ARC EMERGING TECHNOLOGIES ROUNDTABLE

Connected Communities & Energy, Electrification and Resiliency

Report Two

April 2022

Members

Muhammed Ahmed
Research Scientist at Opendoor

Jessica Anderson
Research Scientist and Director of DataWorks at Georgia Tech

Brandon Branham
CTO and Assistant City Manager at City of Peachtree Corners

Dr. Marilyn A. Brown
Regents' Professor School of Public Policy at Georgia Tech

Tiwanna Crawford
Executive Assistant at Atlanta Regional Commission and Emerging Technologies Roundtable Coordinator

Frank Fernandez
President & CEO at Community Foundation for Greater Atlanta

David Giguere
Geospatial Administrator at Atlanta Regional Commission and Co-Chair of the Emerging Technologies Roundtable

Mark G. Lauby
Senior VP and Chief Engineer at North American Electric Reliability Corporation

Mayor Tom Reed
Mayor of the City of Chattahoochee Hills and Co-Chair of the Emerging Technologies Roundtable

Anna Roach
Executive Director of the Atlanta Regional Commission

Laura Rogers
Deputy Director at The Ray

Dr. Nashlie Sephus
Applied Science at Amazon AI and Founder/CEO at The Bean Path

Elizabeth Strickler
Senior Lecturer and Director of Entrepreneurship Programs at Creative Media Industries Institute at Georgia State University

ARC EMERGING TECHNOLOGIES ROUNDTABLE

The second meeting of the Emerging Technologies Roundtable (ETR) was held on February 25th, 2022. During the meeting, Roundtable members explored two Emerging Technology topics: **Connected Communities,** presented by Brandon Branham from the City of Peachtree Corners, and **Energy, Electrification and Resiliency,** presented by Mark G. Lauby from the North American Electric Reliability Corporation (NERC).

Brandon Branham, CTO and Assistant City Manager at City of Peachtree Corners, presented on Connected Communities and the advancements being made connecting high-speed, low latency communications and city infrastructure to autonomous vehicles and other transportation assets. By offering access to secure, high-speed data transmission using 5G wireless and fiber backhaul, Long Range Wide Area Network (LoRaWAN), Vehicle to Everything (V2X) and Cellular Vehicle to Everything (C-V2X) platforms, City of Peachtree Corners is improving the efficiency, availability, and accessibility of government services to all residents.

Mark G. Lauby, Senior VP and Chief Engineer at North American Electric Reliability Corporation introduced the Energy, Electrification and Resiliency topic, providing the Roundtable with an understanding of the NERC mission of reducing risks associated with the reliability, resilience, and security of the energy grid as well as explaining the advantages and challenges found in the trend toward a more distributed, decarbonized, and digitized energy generation and distribution system.

Key Insight #1
Adoption of microgrids can create more resilient local energy systems

The electricity industry represents approximately 7% of the U.S. economy and is often referred to as the "First 7%" because, without electricity, the balance of the economy and nearly every U.S. resident's way of life would not be possible. Extreme weather events like heat waves, winter storms and hurricanes, are increasingly common and place our communities at greater risk for energy supply failures that can cause the loss of human life and serious social and economic disruptions. The increased prevalence of disruptive weather events coincides with a shift toward a 'single-threaded' energy system, with increasing reliance on electricity to power our shift to electric vehicles and warm our homes. Considering these threats, communities need resilient energy generation and distribution systems that are more robust, more reliable, and less sensitive to climate and weather disruption. Adopting distributed, small-scale energy delivery and storage systems (i.e., microgrids) powered by clean and renewable sources, may be an energy solution for local governments to explore. Microgrids advance our outdated energy infrastructure by moving us to an environment that is smart, connected, resilient and designed to be more flexible by providing bi-directional power to communities and energy providers. To increase resilience of these micro grids, long-distance high voltage transmission is needed to provide resources from areas where energy exists to areas that require energy. This will offset the uncertainty from variable renewable energy resources, while, at the same time, improving reliability and resilience to the grid. This design should include cyber/physical-security as part of the development rather than bolted on after construction. From reliable electric vehicle charging to community power generation and storage, microgrids have the potential to greatly reduce energy insecurity, improve equitable access and allow residents to support clean energy initiatives within their own communities.

