2024

EVERETT TRANSIT

BEB OPERATIONAL RESILIENCY PLAN

Prepared by:
Liz Morrison
Environmental Defense Fund Fellow

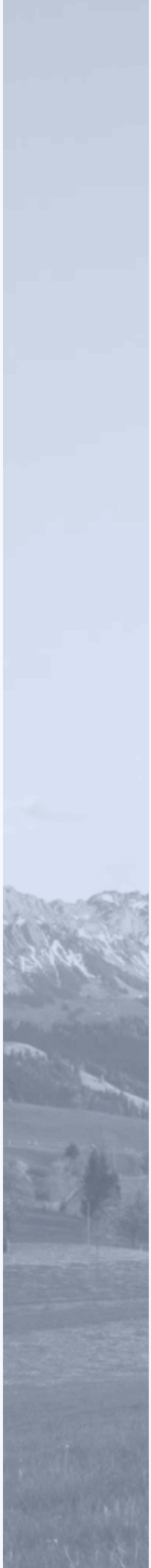


Table of Contents

Introduction

In May of 2024, Everett Transit contracted with the author of this document through the Environmental Defense Fund's Climate Corp Fellowship Program to create a plan for the agency to increase its operational resiliency, primarily through the acquisition of distributed energy resources (DERs). A process of research and discovery including over 30 stakeholder interviews with Everett Transit staff, regional transit agencies, national industry leaders and knowledge experts, culminates in this resulting document -- the Everett Transit Battery Electric Bus (BEB) Operational Resiliency Plan.

This plan intends to provide Everett Transit staff with sequenced, actionable recommendations for strengthening current operations in relation to the battery electric bus fleet while simultaneously planning for future energy resilience and emergency preparedness. This report builds on the considerable work done by Planning Communities, Microgrid Labs, and the International Transportation Learning Center in the creation of the Everett Transit Fleet Electrification Transition Plan.

The consultative work performed and this resulting report was funded by the Environmental Defense Fund. The author would like to thank Everett Transit, CALSTART, and all of the stakeholders and interviewees (full list provided in Appendix A) who generously gave of their time for the purpose of the creation of this plan. Any errors are the author's own.

Electrification Background and Timeline

Everett Transit is a pioneer in the electrification of public transportation on the western coast of the United States. In 2018, Everett Transit introduced its first four Proterra electric buses, shortly thereafter followed by five more Proterra buses. In 2023, 10 Gillig electric buses replaced diesel buses bringing the total number of electric buses to its current count of 19 – 63% of the total fixed-route fleet. This fall, Everett Transit will celebrate one million total zero-emission miles driven.

In 2023, Everett Transit was honored with the Champion of the Challenge Award from the U.S. Department of Transportation's Federal Transit Authority for the agency's Zero Emission Fleet Transition plan, which lays out the agency's approach to electrifying their entire fixed-route fleet by 2028.

Despite large investments, hard work and laudable progress, the agency has seen a fair number of setbacks and challenges throughout the electrification process. These challenges stemmed largely from trickled down impacts of the bankruptcy of the electric bus manufacturer Proterra, the supplier of nine (9) of buses in the fixed-route fleet. Mechanical and electrical issues with both the buses and the Proterra chargers have led to difficulty in keeping these buses on the streets, and, consequently, led to the decision to use local funds to introduce five more refurbished diesel buses to the fleet at the end of 2024.

It is now projected that Everett Transit will achieve full electrification in approximately 2039 with Low/No Emission standards being met in 2032.

Year	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34	'35	'36	'37	'38	'39
Total Number of Buses in Service	46	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
Number of BEBs	19	28	33	33	37	39	39	39	44	44	44	44	44	44	44	47
Number of Hybrids	10	10	7	7	3	3	3	3	3	3	3	3	3	3	3	0
Number of Diesels	17	9	7	7	7	5	5	5	0	0	0	0	0	0	0	0
Percentage of Low Emission Buses	63	81	85	85	85	89	89	89	100	100	100	100	100	100	100	100
Percentage of Zero Emission Buses	63	81	85	85	85	89	89	89	89	89	89	89	89	89	89	100

Purpose

The recommendations in this plan include technologies and actions that Everett Transit can use to strengthen its electric fleet operations, plan for the future, and prepare for emergency scenarios. It incorporates key learnings from other regional and national transit agencies which are well down the path of electrification and have designed and built (or are in the process of building) DERs to support their fleets. This plan considers the unique position Everett Transit is in on its journey towards a zero-emissions future, and recommends a sequence of actionable steps the agency may take to increase ease in this transition while ensuring reliability and resiliency in its daily operations.

Resilience, as is defined by Executive Order 13693, means "the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions." Resilience is an issue of extreme importance for transit agencies as their fleets electrify. Resilience for a battery electric fleet can mean protecting fleet operations from small and large disruptions through robust supportive infrastructure and operational efficiency in order to return to full operations as quickly as possible.

If Everett Transit's BEBs were even temporarily disabled in the event of an extended grid outage, there would be a risk to the general public and user acceptance would likely decline. Everett Transit's fleet is likely to be called upon for use by the City of Everett in the event of an emergency or natural disaster to transport first responders and to evacuate people in areas around the region. Therefore, it is vitally important that Everett Transit be prepared for not only the unexpected, but ensure reliable ongoing operations.

Steps to Resiliency

This plan consists of 12 actionable steps ordered by the immediacy of their implementation.

IMMEDIATE

1 | Assign an electrification project lead

Create a role to bridge administration and operations, enact this plan and scale BEB supportive infrastructure.

2 | Collaborate with the City of Everett

Work with the City to create a joint plan for emergency preparedness and response. Consult on plans for City charging infrustructure.

3 | Build your supporting network

Engage with subject matter experts to help guide the development of a long-term strategy for scaling infrastructural improvements.

4 | Implement a charging management system

Implement a CMS with an onsite controller that can control the charging systems even if the internet and/or grid goes down.

SHORT TERM

5 | Evaluate backup energy storage systems

Determine when and what form of additional energy storage should be acquired to rapidly deploy energy to an acceptable percentage of the fleet.

6 | Maintain a close relationship with SnoPUD

Maintain and increase communications with the local utility provider regarding timelines of new BEB and charger deliveries.

SHORT TERM

7 | Encourage deployment of public charging

Work with SnoPUD and the City of Everett to plan for public charging infrastructure to support both the city-wide emission reduction and resiliency goals.

8 | Equip the workforce

Maintain a workforce that is capable of fully servicing BEBs.

Long Term 2026 and Beyond

9 | Revise the DER analysis for an updated microgrid design

Refine the outdated fleet electrification model to reflect new fleet projections, operating schedules, and timetables. Re-size the microgrid to meet the new specifications.

10 | Contract with a sustainable engineering firm

Form a relationship with a reputable sustainable design engineering firm that is versed in incorporating resiliency elements such as microgrids into the design of a facility.

11 | Engage the services of a microgrid developer

Contract the services of a microgrid supplier who can provide a turnkey system.

12 | Maintain a diversified fleet

Consider implementing a pilot program of a fuel cell electric bus (FCEB) to be incorporated into the 2028-2033 5-year transit development plan.

Immediate (Q3 2024)

1 | Assign an Electrification Project Lead

Everett Transit needs an Electrification Project Lead who can take ownership of enacting this plan and will facilitate and manage the process of scaling BEB supportive infrastructure. This person will act as a bridge between administration and operations, gathering and communicating critical information between the departments to ensure alignment. They will also play a pivotal role in ensuring fleet resiliency through bringing internal and external partners together to drive forward emergency planning initiatives.

Examples of titles of persons acting in a similar capacity at other agencies include:

- Zero Emissions Program Manager (Community Transit)
- Zero Emissions Operational Readiness Lead (King Co. Metro)
- Capital Projects Manager (Santa Barbara MDT)

Case Study: King Co. Metro

From: Zero Emissions: Metro Transit Working to Mitigate Risks to County's Ambitious 2035 Goal

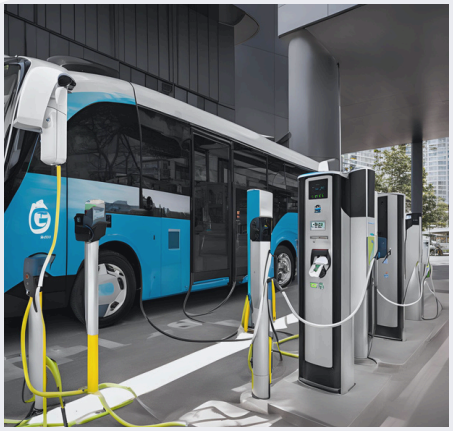
"Metro Transit established a zero emissions strategic management team, engaging department-wide to organize the zero emissions effort, improving necessary collaboration and planning measures for managing the significant workload vital to fully transitioning operations. In 2022, Metro Transit hired new staff to set up a team in the general manager's office to coordinate the zero emissions effort, providing infrastructure to coordinate work across the department.

In 2023, the team led a department-wide collaborative effort to map the internal and external dependencies required for achieving zero emissions goals. This "systems map" provides guidance for Metro Transit staff to proactively engage with internal and external partners to mitigate challenges and increase efficiency."

Immediate (Q3 2024)

2 | Collaborate with the City of Everett

Everett Transit should immediately coordinate with the City of Everett in the following two areas:



Coordinate with the City of Everett to ensure that the parking stalls for the DCFCs are designed to accommodate medium- and heavy-duty vehicles. Additionally, the cables on the chargers need to be long enough to reach the vehicle charging port.

Planning and constructing city charging stations

City-owned and public chargers could be used as a resiliency measure when facing localized grid outages. The City of Everett has recently completed a 10-year (approximately) plan to reach electrification for a large portion of the City's fleet. This plan includes a recommendation for the purchase and installation of two (2) 150kw Direct Current Fast Chargers (DCFCs), which could potentially be used as emergency charging for Everett Transit's BEBs. Since the chargers will be City assets, Everett Transit will need to form an agreement to use the chargers in the event of an emergency.

Planning for emergency preparedness and response

Everett Transit should form a joint Emergency Preparedness Committee with The City of Everett and Public Works. This committee should meet on a regular basis to coordinate emergency planning efforts and create a unified plan across entities. It has been discovered through conversations with Everett Transit and The City of Everett that while there are specific parts of the City's Comprehensive Emergency Management Plan (CEMP) pertaining to public transit (Appendices C, D, E), Everett Transit currently has no formalized emergency management plan of its own. Therefore, it is vitally important that Everett Transit develop its own protocols in tandem with the City's updating of its own emergency preparedness plans. Such **planning should include specifications for the number of buses that need to be available for use**, including plans for ensuring charging for BEBs in the event of a grid outage. **Everett Transit should immediately contact the City of Everett's Office of Emergency Management to be included in impending planning and preparedness efforts, as well as scheduling ongoing meetings for this purpose jointly with Public Works.** Planning Communities (primary author of the Everett Transit Fleet Electrification Plan) has provided an example of a recently completed public transit emergency planning document (Appendix F).

Immediate (Q3 2024)

3 | Build your supporting network

Everett Transit should engage with industry-specific subject matter experts, especially at the start of the process of onboarding the new Electrification Project Lead. Engaging the services of a non-profit or consulting group that has a team of subject matter experts will help guide the implementation of this plan and the development of a long-term strategy for scaling the infrastructure needed to support the expanding BEB fleet.

For example, the nonprofit Center for Transportation and the Environment (CTE) currently works with six other Washington State transit agencies in either a project management or advisory capacity. CTE also offers stakeholder engagement workshops and can help talk to a board or council regarding electrification projects and answer questions they may have. A sheet of services offered can be found in Appendix B. Regional transit agencies that receive advisory services from CTE include:

- Spokane Transit
- King County Metro
- Community Transit
- Intercity Transit
- Kitsap Transit
- Sound Transit

These regional agencies have also either directly expressed desire to engage in dialogue with Everett Transit regarding their expanding BEB fleets or are already actively in discussions with other regional agencies on this topic. **Everett Transit should establish regular communications with other agencies working on similar initiatives, such as the ones listed above.**

Case Study: Community Transit

Community Transit contracted with CTE for three distinct tasks, focused on technical analysis and documentation building. The first was for KPI building, reporting, and strategy for their pilot buses, starting with their BYD 60- foot coach and then carrying into the development of the current side-by-side pilot with the fuel cell bus and the battery electric bus. CTE also reviewed their initial feasibility report for a second opinion on all of those findings. The second task order was specific to hydrogen fueling, RFI spec building, and the bid package put out for their gaseous fueling setup, which is being put in place with Linde. The third task order was for the creation of their electrification transition plan.

Immediate (Q3 2024)

4 | Implement a charging management system

Charging Management Systems (CMS) use machine intelligence to optimize EV charging schedules, enhancing charging infrastructure efficiency and enabling cost-effective charging. This optimized charging scenario allows the vehicles to charge at a lower power rating for a longer amount of time, as allowed by the vehicles schedules, reducing the overall cost of charging.

The Everett Transit Electrification Project Lead should evaluate which charging management platform will best address the agency's needs. **However, it is highly recommended that the charging management system chosen be compatible with the development of a micro-grid system.**

Everett Transit presently has access to a CMS through the ChargePoint/Viricity platform, although it has not been utilized yet. **Although it may seem simplest to utilize a system the agency already has access to, this is not the best option from a resiliency perspective.** The ChargePoint system is an over the air-only style of charge management, which may experience connectivity issues in the event of a power outage.Therefore, **having a CMS with an onsite controller that can control the charging infrastructure even if the internet goes down is especially important** for resilience planning efforts.

Scale Microgrids, developer of the microgrid system for the Santa Clara Valley Transit Authority (VTA), gave two examples of CMS service providers with on-site controllers: The Mobility House and EO Charging, the latter of the two providing a preferable additional level of operation and management. Microgrid Labs, a consulting and software company specializing in commercial fleet electrification and microgrids, also has a charging management platform which meets these requirements and includes a built-in operations planner, which could provide added value to fleet management.

Short Term (2025)

5 | Evaluate backup energy storage systems

Everett Transit recently reacquired a **500 kW Cummins diesel generator**, which is in the process of being tied into the 13 chargers on the back wall of the operations and maintenance facilities lot. This generator utilizes renewable diesel (N99), which greatly reduces the output of GHG emissions, NOx, particulate matter, and VOC emissions.

Page 43 of the Everett Transit Electrification Transition Plan estimates that this generator has the "capacity to charge 10 BEBs", however this information is unspecific and vague. If the 500kW generator was supplying energy to 10 buses on chargers hooked up to the generator, each bus would be charging at 50kW (500kW/10 chargers = 50kW per charger).

Energy required to charge 10 buses to 80% from 20% = 2664 kWh
Power delivered to chargers on generator = 50kW
Time to charge 10 buses from 20% to 80% on generator (2664/50)
= **Approximately 53 hours**

The length of time to charge from a backup energy storage system is dependent upon three primary variables:
1) The power delivered by the energy storage system
2) The output capacity of the chargers tied to that system
3) The number of buses hooked up to the chargers

A 1 MW BESS could slash the above estimated time to simultaneously charge 10 BEBs in half, if connected to chargers with the capacity to output 100kW. The 13 chargers currently installed in the operations and maintenance lot output about an average of 62.5kW, meaning even with a 1 MW storage system, it would still take **42.6 hours** to charge 10 buses.

An additional energy storage system will be required for the 12 new chargers slated for a Q1 2025 installation in the Public Works lot, which can be one incorporated as a component of a microgrid (see Steps 9, 10, 11). These new faster chargers have higher kW outputs, and therefore are better suited to be used in an emergency scenario, once they are installed.

Short Term (2025)

5 | Evaluate backup energy storage systems

The Everett Transit Electrification Project Lead should **evaluate whether it is more feasible to rent a temporary power source that can be used during planned outages and in the months in which severe weather is most likely to occur** (November- February). It may be advisable to rent a battery storage system for the interim while the new transit maintenance facility and microgrid system is built. Battery energy storage systems are available for rent from local retailers such as Sunbelt Rentals, which would provide an additional temporary backup energy supply while not increasing emission and pollutant outputs in the area, as a traditional generator would.

A battery storage system from a startup called **BattGenie** is currently installed in the operations and maintenance facilities lot. The unit pulls power from the grid during off-peak hours, and feeds it back into the wall of chargers. This pilot has been running for two years now, free of charge to the transit agency. According to the CEO of the company, Manan Pathak, the system was not intended to be a backup energy generator; it is a tool to measure the second life of bus batteries. Additionally, he indicated that the system has been down "for a while" and needs to be fixed. Therefore, Everett Transit should not rely on this system as a long-term resiliency method.

The InRush

Another option for zero emissions mobile/temporary energy storage is a battery-powered unit which is coupled with charging infrastructure. This may prove to be useful if the installation of the new chargers into the Public Works lot is delayed and lags behind the delivery of the 9 new Gillig electric buses, slated for delivery in Q2 2025. **BP Pulse** developed such a system, the InRush, with the Anaheim Transportation Network when the agency lacked the charging infrastructure to support a newly delivered fleet of buses.

350 2: Generation Dory

The startup company **ElectricFish** has a similar yet smaller BESS-powered charging system, which could also be acquired and used for on-route or off-site charging. The 350 2: Generation Dory is a plug-&-play AC powered energy storage system with two CCS + NACS charging ports. It is compatible with various architectures and its 350kWh battery pack draws either 40kW or 100kW from the grid, making it efficient and quickly deployable.

Short Term (2025)

6 | Maintain a close relationship with SnoPUD

An important consideration in the maintenance of resilient operations is the reliability of the grid and insurance that there will continue to be enough power to supply the increasing number of BEBs.

Snohomish County PUD (SnoPUD) services the City of Everett with clean power derived almost entirely from renewable sources. The Public Utility was just awarded 30 million USD from the Department of Energy to enhance grid reliability, which is expected to accentuate grid resiliency. SnoPUD reports that Everett Substation Circuit 112 serving the transit depot at 3225 Cedar St is overall very reliable. In the last 5 years (2019-2023), they report no transmission outages affecting the Everett Substation. In the last 5 years (2019-2023) they report 2 outages affecting the entire circuit:

11/6/21 260 min cause: unknown
11/26/22 68 min cause: tree

In terms of ongoing and increasing power supply availability, SnoPUD is confident they will be able to continue to supply the power needed for Everett Transit's increasing number of BEBs. It should be noted, however, that they have long timelines for expanding grid capacity and need to be continuously updated as energy needs change.

It is important to maintain consistent, frequent communication with SnoPUD regarding timelines of new BEB deliveries and charger purchases to empower the utility to plan as far out as possible in regard to upscaling energy deployment.

Regarding the prospective development of a micro-grid system, SnoPUD is incentivized to purchase back power through PPAs, and has expressed that they are very keen to work with Everett Transit on new energy projects. Details about their Small Renewables Program can be found on their website.

Short Term (2025)

7 | Encourage deployment of public charging

Everett Transit should work with SnoPUD and the City of Everett to plan for scaling public charging infrastructure which would support both city-wide emission reduction goals and Everett Transit's own BEB resiliency and emergency preparedness. This can be accomplished through ensuring city-owned and publicly available charging station sites are spatially and structurally equipped to accommodate BEBs.

Most public charging is equipped with Level 2 chargers, however, if at least one Level 3 Direct Current Fast Chargers (DCFC) is incorporated, it would be able to provide charging for the Everett Transit buses in the event of an emergency. [8]

The City of Everett has recently released a plan for the electrification of its city-owned fleet. **Everett Transit should pursue involvement in the planning stages of City charging infrastructure, as it could have the potential to be co-located with public charging and charging for both BEBs and future electrified paratransit vehicles.**

Furthermore, **Everett Transit should encourage SnoPUD consider adding written specifications for public charging infrastructure to be able to accommodate fleet vehicles when deploying state or federal funding to other city governments for public charging infrastructure**. Should an emergency scenario arise where the electric fleet must travel outside the city of Everett, it will be vitally important that it has other charging infrastructures to rely on.

Short Term (2025)

8 | Equip the workforce

Maintaining a workforce that is capable of fully servicing BEBs is vital to operational resiliency. A detailed analysis of Everett Transit's workforce was included in FTA Element 6 in the 2023 Everett Transit Fleet Electrification Transition Plan. Key findings and recommendations from this plan which have yet to be enacted include the following:

- Everett Transit has a significant advantage in upskilling their workforce to transition to ZEBs as their technicians are already skilled in maintaining hybrid-electric buses and have received training on Proterra and Gillig BEBs, however, **a skills gap analysis is recommended in order to determine where the technicians' skill sets are lacking.**

- Where Everett Transit does not have the training staff, facilities, or budget to deliver in-house training, **neighboring transit authorities may be able to supply additional resources**. King Co. Metro and Pierce Transit have established programs with local schools, creating a pipeline for employment. They have robust training, apprenticeship, and mentorship programs. **It is recommended that Everett Transit partner with these agencies on these programs.**

- It is highly recommended that the agency **engage with all manufacturers identified in future procurements as early as possible to determine their ability to deliver on training needed to close skills gaps.**

Long Term (2026+)

9 | Revise the DER analysis for an updated microgrid design

Charging infrastructure coupled with a charging management system (CMS) and linked to distributed energy resources (DERs) has the potential to function as an advanced electric grid, charging the fleet at the lowest possible cost and lowest impact on the grid, simultaneously generating and storing energy. The ability for this system to disconnect from the grid or island from it, makes such a system a microgrid. **A microgrid** uses an uninterruptible power supply that starts instantaneously from the time of a grid disruption, can power multiple loads through the various energy assets, and offers asset diversification rather than reliance on generators as the sole backup energy source.

In addition to providing energy security, **peak shaving** is one of the most critical benefits that microgrids provide. By storing self-generated energy during low demand and then deploying this energy when buses are charging, microgrids reduce power demand even further. This approach can help **reduce demand charges for the fleet and significantly reduce operational costs for Everett Transit in the long term, while providing resiliency from grid distruption.**

A basic DER and resiliency assessment was performed for the creation of the 2023 Everett Transit Electrification Transition Plan, and consisted of estimating a solar PV output from the current Everett Transit depot (utilizing the software Helioscope) and designing an integrated solar PV and BESS that can function as a local microgrid when coupled with a controller software that can direct power generated and stored onsite to the charging stations.

This analysis was conducted by Microgrid Labs with their proprietary platform EVopt. It is important to note that the assessment performed last year was based on the structure of the current operations and maintenance facilities and a previously projected fleet size of 36 BEBs and 13 paratransit ZEVs. It will therefore be necessary to **first refine the outdated fleet electrification model to reflect the new fleet projections, operating schedules, and timetables.** After assessing the fleet operation that needs to be supported, the microgrid model would then be resized to meet the new specifications. **The new updated model could then be utilized in the design process of the new transit maintenance facility to ensure spatial and structural requirements are met (see Step 10). Another consulting firm that has**

Long Term (2026+)

10 | Contract with a sustainable engineering firm

Everett Transit plans to build a new transit maintenance facility on both the site of the current location and the Public Works property adjacent to it, in order to better support their increasingly electric fleet. Engineering and design on a new maintenance facility is currently scheduled and funded for the 2026 - 2029 cycle, utilizing a mix of FTA grants, WSDOT grants, and local matching funds.

The engineering and design for the new operations center needs to be done by a company experienced in designing for sustainability and resiliency, including fleet electrification and microgrid integration. It is important to note that a DER analysis and microgrid modeling (Step 9) may be able to be accomplished by the same company simultaneously. However, grant funding may require breaking this into two different contracts.

Case Studies :

Santa Barbara Metropolitan Transit District (SBMDT)

SBMDT utilized an RFP process to develop an on-call architectural and engineering services contract with the firm Stantec. The firm employs the design-build method, and has just completed an electrification plan for SBMDT which details the buildout of supportive infrastructure and a timeline for equipment acquisitions.

Anaheim Transportation Network (ATN)

ATN also engaged the services of Stantec to develop charging schedules, provided fuel cost projections under different scenarios for the operation of battery electric buses. They then designed a new electrical system for the chargers as well as the new building and ancillary yard loads, including an extensive underground power distribution system that connects each charger location to the main switchboard.

King County Metro

King County Metro contracted Stantec for engineering and design services for its Interim Base Electrification (IBE) project. The $115 million IBE project will provide parking and charging stations for 120 ZEB buses at the existing King County Interim South Base. Stantec is providing electrical engineering services, transportation planning, information and communications technology design, acoustic design, charging system design, and even archaeological services should they be required.

Long Term (2026+)

11 | Engage the services of a microgrid developer

After a sustainable engineering firm is contracted for the design of new transit maintenance facility, Everett Transit should also contract the services of a microgrid supplier who can provide a turnkey system. The microgrid developer should work with the architectural engineering firm to ensure alignment and satisfaction of structural design requirements.

It is important to note that due to site and financial constraints, most transit agencies will feasibly provide enough resiliency for up to 30% of a fully electric fleet to operate during an emergency outage [3]

Case Study : Montgomery County Department of Transportation

The Montgomery County Department of Transportation (MCDOT) Division of Transit in Maryland operates a system consisting of nearly 400 County owned and operated buses. The County has been transitioning its diesel buses to electric buses and has a goal of converting the entire fleet to zero-emission vehicles. In support of this effort, the County entered into a public-private partnership with **AlphaStruxure** to build a microgrid at the Brookville Smart Energy Bus Depot to charge county-owned electric buses. Through the partnership, the entities are developing a 5.6 MW microgrid and 2 MW of solar canopies at the Depot (see photo below), as well as 0.5 MWH of battery energy storage capacity. The energy from the solar panels will be used to charge the electric buses. The microgrid system is designed to support up to 70 buses without support from the electric grid. However, as the fleet grows and power demands increase, electricity from the grid will be used to support over 140 electric buses.

Excerpt from:
FTA Transit Resilience Guidebook - May 2024

Long Term (2026+)

12 | Maintain a diversified fleet

The difficulties experienced by Everett Transit in regard to maintaining its electric bus fleet operations are shared by many others, due to the loss of bus manufacturers such as Proterra, technology limitations, and lagging battery-electric bus performance. In response, Everett Transit has procured 5 refurbished diesel buses. As they were purchased through local funding, they are not required to remain in service for a full 12 years and can be retired when funding for a lower emissions option is secured. At that time, there will be the opportunity to maintain a diversified fleet while achieving zero-emissions by 2039.

Community Transit and King Co. Metro are both exploring diversifying their zero emission bus fleets with **hydrogen fuel cell propulsion**. Fuel cell buses have some operational benefits over conventional battery buses, such as higher fuel capacity, faster refueling, and the ability to operate in more extreme weather conditions, which results in longer ranges and more daily potential use [11]. And with the recent $1 billion investment into the Pacific Northwest Hydrogen Hub, there is a much higher probability for an accessible and lower cost hydropen supply in the future.

Everett Transit should consider following suit and implementing a pilot program of a fuel cell electric bus (FCEB). This pilot program could be incorporated into the 2028-2033 5-year transit development plan. It would be wise to follow the progress of Community Transit's pilot program.

Additionally, **it is important to keep your stakeholders at the City of Everett updated on your progress and shifting timelines and to be sure these changes are reflected in your emergency planning scenarios.**

Long Term (2026+)

12 | Maintain a diversified fleet

Case Study: Community Transit

"Community Transit recently took ownership of a hydrogen-powered bus, making it the first transit agency in the Puget Sound region to procure one. The vehicle is part of a pilot effort to test out fuel cell electric bus technology, an alternative type of zero-emissions bus (ZEB) in the agency's fleet. Community Transit already has a battery-electric bus (BEB) it has yet to phase into service. Both ZEBs are expected to carry riders in the coming months.

In April, Community Transit issued its long-term plan to transition to a 100% zero-emissions fleet by 2044 — though that transition could be realized sooner if things go well. Implementation of the plan is expected to happen incrementally, as the bus fleet is replaced and expanded over the next two decades."

Excerpt from:
Community Transit Rolls Out Region's First Hydrogen-Fueled Bus
By Stephen Fesler - May 29, 2024

Case Study: King Co. Metro

"In spring 2024, Metro Transit made more formal efforts to plan a pilot for hydrogen fuel cell buses to diversify its zero-emission fleet and test the technology to see if it could support its service needs. Metro Transit communicated these plans to its staff and County Executive leadership and included a request for funds for the pilot in a budget communication to Council. This communication might meet requirements in code to provide written communication to Council upon initiating alternative propulsion systems. However, improving clarity and planning could help ensure county decision-makers are informed about how Metro Transit is approaching the zero emissions goal. In addition, Metro Transit has not incorporated its potential emergency responsibilities in its planning to shift from diesel-hybrid coaches to electric or other propulsion systems, which could hinder King County's disaster response."

Excerpt from King Co. Metro Audit Report
dated June 2024

Additional Considerations

Weighing the costs and benefits of off-site solar

Solar arrays on their own cannot supply power to a fleet. They must be coupled with battery storage and connected to the charging system, as in a micro-grid, to provide resiliency against power outages. Everett Transit has expressed that it may have the opportunity to acquire land from the City of Everett on which a solar farm could be built. Although this is not a method for resiliency against a power-outage, it has the potential to provide financial benefits to Everett Transit in the way of off-setting energy costs.

However, there are many considerations when engaging in a project of this magnitude, and it would take a considerable amount of time, money, and coordination amongst Everett Transit, Snohomish Co. PUD, and the City of Everett. Additionally, projects of this scale usually have longer timelines which are susceptible to delays caused by land disputes and community stakeholder concerns. Due to the readily available, abundant clean energy at a considerably low cost that is supplied by SnoPUD, it would take many years for a project of this scope to pencil out, especially considering the peak energy consumption reductions that will occur with the recommendations proposed in this plan.

Route-optimization

Route-optimization is a method some agencies employ to ensure the maximization of their BEB batteries. Route optimization is the process of determining the most cost-effective and efficient routes for a vehicle or fleet of vehicles to take, while taking into account a number of restrictions such time frames, vehicle capacity, and road conditions.

CSched, recommended by one of the interviewed transit agencies, offers a consulting team with specialized knowledge of fixed-route transit scheduling and the HASTUS transit scheduling software system by GIRO, Inc. The team also holds extensive experience in the development and tracking of planned level of service budgets, the creation of organizational plans for the scheduling and planning functions, the benchmarking of system performance against peer agencies, and the evaluation of operating costs related to current and alternate scheduling practices.

Additional Considerations

Community Engagement, Equity and Inclusion

Because this plan is an internal document meant only for use by the Everett Transit team to improve operations and emergency preparedness, community engagement regarding this plan is not anticipated to be needed. Furthermore, the developments this plan proposes will take place on land that already currently houses buses and transit operations. Therefore, it is anticipated that the structural improvements during construction of the new transit maintenance facility should only impact the businesses closely surrounding the existing transit facilities, and standard protocols for notifying the public about construction in the area would be followed.

However, as these resiliency improvements come to fruition, it will be beneficial for Everett Transit to publicize how it is improving the quality of life for the citizens of the City of Everett and making progress towards meeting (and surpassing) city-wide sustainability goals. Social media accounts and the public website Everetttransit.org are the two primary modes that are currently utilized to publicize information regarding Everett Transit's fleet electrification efforts, and these would be good tools for announcing improvements to the facilities as well, if desired.

The bidding and procurement processes that will be required in the execution of this plan offers an opportunity for Everett Transit to advance diversity, equity and inclusion. Recommendations for enhancing these processes include simplifying procurement processes, reducing barriers for applicants, and setting benchmarks for the percentage of contracts granted to businesses owned by under-represented individuals.

