USDOT FY2022 SMART Award # 69A3552341017

Final Implementation Report

for

MetroWest Regional Transit Authority (MWRTA)

15 Blandin Avenue, Framingham, MA 01702

Blandin Energy and Sustainable Storage Technology (BESST) Project

Part 1 of 7 – Executive Summary

Through its FY2022 Strengthening Mobility and Revolutionizing Transportation (SMART) award, MWRTA embarked on Stage 1 of the two-stage Blandin Energy and Sustainable Storage Technology (BESST) project. During BESST Stage 1, the Authority undertook initial planning, review, conceptual design, and engineering to assess the possible incorporation of electric vehicles and smart grid technology across its operations. Planning efforts focused on installing a battery energy storage system at the Authority's Blandin Hub Operations, Maintenance, and Customer Transfer Facility in Downtown Framingham, MA. MWRTA explored the possibility of piloting the use of flow battery technology as a power source for this innovative system. Flow batteries are cutting-edge, electrochemical devices that offer numerous safety and operational efficiencies compared to lithium-ion counterparts. Concurrently, the MWRTA explored the feasibility of deploying electric vehicle (EV) charging facilities adjacent to the Blandin Hub for public use.

BESST Project Stage 1 goals centered around determining the feasibility of installing a 10-megawatt (MW) battery energy storage system for overnight charging of a growing fleet of electric vehicles (EVs), utilizing solar energy collected during the day via photovoltaic canopies. MWRTA determined that flow batteries would ensure safe and responsible system operations.

Throughout BESST Project Stage 1, the MWRTA collaborated with several on-call architect and engineering (A&E) firms, the Facilities Director, the contracted Owner's Representative, General Counsel, regulatory agencies, and subject matter experts (SMEs). These entities oversaw processes related to battery energy storage system planning, design, and development. Consulting agencies also ensured compliance with permitting and other regulatory requirements.

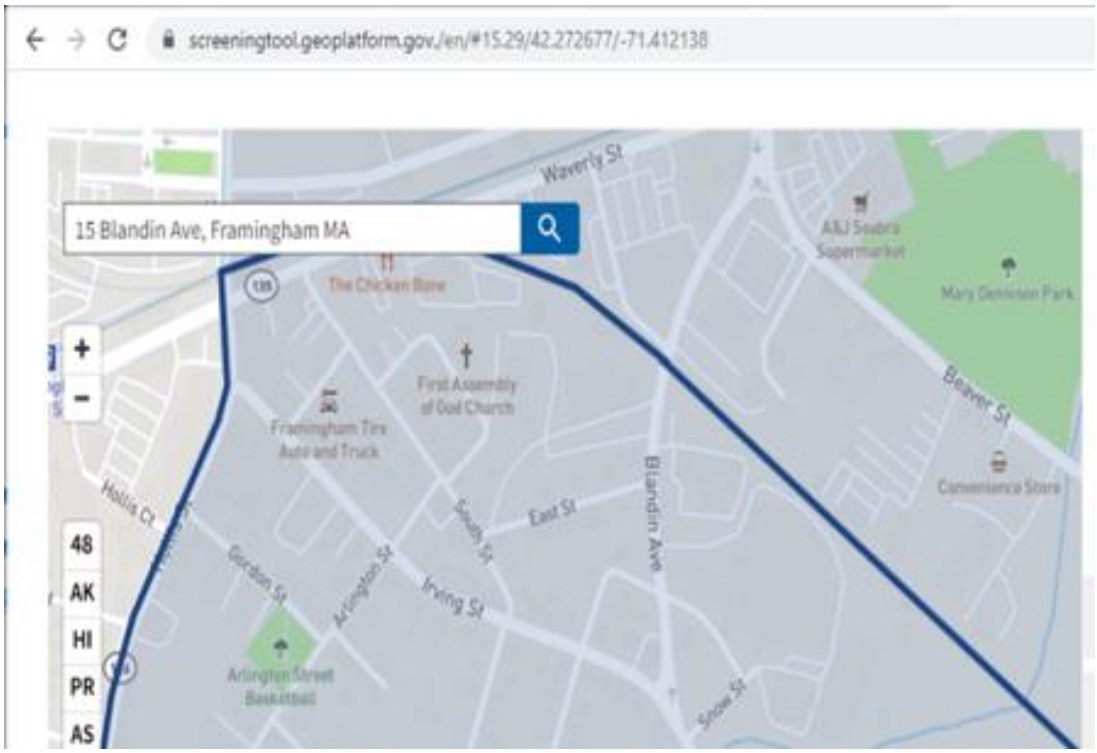
MWRTA's overall goals for the BESST Project include the following:

- Pilot an innovative solution designed to promote system resilience and advance the implementation of renewable energy solutions while reducing dependence on the power grid.
- Improve overall system efficiency through peak shaving or a demand response program.
- Minimize service interruptions and enhance system responsiveness during power outages while maintaining the infrastructure required to operate a safe, reliable public transit system.
- Improve safety through a stable, low-risk energy source.
- Promote cost and operational efficiencies.

