COVER PAGE

Project Title: GreenVillages "Living Labs" – Energy Efficient, Automated, Connected, Electric, Shared (ACES) Mobility Systems in Greenville, SC
Department of Energy (DOE)
Office of Energy Efficiency and Renewable Energy (EERE)
Fiscal Year (FY) 2017
Vehicle Technologies Deployment Funding Opportunity Announcement
Funding Opportunity Announcement (FOA) Number: DE-FOA-0001639
FOA Area of Interest (AOI 2)

Applicant: Greenville County, S.C. and is eligible to apply for funding as a Prime Recipient.

Business points of contact: Joe Kernell, County Administrator/ Fred Payne, Council Member, Greenville County, 301 University Ridge, Greenville, SC, 29602

Technical points of contact: Fred Cartwright, Executive Director/ Dr. Venkat Krovi, Michelin Chair of Vehicle Automation, CU-ICAR, Innovation Drive, Greenville, SC

Teaming Organizations illustrate that the proposed project emphasizes partnerships to support this project in Greenville. Two Lead members (**BOLD**) will be 100% responsible for providing business/financial management and technical/academic expertise to assure a successful project. Other team members are identified and will be delegated specific responsibility if this concept is approved for a full application.

- Governmental/Business/Financial: **County of Greenville**, City of Greenville, City of Mauldin, Greenville Transit Authority, CATbus, SCTAC, and will include others.
- Technical/University-Related: **Clemson University—International Center of Automotive Research (CU-ICAR),** Furman University, Bob Jones University, USC Upstate, Greenville Technical College, etc.
- Non-Profit: Global Autonomous Vehicle Partnership (GAVP), International Transportation Innovation Center (ITIC), Carolinas Innovation Alliance (CIA), Center for Transportation & Energy (CTE), Compass Transportation & Technology (CTT), Legacy Charter Early College High School, Palmetto State Clean Fuels Coalition, etc.
- Foundations: Greater Greenville Foundation, Hollingsworth Fund, Piedmont Healthcare Foundation,
- Corporate: BMW, Michelin, GE, AT&T, IBM, Bosch, Cisco, Duke Energy, Synnex, ScanSource, Hubbell, Verdae Development, etc.

The GreenVillages Living Lab and ACES project will utilize both electric and propane powered vehicles to implement energy efficient mobility systems and technologies. This Living Lab will increase the use of propane energy that currently powers about 300 Sheriff Department fleet vehicles and will adopt the use of electric energy to power all new ACES vehicles and charging infrastructure. Greenville County, SC, is the UZA region impacted and our selection rationale is to improve existing propane and electric vehicles and infrastructure currently operated, to collect more data to analyze and identify better transit options, and to expand fleets with new electric and propane energy efficient vehicles and infrastructure by implementing the ACES shared connected system beginning in the Verdae to CU-ICAR mixed use and multi-modal area.

Project/Technology Description (2 pages)

<u>What</u>: The GreenVillages "Living Lab" will integrate alternative fuels with smart technologies to maximize both mobility and energy efficiency and attract riders to transform mobility. The project focuses on deploying convenient, cost-effective, energy efficient mobility systems using electric and propane energy as alternative fuels; innovative automated, connected, electric, shared (**ACES**) vehicles that will serve as on-demand shuttles for riders and goods; with charging infrastructure. Greenville will deploy ACES shuttles (aka **a-Taxis**) in commercial operation on public roads; provide personalized service with convenient, a-Taxi service to attract riders and reduce fuel use; and competitive aTaxi procurement.

<u>Why</u>: Near-term, the project will reduce use of petroleum and improve mobility to create a **GreenVillages** community pilot in which people love to live, work, learn, shop and play. Long-term, the project will be a model that will transform mobility in Greenville and worldwide by making environmentally sustainable transportation options viable and desirable.

