Rural Reimagined: Building an EV Ecosystem and Green Economy for Transforming Lives in Economically Distressed Appalachia

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Tennessee Technological University (Tennessee Tech)

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Project ID: ti146

Timeline

- ❖ Start: August 1st, 2022
- ❖ End: October 31st, 2025
- ❖ 15% Complete

Budget

- ❖ Total project funding: $8,026,086
  - ❖ DOE Share: $4,012,930
  - ❖ Cost Share: $4,013,156
- ❖ Funding for FY 2022: $4,130,115
- ❖ Funding for FY 2023: $2,558,383

Barriers and Target

- ❖ Lack of EV exposure and experience in rural Appalachia
- ❖ Lack of EV infrastructure in rural areas
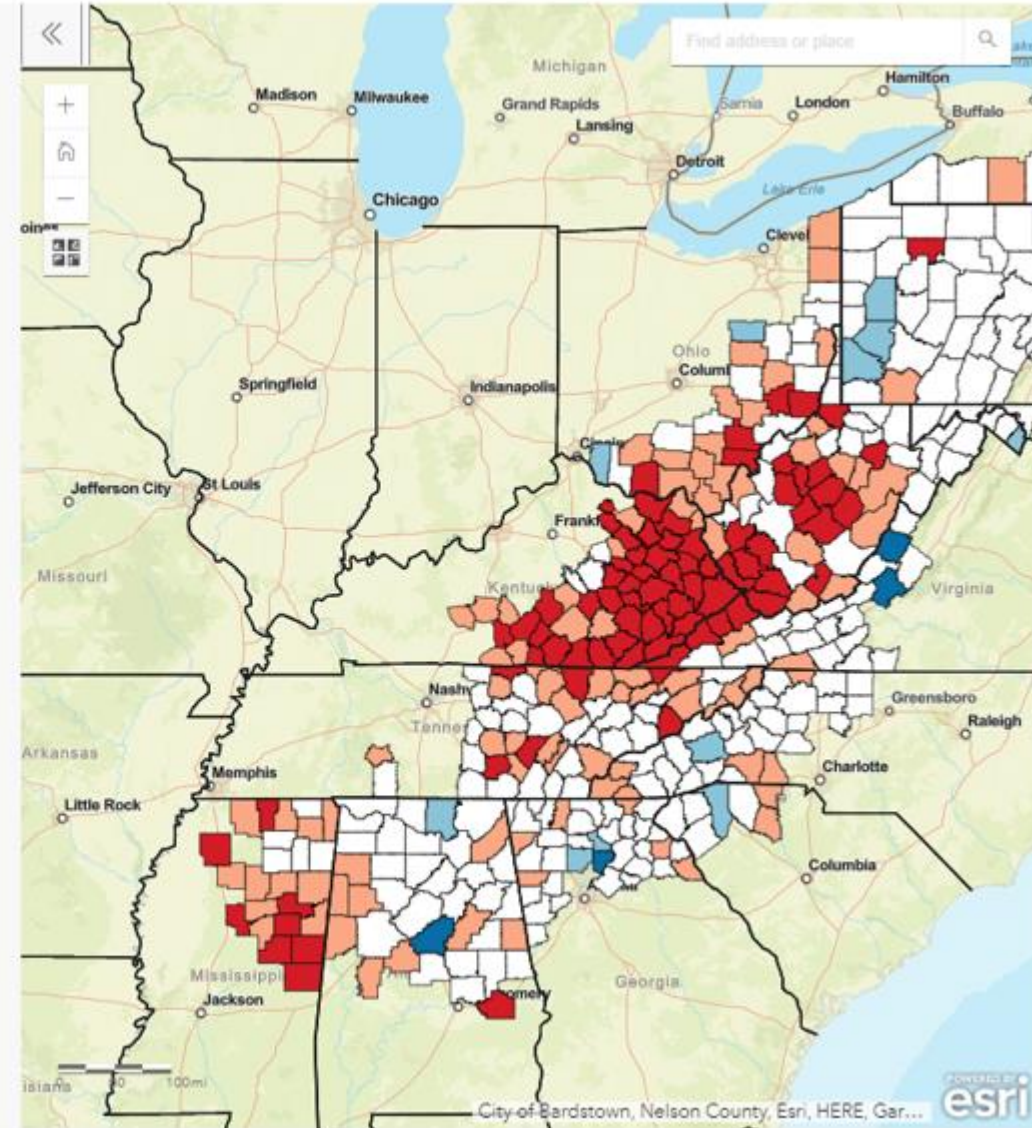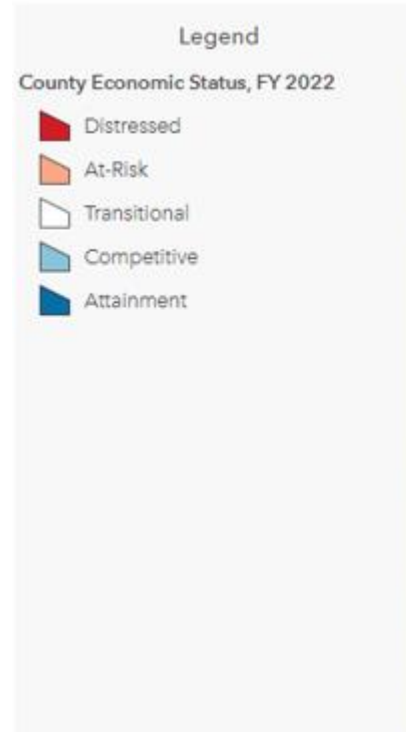- ❖ Lack of information for EV adoption and clean energy jobs