Following the final full-scale design and construction in BESST Project Stage 2, MWRTA aimed to demonstrate its battery energy storage system as a valuable resource for the community while providing a safe, renewable, consistent, and cost-effective energy source for its fleet. Newly acquired electric vehicles (EVs), battery energy storage technology, and publicly available EV charging stations would promote resiliency and pave the way toward a modern, dependable, and responsive transportation system throughout the region.

Part 2 of 7 – Introduction and Project Overview

A. Project Title: Blandin Energy and Sustainable Storage Technology (BESST) Project
B. Recipient name: MetroWest Regional Transit Authority (MWRTA)
C. Fiscal year of award: FY2022
D. Period of performance: 8/1/2023 – 12/31/2025
E. Organization(s) preparing the Implementation Report: MWRTA, Gannett Fleming (GF), and Weston & Sampson Engineers (WSE)
F. Date the Implementation Report is submitted: 1/30/2026
G. To the best of our knowledge, MWRTA has not applied for USDOT funding before (for this or any other project).
H. Maps, diagrams, and photos of the MetroWest Regional Transit Authority (MWRTA).

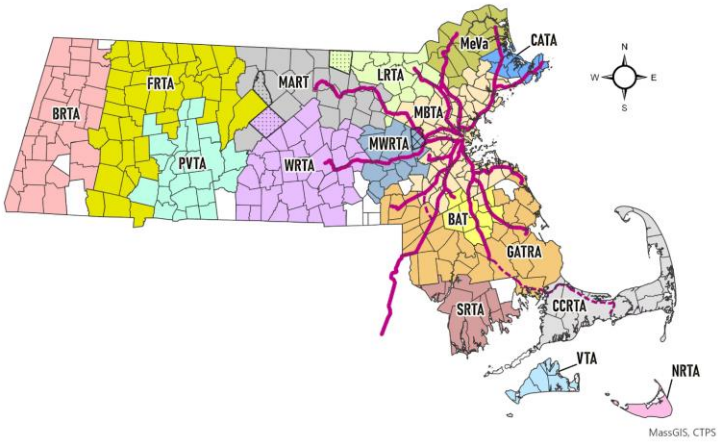


MetroWest Regional Transit Authority (MWRTA)
15 Blandin Avenue Framingham, Massachusetts

The MetroWest Regional Transit Authority is composed of sixteen (16) cities and towns.

Map of Transit Authorities in Massachusetts

Last updated on August 2, 2024



Legend

RTA Boundaries

- BRTA - Berkshire Regional Transit Authority
- BAT - Brockton Area Transit
- CATA - Cape Ann Transportation Authority
- CCRTA - Cape Cod Regional Transit Authority
- FRTA - Franklin Regional Transit Authority
- GATRA - Greater Attleboro-Taunton Regional Transit Authority
- LRTA - Lowell Regional Transit Authority
- VTA - Martha's Vineyard Transit Authority
- MBTA THE RIDE - Massachusetts Bay Transportation Authority THE RIDE
- MeVa - Merrimack Valley Regional Transportation Authority
- MWRTA - MetroWest Regional Transit Authority
- MART - Montachusett Regional Transit Authority
- NRTA - Nantucket Regional Transit Authority
- PVTA - Pioneer Valley Transit Authority
- SRTA - Southeastern Regional Transit Authority
- WRTA - Worcester Regional Transit Authority
- Shared Service Area with Massachusetts Bay Transportation Authority
- Shared Service Area with Montachusett Regional Transit Authoirty
- Not within any RTA service area

MBTA Commuter Rail Lines

- Full Service
- Used Seasonally or for Special Events

The map (and list below) show which cities and towns are within the service areas of each Regional Transit Authority, as well as which cities and towns are served by the MBTA. (updated August 2, 2024)

1. Project Description: Following the completion of its two-staged Blandin Energy and Sustainable Storage Technology (BESST) Project, MWRTA hopes to demonstrate the numerous cost savings and other efficiencies associated with the deployment of flow battery energy storage technology. The Authority also aims to promote this system as a safe, renewable, consistent, and cost-efficient energy source for its fleet. MWRTA also set out to demonstrate how the safety benefits of flow battery storage technology could extend to the deployment of public-facing electric vehicle (EV) charging infrastructure surrounding the Blandin Hub. MWRTA's battery energy storage system is centered on flow battery technology, which has shown promise as a safer, cleaner, and more flexible power alternative to traditional batteries.

