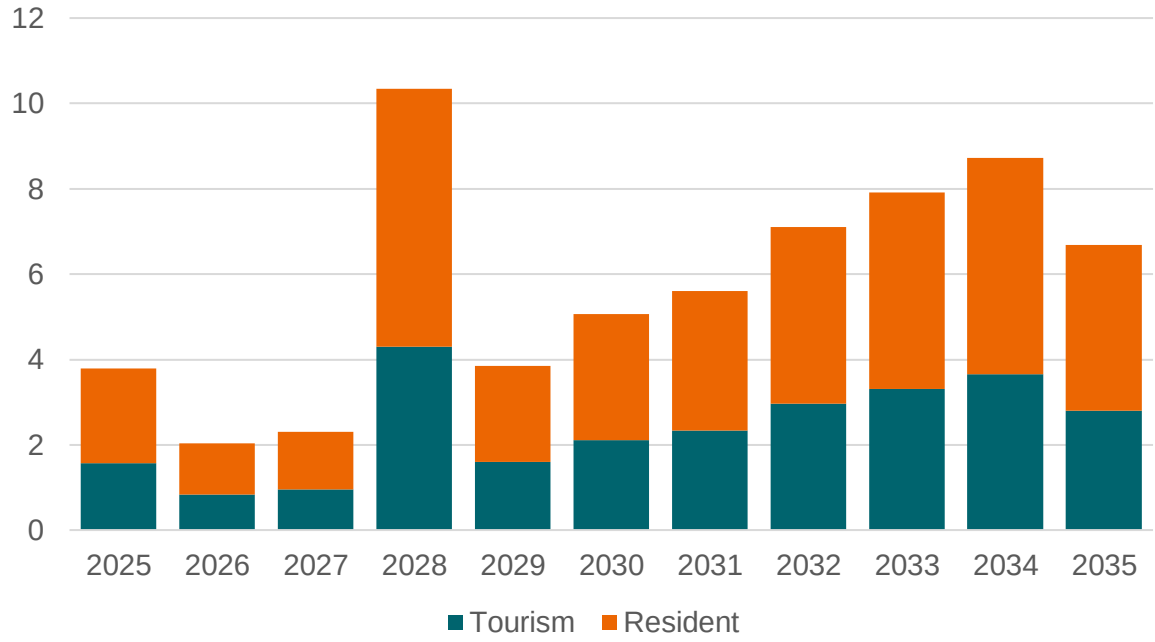
EV charging can bring significant direct and induced benefits

Direct Development & Operations Costs,
$ Thousands



- Including induced impacts would add another 22% to the cost impacts.

Direct Development & Operations Employment,
No. of Jobs



- Including induced impacts would add another 28% to the employment impacts.

Notes:
1. Tourism = impacts of state park EVs
2. Resident = impacts of local resident EVs

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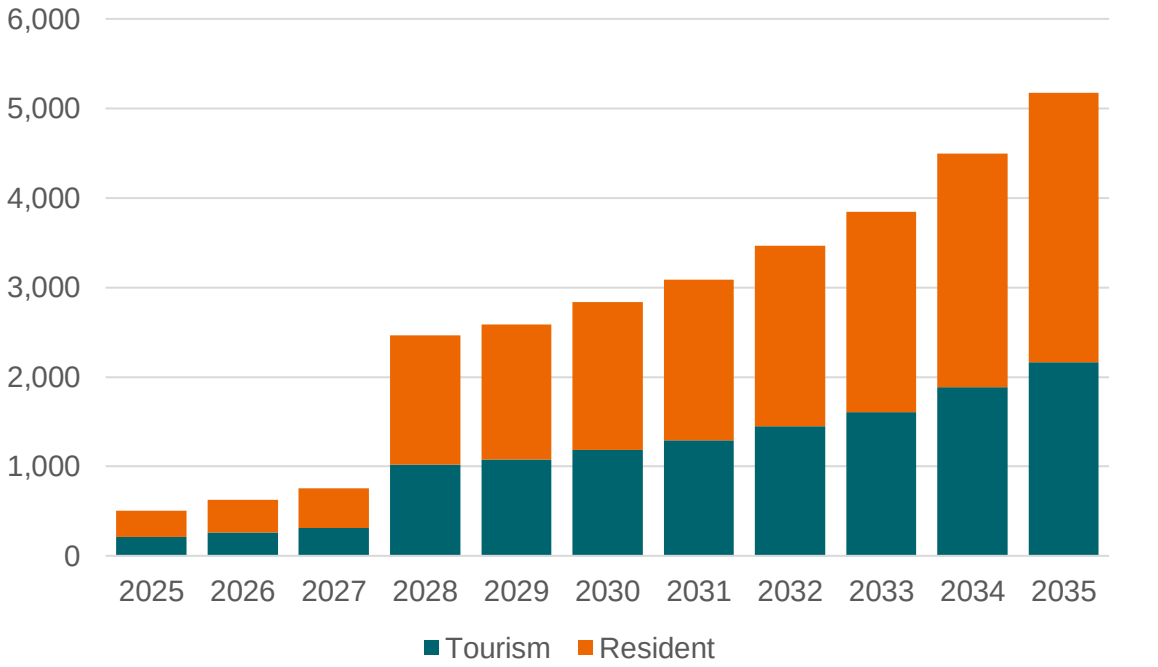
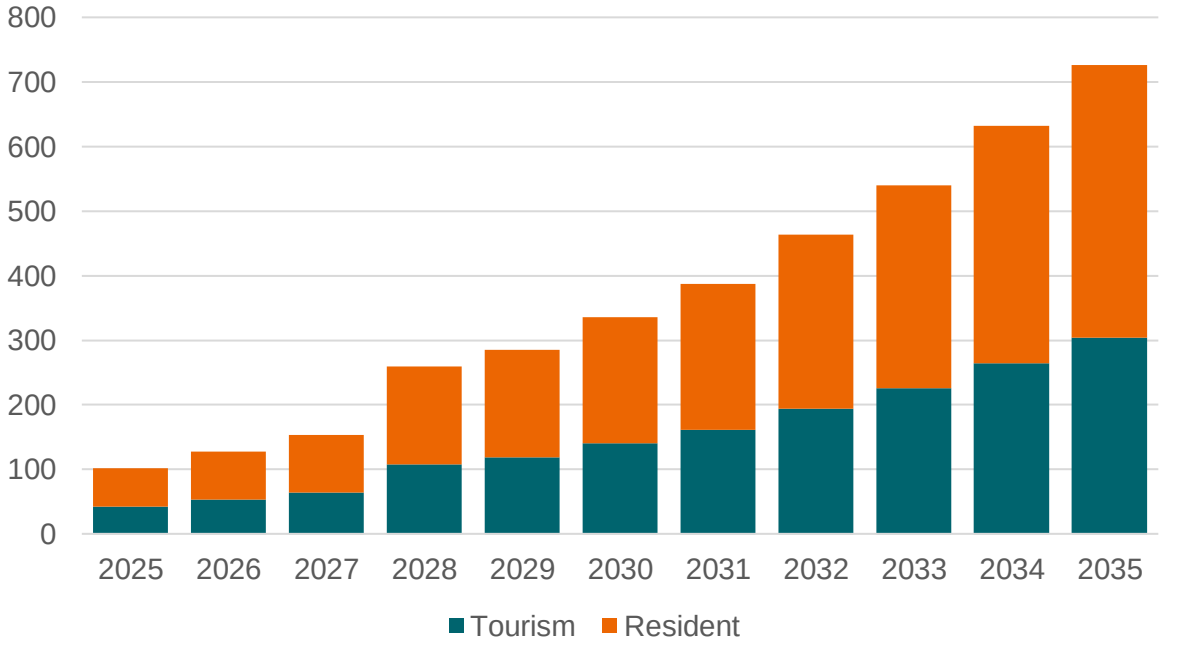
Direct Costs Impacts