Tennessee Tech (lead) and Partners (below)

Clean Fuels Ohio (CFO)	East Tennessee Clean Fuels Coalition (ETCFC)	Kentucky Clean Fuels Coalition (KCFC)	State of West Virginia Clean Cities (WVCC)	Virginia Clean Cities (VCC)
ChargePoint	Siemens	EVmatch	SEA Electric	Phoenix Motorcars
Eastern Eight Community Development Corp.	KCEOC Community Action Partnership Inc	Fairmont-Marion County Transit Authority	Upper Cumberland Human Resource Agency	Tennessee Department of Transportation
Sustainable Ohio Public Energy Council	Appalachian Region Commission (ARC)	Tennessee Valley Public Power Association, Inc.	Tennessee Electric Cooperative Association	Tennessee College of Applied Technology
Rappahannock Electric Cooperative	Shenandoah Valley Electric Cooperative	Old Dominion Electric Cooperative	Frontier Housing, Inc.	Community Housing Partners
Fahe	People Inc.	Hope, Inc.	NET Trans	WV State Parks
HAMC	West Virginia University	VMDAEC	Oak Ridge National Laboratory	University of Texas at Austin
Rural Action Inc	Volkswagen			
DriveOhio	Appalachian Power	GACC	TennSMART	Nissan
East Kentucky Power Cooperative	Carter Caves State Resort Park in KY	City of Pikeville, KY	City of Williamsburg, KY	City of Prestonsburg, KY
Kentucky State Division of Fleet Management	Virginia Department of Mines, Minerals and Energy	Virginia Department of Environmental Quality	WV Department of Economic Development	Ohio Department of Natural Resources
WV Department of Administration Fleet Management Division	Sandy Valley Transportation Service Inc.	Tennessee Public Transportation Association	Tennessee Department of Economic & Community Development	Belmont County Community Improvement Corporation

Economic Overview of Rural Appalachia

- Appalachian Regional Commission (ARC):
  - ✓ 423 counties in total
  - ✓ 81 distressed counties (mostly in Central Appalachia)
  - ✓ 95 at-risk counties
- Main Industries
  - ✓ Coal
  - ✓ Mining
  - ✓ Agriculture
  - ✓ Manufacturing
  - ✓ Tourism

Economic Status of ARC

Legend
County Economic Status, FY 2022
- Distressed
- At-Risk
- Transitional
- Competitive
- Attainment

West Virginia

Kentucky

Tennessee

Virginia

Ohio

(source: arc.gov, 2022)

Objectives

- To provide clean and affordable mobility options to underserved communities in rural Appalachia
- To develop green economy in EV ecosystem to transform rural lives
- To support knowledge gaining, transfer, outreach and education on rural electrification, and
- To compliment DOE VTO's existing EV data set with rural EV operation and use data

VTO TI Goals

- National Security (fuel diversity, alternative fuels)
- Economy Growth (business opportunities related to advanced vehicle technologies)
- Affordability for business and consumers (cost savings from increased efficiency, alternative fuels)
- Reliability/resiliency (infrastructure reliability, diverse/resilient fueling, and transportation options)

Impacts

- Accelerate adoption of EVs in rural communities
- Reduce rural transportation cost and emissions
- Increase availability of EV charging infrastructure
- Create clean energy jobs

Milestones

| Project Period 1 Milestones (FY 2022)	Type	Progress
Acquisition and instrumentation of EVs ✓ All EVs have been ordered. ✓ At least 25 of 30 EVs have been delivered and instrumented	Technical	On track
Preliminary data analysis tasks and methods completed ✓ Key questions related to rural EV electrification formulated ✓ Data analysis methods developed	Technical	On track
Plans for workforce training and promotion of clean energy economy and jobs completed. ✓ Review of available curriculums completed; ✓ Development of a beta version of curriculum completed; ✓ Training at least 20 undergraduate students/graduate students ✓ Successfully training of 10 electricians for EV charging infrastructure development.	Technical	On track
Preliminary design and demonstration of EV ecosystem ✓ Successful installations of 128 EV charging stations ✓ Successful demonstration of ≥ 15 EVs to more than 400 rural residents ✓ Demonstrating ≥45% reduction of transportation costs in ≥100 real-world cases	Go/No Go	On track