<u>Where</u>: The region impacted is Metro Greenville (SC) Urbanized Area (UZA), halfway between Charlotte, NC and Atlanta, GA along I-85. The UZA has about 650,000 people extending from the Greenville-Spartanburg Airport to Clemson University. The first ACES district with aTaxi services will connect Clemson University International Center for Automotive Research (CU-ICAR) and Verdae Properties, a 1,200 acre mixed use and multi-modal development (GreenVillage), to improve mobility options for citizens in nearby housing, businesses, and social centers. Expanded districts will link downtown and low-income areas with jobs, health, and regional transport (see Greenville Autonomous District map).

<u>Goals</u>: The **ACES** vehicle ecosystem will increase EV usage and reduce petroleum dependency. The **ACES** mobility system will transform transportation in the area by 2040 with potential to improve safety, mobility, and accessibility, reduce travel costs and air pollution, and become a more desirable means of transportation. We will deploy on public streets, unlike other private, specialized pilot settings with single manufacturer vehicles and without a sustainable network.

<u>How</u>: Greenville County, a 2016 USDOT Smart City Challenge and Envision America community, is a recognized leader in promoting ACES mobility. We build on smart goals using innovative teams of ACES experts, world-class facilities, favorable public policy, as well as corporate, governmental, and non-profit support. Our "Living Lab" integrates electric fuels with smart technologies. We will deploy and assess the efficacy of innovative, shared mobility concepts, business models, or technologies that maximize both mobility and energy efficiency (e.g. ride share and ACES assessments, including a-Taxi shuttles serving low-income areas).

<u>Realistic, Holistic</u>: The project's goals are to deploy ACES mobility vehicles on public roads in a multi-modal environment, assess human acceptance of aTaxi mobility, and develop a scalable aTaxi business model that is financially sustainable. Various aTaxi vehicles will be evaluated under commercial conditions in a community networked ACES pilot. Analysis of mass data from Vehicles to Infrastructure and Vehicles (V2I, V2V) and riders will enable assessment of life-cycle costs, performance, and reliability as well as human factors. Over time, press coverage of success stories and social media posts will increase public awareness and acceptance of ACES. Greenville has a local public private partnership (PPP) as the operational platform with strong financial and marketing support from many governmental, corporate, and non-profit leaders.

Creative, Sustainable Funding: Proposed resources include a private public partnership with private funds (Verdae commitment); private grant (GAVP finalist); private investment (VW ZEV applicant), and public funds (DoE). If the Global Autonomous Vehicle Partnership (**GAVP**) chooses Greenville in 2017 as an AV pilot, GAVP commitment could provide $1M private matching funds. Private local funds, e.g. a Verdae promise of $600,000 for an ACES mobility hub, plus other support and ridership income will promote long-term sustainability.

Benefits: Greenville will implement a project that demonstrates and assesses the return on investment (ROI) of energy efficient "smart" ACES mobility systems that holistically reduce energy consumption and deliver benefits of new ACES vehicle technologies, multi-modal transport solutions suitable for an urban environment, with infrastructure needed to support consumer adoption of energy efficient mobility systems. Greenville will demo and assess the efficacy of shared mobility initiatives, business models, or technologies that maximize mobility, sustainability, and energy efficiency, such as ride share and electric vehicle assessment projects.

Collaborative: Since Greenville County and City governments and universities are collaborating on this ACES project, we will work to identify effective policies and incentives to deploy fleets of ACES mobility and/or taxi fleets. As the coordinator, Greenville County, can assess the effective policies and incentives to deploy fleets of ACES mobility fleets in the public arena. Local universities can study ACES cars and suggest regulations for EV software, e.g. diagnostic and navigation systems, noting potential cybersecurity attacks and requiring safeguards.

AOI 2 General Requirements and AOI 2 Additional Requirements

Data Collection**:** The Greenville project will quantify the expected energy efficiency benefits that result from the ACES technology to be deployed. We will capture data using online surveys and data analysis lessons to assess and adapt our project. Faculty and students will engage in data analysis. Outside evaluators will audit/verify project activities.

