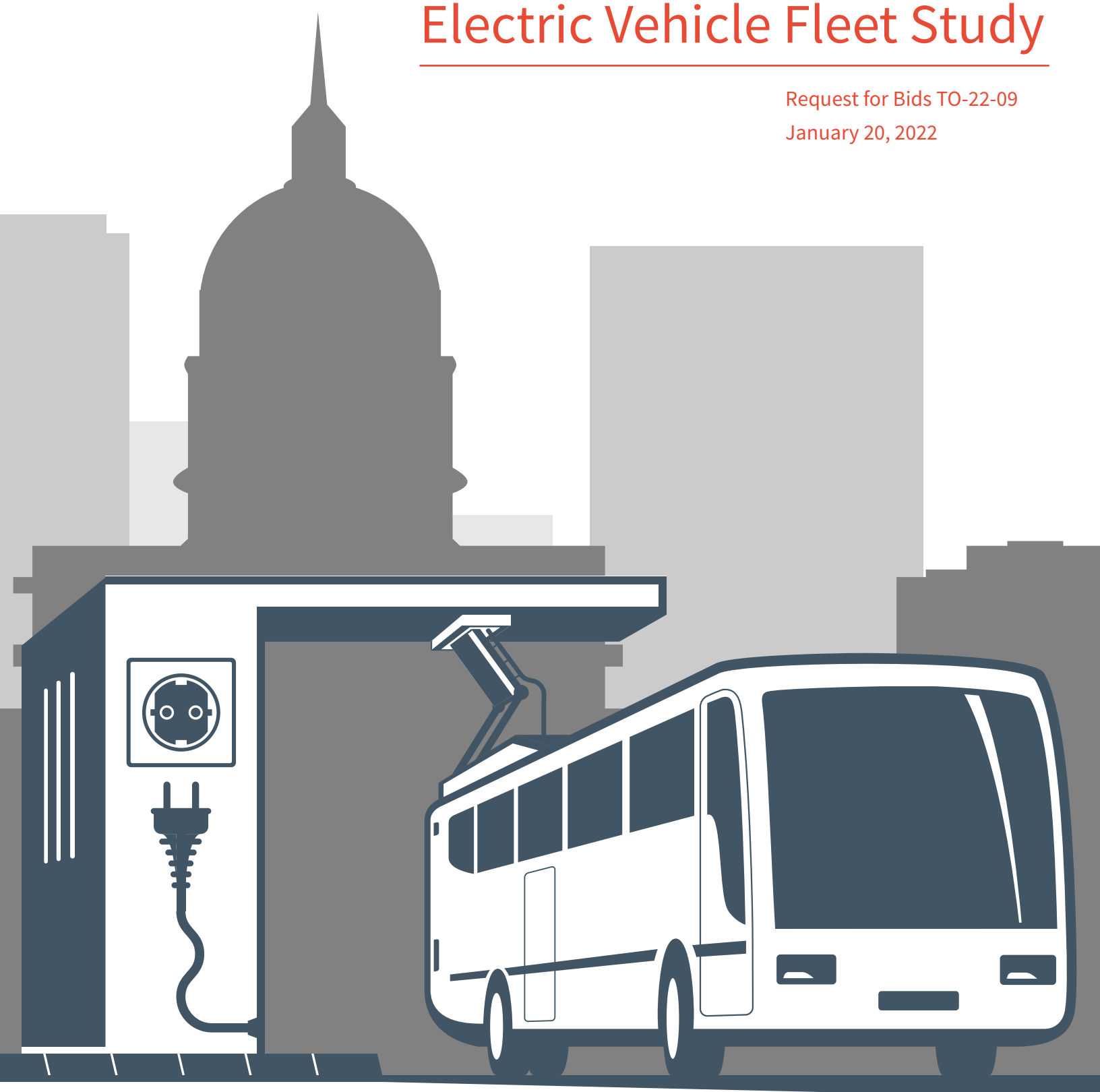
TOPEKA METRO

Proposal for

Electric Vehicle Fleet Study

Request for Bids TO-22-09

January 20, 2022



HATCH LTK

HATCH LTK
Positive Change for the Next Century

January 20, 2022
P6005

Richard Applehanz
Topeka Metropolitan Transit Authority
201 North Kansas Avenue
Topeka, KS 66603

RE: Electric Vehicle Fleet Study
Request for Bids TO-22-09

Dear Mr. Applehanz,

Hatch LTK is pleased to present our proposal to develop an Electric Vehicle Fleet Study for the Topeka Metropolitan Transit Authority (Topeka Metro). We fully understand the pressures and uncertainties Topeka Metro faces in transitioning to electric vehicles. Considerations such as technical maturity, vehicle performance, fleet size, charger placement and capacity, maintenance infrastructure, safety, and overall risk must be carefully considered to inform short- and long-term capital, operational, and financial planning decisions.

Hatch LTK offers the necessary expertise to help Topeka Metro navigate these issues with confidence. We work at the forefront of the electric bus technology evolution, keeping abreast of the industry's latest developments and projected advancements, and we understand how Topeka's unique circumstances must be considered during technology selection and transition planning. We have assembled an experienced team bringing outstanding expertise in all facets of electric transit vehicle engineering, transit operations, economic analysis, energy management, and project management.

Selection of Hatch LTK will offer Topeka Metro a number of significant benefits:

- **An Experienced Project Manager with Extensive Experience.** Daniel Lang, P.E., PMP, leads Hatch LTK's Zero-Emissions practice and offers a comprehensive understanding of the challenges inherent in integrating new electric vehicle technology into existing bus operations, and the consequent management, operational, and facility impacts that must be considered. Dan offers practical insights gained from his experience assisting agencies such as SEPTA in Philadelphia and the MBTA in Boston with electric bus transitions. Dan is a certified Project Management Professional, a licensed engineer, and has more than 15 years of transit industry experience.

- **Outstanding Technical Staff.** We offer technical experts with deep experience in transit vehicles, auxiliary systems (including cold climate HVAC systems) and electric propulsion, coupled with a keen understanding of the practical capabilities – and limitations – of battery-based energy storage systems. Our team includes Vince Pellegrin, who guided Metro Transit in Minneapolis through electric bus implementation during his time at the agency. Vince also offers nearly 40 years of experience in bus operations, maintenance, and planning.

- **Industry-Leading Simulation Capabilities.** Energy Modeling for Intelligent Transportation and Sustainability (EMITS), Hatch LTK's bus propulsion simulation software, offers industry-leading capabilities

to determine “ideal” electric vehicle characteristics (range, performance, size) considering the unique circumstances of each agency and each route.

+ **Knowledge of the Forthcoming Developments in Electric Vehicle Capabilities.** Staff constantly monitor developments in electric vehicle and battery technologies and regularly participate in transit industry and professional engineering committees devoted to the subject. We will provide the insights necessary to align Topeka Metro’s electric transit bus roll-out plan with the vehicle capabilities expected in the marketplace at each stage of implementation.

+ **Insights and Lessons Learned Drawn from Ongoing Zero-Emissions Implementation Efforts.** We are actively engaged in supporting electric bus and zero-emissions implementation programs for multiple transit agencies and will offer the lessons learned from this work. Our team has most recently supported fleet modernization studies, fleet and facility upgrades, and zero-emissions transitions throughout North America, including public transportation clients in Austin, Boston, Crescent City, Fort Collins, Los Angeles, Philadelphia, San Francisco, Seattle, and Toronto.

+ **Appreciation of the Needs of Small Transit Agencies.** We are sensitive to the needs of small transit operators. We appreciate that resources are always limited, and that cost, schedule and technology risks must be minimized. We will base our planning efforts on the transit industry’s growing body of experience with battery-electric technologies to identify discrete steps to make the transition to electric buses as painless as possible.

Please note that we go to market across the United States using the name Hatch LTK. However, as a result of our merger with Hatch, we will contract for this project with the Authority as Hatch Associates Consultants, Inc.

We acknowledge reciept of Q&A 1. Please contact Dan Lang [daniel.lang@hatch.com; (215) 641-8840] or me [dominic.dibrito@hatch.com; (215) 641-8888] if you have any questions or require any additional information. We look forward to partnering with you to successfully deliver design and engineering services.

Respectfully submitted,

Hatch LTK

Dominic A. DiBrito, P.E.
Global Managing Director – Transit

SECTION 2

Project Understanding and Approach

Project Understanding

Topeka Metro provides vital fixed route bus and paratransit service to the greater Topeka region. Ridership in 2018 was 1.02 million passengers. The Authority operates 26 fixed route buses and 10 paratransit buses to serve 12 fixed routes and two paratransit routes.

All buses are fossil-fuel powered and are currently maintained at the Authority's David Ryan Operating Facility. Hatch LTK understands that Topeka Metro is currently considering relocating maintenance and operations to another location.

Like many other US transit systems, Topeka Metro is interested in replacing the current fossil-fuel bus fleet with zero-emissions vehicles to reduce emissions and improve energy efficiency. Through review of published agency documents, it is evident that the agency has been doing its homework to prepare for such a transition. Metro staff have visited other transit agencies to gather information regarding pros and cons of electric buses in operation. In November 2017, electric bus manufacturer, BYD, conducted a demonstration on the SW 21st Street route. Topeka Metro also hosted CCW, a company that overhauls diesel buses with electric drivetrains.

Figure 1: David Ryan Operating Facility

Topeka Metro has received a grant to purchase three Battery-Electric Vehicles (BEVs) to be placed in service in early 2023. Topeka is also currently considering transitioning more of the fleet to BEVs. To assist in this effort, Topeka is seeking a qualified consultant to conduct an electric vehicle study to identify the steps necessary to efficiently transition to an electric fleet. As an industry leader in public transportation consulting and zero-emissions planning, Hatch LTK understands the challenges and opportunities ahead and is uniquely qualified to support Topeka Metro in this effort. We have carefully reviewed the Request for Bid document, as well as substantial published agency information, to develop a custom-tailored plan for the agency's future.

Project Approach

As an industry leader in electric vehicle planning and implementation, Hatch LTK is the ideal consultant to guide Topeka Metro through the transition to battery-electric buses. We offer extensive experience in helping clients make sound technical decisions – Hatch LTK has over 100 years of experience supporting clients in the US with complex issues, such as electric vehicle transitions.

Our project approach is built upon our extensive experience and the expertise of our veteran project team. Our proposed team offers a combined 75 years of electric vehicle and transit experience and has assisted agencies of all sizes, from small bus operations such as Redwood Coast in Northern California to major multi-modal transit systems such as Boston's MBTA. We will leverage our extensive experience to provide Topeka with efficient, accurate, and professional support.

Transit vehicles and their supporting infrastructure must work together in harmony – all assets must be designed and maintained to work as a well-integrated system. Therefore, our engineering and management approach is founded upon these four key principles:

Safety	Safety is the most important consideration in everything we do. We employ industry-recognized safety methods, supplemented by our collective project experience, to confirm that vehicles and systems assets operate safely under an extensive range of normal and degraded conditions. We incorporate safety-related considerations into all work, even high-level planning studies such as this. We will note the key safety issues, such as the need to train maintenance staff to safely work with high-voltage electrical equipment, and others identified throughout this evaluation.
Engineering	We will emphasize uniform practices and standards throughout this analysis. We provide the services of experienced engineers and researchers who are experts in their respective fields. These seasoned professionals will apply their experience to evaluate the various technical issues, and their associated economic and organizational impacts, necessary to support a successful transition to an all-electric fleet.
Management	We will develop effective management and oversight procedures with a keen appreciation for the project timeframe, future uncertainties, and the risks associated with technology transitions. This attention will flow throughout all project activities.
Operations	We retain constant focus on the ultimate goal – assets that function as designed, operate efficiently, and are readily maintained. We advocate the use of the "Concept of Operations" approach to focus on the needs of end users from the very outset of planning.