Operating costs account for about 70% of direct costs

Direct Development Costs,
$ Thousands



Direct Operating Cost,
$ Thousands



Notes:
1. Tourism = impacts of state park EVs
2. Resident = impacts of local resident EVs

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EV Charging Equipment Types

Three types of EV chargers each charging at different rates

Parameter	Level 1	Level 2	Level 3/ DC Fast
Graphical Representa-tion			
Voltage	120 volt 1-phase Alternating Current (AC)	208 volt 1-Phase AC	480 volt 3-phase
Amperage	12 – 16 amps	12 – 80 amps (32 amps typical)	< 125 amps (60 amps typical)
Connector Type	Compatible with: • J1772 connector 	Compatible with: • J1772 connector 	Compatible with: • Combined Charging System (CCS) Connector  • CHAdeMO Connector  • Tesla Co[illegible] 
Typical Power Output	1.4 – 1.9 kW	2.5 – 19.2 kW (Typical 7 kW)	50 -350 kW
Range	2 to 5 miles of range per 1 hour of charging	10 to 30 miles of range per 1 hour of charging	150 to 350+ miles of range per 1 hour of charging

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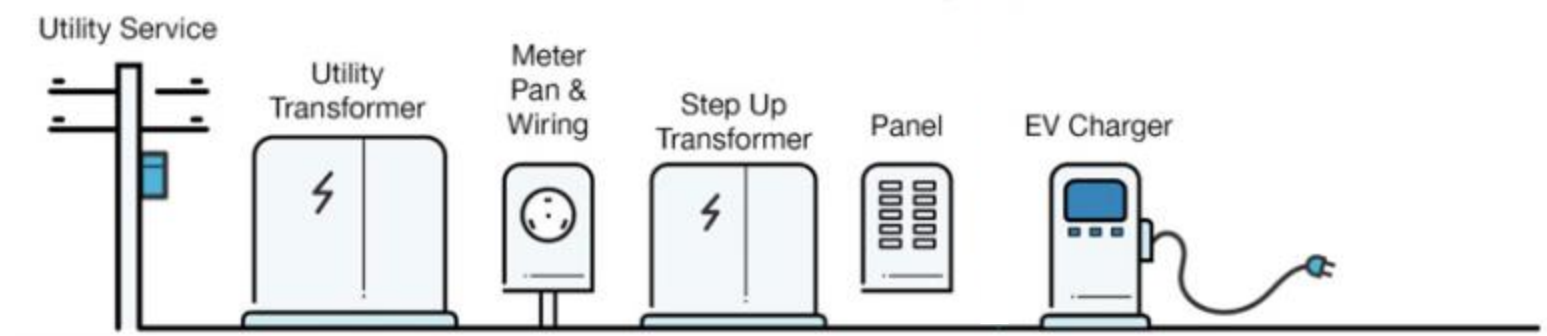
EV Charging Infrastructure Definitions



Utility Make Ready	Customer Make Ready	Charger
• Customers may be required to pay for grid upgrades in excess of utility's design requirements	• Panel • Conduit • Trenching • Wiring • Step Up Transformers • Customer Switchgear	• Signs • Bollard • Network • Maintenance • Design • Permitting • Charging Station • Network Equipment • Station Installation

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Disclaimer

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.

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