Action: Local and Regional Governments can attract and retain stakeholders by working with regulators to develop small-scale, distributed, highly reliable and secure community energy systems for our region. By adopting a smart, bi-directional grid distributing locally generated clean energy from renewable sources, communities will enjoy greater resiliency in the face of extreme environmental events, increased self-sufficiency with local energy storage and be better positioned to support the region by selling generated energy excesses back to the power companies or providing mutual aid to neighboring communities in need by sharing their stored energy.

Key Insight #2
Smart, connected communities reduce costs and improve livability

Each week, more than one million people move to cities around the globe, and it is expected that by 2040, 65% of the world's population will live in cities. These cities will be home to the majority of the world's Gross Domestic Product generation and are projected to use 75% of global energy annually. By investing in connected technologies, sensors and systems communicating across high-speed data networks with devices and vehicles, governments can measure and monitor the various resident and device touchpoints, optimize interactions throughout the community and more efficiently deliver energy and services to residents and businesses. A connected or 'smart' community can leverage the massive amounts of processed and analyzed data collected during the real-time monitoring of assets and devices across the community. Through analyzing data, we can uncover patterns, understand demand, and develop predictive models of behavior.

Action: Communities may improve the efficiency and responsiveness of the government services, improve the safety and travel efficiency of residents, and support equitable digital access by developing a high speed, low latency wireless data network accessible to residents and service providers. For instance, by monitoring the sensor-identified energy demand of each building, your community can adjust and optimize its energy usage and support carbon neutrality goals by reducing emissions. Sensors can also provide the real-time monitoring of waste and alert governments to servicing needs; monitor environmental conditions and report on air and water pollution in real-time; suggest (via analysis) optimized, off-peak energy electric vehicle charging schedules for fleet vehicles; monitor travel movements to improve public safety; reduce traffic congestion and decrease vehicle emissions by analyzing pedestrian, micromobility platforms and vehicle movements; and optimize routes and signal timing.

On the Horizon:
A Future Scenario with Connected Communities & Energy, Electrification and Resiliency

During the second Emerging Technologies Roundtable meeting, members were invited to synthesize and blend the presented information with their industry knowledge to shape and share a vision of possible futures for Metro Atlanta over the next decade. The following future scenario contains plausible themes found in meeting conversation, topic research and our first ETR report.

Scenario: For Every Metropolitan, A Digital Twin

The Digital Cities for Improved Efficiency Act of 2035 required medium and large metropolitan areas to adopt standardized smart city and digital twin monitoring and connectivity protocols to support energy management efforts. Digital Cities for Improved Efficiency brought new complexity to local governments. Yet, once metropolitan governments successfully navigated the array of vendor solutions and implemented changes, they found benefit in the optimization strategies created by monitoring, analyzing, and archiving the real-time feeds of connected sensors, devices, assets, and vehicles. These smart and connected urban metros are now yielding quantifiable reductions in service response times, human capital requirements, regional energy consumption, carbon emissions, and travel times.

The following examples highlight a few of the approaches taken by communities to unlock safety improvements, travel time reductions and energy savings:

Personalized Travel Routing: With nearly one third of the workforce in most major metropolitan areas working efficiently in their home offices or virtual streaming pods, in-person office visits are reserved for collaboration on complex tasks. However, when a visit to the office is necessary, your specific travel needs are optimized to yield an optimal departure time, reduced travel time, lower energy consumption and real-time curb access for autonomous vehicles or parking availability for manually piloted vehicles.

Energy Optimization: Optimization of electric vehicle charging is found in monitoring the travel patterns, current and future weather conditions, slope analysis and the battery State of Charge (SoC) of piloted and autonomous electric vehicles. As a vehicle enters the digital boundary of the metropolitan area, the real-time SoC is monitored, and the route optimized by destination and topography with charging infrastructure availability predicted in real-time. As a vehicle approaches the destination, a usage-optimized charging location is suggested when required.

Environmental Monitoring: Municipal sensors are ubiquitous, continuously monitoring air quality and water and gas utilities, providing instant pollution detection, identification, and automated response measures. Prevention of combined sewage overflows is managed by monitoring water usage and weather conditions to predict and proactively respond to potential overflow events.