Hatch LTK's Proposed Vehicles Lead:
Vince Pellegrin

Vince Pellegrin has been in Topeka's shoes: Vince has 41 years of Public Transit agency experience in bus operations, equipment maintenance, executive management, budgeting and financial management, and service planning and scheduling. He is recently retired from Metro Transit in Minneapolis where he led the implementation of a battery bus fleet. This included bus battery charging equipment, as well as associated electric bus maintenance equipment and procedures and technician training requirements. Also, Vince managed route planning and revenue service implementation of electric battery powered buses.

Project Execution

Hatch LTK has carefully reviewed the Request for Bids document and developed a customized project execution plan to meet Topeka Metro's needs. Our plan addresses Topeka Metro's requested scope of work into four primary tasks.

Task 1 Coordination with Topeka Metro

Hatch LTK will work with Topeka Metro to develop a meeting and communication plan that addresses the overall project needs. We will travel to Topeka to hold a kick-off meeting to discuss project goals, review the work plan, and define communication objectives. Additional meetings will occur at least monthly or as needed throughout the project. We will coordinate regularly through the project duration and will include stakeholders such as operations,

Client Solutions:
Redwood Coast Transit Authority

In our initial meeting with Redwood Coast Transit Authority, we learned of the frequent closures of main roads during winter and the resulting requirement for battery-electric buses to travel longer detour routes on a routine basis. This critical insight led us to focus on layover charging options from the very beginning of the project.

planning, and finance. We will present all draft findings to Topeka Metro for feedback prior to finalizing the content of our deliverables.

Task 2 Baseline Assessment

During the kick-off meeting, we will seek to understand Topeka's near-term plans, challenges, concerns about fleet electrification, and problems specific to Metro's operations. Then, we will introduce our technical approach to obtain feedback. This early coordination will allow us to customize our approach based on Metro's specific problems and opportunities. The baseline assessment in this stage will include much more detailed analysis of the operations, maintenance, infrastructure, and short- and long-term plans. We will collect information regarding:

- Bus schedules
- Bus blocks
- Operations at Quincy Street Station
- Layover locations and durations
- Fleet composition
- Fleet age and replacement schedule
- Fuel prices
- Average fuel economy and total mileage of each vehicle type in the current fleet
- Bus driver assignment methodology
- Ridership
- Bus depot layout and pictures
- Power cabinet pictures at bus facilities
- Availability of unused real estate around the bus depot
- Plans for future relocation of bus maintenance operations
- Agency staffing and capabilities
- Current training programs

Moreover, we will ask for any approved plans that are related to new vehicle acquisitions, infrastructure upgrades, and service changes. The information we will obtain at this stage will be used in the next stages of the project.

The baseline assessment will also include research and familiarization with local regulations, laws and rules that may impact electric vehicle implementation. This information will be coupled with Hatch LTK's nationwide and global knowledge of electric vehicle regulations and policies to inform our recommendations on Topeka's fleet transition.

Task 3 Electrification Planning

With an understanding of Topeka's current operations and future plans in-hand, Hatch LTK will next begin conducting analyses to inform the electric vehicle transition planning. This task will assess Topeka's facilities and operations with respect to future electric vehicle fleets. This is a multi-step and iterative process, as many parameters associated with the transition are interrelated. The primary subtasks involved in this effort are:

- Operational Analysis
  - Drive Cycle Development
  - Vehicle Energy Modeling and Route Simulation
- Bus Depot and Infrastructure Assessments
- Charging Schedule Development
- Life Cycle Cost Analyses

Operational Analysis

The first step in planning for the future is to assess how electric vehicles will perform within Topeka Metro's operations. To do this we will use our proprietary modeling tool, Energy Modeling for Intelligent Transportation and Sustainability (EMITS), to accurately estimate the electrical energy required to complete a route within Topeka's system.

Hatch LTK will work with the Authority to select several routes that are representative of the entire network. We will then develop input data for the EMITS analysis based on characteristics of these routes – distance traveled in each direction, grade profile, stopping locations, speed limits, traffic signs and other features that affect travel speeds. As an example of our approach, Hatch LTK categorized the routes of a transit agency in another project into three groups as outlined in Table 1 below:

*Table 1: Sample Route Categorization for EMITS Analysis**

	Description	Characteristics
Category 1	Downtown Routes	Low average and maximum speeds
Category 2	Routes from Downtown to Suburban Areas	Medium average speeds
Category 3	Routes from One Downtown Area to Another	Low average speed at the start and end, medium average speed in the middle

* The number of categories in Table 1 is just for example purposes and will change based on detailed analysis of Topeka Metro's routes.

We will then use these inputs to conduct the EMITS analysis. This approach will provide accurate, "real world" results specific to Topeka's operating environment, while keeping project effort as efficient as possible by avoiding simulation of all of Topeka's 14 bus routes.

Hatch LTK also understands that Topeka Metro's buses currently do not operate over a single route throughout each day. Therefore, these route categorizations will later be combined to represent typical "runs" that the Authority performs where the bus operates over multiple routes each day.

The next step in the methodology is to assign all of Topeka's routes into one of these categories and to choose a representative route for each category. Then, EMITS calculates the energy consumed by a bus to complete each representative route. This energy calculation is performed in two steps:

Step 1: Drive cycle (speed profile) development

Step 2: Vehicle energy modeling and run simulations

Drive Cycle Development

Hatch LTK uses an innovative method to create drive cycles (speed profiles) that are specific to route categories. In this method, we first digitize the grade of the roads on the target routes using proprietary software that takes inputs from Google Earth and Google Maps. We identify and digitize the locations of traffic lights, stop signs, pedestrian crossings, bus stops, and speed limits on the road segments as shown in Figure 2. Our software automatically generates the drive cycle of a bus running on the target route using the digitized road and traffic signs and a special speed profile database that consists of bus speed profiles collected from major cities around the world.

Figure 22: Digitization of Traffic Lights, Signs, Pedestrian Crossings, Bus Stops, and Speed Limits

We will identify routes that most closely represent categories discussed above. We will then generate drive cycles for these representative routes. As a result, there will be drive cycles that will be representative of all of Topeka's routes and can be combined to represent typical operational "runs." The model is next calibrated against Topeka Metro's actual schedules for the target runs. Moreover, if Topeka has any actual speed data collected through an onboard data acquisition system, Hatch LTK would use those datasets to generate drive cycles such as those shown in Figure 3.

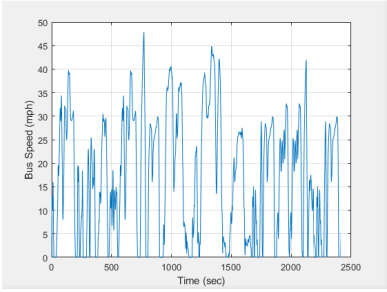
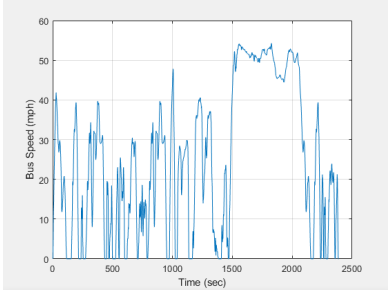
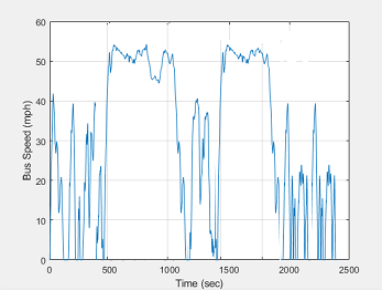
Downtown Area	Downtown to Suburbs	Downtown to Another Downtown
		

Figure 33: Sample Drive Cycles

Vehicle Energy Modeling and Run Simulations

After the drive cycles are developed, we will calculate accurate energy consumption and run time simulations. Our experience with alternative bus technologies indicates that the operating ranges and fuel efficiencies claimed by manufacturers are optimistic, at best. Actual operating range is highly dependent on route characteristics, driving style, climate conditions, and charging infrastructure. For example, steep gradients and high HVAC energy demands significantly degrade operating range, while mid-day and end-of-route layover charging/refueling can materially increase range. We will determine the realistic operating ranges by considering vehicle manufacturers' range claims, actual industry experience, characteristics of individual routes, and opportunities for layover charging/refueling. We will also baseline real-world performance of battery-electric buses from peer systems with similar ridership, operations, and climate.

Hatch LTK will use vehicle energy consumption data, drive cycles and vehicle characteristics to accurately predict the energy requirements of a bus on a given run. EMITS accounts for vehicle characteristics, such as the gross weight, typical passenger loads, road grade, rolling friction, aerodynamic drag, and auxiliary loads, including HVAC.

It is important to note that heating and cooling systems can represent a significant electrical load on the vehicle. As a result, energy consumption and practical vehicle range are highly influenced by seasonal temperature variations. Therefore, Hatch LTK will also consider differential energy demands under summer and winter conditions. EMITS will consider air conditioning and heating loads based on the historical ambient temperature levels.

Per the requirements of the RFB, Hatch LTK will estimate energy demands for the following fleet scenarios:

- Three electric buses added to Topeka Metro's existing fleet
- Sufficient electric buses to operate 25% of Topeka's runs
- Sufficient electric buses to operate service 50% of Topeka's runs
- Sufficient buses to completely electrify Topeka Metro's entire system

Bus Depot and Infrastructure Assessments

With accurate energy demands developed through the operational analysis, we will determine what infrastructure is required to deliver the necessary power. Developing charging infrastructure, however, is one of the toughest issues facing the transportation industry. Therefore, the cost/benefit evaluation of battery-electric propulsion technology requires the analysis of Topeka's existing bus maintenance infrastructure and short-term layover locations.

Review of maintenance infrastructure will focus on facility layout, interior and exterior parking capacity, facility traffic flow and fleet servicing procedures, electrical grid capacity, availability of additional real estate for future expansions, and other site-specific characteristics that will influence the transition to battery-electric technology.

Hatch LTK understands that Topeka Metro is currently considering relocating existing bus maintenance and operations from the current riverfront location. As a result, we can either survey the existing space or review plans of a proposed new facility to develop an assessment of how to incorporate battery-electric bus support infrastructure into these locations.

Figure 4:4 If the existing David Ryan Operating Facility is not replaced, Hatch LTK will survey the location to determine the feasibility of the location for charging infrastructure

If analysis indicates that on-route charging would be necessary for a bus to complete its full daily assigned mileage, Hatch LTK will assess layover locations to determine if and where on-route charging would be feasible. This involves researching available utilities, spatial constraints, local permitting rules, and operational layover times.

We will combine our analysis of Topeka Metro's infrastructure, our assessment of its ability to accommodate electric vehicle operation, and results of the route analysis and energy calculations to develop a clear picture of the type of infrastructure upgrades required for each level of vehicle electrification being considered. Hatch LTK will also investigate the differences between charging at the bus depot only compared to a mixture of depot and on-route charging. The depot-only strategy may require Topeka Metro to alter the size of its bus fleet, depending on operational needs. This is because charging is a lengthy process that can impact vehicle availability. Therefore, our investigation will inform Topeka of any fleet size changes that will be required for two charging strategies.

It is likely that some infrastructure features may be more difficult or expensive to upgrade than others, and that some routes and runs are more conducive to electric vehicles. Therefore, we will develop a staging plan for Topeka Metro that identifies short-, medium- and long-term recommendations for capital planning. We will align these plans to address the three electric bus scenarios, as well as the transition of 25%, 50% and 100% of scheduled runs to electric vehicles. A sample output of such a run conversion analysis is shown in Figure 5.