Additional Considerations

Conferences and Webinars

As Everett Transit remains committed to achieving zero-emissions goals, it is advisable that the agency remain engaged with others making and fulfilling their own goals and commitments towards a cleaner future. Everett Transit has participated in transit conferences in the past on various panels, discussing progress and hurdles of BEB adoption.

It is recommended that Everett Transit continue participation in regional and national conferences, in order to widen their support network, learn from others, and continue increasing their knowledge about best-practices and new technologies. Some events that may be helpful for Everett Transit to attend are:

Zero Emission Bus Conference
AUG 27-29, 2024
Philedelphia, PA

The Zero Emission Bus Resource Alliance (ZEBRA)'s Mixed Fleet Roundtable
September 16 & 17, 2024
Las Vegas, NV

Transit State of Good Repair - West
September 18-19, 2024
San Francisco Bay Area

Additionally, as technology rapidly evolves, webinars specific to the electrification of fleets are a good way to stay up-to-date on the latest advancements. CTE offers many such webinars for free, such as:

"Powering the Future: Advancements in EV Battery Technology for Medium and Heavy-Duty Vehicles"
August 15, 2024 • 2 PM EST // 11 AM PST

References

Everett Transit. (2023). *Everett Transit Fleet Transition Plan.*

Executive Order: Planning for Federal Sustainability in the Next Decade. (2015, March 19). Whitehouse.Gov. https://obamawhitehouse.archives.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade

Federal Transit Administration. (2024). *Transit Resilience Guidebook.* https://www.transit.dot.gov/sites/fta.dot.gov/files/2024-05/TPE-FTA-Resilience-Guidebook-05-29-2024.pdf

Federal Transit Administration. (2024). *FTA Guidebook for Deploying Battery Electric Buses*. https://www.transit.dot.gov/sites/fta.dot.gov/files/2023-08/FTA-Report-No-0254.pdf

Fesler, S. (2024, May). *Community Transit Rolls Out Region's First Hydrogen-Fueled Bus.* The Urbanist. https://www.theurbanist.org/2024/05/29/community-transit-rolls-out-hydrogen-bus/

Garvey, E., Poon, L., & Thompson, B. (2024). *Zero Emissions: Metro Transit Working to Mitigate Risks to County's Ambitious 2035 Goal.* King County Auditor's Office. https://cdn.kingcounty.gov/-/media/king-county/independent/governance-and-leadership/government-oversight/auditors-office/reports/audits/2024/zero-emissions/zero-emissions-2024.pdf

Hance, A. (2023). *Resiliency in a Zero-Emission World.* CALACT Spring Conference. https://calact.org/wp-content/uploads/2023/04/Resiliency-in-a-Zero-Emission-World-Amy-Hance.pdf

King County Metro. (2022). *King County Metro Transit Zero-Emission Bus Fleet Transition Plan*.

Lee, B., Kushwah, A., & Jokinen, K. (2023). *Microgrids: Best Practices for Zero-Emission Bus Resiliency.* CALSTART. https://calstart.org/wp-content/uploads/2023/06/Microgrids-Best-Practices-for-ZEB-Resiliency.pdf

Lee, B. (2023, July). *Santa Barbara Metropolitan Transit District Blueprint. White Paper: Microgrid Replicability (Task 2.5).*

Lepre, N., Burget, S., & McKenzie, L. (2022). *Deploying Charging Infrustructure for Electric Transit Buses*. Atlas Public Policy.

Olsen, B. (2019). *R99 Renewable Fuel in Emergency Diesel Generators.* https://www.researchgate.net/publication/337953124_R99_Renewable_Fuel_in_Emergency_Diesel_Generators

Appendix A

Contact List

Appendix B

Service Offerings
CTE

Appendix C

City-Wide Damage Assessment Annex
CITY OF EVERETT

Appendix D

Evacuation Annex
CITY OF EVERETT

Appendix E

Sheltering Annex
CITY OF EVERETT

Appendix F

Safety & Emergency Preparedness
and Response Plan
GO Raleigh

Appendix G

Powering Fleets
Environmental Defense Fund

Appendix H

Microgrid Development and Financing
Scale Microgrids

Appendix A

Contact List

Organization/ Company	Name	Position	Contact
Everett Transit	Mike Schmieder	Transit Operations Manager	MSchmieder@everettwa.gov
	Tony Cademarti	Fleet Program Manager	TCademarti@everettwa.gov
	Brad Chenoweth	Capital Projects Coordinator	BChenoweth@everettwa.gov
	Agustin Ortega	Operations Supervisor	AOrtega@everettwa.gov
	Tom Hingson	Director	THingson@everettwa.gov
	Melinda Adams	Transportation Services Manager	MAdams@everettwa.gov
	Amanda Koerber	Program Manager	AKoerber@everettwa.gov
	Amanda James (AJ)	Administrative Coordinator	AJames@everettwa.gov
	Gabby Bakun	Office Technician	GBakun@everettwa.gov
	Brian Sinyecho	Risk Management Supervisor	bsenyitko@everettwa.gov
	Matt Coomes	Outreach and Communications Manager	MCoomes@everettwa.gov
	Sabina Araya	IT Project Manager	SAraya@everettwa.gov
City of Everett	Vickie Fontaine	Administrative Coordinator, OEM	VFontaine@everettwa.gov
	Jim Sande	Director of Office of Emergency Management (OEM)	JSande@everettwa.gov
	Jennifer Gregerson	Government Affairs Director	JGregerson@everettwa.gov
Charging			
Cummins	John Carlos Urrutia	Field Service Technician	john.urrutia@cummins.com
Microgrids & Energy storage solutions			
Electric Fish	Anurag Kamal	CEO	anurag@electricfish.co
	Fola Ayoola	CTO	fola@electricfish.com
Scale Microgrids	Tim Vector	Associate Director, eMobility	tvictor@scalemicrogrids.com
Alphastruxure	Christine Weydig	VP, Transportation	christine.weydig@alphastruxure.
BattGenie	Manan Pathak	CEO/Co-Founder	mananp@battgenie.life
Solar Installation			
Infinity Solar USA	Tommy Letchworth	Sales Associate	thomas.letchwoth@infinitysolaru
ET Fleet Electrification Transition Plan			
Planning Communities	Teresa Townsend	CEO	ttownsend@planningcommunitie
	Ann Steedly	COO	Asteedly@planningcommunities.
Microgrid Labs, Inc.	Enric Sabadell	Senior Associate, Transportation Electrification	Enric@microgridlabs.com

	Narayanan Sankar	CEO, Co-Founder	sankar@microgridlabs.com
Public Utility			
Snohomish County PUD	Rob McMannis	Account Manager for Everett Transit	rbmcmanis@snopud.com
	Doug O'Donnell	Sr. Exec. Account Manager, Interconnection Agreements	DCO'Donnell@SNOPUD.com
NPOs / Industry Knowledge Experts			
CalStart	Alyssa Haerle	Director of Infrastructure Incentive Administration	AHaerle@calstart.org
CalStart	Mike Hynes	National Transit Bus Program Manager	MHynes@calstart.org
CalStart	Bryan Lee	Lead Project Manager, Author	blee@calstart.org
Center for Transportation and the Environment (CTE)	Jay Woodbeck	Senior Engineer Project	jay@cte.tv
	Yeshasvi Mahadev	Manager, Community Transit account	yeshasvi@cte.tv
ZEV Tech LLC	James M Hall	Principal | Founder, ZEV Workforce Development Expert	James@tech-zeb.com
Case Studies/Transit Agencies			
Community Transit	Jay Heim	Zero Emissions Program at Community Transit	jay.heim@commtrans.org
Santa Clara Valley Transportation Authority (VTA)	Marc Delong	Assistant Transportation Engineer	marc.delong@vta.org
Santa Barbara Municiple Transit District (SBMTD)	Ryan Gripp	Capital Projects Manager	RGripp@sbmtd.gov
Anaheim Transportation Network (ATN)	Jim Appleby	Director, Operations & Compliance	JAppleby@atnetwork.org

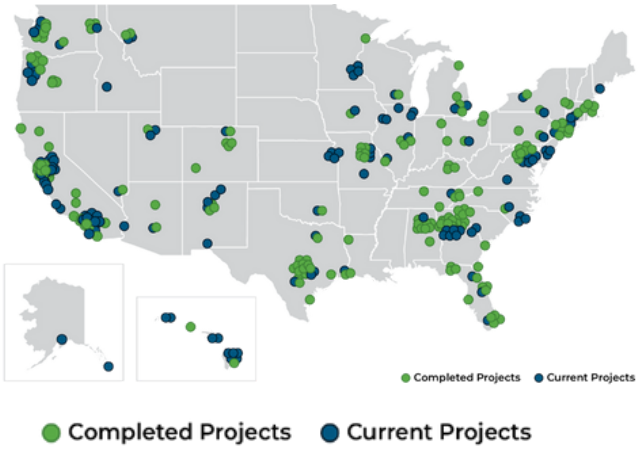
Appendix B

Low or No Emission Vehicle Program

About CTE

The **Center for Transportation and the Environment** (CTE) is a 501(c)(3) nonprofit organization providing technical advisory and project management services to support fleets deploying zero-emission vehicles (ZEVs) and supporting infrastructure. CTE is experienced in developing, implementing, and administering advanced transportation technology projects, with a focus on zero-emission transit buses. CTE has assisted fleets throughout the country in their efforts to deploy and ultimately transition to zero emission.

CTE Clean Transportation Projects



CTE and Low-No

The Bipartisan Infrastructure Bill (BIL) includes historic levels of funding for the Federal Transit Administration's (FTA) Low or Now Emission Vehicle Program (Low-No). BIL also includes a provision requiring inclusion of a Zero- Emission Transition Plan as part of a Low-No application. CTE is an eligible project partner on Low-No grant applications.

CTE has a strong track record of helping transit agencies develop winning Low-No grant applications.

Our success rate is unmatched in the industry and is a direct result of our knowledge of the zero-emission (ZEB) market, experience with ZEB deployments, and our ability to organize and manage the entire grant application process.

CTE: your partner for success

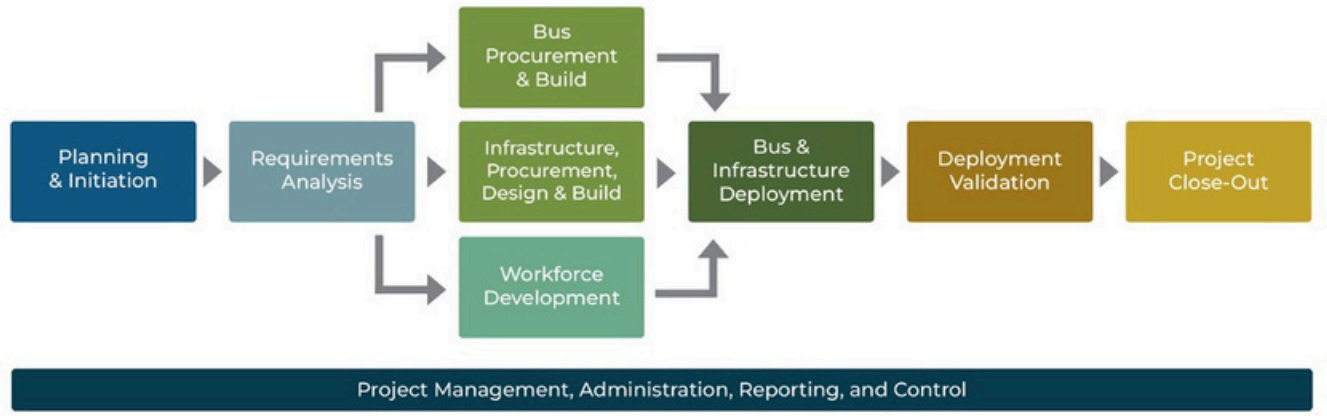
With more than 30 years of experience deploying clean transportation technologies, CTE is positioned to help transit agencies mitigate risk and ensure successful ZEB deployments using a proven methodology. CTE is also the national leader in helping transit agencies develop fleet transition plans, setting the standard for how these plans are developed.

To learn more, contact Wendy Morgan, Director of Grants.

Summary of Services

Approach

CTE's Zero-Emission Bus Smart Deployment Methodology is specifically designed to help agencies understand ZEB technologies and how to successfully deploy them. The cornerstone of CTE's approach is to apply our ZEB engineering tools to match transit service requirements with the right ZEB technologies and operational strategies. CTE's approach equips agency staff with a robust understanding of the ZEB market and technology options, as well as the impact that these options have on operational strategies and related costs.



Services

CTE is available to support your agency in developing a responsive Low-No application. We will assign dedicated staff to work with you throughout the application process.

Based on our success with previous Low-No projects, CTE offers several Low-No project management and technical consulting service packages designed to fit a variety of client requirements. Each service package consists of a combination of tasks from CTE's Smart Deployment services listed below. Your CTE project manager will work with you to customize a plan that best meets your needs.

Low-No Services Available from CTE

Service Packages

- ■ **Full Deployment Service Plan** with RFP Support
- ▲ **Full Deployment Service Plan** with Named Vendors
- ● **Technical Services Plan**

Packages Include:

	■	▲	●
Deployment Planning	■	▲	●
Bus, Route, & Fuel Modeling	■	▲	●
Bus & Fueling Specification Advisory	■	▲	
Procurement Support & Technical Evaluation	■		
Performance Validation	■	▲	●
Benefits Assessment & Deployment Validation	■	▲	●
Project Management and/or Technical Advisory	■	▲	●

Low-No Service Descriptions

Project Planning ■ ▲ ●

CTE helps the agency develop a project management plan to guide their zero-emission bus project. CTE collaborates with the agency to define project objectives and scope, identify resources, and develop a detailed project schedule and implementation plan. The project plan is then presented at the project kickoff meeting held with key team members and stakeholders.

Bus, Route, & Fuel Modeling ■ ▲ ●

CTE's modeling suite uses our proprietary engineering and analysis tools to develop an independent operational analysis that helps the agency match ZEB technologies to service requirements.

- **Bus & Route Modeling** – CTE gathers data on routes, technical specifications of the bus and charging or refueling equipment, and operational assumptions. This route and bus information is used to model the buses' duty cycles, simulating bus performance on selected routes. The process also ensures that adequate power and energy storage specifications are met and inform fueling and charging strategies.

- **Fueling Infrastructure Modeling** - For battery electric bus deployments, CTE defines charging scenarios to model electricity consumption and assess charging equipment requirements. Modeling results for electricity inform infrastructure procurement and operational decisions. For fuel cell electric bus deployments, CTE will determine daily hydrogen consumption and station throughput requirements given the agency's refueling window. CTE will also estimate a station scale-up plan as a starting point for fueling station design discussions.

- **Fuel Cost Modeling** – CTE examines electric utility rate structures to estimate the annual cost of energy to charge battery electric buses. CTE works with the transit agency and local utility providers to determine rate schedules that would be the most advantageous for supporting battery electric bus deployments. For fuel cell electric bus deployments, CTE will identify likely sources of hydrogen supply, evaluate hydrogen supply reliability, and estimate the cost of hydrogen.

Bus & Fueling Specification Advisory ■ ▲

Based on the modeling outputs, CTE helps the agency develop vehicle and infrastructure technical specifications to meet service requirements. The specifications can then be used as part of a competitive procurement or to develop a contract with a named vendor. CTE also provides advisory services throughout the design and build process.

Procurement Support & Technical Evaluation ■

If an agency chooses to select a bus, charging, hydrogen refueling station, or facility modification vendor through a competitive procurement, CTE supports the agency in the procurement process, including providing assistance in the preparation of Requests for Proposals (RFP), technical evaluation of proposals, vendor demonstrations, site visits to vendor facilities, vendor negotiations, and contracting.

Low-No Service Descriptions

Performance Validation ■ ▲ ●

Before the delivered buses enter revenue service, CTE runs a series of tests to validate the expected levels of bus performance. If there are any discrepancies between the modeled and the tested performance, CTE will work with the agency to analyze these discrepancies and reevaluate operational decisions before the agency places the buses into service.

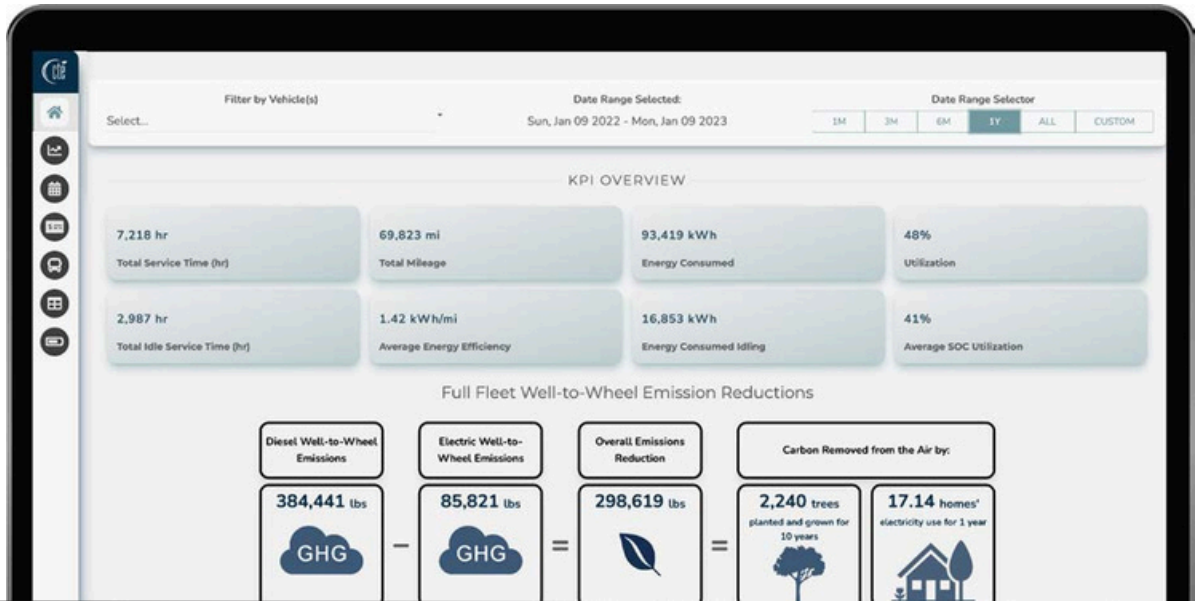
Project Management and/or Technical Advisory ■ ▲ ●

CTE employs a project management methodology specifically designed for zero-emission bus deployments and augmented by established project management, administration, reporting, and controls processes. CTE provides technical advisory services throughout the project to ensure that agency staff understand the differences in technology and the best practices for deploying and operating ZEBs. CTE's Smart Deployment Methodology is designed to address all aspects of a successful implementation including planning, requirements analysis, specifications, workforce development requirements, operator and maintenance training, testing and validation, and performance evaluation. In addition, CTE assists the agency with development of quarterly reports to meet FTA reporting requirements.

Benefits Assessment & Deployment Validation ■ ▲ ●

CTE collects operational data and provides monthly or quarterly analysis with Key Performance Indicators (KPIs) to measure benefits, assess bus performance, and identify issues of ZEBs in service. CTE works with each client to customize KPI metrics to facilitate an understanding of ZEB performance in the context of their baseline fuel types. Common metrics are centered around fuel and efficiency performance, emissions benefits, and financial comparisons for fuel, maintenance, and other costs. Many clients wish to maximize ZEB miles, requiring an understanding of how different factors impact real world performance. CTE's custom KPI offerings include ZEB efficiency by route, by operator, by temperature, and by vehicle to help clients identify what additional daily miles are available. Long-term results are used to validate the deployment strategy and make adjustments if energy usage is higher or lower than expected. Continuous KPI monitoring establishes an understanding of the technology that can be applied to future ZEB procurements, deployments, and long-range fleet management planning.

Data results and insights are provided for each reporting period in the form of a live presentation with in-depth analysis provided by CTE's engineering team. Clients also receive access to a dashboard, providing the opportunity for independent data exploration, including filtering by custom time periods and by individual vehicles in the fleet.



Other Project Support Services

Workforce Development

Transitioning to a zero-emission bus fleet brings opportunities and challenges for transit agencies and their entire workforce. CTE's Zero-Emission Bus 101 course (ZEB 101) provides technology background, key considerations, lessons learned, and a realistic look at operating capabilities for transit agencies. Each course is tailored to meet an agency where they are in the ZEB transition -- from preparing for the first ZEB procurement to the unique challenges of operating a 100% ZEB fleet. ZEB 101 is structured to introduce management, operations, and maintenance staff to zero-emission bus technologies and the basics of deploying battery and fuel cell electric buses. With this framework, agencies can identify key interfaces between departments to ensure the entire organization is able to work together effectively in planning for and implementing a zero-emission fleet. ZEB 101 also trains participants on the technical aspects of ZEBs, preparing them to ask the right questions of bus manufacturers and infrastructure providers prior to investing in a particular technology solution.

After the ZEB 101 course, CTE will work with the agency to evaluate the impact of transitioning to zero-emission technologies on their workforce. CTE will analyze the gap in skills between the current workforce and future needs of the workforce, and work with the agency to build a roadmap to develop the required skills across impacted departments. This roadmap will include a suggested training content and timeline for hands-on departments and skills advancement guidelines for ZEB support departments. CTE will follow FTA guidance to ensure the current workforce is not displaced by the transition to ZEBs.

Buy America Audits

Pre-Award and Pre-Delivery Buy America audits ensure the buses meet Buy America requirements. If desired, CTE can provide qualified auditors to complete these requirements for the project.

Periodic Quality Assurance Audits & Inspections

CTE provides qualified inspectors to review the manufacturer's production procedures, monitor the build, and periodically inspect the buses. The goal of the inspection is to ensure that the buses meet the specification requirements and that the OEM is adhering to its quality control and quality assurance standards.

Redundancy, Resilience, & Response Planning

The Redundancy, Resilience, and Emergency Response Assessment investigates the risks of deploying a full ZEB fleet, analyzes the impacts of power outages or other fuel disruptions, and develops risk mitigation alternatives. The assessment also evaluates the agency's ability to fulfill any emergency response obligations, such as evacuation support. The assessment then produces recommendations to mitigate the identified risks specific to an agency's risk tolerances, facility constraints, and budget.

Other ZEB Deployment Support Services

Transition Planning Support

CTE provides transit agencies with a comprehensive and robust roadmap for converting their fleets to zero-emission buses. This plan meets and exceeds FTA's requirements for Low-No applications. CTE supports transit agencies planning for compliance with stakeholder zero-emission goals— and for California transit agencies, the California Air Resources Board's Innovative Clean Transit Regulation. CTE's comprehensive ZEB Transition Planning methodology includes a Feasibility Assessment, Alternatives Analysis, Alternative Selection, and ZEB Transition Plan. The resulting product is a plan for phased implementation of ZEBs and supporting infrastructure that is based on the agency's service and operations requirements. The analysis includes assessments of the fleet vehicles, refueling requirements, facilities, maintenance needs, emissions reductions, and overall resilience. The analysis effort will also include a comparison of the total cost of ownership of various technology transition scenarios. In addition to these analyses, the plan meets FTA's requirements by including an assessment of the agency's workforce and the impact of transitioning to zero-emission technologies, funding availability, the impact of policies and legislation on the transition, and considers the partnerships required to support the transition to zero emission. This effort culminates in the creation of the ZEB Transition Plan, a comprehensive report guiding the agency's implementation of a zero-emission bus fleet.

City-Wide Damage Assessment Annex

CITY OF EVERETT

EVERETT
WASHINGTON

12/31/2020

City-Wide Damage Assessment Annex

Pre-Event Considerations

- The Citywide Damage Assessment is an immediate and uninterrupted evaluation of city facilities, structures, infrastructure, roads and neighborhoods. When implemented, it is a whole city effort that utilizes all city employees.
- The Citywide Damage Assessment may be implemented for major disasters such as major earthquakes, terrorism, or other city-wide events that require rapid evaluation for Situational Awareness.
- EOC Call Center line (x6200) should be forwarded to Public Works 24/7 switchboard (x8832).

*** Trigger for Citywide Damage Assessment ***

The Citywide Damage Assessment should be automatically implemented when one of the following occurs:

- Earthquake with collapsed structures
- Earthquake with resulting power outage
- Earthquake with loss of communication systems
- Catastrophic explosion
- Tornado or Typhoon in Everett
- Any other event as determined by the Mayor, Chief of Staff, Department Head, or OEM duty officer

Initial Actions (Mayor, Executive Leadership, Department Heads, OEM Duty Officer)

- □ Activate the EOC. Prepare to receive incoming damage assessments.
- □ Contact Public Works Switchboard (x8832). Request them prepare for incoming damage assessment information.
- □ Get a status update from City departments (Conditions, Actions they are taking, and Needs).
- □ Get a status update from other agencies and jurisdictions involved (see considerations below).
- □ Contact State for Mission Number and initiate WebEOC (800-258-5990).

Considerations

- Communication may be compromised. Consider activating the Auxiliary Communication Service (see ACS Play).
- Staff may not be able to report to work. Departments may need to consider alternative work options and staffing schedules.
- Incoming damage assessment information will be coming from a wide variety of sources, including phones, email, social media, 800mHz radios, UHF radios, Amateur radios (city HAM repeater is 440.175mHz), runners, and other non-traditional sources.
- Refer to both City and State traffic cameras for conditions (https://everettwa.gov/1634/Everett-Traffic-Cameras, https://www.wsdot.com/traffic/seattle/default.aspx).

Other agencies that are likely to be impacted or responding:

- Snohomish County Public Utility District – power restoration, downed line assessments and repair
- Puget Sound Energy – maintain natural gas service (electric in other counties)
- Washington State Department of Transportation – state transportation infrastructure status
- Community Transit – regional damage assessment along routes
- Snohomish County Department of Emergency Management– coordinate county departments and regional partners
- Washington State Emergency Operations Center– coordinate state agencies and statewide resource management
- Snohomish County 911– situational awareness of other agencies
- Port of Everett – port and marina damage assessment
- Boeing – facility damage assessment
- Providence Regional Medical Center Everett – hospital damage assessment
- Everett Public Schools and Mukilteo School District – school facilities damage assessment

Responsibilities

All departments:

- Determine safety and status of staff
- Evaluate department structures for:
    - Injuries
    - Damage to buildings (ATC-20 evaluation)
    - Operational readiness
    - Electrical Power status
    - Vehicle status
- Staff EOC with appropriate departmental employees
- Maintain documentation of personnel, equipment, and supplies used for potential federal reimbursement
- Provide updates to Public Works Operations Center Public Works:
- Using on-duty 24/7 switchboard operators, begin collecting damage assessment information and:
    - Before EOC activation= relay life safety concerns to Police and Fire. For non-life threatening concerns, hold until EOC activation
    - After EOC Activation= relay damage assessment information to EOC
- Activate Public Works Operations Center as needed
- Evaluate PW infrastructure including city bridges, Water Filtration Plant, Transmission Lines, Reservoirs, Sewer Lift Stations and the WPCF
- Prepare Building Department for inspection of damaged structures

Transportation Services

- Recall all off-duty Everett Transit Employees

- Implement the Transit Windshield Survey Plan using coaches and Paratransit
- Transit Dispatcher to relay life safety concerns to:
    - Before EOC activation= relay life safety concerns to Police and Fire
    - After EOC Activation= relay damage assessment information to EOC
- Transit Dispatcher to relay non-life threatening concerns to PWOC

Fire

- Follow checklist in "Company Officer's Disaster Field Guide"
- Activate the Fire Operations Center
- Limit responses to life saving only (until city wide damage assessment is complete)
- Modify response as needed
- Relay damage assessment information to:
    - Before EOC activation= relay life safety concerns to Police and Fire
    - After EOC Activation= relay damage assessment information to EOC

Police

- Limit responses to life saving only (until city wide damage assessment is complete)
- Modify response as needed
- Relay damage assessment information to:
    - Before EOC activation= relay life safety concerns Fire and Public Works
    - After EOC Activation= relay damage assessment information to EOC

Facilities

- Evaluate EMB and other City buildings (ATC-20 evaluation)

Parks and Community Services/Animal Shelter

- Evaluate Parks and Animal Shelter buildings (ATC-20 evaluation)

Communications and Marketing

- Provide status updates to public
- Update City staff information line (425-257-7010)
- Provide messaging for Limited English Proficiency and Access and Functional Needs populations
- Consider standing up a Joint Information Center
- Update City switchboard employees of city services changes

Office of Emergency Management

- Activate EOC
- 24/7 monitoring of the event
- Notify PW Switchboard, FOC, PWOC, Police CDO, and Transit Ops Center when EOC is activated.
- Notify DEM, WA EMD, Naval Station Everett, Port of Everett, and Marysville EOC of activation
- "Unforward" the EOC Call center line when Call center staffing is available
- Collect damage assessment information with life safety as the priority and immediately relay life safety information to Fire, Police or Public Works
- Develop and distribute timely Situation Reports (SitReps to internal and external stakeholders)
- Assist with resource requests and liaison with other agencies as needed

- Coordinate use of emergency workers
- Monitor partner briefings

Administration:

- Guide overall response policy direction

City Council:

- Provide policy approval for funding support/allocation
- Approve appropriate motions, ordinances, or other required legislation to facilitate an expedient response.

All other departments

- Maintain normal level of operations if possible and notify Mayor's office and EOC of changes

Messaging (approved initial messaging)

- The City of Everett is evaluating damage at this time and an update will be available as soon as possible. Life Safety concerns are being addressed as soon as possible.
- To report damage or injuries, call 911.

Evacuation Annex

CITY OF EVERETT

EVERETT
WASHINGTON

12/31/2020

Evacuation Annex

Pre-Event Considerations

- Consider Shelter in Place versus evacuation.
- Evacuations may be anticipated or planned for depending on the situation.
- Consider alternative work plans for employees to work remotely if applicable and expectations for coming in to work and their need to have supplies and equipment at home.
- Determine if the EOC and/or mobile command post needs to be activated (would the City benefit from a higher degree of coordination that the EOC can provide or does a department need additional support?)
- Contact State for Mission Number and initiate WebEOC (800-258-5990).
- Create signage in advance as appropriate.