   The MWRTA's goal to implement battery energy storage technology at the Blandin Hub represents a critical step toward modernizing the facility through smart grid technology and intelligent sensor-based infrastructure. Full-scale implementation of this system would directly address real-world challenges such as peak demand management, grid instability, and rising energy costs. The deployment of battery energy storage technology will enhance the Authority's ability to monitor and respond to fluctuations in energy usage, reduce strain on the regional power grid, and ensure uninterrupted operations during outages or emergencies. This technology would also strengthen systemwide reliability and resilience while reducing operational and maintenance costs, allowing the MWRTA to allocate additional resources toward service improvements.

   MWRTA's BESST Project will ensure convenient, reliable access to employment, healthcare, education, and essential services by ensuring consistent, reliable transit connections across the Authority's 16 cities and towns (member communities). MWRTA's programs and services represent a critical lifeline for underserved and disadvantaged populations who may not have access to single-occupancy vehicles. Modern, resilient public transit infrastructure will reduce service disruptions and enhance the quality of life of seniors, people with disabilities, low-income families, and others who rely on public transit as their primary means of mobility. MWRTA will consult with the general public throughout the design and integration processes to ensure enhancements effectively serve the local community.

2. Impacted Communities: Originally serving the municipalities of Framingham and Natick in 2006, the MWRTA has become the primary provider of public transportation services throughout 16 member communities which comprise the MetroWest region of Massachusetts (Ashland, Dover, Framingham, Holliston, Hopedale, Hopkinton, Hudson, Marlborough, Milford, Natick, Sherborn, Southborough, Sudbury, Wayland, Wellesley,

and Weston). The Authority's flexible and responsive network of fixed routes, commuter shuttles, ADA paratransit, Dial-A-Ride, and on-demand microtransit (MT) services offers intermodal connections to surrounding communities throughout the region. Since its founding in 2006, the MWRTA has prioritized operational innovations designed to maintain modernized facilities and fleets, ensuring dependability and effective service delivery.

MWRTA's Blandin Hub Operations, Maintenance, and Customer Transfer Facility is located within the heart of Downtown Framingham, Massachusetts. Situated within one of MetroWest's largest commercial neighborhoods, the Blandin Hub functions as the focal point of MWRTA's operations. MWRTA has occupied this facility since July 1, 2015. The Authority has retrofitted the Blandin Hub with state-of-the-art technology solutions designed to enhance safety, increase mobility, and promote sustainable operations.

MWRTA's BESST Project has been shaped by numerous community stakeholders and partners. Collaborations between the Authority and the City of Framingham's Sustainability Coordinator have guided the development and completion of Stage 1. Throughout the next phase of the project, the MWRTA will maintain this partnership to ensure the project is both technically feasible and aligns with community priorities.

MWRTA has also collaborated with the City of Framingham's Fire Department, Eversource, and other relevant agencies and officials to ensure compliance with regulatory and permitting requirements. These entities continue to offer technical expertise as the project progresses. MWRTA has received additional support for its BESST Project from several other local stakeholder organizations and elected officials who represent the region.

3. Stage 1 and Stage 2 Deployment Comparison: BESST Project Stage 1 yielded the following plan for battery energy storage system design:

- Install a 257-kilowatt (kW) solar photovoltaic (PV) canopy (charging barn) at the Blandin Hub facility.
- Install 13 dual-port level 2 (L2) and 1 dual-port level 3 (L3) electric vehicle (EV) chargers, manufactured by ChargePoint.
- Implement a 0.5-mW (500 kW) capacity storage system, which will be fed from the grid for ancillary electricity needs. Include a 500-kW diesel generator to power EV charging stations in the event of a long-term power outage.
- Collaborate with the public utility (Eversource) to implement an expanded electrical service under the Eversource Medium General Service (G2) rate.

4. BESST Project Stage 1 Activities: In the fall of 2023, MWRTA procured the on-call engineering services of Gannett Fleming (GF), a qualified architect and engineering (A&E) firm. GF assisted with initial Stage 1 research and planning for EV charging and battery storage systems, as well as preliminary cost-benefit analyses. GF and MWRTA incorporated initial findings from these efforts into the BESST Project Evaluation Plan (EP). In addition, MWRTA and GF developed the Data Management Plan (DMP), which outlined the methodology for data collection, review, and storage. In line with initial program requirements, , MWRTA procured atmospheric and environmental monitors from SGS USA in January 2024.

   In August 2024, MWRTA and GF released the initial BESST Project Feasibility Study, which discussed the viability and efficacy of installing the proposed 10-megawatt (MW) battery energy storage system. The initial Feasibility Study also explored opportunities to increase solar photovoltaic (PV) infrastructure throughout the Blandin Hub, as well as the implementation of publicly accessible electric vehicle (EV) charging stations surrounding the facility. The BESST Project team consulted frequently with City of Framingham officials throughout the development process to determine safety and regulatory requirements. The parties also examined the potential acquisition of property adjacent to the Blandin Hub with the assistance of a licensed real estate appraiser.