Client Solutions:
Redwood Coast Transit Authority

Redwood Coast Transit Authority in Northern California is transitioning to battery-electric buses. Hatch LTK developed a transition plan outlining the market availability of the appropriate fleet, the operating requirements of the new fleet, and electrical requirements for their existing bus maintenance facility.

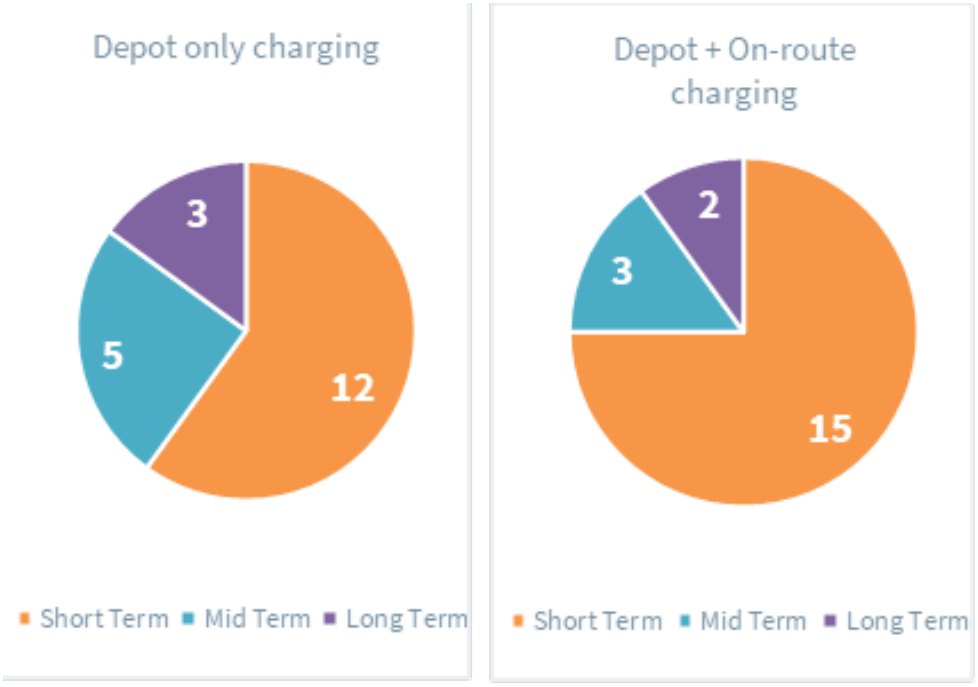


Figure 5: Sample Output – Electrification Conversion Opportunities by the Number of Runs

Charging Schedule Development

Hatch LTK will leverage the service schedules provided by Topeka Metro and combine these with the energy calculations developed for the project to create charging schedules for the agency. These schedules will be developed to optimize the availability of the new electric bus fleet to support revenue operations and maintenance. The charging schedule will also take into account any variability in utility charges throughout the day and seek to reduce electric costs for the agency. Hatch LTK has developed these types of charging schedules for major agencies such as the MBTA. An example of a charge plan developed by Hatch LTK is shown in Figure 6.

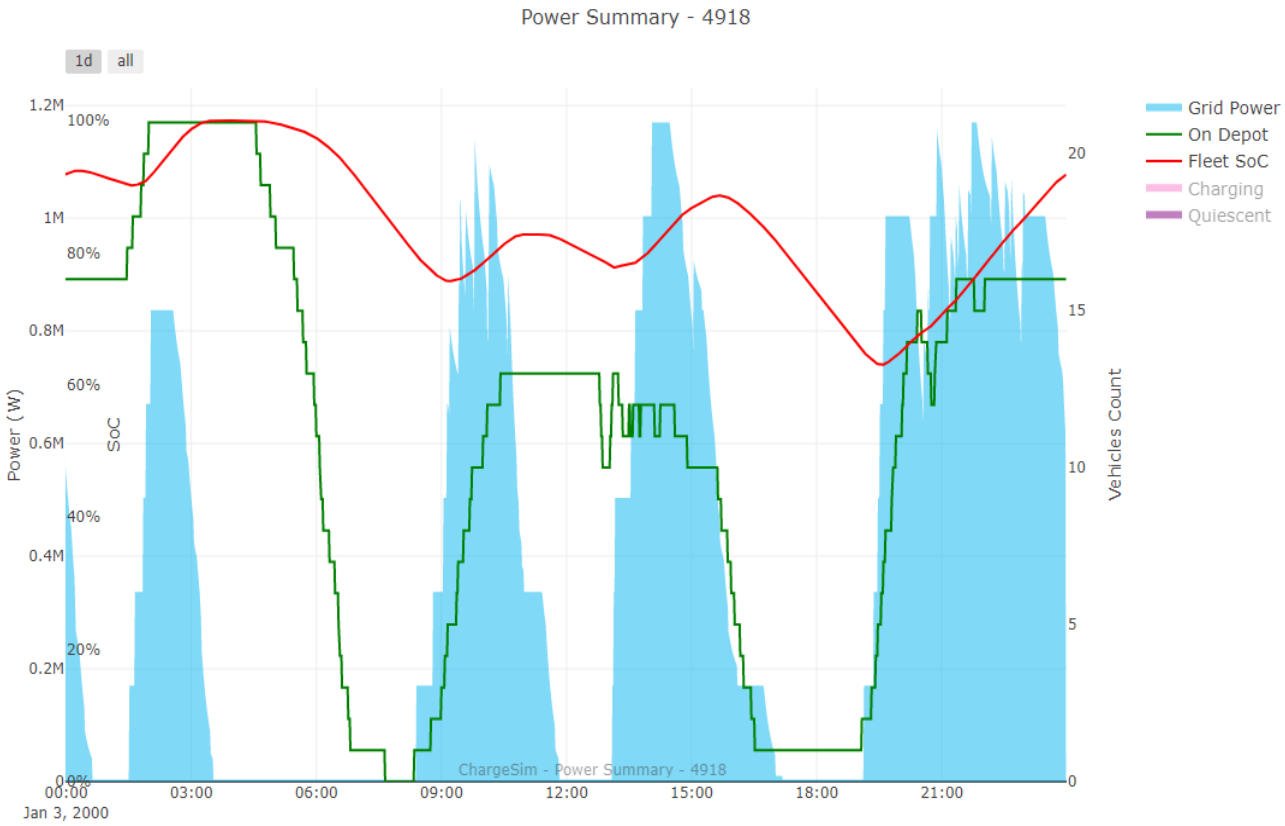


Figure 6: Hatch LTK has developed accurate charging schedules for agencies such as Boston's MBTA

Life Cycle Cost Analyses

The results of all of the previous steps will next be combined to later develop accurate cost projections. Hatch LTK will calculate the life cycle cost (LCC) of the proposed electrification scenarios using a net present value (NPV) model. This allows for the evaluation of all costs incurred over the service life of the technology through the lens of the value of the investment in today's dollars. The life cycle cost includes initial capital costs, operating costs, and maintenance costs of the vehicles and the supporting infrastructure. It will also include costs associated with the potential need for battery replacement at the mid-point of the service life of each bus. The present value of the costs for each year will be calculated using a discount/hurdle rate to be provided by Topeka Metro. The objective of the life cycle cost analysis is to determine which alternative exhibits the most cost-effective solution over the term of its life cycle.

Transitioning operations to alternative vehicle technologies and support systems will have economic implications for Topeka Metro. Taking the total cost of ownership into account is a key issue that requires a solid understanding of end-of-life issues for emerging technologies. In addition, understanding the profile of costs over time is important. We will work with Topeka Metro to define the key criteria needed to assess whether a particular option meets the transit agency's financial capabilities and to serve as metrics to compare among alternatives.

Table 2 below lists the major economic criteria that Hatch LTK will consider in the life cycle costs:

Table 2: Life Cycle Cost Considerations

Category	Diesel (Base case)	Battery-Electric Buses
Capital	Purchase of the vehicles	Purchase of the vehicles
	Mid-life overhaul	Mid-life overhaul
		Battery replacement, recycling, disposal
	Fueling infrastructure upgrades if necessary	Install EV charging stations
		Electrical infrastructure upgrades
		Utility feed upgrades
Operations	Diesel	Electricity
		Demand charges for electricity
		Charge management software subscriptions
Maintenance	Vehicle maintenance costs	Vehicle maintenance costs
		Charging infrastructure maintenance costs
Transition Costs		Operator training
		Maintenance staff training
Financial Incentives		Grants
		Tax incentives

We will complete LCC analyses for the operation of three electric buses as well as 25%, 50% and 100% conversion of all of Topeka's runs to electric vehicles over time.

We will deliver a life cycle cost analysis software prepared in Microsoft Excel at the end of the project so that Topeka Metro can perform its own sensitivity analyses even after our work is finished. The snapshot of the tool prepared for another customer of Hatch LTK is shown in Figure 7:

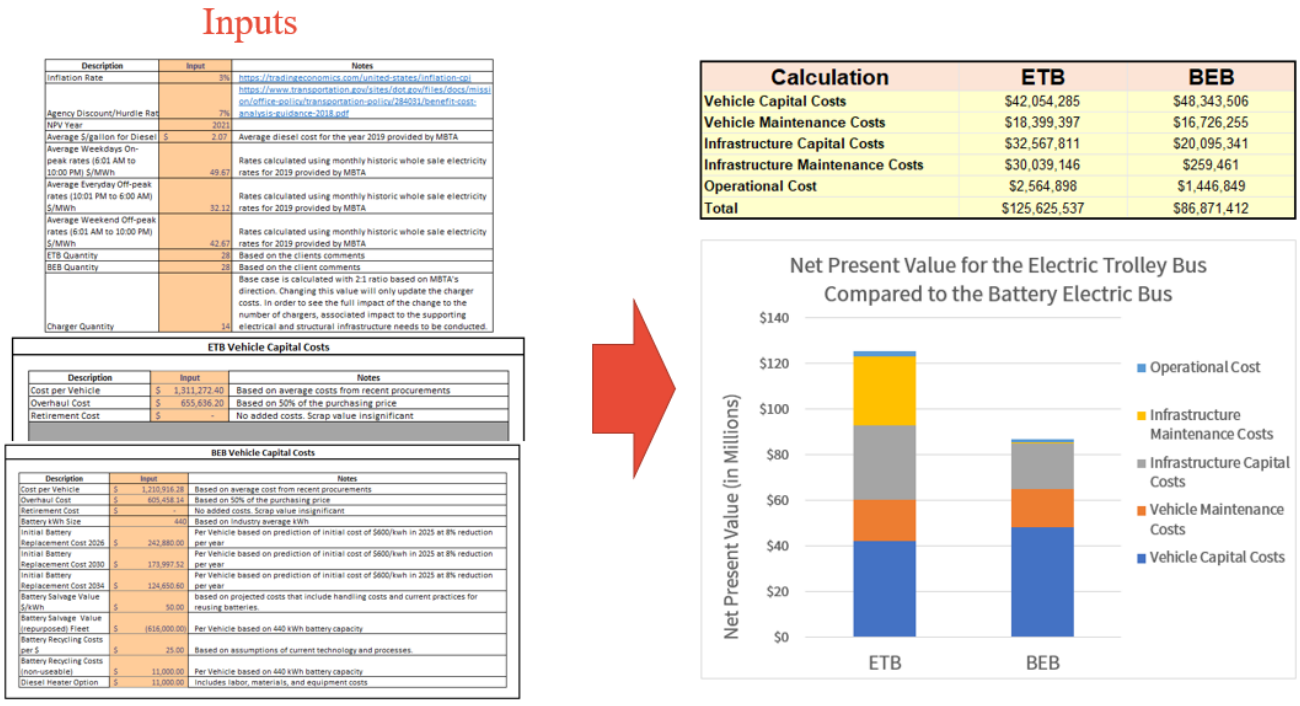


Figure 7: Snapshot of Hatch LTK's Life Cycle Cost Analysis Software

Task 4 Fleet Transition Plan

The inputs from previous tasks will drive the development of the Fleet Transition Plan. We will develop the plan iteratively, validating the outputs and requirements identified in the other tasks, until all the requirements and constraints (cost, technology and infrastructure, and regulatory/policy) are met with minimum effort and risk. From that perspective, the generation of the fleet electrification plan is really an optimization effort with three constraint pillars as shown in Figure 8 below.