Initial Actions (Mayor, Executive Leadership, Department Heads, OEM Duty Officer)

- □ Get a status update from City departments (Conditions, Actions they are taking, and Needs)
- □ Get a status update from other agencies and jurisdictions involved (see considerations below)
- □ Contact State for Mission Number and initiate WebEOC (800-258-5990)

Considerations

- Large scale and/or citywide evacuations may be ordered by the Mayor or his/her designee, Incident Commanders, and Disaster Managers.
- Priority is to lessen the loss of life and injury to people and their animals by conducting an orderly evacuation from specified areas.
- People who may need to be evacuate include residents, people who work in the City but live elsewhere, and visitors.
- Some population groups may need additional guidance on how to address specific needs to evacuate, use emergency or public transportation, or stay in shelters. These groups include, but are not limited to:
    - People without cars or other methods of private transportation
    - People with physical or mental disabilities
    - People with low mobility (the elderly or infirm)
    - People with pets or service animals
    - People who support specific population groups (e.g., staff at schools, day care centers, hospitals, jail, and retirement homes)
- Certain populations will face challenges receiving evacuation-related information and may require additional notification methods. The City will strive to make every reasonable effort to provide information to individuals who may be affected. These groups include, but are not limited to:
    - Limited English Proficiency groups
    - Individuals with Access and Functional Needs
    - Individuals who do not have access to electronic media

    - Visitors unfamiliar with the city
- Evacuation activities, particularly for those with specific needs, may be supplemented with transit coaches, paratransit, school buses, privately owned buses (senior centers, churches, casinos, etc), boats, or other vehicles. Refer to large scale evacuation play.
- Areas from and to which people are evacuating will require added safety/security measures to deter theft and looting.
- Transportation routes and areas individuals are evacuating too may be in other jurisdictions so close coordination is necessary.
- Some people may arrange their own alternative place to stay while others will not have arrangements made.
- **Evacuation alerts** in Snohomish County follow the **Ready, Set, Go** model.
    - **Level 1 – Ready:** The alert occurs when there is no immediate danger to people or to property in the affected area but the fire may be headed that way. This is the time to for people to scout evacuation routes, to firm up their personal plans for leaving the area, to gather up necessities, to check on neighbors who may need help and to take steps to keep pets and livestock safe.
    - **Level 2 – Set:** There is significant risk of fire in the area and a high probability there will be need to evacuate. People should prepare to leave the area at any time. Do they know where they will go? Law enforcement may be making door-to-door notifications. Older people and those living with disabilities should be encouraged to leave the area at this time.
    - **Level 3 – Go:** Evacuate. There is immediate danger. People need to load up their families and pets and leave using pre-designated routes.
- Evacuations fall into two different categories:
    - Small scale – less than ~2,000 people. Events such as: police actions, large fires, landslides, or minor hazardous materials releases.
    - Large Scale – more than ~2,000 people. Events such as: major hazardous materials incidents or natural/technological hazards with widespread danger.
- In large scale evacuations, control measures should be used to facilitate orderly evacuation. Evacuating geographic areas or neighborhoods one at a time could help ease congestion.
- While priority routes can be established ahead of time, the actual routes used in an evacuation will need to be evaluated as they may not be the most effective in the given situation.
- Persons living in assisted living facilities will be cared for by their providers whether in their own facilities, in a temporary shelter arrangement or at an American Red Cross shelter, as designated and available. As outlined in the State of Washington Adult Family Home Minimum Licensing Requirements, adult or assisted living homes are required to meet the needs of each resident during emergencies and disasters (WAC 388-76-10830). The City will strive to provide appropriate assistance as available.
- Notification methods may include: Wireless Emergency Alerts, Emergency Alert System, Reverse 911, Public Alert Signups, door-to-door notifications, loudspeakers, and variable message boards. See Emergency Public Information Annex for details.
- Tsunami and flooding evacuations covered under those annexes.
- In Washington State, we cannot force people to evacuate and some individuals may choose not to evacuate.

Other agencies that are likely to be impacted or responding:

- Red Cross – sheltering, disaster support services
- Naval Station Everett – evacuation of naval facilities
- Washington National Guard – evacuation support
- Washington Department of Transportation – coordination of state transportation infrastructure
- Washington State Patrol – traffic control, evacuation coordination
- Snohomish County Department of Emergency Management - coordinate state agencies and statewide resource management
- Washington State Emergency Management Division - coordinate state agencies and statewide resource management
- Community Transit – evacuation transport
- Snohomish County 911 - situational awareness of other agencies
- Neighboring Jurisdictions – coordination as potential destinations or pass through locations
- Snohomish County Sheriff's Office – evacuation coordination
- Port of Everett – marina evacuations
- NW Ambulance – evacuation transport
- Falck – evacuation transport
- American Medical Response (AMR) – evacuation transport
- Paine Field – aviation transportation
- Sound Transit – rail transportation
- Amtrak – rail transportation

Responsibilities

All Department Responsibilities

- Ensure the safety of staff
- Have staff for disaster policy group/EOC as needed
- Determine staffing needs and potential work alternatives.

Police

- Initiate and facilitate evacuation or shelter in place orders as necessary
- Provide crowd/traffic control and site security
- Assist with warning and emergency notification (see emergency info annex)
- Consideration and potential coordination with Snohomish County government and entities such as jail, county courthouse, Snohomish County Sheriff's Office, and Courthouse Marshals/security.

Fire

- Initiate and facilitate evacuations or shelter-in-place where deemed necessary
- Determine decontamination, special rescue, and patient transport needs
- Expert assistance will be needed to move people down stairs

Transportation Services

- Recall all coach and paratransit drivers

- Provide transportation for evacuees to designated public shelters or evacuation staging areas
- Support the identification of sustainable safe evacuation routes
- Consider Transit Center may be needed as a shelter or evacuation transportation hub
- Coaches and Paratransit should all be utilized
- Consider changes to services based on road congestion and transportation needs
- Collect the names of all people transported and their destination when transporting for evacuation purposes

Public Works

- Coordinate with the Incident Commander to establish safe evacuation routes
- Clear evacuation routes if necessary
- Assist with production and distribution of evacuation route maps and signage
- Provide video feeds from cameras

Parks and Community Services / Animal Shelter

- Provide animal control services for relocated/evacuated residents, including shelter, quarantine, and decontamination of relocated/evacuated animals
- Rangers should be used to assist in evacuations as appropriate
- Facilities may be used as shelters

Communications and Marketing

- Provide status updates to public
- Update City staff information line (425-257-7010)
- Provide messaging for Limited English Proficiency and Access and Functional Needs populations
- Consider using staffing from other departments who are familiar with using the language line including: Municipal Court, Police, and Fire
- Stand up a Joint Information Center
- Update City switchboard employees of city services changes
- Carefully document all communications efforts

Office of Emergency Management

- Define evacuation areas based on input from Police and Fire
- Determine evacuation destinations
- 24/7 monitoring of the event
- Develop and distribute timely Situation Reports (SitReps to internal and external stakeholders)
- Assist with resource requests and liaison with other agencies as needed
- Coordinate use of emergency workers
- Monitor partner briefings
- Assist with warning and emergency notification

Library

- Coordinate reunification efforts
- Consider the libraries may be temporary shelters

Facilities

- Consider City facility shut downs

Municipal Court

- Consider defendants and visitors present in the facility
- Staff may be used to facilitate language line calls in evacuation or reunification efforts

Administration:

- Guide overall response policy direction

City Council:

- Provide policy approval for funding support/allocation
- Approve appropriate motions, ordinances, or other required legislation to facilitate an expedient response.

All other departments

- Maintain normal level of operations if possible and notify Mayor's office and EOC of changes
- Consider evacuating or shelter in place as directed by City leadership or department head

Messaging (approved initial messaging)

- Please make your safety and that of your family the top priority.
- Check on your neighbors if you can – take care of each other.
- If you know somebody in the hazard area who speaks little English or faces other communication challenges, please make sure they know about the situation.
- Avoid travel near the hazard zone. The roads must be kept clear for emergency responders and those who may need to leave their homes.
- Please pay attention to emergency alerts. Leave the area if authorities advise evacuation. There won't be time later for rescue.
- Don't call 9-1-1 except in emergency.
- If you live near the hazard area and haven't already been told to leave, take time now to prepare for the possibility. Identify where you will go. Pack up enough clothing for several days, along with bedding, towels, prescription medications and spare glasses. Grab your phone charging cable. Keep your checkbook, credit cards, cash and identification handy. Pack your address book, a list of key phone numbers and important papers. Make sure your vehicle is fueled up and that you have emergency supplies inside, including first aid, a portable radio and flashlight.
- Phone lines may be overwhelmed. Texts may make it through when voice calls can't. If possible, use text and social media to contact family to let them know your status.
- If you are in the area affected by this event, consider registering with the American Red Cross Safe and Well site as another option to let family and friends know your situation and whereabouts.
- Emergency personnel are responding to _____ at _____. Avoid area until further notice.

Evacuation Routes

The following are primary and alternate relocation/evacuation routes based on the localized neighborhood zones:

Northwest Everett

- **North** – West Marine View Dr. via Rucker/Alverson or Broadway/North Broadway **to SR 529**
- **South** – West Marine View Drive or Rucker or Broadway **to 19th or Everett Ave**

Delta

- **North** - Broadway/North Broadway or East Marine View Drive **to SR 529 northbound**
- **South** – Broadway or East Marine View Drive **to 19th or Everett Ave**

Bayside

- **North** – West Marine View Dr. via Rucker/Alverson or Broadway/North Broadway **to SR 529 northbound**
- **South** – West Marine View Drive or Rucker or Broadway **to Hewitt Ave or Pacific Ave**

Riverside

- **North** - Broadway/North Broadway or Grand Ave/Walnut/East Marine View Drive **to SR 529 northbound**
- **South** – Broadway or Grand Ave/Everett/Maple **to 41st or I-5 southbound**

Port Gardner

- **North** – Norton/West Marine View Dr. or Rucker or Broadway **to Hewitt or 19th or SR 529 northbound**
- **South** – Federal or Rucker or Colby or Broadway **to 41st**

Boulevard Bluffs

- **East** – Mukilteo Boulevard **to Glenwood or Dogwood or 41st**
- **West** - Mukilteo Boulevard **to Mukilteo Speedway SR 525**

Harborview – Seahurst –Glenhaven

- **East** – Mukilteo Boulevard **to Dogwood or 41st**
- **West** - Mukilteo Boulevard **to Mukilteo Speedway SR 525**
- **South** – Glenwood **to Madison**

View Ridge – Madison

- **East** – Mukilteo Boulevard **to 41st**
- **West** - Mukilteo Boulevard **to Mukilteo Speedway SR 525**
- **South** – Dogwood **to Madison**

South Forest Park

- **East** – Mukilteo Boulevard **to 41st**
- **West** - Mukilteo Boulevard **to Dogwood or Glenwood**
- **North** – Evergreen/Rucker **to Pacific Ave**
- **South** – Evergreen **to Madison**

Glacier View

- **North** – Evergreen/Rucker or Colby or Broadway **to Pacific Ave**
- **South** – Evergreen or Colby or Broadway **to Madison**

Lowell

- **East** – Lenora **to Lowell River Road**
- **West** – 52nd **to Broadway**
- **North** – South 2nd Ave/Junction Ave/South 3rd Ave **to 41st**
- **South** – South 2nd Ave **to Larimer Road**

Southwest Industrial Area

- **East** – Merrill Creek Parkway or 75th Street SW/Severs-Duecy Boulevard **to Madison – or –** Hardeson **to West Casino Road – or –** Seaway Boulevard **to SR 526 eastbound**
- **West** – Hardeson **to West Casino Road – or –** Seaway Boulevard **to SR 526 westbound**

Evergreen

- **North** – **Evergreen to 41st - or –** Hardeson/Merrill Creek Parkway/Glenwood **to Mukilteo Boulevard**
- **South** – Hardeson **to West Casino Road – or –** Evergreen **to SR 526**

Pinehurst

- **North** – Evergreen/Rucker or Beverly Boulevard/Colby or Broadway **to 41st**
- **South** – Evergreen or Beverly Boulevard or Broadway **to SR 526**

Valley View

- **West** – 75th to **Broadway**

Westmont / Holly

- **North** – Airport Road or Evergreen **to SR 526**
- **South** – Holly Drive/Beverly Park **to SR 525 – or -** Evergreen/Pacific Highway/Airport Road **to I-5**

Cascade View

- **North** – Evergreen or Broadway **to Madison**
- **South** – Evergreen/Pacific Highway or Broadway/Everett Mall Way/Evergreen/Pacific Highway **to SR Airport Road**

Twin Creeks

- **North** – Pacific Highway/Evergreen or Everett Mall Way/Broadway **to SR 526 – or - I-5 northbound**
- **South** – Evergreen/Pacific Highway or Broadway/Everett Mall Way/Evergreen/Pacific Highway **to SR Airport Road**

Silver Lake

- **West** – 112th Street **to Evergreen**
- **North** - 19th Ave SE **to SR 526 – or – I-5 northbound**
- **South** – 19th Ave SE **to 132nd Street SE**

Sheltering Annex

CITY OF EVERETT

EVERETT
WASHINGTON

12/31/2020

Sheltering Annex

Pre-Event Considerations

- The need for shelter operations may be anticipated or planned for depending on the situation.
- Determine if the EOC and/or mobile command post needs to be activated (would the City benefit from a higher degree of coordination that the EOC can provide or does a department need additional support?)
- Contact State for Mission Number and initiate WebEOC (800-258-5990).

Initial Actions (Mayor, Executive Leadership, Department Heads, OEM Duty Officer)

- □ Get a status update from City departments (Conditions, Actions they are taking, and Needs)
- □ Get a status update from other agencies and jurisdictions involved (see considerations below)
- □ Contact State for Mission Number and initiate WebEOC (800-258-5990)

Considerations

- Individuals and families should be encouraged to stay in their own places of residence if possible. Families should have supplies and be prepared to be on their own for 14 days.
- People who may need to be sheltered include residents (and their pets), people who work in the City but live elsewhere, and visitors.
- It is the responsibility of local government to coordinate and facilitate emergency shelter and temporary housing for disaster victims within its own capabilities, and to request the implementation of shelter assistance provided by private relief agencies and other state and federal programs. When local resources are fully committed, and upon request, County and/or State government may assist in providing emergency shelter and/or temporary housing for disaster victims.
- Shelter operations are routinely conducted by the Red Cross and should be the first contact to stand up a shelter. If Red Cross or other non-governmental organizations (NGOs) are not available or overwhelmed, City resources should be used.
- Some population groups may need additional guidance on how to address specific needs while getting to a shelter and residing in a shelter. The City will strive to make every reasonable effort to provide information to individuals who may be affected. These groups include, but are not limited to:
    - People without cars or other methods of private transportation
    - People with Limited English Proficiency
    - People with access or functional needs
    - Children
    - People with pets or service animals
    - People who support specific population groups (e.g., staff at schools, day care centers, hospitals, jail, and retirement homes)
    - Visitors unfamiliar with the city

- Types of shelter includes, but is not limited to:

    - Mobile sheltering (tents or other mobile shelter)
    - Temporary sheltering (hard structure with temporary living conditions)
    - Temporary housing (which includes unoccupied, available public or Federally owned housing, rental properties, mobile homes or other readily fabricated dwellings).
- Facilities owned by the City or that have existing MOUs with the City or an NGO should be used as shelters first.
- Persons living in assisted living facilities will be cared for by their providers whether in their own facilities, in a temporary shelter arrangement or at an American Red Cross shelter, as designated and available. As outlined in the State of Washington Adult Family Home Minimum Licensing Requirements, adult or assisted living homes are required to meet the needs of each resident during emergencies and disasters (WAC 388-76-10830).
- Shelters protect people in the event of a disaster and serve two basic functions:
    - One is the pre-designated shelter that protects people from an immediate or ongoing danger during a disaster.
    - The other function is the care of disaster victims made homeless as a result of a major disaster or emergency. This is accomplished by use of pre-selected shelters and is the subject of this annex.
- Everett's Mobile Support Facility is capable of maintaining a temporary facility, including a shelter if required. There are also cots, blankets, and food to support a hard-sided shelter. Two trailers hold the mobile shelter and supplies. The third trailer is a shower trailer, which includes portable toilets with privacy enclosures.
- Sheltering of City staff may be necessary in pandemic/epidemic scenarios. These individuals may need to be isolated or quarantined and unable to return to their own homes. Shelters could be set up that also include work stations if they are able to work remotely.
- American Red Cross guidance for selecting shelters will be used when possible. Selection may also depend on damage to structures, access to the site, available amenities, and unique needs of the situation. City Building officials and the Fire Marshal's Office will be included as needed.
- Standing up a shelter will include other elements that will need to be coordinated. These include establishing a reception process for incoming individuals, managing disbursement of supplies, and organizing feeding operations (on- or off-site). These may be handled by the City or partner agencies.
- Appropriate departments or agencies will be included when dealing with certain situations (unaccompanied minors, registered offenders, household pets/animals, etc.).
- Notification methods may include: Wireless Emergency Alerts, Emergency Alert System, Reverse 911, Public Alert Signups, door-to-door notifications, and variable message boards. See Emergency Public Information Annex for details.

Other agencies that are likely to be impacted or responding:

- Red Cross – shelter operations/disaster services/volunteers
- Snohomish Health District (Medical Reserve Corps) – shelter operations/disaster services/volunteers
- Snohomish County Department of Emergency Management - coordinate county departments and regional partners

- Washington State Emergency Management Division - coordinate state agencies and statewide resource management
- Snohomish County 911 - situational awareness of other agencies
- Everett Housing Authority – affordable housing
- Everett Public Schools/Mukilteo School District – school facilities

Responsibilities

All Department Responsibilities

- Determine staffing needs and potential work alternatives
- Communicate updates and directives to staff and update staff information lines
- Maintain documentation of personnel, equipment, and supplies used for potential federal reimbursement
- Provide updates to OEM Duty Officer or EOC
- Have staff for disaster policy group/EOC as needed

Parks and Community Services / Animal Shelter

- Lead department for shelter operations; provide coordination and staffing (when necessary) for City operated shelters
- Deploy the mobile shelter
- Provide animal control services for relocated/evacuated residents, including shelter, quarantine, and decontamination of relocated/evacuated animals
- Rangers to provide site security
- Consider facilities may be a site for sheltering

Police

- Provide crowd/traffic control and site security
- Assist with warning and emergency notification (see emergency public information annex)
- Consideration and potential coordination with Snohomish County government and entities such as jail, county courthouse, Sheriff's Office, and Courthouse Marshals/security.

Facilities

- Support City facilities that may be used as shelters

Public Works

- Evaluate potential shelter facilities for safety
- Assist with production and distribution of shelter access routes and signage

Transportation Services

- Provide transportation to designated public shelters as needed
- Consider that the Transit Center may be needed as a shelter
- Consider changes to services based on transportation needs

Fire

- Fire Marshal's office provide evaluation of sheltering facilities as appropriate

Communications and Marketing

- Provide status updates to public
- Update City staff information line (425-257-7010)
- Provide messaging for Limited English Proficiency and Access and Functional Needs populations
- Consider using staffing from other departments who are familiar with using the language line including: Municipal Court, Police, and Fire
- Consider standing up a Joint Information Center
- Update City switchboard employees of city services changes

Office of Emergency Management

- 24/7 monitoring of the event
- Develop and distribute timely Situation Reports (SitReps to internal and external stakeholders)
- Assist with resource requests and liaison with other agencies as needed
- Coordinate use of emergency workers
- Monitor partner briefings
- Assist with warning and emergency notification

Libraries, Municipal Court

- Consider facility may be used as a shelter

Administration:

- Guide overall response policy direction

City Council:

- Provide policy approval for funding support/allocation
- Approve appropriate motions, ordinances, or other required legislation to facilitate an expedient response.

All other departments

- Maintain normal level of operations if possible and notify Mayor's office and EOC of changes

Messaging (approved initial messaging)

If it is safe for you to do so, remain in your home as long as is comfortable.

Shelter is available at _____.

Rules and details will change depending on the nature of the shelter needs and agency operating the shelter. Consult with agency operating the shelter or the EOC/JIC to confirm messaging. Messaging should include details such as who can use the shelter, what people should do with animals, things that are/aren't allowed in the shelters, etc.

Animals and pets may not be allowed in shelters. Make other arrangements for them or bring them on a leash or in a carrier.

A temporary animal shelter has been set up at _____.

GO Raleigh

SAFETY & EMERGENCY PREPAREDNESS AND RESPONSE PLAN

MARCH 2022

PREPARED BY

Planning Communities

Table of Contents

Transit Agency Information

Transit Agency Name	GoRaleigh and GoRaleigh Access		
Transit Agency Address	**GoRaleigh** 4104 Poole Road Raleigh, NC 27610	**GoRaleigh Access** 1430 South Blount Street Raleigh, NC 27603	
Name and Title of Accountable Executive	Byron Byrant GoRaleigh General Manager	CJ Loomis GoRaleigh Access General Manager	
Mode(s) of Service Covered by this Plan	Fixed Route Bus; BRT*; Paratransit	List all FTA Funding Types (e.g. 5307, 5337, 5339)	Section 5307, 5339
Mode(s) of Service Provided by the Transit Agency (Directly operated or contracted service)	Fixed Route Bus; BRT*; Paratransit		
Does the agency provide transit services on behalf of another transit agency or entity?	Yes	Description of Arrangement(s)	GoRaleigh is contracted to operate routes serving the Town of Rolesville
Name and Address of Transit Agency(ies) or Entity(ies) for Which Service is Provided	**Town of Rolesville** 502 Southtown Circle Rolesville, NC 27571		

*BRT service will be operational in the next few years

Plan Development, Approval, and Updates

Name of Entity that Drafted This Plan	City of Raleigh Transit Division/GoRaleigh	
Signature by the Accountable Executive	Signature of Accountable Executive	Date of Signature
Approval by Safety Committee	Name of Individual/Entity That Approved This Plan	Date of Approval
Approval by the Board of Directors or an Equivalent Authority	Name of Individual/Entity That Approved This Plan	Date of Approval
	Relevant Documentation (Title and Location)	
Certification of Compliance	Name of Individual/Entity That Certified This Plan	Date of Certification
	Relevant Documentation (Title and Location)	

Version Number and Updates
Record the complete history of successive versions of this plan

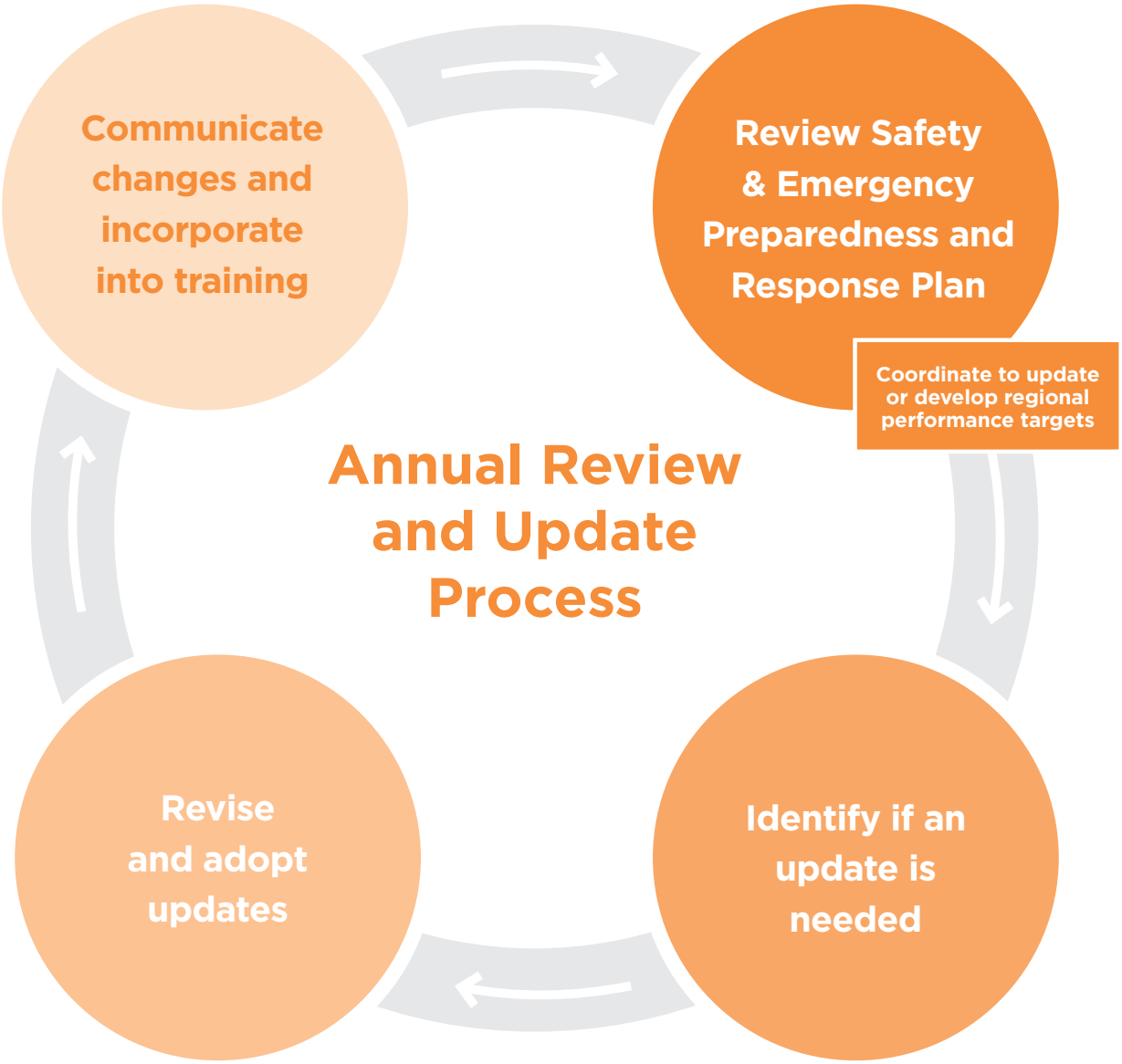
Version Number	Section/Pages Affected	Reason for Change	Date Issued
1		Initial adoption	July 2020
2	global	Integrate safety and emergency preparedness agency-wide; improve readability; incorporate changes required by Bipartisan Infrastructure Law	

Annual Review and Update Process

This document will be reviewed each year in June and may be updated if needed. In addition to annual reviews, performance targets are developed and coordinated regionally each year. An update may be needed if:

- Substantial organizational changes occur
- FTA requirements or guidance change
- New programs or services need to be integrated
- New hazards or management processes are identified

If the plan is updated, a new version number will be assigned and the revision will be recorded in the version history.



Safety Performance Targets

GoRaleigh's safety performance targets are established through coordination with the Captial Area Metropolitan Planning Organization (CAMPO). The key performance measures are based on those identified in FTA's National Public Transportation Safety Plan. These measures include: fatalities, injuries, safety events, and system reliability. Current targets are based on data collected from 2015 to 2019. GoRaleigh and CAMPO will review and update safety performance targets by October of each year.

Regional Targets for FY 2021 Approved by CAMPO February 2021		**Targets**	
		Fixed Route	**Paratransit**
Fatalities	Fatalities	0	0
	Rate of Fatalities (per 10M revenue miles)	0	0
Injuries	Accidents with Injuries	207	8
	Rate of Injuries (per 10M revenue miles)	125.7	4.82
Safety Events	Safety Incidents	325	63
	Rate of Safety Incidents (per 10M revenue miles)	197.3	38.25
System Reliability	# of Revenue Miles in between each Major Mechanical Failure	294,156.5	61,347.1

Why are these measures important?

Fatalities: Measuring fatalities aids in understanding the factors involved to prevent them in the future.

Injuries: Analyzing the factors that relate to injuries is a significant step in developing actions to prevent them.

Safety Events: Movement in safety events correlates with efforts related to reducing fatalities and injuries, as well as damages to transit assets.

System Reliability: The system reliability measure expresses the relationship between safety and asset condition. This is a measure of how well a fleet of transit vehicles is maintained and operated. FTA recognizes the diversity of the transit industry, and that agencies have varied equipment types, with varied rates of performance, so this measure allows agencies to develop safety performance targets that are specific to their own fleet type, age, operating characteristics, and mode of operation.

Based on *FTA National Public Safety Plan, January 2017*

Potential Emergency Response Performance Measure

Emergency response and recovery are key elements for a resilient public transportation system; however, few transit agencies have adopted performance measures for emergency response. If performance measures are considered in the future, possible metrics include:

- Time to restore service following a disruption
- Effectiveness of communications regarding service changes or disruptions
- Damage sustained
- Distribution of system functionality versus time after the onset of response event

Safety Management Policy

GoRaleigh strives to provide safe, reliable, comfortable, and innovative transportation options to every member of the community. The Public Transportation Agency Safety Plan (PTASP) has been developed to integrate safety into all GoRaleigh operations. By using the procedures contained in the PTASP, GoRaleigh can continue to improve the safety and security of GoRaleigh's operation and services.

This PTASP describes the policies, procedures, and requirements to be followed by management, maintenance, and operations personnel to provide a safe environment for GoRaleigh employees, customers, and the general public. The goal of this program is to eliminate the human and fiscal cost of avoidable personal injury and vehicle accidents. This PTASP addresses all applicable requirements and standards in accordance with the FTA Public Transportation Safety Program and the National Public Transportation Safety Plan.

A key to the success of this effort is for employees to be aware that they are accountable for safely performing the requirements of their position.

Each department has a responsibility under the PTASP. The Director and supervisors shall provide the continuing support necessary to achieve the PTASP objectives. A key to the success of this effort is for employees to be aware that they are accountable for safely performing the requirements of their position. The success of the program also depends on all employees actively identifying potential hazards and making a commitment to the safety of others.

GoRaleigh must be aware that decisions and actions often affect the safety of those in other operations. By following the processes described in the PTASP, GoRaleigh will continue to improve performance and the safety of the system while creating a culture of safety.

GoRaleigh's commitment is to:

- Support the management of safety through the provision of appropriate resources that will result in an organizational culture that fosters safe practices, encourages effective employee safety reporting and communication, and actively manages safety with the same attention to results as the attention to the results of the other management systems of the organization;
- Integrate the management of safety among the primary responsibilities of all managers and employees;
- Clearly define for all staff, managers, and employees alike, their accountabilities and responsibilities for the delivery of the organization's safety performance and the performance of GoRaleigh's safety management system;
- Establish and operate hazard identification and analysis, and safety risk evaluation activities--including an employee safety reporting program as a fundamental source for safety concerns and hazard identification--to eliminate or mitigate the safety risks of the consequences of hazards resulting from GoRaleigh operations or activities to a point which is consistent with an acceptable level of safety performance;

- Ensure that no action will be taken against any employee who discloses a safety concern through the employee safety reporting program, unless disclosure indicates, beyond any reasonable doubt, an illegal act, gross negligence, or a deliberate or willful disregard of regulations or procedures;
- Comply with, and wherever possible exceed, legislative and regulatory requirements and standards;
- Ensure that sufficient skilled and trained human resources are available to implement safety management processes;
- Ensure that all staff are provided with adequate and appropriate safety-related information and training, are competent in safety management matters, and are allocated only tasks commensurate with their skills;
- Establish and measure safety performance against realistic and data-driven safety performance indicators and safety performance targets;
- Continually improve safety performance through management processes that ensure that appropriate safety management action is taken and is effective; and
- Ensure externally supplied systems and services to support operations are delivered, meeting established safety performance standards.

GO Raleigh Safety Goals

- In collaboration with the City of Raleigh, design, construct, test, and operate a transportation system that achieves an optimum level of safety, exceeding the safety performance of other transit systems of a similar size in the United States.
- Identify and evaluate, then eliminate or control hazards to employees, customers, and the public.
- Meet or exceed all government and industry occupational health and safety standards and practices.
- Maximize the safety of future operations by affecting the design and procurement processes.
- Train employees and supervisors on the safety components of their job functions.

GoRaleigh takes these commitments seriously as the lives of GoRaleigh riders, employees and the general public depend on GoRaleigh's ability to operate in a culture of safety.

PTASP Objectives

The objectives of the PTASP are the means to achieving its goals. They also provide a method of evaluating the effectiveness of GoRaleigh's safety efforts.