Project Approach

Overall approach

- To build the underpinnings of a comprehensive EV ecosystem and green economy in the most economically distressed Appalachian region to transform the lives of rural and low-income communities, through strong regional collaboration
- Learn from proof-of-concept Upper Cumberland EV Testbed
(DE-EE0008888, 10/1/2019 – 12/31/2022)

Main tasks

- Establish Public Charging Station Network
- Delivery and Instrumentation of PEVs
- EV Demonstration
- Data Collection and Data Analysis
- Information Sharing, Outreach and Education
- Workforce Training and Economic Development
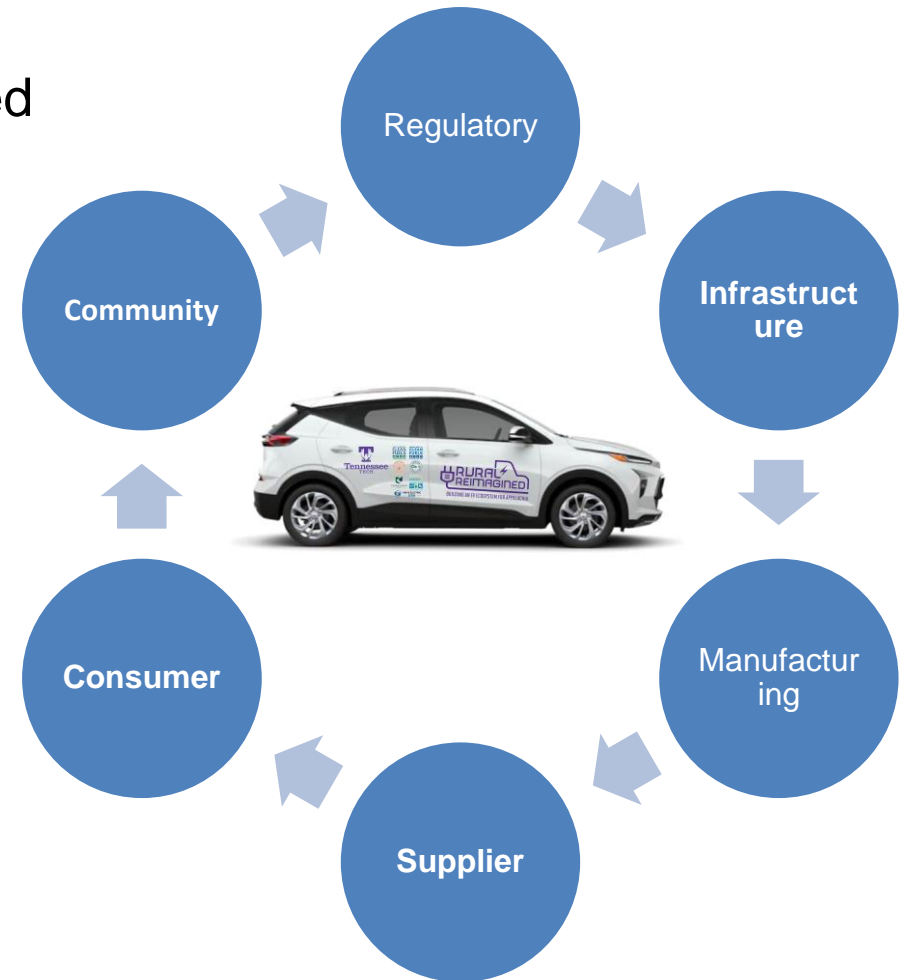
EV Charging Stations

- DCFC: CPE250 (62.5 kW)
- Level-2
  - CT4021 (7.2 kW)
  - CPF50 (12 kW)
  - Enel X JuiceBox (7.7 kW)

Parameter	BP-1	BP-2	BP-3	Total
Number of New Public dual-port Level-2 Charging Stations	25	25	0	50
Number of Networked Residential Level-2 Chargers	42	43	15	100
Number of Smart and Connected EV Charger	5	0	0	5
Number of New DC Fast Charging Stations	7	8	0	15
Number of Level-2 Chargers for Rural Transit Agencies	16	0	0	16
Number of Multi-family Housing Chargers for Families with No Access to Street Parking	31	25	0	56
Number of 16-Amp Level-2 Chargers	18	0	0	18
Number of Mobile Chargers	0	1	1	2

EVSE Applications

(a) CT4000 dual-port (Level 2) (b) CPE250 DCFC (c) CPF50 (Level-2) (d) JuiceBox (Level-2)

Cities & municipalities   Parking   Retail

Commercial real estate   Hospitality   Recreational area

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EVSE Installation Strategies

- Deploy and train (if needed) local electricians
- Allocate funding to reduce EVSE installation cost
- Seek in-kind contribution from local communities
- Leverage other EVSE development programs
- Apply for additional grants
- Provide various EV infrastructure options based on capacities of local communities.

(a) CT4000 dual-port (Level 2)   (b) CPE250 DCFC   (c) CPF50 (Level-2)   (d) JuiceBox (Level-2)

Type of EVSE	No	Installation & Maintenance Cost/Unit	Total
DCFC	15	Up to $7,000*	$105,000
Public Dual-port level-2	50	Up to $2,000*	$100,000
Multi-family or Fleet Level-2	56	Up to $1,000*	$56,000
Residential Level-2	100	Up to $1,000*	$100,000
Total			$361,000

* these numbers are estimated numbers and will be finalized later.