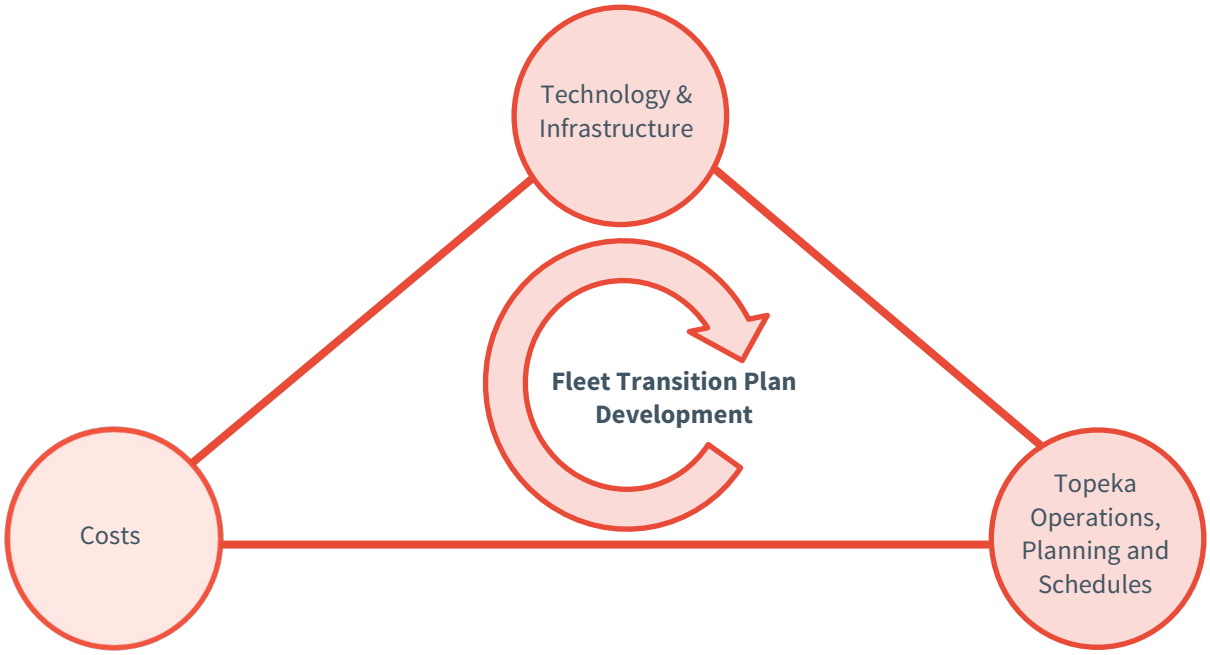


Figure 8: Fleet Transition Plan Development is an Optimization Problem with Iterations while staying within Constraints

We will analyze the technical feasibility and infrastructure sufficiency to meet the operational requirements of Topeka and the life cycle cost for each fleet mix option. We will conduct this analysis for each iteration of fleet mix and select a plan that best suits the agency. We will provide high level sketches of infrastructure layouts, parking flow, and recharging/refueling at the bus depot associated with the suggested plan. These sketches will include details for expansion over time.

The transition plan will also document other required changes within the organization related to staffing, training, maintenance, operations, planning and scheduling. Hatch LTK will provide recommendations to minimize the impact of these changes based on our extensive experience and "lessons learned" from other agencies.

We will also provide guidance to Topeka Metro on conducting the pilot program with the initial three electric buses. We will provide Metro with a roadmap to successfully integrate the three buses into current operations. We will also provide recommendations for how to develop the initial electric bus support infrastructure so that it forms a practical starting point for gradually migrating facility capabilities to accommodate a 100% electric fleet. Therefore, suggested placement of charging infrastructure and operational suggestions will be made with future expansion in mind.

Finally, the transition plan will provide general expansion and implementation strategies that provide guidance on infrastructure management, potential public-private partnerships to improve local charging infrastructure, and vendor selection. For example, we will provide Topeka Metro with a summary of vendors delivering applicable products such as electric buses and charging infrastructure to the US market. This summary will include information on different product lines and performance variables that fit Topeka's needs. We will also provide recommendations regarding required electric bus operating and maintenance activities and the associated operator and technician training.

Project Management

Hatch LTK's Team will effectively manage the project through a strong project management approach. Hatch LTK will begin the project by developing a Project Management Plan (PMP), which will guide Hatch LTK and Topeka Metro through successful execution of all elements of the project. Hatch LTK's PMP will leverage proven techniques included in the Project Management Institute's Project Management Body of Knowledge and Hatch LTK's extensive experience managing electric bus planning projects to ensure that the project is managed efficiently and to Topeka's satisfaction. Hatch LTK's PMP will include the following sections:

- Project Control Procedures
- Scope Management
- Requirements Management
- Schedule Management
- Financial Management
- Quality Management
- Resource Management
- Stakeholder Management
- Communications Management
- Project Change Management
- Risk Management

We will monitor, update, and reference the PMP throughout the project to professionally, efficiently, and successfully manage Hatch LTK's project scope, schedule, and budget.

Hatch LTK's Proposed Project Manager:
Dan Lang, P.E., PMP

Dan is an experienced Project Manager with over 15 years of experience managing complex bus and transit projects for agencies throughout the US. Dan is certified through PMI as a Project Management Professional (PMP) and is well-versed in developing detailed project management plans for guiding major capital planning projects in the bus industry.

Schedule

Hatch LTK has developed the following preliminary schedule based on the Request for Bid document, shown below in Figure 9. This schedule is based on our experience completing electric fleet studies and provides Topeka with efficient results. Please note that this schedule is subject to change once the project is initiated and further details are provided. Please also note that we have assumed a starting date of April 4th but can readily adjust the starting date at Topeka's request.

Task Name	Duration	Start	Finish
Topeka Metropolitan Transit Authority | Electric Vehicle Fleet Study | RFB TO-22-09	**77 days**	**Mon 4/4/22**	**Tue 7/19/22**
Task 1 Coordination with Topeka Metro	7 days	Mon 4/4/22	Tue 4/12/22
Task 2 Baseline Assessment	14 days	Wed 4/13/22	Mon 5/2/22
Task 3 Electrification Planning	**55 days**	**Tue 5/3/22**	**Mon 7/18/22**
Operational Analysis	20 days	Tue 5/3/22	Mon 5/30/22
Bus Depot and Infrastructure Assessments	20 days	Tue 5/31/22	Mon 6/27/22
Charging Schedule Development	7 days	Tue 6/28/22	Wed 7/6/22
Lifecycle Cost Analysis	14 days	Wed 6/29/22	Mon 7/18/22
Task 4 Fleet Transition Plan	14 days	Thu 6/30/22	Tue 7/19/22

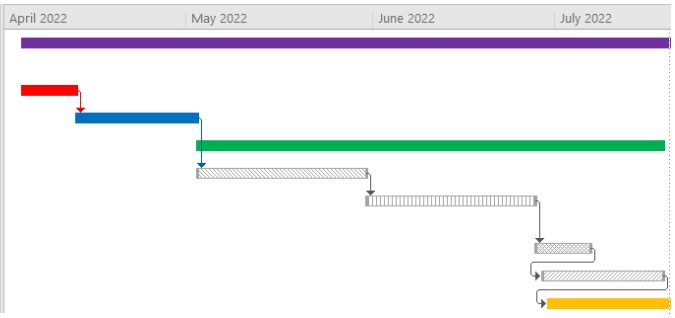


Figure 9: Preliminary Schedule for Topeka's Electric Fleet Study Project

Quality Assurance

We will use our well-established quality control procedures to guide the work of the Hatch LTK Team. These procedures govern our current work and will continue to do so going forward.

Our Quality Policy provides for a quality program that continually evaluates Hatch LTK's performance and takes steps to ensure we meet client requirements. Hatch LTK has established processes so that our project activities are well-managed, written work products are verified for accuracy and completeness through peer review, subconsultant work is controlled, and project documents and records are maintained so they are of maximum use to the project team.

Although not seeking formal registration, Hatch LTK's Quality Management System endeavors to comply with the quality management principles of the ISO 9001:2015 Standard. Although not seeking formal registration, Hatch LTK's Quality Assurance Program also conforms to the quality management principles of the ISO 9001:2000 Standard.

> Our clients have consistently benefited from Hatch LTK's constant focus on the quality of our work products and services.

The Hatch LTK Quality Manual, Revision 4.1, dated January 2019 contains 13 Quality Assurance Procedures (QAPs) and is further supported by more detailed work instructions contained in the Hatch LTK Engineering Procedures Manual. These documents, including forms that serve as quality records, are available to all Hatch LTK employees through Hatch LTK's computer network, and all employees have received quality system orientation. Hatch LTK's standard QAPs are listed below:

QAP 1	Control of Documents and Data	**QAP 8**	Internal QC of Engineering Documents
QAP 2	Control of Records	**QAP 9**	Purchasing
QAP 3	Internal QA Audits	**QAP 10**	Vehicle Inspection and Testing Oversight Services
QAP 4	Control of Nonconforming Items	**QAP 11**	Facilities and Systems Inspection and Testing Oversight Services
QAP 5	Preventive and Corrective Action	**QAP 12**	Calibration
QAP 6	Quality Plan Preparation	**QAP 13**	Quality Training
QAP 7	Management Review		

After Notice to Proceed (NTP), if Hatch LTK activities are not detailed in a client-controlled Project Quality Plan, the Hatch LTK Project Manager is required to prepare a Hatch LTK Project Quality Plan, which assigns project staff responsibilities for Hatch LTK Quality Manual requirements, and identifies details such as the procedures that apply to the work, list of deliverable Hatch LTK work products and services, sequence and schedule for processes required to complete the work, and description of records that must be maintained. Hatch LTK also requires its subconsultants to adhere to our Project Quality Plan or use one of their own if it meets or exceeds, and is consistent with, requirements of the Hatch LTK Plan.

The Project Manager conducts training on Project Quality Plan requirements in an orientation meeting at the beginning of the project to ensure that each member of the Project Team knows how to fulfill their project roles and responsibilities as outlined in the Project Quality Plan.

An assigned Auditor is responsible to periodically audit the project and determine if project activities are performed consistent with the requirements of the Plan. If shortcomings are discovered, the Auditor provides the Project Manager with a report of deficiencies, to which the Project Manager proposes corrective action and agrees to dates when any detected deficiencies will be corrected. The Auditor reviews this information and conducts a follow-up audit as necessary to verify that the remedies have been implemented.

The Hatch LTK Chief Internal Quality Assurance Auditor monitors quality activities and reviews our internal audits. The project Auditor reports to the Chief Internal Quality Assurance Auditor, who reports directly to the Managing Director. This level of involvement ensures that the findings and recommendations of the audits are taken seriously and implemented.

The Managing Director and Chief Internal QA Auditor also discuss overall quality program performance during quarterly management reviews and identify opportunities to improve Project Team performance.