- Integrate safety management and hazard control practices within each GoRaleigh department.
- Assign responsibilities for developing, updating, complying with, and enforcing safety policies, procedures, and requirements.
- Verify compliance with GoRaleigh safety policies, procedures, and requirements through performance evaluations, accident/incident trends, and internal audits.
- Investigate all accidents/incidents, including identifying and documenting the causes for the purpose of implementing corrective action to prevent a recurrence.
- Increase investigation and systematic documentation of near misses.
- Identify, analyze and resolve safety hazards in a timely manner.
- Minimize system modifications during the operational phase by establishing and utilizing safety controls at system design and procurement phases.
- Ensure that system modifications do not create new hazards.
- Train employees and supervisors on the safety components of their job functions.

GoRaleigh takes these commitments seriously as the lives of GoRaleigh riders, employees and the general public depend on GoRaleigh's ability to operate in a culture of safety.

This policy statement was current as of December 2020.

Authorities, Accountabilities, and Responsibilities

Everyone at GoRaleigh plays a role in delivering a safe transit system. Several key individuals are responsible for the agency's preparedness and response.

Accountable Executive (AE) - Transit Manager

The Accountable Executive is the ultimate authority responsible for the safety plan. Responsibilities include:

- Determine how to incorporate Safety Management System (SMS) principles into agency operations
- Create a culture of safety
- Provide the tools and training needed for employees to be successful and safe
- Develop an annual training budget
- Direct human and capital resources to develop and maintain GoRaleigh's safety plan
- Implement and update the plan as needed

Chief Safety Officer (CSO)

The Chief Safety Officer manages day-to-day adherence to the plan and reports directly to the AE for this role. Responsibilities include:

- Developing and maintaining SMS documentation
- Directing hazard identification and safety risk assessment
- Monitoring safety risk mitigation activities
- Providing periodic reports on safety reports
- Briefing the AE and Board of Directors on SMS implementation progress
- Planning Safety Management training

Supervisors

Supervisors are responsible for the safety performance of personnel and equipment under their supervision. Supervisors are responsible for initial investigation of all accidents and incidents and reporting them to Human Resources, Risk Management, and Transportation Operations Department.

Safety Committee and Administrative Staff

The GoRaleigh Safety Committee and Administrative staff are responsible for maintaining high standards of safety, customer service, and security. Safety Committee Membership includes front-line operators and maintenance representatives; an equal number of operators are selected to serve on the committee by the Union and the management team.

Employees

All GoRaleigh employees are responsible for performing their work safely and in accordance with established safety-related rules, procedures, and work practices.* Employees are responsible for reporting accidents, incidents, and hazards to their supervisors for protection of themselves, co-workers, customers, facilities, and equipment.

Contracted Services

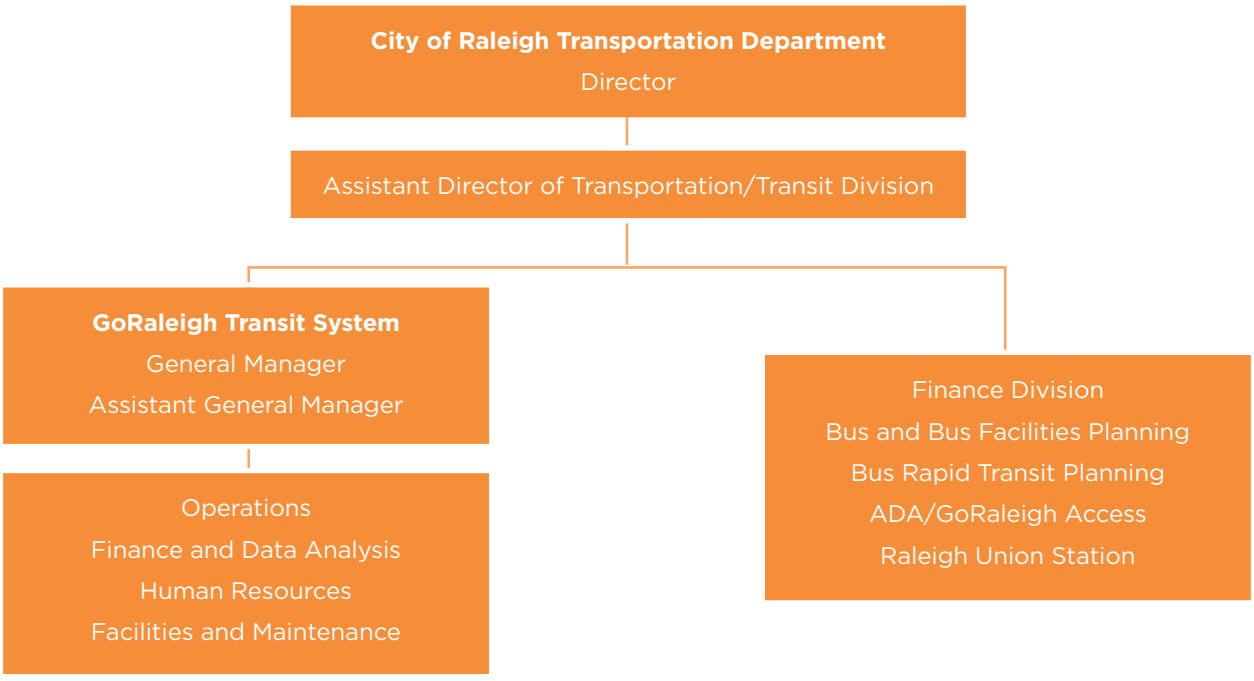
Some of GoRaleigh's services are provided through contracting. Contractors develop safety plans for their operations that align with GoRaleigh's overall safety plan. Current safety plans developed for contracted services are included in Appendix C.

Regional Coordination

GoRaleigh works with other City departments and agencies in the region to promote safety and respond to emergencies. Key partners and their roles include:

- Federal Transit Administration (FTA) - establishes regulations for required safety and emergency management practices and provides resources for carrying them out
- Capital Area Metropolitan Planning Organization (CAMPO) - adopts regional transportation safety performance metrics and targets
- Raleigh Emergency Operations Center - coordinates emergency response across City departments
- GoRaleigh - carries out the day-to-day safety program for transit and leads the transit response in emergency situations

GO Raleigh Organizational Structure.



*As City Employees, required safety and emergency management procedures and protocols include those established by the City as well as GoRaleigh.

Safety & Emergency Risk Reduction Program

There are four (4) steps to risk management:

1 Hazard Identification

A hazard is "any real or potential condition that can cause injury, illness, or death; damage to or loss of the facilities, equipment, rolling stock, or infrastructure of a public transportation system; or damage to the environment" (49 CFR Part 673).

GoRaleigh identifies hazards through routine and random evaluations of its system, employees, and assets. In addition, each employee is trained to identify hazards and report them. GoRaleigh takes all hazard reports seriously and investigates each. Employees may report hazards to their immediate supervisor or the CSO. Employees reporting hazards will not face disciplinary action unless that employee contributed to the hazard.

Hazard identification is also informed by the City of Raleigh Emergency Operations Plan, Wake County Hazard Identification and Risk Assessment, and FTA resources related to transit hazards.

Hazard Identification Process

Define the System
Physical and functional characteristics
People, procedures, facilities, equipment, environment

Identify hazards
Hazards and undesired events
Causes of hazards

Assess Hazards
Severity
Probability
Determine whether to accept risk or eliminate/ control

Resolve Hazards
Accept risk
Implement mitigation actions
Eliminate
Control

Follow-up
Monitor for effectiveness
Determine if different or additional action is needed
Review data to determine commonalities and trends

2 Risk Assessment

Risk assessment means examining all available information about identified hazards, assessing the severity or potential consequences of the hazard, assessing the likelihood or probability of the hazard occurring, and determining the overall level of risk after considering mitigations that are already in place to reduce the risk level. The need for mitigation is based on both severity and likelihood of the risk; mitigation should be identified for hazards that are both likely and severe, while hazards that are unlikely to occur and have minimal consequences would be a low priority for mitigation measures.

Risks are based on local historic data to the extent possible. Key sources include data submitted to the national transit database regarding the rates of accidents, injuries, and assaults on transit workers, the Wake County Multi Jurisdictional Hazard Mitigation Plan and the Triangle Regional Resilience Assessment. If local historic data is not available, ratings were based on a scan of transit agency plans and risk assessments.

Potential hazards are listed in the table on the following page and explored in more detail in Part 2 of the plan. The likelihood and severity of hazards are rated on a scale from low to high, as described below.

Likelihood

Low - Hazard tends to occur less than once a year.

Medium - Hazard tends to occur one or more times per year, but less frequent than monthly.

High - Hazard tends to occur one or more times per month.

Severity

Low - Hazard may result in injury or illness that does not result in a lost workday, damage to facilities, or equipment that disrupts service for a maximum of 30 minutes.

Medium - Hazard may result in injuries that result in one or more lost workdays, hospitalization, or damage to facilities or equipment that disrupts service in the affected area for more than 30 minutes but less than 24 hours.

High - Hazard can lead to death, permanent disability, or damage to facilities or equipment that disrupts service in the affected area for more than 24 hours.

Note: Most hazards can range in severity; rankings are based on the most likely level of severity.

3 Risk Mitigation

GoRaleigh focuses on prevention when possible to mitigate risks, such as focusing on defensive driving and preventative maintenance to reduce the likelihood of vehicle incidents. Employee training ensures that our staff knows how to minimize risks and how to respond in the event of a hazard.

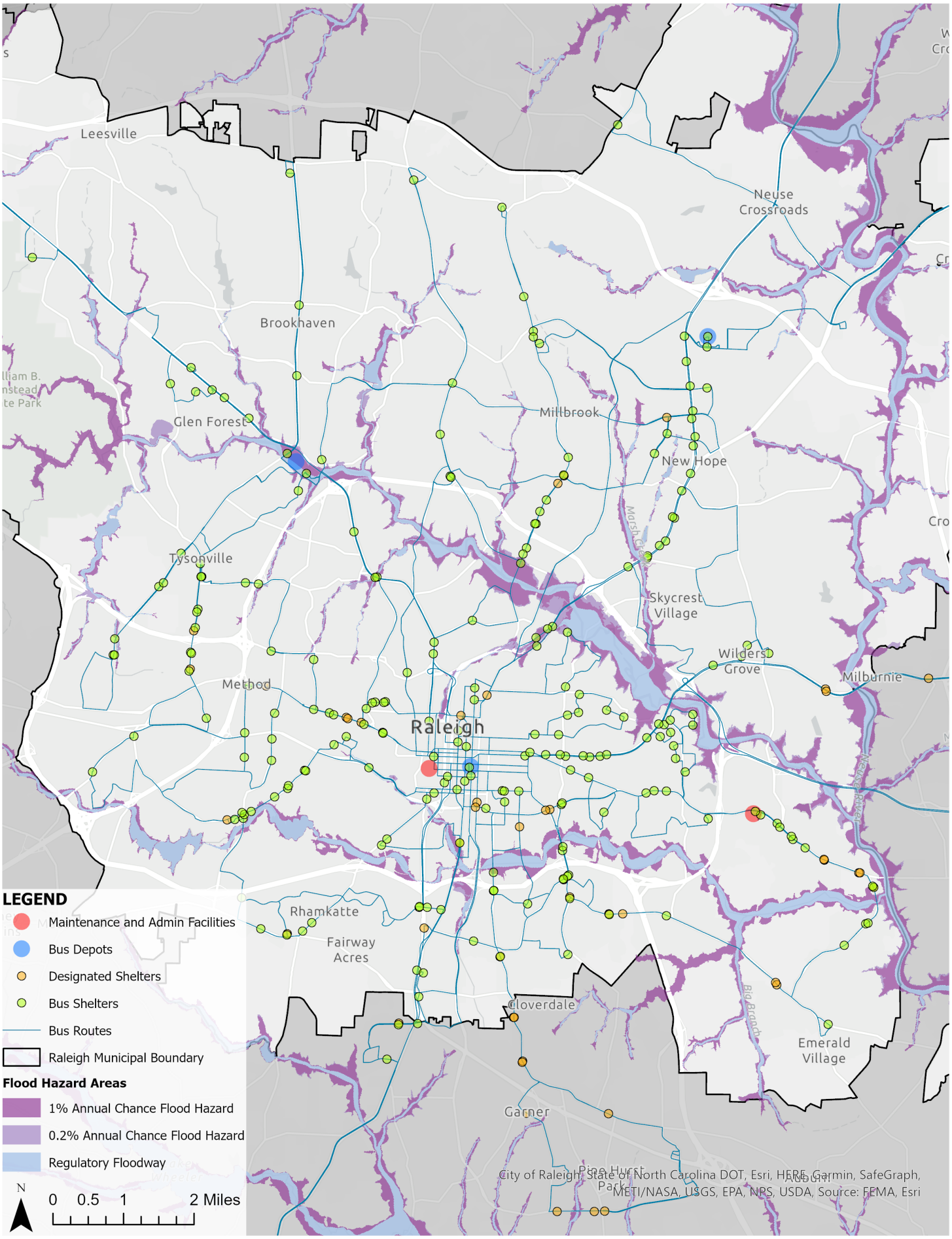
Mitigation strategies depend on the factors that contribute to the risk and may be developed collaboratively with other departments or partner agencies. Mitigation strategies are communicated to appropriate staff through the channel most appropriate to the circumstances. A hazard requiring an immediate mitigation response such as a temporary re-route or closure of a transit station may be communicated through the dispatch system, a text burst, or email or web alerts. Other mitigation strategies may be communicated through bulletin board postings, memos, training, or other means.

4 Response

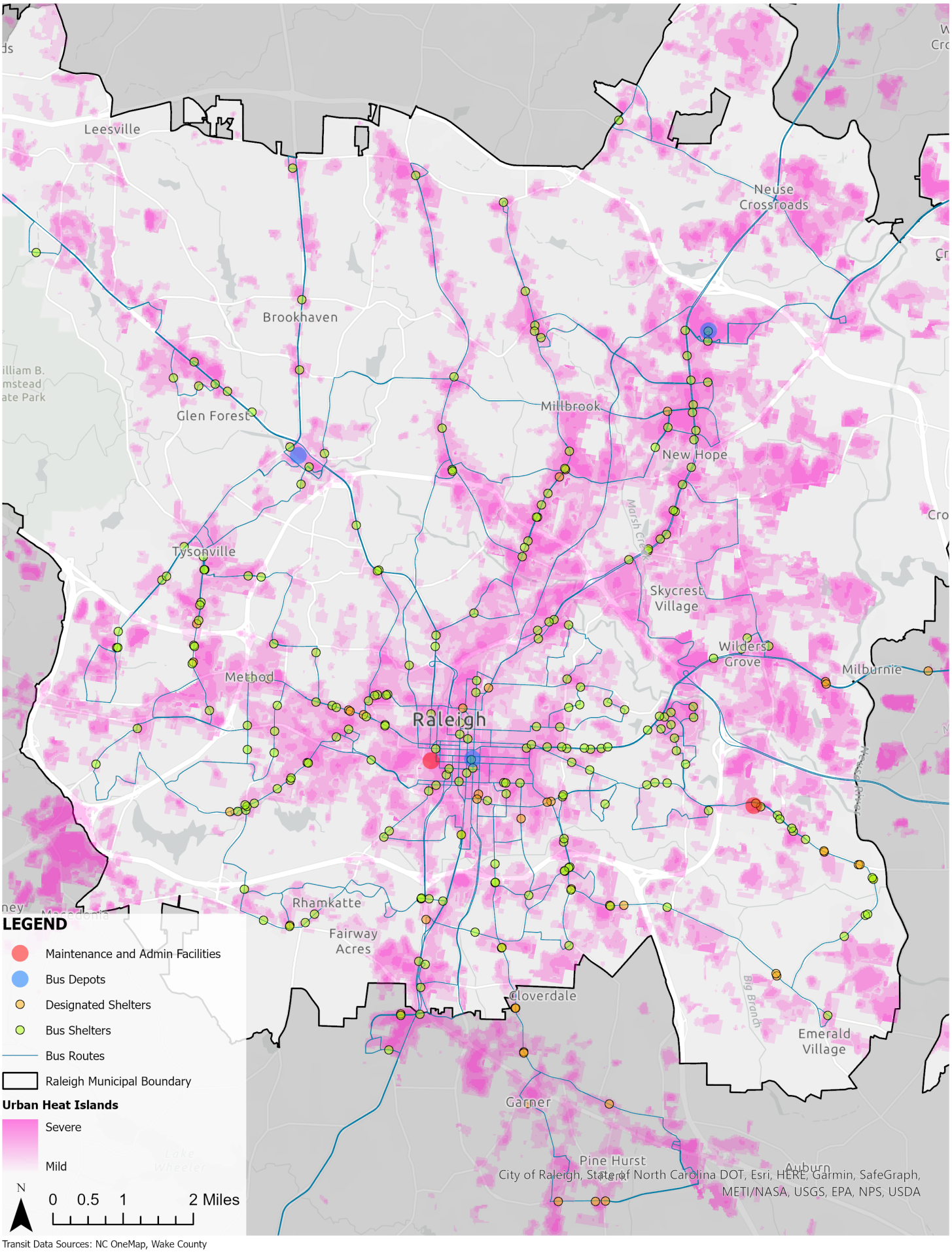
GoRaleigh focuses on prevention when possible to mitigate risks, such as focusing on defensive Not all hazards can be avoided, so it is important to know how to respond when a hazard is encountered. Part 2 of this plan helps employees prepare to respond to the hazards they may encounter on the job and at home.

Summary of Hazards and Risks

Hazard	Likelihood	Severity
Climate and Natural Hazards		
Winter Storms	Medium	Medium
Severe Thunderstorms	Medium	Medium
Floods	Medium	High
Tornados	Low	High
Hurricanes	Low	High
Earthquakes	Low	Medium
Forest/Brush Fires	Medium	High
Extreme Heat	Low	Low
Health Hazards		
Disease/Pandemic	Medium	Medium
Medical Emergency	Medium	High
Human-Involved Events		
Suspicious Objects/Substances	Low	High
Suspicious Activities	Low	Medium
Threats	Medium	Medium
De-Escalation of Disruptive Incidents	High	Low
Technology or Mechanical Events		
Fires	Low	High
Power Outages	Medium	Low
Hazardous Materials Releases	Low	High
Cyber Security	Medium	Medium
Vehicle Incident	High	Medium
Explosions	Low	High



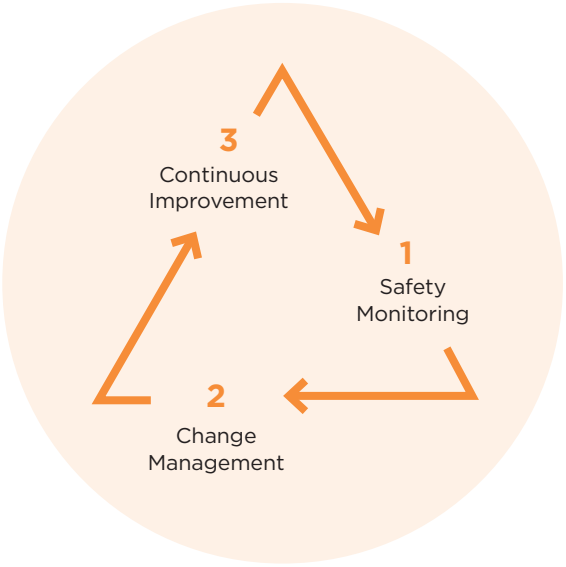
Transit Data Sources: NC OneMap, Wake County



Transit Data Sources: NC OneMap, Wake County

Safety Assurance and Performance Monitoring and Measurement

GoRaleigh is committed to providing a safe transit system for our employees and our customers. Safety is a critical element in everything GoRaleigh does and everyone plays a role in ensuring that safety comes first. GoRaleigh's "Let's GOSafety!" Program details key safety considerations for bus operators, mechanics, and utility service workers.



1. Safety Monitoring

Safety data is collected through monitoring the system, investigating incidents, the employee safety reporting program, and data collection for performance targets.

Routine Monitoring

Hazards and safety conditions may be identified on an ongoing basis from a variety of routine monitoring activities, including:

- Pre-trip and post-trip vehicle inspection reports
- Employee meetings and workshops
- Employee surveys and outreach
- Monthly safety committee meetings
- Periodic route reviews to identify hazards
- Workplace observations by management personnel
- Regular ride checks
- Mystery rider program
- Rule compliance assessments
- System inspections
- Quality inspections
- Transit Asset Management Program activities
- Inspections, audits, and observations by Safety Department personnel
- Customer, public, and law enforcement reports
- After Action Reviews following emergency events or exercises
- Safety directives, bulletins, alerts, regulations, and recommendations from FTA or other authorities

Investigations

The Safety Management Team investigates each incident involving a collision and/or injury to determine whether the incident was preventable or non-preventable. Investigations will also be conducted when hazards or security threats are reported to determine whether the risk can be mitigated.

When a preventable collision or injury occurs, the Safety Manager will formally recommend appropriate corrective training. Recommended training will focus on the nature of the incident and the specific defensive driving skills that could have been employed to avoid it. The training will be conducted within 30 days of the incident unless there are extenuating circumstances. Disciplinary action may be considered necessary depending upon the severity of the incident and the operator's record of preventable incidents within the preceding 12-month period.

Employee Safety Reporting Program

Staff are trained to note changes which may be considered a hazard or security threat and report them to a supervisor, CSO, or member of administration. Supervisors will be notified of identified risks immediately or upon return to GoRaleigh depending on the severity of the hazard. Corrective actions will be identified to mitigate the hazard.

Safety Performance Targets

Ongoing data collection supports reporting safety performance.

2. Change Management

Changes occur when routes, equipment, facilities, or practices are introduced or modified. All changes are reviewed for safety concerns prior to implementation and monitored following implementation. Changes are strategically designed with safety as a priority.

Change management practices include

- Testing new routes prior to initiating service to determine if hazards may require modification to the route, schedule or vehicle
- Reviewing drawings and specifications for new or modified equipment or facilities

3. Continuous Improvement

GoRaleigh's commitment to safety means that services and procedures are always evolving. The results of routine monitoring, investigations, technology improvements, and service expansions may lead to changes or new safety practices. After improvements are implemented, they are monitored for effectiveness.

Assuring Safety in Emergencies

Safety is always a priority, and emergency situations can heighten safety risks. The safety assurance process prepares GoRaleigh for routine safety and emergency response situations. Awareness of potential hazards prepares GoRaleigh to recognize changes or additional hazards in emergencies. After Action Reviews contribute to continuous improvement in emergency operations.

Safety Promotion

Training Program

GoRaleigh's extensive training program is intended to foster a culture of safety.

All employees receive training at the following times:

- New hire orientation
- Annual refresher and topical training
- Refresher or remedial training as needed
- Following involvement in a preventable accident
- Before a new policy or procedure takes effect

Job-specific training programs prepare employees for the following roles:

- Operators (bus and paratransit drivers)
- Maintenance Staff
- Supervisory Personnel (managers, supervisors, foremen)
- Operations Staff

Employee evaluations ensure that training standards are met and verify competencies. Regular training refreshers and mentorship for new employees support implementation of safe practices.

Let's GOSafety!

GoRaleigh safety policies and procedures are clearly communicated through training, handbooks, and team meetings. The Let's GOSafety! Recognition and Rewards Program seeks to motivate employees to perform all activities in a safe manner. Eligible employees can earn safety incentive bonuses- and for employees who continue to operate safety, the bonuses can really add up over time!

Awards

Time Without Occurrence	Prize
30 days	$10 gift card
90 days	$40 gift bonus
6 months	$75 gift bonus
9 months	$125 gift bonus
1 year	Exclusive catered luncheon with goody bags and drawings for major prizes; framed certificates for those with less than 5 years of service, pins for those with 5 years of service or more

Safety recognition details from safety program adopted in 2017 and current in 2020.

Preparedness and Response

As a transit agency, GoRaleigh plays an important role in the community and provides critical services to its customers. The agency and its employees must be prepared to respond to a wide variety of hazards and emergency situations. Employees are encouraged to be prepared for emergencies on the job AND at home - going home to take care of their family right away may not always be possible. Preparing for emergencies at work and at home before they happen means that employees can be confident that their family is protected even if they are at work.

Be Prepared - On the Job

Before an emergency

- Make sure you are familiar with your surroundings at work - emergency exits, environmental conditions, equipment controls, safety features, etc.
- Understand how your job might be affected by an emergency or hazard. Know whether you are considered an essential worker, whether you are able to leave work immediately if an emergency situation arises, whether your schedule may be affected, whether you may have to work overtime, and any other expectations around your job during an emergency.
- Make sure Human Resources has current contact information for your family.
- Be alert for hazardous conditions and report potential hazards immediately.
- Familiarize yourself with agency policies, procedures, communications plans, and protocols for hazard response. Know how to operate emergency equipment, what alternative communication methods are available, and how to respond to hazardous situations.
- Keep key information readily accessible, including a checklist of notification procedures and emergency contact information.
- If permitted, keep a personal emergency supply kit near your workstation and keep your phone charged.
- If you are a transit operator, know alternate routes or be prepared to request alternate routes in the event your main route is impassible or obstructed.

During an emergency

- Priorities during an emergency are:
    1. Protect life
    2. Preserve property
    3. Maintain service
- Remain calm. Be patient and prepared to act.
- Communicate clearly. Be specific and concise when reporting conditions or providing updates.
- Listen for instructions from dispatch or supervisors; listen to local radio for developing news.
- Inform customers of the situation, provide clear directions, and keep them updated throughout the event.

- Determine the safest response activity (such as shelter in-place, relocation, or evacuation) and implement it.
- If evacuation is necessary, consider evacuation routes, timing, preferable exits, and special accommodations that may be needed for seniors and/or persons with disabilities.
- Provide assistance to customers that may have difficulty following instructions or procedures, including children, seniors, and persons with disabilities.
- Provide first-aid if you are trained and sanctioned by GoRaleigh to do so.
- Follow the instructions of local emergency officials and first responders.

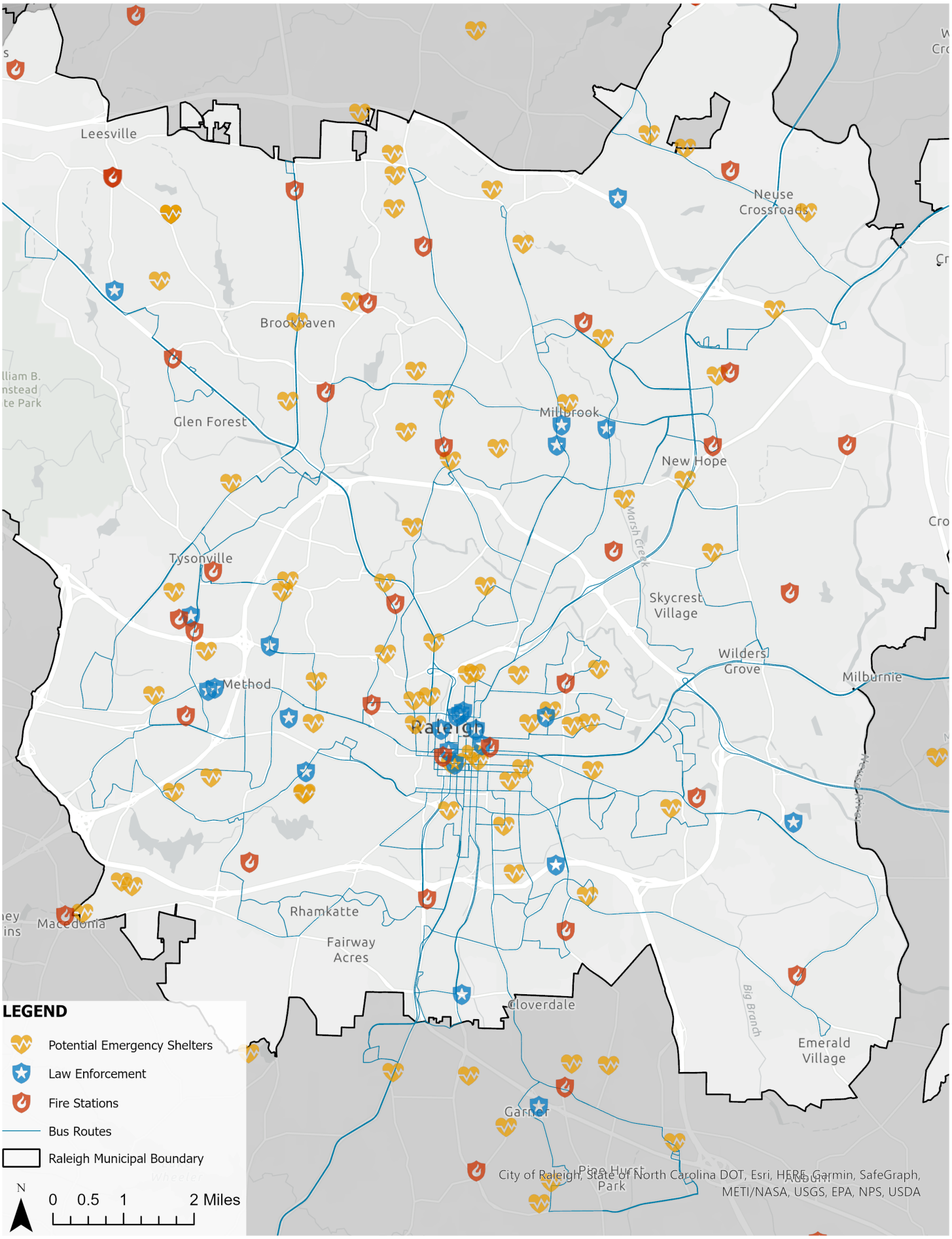
Be Prepared - At Home

Before an Emergency

- Have plans in place for vulnerable family members, including contact information and procedures, alternative caretaking arrangements, and adequate supplies of medication or other supplies (children, seniors, persons with disabilities, pets).
- Make sure your family knows the best way to reach you at work in the event of an emergency.
- Develop a household emergency communications plan.
- Review and update your home emergency plan regularly. Include an evacuation plan and designate two alternative meeting places if you are unable to reach your home.
- Prepare an emergency supplies kit.
- Make sure all family members know your family's emergency plans and how to operate safety equipment.
- Understand potential natural disasters, community warning signals, and prepare your home and family to respond to them.
- Know which radio stations or other media will provide local emergency information.
- Make sure you have adequate insurance coverage and safety equipment in good working order, such as fire alarms, fire extinguishers, sump pumps, weatherization, alternate heating sources, generators, etc.
- Know where emergency shelters are located. If you have pets, know whether shelters allow pets.

Emergency Preparedness Basics

1. Understand threats - be aware of the hazards you may encounter, including the types of disasters that may strike your community. Learn how to prepare for these events.
2. Stay informed - Follow local radio, television, or internet news sources to be aware of potentially hazardous situations and get updated local information in the event of a disaster. Consider purchasing a weather radio for alerts related to storms, tornados, or flooding.
3. Communicate clearly - Understand agency communications procedures and establish a family communication plan that will allow you to check in with family members.



Transit Data Sources: NC OneMap, Wake County

How to Prepare Emergency Supplies Kits

The following checklist identifies supplies to include in your at-work and at-home emergency kits. Adjust your kit as needed to meet your and your family's needs. Make sure all family members are aware of the location of your at-home kit, and keep a smaller version in the trunk of your car. Evaluate, check the condition, and resupply the kit on a regular basis (at least annually).