EV Infrastructure Working Group

- Community housing partners
- Clean Fuels Coalition
- Rural planning group
- Rural transit agencies
- Local power companies
- EVSE partners
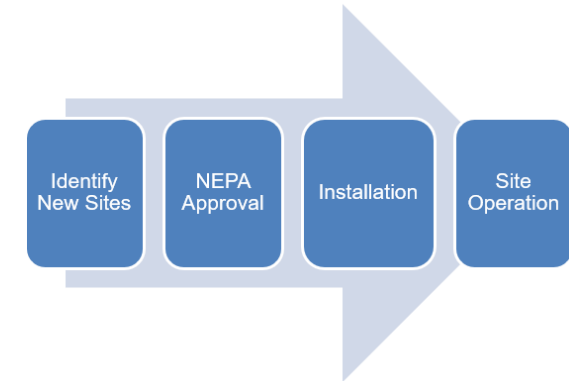
Infrastructure Development

- Round 1 - 27 EVSE sites (NEPA pending, level-2, as of 3/21/23)
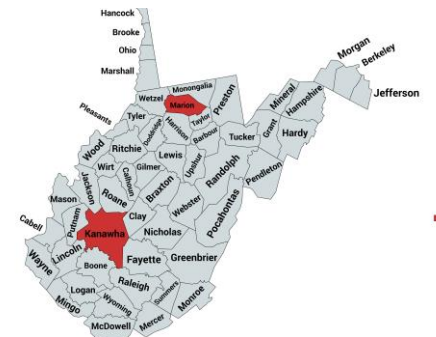- Round 2 - 10 new sites (including 2 DCFC, as of 5/2/23)

Local Business / Property Owners / Vehicle OEMs / Economic Development organization / Local Power Companies/Utilities / Local/State Government / Working Group

Identify New Sites → NEPA Approval → Installation → Site Operation

EVSE Site in OH

EVSE Sites in VA

EVSE Sites in TN

EVSE Sites in KY

EVSE Sites in WV

EVs (Delivered)

- 5 Chevrolet Bolt EUV
- 3 Ford F150 Lightning trucks
- 1 electric passenger transit van
- 2 VW ID 4 SUV

EVs (Reserved)

- 3 Ford Mach-E
- 1 VW ID 4 SUV

27 EVs in total

EVs (to be Ordered)

- 12 additional EVs for TN rural transit agencies

Data acquisition systems
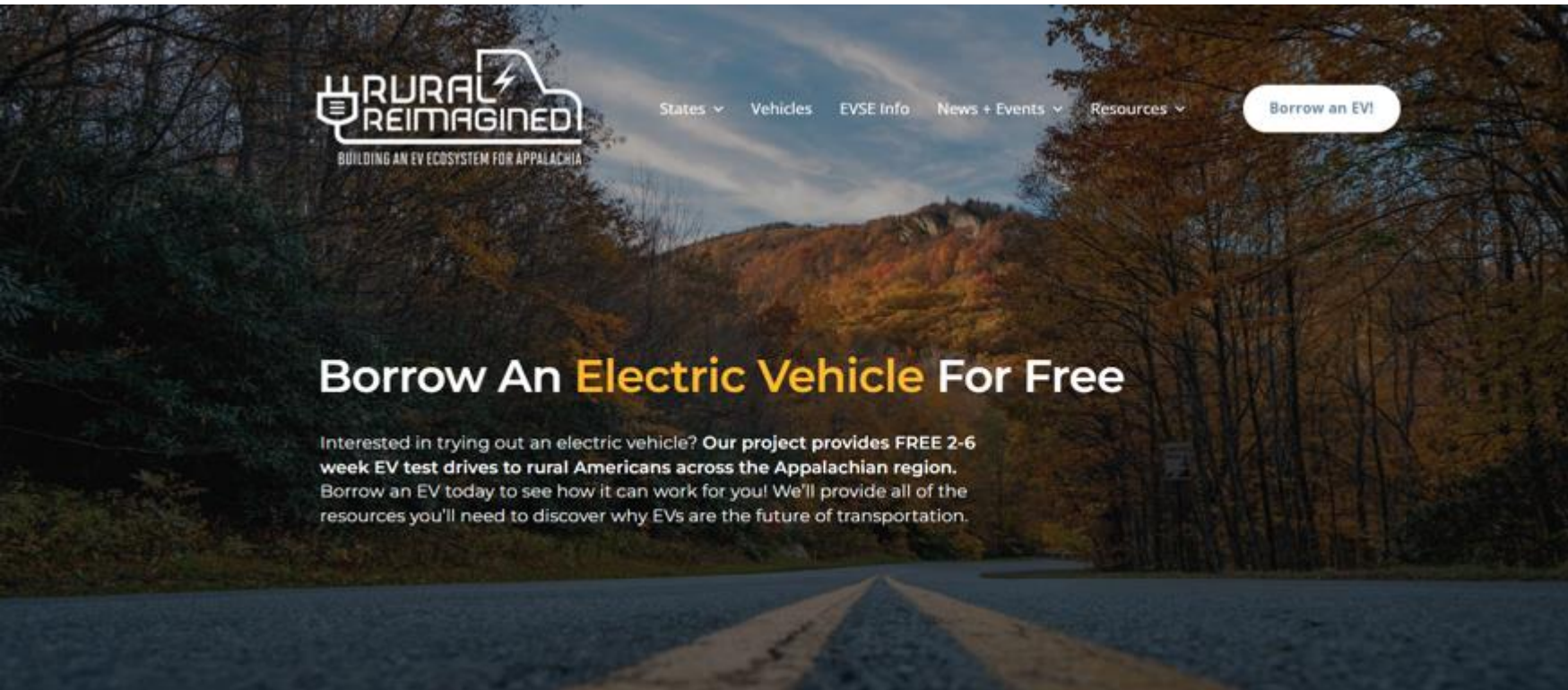
- HEM OBD data logger
- OEM support (e.g., VW)