Best Practices and Lessons Learned**:** Using actual data and successes, Greenville will develop best practices and case studies as templates for other communities. Outside evaluation will verify performance measures. Positive results will be disseminated in public information channels. Our replicable models will facilitate scalability as successes are shared with other communities through reports presented in seminars, webinars, and national conferences to replicate successes.

Energy Saving: As Greenville uses electric and propane alternative fuels and vehicles in our project plans, we will follow appropriate Energy Policies. County EV charging will use solar energy (photovoltaics & improved battery storage) where possible which can allow higher energy efficiency (30% gain over an AC based energy system).We will estimate fuel savings and emissions reductions in the project and use the AFLEET tool to quantify these reductions.

Sustainability: The ACES successful operations will demonstrate the practicality of the technology, and systems by improving mobility options and reducing costs to the user. The growing user base will eventually cover operation costs and the success and cost effectiveness of the project will demonstrate feasibility and encourage replication of the technology. As the project is implemented, returns on investment will be monitored in order to determine the scale and ridership necessary for such a project to be financially viable.

Dissemination of successes include County publicity department and website, printed media articles, social media releases (e.g. YouTube and Facebook), as well as academic and popular presentations on fuel savings and emissions reductions in seminars and conferences.

<u>Addendum</u> (2 pages)

The proposed Greenville "Living Lab" project has a well-qualified, experienced, and capable <u>Project Team</u>. Its Lead members have vast prior experience which demonstrates their ability to perform tasks of similar risk and complexity to this grant.

Greenville County Administrator Joe Kernell and his administrative team have the skill and expertise needed to successfully execute the project plan and maintain financial integrity. He has led Greenville County for 14 years and has maintained a Triple AAA credit rating without raising taxes. Fred Payne has served 10 years on Greenville County Council, is a member of GPATS, and 2014-2016 Chair of the County's Economic Development Corporation. He serves on the National Association of Counties Transportation Committee, Vice-Chair of the Transit/Rail Sub-Committee, and a Board member of American Transit Association.

CU-ICAR Director Fred Cartwright, Dr. Venkat Krovi, and the Clemson project team have the technical and management leadership skills to manage the Greenville "Living Lab" project and Principal Investigator issues related to ACES vehicles and mobility systems in Greenville.

<u>Prior projects or programs</u>: Greenville County has worked with many partners on several TIGER grants, a 2015 Federal Highway Administration grant application as a sub-recipient, 2016 USDOT Smart City Challenge, 2016 Envision America/Envision Greenville project, 2016 Legacy Integrated On-demand Network (LION) project at Legacy Charter School, the 2017 Volkswagen Zero Emission Vehicle (ZEV) charging infrastructure and visibility/education investment proposal, and the 2017 Global Autonomous Vehicle Partnership (GAVP) project.

<u>Project Support and Management</u>: The Center for Transportation and the Environment (CTE) is a 501(c)(3) member-based organization focused on advancing clean, sustainable, innovative transportation and energy technologies. Since its inception in 1993, CTE has managed a portfolio of more than $400 million of cost-shared development, demonstration, and commercialization projects focused on a broad range of advanced transportation and clean energy technologies. CTE has provided management/consulting services for a variety of zero emission bus projects. These projects range from "ground up" new bus development and demonstration projects, to full fleet deployment projects. CTE understands the technical challenges associated with battery electric vehicle technology and charging infrastructure, as well as the challenges associated with the procurement, deployment, and operation of the vehicles in a fleet environment. Through it technical capability and modeling and simulation program, CTE uses a data-driven, methodical approach to managing and deploying its projects, and the this experience will support quality project management.

<u>Support statement</u> from GAVP Executive Director Art Shulman:

"The Global Autonomous Vehicle Partnership is committed to making connected, fuel efficient and environmentally friendly self-driving vehicles commonplace. Such vehicles would not only save lives and energy but they offer the opportunity to dramatically increase mobility and on-demand access to underserved populations. Accordingly, the GAVP is in strong support of Greenville's "Living Lab" project."

Greenville Map: Potential Autonomous Connected Electric Shared (ACES) Vehicle Deployment