SECTION 3

Firm Qualifications and Experience

Introduction to Hatch LTK

Firm Profile

On October 30, 2020, LTK Engineering Services (LTK) merged with Hatch to become Hatch LTK. Hatch is a privately held, multidisciplinary professional services firm delivering a comprehensive array of technical and strategic services to the infrastructure, energy, and mining and metals sectors. Hatch LTK is now part of Hatch's Infrastructure group with the main office in Ambler, PA and offices in 27 other cities across the US.

Founded in 1921, LTK provided superior service to clients for almost a century. Hatch LTK will build upon LTK's strong legacy of technical excellence and corporate commitment to the rail and transit industries to create positive change for the next century. Hatch LTK will continue to provide the same high levels of staff expertise and work quality in all areas of practice formerly served by LTK, plus offering new capabilities available through the wider resources of Hatch. From the initial project phases — conceptual engineering, project alternatives, right-of-way, and environmental mitigation — through design, construction, and commissioning, we will continue to provide clients with vital support.

As the single most experienced transit vehicle and systems consultant in North America, Hatch LTK has been actively involved in most of the major passenger rail projects in the United States. Our capabilities address all phases of project development. We assist our clients to prioritize projects in accord with available budgets, provide conceptual planning, project alternatives, design, and construction. We provide clients with vital support for the full life cycle of transit assets – from start-up planning, to overhaul, to retirement. Our staff of more than 350 engineers and technical specialists offer expertise in project planning; development of designs and specifications; procurement support; design review; oversight of manufacturing, construction and installation; field testing and commissioning support; and technical support for ongoing maintenance and troubleshooting activities.

Additionally, the broad range of technical and management capabilities available with the Hatch Infrastructure group will allow Hatch LTK to provide an even wider range of services to our rail and transit clients in urban planning and solutions, multidisciplinary project integration, and on-time delivery of systems engineering solutions.

Zero-Emissions Transportation

Many states have mandated reduced emissions from transit. Agencies are looking at all-electric, hybrid diesel/electric, and hydrogen as sources of lower- or zero-emissions vehicles. Hatch LTK has worked with zero-emissions buses and

infrastructure for decades. Planning for the change-over, purchasing the equipment, testing it to be sure it all works, making sure there is enough power along the route – we are experts.

Planning and Analysis

Transitioning to zero-emissions operations is a major effort for any transit agency. Hatch LTK has the experience to conduct a thorough analysis of agency needs and to assist in the delivery of vehicles and systems that meet those needs.

Vehicles (Battery-Electric and Fuel Cell)

Hatch LTK has assisted clients in the procurement, design, and maintenance of zero-emissions bus fleets for decades.

Infrastructure

Hatch LTK has been designing transit power substations since 1935. Today, Hatch LTK leverages its extensive experience to help agencies design charging infrastructure for zero-emissions buses.

Capabilities Matched to Topeka Metro's Needs

Overview

The proposed scope of work covers the key areas where we serve as a market leader – transit vehicles, transit systems, and energy, and all these capabilities are centered in our dedicated zero-emissions practice. With the combined skill sets of our newly merged firm as noted above, the Hatch LTK Team will bring comprehensive capabilities to help Topeka's transit operators evaluate new vehicle technologies by using an integrated systems engineering process. Hatch LTK can assist with every aspect of battery-electric technology transition planning:

- Operations concept development
- Technology assessment, including the future technology trends
- Energy storage and renewal integration
- Utility coordination
- Resiliency and sustainability planning
- Financial and feasibility analysis
- Detailed design and implementation planning
- Economic and data analysis
- Workforce training and development

Zero-Emissions Transportation

Many states and local governments are mandating or strongly encouraging reduced emissions from transit operations. Agencies are looking at all electric, hybrid diesel/electric, and hydrogen fuel cell technologies as they transition to lower or zero-emissions vehicle fleets. Hatch LTK has worked with zero-emissions buses and infrastructure for decades. Planning for the change-over, purchasing the equipment, testing it to be sure it all works, making sure there is enough power to complete the route, and creating system resiliency and sustainability is what we do – we are experts.

Battery-Electric Vehicles

Hatch LTK brings decades of experience in traditional electric vehicle applications, plus recent experience in the burgeoning world of the latest battery and energy storage technologies, to help design a transit vehicle solution tailored to each client's specific requirements, local operation, and zero-emissions goals. Using our proprietary Energy Modeling for Intelligent Transportation and Sustainability (EMITS) simulation software, Hatch LTK can conduct a thorough analysis of our clients' operating needs and define the technologies, vehicle configurations, and power systems necessary to fulfill those requirements. Hatch LTK has also assisted clients in the procurement, design, and maintenance of electric vehicles for decades.

Hatch LTK offers the industry's largest portfolio of high-tech transit rolling stock, totaling over 26,000 passenger vehicles. That level of success means our team can identify opportunities to evaluate and refine every aspect of the vehicle life cycle, from engineering and manufacturing through testing and in-service maintenance, plus midlife overhaul and selective replacement of obsolete components and systems. We can further evaluate the supply chain and infrastructure necessary to support the operation long-term.

Hatch LTK has vehicle engineering specialists covering every aspect of vehicle design and performance. Our deep bench of vehicle engineers and specialists regularly troubleshoot, analyze, and prepare repair plans, procedures, guidelines, and modifications to improve vehicle reliability and availability. From vehicle maintenance plans and procedures, to troubleshooting and obsolescence resolution, Hatch LTK provides its experience and knowledge to enhance and improve transit maintenance and operations.

We understand the current state of battery-electric technology and future trends. We bring experience with a wide variety of alternative propulsion applications covering buses and some of North America's first battery-electric applications in streetcars, locomotives, and work trains. We have recently simulated fuel cell and battery-electric performance of various types of rail vehicles and work equipment. We appreciate the energy storage capabilities and service limitations of battery technologies and the effects of route topology, drive cycle, onboard systems, stopping patterns, and climate on energy requirements and vehicle performance. We provide expert advice regarding practical performance expectations and operating ranges based on our clients' logistical requirements.

Hatch LTK has been involved in some of the most innovative alternative vehicle technology projects in the United States:

+ Battery-electric buses
+ Off-wire electric trolley buses
+ Compressed natural gas buses
+ Battery-operated streetcars
+ Battery-operated locomotives
+ Fuel cell multiple unit railcars
+ Compressed natural gas locomotives

Accurate Energy and Emissions Modeling

Hatch LTK offers highly accurate and detailed simulation of the performance of vehicle propulsion systems and defining the requirements of supporting infrastructure (chargers, fueling infrastructure, maintenance equipment, substations, etc.) Our software suite allows comprehensive modeling of traditional electric traction networks, from utility feeds down to the performance of individual vehicles, and we have expanded our capabilities to calculate the energy demands of battery-electric and fuel cell operations and the anticipated emissions reduction from the transition to alternative propulsion technologies. We offer the capacity to estimate the changes in electrical energy demand as client fleets transition to electric propulsion and the progressive increase in utility usage and needed charger capacity. We can also design energy storage solutions to improve system resilience and reliability.

Our proprietary EMITS model is a step ahead of everything else on the market today. Our fully customizable tool can easily be optimized to meet the exact needs of our clients. Other simulation tools use generic data to give best estimates of your electric vehicle's battery capacity and resulting vehicle range, but our tool takes into consideration all your specific conditions and requirements. Many pieces of information are used to determine the battery life of your bus, including Google Earth route maps, weather and temperature data, passenger loads, current traffic conditions, and more. EMITS can program in specific operational scenarios to allow clients to definitively know if a battery-electric bus will be able to meet its assigned daily schedule on a single charge, require in-route recharging, or if a different propulsion technology should be considered. Our tool can model all routes with specific scenarios so clients can be confident in our recommendations for each one of them.

> EMITS can address specific operational scenarios to allow operators to definitively know if a battery-electric bus will be able to meet its assigned daily schedule on a single charge.

Practical Determination of Electrical Infrastructure Requirements

Hatch LTK designed its first transit electrical power substations in 1935, followed by many more. Today, we leverage this extensive experience to help agencies design charging infrastructure for battery-electric vehicles and modify legacy facilities accordingly. Our expertise in both electric vehicles and wayside electrical systems allows us to examine the interplay between vehicle charging times and vehicle energy demands to determine the number, location, and capacity of charging stations required to support service.

Developing charging infrastructure to support operations is one of the toughest issues facing the transportation industry. Integration of this infrastructure into existing facilities and operational footprints requires careful planning and

optimization modeling to verify that the configuration selected provides efficient results. We consider the following design requirements when integrating new charging infrastructure:

- Substation and utility capacity
- Space requirements to accommodate charging
- Structural requirements to support charging systems
- Permitting/ordinance management for installation
- Cabling and utility routing
- Traffic flow within facilities/properties to accommodate charger locations and charging dwell times
- Ventilation and fire suppression requirements within a facility
- Energy resilience planning and on-site energy storage

Hatch LTK has the needed experience with planning and designing the functional layouts of facilities and yards to optimize operational efficiency. We can simulate client facilities and the associated dynamic duty cycles to accurately determine energy demands and equipment sizing to support the current fleet and future capacity improvements. In addition, we can simulate traffic flow within the property to optimize charging to support operations and reduce costs. For dynamic and opportunity charging, Hatch LTK can develop plans to optimize the spacing of charging infrastructure along the rights-of-way to provide adequate energy supply with minimal operational changes. Finally, Hatch LTK can help design a reliant system by incorporating battery backup systems and additional utility feeds to minimize service interruptions.

Systems Engineering and Integration

Hatch LTK has been actively involved in most of the major and innovative transportation projects in the United States. From our experience, projects that take an interdisciplinary, systems-based approach to project management, design, and implementation are better able to expedite schedules and maintain project controls (as viewed through the lens of cost, number of change orders, risk, etc.). While common in rail projects and Intelligent Transportation Systems (ITS), systems engineering is less commonly applied to bus projects because the project elements are typically designed and procured separately (e.g., bus, facility, farebox, security system) or operate independently (e.g., public highways, traffic signals). Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process for projects to seamlessly proceed from concept to construction to operation. This holistic approach of considering all project elements required to solve a problem typically results in budget and schedule savings.

Adoption of battery-electric buses will create new functional requirements for bus garages regarding charging and parking that will directly affect facility layout and workflow. For electric buses, the physical arrangement of parking areas must now be coordinated with charging infastructure so that buses can be charged during nighttime layover. En-route or midday layover charging may also be nececesary to achieve the required operating range. We offer deep familiarity with the techncial issues that drive these concerns (e.g., battery capacity, operating range, parasitic energy demands of HVAC systems) and can apply our systems engineering expertise to develop well-integrated vehicle concepts tailored to meet Topeka's challenging operating environment.

Creative Design Solutions

Hatch LTK offers decades of experience in the engineering and implementation of systemwide electrical infrastructure for the myriad of power and communications systems located in passenger stations, at maintenance facilities, and along rights-of-way. We are known for our versatility in designing practical electrical solutions for challenging situations and considering how these solutions will interface with the vehicle and support the operations. This experience is extremely valuable in addressing the challenges encountered when designing support services for new technologies that need to be retrofitted into existing facilities and active operations.

Easing the Transition of O&M Staff to Electric Propulsion

Through our extensive experience with vehicles and related logistics, we have developed the expertise to support any client's operation. We offer the services of staff with operating experience to determine how to best integrate electric vehicles (with their charging time requirements, range limits and unfamiliar energy storage systems) into the overall flow

of a client's operations and maintenance activities. We work with our clients to evaluate how to efficiently and effectively integrate electric propulsion and charging infrastructure into O&M plans. We can also develop workforce training plans to address the new requirements of the new technologies that will be employed.