Supply	At Work	At Home
Food and Water		
Water	At least 1 gallon	1 gallon/person/day for 3 days
Food (non-perishable, little to no preparation or water required). Examples include canned foods and juices, granola or energy bars, and vitamins.	1-day's worth	3-day supply
Food for any infants		X
First Aid Supplies		
20 Adhesive bandages, various sizes	X	X
1 5"x9" Sterile dressings	X	X
1 Conforming roller gauze bandages	X	X
2 Triangular bandages	X	X
2 3"x3" Sterile gauze pads	X	X
2 4"x4" Sterile gauze pads	X	X
1 Roll 3" cohesive bandage	X	X
2 Germicidal hand wipes or alcohol-based sanitizer	X	X
6 Antiseptic wipes	X	X
2 pair Medical-grade non-latex gloves	X	X
Adhesive tape, 2" width	X	X
Anti-bacterial ointment	X	X
Cold pack	X	X
Scissors, small, personal	X	X
Tweezers	X	X
CPR breathing barrier such as a face shield	X	X

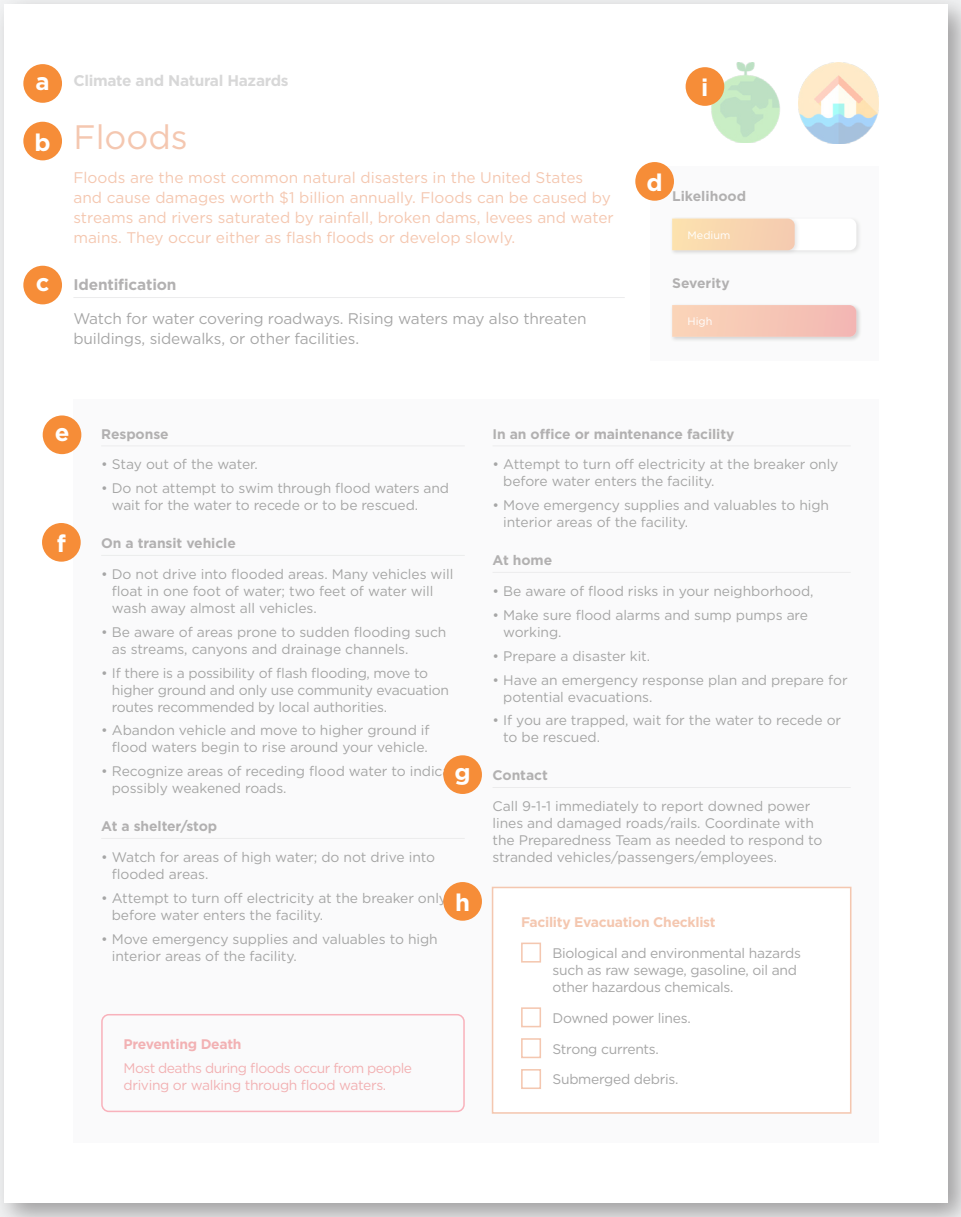
How to Prepare Emergency Supplies Kits (continued)

Supply	At Work	At Home
Tools and Emergency Supplies		
Emergency preparedness guide	X	X
Flashlight with extra batteries	X	X
Battery-powered radio with extra batteries	X	X
NOAA weather radio		X
Paper plates, cups, plastic utensils	X	X
Non-electric can opener	X	
Utility knife		X
Personal hygiene items (toothbrush, toothpaste, comb, brush, soap, contact lens supplies, feminine supplies)	X	X
Credit card and cash or traveler's checks; change		X
Plastic garbage bags and ties	X	X
Dust mask		X
Extra glasses if you wear them	X	X
Emergency "space" blanket (mylar)	X	
Fire extinguisher ABC type		X
Tube tent		X
Pliers		X
Tape		X
Compass		X
Matches in waterproof container		X
Aluminum foil		X
Plastic storage containers		X
Signal flair		X
Pencil/pen, paper/pads		X
Needles, thread		X
Medicine dropper		X
Shut-off wrench to turn off gas and water		X
Whistle		X
Plastic sheeting		X
Map of the area for locating shelters		X

How to Prepare Emergency Supplies Kits (continued)

Supply	At Work	At Home
Clothing and bedding (per person)		
Complete change of clothing and footwear (long-sleeved shirt and long pants)	X	X
Jacket	X	X
Blanket	X	X
Sturdy, closed-toe shoes or boots	X	X
Hat and Gloves		X
Sleeping bag		X
Thermal underwear		X
Sunglasses		X
Special items	X	
Non-prescription medicine (pain relievers, stomach remedies, other medicines you use regularly)	X	X
Additional non-prescription medications (Syrup of Ipecac, activated charcoal, antacid, anti-diarrheal, laxative)		X
Prescribed medicine (3-day supply). Consult with your physician or pharmacist on how to store medication and your employer about any storage concerns.	X	X
Baby supplies (formula, diapers, bottles, powdered milk, medications)		X
Extra set of car keys		X
Family documents in waterproof, portable container (will, insurance policies, contracts, deeds, stocks and bonds, passports, social security cards, driver's license, immunization records, banking information, credit card account numbers, inventory of valuable household goods, important telephone numbers, family records)		X
Toilet paper, towelettes		X
Soap, liquid detergent		X
Plastic bucket with tight lid		X
Disinfectant		X
Household chlorine bleach		X
Games, books		X

Example



- **a** Hazard Type
- **b** Hazard
- **c** Identification
- **d** Likelihood/Severity Levels
- **e** Response (Response actions that apply in all situations)
- **f** Location-Specific Responses (Transit vehicle response actions apply to any transit vehicle, including buses and paratransit vehicles.*)
- **g** Contact
- **h** Callouts/Checklists/Additional Information (Where applicable)
- **i** Indicates Climate-related Hazard (Where applicable)

*Paratransit services include trips provided by approximately 35 individual taxi companies in Raleigh

Climate and Natural Hazards

Many of the hazards faced by our community are naturally occurring events. Some are based on the natural features present in our area, like earthquakes. Others are functions of our climate and weather patterns. Climate and natural hazards can often be predicted, but cannot be prevented. GoRaleigh must be prepared to respond to these events and continue to meet the transportation needs of our customers to the best of our abilities.

Winter Storms

Severe Thunderstorms

Floods

Tornadoes

Hurricanes

Earthquakes

Forest and Brush Fires

Extreme Heat

Winter Storms

Winter Storms can cause hypothermia, frostbite and heart attacks from overexertion. The storms may be caused by heavy snow or blizzard conditions such as high winds, sleet and freezing rain. Severe storms may cut off heat, power and communication services and may have the potential to cause damage and immobilize areas.

Likelihood

Medium

Severity

Medium

Identification

Imminent or occurring heavy sleet, heavy snow, heavy freezing rain or blizzard. Winter Storm Warnings are issued 12-24 hours before the event is expected to begin.

Response

- Stay indoors.
- Maintain body heat by adding clothing layers, exercising and huddling together.
- Keep dry and ensure areas around are dry as well.
- Maintain intake of foods and fluids to provide the body with energy and heat and to prevent dehydration.

On a transit vehicle

- Stay inside the vehicle.
- Keep the interior lights on to enable locating by crews and rescuers.
- Set the hazard lights to flash.
- Run the engine and heater for about ten minutes every hour to keep the vehicle interior warm.
- Keep the exhaust pipe free of snow while running the engine to reduce carbon monoxide risk.
- Ensure the vehicle battery does not run down.

In an office or maintenance facility

- In the condition that there is no heat, seal off unused rooms by stuffing towels or rags in cracks under doors and covering windows at night.
- To prevent heating system failures in winter storm events, maintain the facility's heating system

Contact

Call 9-1-1 to report being stranded/stuck in a storm. Coordinate with the Preparedness Team as needed to respond to heavy snow or blizzard conditions.

Severe Thunderstorms

Thunderstorms are always accompanied by lightning and are a common occurrence. Severe thunderstorms may be associated with flash floods, hail, strong winds and/or tornadoes. A thunderstorm warning issued in an area indicates imminent danger for life and property in the path of the storm.

Likelihood

Medium

Severity

Medium

Identification

When severe thunderstorms are likely, a prior thunderstorm watch will be in effect. Additionally, rapid darkening of the sky, lightning and gusts of wind may indicate an impending thunderstorm.

Response

- If a colleague or customer is struck by lightning, provide first aid immediately if you are trained to do so and perform resuscitation if the person is not breathing.

On a transit vehicle

- Stay inside the vehicle.
- Pull the vehicle to the shoulder and set the hazard lights to flash.
- Keep the interior lights on to enable locating by crews and emergency responders.

In a transit center

- Consider all downed power lines as dangerous and deadly. Report the incident immediately.
- Do not touch/handle electrical equipment and telephones.
- Avoid using sinks and water faucets as the water and metal pipes might be transmitting electricity.

Contact

Call 9-1-1 immediately to report downed power lines and damaged property, including fires. Coordinate with the Preparedness Team as needed to respond to stranded vehicles/passengers/employees.

Prepare for power outage by locating the following:

- Flashlights
- Battery operated radio
- Batteries

Floods

Floods are the most common natural disasters in the United States and cause damages worth $1 billion annually. Floods can be caused by streams and rivers saturated by rainfall, broken dams, levees and water mains. They occur either as flash floods or develop slowly.

Likelihood

Medium

Severity

High

Identification

Watch for water covering roadways. Rising waters may also threaten buildings, sidewalks, or other facilities.

Response

- Stay out of the water.
- Do not attempt to swim through flood waters and wait for the water to recede or to be rescued.

On a transit vehicle

- Do not drive into flooded areas. Many vehicles will float in one foot of water; two feet of water will wash away almost all vehicles.
- Be aware of areas prone to sudden flooding such as streams, canyons and drainage channels.
- If there is a possibility of flash flooding, move to higher ground and only use community evacuation routes recommended by local authorities.
- Abandon vehicle and move to higher ground if flood waters begin to rise around your vehicle.
- Recognize areas of receding flood water to indicate possibly weakened roads.

At a shelter/stop

- Watch for areas of high water; do not drive into flooded areas.
- Attempt to turn off electricity at the breaker only before water enters the facility.
- Move emergency supplies and valuables to high interior areas of the facility.

Preventing Death

Most deaths during floods occur from people driving or walking through flood waters.

In an office or maintenance facility

- Attempt to turn off electricity at the breaker only before water enters the facility.
- Move emergency supplies and valuables to high interior areas of the facility.

At home

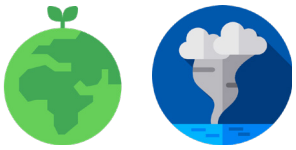
- Be aware of flood risks in your neighborhood,
- Make sure flood alarms and sump pumps are working.
- Prepare a disaster kit.
- Have an emergency response plan and prepare for potential evacuations.
- If you are trapped, wait for the water to recede or to be rescued.

Contact

Call 9-1-1 immediately to report downed power lines and damaged roads/rails. Coordinate with the Preparedness Team as needed to respond to stranded vehicles/passengers/employees.

Facility Evacuation Checklist

- [ ] Biological and environmental hazards such as raw sewage, gasoline, oil and other hazardous chemicals.
- [ ] Downed power lines.
- [ ] Strong currents.
- [ ] Submerged debris.



Tornadoes

Tornadoes are funnel-shaped clouds that rotate and extend to the ground. They are formed from powerful thunderstorms and may reach speeds of up to 250 mph.

Likelihood

Low

Severity

High

Identification

Tornado watches are issued when there is a possibility of tornadoes or when they have been sighted.

Response

- Move to a designated place of safety once a tornado watch has been issued.
- Shield yourself from flying debris by crouching under sturdy furniture and/or wrapping yourself in a blanket or thick clothing.
- Lookout for downed wires after the storm.

On a transit vehicle

- Seek shelter in a nearby building and do not try to outrun a tornado.
- If not in an urban/congested area, drive at a right angle away from the tornado's path.
- In case a tornado is unavoidable, get your passengers and yourself to lie flat in a nearby depression such as a culvert, ravine or ditch. Make sure everyone has their head protected.

In a transit center/office/maintenance facility/ shelter/shop

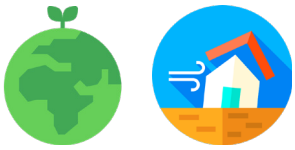
- Move to pre-designated shelter areas.
- If a shelter area is unavailable or you are in a mobile structure, move to an interior room and seek shelter under sturdy furniture or stairways.
- Keep away from windows and do not open them.
- Move away from large open areas such as cafeterias, auditoriums or shopping centers.

At home (when relevant)

- Seek shelter in the basement area for the duration of the tornado.
- If a basement isn't available/accessible, move to an interior room and seek shelter under sturdy furniture or stairways.

Contact

Call 9-1-1 immediately to report damaged property, fires and downed power lines. Coordinate with the Preparedness Team as needed to respond to stranded vehicles/passengers/employees.



Hurricanes

Hurricanes are a type of tropical cyclone and are classified into five categories, with Categories three (3) and higher being considered major hurricanes. They may carry winds that exceed 155 mph causing major damage to coastlines and inland regions, possibly resulting in severe flooding.

Likelihood

Low

Severity

High

Identification

A Hurricane Watch is issued 24-36 hours prior when there is a threat of hurricane conditions and a Hurricane Warning is issued when hurricane conditions are expected in 24 hours or less.

Response

On a transit vehicle

- Familiarize yourself with community evacuation routes and procedures.
- Avoid coastal areas, riverbanks and streams.
- Beware of weakened road infrastructure while operating your vehicle.
- Do not drive or operate on flooded or barricaded bridges and roads.
- Do not walk through flowing water and stay away from downed power lines.

In a transit center/office/maintenance facility

- Follow flooding guidelines if flooding occurs.
- Follow tornado guidelines if excessive high winds persist.
- Stay inside the vehicle and away from glass doors, windows and skylights.
- Do not use elevators.
- Turn off/unplug electrical devices when power is lost to prevent power surge when power is restored.
- Check tie-downs and evacuate immediately if in a mobile structure.

At home

- Follow mandatory evacuation orders and procedures.

Contact

Call 9-1-1 immediately to report damaged property, fires and downed power lines. Coordinate with the Preparedness Team as needed to respond to stranded vehicles/passengers/employees.

Facility Evacuation Checklist

- [ ] Unplug electrical devices
- [ ] Turn off appropriate utilities
- [ ] Collect emergency supplies, extra clothing and blankets
- [ ] Lock up facility

Earthquakes

Earthquakes are caused by the breaking and shifting of rocks beneath the earth's surface. They may lead to collapsing of bridges and buildings and may result in landslides, flooding, explosions and fires. Aftershocks may occur hours, days, weeks or even months after the earthquakes causing more damage and bringing down weakened structures.

Likelihood

Low

Severity

Medium

Identification

Tremors causing shaking of the ground and building floors accompanied by shaking/moving of furniture and possible falling objects.

Response:

- Prepare for aftershocks.
- Move away from buildings, streetlights and utility wires when outside.

On a transit vehicle

- Stay inside the vehicle.
- Move away from overhead structures such as bridges and flyovers.

In a transit center/office/maintenance facility/home

- Stay inside.
- Seek cover under a piece of heavy furniture, in a doorway or against a wall.
- Do not try to leave the building as falling objects may injure you.
- Help injured or trapped persons after the tremors subside.

Contact

Call 9-1-1 immediately to report damaged property, fires and downed power lines. Coordinate with the Preparedness Team as needed to respond to stranded vehicles/passengers/employees.

Forest & Brush Fires

Wildfires affect more than 6,000,000 acres of forest and brushland across the United States each year. Fires are part of the natural life cycle for many habitats, but pose a hazard to human health and safety and a threat to property. Drought conditions, low humidity, and high winds can increase the likelihood and intensity of wildfires. Forest or brush fires can spread rapidly, be difficult to contain, and persist for extended periods of time.

Likelihood

Medium

Severity

High

Identification

Identification: Flames, smoke, or haze may indicate an active forest or brush fire, depending on the size of the fire and the distance.

Response:

- Immediately evacuate or avoid the area.
- If you see a fire, report it as soon as you safely can.
- Follow the instructions of emergency responders upon their arrival.
- If a fire is active in the area, stay alert for changing conditions.
- Communicate facility closures and route or service changes to riders as soon as possible.

On a transit center

- If safe, close windows and doors.
- Assist in evacuation.

In an office or maintenance facility

- If safe, close windows and doors.
- Shut off, operate, or limit building mechanical systems as required to control hazards.

Wildfire Prevention

If you must pull a vehicle off the road, avoid dry vegetation. Vehicle maintenance and proper handling of equipment also reduces the risk of fire.

At home

- Evacuate as directed if your home is threatened.
- Be alert for conditions that may affect your household (transportation changes, school closures, etc.)

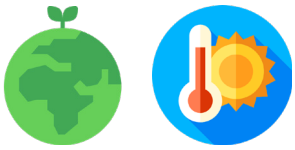
Contact

Call 9-1-1 to report a fire. Coordinate with the Preparedness Team as needed to respond to fire conditions.

Reporting a Fire

If you see a fire, report it as soon as possible. Be prepared to give first responders as much information as possible regarding:

- Fire location
- Source of the fire
- Size of the fire
- Whether lives or properties are threatened
- How quickly the fire is spreading
- Color of the smoke



Extreme Heat

Extreme heat poses a threat to those who work outdoors, older adults, people with chronic health conditions, and others. Extreme heat may amplify ground-level air pollution, exacerbating respiratory conditions. The changing climate is expected to result in increased frequency and severity of heat events. During extreme heat events, transit ridership tends to decrease as people choose to avoid waiting for buses in the heat. GoRaleigh can support transit-dependent riders by maintaining service frequency and reliability and providing shaded stops and comfortable shelters.

Likelihood

Low

Severity

Low

Identification

Extreme heat occurs during periods of high heat and humidity. Temperatures above 90 degrees persisting for at least two to three days are considered extreme heat.

Response

- Stay indoors in air-conditioned spaces as much as possible.
- Drink plenty of water and stay well-hydrated.
- Dress in loose-fitting, lightweight clothing that covers as much skin as possible. Avoid dark colors.
- Take frequent breaks if doing strenuous work or exercise; and limit strenuous activity during the heat of the day.
- Wear sunscreen.
- Watch for signs of heat-related illness in yourself and others and seek medical help if needed.
- Use air conditioning when available

At home

- Make sure children, elderly, or other at-risk individuals have access to a cool place.
- Keep pets indoors during the heat of the day and provide plenty of water.

Best Practices

Some transit agencies provide free rides to cooling centers during extreme heat events. In some cases, transit centers or air-conditioned transit vehicles may provide refuge to individuals seeking relief from the heat.

Health Hazards

Health hazards threaten the lives and well-being of customers and employees. GoRaleigh provides daily access to the places our customers need to go to support their overall well-being and must be prepared to support them in times of crisis.

Disease/ Pandemic

Medical Emergency

Disease/Pandemic

Infectious disease outbreaks, whether a seasonal flu or a global pandemic, pose a risk to GoRaleigh employees and customers. Transit brings together a large number of diverse people in close proximity, increasing the risk of transmitting infection.

Likelihood

Medium

Severity

Medium

Identification

Local health officials can provide information about infectious diseases circulating in the area.

Response

- If you are sick, stay at home.
- Wash your hands frequently and use hand sanitizer when soap and water are not available.
- Cover coughs and sneezes.
- Wear a mask or other personal protective equipment (PPE) when recommended.
- Routinely clean surfaces that have frequent hand contact.
- Get vaccinated for seasonal flu or other infectious diseases.
- Service may be suspended or altered, and vehicle capacities may be reduced when contagions pose a safety concern in the community.
- Daily wellness checks for employees may be recommended.

On a transit vehicle

- Follow public health protocols such as rear-door entry when recommended.
- Follow physical distancing and sanitization recommendations.

At home

- When possible, have backup caregiving plans for children or other dependents.
- Be prepared for mandatory quarantines.

Best Practices

Follow CDC and local health guidelines to stop the spread of disease. Guidelines may vary depending on the specific risk.

Medical Emergency

A medical emergency occurs when there is an immediate risk to someone's life or long-term health. A medical emergency can occur at any time and may affect anyone, including your customers, coworkers, or yourself.

Likelihood

Medium

Severity

High

Identification

Response

- Stay calm.
- Call 9-1-1 for assistance.
- Notify GoRaleigh General Manager, Director of Operations, Director of Maintenance, and Safety Manager.
- Administer first aid if you are trained to do so.

On a transit vehicle

- Safely pull out of traffic.
- Provide assistance if possible.
- Wait for first responders.

At a shelter/stop

- Provide assistance if possible.
- Wait for first responders.

In a transit center

- If possible, limit crowding around the person. Direct others to give the affected person some space or help the person to a more comfortable place to wait for assistance if they are able to safely move.

In an office or maintenance facility

- If possible, limit crowding around the person.
- If necessary, make sure there is a clear path for first responders.

Contact Information:

Call 9-1-1 for assistance.

Notify

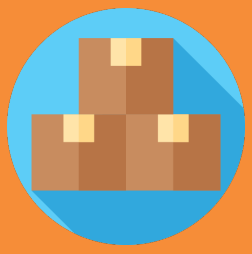
- General Manager: 919-795-0957
- Director of Operations: 919-576-3393
- Director of Maintenance: 984-289-2344
- Safety Manager: 919-745-0451

Human-Involved Events

Some of the most common hazards encountered in the transit environment are the result of human behavior. Complaints, arguments, and unruly behavior are hazards that transit employees may face on a daily basis. Knowing how to respond to human-involved incidents can prepare you to protect yourself, your coworkers, and your customers.

The following section provides guidance on how to respond to the following human-involved events:

Suspicious Activities



Suspicious Objects/ Substances

Threats

De-escalating Disruptive Events

Active Shooter Events

Suspicious Activities

Suspicious Activities refers to intentional acts and situations caused or created by people. They can range from small-scale situations such as vandalism or theft that are aimed at individuals or small groups to bomb threats and other terrorist activities.

Likelihood

Low

Severity

Medium

Identification

Watch for actions that appear strange, inconsistent, or out of the ordinary for your work environment. To identify suspicious behaviors pay attention to:

- Location (restricted areas, hiding, loitering in an area you would not expect to see people waiting
- Time of day (late at night, off hours, or behaving unusually during busy periods)
- Activity (behaviors that do not fit the setting, taking notes, watching)

Response

- Observe and report people and activities that are out of place and out of the ordinary.
- Trust your instincts and experience in determining suspicious activities.
- Report information to the control center and maintain communication with customers.
- If a person is in a restricted area, ask for an ID and try to escort the person out of the area.
- Do not approach a person who is threatening or dangerous.
- Do not attempt to hold or detain a person.
- Make note of license plates, direction of travel, personal characteristics and clothing of the person.

Contact

Call 9-1-1 immediately to report suspicious activity. Coordinate with the Preparedness Team as needed to respond to the situation.

Practice Prevention

- Follow policies and procedures
- Report security weaknesses
- Practice good housekeeping
- Inspect vehicles regularly

Human Trafficking Prevention

Transit agencies are among the front lines in the effort to end human trafficking. Suspicious activities include signs of human trafficking - be alert for signs of control or vulnerability, recruitment behaviors. or indications that a person is involved in commercial sex. The Transit on the Lookout to Combat Human Trafficking toolkit identifies the following red flags to watch for:

- Anyone offering to exchange sex for money, goods, or services, especially if they appear to be a minor
- Anyone acknowledging having a pimp or needing to make a quota
- Minors traveling without adult supervision
- Passengers who are not allowed to speak for themselves or make eye contact
- Passengers with bruising, branding, or other physical trauma
- Passengers who look dirty and disheveled, or seem confused, panicked, or afraid
- Passengers whose tickets, money, identification documents, or phone are being controlled by another person
- Cars that are frequently at the transit center or terminal but no one gets out to board a bus
- People in the transit center or terminal who regularly approach people who look vulnerable

National Human Trafficking Hotline: 1-888-373-7888

Suspicious Objects/Substances

Suspicious Objects/Substances may refer to unattended packages, leaking objects and unusual materials and may be determined by persons or animals exhibiting signs of exposure.

Likelihood

Low

Severity

High

Identification

Unattended packages and suspicious objects or substances

- Object - If the object is hidden or out in the open and if it is leaking, has notes attached or has wires exposed
- Substance - If there are unusual materials present (fine powder, residue, fog, mist, oily liquid or odor) and/or people or animals are exhibiting unusual symptoms (coughing, choking, vomiting, fainting, unconsciousness)

Response

- Observe and report things that are out of place and out of the ordinary.
- Unattended packages may represent a potential threat and need to be dealt with systematically.
- Look out for symptoms of exposure by potential victims to colorless and odorless chemical agents and visible chemical, biological and radiological agents (CBR).
- Report information to the control center and maintain communication with customers.
- Avoid the usage of cell phones or radios within 300 ft. of an incident involving suspected explosives or explosive devices.
- If suspicious substances are found, isolate, secure and evacuate the area. Move people uphill and upwind from the substance and attempt to shut down the HVAC system.

Contact

Call 9-1-1 immediately to report suspicious activity. Coordinate with the Preparedness Team as needed to respond to the situation.

Information Gathering and Reporting

- Location and type of threat/incident
- Safe Access and Exit Routes
- Weather Conditions
- Passenger information
- Suspicious Activities/Objects/Substances

Threats

Transit systems may receive threats by phone or written threats. Bomb threats are the most likely, but not the only type of threat received by transit agencies. All threats should be considered sincere. Follow the phone and written threat response protocols during an occurrence.

Likelihood

Medium

Severity

Medium

Identification

Telephone threats are the most common type of threat and may be placed by the person who placed the device, a person who has knowledge of who placed the device, or a caller who wants to disrupt system operations. Written threats may come by mail, email, or other means. They are generally more difficult to trace than threats received by phone.

Response

Phone Threat

- Remain as calm and attentive as possible.
- Pay attention to every detail of the caller's voice and any background noise.
- Try to keep the caller on the line as long as possible, Questions to ask the caller are noted in the callout to the right.
- As soon as the call is terminated, write down the exact wording of the threat. Note the time the call was received and the phone number or extension used to answer. Use the form in Appendix C to note details.
- Contact local law enforcement.
- If circumstances, such as time constraints dictate, initiate an orderly evacuation and then contact local law enforcement.

Written Threat

- Pay attention to details of how the threat was received and retain any information (keep the envelope or anything else connected to the threat).
- Contact local law enforcement.
- If circumstances, such as time constraints dictate, initiate an orderly evacuation and then contact local law enforcement.

Contact Information

Call 9-1-1

Receiving a Bomb Threat by Phone

Questions to ask the caller

- What is your name and phone number?
- Where is the bomb (building address, room, etc.)?
- What does the bomb look like?
- When will it explode?
- What kind of bomb is it?
- Why was the bomb planted?

De-Escalating Disruptive Events

Disruptive events occur when something happens that prevents or disturbs normal operations. For transit systems, this is often disruptive behavior on the part of customers or conflict between customers and/or employees. Such situations can quickly escalate into serious confrontations or even assaults if not handled well.

Likelihood

High

Severity

Low

Identification

Disruptive events can result from a variety of situations. Customers may dislike being asked to do or not to do something. Unrelated conflicts may be brought into the transit experience. Most confrontations start small, but can escalate rapidly into unruly or even violent behavior.

Response

- Treat others with dignity, respect, and kindness. Conflicts can result from emotional stress or medical conditions including dementia, mental illness, or substance abuse.
- Stay calm and in control of your emotions.
- Lower your voice and slow your speech in tense situations. Be friendly and confident.
- Explain policies clearly and consistency.
- Stay vigilant and aware of your surroundings. Be prepared in case the situation escalates.

On a transit vehicle

- Discreetly contact the dispatcher (panic button or emergency code) to alert that assistance is needed. In some situations, it may be necessary to dial 9-1-1 and leave the line open.
- If in route, pull over to a safe area and open the door.
- Never trap an out-of-control person. Don't close the door if a passenger seems dangerous.
- Stay in place with the door open, allowing other passengers to exit. Announce a mechanical problem if necessary.

At a shelter/stop

- Discreetly contact the dispatcher (panic button or emergency code) to alert that assistance is needed. In some situations, it may be necessary to dial 9-1-1 and leave the line open.
- Stay in place with the door open, allowing other passengers to exit. Announce a mechanical problem if necessary.

In a transit center

- Discreetly request assistance if needed. In some situations, it may be necessary to dial 9-1-1 and leave the line open.
- Give the person space and be sure not to block or corner them.

In an office or maintenance facility

- Discreetly request assistance if needed. In some situations, it may be necessary to dial 9-1-1 and leave the line open.
- Give the person space and be sure not to block or corner them.

Contact Information

Call 9-1-1

Strategies to De-Escalate a Conflict

- Listen. Show that you are actively listening to what the person is saying.
- Show concern. Place the issue on higher ground, such as showing that you are concerned about their safety and the safety of others.
- Find something to agree on. Redirect the conversation away from the negative.
- Offer an explanation. Give them a reason for the policy or guideline.
- Offer a solution. Show that you are willing to work to solve the problem.
- Divert attention. Refocus the attention on something else.
- Try a compliment. A complement can refocus the conversation or shift it in a positive direction.
- Ask a question. Ask if you are able to help or if there is something the person needs.
- Pick your battles. Sometimes letting it go is the best response.
- Give them an option. Present a positive and negative option and allow them to decide.

Source: Adapted from Transit Manager's Toolkit 2020 Update

Active Shooter Events

Active Shooter Events occur when an individual actively attempts to keep people in a confined and populated area.