   Following a thorough public review process in the fall of 2024, MWRTA procured two (2) additional architect and engineering (A&E) firms – Weston & Sampson Engineers (WSE) and STV, Inc. – to assist with BESST Project development. In collaboration with GF, these additional entities broadened the range of expertise and technical knowledge available for the development of plans outlined in the initial BESST Project Feasibility Study. The procurement of these additional on-call A&E firms also enhanced capacity to meet project timelines and ensured that design considerations fully addressed both the technical complexity and long-term resiliency of the proposed systems. Additional firms also provided valuable experience with emerging technologies and regulatory requirements, further strengthening the project's foundation and maximizing the likelihood of successful implementation.

   MWRTA ultimately selected WSE to assist with the development of plans to carry out Stage 1 BESST Project conceptual design activities (through 60% design stage), as outlined in the initial Feasibility Study. This process resulted in the following activities:

- MWRTA and WSE performed an assessment of power requirements at the Blandin Hub. This assessment allowed the MWRTA to determine the electrical component upgrades necessary for the future design and construction of sitewide integration of a battery storage system. WSE also identified requirements for electric vehicle (EV) charging infrastructure along the south property line on East Street, as well as the integration of additional solar photovoltaic (PV) canopies, as outlined in Feasibility Study Scenario 2.
- MWRTA and WSE completed a topographical and boundary survey, including site surveys of 15 Blandin Ave and adjacent East Street properties. The team identified all property lines, drainage infrastructure, and utilities (gas, electric, water, sewer, telecom, etc.).
- Performed geotechnical surveys, documenting boring locations, soil profiles, and depths on the final site plan.
- Designed solar canopy MB as outlined in the GF Feasibility Study.
- Devised a framework for the development of a future deluge fire suppression system in Canopy MB.
- Drafted plans for electric vehicle (EV) charging infrastructure along the property line on East Street.
- Designed a 10-foot concrete firewall (~250 linear feet) along the southern property line.
- Conducted a technical feasibility study for flow battery deployment at the Blandin Hub, assessing safety, sizing, operational suitability, scalability, and long-term lifecycle value.
- Performed various cost-efficiency analyses based on evolving data and findings.

Through these activities, MWRTA developed a series of design schemes for its onsite battery energy storage system, expanded solar canopies, public EV charging facilities, and fire protection infrastructure. WSE determined that the design would include level 2 (L2) and level 3 (L3) electric vehicle (EV) chargers, a charging barn (solar canopy), and a flow battery energy storage system.

5. Project Media Attention/Conferences: MWRTA's BESST Project was featured in the April 5, 2023, Massachusetts Department of Transportation (MassDOT) press release highlighting SMART projects throughout the Commonwealth. https://www.mass.gov/news/massachusetts-awarded-4-million-in-us-department-of-transportation-strengthening-mobility-and-revolutionizing-transportation-smart-grants The BESST Project was also highlighted in a March 21, 2023 article published by the Framingham Source (https://katherineclark.house.gov/in-the-news?ID=A306646C-C77B-45C1-879F-). This story was also featured on social media as well as the MetroWest Daily News (https://www.metrowestdailynews.com/picture-gallery/news/2023/03/21/u-s-

rep-katherine-clark-visits-mwrta-framingham/11514971002/). MWRTA participated in the FY2023, FY2024, and FY2025 Strengthening Mobility and Revolutionizing Transportation (SMART) Summit for award recipients. In August 2025, the MWRTA hosted reps from the City of Framingham and the Northeast Renewable Energy Coalition (NREC) at the Blandin Hub, as part of NREC's Massachusetts Clean Energy Week. Representatives were introduced to several components of MWRTA's clean energy transition, including its solar photovoltaic (PV) canopy and related infrastructure, water reclamation system, and publicly available compressed natural gas (CNG) Fueling Facility. MWRTA utilized this event as an opportunity to highlight activities taking place throughout the BESST Project development.

6. Changes/Deviations from the Original Proposal: Not applicable.

Part 3 of 7 – Proof-of-Concept or Prototype Evaluation Findings

7. Project Findings

MWRTA's 2024 BESST Project Feasibility Study yielded strong potential for significant solar energy generation to support a 4-7 MWh battery energy storage system (BESS), capable of powering demand response vehicles and public charging stations for 24 hours. Gannett Fleming (GF) determined that this system would provide reliable, cost-effective resiliency for MWRTA's fleet without requiring additional property acquisition. It was determined that maximum solar generation can be achieved through ground-mounted canopies and rooftop panels. An evaluation of five (5) scenarios for solar PV canopy development identified Scenarios 2 and 5 as preferred options, with Scenario 2 meeting operational and funding requirements for efficient long-term sustainability. Throughout 2025, the MWRTA and WSE performed several examinations of existing infrastructure, which will shape the development and evolution of its battery energy storage system. MWRTA completed a review of the Blandin Hub facility's current electrical load. Per this review's findings, MWRTA installed the necessary infrastructure to support 15 EV charging stations. MWRTA and WSE have considered the placement and setup of solar canopies and charging infrastructure, noting the potential need to heat-trace roof downspouts and mount them to column supports with protective elements.