EV Demonstration

- EV fleet in rural transit agencies
- Short-term ride-n-drive or show-n-tell events
- EV test-drive program (individuals + fleet)

(Project website: www.rural-reimagined.com)

(Sample of flyer)

EV Test-drive Program (started in VA) – 2 Cities Completed (as of 5/2/23)

- Pennington Gap, VA (1,100 miles, 1-month)

- Wytheville, VA (314 miles, 1-month)

Ongoing

Information Exchange, Outreach and Education

- Actively host or participate in 2022 National Drive Electric Week (NDEW) events and 2023 Drive Electric Earth Day (DEED) events – 13 in ARC;
- Non-NDEW/non-DEED EV outreach events – 14 in ARC
- Participate in state and local EV-focused forum and expo – 3 in total
- EV ribbon-cutting events – 1 in Fairmont, WV; 1 in Cookeville, TN

Best Practices

- Establish communications with local government and local economic development division;
- Meet in person with local communities to initiate discussion;
- Invite local mass media and promote rural electrification;
- Contact local school systems (teachers, especially STEM-focused are ideal targets);
- Partners with local power companies/utility companies/electric co-ops, auto dealers;
- Partner with state parks to support EV events;
- Synchronize EV outreach events with local events (e.g., state/local fairs, local festivals);
- Hybrid EV outreach strategies (decentralized + centralized);

EV Outreach Event and Location	Date	No. of Participants	No. of Exposure	No. of EVs	No. of Ride and Drives
Carthage, TN	09/10/22	40	400	3	1
Knoxville, TN	09/24/22	70	70	2	0
Shenandoah Junction, WV	09/24/22	43	43	12	0
Belpre, OH	10/02/22	75	75	17	23
Cookeville, TN	10/02/22	40	120	10	8
Byrdstown, TN	12/03/22	20	40	2	3
Woodbury, TN	12/10/22	9	500	3	2
Spencer, TN	12/17/22	8	20	2	0
Pikeville, TN	02/11/23	8	10	3	2
Dunlap, TN	02/11/23	11	500	3	1
Wartburg, TN	02/19/23	15	100	3	0
Oneida, TN	02/19/23	20	200	5	0
Sneedville TN	03/15/23	18	25	2	0
Albany, KY	03/25/23	4	50	2	0
Celina, TN	03/25/23	11	100	2	0
Monteagle, TN	03/25/23	17	45	2	3
Newport, TN	03/29/23	9	30	2	0
Huntington, WV	04/12/23	120	1,000	5	0
Cookeville, TN	04/15/23	50	750	17	12
Jefferson City, TN	04/15/23	5	25	9	5
Monticello, KY	04/16/23	20	20	2	0
Somerset, KY	04/16/23	100	200	4	0
Oak Ridge, TN	04/22/23	15	40	2	0
Knoxville, TN	04/22/23	20	75	2	0
Knoxville, TN	04/23/23	70	200	3	0
Athens, OH	04/27/23	80	80	1	0
Abingdon, VA	04/29/23	75	100	12	0
Total		973	4,818	130	60

List of EV Outreach Events in ARC (27)

EV Event Sites in TN
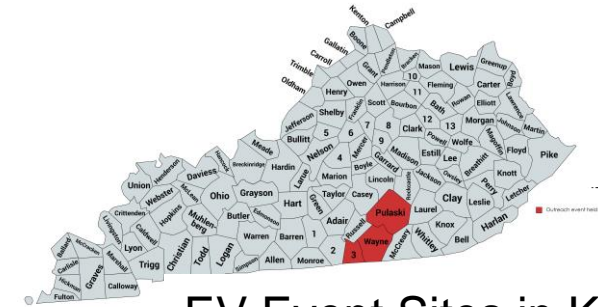
EV Event Sites in KY