Stakeholder Outreach and Facilitation

Successful transitioning to electric vehicle technology will require close coordination among Topeka Metro, the various agencies, local stakeholders, fleet contractors, other project consultants, and third-party agencies to develop project plans that are based on local needs considering local operational and financial constraints. Our team brings relevant experience in:

- Coordination with transit agencies and third-party contractors and consultants
- Coordination with third-party agencies such as state agencies, regional development groups, transportation partners and municipalities
- City and utility coordination
- Coordination with OEM suppliers
- Community outreach and engagement

Relevant Experience and References

RCTA Zero-Emissions Transition Planning

Hatch LTK assisted Redwood Coast Transit Authority (RCTA) in Northern California in developing a Zero-Emissions Transition Plan. The Plan will assist the agency with meeting the requirements of California Air Resources Board (CARB) mandate to transition their entire fleet of buses and paratransit vehicles to zero-emissions technology by 2040.

To complete this task, Hatch LTK reviewed RCTA's facility to determine areas that would need to be upgraded or reorganized prior to the introduction of zero-emissions technology. Hatch LTK also metered power supply infrastructure and completed calculations to determine what upgrades were necessary.

Hatch LTK is also coordinating with the local utility to determine required infrastructure upgrades and to coordinate the transition of facilities to support battery-electric bus operation.

In addition, Hatch LTK developed a matrix to outline potential replacement models for each vehicle in their existing fleet, documenting differences in operating range, passenger capacity, and other amenities. Hatch LTK also developed a cost estimate for replacing the fleet, and phased schedule for the phasing out of fossil-fueled vehicles.

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Hatch LTK performed an EMITS simulation of RCTA's operations to determine whether zero-emissions vehicles would affect their current operations. Hatch LTK's model was developed using actual grade, speed profiles, and stopping patterns for RCTA's operation to develop real-world, accurate estimates for how actual battery-electric bus models would perform in its system. The results of the simulation indicated that the agency would need to use in-route charging to compensate for the reduced range offered by battery-electric vehicles.

MBTA North Cambridge Trolley Bus/ BEB Fleet Planning Study

As part of Massachusetts Bay Transportation Authority's (MBTA) Bus Modernization Program, Hatch LTK is currently assisting the MBTA with evaluating the next generation bus fleet including battery-electric buses and electric trolley buses. Hatch LTK has been reviewing MBTA documentation and working directly with the agency to develop an expert understanding of the vehicle fleet and the various considerations that should inform fleet and facility planning. Examples of information reviewed by Hatch LTK includes:

- Operating procedures
- Maintenance statistics
- Operating and maintenance cost information
- Key reliability performance indicators
- Vehicle specifications
- Service characteristics
- Utility costs and pricing strategies
- Inspections and corrective work performed on the buses
- Peer system performance

Hatch LTK used the information extracted from this documentation to develop a life cycle cost (LCC) model to compare total cost of ownership (TCO) of an electric trolley bus (ETB) fleet with a battery-electric bus (BEB) fleet. This model projected the relative costs to procure, operate, and maintain these two vehicle technologies and their supporting systems. This included an evaluation of the condition of the existing fleet and systems so that the team can document the baseline condition of existing assets. Hatch LTK reviewed years of maintenance data on fleets both at MBTA and at peer agencies to accurately project future maintenance requirements.

Hatch LTK performed simulations to determine the charging schemes appropriate for MBTA's needs (e.g., depot charging, layover charging, on-route charging), the utility costs associated with the various charging approaches, and the emissions saved based on the vehicle performance. We also evaluated the effects and benefits of diesel heaters during extreme winter conditions.

We developed a vehicle evaluation model based on the cost considerations identified in this analysis that can be later used by the MBTA to further evaluate vehicle technologies based on unique characteristics of its other bus garages. The results of the study will inform the agency's capital and maintenance planning activities for their bus fleets for decades to come.

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MBTA Southampton Bus Charge Power Supply Evaluation

The Massachusetts Bay Transportation Authority (MBTA) won a grant from the Federal Transit Administration (FTA) for the Silver Line Zero-Emissions Bus project. Under this pilot project, the MBTA will receive five electric, battery-powered, articulated buses, which will operate on the MBTA Silver Line. The batteries will be recharged at specific on-route locations and at the Southampton Depot facility using high-power, fast charging stations.

The bus battery charges are powered by 480 Vac, 60 Hz, three-phase power. The purpose of this project was to develop and analyze various methods for suppling the power and then recommend the optimal solution for providing 480 Vac power to the battery chargers. The Southampton Depot and adjacent unit and traction power substations are powered by MBTA's own 13.8 kV distribution system.

Hatch LTK visited the Southampton Depot and the unit substation and conducted equipment and power demand audits to determine electrical parameters of the equipment and the loading of the auxiliary transformers. Hatch LTK also performed the depot site survey to determine the most suitable battery charger locations and supply cable routing. Subsequently, the data collected during the site visit were input into PowerFactory software that already included the complete model of MBTA's 13.8 kV distribution network. Hatch LTK performed comprehensive load flow studies to determine loading on the distribution system and charger feeder cable loadings and busbar voltages.

The following options for the charger feeding were developed:

- Supplying the chargers from existing auxiliary transformers in the unit substation and expanding the 480 Vac switchgear by additional circuit breakers
- Replacing the existing auxiliary transformers with larger capacity units if the existing units are insufficiently rated
- Procurement and installation of an additional new transformer and new 480 Vac switchgear dedicated to the bus chargers
- Obtaining a 480 Vac supply from Eversource, the local power utility company

The above options were reduced to three, with the option to obtain a new power source from the utility eliminated immediately due to its high cost. Subsequently, preliminary engineering was performed for each of the remaining options. The work included determination of transformer parameters, 480 Vac switchgear configuration

and rating, cable sizing, locations of equipment and cable routing. The options were evaluated for their advantages, disadvantages, technical feasibility, and cost. Based on these factors, Hatch LTK recommended that Option 3 (one additional transformer and new 480 Vac switchgear) would be the best option for the MBTA.

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King County Trolley Bus Evaluation

Serving the Seattle metropolitan area, King County Metro operates one of North America's largest trolley bus networks. The 14 trolley bus routes carry 20 percent of Metro's weekday riders on 159 trolley buses. The routes have 70 miles of two-way overhead wire. Maintenance of this infrastructure incurs costs that using self-contained vehicles could avoid, and progress continues developing such "wireless" vehicles that also retain the advantages of electric propulsion.

Trolley buses have an expected useful life of about 15 years. In anticipation of its next procurement of replacements for the present aging fleet, Metro retained Hatch LTK to assist in evaluating several vehicle alternatives:

- Electric trolley buses taking power from the overhead contact system
- Battery-electric buses
- Fuel-cell powered electric buses
- Hybrid diesel-electric buses
- Motor buses burning compressed natural gas

Hatch LTK had responsibility for several tasks within the study. First, the firm surveyed trolley bus fleets of the six systems that continue to operate them in North America: Boston, Philadelphia, Dayton, San Francisco, Seattle and Vancouver, BC. This reconnaissance supported preparation of a bus technology and vehicle system assessment. We evaluated the capability of candidate vehicles to operate successfully on Seattle's steeper hills. We also reviewed trends in the use and further development of diesel-generator and battery-based auxiliary power units (APUs).

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With these technical analyses completed, Hatch LTK prepared a life cycle cost analysis of vehicle alternatives. The results of these studies were combined in a project report with environmental comparisons and consideration of federal funding sources. The study concluded that two technologies merited further study: electric trolley buses equipped with battery APUs and hybrid diesel-electric buses, though we noted that the latter might require modification to the drive train system for travel on the steep hills in Seattle, which would limit top speed on level grades. We recommended that these be dropped from further consideration as trolley bus replacements: battery-electric buses, fuel-cell powered electric buses, and motor buses burning CNG. In evaluating the study, Metro decided that the risks of trying to use wireless buses on Seattle's steeply graded transit lines, combined with the environmental advantages of electric propulsion in a region largely dependent on hydropower power, made procurement of new electric trolley buses the most desirable course of action.

GDRTA Electric Trolley Bus Opportunity Charging Station Development

The Greater Dayton Regional Transit Authority (GDRTA) operates a fleet of next generation electric trolley battery buses (ETBB) that can operate both on-wire and off-wire, using an overhead contact system and their onboard battery storage systems, respectively. To take advantage of their new off-wire capabilities, GDRTA engaged Hatch LTK to procure a custom ETBB charging station unit that could be installed at bus stops and depots along off-wire routes to take advantage of the ETBB's trolley collector poles to charge the battery.

The 15 miles of off-wire battery range of the fleet has allowed for GDRTA to extend routes without the high cost of infrastructure to extend the overhead trolley wires. By installing strategically located opportunity chargers at bus layover locations, GDRTA has the capability to extend the off-wire sections of the routes to provide greater access and route flexibility to GDRTA riders.

Hatch LTK supported GDRTA in developing an opportunity charge solution that can be implemented at multiple locations in the GDRTA system. Hatch LTK performed an industry review of the existing products on the market that met GDRTA's requirements for an opportunity charger. Following the industry review, Hatch LTK developed the requirements for a custom opportunity charger that met GDRTA's specific needs while allowing for existing products to be adapted for application to the GDRTA system.

Project Highlights

- Hatch LTK performed an industry review to survey existing products that could be adapted to interface with trolley bus poles
- Hatch LTK and GDRTA worked closely to develop the electrical, mechanical, and communication requirements of the opportunity charge solution
- Hatch LTK developed performance specifications and drawings for GDRTA to solicit bids for an opportunity charger solution
- The charging stations will have a smaller footprint than traditional traction power substations and will consist of two main components: the charger unit, and the overhead charging assembly
- The charger unit will convert 480 Vac 3-phase power to 600 Vdc and will deliver power to the ETBB

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TTC eBus Program

Toronto Transit Commission (TTC) procured Hatch's service to assist with their electric bus roll out program. As part of their pilot, TTC currently operates 60 battery-electric buses from manufacturers like New Flyer, Proterra and BYD. TTC currently operates these vehicles out of three garages. Hatch has played a central role in this pilot roll out and continues to provide planning and design assistance to TTC with the future electric bus deployment. Hatch has been involved with various aspects of battery-electric bus deployment, from specification and technology review to facility assessment and preparation for electric bus operation.

Scope of Services

Technology Assessment: Hatch was heavily involved with design, procurement, installation, and commissioning of a proof of concept (POC) for installation of a centralized charging system and pantograph dispensers for 40 electric buses. This installation is being done on an existing outdoor gantry system, which required Hatch to perform a

structural assessment. Hatch also performed a technical assessment of the available electric bus charging stations, and charging management products in the market for suitability in TTC's operation.

Facility Readiness: Hatch played a crucial part in preparing the three garage locations for the electric bus operation including coordinating with the various TTC Departments to get consensus and approval for transforming the existing garage locations to safely house the new switchgear and charging equipment.

Hatch was involved with the following steps of the facility transformation:

- Removal and/or relocation of existing equipment and material, and preparations for the site to accept the new system
- Design and procurement of the appropriate switch gear equipment, transformers, and breakers to safely supply the correct power to the charging equipment
- Design, procurement, delivery, installation, and commissioning of 60 charging stations and the associated dispensers
- Installation of energy monitoring and smart charging systems at all the garages
- Design procurement, delivery, installation, and commissioning of battery energy storage systems (BESS) ranging from 3 to 4 MWh and the related supporting interface switchgear at the three facilities
- Installation of all safety and monitoring systems for safe operation of the BESSs, including installation of the adequate SCADA systems and connections to the local fire alarm system
- Design, development, and installation of the safety systems as per Toronto Fire Services (TFS) requirements
- Development of the emergency response plan to be used by emergency services in case of a thermal runaway condition
- Development of the FMEA (Failure Modes and Effects Analysis) document

Utility Feeder Upgrade: Due to the increased energy demand from the electric buses, the feeders at two of the bus garages needed upgrading. Hatch coordinated with Toronto Hydro to upgrade the incoming feeders at one of the bus depot facilities to 2MVA, and coordinated upgrades to supply transformers, fuses, and cabling. Hatch is currently coordinating upgrades to the feeders and the appropriate offer to connect (OTC) at the second garage.