An initial regulatory review, conducted by MWRTA and GF in 2024, confirmed that the proposed battery energy storage system meets the City of Framingham and local fire department regulations. In compliance with NFPA 855 standards, the system will be installed at least 10 feet from buildings, property lines, public ways, stored combustible or hazardous materials, high-piled stock, and other potential hazards. GF indicated that this distance can be reduced to 3 feet if a firewall is present. MWRTA initially explored

vehicle-to-grid (V2G) and vehicle-to-building (V2B) technologies, but does not plan to proceed with these pilots due to regulatory/technical barriers and funding requirements.

MWRTA and WSE conducted a thorough assessment of available battery energy storage system technologies, sizing considerations relative to discharge rate and physical configuration, and energy efficiency and resiliency benefits relative to stored energy systems. A key component of this assessment involved examining vanadium redox flow batteries (VRFBs) and iron flow batteries as mechanisms for powering its battery energy storage system. Both VRFBs and iron flow batteries are inherently nonflammable and have a very low risk of thermal runaway or combustion, making them an attractive solution for energy storage. Additional benefits of flow battery systems include, but are not limited to, significantly longer lifecycles, greater operational efficiency, no off-gassing or explosion potential, and simplified fire code compliance. MWRTA has determined that the environmental and safety benefits of flow batteries far outweigh the numerous risks associated with lithium-ion batteries, which contain a higher megawatt rating.

WSE's initial review determined that the MWRTA's VRFB or iron flow battery mechanism would require a 0.5 MW modular containerized system with integrated power conversion and monitoring. This system would be powered by an 800-amp service with 12 Conex boxes measuring 8 'x 8' x 20 and 16' high. MWRTA identified the need to install a standby diesel-powered generator to serve as a backup for the system in the event of a long-term power outage.

MWRTA's use of VRFBs or iron flow batteries would maximize opportunities for peak shaving during EV charging, using discharge during times of high grid demand when kilowatt-hour billing rates are higher. MWRTA's ability to maximize this benefit would depend on a series of environmental factors, including seasonal impacts on battery drain in electric vehicles, which would require more frequent charging. Alternatively, it was determined that MWRTA could launch a demand response program with the local public utility (Eversource) and ISO New England to coordinate discharges during peak utility grid use. This arrangement could enable exporting power back to the utility to generate cost savings or reduce facility demand to support utility grid stability. MWRTA and WSE are currently consulting with Eversource in order to determine whether peak shaving or demand response would be the most suitable operational solution. The BESST Project team's initial sizing assessments concluded that the power rating required for the proposed battery energy storage system to support 4.5 hours of uninterrupted power supply during outages is approximately 1 megawatt (MW).

WSE's November 2025 Blandin Hub geotechnical survey and site assessment consisted of the following activities:

- WSE completed a preliminary desktop review of the Blandin Hub site, including available geologic maps, current and historic aerial imagery, and current and historic topographic maps of the area. Findings indicate that the facility is located in an area of fine-grained glacial stratified deposits, deposited in layers by glacial meltwater. These soils are composed of very fine sand, silt, and clay, occurring as well-sorted, thin layers of alternating silt and clay or thicker layers of very fine sand and silt. Bedrock (at depths of approximately 65 to 135 feet) consists of metamorphosed mafic to felsic flows, volcaniclastic rocks, and hypabyssal intrusive rocks.
- WSE performed a Geophysical Subsurface Utility Investigation, documenting shallow subsurface utilities and other below-grade features at potential excavation locations. The results of this investigation are available within a report prepared in February 2026 by WSE. This report also contains Boring and Test Pit Logs, as well as Geotechnical Engineering Design & Construction Recommendations.
- WSE explored subsurface conditions by advancing ten borings (B-1 through B-9 and B-4A) and three test pits (TP-1 through TP-3). Conditions generally consisted of a surficial layer of asphalt concrete (AC) pavement underlain by previously placed granular fill, organics, native sand and silt, and glacial till.
- Select soil samples were submitted for laboratory grain size (ASTM D6913) and organic content (ASTM D2974) testing to confirm field classifications and estimate engineering properties. Select samples were also tested for Electrical Resistivity (ASTM G57) or corrosion potential, including pH (ASTM D4972/G51), oxidation-reduction potential (ASTM G200), sulfate content (ASTM D4327), and chloride content (ASTM D4327) to evaluate grounding and cathodic protection needs.