EV Event Sites in OH

EV Event Sites in VA
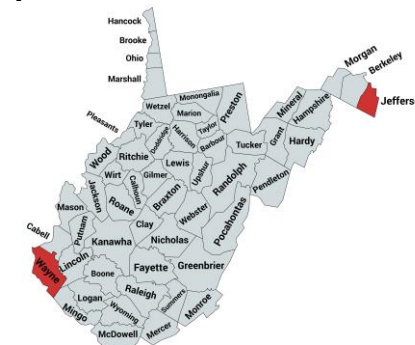
EV Event Sites in WV

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Information Exchange, Outreach and Education

Workforce Training

- Workforce training group established (Tennessee Tech, WVU NAFTC, 5 community colleges);
- Reviewing existing curriculum and design new curriculum
- Partnered with major vehicle OEMs (e.g., Nissan and VW) to improve curriculum
- Tennessee Tech provided EV-related training to 43 undergraduate students in Fall 2022
- Tennessee Tech designing an EV-focused course and will launch it in Fall 2023
- Tennessee Tech actively recruiting new undergraduate students to vehicle engineering program

Green Economy Development

- Promote awareness of clean-energy jobs
- Promote EV tourism-based economy

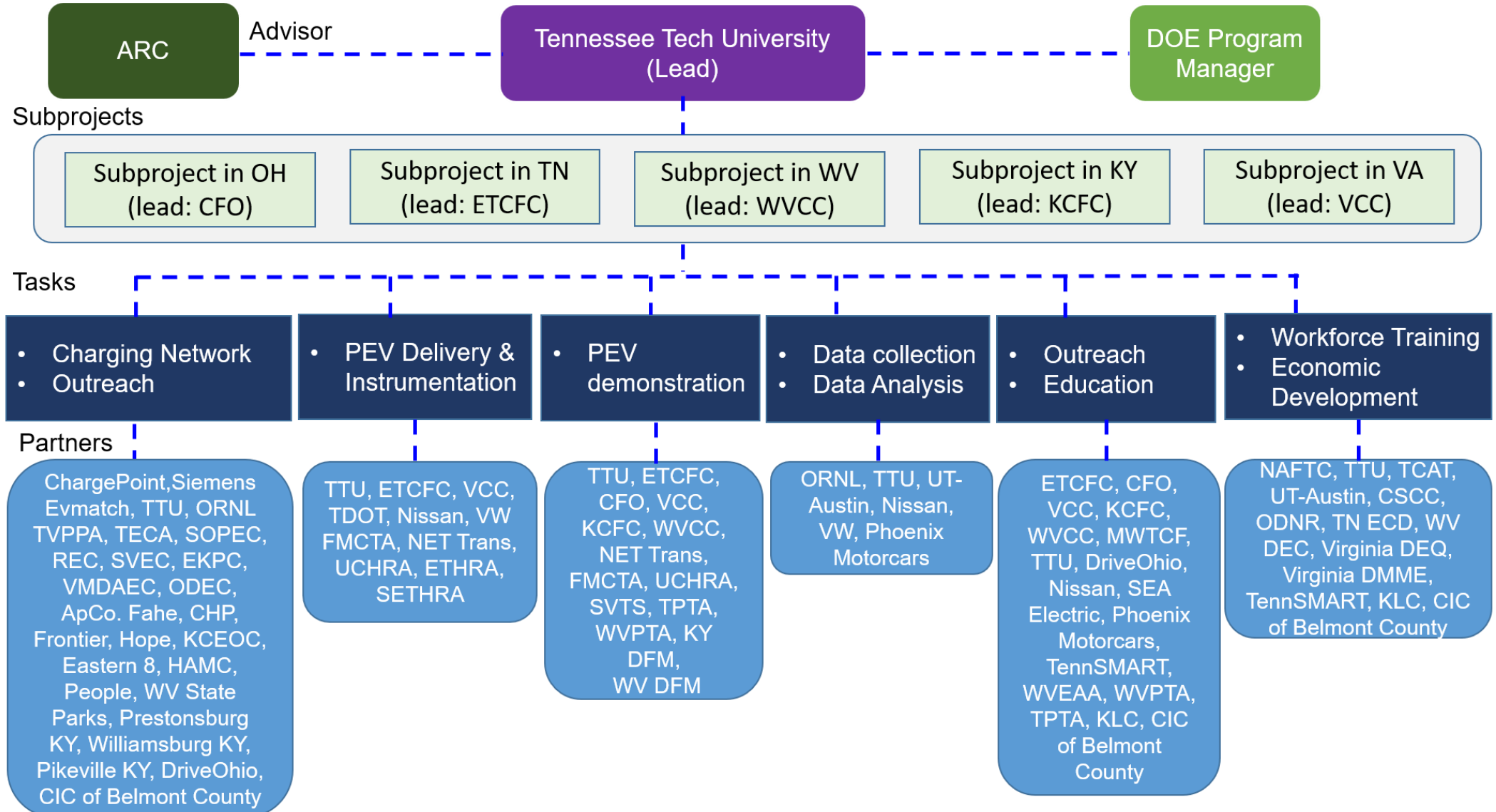EV Manufacturing   EV Infrastructure Development   EV Sales and Service   EV R & D