Likelihood

Low

Severity

High

Identification

Active shooter events are generally unpredictable and happen quickly. In some cases, an active shooter event may be preceded by suspicious behavior or evolve from other events; however, such events can also occur with no warning.

Response

Phone Threat

- Before an event occurs, monitor your work area and report any suspicious activities or security concerns.
- DO NOT confront the attacker.
- Notify dispatch, the preparedness team, or call 9-1-1 as soon as you can safely do so.
- Assess your safety and that of uninjured customers.
- Look for safe routes to escape or evacuate if possible. Run or hide.
- Take note of information to provide to emergency responders, such as:
  - Number of shooters if more than one,
  - Location of the shooter(s) or direction they went following the attack
  - Description of the shooter(s)
  - Number and type(s) of weapons
- Follow instructions from emergency responders or the preparedness team.

Contact Information

Contact dispatch, a supervisor, or the preparedness team as soon as you can safely do so. Call 9-1-1 if possible.

Active Shooter Response

1. RUN If you can safely get to as escape path, get away as quickly as possible.
2. HIDE If you can't get away, find a secure place to hide. Try to get as far from the threat as possible and find barriers to prevent or slow the shooter from getting to you.
3. FIGHT As a last resort, yell, throw things, fight back and attempt to survive by any means necessary.

Adapted from The University of Texas at Austin Emergency Preparedness Active Shooter Response Guide.

Technology or Mechanical Events

Hazards may arise when the technology or equipment we rely on to do our work is damaged. Even well-maintained equipment occasionally malfunctions, and even the most cautious driver can be involved in a crash. Preventing such incidents is always a priority, but it is still important for employees to be prepared to respond if an event occurs.

The following section provides guidance on how to respond to the following technology or mechanical events:

Fires

Power Outages

Hazardous Materials

Cyber Security

Vehicle Incidents

Explosions

Fires

Fires spread rapidly and cause deaths due to asphyxiation from heat and smoke. Annually, there are 1.5 million fires nationwide killing approximately 4,000 Americans.

Likelihood

Low

Severity

High

Identification

A small or a large blaze emitting smoke and heat.

Response

- Report the fire as soon as you safely can.
- Do not attempt to re-enter a building or a vehicle on fire or that filled with smoke.
- Follow the instructions of emergency responders upon their arrival.

On a transit vehicle

- Immediately evacuate the vehicle, if possible. Ensure the passengers are at least 100 ft. away from a burning vehicle.
- Steer vehicle out of traffic and turn off engine after completely stopping.

In a transit center

- Close doors and windows to contain the fire, only if it is safe to do so.
- Immediately evacuate the area; assist others to evacuate if you are able to do so safely.
- Familiarize yourself with the location and working of a fire extinguisher.
- Only attempt to extinguish small fires if it is safe and the area has been evacuated. In most cases, it is best to leave the firefighting to trained responders.

In an office or maintenance facility

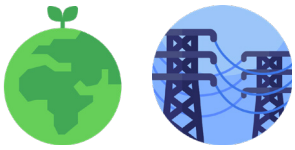
- Clear the area and close the door to the room with the fire.
- Inform others in the immediate area in a loud voice.
- Immediately evacuate the area.
- Familiarize yourself with the location and working of a fire extinguisher.
- Extinguish small fires if it is safe and only after evacuating the area. In most cases, it is best to leave the firefighting to trained responders. Never use a water-type extinguisher on an electrical fire.

At home

- Have a fire evacuation plan for your home and practice with all members of the household.
- Regularly test and replace batteries in smoke detectors.

Contact

Call 9-1-1 to report a fire. Coordinate with the Preparedness Team as needed to respond to fire conditions.



Power Outages

Power Outages result in the loss of heat, water and artificial light, sometimes for an extended period of time due to extreme weather conditions or other types of disasters. Most power outages resolve in a matter of hours and are not themselves emergencies.

Likelihood

Medium

Severity

Low

Identification

Loss of power, light, heat and water.

Response

- Keep at ready flashlights with fresh batteries or snap-activated glow sticks.
- Refrain from using candles, kerosene lamps and other open flames as light sources.
- Unplug electrical devices to protect from power surge when power is restored.

In a transit vehicle

- Be prepared to experience congestion and safety hazards due to traffic signal outages.

Contact

Call the Utility supplier after a prolonged power outage. Call 9-1-1 for immediate assistance because of a power outage induced emergency. Coordinate with the Preparedness Team if the cause is determined to be within the facility.

Electrical Grid Failure

Climate change may lead to more severe or prolonged extreme weather events. Such events can strain the electrical grid, leading to extended power outages and/or rolling blackouts. During extreme weather, reduce power usage when possible.

Hazardous Materials

Hazardous materials may include industrial chemicals, toxic substances and chemical, biological or radiological (CBR) weapons. Accidents or attacks involving these substances can have catastrophic effects and may require large scale evacuations.

Likelihood

Medium

Severity

High

Identification

You may observer the presence of a spill, a vapor cloud, objects containing hazardous materials or chemical warning labels, and sick or injured people showing symptoms of exposure.

Response

- Remain calm and be patient to avoid breathing heavily and inhaling more of the contaminate.
- Adhere to the advice of local emergency officials.
- Move away from the affected area to stay upwind, uphill and upstream to avoid or minimize exposure.
- Upon direct exposure to the contaminant, shed your clothes and rinse with cold water once safely away. Discard the contaminated clothes in a trash bag or seal-able container.
- Shield yourself from inhaling, ingesting, injecting or absorbing hazardous substances either by relocating away or seeking refuge in sealed structures such as buildings or vehicles.

On a transit vehicle

- Report the incident to dispatch or your supervisor; follow their instructions.
- Stop short or detour around suspected incidents or contaminated areas.
- Evacuate passengers and relocate them uphill and upwind if hazardous substances are discovered in the vehicle.
- Shelter-in-place from contaminated areas to reduce the risk of exposure to the hazard. Turn off HVAC and close the windows and doors.

In an office or maintenance facility/transit center/ shelter/shop

- Turn off the HVAC system if you cannot evacuate the area after the suspicion of hazardous materials outside the facility. Proceed to an interior room after closing and sealing all windows and doors.
- Evacuate and move away from the facility if hazardous materials are suspected inside. Move to higher floors if you are unable to evacuate.
- Do not turn on switches or light matches/candles

Contact

Call 9-1-1 immediately to report hazardous materials and fallout. Coordinate with the Preparedness Team as needed to respond to the situation.

Cybersecurity

Cyberattacks are growing in volume and complexity. Social engineering is used to target individuals beyond the realm of information technology, making cybersecurity a concern for all employees. Cyberattacks pose risk to information systems, personal information, and operation and include attacks to software, data, and physical hardware.

Likelihood

Medium

Severity

Medium

Identification

Cyberattacks and security risks can be difficult to identify and are constantly evolving. Attacks may target protected information, computer systems, or physical access to restricted areas. Many attacks appear legitimate and may even appear to come from trusted individuals. The best way to be sure you are not vulnerable to cyberattacks is to understand security policies and be alert to any requests for information that come in an unusual way or requests to deviate from normal practices.

Response

- Follow all security policies and practices.
- Participate in security training.
- Be alert for scams, phishing attempts, and other threats.
- Protect your personal information.

Vehicle Incident

Vehicle incidents include mechanical failures and collisions.

Likelihood

High

Severity

Medium

Identification

Any collision, injury, or mechanical failure involving a transit vehicle. GoRaleigh's focus is on preventing vehicle incidents whenever possible.

Response

- Notify Dispatch immediately.
- If there are any injuries
  - Call 9-1-1 for assistance
  - Administer first aid of you are trained to do so
  - Wait for first responders
- Operators must complete an Incident Report when relieved of driving duties on the same day a collision or injury occurs.

Preventing Vehicle Incidents

- Inspect the vehicle before starting a trip. Make sure all equipment is in good working condition and safe to operate.
- Strictly adhere to all traffic rules and regulations.
- Be alert for unsafe actions or errors from other drivers.
- Adapt driving techniques to hazards and changing conditions.
- Take no chances.
- Be confident in your defensive driving abilities.

-Identify visibility impairments that should be addressed.

Explosions

Explosions may be caused by intentionally placed bombs, gas leaks and electrical malfunctions. Bombs may be fatal at the point of explosion and surrounding areas due to heat, pressure, shrapnel and other flying objects. They may also cause damages to buildings, weakening or destroying structures and turning utilities into hazards.

Likelihood

Medium

Severity

High

Identification

You may see a bright flash or hear a loud bang from the explosion.

Response

- Take cover from immediately impending or occurring explosions by hiding behind solid objects to protect yourself from shrapnel and projectiles.
- Move and stay away from the affected area.
- Be aware of the possibility of secondary explosions.

On a transit vehicle

- Stay inside the vehicle.
- Contact your supervisor/control center to report the incident and maintain communication for further instructions.
- Avoid overpasses, bridges, power lines and other hazards if the explosion has affected their stability.
- Pull over and set the parking brake if the incident makes it difficult to control the vehicle.

At a shelter/stop/transit center/office/maintenance facility

- Call 9-1-1 if Emergency Medical Services are needed.
- Administer first aid if qualified to do so.
- Move the seriously injured only if there is an imminent danger of further injury.
- Inspect the facility for damages and other environmental hazards.

At home

- Make your way out and away from the house, if possible.
- Move away from utility lines

Contact

Call 9-1-1 immediately to report explosions, damages and fires. Coordinate with the Preparedness Team as needed to assist the injured.

If You are Trapped

- Remain calm and wait to be rescued
- Remain still to prevent further injury
- Speak less to avoid inhaling dust
- Make your presence known to the rescuers by tapping something

Environmental Hazards that May Result from an Explosion

- Downed wires
- Leaking gas
- Chemical spills
- Fires

Appendix A: Definitions

Accident: An event that involves any of the following: a loss of life; a report of a serious injury to a person; a collision of public transportation vehicles; a runaway train; an evacuation for life safety reasons; or any derailment of a rail transit vehicle, at any location, at any time, whatever the cause.

Accountable Executive: A single, identifiable person who has ultimate responsibility for carrying out the Public Transportation Agency Safety Plan of a public transportation agency; responsibility for carrying out the agency's Transit Asset Management Plan; and control or direction over the human and capital resources needed to develop and maintain both the agency's Public Transportation Safety Plan, in accordance with 49 U.S.C. 5329(d), and the agency's Transit Asset Management Plan in accordance with 49 U.S.C. 5326.

Agency Safety Plan: The documented comprehensive agency safety plan for a transit agency that is required by 49 U.S.C. 5929 and Part 673.

Chief Safety Officer: An adequately trained individual who has responsibility for safety and reports directly to a transit agency's chief executive officer, general manager, president, or equivalent officer. A Chief Safety Officer may not serve in other operational or maintenance capacities, unless the Chief Safety Officer is employed by a transit agency that is a small public transportation provider as defined in Part 673, or a public transportation provider that does not operate a rail fixed guideway public transportation system.

Disaster: A disaster is a large-scale adverse event. The Stafford Act defines a federally declared major disaster as "any natural catastrophe..., or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby."

Emergency: An emergency can be any adverse event. It can be defined as an event that can be handled with existing community resources. The Stafford Act defines a federally declared emergency as "any occasion or instance for which, in the determination of the President, Federal assistance is needed to supplement State and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophy in any part of the United States."

Event: Any accident, incident, or occurrence.

Hazard: Any real or potential condition that can cause injury, illness, or death; damage to or loss of the facilities, equipment, rolling stock, or infrastructure of a public transportation system; or damage to the environment.

Incident: An event that involves any of the following: A personal injury that is not a serious injury; one or more injuries requiring medical transport; or damage to facilities, equipment, rolling stock, or infrastructure that disrupts the operations of a transit agency.

Investigation: The process of determining the causal and contributing factors of an accident, incident, or hazard for the purpose of preventing recurrence and mitigating risk.

National Public Transportation Safety Plan: The plan to improve the safety of all public transportation systems that receive Federal financial assistance under 49 U.S.C. Chapter 53.

Occurrence: A term used to capture all events which have or could have significance in the context of safety, ranging from serious incidents to those with lesser severity.

Operator of a Public Transportation System: A provider of public transportation as defined under 49 U.S.C. 5302(14).

Performance Measure: An expression based on a quantifiable indicator of performance or condition that is used to establish targets and to assess progress toward meeting the established targets.

Performance Target: A quantifiable level of performance or condition, expressed as a value for the measure, to be achieved within a time period required by the FTA.

Risk: The composite of predicted severity and likelihood of the potential effect of a hazard.

Risk Mitigation: A method or methods to eliminate or reduce the effects of hazards.

Safety Assurance: Processes within a transit agency's Safety Management System that functions to ensure the implementation and effectiveness of safety risk mitigation, and to ensure that the transit agency meets or exceeds its safety objectives through the collection, analysis, and assessment of information.

Safety Management Policy: A transit agency's documented commitment to safety, which defines the transit agency's safety objectives and the accountabilities and responsibilities of its employees in regard to safety.

Safety Performance Target: A performance target related to safety management activities.

Safety Promotion: A combination of training and communication of safety information to support SMS as applied to the transit agency's public transportation system.

Safety Risk Assessment: Means the formal activity whereby a transit agency determines Safety Risk Management priorities by establishing the significance or value of its safety risks.

Safety Risk Management (SRM): A process within a transit agency's Agency Safety Plan for identifying hazards and analyzing, assessing, and mitigating safety risk.

Transit Agency: An operator of a public transportation system.

Appendix B: Abbreviations and Acronyms

AAE - Accountable Executive

BRT - Bus Rapid Transit

CAMPO - Capital Area Metropolitan Planning Organization

CBR - Chemical, biological, or radiological

CDC - Centers for Disease Control and Prevention

CFR - Code of Federal Regulations

CPR - Cardiopulmonary resuscitation

CSO - Chief Safety Officer

FTA - Federal Transit Authority

HVAC - Heating, ventilation, and air conditioning

mph - Miles per hour

NOAA - National Oceanic and Atmospheric Administration

PTASP - Public Transportation Agency Safety Plan

SMS - Safety Management System

Appendix C: References and Resources

AC Transit. Public Transportation Agency Safety Plan. Alameda-Contra Costa Transit District, 13 May 2020, p. 39, https://www.actransit.org/sites/default/files/2021-03/PUBLIC%20TRANSPORTATION%20AGENCY%20SAFETY%20PLAN%20V1.0%20.pdf.

Adapting to Rising Tides. Transportation Vulnerability and Risk Assessment Pilot Project Technical Report. Adapting to Rising Tides. November 2011, pp 5-1 - 5-22. http://www.adaptingtorisingtides.org/wp-content/uploads/2015/04/RisingTides_TechnicalReport_sm.pdf

American Public Transportation Association. Transit Agency Emergency Management Program. American Public Transportation Association, 21 Feb. 2020, https://www.apta.com/wp-content/uploads/APTA-SS-SEM-S-014-20.pdf.

Brown, Donald E., and C. Donald Robinson. Development of Metrics to Evaluate Effectiveness of Emergency Response Operations. https://pdfs.semanticscholar.org/ebff/b669759e2bef47c474141a9c4fbd4d9dd50e.pdf. 10th International Command and Control Research and Technology Symposium.

Busing on the Lookout. Transit on the Lookout to Combat Human Trafficking. https://truckersagainsttrafficking.org/wp-content/uploads/2020/06/BOTLtoolkit_transit_FINAL.pdf

Capital Area Metropolitant Planning Organization. Transportation Performance Measures. https://www.campo-nc.us/programs-studies/transportation-performance-measures. Accessed Oct. 2021.

City of Raleigh. City of Raleigh, North Carolina Emergency Operations Plan. City of Raleigh, Aug. 2017.

City of Raleigh. City of Raleigh Inclement Weather Guidelines. City of Raleigh, 21 Mar. 2018.

Enid Public Transportation Authority. Infectious Pandemic Plan. Enid Public Transportation Authority, 13 Mar. 2020, https://www.enid.org/home/showdocument?id=16845.

Enterprise Cyber Security Working Group. Cybersecurity Considerations for Public Transit. American Public Transportation Association, 17 Oct. 2014, https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SS-ECS-RP-001-14-RP.pdf.

Federal Emergency Management Agency. Local Mitigation Planning Handbook. Handbook, Federal Emergency Management Agency, Mar. 2013, p. 162, https://www.fema.gov/sites/default/files/2020-06/fema-local-mitigation-planning-handbook_03-2013.pdf.

Federal Transit Administration. Immediate Actions for Transit Employees: Protecting Against Life-Threatening Emergencies. Federal Transit Administration, October, 2011. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/IA_Update_Final%281%29.pdf

Federal Transit Administration. National Public Transportation Safety Plan. Federal Transit Administration, January, 2017. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/National%20Public%20Transportation%20Safety%20Plan_1.pdf

Federal Transit Administration. Public Transportation Agency Safety Plan Template for Bus Transit. Federal Transit Administration, 9 Sept. 2019, transit.dot.gov/sites/fta.dot.gov/files/docs/regulations-and-programs/safety/public-transportation-agency-safety-program/117301/public-transportation-agency-safety-plan-template-bus-transit.pdf.

GoRaleigh. Let's GO Safety. GoRaleigh, 18 July 2018.

GoRaleigh. Emergency Preparedness for GoRaleigh Staff. GoRaleigh, 20 June 2018..

GoRaleigh. GoRaleigh Public Transportation Safety Plan. GoRaleigh, 2 Dec. 2020..

Intercity Transit. Public Transportation Agency Safety Plan. Intercity Transit, 16 Sep. 2020.

KFH Group, Inc. Transit Manager's Toolkit. National Rural Transit Assistance Program, 27 Oct. 2020, p. 219, https://irp.cdn-website.com/270961f6/files/uploaded/Transit_Manager%27s_Toolkit.pdf.

MV Raleigh. MV/Raleigh Active Shooter Plan. MV Transportation, July 2021.

National Fire News | National Interagency Fire Center. https://www.nifc.gov/fire-information/nfn.

National Transit Institute. Emergency Preparedness Guide for Transit Employees. Federal Transit Administration. n.d. transit.dot.gov/sites/fta.dot.gov/files/docs/Emergency%20Preparedness%20Guide%20for%20Transit%20Employees%20on%20the%20Job%20and%20at%20Home.pdf

Office of Budget and Policy, FTA, DOT. Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation . 0069, Federal Transit Administration, Aug. 2011, p. 128, transit.dot.gov/sites/fta.dot.gov/files/FTA_0001_-_Flooded_Bus_Barns_and_Buckled_Rails.pdf.

Office of Budget and Policy, FTA, DOT. Transit and Climate Change Adaptation: Synthesis of FTA-Funded Pilot Projects. 0069, Federal Transit Administration, Aug. 2014, p. 27, https://www7.fta.dot.gov/sites/fta.dot.gov/files/FTA_Report_No._0069.pdf.

Recognizing Medical Emergencies: MedlinePlus Medical Encyclopedia. https://medlineplus.gov/ency/article/001927.htm.

Triangle Regional Resilience Partnership. Resilience Assessment. Triangle J Council of Governments, 2018. https://www.tjcog.org/publications/triangle-regional-resilience-assessment

The University of Texas at Austin Emergency Preparedness. Active Shooter Response Guide. The University of Texas at Austin, 2022. https://preparedness.utexas.edu/safety/active-shooter-response-guide

Wake County. Wake County Multi-Jurisdictional Hazard Mitigation Plan. Wake County, 2015. https://s3.us-west-2.amazonaws.com/wakegov.com.if-us-west-2/prod/documents/2020-11/Wake_MJ_HMP_adopted_09152015.pdf Warning Signs and Symptoms of Heat-Related Illness | Natural Disasters and Severe Weather | CDC. 15 Apr. 2020, https://www.cdc.gov/disasters/extremeheat/warning.html.

Washington Metropolitan Area Transit Authority. WMATA Transit Agency Safety Plan 2020. Washington Metropolitan Area Transit Authority, 5 Nov. 2020.

POWER RESILIENCY FOR ELECTRIC FLEETS

A practical guide for addressing resiliency in transitioning fleets

James Di Filippo & Daniel Wilkins

April 2024

Environmental Defense Fund

POWER RESILIENCY FOR ELECTRIC FLEETS

A practical guide for addressing resiliency in transitioning fleets

Authors

James Di Filippo
Atlas Public Policy

Daniel Wilkins
Atlas Public Policy

Acknowledgments
This report was coordinated with and supported by the Environmental Defense Fund. We wish to thank Dakoury Godo-Solo, Casey Horan, Cole Jermyn, Pam MacDougall, Marilynn Marsh-Robinson, Jason Mathers, and Mike Zimmerman from the Environmental Defense Fund for extensive peer review and feedback. We would also like to thank Chris Faretta from San Diego Gas & Electric for providing their feedback and review. The findings and views in this publication reflect the data, analysis, and views of the primary author of the report, Atlas Public Policy.

Disclaimer
This report was made possible by funding from the Environmental Defense Fund. The analysis presented is that of the authors and does not necessarily reflect the views of the Environmental Defense Fund. The authors are grateful for the input of the contributors acknowledged above, but those contributions do not imply any endorsement of this report's content or conclusions. Any mistakes, errors, and omissions in this report are solely attributable to the authors.

Cover photo: iStock, Scharfsinn86

TABLE OF CONTENTS

EXECUTIVE SUMMARY

When fleets trade in gasoline or diesel vehicles for electric vehicle (EV) models, they are also trading traditional fuel suppliers for electric utilities. Fortunately, electric power systems in the United States are extremely reliable—utility customers enjoyed 99.9 percent uptime in 2021 [1]. Due to that reliability, most fleets will find they can switch to EVs with little need to address outage risk. However, in some cases (such as vehicles that provide emergency services), power outages may pose a large enough threat to their fleet operations that the risk of outages must be mitigated with planning and backup power systems.
EVs pose different challenges than fossil fuel systems, which are also vulnerable to disruption. These challenges include:

- More frequent and longer refueling sessions, increasing the impact of missing a refueling event or the need to fuel offsite.
- Considerably larger backup power systems than onsite fuel pumps require.

Many industries have long been critically reliant on electric power and thus there are established strategies and backup systems to mitigate the risk of outage. There are resources and industry experience fleets can pull from when assessing and deploying back-up power solutions. Fleets that determine backup power is right for them will find that existing solutions are available that can be adapted to meet their needs.

SOLUTIONS

Fleets have options to increase their resiliency to power disruptions without investing in costly backup power systems.

Increasing operational margins: Moderately oversizing vehicle batteries and charging equipment can provide an operating margin that can absorb the impact of a shortened or missed charging session.

Offsite charging: Unlike other equipment, vehicles can be moved to power. Fleets may be able to rotate vehicles to charge at unaffected facilities or charge at public chargers.

Increasing utility connection resiliency: Fleets may be able to request utilities build in additional redundancy to their grid connection, which can insulate fleets from local outages. Fleets that require additional resiliency, especially from long outages will likely require onsite backup power solutions such as:

Battery energy storage: Rechargeable batteries can store power from the grid or a solar array. Batteries are a flexible resource, which can provide value in non-emergencies and are eligible for incentives. However, they have high upfront costs and are less energy dense than stored fuel.

Solar photovoltaics: Solar energy generates clean energy from sunlight. It does not require any onsite fuel supply and can generate power indefinitely. Solar photovoltaics also provide electricity during non-emergencies and are eligible for incentives. However, because solar power only generates power in the day, it should be paired with batteries to store electricity for overnight charging.

Combustion generators: Backup power that runs on diesel, natural gas or propane has lower upfront costs and provides more power and stored energy capacity in a smaller footprint than batteries and storage. However, fossil-fueled generators emit both air pollution and greenhouse gases. They require fuel resupply in extended outages and much more maintenance than batteries and solar systems. Finally, they are not eligible for incentives or credits.

DECIDING ON SOLUTIONS

Fleets considering backup power solutions should engage in assessments of the risk of outage impacts, the costs of those impacts and the costs of solutions that can mitigate a given level of risk. However, fleets note that in-depth analysis is both technically challenging and suffers from data availability limitations.

Understanding outage impact risk: Outages will only have impacts on operations if they are at the right time and long enough to disrupt vehicle charging, meaning that fleets are most vulnerable to sustained outages during vehicle downtime. While shorter outages are common, long ones are rare, meaning that most fleets have a low risk of outages impacting their operations. However, risk can be higher in areas prone to causes of extended outages, such as public safety power shutoffs and hurricanes.

Understanding costs of impacts: Commercial fleet impact costs are similar to existing vehicle downtime costs, including lost revenue and idle labor time. For non-commercial fleets, costs might be expressed in terms of lost services. Fleets should adjust their estimates of cost by their individual outage impact risk.

Comparing costs and benefits: A backup power solution's resiliency value is the sum of the risk-adjusted costs that backup solution can help avoid. This value should be compared with system costs to determine whether a solution is financially feasible. Because outage risks are typically small, and solutions are expensive, many commercial fleets may find that implementation is not worth it. Alternatively, public service fleets may find even small chances at disruption of critical services to be intolerable, making back-up solutions necessary. Finally, solar and battery solutions offer additional revenue and cost savings opportunities which may help to render them financially viable.

IMPLEMENTING BACKUP POWER SOLUTIONS

If fleets decide to pursue a backup power solution they must plan, coordinate and address a number of practical concerns before deployment and during operation.

Assessing power and energy needs: Fleets must identify how much power and stored energy they need. This will include an assessment of what loads are critical and whether they can scale back vehicle operations. Armed with information on

power energy and needs, fleets can plan and size their backup systems accordingly.

Deploying systems: Many contractors offer planning, design and construction services for backup power systems. Fleets should find those with experience and good reputations.

Engaging utilities: Utilities are valuable sources of outage information and necessary partners for electrical infrastructure deployment, especially those that require grid interconnection such as solar and battery storage. Additionally, fleets that are participating in utility make-ready programs should discuss the implications of installing backup power in conjunction with those programs.

Permitting: Fleets should anticipate needing multiple permits to deploy backup power systems. Installation of a generator will require air quality permits in many jurisdictions.

Operations and maintenance: Fleets should regularly test backup systems to ensure that the system responds to outages, power is switched over successfully and that vehicles resume charging on backup power. All systems require regular service to ensure reliable operation and generators require a well-maintained fuel supply.

CONCLUSION

Powering fleets with electricity requires a paradigm shift in thinking about secure, resilient fuel supply. The U.S. electrical grid will offer exceptionally reliable fuel supplies for most fleets, allowing them to operate with minimal or manageable disruption. However, fleets (especially those in higher outage hazard areas) should develop an understanding of how outage risk might impact them, and whether a backup power solution is viable. Those fleets that do pursue a backup power solution should plan carefully, engage their utility and carefully test and maintain their systems to ensure they can be called upon when needed.

Key Terms

Term	Definition
Air Pollutant Emissions	Emissions that degrade air quality and harm human health.
Ancillary Value	Secondary benefits or services provided by a system besides its primary function.
Backup Power Systems	Equipment designed to provide electricity during a grid power outage.
Downtime Costs	Costs associated with the time equipment or systems are out of service.
Energy Arbitrage	The practice of buying electricity when it's cheap and selling or using it when it's more expensive.
Energy Density	The amount of energy stored in a system or region per unit of volume.
Greenhouse Gas (GHG) Emissions	Gases that trap heat in the atmosphere, contributing to the greenhouse effect and global warming.
Peak Shave	Reducing energy consumption during peak demand periods, often to save on costs.
Power Density	The amount of power (rate of energy flow) per unit volume.
Public Safety Power Shutoff (PSPS)	A safety measure where electricity is turned off during extreme weather conditions to prevent wildfires.

INTRODUCTION

Among the changes that fleets must navigate as they electrify their vehicles is ensuring a reliable supply of electricity. Much of the focus of planning for fleet electrification has been on securing an electrical service sufficient to power fleets. Fleets must also recognize that as electric utilities become the new fuel suppliers for fleets, power outages become fuel supply disruptions. While electric grids are very reliable overall, in some cases power outages may pose an intolerable risk to fleet operations. In those cases, resiliency planning, and backup power systems are necessary to ensure power (and thus fuel) supplies.

While fleet electrification is rapidly expanding, its relative newness means that there is limited experience developing power resiliency in a fleet context. However, in general, developing resiliency against power outages is not a new concept. Many other industries, from datacenters to hospitals to grocers, have long relied on backup power to mitigate risks to operations from loss of grid electricity. Many fleet operators may even be familiar with the backup power needs of their buildings. So, while electric vehicles (EVs) introduce some unique dimensions and challenges to the subject, fleet operators can learn from the extensive experience of other industries.

This report draws on lessons and best practices from established literature for resiliency and backup power, interviews with utilities and early fleet electrification practitioners, and subject matter expertise on fleet electrification. It provides fleet operators with context, background, decision-making tools, and practical implementation guidance. The report is focused on fleets that operate out of yards or depots, and where maintaining power supplies for charging fleet vehicles is the primary concern, though it has relevance for fleets housed at facilities with other onsite critical electric loads.

Challenges with electric fuel supply resilience

Developing electricity supply and EV fueling resilience is varied and complex.

- Compared to combustion vehicles, EVs generally have less built-in fuel (battery) capacity, and therefore need to be refueled more often, increasing the impact of missed fueling opportunities.
- EVs take longer to refuel than liquid fueled counterparts meaning that emergency fueling at an offsite location will take longer and thus have a larger

impact on operations compared to refueling diesel.

- Much larger alternative onsite power supplies are needed to provide the power needed for charging an EV than are needed to run fuel pumps.
- Compared to many other backup power needs, EVs have high power and energy demands.

While electric fueling brings challenges for fuel supply security, it also can have advantages. Onsite renewables paired with storage can provide fuel cost savings during normal operations in addition to their resilience value. Moreover, in the case of a severe disaster where fuel supply chain breakdowns may ground non-EVs, electrified fleets with onsite solar power may be able to support some operations with their locally generated power.

Risks to electricity supply

Overall, the electricity supply is quite reliable, with the average U.S. utility customer enjoying greater than 99.9 percent uptime in 2021. Average U.S. outage statistics, however, mask substantial variation in reliability by geography. An example of this variability can be found in Louisiana where utility customers experienced more than 10 times as many outage hours as the average American in 2021 due to the impacts of Hurricane Ida. While storms like Ida will not strike Louisiana every year, even their infrequent occurrence render Louisiana's grid less reliable on average over time. Similarly, anywhere with more exposure to extreme weather will have a less reliable grid on average. However, some locations had much more reliable electric service than the national average. Washington D.C. had the most reliable power in 2021 with the average customer there experiencing seven times fewer outage hours than the typical U.S. utility customer.

Power disruptions can arise due to several scenarios from the routine to the exceptional. They can last minutes, hours, or even days, and they may be easily foreseeable or completely unpredictable [1].

Local interruptions caused by equipment malfunction and accidents are frequent but unpredictable and are usually confined to a small area and repaired quickly [1].

Routine weather-related impacts caused by regular storms, lightning, and ice are more predictable in advance, but also may cause longer outages across wider areas. Routine seasonal variation in electricity demand can also cause temporary outages when peak demand exceeds system supply (i.e., on the hottest summer days of the year) [1].

Exceptional weather events such as hurricanes, tornados, floods, heatwaves, and blizzards usually come with advance warning, but have the potential to knock out power for days at a time as repair crews are overwhelmed by extensive damage. Additionally, fleets located in the U.S. West Coast might face preemptive public safety power shutoffs during high-fire hazard weather conditions [1].