8. Selected Concept vs. Original Concept

   As the MWRTA continues to evaluate opportunities to expand its fleet of electric vehicles (EVs), the Authority's current focus is on exploring potential designs to ensure the safety and efficiency benefits of its proposed flow battery energy storage system. MWRTA's original proposal discussed the potential for acquiring additional properties adjacent to the Blandin Hub. While initial feasibility study findings indicated that the Authority could generate sufficient energy from its combined battery storage system and solar infrastructure without these additional properties, MWRTA continues to explore opportunities to acquire properties to support spacing and sizing requirements for the flow battery system. Phase I Environmental Site Assessments determined that a Soil Management Plan and hazardous-material inspections would be required as part of the geotechnical and site surveys conducted by WSE in 2025. It was also determined that acquiring adjacent properties would require the development of stormwater management plans.

Part 4 of 7 – Anticipated Costs and Benefits of At-Scale Implementation

9. Demonstrated Impacts: MWRTA's battery energy storage system will provide the foundation for a more reliable and modern transit network. The Authority will employ state-of-the-art technology to ensure a consistent power supply for critical operations, support electric vehicle (EV) charging, and enable the use of renewable energy sources. By improving service reliability and reducing vehicle downtime, battery energy storage technology supports initiatives to reduce traffic congestion, improve travel time consistency, and enhance regional mobility. Expanding the local network of public-facing EV charging stations while modernizing the local public transportation network will eliminate access barriers to employment, education, healthcare, and other essential services.

   MWRTA's BESST project will address the following goal areas:

Goal Area	Goal Definition	Stage 1 Goal Achievement
Congestion	Reduced congestion/delays for commerce and the traveling public	Improving the efficiency and reliability of the public transportation system will encourage a mode shift away from single occupancy vehicles (SOVs), reducing traffic congestion on roadways while encouraging the adoption of sustainable transportation alternatives.
Safety	Improve the safety and integration of transportation facilities and systems for pedestrians, bicyclists, and the broader traveling public	The incorporation of flow battery technology will minimize the risk of thermal runaway and fire hazards commonly associated with lithium-ion systems.
Accessibility	Improve access to jobs, education, and essential services, including health care. Connect or expand access for underserved or disadvantaged populations and reduce transportation costs.	MWRTA's BESST Project prioritizes system modernization, infrastructure preservation, and operational reliability. Resilient public transportation infrastructure reduces maintenance costs and accelerates mobility by ensuring an accessible,

		barrier-free public transit system.
Economic Development	Contribute to medium – and long-term economic competitiveness	Enhancements will lower costs associated with operations and vehicle maintenance and promote energy efficiency, while supporting workforce and business mobility. The integration of innovative flow battery technology strengthens the region's resilience against energy disruptions.
Reliability/resilience	Improve the reliability of existing transportation facilities and systems.	Battery energy storage technology will provide a stable, dependable, and resilient backup power source designed to minimize disruptions during outages, peak demand periods, or extreme weather events. MWRTA will integrate renewable energy resources to reduce reliance on the power grid and ensure long-term sustainability of critical infrastructure and services throughout the region.
Connectivity	Promote connectivity between and among connected vehicles, roadway infrastructure, pedestrians, bicyclists, the public, and transportation systems	MWRTA's battery energy storage system is designed to ensure reliable, uninterrupted power for its transit operations and electric vehicle infrastructure, enabling consistent service across the region. Maximizing service reliability supports seamless connectivity between routes, transit hubs, and charging stations while ensuring efficient, connected travel between communities.

Partnerships	Incentivize private sector investments or partnerships, including by working with mobile and fixed telecommunication service providers to the extent practicable	MWRTA has procured the services of an Owner's Representative, who collaborates with its Facilities Director and serves as Project Manager throughout BESST Project development. In addition to numerous municipal officials and authorities, MWRTA continues to leverage assistance from its on-call architect and engineering (A&E) firms, original equipment manufacturers (OEMS), General Counsel, and other experts to ensure the availability of resources as well as adherence to various regulatory requirements.
Efficiency	Improve energy efficiency or reduce pollution	MWRTA will incorporate solar PV units throughout its battery energy storage system in order to maximize its ability to capture renewable energy. At full-scale implementation, a 1,000 kWh backup system will provide a reliable source of energy for up to 24 hours in the event of a power outage. It was also determined that this system could support an additional day of charging if 3.69 MWH of solar energy was generated.
Improve emergency response		A fully operational battery energy storage system will improve the Authority's response capability during emergencies by providing a backup source of power to sustain operations.