# Collaboration and Coordination Among Project Team

Project Organization Chart

Advisor

ARC

Tennessee Tech University (Lead)

DOE Program Manager

Subprojects

| Subproject in OH (lead: CFO) | Subproject in TN (lead: ETCFC) | Subproject in WV (lead: WVCC) | Subproject in KY (lead: KCFC) | Subproject in VA (lead: VCC) |

Tasks

- Charging Network
- Outreach

- PEV Delivery & Instrumentation

- PEV demonstration

- Data collection
- Data Analysis

- Outreach
- Education

- Workforce Training
- Economic Development

Partners

ChargePoint, Siemens Evmatch, TTU, ORNL TVPPA, TECA, SOPEC, REC, SVEC, EKPC, VMDAEC, ODEC, ApCo. Fahe, CHP, Frontier, Hope, KCEOC, Eastern 8, HAMC, People, WV State Parks, Prestonsburg KY, Williamsburg KY, Pikeville KY, DriveOhio, CIC of Belmont County

TTU, ETCFC, VCC, TDOT, Nissan, VW FMCTA, NET Trans, UCHRA, ETHRA, SETHRA

TTU, ETCFC, CFO, VCC, KCFC, WVCC, NET Trans, FMCTA, UCHRA, SVTS, TPTA, WVPTA, KY DFM, WV DFM

ORNL, TTU, UT-Austin, Nissan, VW, Phoenix Motorcars

ETCFC, CFO, VCC, KCFC, WVCC, MWTCF, TTU, DriveOhio, Nissan, SEA Electric, Phoenix Motorcars, TennSMART, WVEAA, WVPTA, TPTA, KLC, CIC of Belmont County

NAFTC, TTU, TCAT, UT-Austin, CSCC, ODNR, TN ECD, WV DEC, Virginia DEQ, Virginia DMME, TennSMART, KLC, CIC of Belmont County

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**Energy Democracy - Stakeholder Engagement (as of 5/3/23)**

- # of organizations with a funded role that represent underserved communities (UCs) – **34**
- Funding budgeted to EVSE site hosts (84% in UCs) and rural transit agencies - **$2,234,094**
- # of stakeholder engagement events that include people from UCs – **40 (including 4,665 people)**
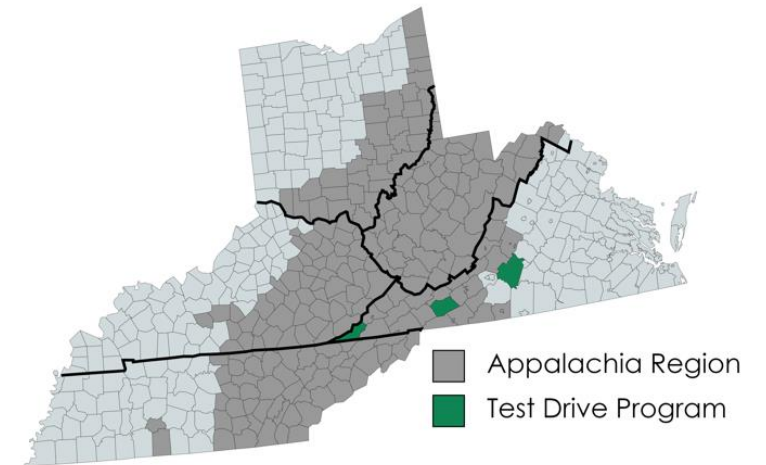
Clean Energy Jobs (as of 5/3/23)

- No. of workforce training events for people work or live in UCs – **2 EV-related courses** in Fall 2022
- $ budgeted on job training events that train people work in or live in UCs – **$1,106,483**
- Amount of project funding for jobs located in UCs - **$303,240** (EVSE installation cost)
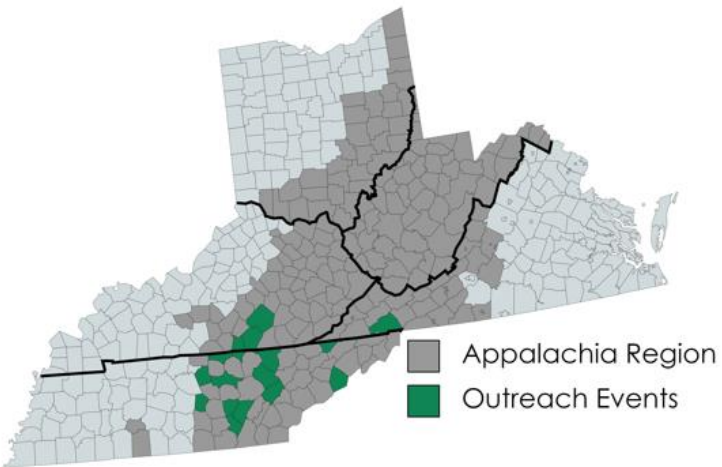
17 EV Outreach Events inside UCs
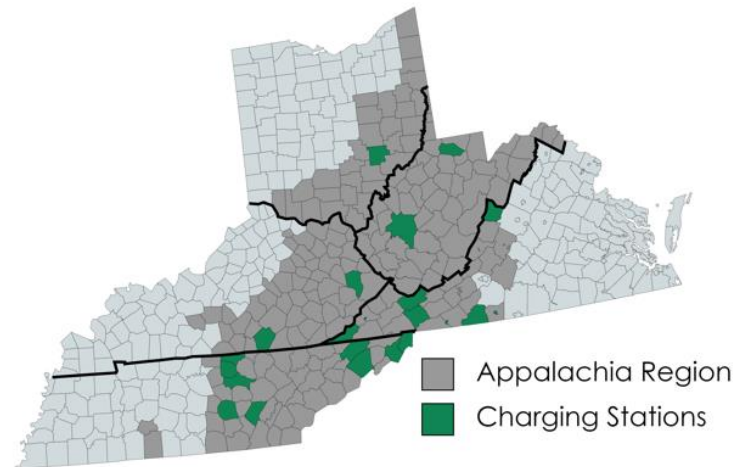
31 EV Charging Station Sites inside UCs