Hatch was also involved on the commercial side of the feeder upgrade supporting the design specifications and the offer to connect/connection cost agreement (OTC/CCA) for Toronto Hydro to approve the technical design, cost of the upgrade and the installation schedule.

For an energy storage system and on-site backup generation, Hatch coordinated the connection impact assessment (CIA), Toronto Hydro conditions of service (COS) for distributed energy resource (DER), and agreements for Toronto Hydro's access to TTC property for parallel generation facility.

Resilience Planning: Pulling from the deep expertise in the distributed generation and remote mining site resiliency planning, Hatch was able to assist TTC with the design, procurement, installation, and commissioning of a 6MW CNG emergency back-up generator plant for backup power. This included working with Enbridge on the guaranteed long term CNG supply for the new generators.

Hatch also worked with the manufacturers in securing maintenance agreements for charging equipment and the CNG plant.

Future Planning: Hatch is working with Toronto Hydro on the design, construction, and installation of 10MW redundant feeders at eight other TTC bus garages to be able to support the future electric bus roll out from these garages. The upgrades include appropriate substations, PMS (Pad Mounted Switches), switch gear, transformers, and breakers.

Hatch has also coordinated with contractors to assess the feasibility of installing on-site solar generation on existing TTC garages and other buildings' roof structures.

Project Highlights

- Provided integral support on the bus depot facility upgrades for battery-electric bus operation
- Implemented an onsite backup generator for system resiliency
- Assessment of smart charging technologies and strategies

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Proposed Project Team

Daniel Lang, P.E., PMP
Project Manager

Daniel Lang has 15 years of experience in vehicle, wayside infrastructure, systems engineering, and system safety aspects of transit, rail, and bus industries including hands-on assignments with clients in both the transit and freight sectors. He currently leads Hatch LTK's Zero-Emissions Group, which assists clients with planning for electric vehicle implementation. His work history includes providing consultation to transportation, maintenance, and vehicle procurement departments. Dan is experienced working both as a design specialist and a project manager. At a major equipment supplier, he managed large scale capital improvement projects for Class I railroads and transit agencies with budgets exceeding $250 million. Dan has design experience working with buses, locomotives, electric multiple units, and light rail vehicles. He has participated in the testing of wayside and vehicle systems and has conducted reliability studies and failure analyses. Additionally, Dan has helped develop maintenance and training programs and has provided vehicle inspection services to several transit authorities. Dan has also managed multiple structural overhaul, instrumentation studies, and fleet assessment programs.

Vincent D. Pellegrin
Vehicles Lead

Vince Pellegrin has 40 years of Public Transit agency experience in bus operations, equipment maintenance, executive management, budgeting and financial management, labor relations, and service planning and scheduling. He is recently retired from Metro Transit in Minneapolis where he led the implementation of a Federal No-Lo grant for battery-electric battery powered bus and bus fleet implementation. This included technical specification preparation for electric buses, bus battery charging equipment, as well as associated electric bus maintenance equipment and procedures and technician training requirements. Also, Vince managed route planning and revenue service implementation of electric battery powered buses. In sum, his public transit agency experience has included the development and service implementation of low emission CNG, Methanol, and hybrid-electric powered buses. He prepared the technical specifications, procurement, and construction of a heavy-duty diesel test facility for the California Air Resources Board. He has worked on bus low exhaust emission projects with the California Energy Commission and the South Coast Air Quality Management District in Southern California.

Mihir Bodarya, P.Eng.

Infrastructure Lead

Mihir Bodarya has 6 years of experience in the industry and is a business and engineering professional with extensive experience creating a positive and lasting impact through process and strategy changes within engineered equipment manufacturing and consulting industries. In his previous position, Mihir was a supplier of electric vehicle charging equipment. This experience provides him with keen insights into how a transit agency can best implement electric vehicle charging infrastructure. He is respected for strategic thinking and getting to root causes of issues. Mihir possesses a unique combination of technical know-how and business operations knowledge, which makes him an effective problem solver. He can effectively draw connections between business objectives and technical specifications.

Mihir is passionate about sustainable technologies, and he is an advocate for reducing environmental impact through adoption of sustainable technologies and improving business practices.

Oguz H. Dagci, Ph.D., P.E.

Route Planner

Oguz Dagci has 21 years of experience and his background in electric vehicle design provides him with a detailed understanding of the dynamics between the vehicle and the charging infrastructure and the future direction of the industry. Oguz brings specialty expertise in the design of battery-based energy storage systems, charging and discharge characteristics, and application in the transit environment. Oguz has developed the Hatch LTK's electric bus simulation model, EMITS, to evaluate electric bus performance and determine required battery capacity and charger requirements. The model is integrated with Google maps to allow visualization of the operations of an electric bus fleet and can be localized to reflect Topeka Metro's unique operating characteristics.

Before joining Hatch LTK, he worked in the automotive industry, including both light-duty and heavy-duty vehicle segments, with emphasis on electronic control of diesel and gasoline engines, automatic transmission control, vehicle electrification including battery system and electric powertrain modeling, hybrid electric and full electric vehicle system specification, optimization, simulation, and control. Oguz started his career working for General Motors focused on vehicle instrumentation, control software development, and electronic hardware for research projects.

Later, he switched his focus from gasoline and diesel engines to vehicle electrification and completed his Ph.D. in this area while working as a technical specialist in vehicle electrification in the industry at various roles ranging from advanced engineering projects to production software development programs.

Rachel Bramwell, AICP

Cost Analyst

Rachel Bramwell is a Senior Urban Planner in Hatch's Urban Solutions group in New York City, where she manages planning, economic and real estate advisory projects across the United States. Since joining Hatch in 2018, Rachel has contributed to the Port Master Plan 2050 for the Port Authority of New York and New Jersey and has completed economic impact analyses for mixed-use developments in New York. She is currently managing Transit-Oriented Development land use planning and real estate projects for Sound Transit and for the San Francisco Municipal Transportation Agency. Prior to working at Hatch, Rachel was a Senior Strategist at MKThink, a San Francisco-based design and planning firm, where she developed real estate and portfolio optimization strategies for education and municipal clients. Prior to joining MKThink, Rachel worked as an Urban Planner in Deloitte's Real Estate group, focusing on real estate advisory in Central London for private developers, and at AECOM, where she focused on the socio-economics of infrastructure planning, primarily for the London Olympic Legacy Plan.

Daniel Lang, P.E., PMP

Project Manager

Education

Ph.D., Systems Engineering, Colorado State University, Anticipated Graduation 2022
M.S., Engineering/Engineering Management, Purdue University, 2014
B.S., Mechanical Engineering, Drexel University, 2011

Professional Affiliations

Professional Mechanical Engineer: Delaware #20706
Project Management Professional: Global #2177249

Years in Practice	Years with Hatch LTK	Years with Other Firms
15	6	9

Selected Experience

Rail Car Procurement, Greater Cleveland Regional Transit Authority (GCRTA), Cleveland, OH
Project Manager. Responsible for guiding the transit agency through the procurement of a new rail vehicle fleet. Completed an industry survey of all new vehicle designs being used in North America. Conducted an analysis that concluded that a single new fleet could replace two existing legacy fleets. Conducted cost benefit analyses associated with required infrastructure changes and operational improvements offered by available vehicle platforms. Completed industry reviews to identify key design features for the new fleet. Developed vehicle specifications that included cutting edge technologies such as viral mitigation. Developed commercial terms and cost estimates associated with the procurement.

Trolley Modernization Vehicle Specification Development, Southeastern Pennsylvania Transportation Authority (SEPTA), Philadelphia, PA.
Project Manager. Led a team of experts tasked with developing technical specifications for a new fleet of low floor trolleys (Light Rail Vehicles). The team incorporated the complexity of integrating a modern vehicle into a legacy system with some of the most challenging infrastructure and operating conditions present in North America. LTK conducted surveys of various vehicle technologies and trends and presented them to SEPTA to assist in their conceptualization of their modernized system.

Proterra Bus Composite Cracking Issue, Southeastern Pennsylvania Transportation Authority (SEPTA), Philadelphia, PA
Project Director. Oversaw a team tasked with investigating systemic cracking issues identified on SEPTA's new fleet of Proterra buses. The team reviewed structural drawings, bus builder presentations, Finite Element Analysis models, and conducted ultrasonic inspection of the cracks to identify the root cause.

Proterra Bus Axle Rating Review, Southeastern Pennsylvania Transportation Authority (SEPTA), Philadelphia, PA
Project Manager. Conducted a structural review of the Proterra Catalyst E2 bus being delivered to SEPTA. Completed an industry review of testing completed on transit buses. Reviewed the electric bus market to

identify operating histories and trends in the industry. Produced a report documenting the predicted duty cycle for SEPTA's fleet and recommendations for further structural analysis.

COVID-19 Pilot Programs, Toronto Transit Commission (TTC), Toronto, ON.
Safety Expert. Provided TTC with technical guidance in response to the COVID-19 pandemic. Designed multiple pilot programs to test and validate the efficacy, reliability, maintainability, and costs associated with technologies such as ionization, ultraviolet, filtration, and antimicrobial materials. Presented cost estimates and efficacy review to TTC's general manager and executive team.

COVID-19 Mitigation Efforts, Buffalo Niagara Frontier Transportation Authority (NFTA), Buffalo, NY.
Safety Expert. Provided NFTA with technical guidance in response to the COVID-19 pandemic. Reviewed NFTA's cleaning and disinfection procedures and provided a gap analyses versus industry standards and best practices. Provided NFTA with a list of potential methodologies and technologies that could be incorporated into their operations to improve COVID-19 mitigation.

Rail Car Evaluation, Greater Cleveland Regional Transit Authority (GCRTA), Cleveland, OH.
Project Manager. Conducted an assessment on GCRTA's heavy rail and light rail vehicle fleets. Performed a structural and systems assessment of the fleets. Developed cost estimates and financial histories to help GCRTA assess whether to overhaul or buy new vehicles. Created updated maintenance practices and systems upgrades for the fleets.