Electricity Generation and Storage: Combining historic, current, and future weather conditions with the forecasted usage patterns (based on connected, smart energy monitoring systems found in homes and buildings), we can determine energy generation and storage capacity needs in real-time. With perfectly balanced demand, intentionally generated excess energy may be sold back to the electricity market or stored in local battery arrays and vehicle-to-grid connected electric vehicle fleets to meet usage based on predicted demand, weather,

or climate factors. Long-distance high voltage transmission is needed to take advantage of the diversity of environmental conditions across the region to provide resources from areas where energy exists to areas that require energy.

Pedestrian Safety: Monitoring the location and movement of pedestrians, micromobility platforms and ground transportation vehicles simultaneously, with microsecond-level latency, provides prioritized human-scale travel timing and offers accessible safety announcements for pedestrians where unsafe movements are predicted.

Glossary

Autonomous Vehicles (AVs) use technology to partially or entirely replace the human driver in navigating a vehicle from an origin to a destination while avoiding road hazards and responding to traffic conditions. *Source:* Anderson, J., *et al. Autonomous Vehicle Technology: A Guide for Policymakers*, 2016, Rand Corporation, Santa Monica, CA.

State of Charge (SoC) refers to the battery charging status of an electric vehicle and displayed as a percentage of charge. The SoC in battery electric vehicles is similar to the fuel gauge found in internal combustion engine vehicles. A properly functioning, fully charged battery should have a SoC of 100%, however an SoC percentage does not convey battery health or capacity.

Cellular Vehicle to Everything (C-V2X) uses the 5.9Ghz band and cellular radio technology to communicate between a vehicle and other radios, including those found in vehicles, traffic signals, infrastructure sensors and more. Communication is used to improve vehicle and pedestrian safety, travel efficiency and the broadcasting of pertinent data to and from connected vehicles.

Digital Twin is a virtual representation of an object or system that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision-making. *Source:* Armstrong, M., IBM Business Operations Blog, *Cheat sheet: What is Digital Twin?*, December 4, 2020, https://www.ibm.com/blogs/internet-of-things/iot-cheat-sheet-digital-twin. Accessed 12 April 2022.

Long Range Wide Area Network (LoRaWAN) specification is a Low Power, Wide Area (LPWA) networking protocol designed to wirelessly connect battery operated 'things' to the internet in regional, national or global networks, and targets key Internet of Things (IoT) requirements such as bi-directional communication, end-to-end security, mobility and localization services. *Source:* LoRa Alliance, *What is LoRaWAN® Specification*. https://lora-alliance.org/about-lorawan. Accessed 12 April 2022.

Microgrid is a local energy grid with control capability, which means it can disconnect from the traditional grid and operate autonomously. Source: Lantero, A. United States Department of Energy, How Microgrids Work, June 17, 2014, https://www.energy.gov/articles/how-microgrids-work. Accessed 12 April 2022.

Micromobility Federal Highway Administration broadly defines micromobility as any small, low-speed, human- or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles, electric scooters (e-scooters), and other small, lightweight, wheeled conveyances. *Source:* Jeff Price, Danielle Blackshear, Wesley Blount, Jr., and Laura Sandt, *Micromobility: A Travel Mode Innovation*, Public Roads - Spring 2021, Vol. 85 No. 1, U.S. Department of Transportation Federal Highway Administration, highways.dot.gov/ public-roads/spring-2021/micromobility-travel-mode-innovation. Accessed 27 January 2022.

Smart Cities, or Connected Cities, leverage physically or wirelessly connected Internet of Things (IoT) devices, sensors and connected vehicles to monitor infrastructure, transportation, utilities, weather and more in real time with the goal of improving public safety, operational efficiency, and quality of life.

Vehicle to Grid (V2G) technology allows for the energy stored in private, public, and fleet electric vehicle batteries to be transferred from the vehicle to connected infrastructure, power grids, buildings and homes during periods of increased demand.

About the Emerging Technologies Roundtable

Initiated in 2021 by the former Atlanta Regional Commission Executive Director, Doug Hooker, the Atlanta Regional Commission's Emerging Technologies Roundtable is comprised of subject matter and issue experts from the Atlanta community. Emerging Technologies Roundtable members meet quarterly to explore, advise, and report on the ways in which emerging technologies may impact how we will live, work and travel in our region over the coming decade and beyond. Each Emerging Technologies Roundtable report is designed to better prepare ARC staff and the governments we serve to plan for preferred outcomes by providing actionable insights on plausible futures.

Atlanta Regional Commission

atlantaregional.org