10. Anticipated Costs of At-Scale Implementation: WSE's November 2025 Energy Cost Efficiency Analysis provides detailed information related to all costs associated with full-scale BESST Project implementation. Costs noted in this analysis include the following:
    - Charging Barn
    - EV chargers and associated infrastructure
    - Eversource electric service under G2 rate
    - Fleet management software
    - Estimated annual operational and maintenance costs

    WSE's analysis estimated the total cost of the BESST Project would be between $10 and $15 million. This estimate accounts for cost variability over time and assumes full funding under the USDOT SMART Program or other funding opportunities. EV chargers are projected to last 15 years, as they will be protected by a rooftop canopy. While the initial capital cost of flow batteries is roughly 1.5-2 times higher than lithium-ion systems, their longer service life (20-30 years) and minimal degradation yield lower long-term replacement costs.

11. Expected Deployment Costs and Benefits:

    WSE's Energy Cost Efficiency analysis estimated that the MWRTA's costs to operate a fleet of electric vehicles (EVs) would be $294,634, compared to $435,158 to operate a fleet of internal combustion engine (ICE) vehicles. It was estimated that the MWRTA's 257.4 kW (DC) solar array will allow the Authority to receive approximately $27,340 in annual credits from the Eversource 2026 Solar Massachusetts Renewable Target (SMART) 3.0 plan. MWRTA's ability to benefit from credits generated from solar production and flow battery technology could reduce EV fleet operational costs to $92,921. The Authority may realize additional cost savings through the Department of Public Utilities' (DPU) net metering program and Eversource's demand response contract initiative. The use of EV fleet management software would enable the MWRTA to optimize vehicle charging times based on operating schedules and strategically schedule EV charging to reduce demand charges.

    MWRTA's Energy Cost Efficiency Analysis determined that the benefits of the BESST project outweigh the costs. It was noted that the combined Charging Barn, EV chargers, and flow battery storage system will lead to significant long-term savings in operational and maintenance costs. MWRTA's flow battery energy storage system will be surrounded by a protective firewall and free of hazardous materials, providing significant safety benefits compared to traditional fueling and power alternatives.

12. Stage 1 Baseline Data Collection:

    The initial information collected serves as a reference point for measuring future progress and determining current ability or state.

Part 5 of 7: Challenges and Lessons Learned

13. Challenges/Lessons Learned/Recommendations

    A. Legal, Policy, and Regulatory Requirements: Battery storage technology must perform within National Fire Protection Association (NFPA) standards.

    B. Procurement

- Utilize available state contracts with federal approvals for EV procurement.
- Update and revise Fleet Transition Plan every five (5) years, or as deemed necessary.
- Consider the purchase of additional properties to increase opportunities for solar energy collection.
- Explore public-private partnerships for funding and project support.

    C. Partnerships

- Partnerships with local utility (Eversource), municipal officials, and other key stakeholders remain a critical component of MWRTA's Fleet Transition Plan.
- MWRTA will need to consult with Eversource to determine if the EV-2 rate can support a PV system and battery energy storage. Consultations will also determine whether peak shaving or a demand response program is the best solution for the flow battery system.

    D. Technology Suitability

- The 15 Blandin Avenue facility can support significant photovoltaic (PV) generation with added battery energy storage.
- Structural reinforcements to existing buildings are needed for future solar installations.
- Deploying 1 MWH of flow battery storage can also meet charging demand for 4-12 hours when combined with solar generation and is recommended for cost efficiency.

- Vehicle-to-grid (V2G) and vehicle-to-building (V2B) pilots are not currently feasible due to regulations and technological limitations; these may be considered as MWRTA's EV fleet matures.
- Flow batteries offer numerous safety, lifecycle, and efficiency benefits over lithium-ion batteries.
- MWRTA needs to consider requirements for a larger physical footprint and hazardous chemical storage procedures to ensure optimal system function.
- MWRTA will need to install a diesel generator to power the pumps that circulate the non-toxic fluid, which generates power in the flow batteries. This will prevent potential issues resulting from power outages or other emergencies.
- MWRTA will benefit from adding a new electric service for EV chargers to take advantage of the EV2D rate in conjunction with the Charging Barn PV array and battery storage.

E. Data Governance

- MWRTA has developed a Data Management Plan (DMP), which is regularly reviewed by management and consultants.
- Data obtained during the BESST Project Stage 1 Feasibility Studies is collected and managed in conjunction with stakeholder needs.

F. Workforce Capacity

- The initial BESST Project Feasibility Study recommended that MWRTA establish a Workforce Readiness Team.
- Identify necessary skills and training resources for specific electric bus equipment, facility operations, and maintenance.

G. Internal Project Coordination

- MWRTA's BESST Project will proceed in consultation with the administrative team, Facilities director, Owner's Representative, and Fleet Director, as well as contracted IT Consultant, General Counsel, and On-Call Architect and Engineering (A&E) firms.