Earthquakes and other non-weather disasters such as physical or cyberattacks on grid infrastructure may cause extended power outages without warning. Fortunately, these disasters are infrequent [2].

While some outage risk is present everywhere, weather-based and other disaster risk depends on location. For instance, fleets with operations in the hurricane-prone Southeastern United States, or high wildfire risk areas on the West Coast should more carefully consider how power loss may affect their operations. Fleets should also expect that some causes of sustained outages may also interrupt their own operations because of damaged road infrastructure, decreases in demand for

services, or other non-electricity supply related issues. This means that the need for backup power might be reduced in more extreme disaster scenarios.

Notably, current conditions are also not perfect indicators of future risks. When planning for the longer term, fleets should also consider the upward pressures on outage risks through climate change-related increases to the frequency and intensity of storms and heat impacts [2].

Planning for Power Resiliency

Developing power resiliency reduces risks that fleets will experience operational downtime due to power outages. However, completely eliminating risk is unlikely to be technically feasible or cost effective. The level of acceptable risk will differ from fleet to fleet. Emergency vehicle fleets are likely to tolerate very little risk of interrupted operations while non-emergency public service fleets are likely to have a higher threshold for risk. On the private side, some commercial fleets may decide that no special resiliency measures are warranted if they decide that the costs outweigh the likely loss in revenue from operational downtime. Regardless, all fleets should consider the risks that power interruptions pose to their fleet and plan for their response to outage events.

While fleets are mid-transition, having both electric and internal combustion vehicles in a fleet will soften the impact of outages. As operational improvements and policy and sustainability goals drive fleets towards full electrification, the need to address outage risk will increase. In many cases, resiliency may be an ancillary benefit that fleets should consider when planning onsite renewables and storage options that are primarily intended to reduce charging costs or overcome challenges with securing enough grid-supplied power.

The following sections of this report guides fleets along a pathway towards understanding:

a) What resiliency options exist and how they relate to fleet needs;

b) How to decide what solutions (if any) are economically justified and how to evaluate tradeoffs of different solutions; and

c) High-level guidance on how fleets should approach resiliency planning and implement solutions.

RESILIENCY SOLUTIONS AND MEASURES

For as long as businesses and organizations have relied on electrical power for critical operations, there has been a need for backup or emergency power supplies in case of grid failure. Backup generators were the only option for decades, but recently, backup power systems based on battery energy storage and onsite renewable generation have become more popular. As the upfront cost has fallen and the bill-saving attributes of distributed energy generation have become apparent, backup power users have increasingly adopted those solutions. Additionally, fuel-cell based energy storage systems have found use in some niche applications. Fleets looking to increase the resiliency of their power supply will consider the same set of solutions, though with specific considerations unique to fueling vehicles with electricity.

Power Resiliency and Electric Fleets

EV charging has different electrical usage patterns than most users that have traditionally pursued resiliency solutions. Many of those users—data centers, manufacturing facilities, and telecom hubs—have constant energy use patterns. In contrast, charging EVs typically involves shorter periods of high-power use while charging, followed by longer idle periods while vehicles are in operation or fully charged. This difference means that some lessons learned in more constant-load facilities like data centers might not directly apply to EV fleets. In addition, unlike data centers or manufacturing, where momentary power loss can cause data loss or equipment damage, EVs and charging equipment usually do not have such vulnerabilities.

Also, fleet charging usually occurs at night during post-operational hours which contrasts with most other power users that usually see their highest power demands during the day. Therefore, EV operations are likely to be more vulnerable to overnight outages, but more naturally resilient to daytime power loss. Understanding EV's unique consumption patterns and their implications is crucial for devising effective resiliency strategies. Some aspects of EV charging make them less impacted by short term outages. Though, just like other industries reliant on electric power (including diesel and gas fueling infrastructure), longer disruptions, such as those caused by extreme weather events or grid failures, will affect EV operations. Guarding against more prolonged outages will require resiliency solutions.

Resiliency Without Backup Power

Before considering backup power solutions, fleets should first consider how they can build resilience into their infrastructure and vehicle planning. Because EVs run off an internal battery, they have built in energy storage that can be used to increase short term resilience to power outages. For example, fleets can hedge against short outages that coincide with charging times by moderately oversizing charging infrastructure size relative to their typical energy recovery needs. This allows a vehicle to sufficiently charge even if a brief outage shortens its charging window. Fleets also may consider vehicles with slightly larger internal batteries, so that missing some or all of a single charging session will not completely knock them out of service.

Building in this flexibility provides resiliency value and provides greater general operational flexibility to recover from non-outage issues such as a charger failure, a missed charging session, or the occasional abnormally high mileage day. While increasing charger power and vehicle battery size is not free, moderate increases in either may prove to be a low-cost solution for eliminating risks from most short power outages while supporting greater operational flexibility. Of course, in cases where vehicles are operating at or near the edge of their capability, adding substantial flexibility will not be possible.

Additionally, because vehicles can travel beyond their depot or yard, there are opportunities to supply them with power elsewhere unlike the stationary power needs of buildings. Fleets with multiple nearby locations might be able to maintain operations (even if in a reduced capacity) by rotating fleet vehicles into a facility that has not lost power. Public fast charging infrastructure that can handle large vehicles is not yet common, but light-duty and smaller medium-duty vehicles may be able to charge at unaffected public fast charging locations. If possible, fleets should develop operational plans for offsite fueling in case of outage.

Utilities may offer fleets the ability to increase resiliency by building redundant grid connections such that if there is power loss on one feeder, the fleet location does not lose power. This will insulate fleets from incidental local power loss, and can provide increased resiliency in inclement weather, but only provides limited insulation from widespread, systemic outages or public safety power shutoffs. Additionally, building that redundancy comes with added costs that utilities pass on to their customers.

Backup Power Solutions

Developing resiliency to longer duration power outages will likely require onsite backup generation and/or energy storage solutions. Solutions vary in complexity and capability to supply power, but all share a basic set of required features:

- **A fuel source:** whether this is a tank of diesel, grid energy stored in a battery, or sunlight for a photovoltaic system, all backup power requires some sort of fuel.
- **A generator or power source:** such as a photovoltaic array, a fuel cell, or a battery system.
- **Isolation from the grid:** Whether through a subpanel with a transfer switch or a complex microgrid, backup power must be isolated from the grid to prevent harmful electrical backfeeding.

Unlike many other industries, fleets are unlikely to need standby power or uninterruptable power supplies because charging systems should easily recover from momentary power loss. However, automated switchover systems will be valuable because staff may not be present to switch over to off grid power during overnight outages when vehicles are

charging. The following is a list of backup power systems that may be suitable for fleet operations.

Battery Energy Storage typically uses rechargeable lithium-ion batteries to recharge vehicles at will. Battery systems have both power ratings (in kilowatts), which determine how much instantaneous power they provide and energy capacity ratings (in kilowatt-hours) that determine how much total electrical energy they can provide. Batteries come in a wide variety of power and energy ratings to meet differing fleet needs. Because batteries output direct current (DC) power, batteries need inverters to feed alternating current (AC) systems, which is typically used for EV charging below 20 kilowatts. Since high power charging takes DC power, fleets may find systems where batteries can directly power chargers to be a superior solution because it avoids the need to inefficiently convert power from DC to AC and back again.

Batteries do not generate their own power, so they must store power either from the grid or generated onsite and are often best paired with solar photovoltaics [3, 4]. Batteries can be used to reduce electricity bill costs outside of power loss events and are eligible for tax credits and incentives.

Solar Photovoltaics (usually called solar panels) generate power from solar energy. Vehicle chargers can be powered using just solar power. Since solar power is intermittent and only generates during the day, solar panels have limited resilience value for most fleets unless paired with battery energy storage. Batteries can store solar power and recharge vehicles overnight or augment solar output during daytime charging for a faster charge. Solar array capacity can be scaled by adding more panels as much as space and budgets permit.

Like batteries, solar arrays require an inverter. While solar panels can generate power any time the sun is up, solar power output varies greatly by direct sun exposure which depends on the season, time of day, and cloud cover [3]. Solar panels will generate useful energy throughout the year, offsetting electricity bills when not providing backup power. They also qualify for tax credits and other incentives.

Fuel Cells are a niche solution that converts a fuel (usually natural gas in backup power applications) to electricity through an electrochemical process. Fuel cells can be thought of

as almost a hybrid of a battery system and a generator. Like generators they convert fuel to electricity (rather than being charged by electricity), but the fuel cells themselves work like a battery outputting DC power [3]. Fuel cells may be eligible for incentives in some jurisdictions.

Combustion-based Generators (often simply called generators) that burn fuels such as diesel or natural gas are the most common solution for backup and temporary power needs. Generators are reliable and available in a wide range of power configurations to suit the large power loads caused by fleet charging. Bi-fuel or multifuel generators offer added fuel supply resiliency at the cost of higher prices premiums and reduced equipment reliability. Generators need onsite fuel storage or a gas line and will rely on fuel deliveries to cover extended outages—which may cause challenges if fuel supply chains are disrupted in a disaster scenario [5, 3]. In the short term, fleets transitioning from a diesel- or natural gas-powered fleet will have substantial experience with fuel logistics and may even have existing fuel storage facilities on site, though that expertise may diminish as fleets electrify.

Generators require consistent upkeep and emit GHG. Pollutants emitted by generators both pose a hazard to local air quality and present an acute risk to onsite personnel who are directly exposed to carbon

monoxide, nitric oxides and particulate matter which are linked to poor occupational health. Unlike other solutions in this list, combustion generators are usually ineligible for incentives and tax credits available for other solutions.

System Configuration and Microgrids

Backup power systems configurations can be quite simple, with just a single switch that transfers the critical load from the grid to a single backup system on grid outage. However, solutions that incorporate multiple generation or energy storage assets or work in concert with grid power (like solar and storage) require more complex solutions. Microgrid controllers manage, prioritize, and balance power sources and load connected to the system and control interaction with the grid. This added complexity increases design, equipment, and engineering costs but can provide substantial value over backup-only systems, particularly in the case of solar plus storage solutions where the system can provide cost savings during non-emergency operations.

Systems can also be built modularly, with added backup power assets added as more EVs are added to fleets and power and energy requirements increase. The value of as-needed upgrades should be weighed against the cost of repeated construction.

DECIDING ON SOLUTIONS

Deciding on and between different resiliency solutions is an exercise in evaluating criteria, assessing trade-offs, and examining the costs and benefits of solutions. Fleets should consider the tradeoffs and limitations of each solution, including their feasibility, challenges to deployment, and alignment with other goals such as environmental sustainability, availability of public funding, and reducing operating costs and barriers to EV deployment. Additionally, while vehicle downtime due to power loss can be costly and damaging, power resiliency solutions are also often expensive to implement. Therefore, fleets should analyze the economics of potential solutions to decide whether they provide sufficient value to justify their expense while also considering whether operational modifications can provide sufficient resiliency value to meet their needs. Fleets with different resiliency needs, power requirements, priorities, and economic conditions will likely come to different conclusions about which solutions (if any) are right for them.

Evaluating Backup Power Systems

Backup power systems each come with their own strengths and weaknesses that affect their effectiveness under different conditions, their cost, and their attractiveness to different fleets.

Costs

Backup power system costs vary in upfront cost of installation, operating cost, and maintenance and repair costs to ensure continuing reliability. In addition, costs scale with the amount of power output and energy storage that is needed, meaning that costs increase depending on the number of vehicles that need to be recharged and the number of recharge cycles that must be covered. Notably, battery energy storage system costs are much more dependent on energy storage needs than generators, because additional batteries are considerably more expensive than a larger fuel tank. In addition to varying by performance parameters, costs also vary by installation complexity, local labor costs, and other geographically defined cost factors. Table 1 provides a high-level summary of upfront, non-fuel operation costs for different systems assembled from national lab studies estimates. Readers should note that while generators are mature technologies with long-run stable prices, both solar power and battery energy storage systems are experiencing considerable

TABLE 1

Evaluating Backup Power Systems

Backup power systems each come with their own strengths and weaknesses that affect their effectiveness under different conditions, their cost, and their attractiveness to different fleets.

Diesel Generators	High fuel efficiency Lowest upfront cost High durability & longevity Widely available fuel Highest energy and power density	Highest GHG and air pollutant emissions Highest fuel cost High maintenance needs Subject to fuel disruption Permitting challenges Fire risk Noise impacts
Natural Gas Generators	Pipeline access to fuel Relatively low and stable fuel costs High energy and power density Fewer permitting issues Lower upfront costs	GHG and air pollutant emissions High maintenance needs Fire risk Lower fuel efficiency Subject to fuel disruption
Natural Gas Fuel Cells	Low maintenance Very reliable High energy density Minimal air pollutant emissions	GHG and other emissions Very high upfront cost Subject to fuel disruption Fire risk Lower power density
Battery Energy Storage System	High flexibility Provides non-emergency value Low and stable fuel costs Can be charged by onsite power Very reliable Low maintenance Eligible for incentives and tax credits	Low energy density High upfront costs Performance degrades over time Fire risk Requires electricity to refuel
Solar Power	No fuel costs or dependency No air pollutant or GHG emissions Provides non-emergency value Very reliable Low maintenance Eligible for incentives and tax credits	Intermittent power generation Needs energy storage to maximize resiliency value Low power density High upfront costs

year-over-year price declines as those technologies scale.

Funding Availability

Public funding is available that can significantly defray the upfront costs of solar and battery-based backup power systems. All fleets should be able to benefit from the investment tax credit contained in the Inflation Reduction Act of 2022 (IRA) that allows for an up to 30 percent tax credit for qualifying solar and energy storage projects [6]. Additionally, other state-based programs may provide added funding for battery storage systems. For example, a fleet located in California may be eligible for a $350 per kWh incentive through the Self-Generation Incentive Program (SGIP). Qualified fleets in low-income areas may be eligible for incentives up to $850 per kWh through the same program [7]. Some utilities also provide incentive programs for customers to install batteries such as Green Mountain Power's

TABLE 2

Example Average Costs for Backup Power Systems

System[a]	Upfront Costs	Non-fuel Annual Operating Costs	Fuel Costs
Diesel Generators	$800/kW [3]	$35/kW [3]	$0.27/kWh[c]
Natural Gas Generators	$1,000/kW [3]	$35/kW [3]	$0.10/kWh[d]
Solar Power	$1,630 – 1,840/kW [4]	$5-6/kW [4]	$0/kWh
Battery Energy Storage System	$392 – 493/kWh[b] [5]	$4-5/kWh [5]	$0-$0.13/kWh[e]

a. Due to its niche applications, backup power fuel cell system costs are not widely reported.
b. The relevant cost metric for battery storage systems is energy (kWh) rather than power (kW).
c. Based on $4 per gallon offroad diesel price.
d. Based on $10 per thousand cubic feet commercial gas price.
e. Lower end assumes onsite solar generation and upper end based on average commercial electricity cost.

Bring Your Own Device program that provides incentives up to $900 per kW. Fleets should identify whether they can benefit from these incentives or others available in their area and include them in their financial calculus when comparing to generator-based systems that will not be eligible for public funding.

Ability to Cover Outages

Fleets charging can result in very high power and energy demands compared to most typical building loads. Power demands in the high hundreds of kilowatts (kW) and even megawatts (MW) are not uncommon for larger fleets or those with heavy duty vehicles. Moreover, daily energy demand by fleet vehicles can easily top 20 megawatt-hours (MWh) for those same fleets. High energy demand and power demands are a concern for all backup power solutions but are most acutely challenging for solar and battery systems. Both solar and storage cost considerably more on a per-kWh and kW basis than competing solutions and have lower energy and power densities. This means that for any given system size, solar and storage solutions will be more expensive (upfront) and larger than alternatives that use diesel or natural gas.

Outside of cost, size can be a considerable constraint for fleets that already must trade valuable yard real-estate for charging equipment. For example, a five MWh battery system capable of outputting about 2.5 MW will take up about the same volume as a 20-foot shipping container. Solar systems have even larger footprints, with the average 1 MW solar array needing at least six acres of rooftop or ground space [8]. While some fleets may be co-located with large warehouses with sufficient unused rooftop space, many fleets will find it challenging to accommodate large solar arrays.

In comparison, a 2.5 MW diesel generator will be of comparable size to the five MWh / 2.5 MW battery described above. Because diesel fuel is far more energy dense than lithium-ion batteries, it will need just five percent of the volume of the battery system to power the generator and produce an equivalent amount of energy.

In addition to lower storage costs and space requirements, fuel supplies can also be augmented by fuel deliveries. In an extended

BOX 1

Example Fleet Vehicle Outage Exposure

For a simplified example, consider a delivery van that:

a) drives about 50 miles per day and has a range of about 80 miles
b) can recover about 7 miles of charge per hour on a dedicated L2 charger
c) has a 10-hour overnight charging window (8 pm to 6 am)

Assuming a full charge during the prior charging window, this van only needs to recharge 30 miles worth of range (about 5 hours) to be able to run the next day with a generous 20 percent safety margin. This example vehicle can withstand a 5-hour outage during its charging window with no impact on operations, making 5+ hour outages the threshold for impacts on this fleet vehicle.

disaster scenario fuel or natural gas supplies may be disrupted, making additional fuel expensive and difficult to obtain. Solar power is fueled by sunlight, meaning that a solar plus storage solution can continue to provide power almost indefinitely in an extended outage.

Environmental Concerns

Electrifying a fleet substantially reduces its environmental footprint, and fleets may wish to deploy other zero-emission technologies in their backup power generation system to further cut harmful emissions. Generators will produce both greenhouse gas and air pollutant emissions when running. Additionally, many jurisdictions require air permits for diesel and natural gas backup power generators, a challenge not faced by low or zero emissions options. Solar and storage solutions are by far the most environmentally advantageous because they provide clean power all year-round, including during outages. Fleets concerned about environmental impacts but unable to use solar and storage might wish to consider fuel cells but should expect to pay a large premium while still emitting greenhouse gases on site if using natural gas as a fuel.

Ancillary Value

Batteries and solar can provide substantial ancillary value and additional revenue streams during use in normal operations. Solar power can be used to reduce utility electricity costs, while batteries can peak shave, provide valuable grid services, and even perform energy arbitrage. Moreover, solar and battery storage solutions may also be able to augment grid power to the extent that fleets may avoid high costs to upgrade electrical service. In fact, it is likely that the value a solar plus storage system provides in normal operations will eclipse the resilience value of those assets (see Box 3), making resiliency the ancillary value in that equation [9]. Fleets should note that using batteries for grid services or peak shaving will reduce their average charged capacity, which reduces their value during an unexpected outage. When outages are predictably imminent, such in the case of a forecasted storm or public safety power shutoff, fleet operators can put battery systems into an energy conserving mode.

On the other hand, other generator types are generally only of use during a power outage. In most cases energy generated by generators is more expensive than utility provided energy. Moreover, most backup generators do not have emissions ratings that allow them to run in non-emergency situations and those that do are considerably more expensive.

Risk-Based Economic Analysis

Fleets deciding on whether or not to employ a resiliency solution, and if so, which solution to pursue, should put considerable focus on the risks of outage impacts, the cost of those impacts (in terms of lost revenue or impeded operations), and the cost of solutions that can mitigate that risk. Fleets should note that such analyses are both technically challenging and marked by data availability limitations. Full quantitative analyses may be difficult or impossible for many fleets to conduct but that does not mean that fleet managers should not do their best to assess the costs and benefits of potential systems.

Fleets that are already considering onsite renewable generation and battery energy storage to offset their utility bills should consider the resiliency value of that system in their financial calculus. Doing so may render the project more financially feasible or justify the deployment of a more robust system [9].

Understanding Outage Risk

Quantifying the risk of outages is complicated. Fleets can often get some understanding of the average frequency and duration of outages in their specific area from their utility. Additionally, data on average outage frequency and duration for each U.S. utility is also available from the Energy Information Agency's Form 861 data that reports both System Average Interruption Frequency and Customer Average Interruption Duration indices (SAIFI and CAIDI) [10]. SAIFI provides the number of outages the average customer experiences in a year, and CAIDI, the average length of those outages.

While these average statistics are useful to get a general understanding of outage risk, they are not sufficient for precise quantitative analyses because they do not convey recurrence probabilities—the likelihood of an outage over a specified length (e.g., 6 hours or 12 hours). Without this information, it is difficult to understand how outages might impact a fleet because EVs may be able to withstand shorter outages, even when those outages coincide with the time when the vehicle would normally be charging. This means there will be a threshold where an outage begins to affect vehicle operations. Due to these threshold effects, a single averaged outage duration number or a single statistic on the annual frequency of outages cannot be used to precisely predict a fleet's exposure to outage impacts.

The threshold where outages begin to affect operations is dependent on how much energy vehicles must recover and the length of time they have to charge. Box 1 provides an example of a vehicle with a moderate risk of outage impact. A vehicle with a heavier duty cycle, larger energy demand, or a shorter charging window than the example would have a higher exposure to outage risk and, in the opposite case, a more lightly used vehicle would have less.

Unfortunately, securing granular information on outage risks is challenging. Lack of data is a barrier to cost benefit or cost-effectiveness analyses of resiliency solutions across industries. In a novel 2022 study, the National Renewable Energy Laboratory (NREL) developed probability estimates for the recurrence interval of outages of varying lengths in the United States [11]. The research provides the most current and best publicly available information about outage risk. This report confirms the overall reliability of the U.S. electrical grid, showing that on average, customers experience relatively few outages—only 1.2 outages less than 12 hours per year and vanishingly few outages over 12 hours per year. When outages do happen, only about half will exceed 12 hours duration. The report highlights variation in risk due to specific hazards, reporting that almost 70 percent of hurricane-induced outages exceed 12 hours in length and 52 percent last longer than a day. The same

statistics for public safety power shutoffs are worse, at 87 percent and 66 percent, respectively.

Even armed with this state-of-the-art research, fleet managers will have to make assumptions about outage risks that fall between reported outage length bands. When making assumptions about outage risk, fleets should consider whether their fleet locations are acutely vulnerable to common causes of longer-than-average power outages such as hurricanes or public safety power outages. Utilities also may be able to provide precise historical records of outages at the circuit level for a fleet's specific location which could be used to better inform risk analysis.

Risk Tolerance and the Cost of Outages

Understanding the risk and exposure to outages is important, but just as important is understanding tolerance of risk and of the potential costs of outages. Fleets that serve public safety purposes such as emergency medical services or firefighting should have a low tolerance of risk, because interruptions in services could easily come at the expense of lives. Bus services or similar public fleets may have a higher tolerance of outage risks because, while they offer a critical public service, the consequences of reduced transit services are less likely to be life threatening. It is difficult or impossible to put a monetary value on the loss of these public services, meaning that these fleets must find a balance between the cost of adopting resiliency solutions and the operational risks they are willing to tolerate.

Commercial fleets can more readily monetize their risk assessment as a function of lost revenue, lost reputation, or other impacts of interrupted service which they can then weigh against the cost of solutions. Calculating the cost of an outage impact for a commercial vehicle is similar to calculating the downtime costs for other conditions that might take a vehicle out of service (such as maintenance or repair). Calculating this cost

BOX 2

Example Resiliency Benefit Estimate

Consider a fleet of 20 delivery vans with the exposure to outage described in Box 1 (impacts after five hours of coincident outage). Downtime costs for these vans are $1,000 per day, prorated to $100 per hour of downtime. The outage risk is taken from NREL's estimates. Based on these inputs, our simplified annual benefit value estimation (by outage length) is shown in the table below.

Annual Benefit

0-12 hours:	$6,250
12-24 hours:	$149
1-2 days	$508
2-3 days:	$394
3-5 days:	$526
5-7 days:	$242
7+ days:	$253
Annual total	**$8,323**

If the resiliency solution has a life of 20 years, and it generated these benefits in each year, then that solution would be worth about $123,000 in present value. Note that this value is directly proportional to changes in both outage risk and downtime costs. Because risk of outage decreases as duration increases, value does not decrease proportionally to the length of outage that a given resiliency solution can cover. For example, a solution that can only cover two days is 3.5 times less capable than one that can cover over seven days but delivers about 83 percent of the value.

is widespread practice for fleets, and there are a number of guides and calculators fleets may find useful for this exercise. These guides typically cover lost revenue, unproductive wages, reputational impact, and other costs. Fleet managers should also consider the extent to which lost power might knock out all or a large part of their fleets, potentially exposing them to damaging impacts to operations, revenue, or company reputation that might not occur with only a few downed vehicles.

Because commercial fleet risk is predominantly a function of lost revenue, commercial fleet operators might wish to insure against the risk of loss with a utility interruption insurance policy instead of pursuing direct risk-mitigation options such as backup power systems. While such policies will not insure against reputational losses, they may offer a very cost-effective option to mitigate risk to business revenues.

Modeling the Benefits and Costs of Solutions

Economic analysis of resiliency can be very complex and challenging and may be beyond the in-house capabilities of many fleet operators. This section provides a simplified example analysis to illustrate how fleets might conduct their own first-cut analyses of resiliency solutions.

Outage resilience benefits are the avoided costs of vehicle downtime that a resiliency solution will provide if it eliminates (or reduces) the risk of outage impacts. For example, if the cost of an outage is $1,000 and the probability that outage will occur in a given year is 1 in 10, then the value at risk in any given year is the product of $1,000 and 1/10 ($100). For non-commercial fleets, costs might be better expressed by of hours of lost service, or a similar operational metric. See Box 2 for a simple example of a resiliency benefit estimation for a fleet of delivery vans with monetized downtime cost.

The example analysis in Box 2 is of course very simplified. Among others, it makes strong assumptions about the distribution of outage risk that underlies the banded risk data sourced from the NREL report [11] and assumes that the cost of downtime is constant, rather than changing based on duration. However, this level of analysis is also simple to accomplish with basic spreadsheet modeling and limited downtime cost and risk data.

Modeling Costs and Comparing to Benefits

Cost modeling is complex and depends on local factors. It is also difficult to directly compare the costs of differing backup power systems on a perfect apples-to-apples comparison. However, it is important to develop reasonable estimates of overall cost as a benchmark to compare against benefits. As an illustrative example, consider the example in Box 3.

Readers should note that the modeling presented in Box 3 is meant to be illustrative and is therefore very simplified. It does not account for finance costs, replacement, or real estate costs (if solutions cannot be sited on existing property) or other site-specific challenges. The systems modeled in this example are also sized to prevent the impact of any outage, which may not be possible given space limitations or other constraints. Note that smaller systems might provide substantial benefits with a smaller footprint and lower upfront costs.

This type of rough analysis is a useful exercise for fleets to undertake to understand the rough magnitude of system costs to support their fleet. If roughly estimated costs are substantially higher than expected benefits, that is evidence that a backup power system is not practical. On the other hand, if benefits are similar to or outweigh costs in this simple analysis, that should indicate to fleets that in-depth, expert analysis of options is called for. For public

fleets, such analyses can inform budget conversations and help decision makers understand the costs they might expect to achieve varying levels of resilience to power outages. When conducting these analyses, fleet managers should not neglect the value of solar and storage solutions to provide bill savings value, which can meaningfully affect project economics.

BOX 3

For a simplified example of a project level cost model, take the following model of a system to support a California-based fleet of delivery trucks described in Box 2. This fleet of vehicles requires 1.5 MWh of energy recovery each night and has a peak power draw of 200 kW. Each of the systems modeled below could cover a sustained outage of a week or more in length, delivering about $123,000 in avoided downtime costs over a 20-year period. The project is eligible for IRA tax credits and California's $350/kW SGIP battery incentive.

Project Cost Breakdown

	200 kW Diesel Generator	200 kW Natural Gas Generator	400 kW solar array + 1.8 MWh Battery
Capital Cost	$160,000	$200,000	$526,000[a]
Operating Costs (annual)	$7,500	$7,200	$9,000
Avoided Electricity Costs (annual)	$0	$0	$50,000[b]
Present Value of 20-year Project Costs	$273,000	$310,000	-$137,000[c]

a. Includes IRA tax credits and SGIP incentive.
b. Does not include grid service value or arbitrage.
c. Negative costs indicate cost savings.

Notably, in this example, neither the diesel nor natural gas generator provides enough value in avoided downtime costs to justify their 20-year project costs. With the IRA tax credit and the SGIP incentive, however, the solar plus storage solution has a net negative cost over 20 years. That solution pays for itself through avoided electricity costs, and actually provides more value through electricity generation than it does through resilience.

PLANNING FOR AND IMPLEMENTING SOLUTIONS

Outside of the complexity of analyzing competing solutions and evaluating the economic benefits and tradeoffs of deploying a backup power system, there are also many practical concerns to consider in deploying and maintaining those systems. Deploying backup power systems can be a major undertaking with all the planning complexities of any major construction project. This section offers a high-level look at some of those complexities. However, fleets should strongly consider seeking contractors and consultants that are well versed in backup power to aid in this process.

Assessing Power Need

Determining how much power and energy is needed to maintain operations is an important first step in developing a resilient backup power system [12], [13], [14]. It is also a critical input to the decision-making process described in the Deciding on Solutions section because power and energy need determines the cost and feasibility of varying systems and solutions. For traditional power users this exercise begins with identifying the critical and non-critical loads. In other words, what equipment is absolutely essential and what can be left off in a power outage.

In a fleet charging context, vehicle charging will usually be a critical load. For many fleets, however, individual vehicles may have differing priorities. If only a subset of the fleet's vehicles must have access to charging, then those vehicles' charging demand is the critical load. For example, a public service fleet might prioritize its most critical operations vehicles (for example, road repair vehicles or snowplows) to ensure that their most important vehicles remain operational. Fleets might also decide to tolerate reduced capacity during extended outages. A transit fleet might, for example, run on a reduced schedule during sustained outages to maintain a minimum of service while extending the capabilities of their backup power system.

Power needs are determined by sustained peak load (or highest kW power draw) of critical vehicle charging loads, along with any other critical loads (such as lighting) that are backed up on the same system. This is because backup power solutions must be sized (in terms of kW output) to meet the simultaneous demands of charging and other electrical loads when their sustained combined power draw is highest. Overloaded systems will shut down for safety reasons.

For generator-based or battery-only backup systems, system sizing is simply the rated (continuous) power output of the equipment. For solar plus storage systems—where fleet vehicles will charge during the day—determining sizing is more complicated because solar output varies both on time of day and seasonally. Fleets can use solar power calculators to assess the capabilities of a solar system to provide charging power.

Energy needs are a function of both how much energy recovery vehicles require, along with how long the fleet will operate without grid power. Additional considerations for energy need are standby loads for managed/smart charging systems and any other ancillary energy use, such as lighting, space heating, transportation refrigeration units, etc. Fleets should note that there will be minor energy losses when charging vehicle batteries and should take that into account when calculating energy need.

For generators, energy need determines the amount of fuel that fleets must store. For example, one gallon of diesel will generate about 15 to 17 kWh of electricity in a typical diesel generator, meaning that fleets can divide their estimated energy needs by about 16 to get a rough understanding of how much fuel storage they require. Battery-only storage systems will be rated by their maximum energy storage capacity, making sizing relatively simple. However, solar plus storage systems will recover energy while the sun is shining, meaning that fleets must estimate the energy output of a solar array to understand how much of their energy demand can be recovered by a given system size.