EV Test-drive Program inside UCs

Summary

Goal

- Help rural communities in economically distressed Appalachia reduce energy burden, transportation cost, and emissions, and support development of green economy around EV ecosystem

Approaches

- Develop a sustainable EV ecosystem to accelerate EV adoption in rural Appalachia
- Provide various workforce training and economic development opportunities

Accomplishments

- Established an EV fleet to support test-drive program, various EV outreach and education activities
- Identified 37 EV charging station sites for EV charging infrastructure development
- Created or participated in 27 EV outreach events in rural Appalachia
- Generated EV-focused training materials and provided EV workforce training
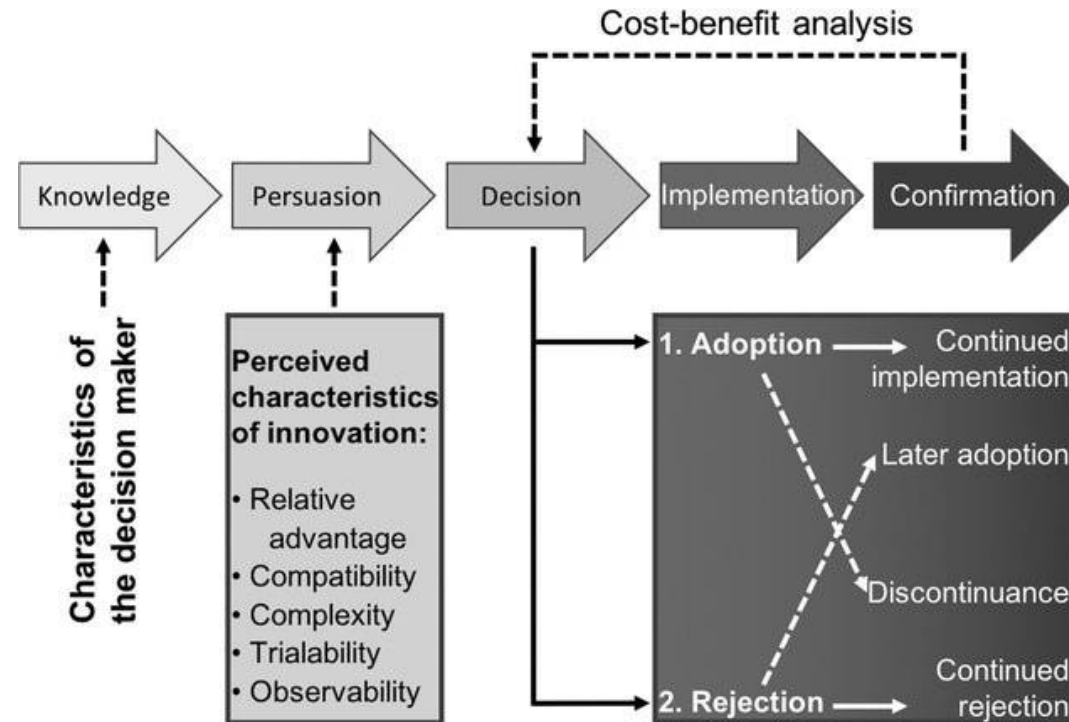
Next Steps

- Continue developing EV fleet and EV charging infrastructure for various applications
- Expand EV test-drive program, outreach, and education efforts to broader rural Appalachian region
- Collect EV data and survey data to support EV cost analysis

Technical Backup Slides

EV-decision Process

❖ **Knowledge**: aware of EV existence and how EV works

❖ **Persuasion**: form a favorable or unfavorable attitude toward EVs

❖ **Decision**: engaged in engages in activities that lead to a choice to adopt or reject EVs

❖ **Implementation**: put EV into use

❖ **Confirmation**: reinforce/reverse EV decision

Adapted from Rogers, 2004