H. Community Impact

- MWRTA is a good steward of the neighborhood and will coordinate with City of Framingham officials to ensure proper placement of its flow battery energy storage system and public-facing EV charging infrastructure.
- MWRTA has completed the required environmental site/geotechnical assessments.

I. Public Acceptance

- MWRTA will proactively share safety standards, regulatory compliance measures, and emergency response protocols developed in collaboration with the Framingham Fire Department, sustainability team, Eversource, and system manufacturers.
- MWRTA will promote the environmental advantages of flow batteries to stakeholders, demonstrating their safety and sustainability benefits.
- Continued collaborations with municipal leaders, first responders, local businesses, and neighborhood groups will ensure opportunities for the public to ask questions and offer input as the project progresses.

J. Cybersecurity

- All data collected from atmospheric and environmental monitors will be stored and transmitted utilizing encrypted channels and secure servers that comply with industry-standard cybersecurity protocols. MWRTA will adopt clear internal policies related to the handling, retention, and sharing of data.
- MWRTA will implement strict user access controls, including role-based permissions and multi-factor authentication, to ensure the privacy of data and analytics.
- All MWRTA team members are required to complete regular cybersecurity awareness training covering topics including safe data handling practices, recognizing phishing attempts, and maintaining strong password hygiene.
- MWRTA will regularly conduct cybersecurity audits, vulnerability assessments, and penetration testing to evaluate the robustness of security measures and identify areas for improvement.

Part 6 of 7: Deployment Readiness

14. Requirements for Successful Implementation

Prior to system installation and implementation, the MWRTA must finalize all operational requirements to ensure sufficient physical space is available. The Authority's

ability to acquire properties adjacent to its Blandin Hub facility will determine the system's geographic impact on neighboring privately-owned properties, as well as the Authority's future bus maintenance facility.

The MWRTA has determined that the following steps are necessary to support continued development of the BESST Project:

- Determine whether to utilize a vanadium redox flow battery (VRFB) or an iron flow battery.
- Obtain appropriate clean air permits for backup flow battery diesel generator.
- Obtain warranty for solar panels and inverters.
- Review and analyze data collected during geotechnical laboratory testing.
- Install a modular containerized system with integrated power conversion and monitoring.
- Implement real-time data monitoring to evaluate operational efficiency, safety, and degradation.
- Apply for the Commonwealth of Massachusetts 2026 Solar Massachusetts Renewable Target (SMART) 3.0 and the Department of Public Utilities (DPU) Net Metering credit opportunities.
- Procure a suitable EV Fleet Management Software program to ensure optimal system operations.
- Finalize data collection and storage system parameters; revise BESST Project Data Management Plan (DMP) as required.
- Continue collaborations with the local utility, stakeholders, partnering organizations, and the general public.
- Measure the increased number of transfers through rider surveys to assess how integrated infrastructure connectivity will service MWRTA customers.

15. BESST Project Long-Term Sustainability:

To ensure ongoing successful operations following full-scale deployment, the MWRTA will need to maintain a thorough understanding of the flow battery system's routine maintenance needs, long-term performance characteristics, and component lifecycle requirements. The MWRTA will partner with its selected flow battery manufacturer to obtain critical knowledge on monitoring electrolyte health, managing pump and power conditioning equipment, assessing system efficiency, and interpreting diagnostic data. MWRTA will continually ensure its vehicle maintenance staff, facilities team, and other

safety-sensitive personnel are well-versed regarding standard operating procedures (SOPs) for all associated equipment, including electric vehicles (EVs) and associated infrastructure. In consultation with its contracted IT Consultant, the MWRTA will ensure that all associated equipment complies with industry standards. As deemed necessary, the Authority will conduct timely hardware and software upgrades designed to promote system security and operational efficiency.

16. Impacts on Workforce

The MWRTA values the expertise of its vital workforce as a critical component of its Fleet Transition Plan. The implementation of cutting-edge flow battery storage technology will enable the Authority to capitalize on existing employees' skill sets while creating opportunities for skilled technical roles in system installation, maintenance, data analysis, and operational management. MWRTA remains committed to cultivating a talented, resilient workforce dedicated to enhancing the region’s public transportation network.

Part 7 of 7: Wrap-Up

17. Conclusion

MWRTA’s BESST Project Stage 1 assessments have enabled the development of a path forward that meets key project objectives and addresses community commitments. Key findings support a 4-7 megawatt-hour (MWH) flow battery storage solution for daily operations, as well as a significant expansion of solar photovoltaic (PV) canopies. At this time, MWRTA will not pursue its previously-proposed vehicle-to-grid (V2G) solution as it works toward full-scale system implementation. The Authority recommends that communities pursuing similar projects develop detailed feasibility studies particular to their site and needs, focusing on the numerous benefits associated with flow battery storage infrastructure.