Fleets with existing operations can use telematics and charging station data to estimate how much power and energy their business or mission critical vehicles use. Fleets still in the planning phase for electrification can use the same vehicle power and energy use modeling needed to size charging equipment installations to also determine their resilience energy and power needs.

For a simple example, take a fleet with 100 electric buses that travel 100 miles a day, consume 2.5 kWh per mile, and require 50 kW charger to recover their daily energy. If no operational modifications are possible and all buses must charge simultaneously, then this fleet will require a backup power system capable of delivering 5 MW of power and 25 MWh per day of energy. If this bus fleet could modify service to limit the number of buses that need to be in operation and potentially allow for daytime charging (when solar is producing), then the fleet could make do with a smaller backup system.

Deploying Backup Power Systems

There are many contractors to choose from when looking to deploy a backup power system. Many companies offer turnkey solutions and fleets can seek out contractors that specialize in specific applications such as deployment of integrated EV charging with solar plus storage solutions. Like any other contracted work, fleets should seek out firms with expertise, experience and good reputations deploying backup power systems.

Fleets with many locations, complex installation needs, and/or high-power requirements should consider putting projects out to bid with established engineering consultant firms that can manage the planning, design and construction of backup power systems end to end and may even manage the deployment of charging equipment as well.

Utility involvement and engagement

Utilities are a critical partner in all aspects of vehicle electrification, including resiliency planning and backup power generation. Communicating with utilities early and often is common advice for fleets seeking to

electrify their fleets and it is no less true for those looking to deploy backup power systems.

Outage Information

In addition to providing information about outage risk, utilities are the primary source of real time outage information. Many utilities provide live outage information on web portals. However, establishing lines of communication and building relationships with utility personnel responsible for managing power restoration and communicating information to customers in advance of power outages can simplify getting access to crucial information about power restoration efforts and timelines when an outage occurs. These contacts may also be useful for gaining information about when the utility foresees increased outage risk. Those fleets in areas subject to public safety power shutoffs should ensure they closely track shutoff information provided by their utility.

Interconnection of Distributed Generation

Switchover solutions that do not export power to the grid (such as backup generators) do not require special coordination with utilities. However, battery and solar systems that will be interconnected to the grid must go through utility interconnection processes, which include an analysis of whether existing grid infrastructure can handle increased distributed generation at a fleet's location. These processes are usually routine and well defined by utility regulators, but they may take a considerable amount of time to complete. Where the utility decides there is insufficient local hosting capacity, it may be the fleet customer's responsibility to pay for grid upgrades to deploy onsite generation and batteries. Many utilities provide hosting capacity maps that fleets can use to understand up front whether there are likely to face constraints in deploying solar and storage systems.

Interaction with Other Utility Programs

One particularly novel issue for fleets is the interaction of backup power planning and utility rules around their EV charging rates and incentive programs. Special EV rates often require a second metered service for EV charging equipment separate from other facility electrical load. This setup can increase the complexity of (or render infeasible) backup power solutions designed to cover both EV charging load and other facility load. Additionally, many utility incentive programs for EV charging deployment feature utility-owned onsite electrical infrastructure—such as switchgear, wiring, etc.—often referred to as customer make-ready. Utilities are unlikely to want fleets to build complex backup power systems onto utility-owned infrastructure. This means that fleets that wish to deploy backup power systems now or in the future, should work with the utility to determine a design that both maximizes incentives the utility may provide as well as allows for the operational needs of the fleet, including resiliency-driven backup systems. Separately, most utility programs provide optionality for the customer to receive rebates for customer side infrastructure they independently own and install.

Priority Power Restoration

Many utilities have priority power restoration lists for circuits serving public safety, health, and critical infrastructure—such as hospitals and fire stations. Utilities will respond to outages on these circuits quickly and before less critical areas. Fleets that fulfill a public safety critical role, such as emergency response, should discuss with their utility about the potential to include their facility on those priority lists once their fleet vehicles are electrified. Reduced service restoration time can meaningfully decrease the need for and size requirements of backup power systems.

Permitting

Fleets should be aware that deploying backup power systems will potentially require multiple permits from different local authorities. While permitting is a routine part of any construction project, it can take a substantial amount of time and can cause significant project delays. Moreover, some permit requirements may place constraints on deployment.

All backup power systems are subject to electrical permitting requirements. While these vary from jurisdiction to jurisdiction, fleets can expect that installation will require permits, just like any other electrical work. Permitting requirements will likely require work to be completed by a licensed electrician on plans from a licensed electrical engineer. Permits for backup power systems often require a load study that demonstrates that the backup power system can sufficiently cover the expected load it will cover. Because installing chargers will also require electrical permits, it will be helpful to build backup power systems out at the same time as charging station installation.

In many jurisdictions, installing a generator will also require an air quality permit from the relevant regulatory authority (usually an air pollution control district). While permitting emergency backup generators is usually straightforward, such permits typically come with limits on annual operating hours and in some cases may require fleets to buy generators with sophisticated emissions controls.

Finally, because fuel storage and battery systems are a fire risk, many jurisdictions have specific requirements for their installation. These may include both hardening requirements as well as safe distance requirements. Permitting schemes that require wide buffer spaces between fuel storage or battery systems and other structures may present an added challenge to space constrained fleet yards.

Operating and Maintaining a Backup Power System

Once systems are in place, they must be regularly maintained and tested to ensure operability when power failures arise. Different solutions require various levels of ongoing maintenance, but all systems require a minimum level of ongoing attention. In addition, staff must have procedures and training in place to ensure swift recovery in case of outage.

Maintenance and Testing

Regardless of the system type, fleets should run full tests of the backup systems on a regular basis and in anticipation of any upcoming weather event that is likely to cause a power outage [1], [12], [13], [15]. Testing should not be limited to just the backup power equipment itself, but the full system, including any charging management systems and the chargers and vehicles themselves. This means testing the entire system and confirming that power switches over from grid to backup sources and that chargers and vehicles recover from a temporary loss of power and resume charging.

Generators in particular have high maintenance requirements. Fleets must regularly service generators just as they would vehicle engines. Regular maintenance items include oil and filter changes, coolant checks and checks for wear or damage to parts such as belts and seals [12, 13, 14]. Solar, fuel cell and battery storage systems also require maintenance, although less so than a comparable generator set. Solar panels must be cleaned, tested, and checked for damage regularly to ensure they run at peak efficiency. Battery storage systems and fuel cells also require maintenance, particularly their temperature control systems, which must run well to ensure batteries or fuel cells are not subject to extreme heat or cold [13].

Ensuring Adequate Energy Supply

Fleets must also have procedures in place to ensure that they have an adequate energy supply in the advent of an outage. For battery systems, fleets should put procedures in place to switch the battery into an energy conservation mode (a mode where the battery prioritizes keeping a high state of charge) whenever outage risk is high. For fleets with generators, they must ensure they have enough fuel stored on site and have the ability to take fuel deliveries in the case of a long duration outage. Fleets should note that diesel fuel can degrade when stored for extended periods of time, so it is advisable to turn over or treat fuel stores regularly to ensure the fuel is in good condition when outages arise [1, 12, 15].

CONCLUSION

Understanding the risk that power outages might disrupt fleet operations and considering potential resilience solutions to counter that risk is a key area of focus when transitioning to electric fleet vehicles. Though U.S. electricity supply is exceptionally reliable, power outages are inevitable. Additionally, many fleets work in areas where grids are more vulnerable to extreme weather, disaster, and other risks to the power supply and weather-related risks are steadily increasing due to the impacts of climate change.

Power resiliency and backup power solutions are mature concepts in other power critical industries. Fleets can learn from those industries experience to develop an understanding of the risks of outages and the solutions that exist, but they also must translate those concepts into a fleet context where electricity use can be substantially different than traditional stationary and buildings based electrical loads.

By developing a sophisticated understanding of how outage risk interacts with their operations and the costs those outages can impose, fleets can make informed decisions about whether to pursue a backup power solution, what solutions are the best fit for their use case, and how to right size those solutions to fit their needs.

When deploying a solution, fleets should plan carefully, select the best contractors or vendors for their needs and engage with their utility early and often. Finally, with a solution in place, fleets must continually maintain and test their system's capabilities to ensure that it is in working order when a power outage strikes.

REFERENCES

1. S. Stout, N. Lee, S. Cox, J. Elsworth and J. Leisch, "Power Sector Resilience Planning Guidebook," June 2019. [Online]. Available: https://resilient-energy.org/training-and-resources/publications/73489-guidebook-final.pdf/view.
2. United States Department of Energy, "Transforming the Nation's Electricity Sector: The Second Installment of the QER - Chapter IV," U.S. Department of Energy, 2017.
3. S. a. D. O. Ericson, "A Comparison of Fuel Choice for Backup Generators," 2019.
4. V. J. Z. E. O. D. F. J. D. Ramasamy, "U.S. Solar Photovoltaic System and Energy Storge Cost Benchmark, With Minimum Sustainable Price Analysis: Q1 2022," United States Department of Energy, 2022.
5. R. Baxter and M. P. Energy, "Energy Storage Pricing Survey," Sandia National Laboratories, 2019.
6. U. S. I. R. Service, "Increased Credit or Deduction Amounts for Satisfying Certain Prevailing Wage and Registered Apprenticeship Requirements," Federal Register, August 2023. [Online]. Available: https://www.federalregister.gov/documents/2023/08/30/2023-18514/increased-credit-or-deduction-amounts-for-satisfying-certain-prevailing-wage-and-registered.
7. California Public Utilities Commission, "Self-Generation Incentive Program (SGIP): Energy Storage Rebates for Facilities Brochure," October 2020. [Online]. Available: https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpucwebsite/content/news_room/newsupdates/2020/sgip-non-res-web-120420.pdf.
8. S. Ong, C. Campbell, P. Denholm and R. a. G. H. Margolis, "Land Use Requirements for Solar Power Plants in the United States," National Renewable Energy Laboratory, 2013.
9. National Renewable Energy Laboratory, "Valuing Resilience in Electricity Systems," September 2022. [Online]. Available: https://www.nrel.gov/docs/fy19osti/74673.pdf.
10. U.S Energy Information Administration, "Annual Electric Power Industry Report, Form EIA-861," eai.gov, October 2023. [Online]. Available: https://www.eia.gov/electricity/data/eia861/.
11. S. Ericson, J. Cox, M. Abdelmalak, H. Rabinowitz and E. Hotchkiss, Exceedence Probabiliites and Recurrance Intervals for Extended Power Outages in the United States, Golden, CO: National Renewable Energy Laboratory, 2022.
12. "Resilient Power Best Practices for Critical Facilities and Sites: Guidelines, Analysis, Background Material, and References," United States Cybersecurity and Infrastructure Security Agency (CISA), 2022.
13. S. Mullendore and L. Milford, "Solar + Storage 101: An Introductory Guide to REsilient Power Systems," Clean Energy Group, March 2015. [Online]. Available: https://www.cleanegroup.org/wp-content/uploads/Energy-Storage-101.pdf.
14. United States Environmental Protection Agency, "Power Resilience Guide for Water and Wastewater Utilities," 2016.
15. Pacific Northwest National Laboratory, "Best Practices for Standby Generator Operations and Maintenance," July 2021. [Online]. Available: https://www.pnnl.gov/projects/om-best-practices/standby-generators.
16. Valley Transportation Authority, "VTA Rolls Toward Cleaner, Greener Future Fleet," vta.org, January 2022. [Online]. Available: https://www.vta.org/blog/vta-rolls-toward-cleaner-greener-future-fleet.
17. Track Your Truck, "Effects of Downtime on Fleets," trackyourtruck.com, December 2020. [Online]. Available: https://www.trackyourtruck.com/blog/ways-to-avoid-fleet-downtime/#:~:text=In%20total%2C%20downtime%20expenses%20can%20run%20eight%20times,between%20%24850%20and%20%241%2C000%20per%20day%20on%20average..

NOTES

1 U.S. utility customers averaged just over seven hours of power outage in 2021 (just under 0.08 percent of total hours in 2021)[https://www.eia.gov/todayinenergy/detail.php?id=54639]

2 For example, Valley Transportation Authority has planned an on-site solar and battery storage system in concert with their bus electrification efforts [16].

3 Backfeeding happens when onsite generation feeds back into local distribution grids. Uninsulated systems can cause damage to local equipment and pose risk to utility workers working on nearby lines.

4 Charging management systems may require their own small uninterruptable power supply unit to prevent system reboots or damage from unanticipated power loss, but these do not need to cover the whole fleet facility.

5 The costs benchmark shown in Table 2 are suitable for high-level planning purposes but should not be considered substitutes for engineering cost estimates. These costs are the most recent available but have not been adjusted for inflation or cost declines since publication.

6 Green Mountain Power's program requires enrollees to make their battery capacity available to grid operators during periods of high energy demand. https://greenmountainpower.com/rebates-programs/home-energy-storage/bring-your-own-device/

7 Estimate based on analysis of several commercially available megawatt-scale battery systems.

8 Estimate based on analysis of several commercially available large diesel generator systems.

9 Recurrence intervals give the average number of years between outages of that duration. The reciprocal of the recurrence interval is the probability that an outage of that duration will occur in any given year.

10 See Table ES-1 of [11] for estimates of reoccurrence intervals for US regional electric grids.

11 E.g. https://www.atlassian.com/incident-management/kpis/cost-of-downtime..

12 $1,000 per day is a reference value from the top end of estimated costs of vehicle downtime provided by an informal source [17]. Hourly proration is based on a ten-hour operating day and the assumption that an hour of lost charging translates into an hour of lost revenue service.

13 Present value calculated using standard discount cashflow analysis using a 7% real discount rate.

14 There are a number of free solar power calculators available such as the PVWatts Calculator developed by the National Renewable Energy Lab - https://pvwatts.nrel.gov/

15 Charging losses range from 1 to 15 percent. Lower power AC chargers tend to be less efficient than higher power DC chargers. These losses mean that backup systems must supply a slightly higher amount of energy than the vehicle uses during operations.

16 Based on assumption of a 37-42 percent generator efficiency. Factors such as inefficient operation, extreme cold, or poor maintenance can reduce generator efficiency considerably.

17 This metric includes both energy used by the vehicle and charging losses.

Take Charge of Your Fleet Electrification with Microgrids

SCALE MICROGRIDS

About Scale

Scale Microgrid Solutions is a vertically integrated distributed energy platform, with a core focus on designing, building, financing, and operating cutting-edge distributed energy assets that offer cheaper, cleaner, and more resilient power. As a team of energy and financing experts, Scale enables customers to take charge of their energy infrastructure and lead with a competitive advantage.

Scale is investing millions of dollars into distributed energy assets yet remains flexible and combines capital with technical expertise to step in and pull projects over the line.

DISTRIBUTED ENERGY

ENERGY INFRASTRUCTURE

Scale's microgrids simultaneously deliver cost savings, resiliency, and sustainability. Our platform drives efficient project development, minimizes soft costs, and maximizes dependability.

CUSTOM MICROGRIDS

MODULAR MICROGRIDS

SCALE MICROGRIDS

Feasibility Analysis and Audit

We conduct a comprehensive analysis of your site to understand your energy consumption patterns and backup power needs.

1

Engineering and Design

We include a custom engineered and designed energy solution that maximizes both backup power and energy savings.

2

Financing

We offer a range of flexible financing and ownership options that enable you to capture energy savings and enjoy back-up power with no upfront cost.

3

Installation and Commissioning

Our in-house team ensures your system is installed safely, efficiently, and professionally – so you can start saving the moment it's switched on.

4

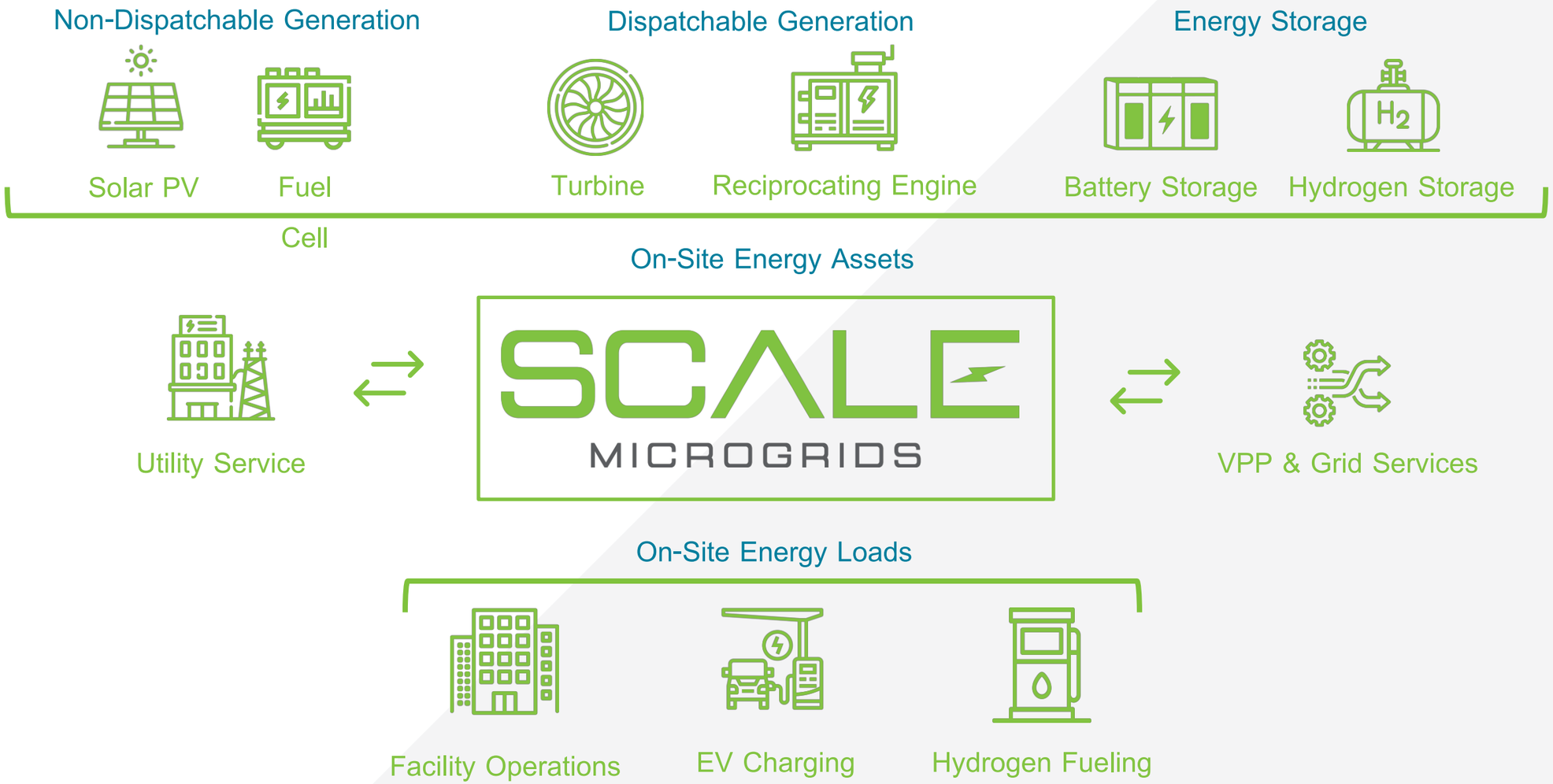
Asset Management

For the lifetime of your system, we provide top service and maintenance to ensure optimal operation.

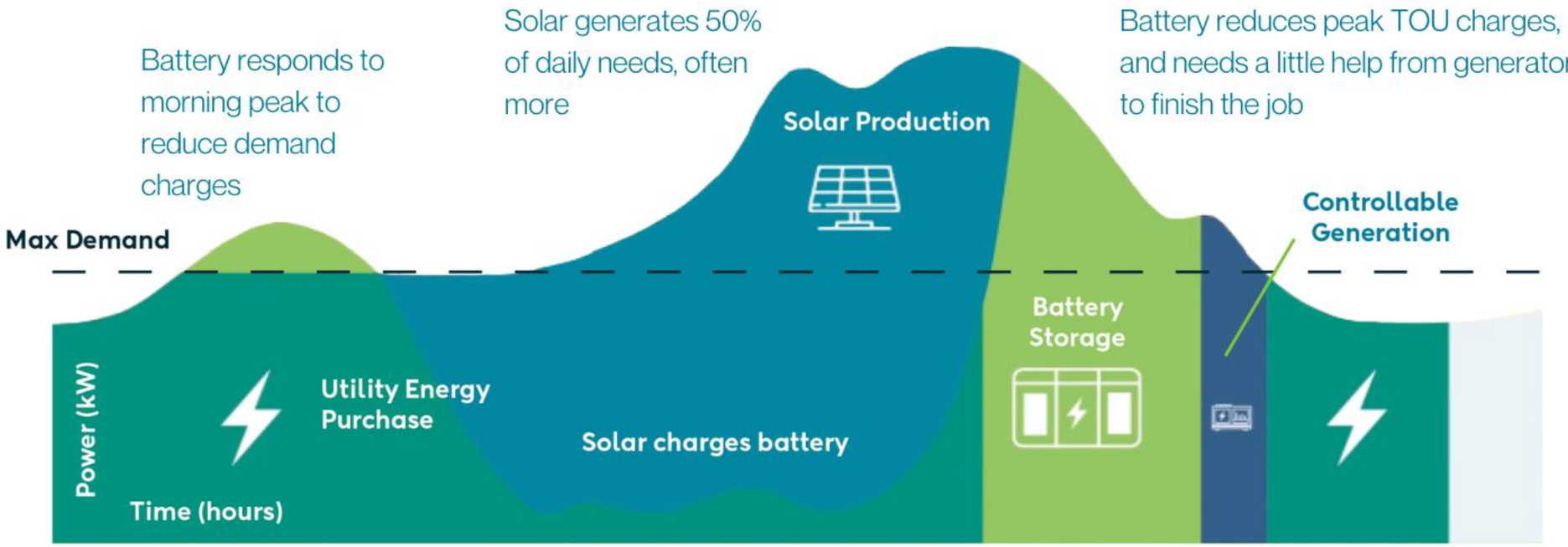
5

Making a complicated process headache-free.

Building on the Microgrid Platform



What does a normal day look like?



Think of the microgrid controller as the brains of the system.
As your facility's energy needs change, the controller allows us to continue to modify usage behind the meter.

SCALE MICROGRIDS

How fleets can get power to fuel their new EV assets

1 New Utility Meter Drop

Option for locations where capacity is widely available

\+

SCALE MICROGRIDS

=

Future proofing a new service with DERs

Adding DERs to a new service increases the capacity of that service and serves to reduce the cost of energy.

2 Utilize Existing Service

Avoid a new service upgrade by utilizing the existing service on site.

\+

SCALE MICROGRIDS

=

DERs to avoid the capacity upgrade

Microgrids can safely meet demands that would normally exceed the service capacity.

3 Additional Service Capacity Request

Procuring new service capacity for the site comes with long delays and high costs.

\+

SCALE MICROGRIDS

=

DERs to provide a stop-gap solution

DERs can provide supplemental power now while a service upgrade is in process. Reoptimize when capacity is available.

Why Fuel Comes First

How you power your site determines the success (or failure) of your transition.

- Buses must be 100% available and on-time
- Need to meet organizational budget goals
- Emissions impact communities and the planet

SCALE MICROGRIDS

Flexibility

Microgrids help ensure a smooth transition today and tomorrow

- Avoid near-term utility delays
- Platform for future expansions
- Tech neutral, supports all chargers
- Power EV chargers or H2 fueling

SCALE MICROGRIDS

Economics

Fully-financed microgrids offer multiple budget benefits

- Infrastructure as opex instead of capex
- Potential savings vs utility costs
- Reduce exposure to rate increases
- Make federal and state funding go farther

SCALE MICROGRIDS

Resilience

Microgrids ensure service when your community needs you

- Fleet uptime during utility grid outages
- Multiple resources for redundancy
- Choose the amount of backup you need

SCALE MICROGRIDS

Sustainability

Deliver sustainability benefits beyond bus emissions

- On-site solar and storage reduces power emissions
- Avoid need for diesel-fueled backup generators
- Demonstrate sustainability leadership to stakeholders

SCALE MICROGRIDS

Santa Clara Valley Transit Authority Microgrid Case Study

- First of its kind clean energy microgrid for transit operations
- Modular design sized for full fleet without an additional service upgrade
- Designed for cost-effective growth of the fleet over time
- Integrated design includes a solar canopy with inverted pantographs for overhead charging
- Energy cost-savings via TOU arbitrage
- 34 Battery Electric Buses, 3MW of Power Electronic Chargers, 500 kW Solar PV, 1MW/4MWh BESS, and provisions for rollup generator for extended outages

PG County Microgrid Opportunity Case Study

- Solar PV, Battery Storage, Natural Gas Generation, Medium Voltage Service
- Infrastructure Transition Planning & Interconnection
- Phasing for cost-effective growth
- 100% Resilient

SCALE MICROGRIDS

Quality Custom Distribution Microgrid Case Study

- Truck Fleet: 30 Volvo Battery-Electric Trucks
- Charging Strategy: Opportunity Charging (Mid-Day)
- 2,800kW DC Fast Charging Infrastructure
- Charge Management Software
- Solar PV: 1.3MW Rooftop & Carport Combination
- Battery Energy Storage System: 770kW/3MWh
- 1.5MW NG Generator for 100% Backup Power
- Microgrid covers entire site and cold storage for complete operational resilience
- NPV positive in the first year
- Avoids service upgrade

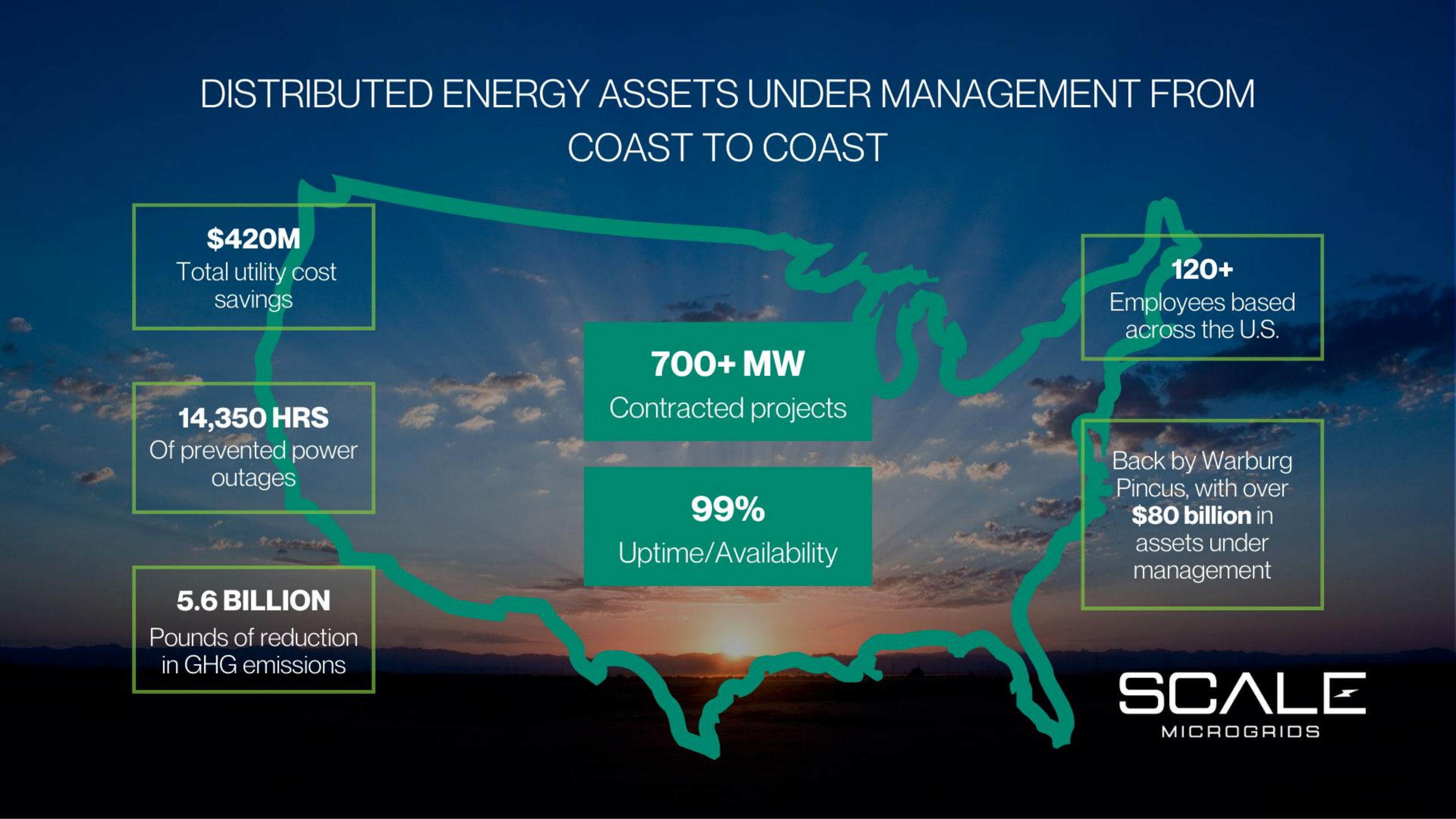
SCALE MICROGRIDS

Who We Are

Scale is a vertically-integrated energy company that designs, builds, finances, owns, and operates distributed energy assets that deliver cheaper, cleaner, and more resilient power. Our team of energy and financing experts enables EV fleet owners to take charge of their energy supply with microgrids that integrate solar, batteries, backup generation and EV chargers.

SCALE
MICROGRIDS

DISTRIBUTED ENERGY ASSETS UNDER MANAGEMENT FROM COAST TO COAST



Highlighted Project Experience Includes:

AMOND REFRIGERATED COLD STORAGE WORLD ESTD 2017

QCD QUALITY CUSTOM DISTRIBUTION

SOBOBA CASINO RESORT

Valley Transportation Authority

BOWERY

verano

BROOKLYN SINCE ACME 1906 SMOKED FISH

Cadiz

Santa Margarita Water District

SEAL OF THE CITY OF BRIDGEPORT, CONNECTICUT INCORPORATED 1836

GALLAUDET UNIVERSITY

CALIFORNIA AMERICAN WATER

TRINITY COMPANY

CSU PUEBLO

PCS Petaluma City Schools

Developing effective communicators and critical thinkers.

GOLETA WATER DISTRICT

Awards

S&P Global Platts
Global Energy Awards

2021 Rising Star Company
2021 Rising Star Individual - Duncan Campbell
2022 Lifetime Achievement - Howard Goodman
2023 Financial Deal of the Year Award

Real Leaders ECO INNOVATION AWARDS

2020 Top 100 Eco Innovative Companies

The Tech Tribune
Best Tech Startups
2021

2021, 2022, 2023, 2024 Best Tech Startup in New Jersey

MICROGRID KNOWLEDGE

2023 Greater Good Award: Gallaudet University Microgrid

SMART ENERGY DECISIONS
INNOVATION AWARDS 2020

Best Project:- Bowery Farm

THE CLEANIE™ AWARDS

2020 Rising Star Under 40
2021 Project of the Year

We focus on the power, so you can focus on your core business.

Tim Victor
Associate Director, eMobility
TVictor@scalemicrogrids.com

Chris Cantone
Chief Revenue Officer
CCantone@scalemicrogrids.com

SCALE MICROGRIDS