Technical Papers

- Lang, D., Radford, D.W. "Design Optimization of a Composite Rail Vehicle Anchor Bracket," Urban Rail Transit (2021). https://doi.org/10.1007/s40864-021-00144-9
- "Cleaning and Disinfecting Transit Vehicles and Facilities During a Contagious Virus Pandemic," B. Alberts, D.O. Lang, APTA Standards Development Program White Paper APTA-SS-ISS-WP-001-20, 10 June 2020
- "Fleet Assessments: A Key Step in Planning for the Future," D. O. Lang Mass Transit Magazine, 6 June 2017
- "Measurements of Dimensionless Light Extinction Constants for Biodiesel and Diesel Soot," Park, S. H., D. O. Lang, M. Y. Choi, 18th International Symposium on Transport Phenomena, Daejeon, Korea; US-Korea Conference on Science, Technology and Entrepreneurship, 2007

Employment

- Hatch LTK (previously LTK Engineering Services)
  (2020-Present) Manager Vehicle System Assurance
  (2017-2019) Principal Engineer – Mechanical/Systems
  (2015-2017) Staff Consultant – Mechanical
- Xorail Corporation
  (2015) Project Manager II
  (2011-2015) Project Manager
- STV Incorporated
  (2009-2010) Vehicle Specialist
- Sarnoff Corp.
  (2008) Optical Engineer
- Drexel University
  (2006-2010) Researcher Mechanical & Material Engineering Departments

Vincent D. Pellegrin

Vehicles Lead

Education

Bachelor of Science, University of Southern California, 1975

Professional Affiliations

State of Minnesota Certified Emergency Manager

Years in Practice	Years with Hatch LTK	Years with Other Firms
40	1	39

Selected Experience

Metro Transit, Minneapolis, MN.
Chief Operating Officer, Lead the Bus Service Operation. Lead the Light Rail and Commuter Rail Service Operation. Responsible for the 86 car Light Rail Vehicle Fleet. Responsible for 6 diesel locomotives and 18 commuter rail cars. Responsible for a fleet of 980 buses. Responsible for Bus and Rail Transportation Operations. Responsible for Bus and Rail Service Planning and Scheduling. Responsible for Facility Maintenance, Engineering, and Capital Improvement Program management. Responsible for Northstar Commuter Rail Operations and Equipment Maintenance. State of Minnesota designated of Emergency Manager for the Metropolitan Council. Responsible for Electric Bus implementation project, including service operations, bus charging and maintenance strategies.

Metro Transit, Minneapolis, MN.
Director of Equipment Maintenance, Directed maintenance policy and activities for 950 bus fleet and 300 non-revenue vehicles. Directed the preparation and development of technical specifications for new buses, all electric buses and non-revenue vehicles. Developed fleet replacement plans in cooperation with service planning needs. Developed, negotiated, and implemented solutions to labor union bargaining unit contracts and issues.

Metropolitan Transportation Authority/New York City Transit, New York, NY.
Chief Officer Research and Development, Directed and approved technical specification development for all new and remanufactured buses. Managed new bus procurement contracts manufacturing, plant inspection and new bus delivery. Developed and directed the accelerated Bus Manufacturer Qualification Program including qualification of articulated and low-floor buses. Implemented the innovative use of Finite Element Analysis and accelerated road simulation stress testing of bus structures. Directed the Hybrid-Electric Bus Development Program with Orion and GE, resulting in an operational low-floor bus. Principal responsibility for the compressed natural gas (CNG) bus evaluation and demonstration program. Implemented several ongoing R&D programs including Battery Powered Bus Project with the New York Power Authority and Hybrid Electric Retrofit project with General Motors and the New York Power Authority. Researched in the field of advanced technology for buses including serving as NYCT representative on several national advisory committees, e.g., fuel cell propulsion, and the Federal Transit Administration's Advanced Technology Transit Bus Project. Advised the Senior Vice President on all technical matters including bus technical specifications, bus engine emissions,

American Disabilities Act, national Energy Policy Act, Clean Air Act, NY State Implementation Plan, equipment safety, and dynamometer-brake testing. Directed the testing and qualification of all new bus components and sub-systems, including engines, transmissions, A/C systems, electrical systems, air systems, and structural durability. Develop and updated the fleet procurement plan for the Capital Program. Chief technical representative for bus procurement negotiations.

Los Angeles County Metropolitan Transportation Authority, Los Angeles, CA.
Senior Engineer, Managed the introduction of the nation's largest alternative fuel bus program including CNG buses, methanol buses, and diesel particulate trap programs. Developed original or new specifications for CNG buses, fueling equipment and maintenance facilities. Specified, constructed and operated the California Air Resources Board Heavy Duty Vehicle Emission Test Facility. This test facility documented the exhaust emission level of buses and trucks powered by alternative fuels. Developed specifications for and designed the Federal Transit Administration's Advanced Technology Transit Bus Program with Northrop Grumman. Directed and developed bus technical specifications and bus procurement activity, both diesel and alternative fuel powered. Advised senior management and conducted analytical evaluations on the implications of alternative fuels both environmentally and operationally. Directed testing of, and qualified for purchase, new components for buses and additional sources of supply. Prepared all of the technical specifications for the fuels and lubricants used in the bus fleet. These include diesel, CNG, methanol, engine and transmission lubricating oil, and gear oils. Supervised the bus Maintenance Quality Assurance department and State of California bus safety inspections. Managed support for 1984 Olympic Games bus service task force. Conducted instructional classes in all areas of bus maintenance. Conducted instructional classes in NIMS 100, 200, 700, 800. Conducted emergency preparedness classes for the National Transit Institute. Prepare Emergency Operations Plans for Light Rail and Commuter Rail.

Publications

- "Retrofitting a Catalytic Trap Oxidizer to a Metropolitan Transit Bus", Society of Automotive Engineers Technical Paper Series.
- "Correlation of Lubricating Oil Solids with Engine Smoke Levels", Society of Automotive Engineers Technical Paper Series.
- "Methanol Engines Research and Development to Operational Reality", Society of Automotive Engineers Technical Paper Series.

Presentations

- Bus Fleet Exhaust Emission Reductions, Metro Transit April 2010. New York City Transit, November 1995, L.A Metro, July 1988.
- Implementation of Zero Emission Buses in the Twin Cities, Metro Transit, March 2018
- Operational Cost Implications of Battery Electric Buses, Metro Transit, May 2020
- Operations Facility Requirements and Safety Considerations for Battery Powered Buses, Metro Transit, February 2020
- Hybrid Electric Bus Fleet Reliability and Cost Comparison, Metro Transit, May 2015

Employment

- Hatch LTK (previously LTK Engineering Services)
  (2021 to Present) Zero Emissions Consultant
- Metro Transit
  (2000 to 2021) Chief Operating Officer
  (1998 to 2000) Director of Equipment Maintenance
- Metropolitan Transportation Authority/New York City Transit
  (1994 to 1998) Chief Officer Research and Development
- Los Angeles County Metropolitan Transportation Authority
  (1981 to 1994) Senior Engineer

Mihir Bodarya, P.Eng.

Infrastructure Lead

Education

Master of Business Administration, Western University, 2017
Bachelor of Applied Science, Electrical Engineering / Management Science, University of Waterloo, 2012

Professional Affiliations

Professional Engineer: Alberta #152533

Memberships

Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Years in Practice	Years with Hatch LTK	Years with Other Firms
6	1	5

Selected Experience

Zero-Emissions Facility Analysis, City of Fort Collins, TX.
Electrical Engineer. Evaluating power availability at the operations and maintenance facility of the city's transit agency for electric fleet operation. The evaluation will feed into recommendations for necessary upgrades to support the planned transition, the rough order of magnitude costs for the upgrades and development of conceptual layouts for charging infrastructure. The scope also includes market evaluation of on-site energy storage options.

Trolleybus Study, Massachusetts Bay Transportation Authority (MBTA), Boston, MA.
Charging Infrastructure Consultant. Conducting a comprehensive study that will help MBTA in deciding whether to replace the trolleybus system, that is operating out of one of their garages, with battery-electric buses or procure Trolleybuses again at the end of the current system life cycle. The study includes life cycle costs analysis for the two technologies using net present value (NPV) as well as analysis of various non-financial factors like customer experience, safety, operational flexibility, reliability, operating environment, market direction, available funding etc.

Zero-Emissions Transition Planning, Redwood Coast Transit Authority (RCTA), Washington, DC.
Charging Infrastructure Consultant. Analyzed the route energy needs and route schedule to determine the charging needs for deploying battery-electric bus fleet on RCTA routes. The current electrical infrastructure and utility feed at the RCTA maintenance facility was also analyzed for its ability to support the charging needs. Outcome of the analysis informed recommendations for the charging system, electrical infrastructure upgrade, utility feed upgrade as well as order of magnitude cost estimates.

AddÉnergie/Services Flo Inc
Specifications Manager – Central Canada. Developed and nurtured relationships with key influencers and decision makers to position AddÉnergie as the preferred Electric Vehicle (EV) charging infrastructure provider.

Conducted seminars and delivered presentations to educate stakeholders on EV charging including return on investment (ROI), technical standards, regulations, and best practices. Helped clients and engineers determine most optimal EV charging infrastructure arrangement based on the unique needs and challenges of the application. Increased the company's brand awareness in the engineering and architect's community through networking activities and participating in industry events. Proactively collected feedback from different stakeholders, in the decision-making process, as well as end users to inform product managers on the areas for product improvements, software bugs, and potential new features for future upgrades. Spearheaded multi-pronged initiatives which were aimed at getting the company's products specified in new construction projects; the project included website revamp, creating technical document templates, and registering products on specification writing platforms.

The StressCrete Group
Sales Engineer. Created customer interface and sales strategy to strengthen the company's presence in the US northeast utility market. Assisted in developing marketing material and pricing strategy for the utility concrete pole product line. Developed new relationships with standards engineers, specifiers, decision makers, and influencers and educated them on the operation and financial benefits of using concrete poles in grid resilience applications through Lunch & Learns, trade shows, and other networking activities. Served as a liaison between the client and various functions within the company such as engineering, production, and accounting to deliver custom solutions that met customer specifications, managed changes to Purchase Orders, and ensured timely delivery and payments. Led an initiative to develop a new utility and streetlight pole product line that would integrate 5G small cell antenna to serve the upcoming demand in telecom industry for 5G network deployment. Helped prepare bids for LED conversion and new lighting projects for clients such as cities and utilities.

Edmonton Terminal Expansion, Enbridge Pipeline
Electrical Engineer in Training. Worked on the Front-End Engineer Design (FEED) and Detail Design work for the expansion project. Created Material Takeoffs (MTO) to aid with the detailed cost estimates. Worked on all aspects of detailed electrical design of the plant including electrical layouts for buildings, cable and equipment sizing, and electrical heat tracing. Created load lists for sizing and specifying electrical equipment such as transformers, generators, and Uninterruptable Power Supplies (UPS). Created scope of work documents and Material Requisition documents for building subcontractors and equipment vendors. Assisted with vendor selection for various equipment including Motor Control Centers (MCC), Variable Frequency Drives (VFD), and Uninterruptable Power Supplies (UPS) by preparing Requests of Quotations (RFQ) and performing Technical Bid Evaluations (TBE). Reviewed vendor documents for design approvals. Helped deliver high quality deliverables to the clients by adhering to company's quality assurance policies and performing interdisciplinary and discipline quality checks on deliverables. Lead electrical design work for a portion of the expansion project which included end-to-end electrical design work, scope management, change management, monitoring project progress, and delivering final construction work packages.

Employment

- Hatch LTK (previously LTK Engineering Services)
  (2020-Present) Staff Engineer
- AddÉnergie/Services Flo Inc.
  (2018-2019) Specifications Manager – Central Canada
- The StressCrete Group
  (2017-2018) Sales Engineer
- Stantec Consulting Ltd
  (2012-2015) Electrical Engineer in Training

Oguz H. Dagci, Ph.D., P.E.

Route Planner

Education

Ph.D., Electrical Engineering and Computer Science, University of Michigan, 2018
MBA, Indiana University, 2008
M.S., Electrical Engineering, The Ohio State University, 2002
B.S., Electrical and Electronics Engineering, Bogazici University, Istanbul, 2000

Professional Affiliations

Professional Electrical and Computer Engineer: Michigan #6201070042

Years in Practice	Years with Hatch LTK	Years with Other Firms
21	3	18

Selected Experience

Battery-Electric Bus and Electric Trolleybus Life Cycle Analysis, Massachusetts Bay Transportation Authority (MBTA), Boston, MA.
Lead Engineer. Lead modeler assessing the power demand of electric trolleybuses on the power stations and the energy consumption of battery-electric buses and trolleybuses. Developed model to simulate propulsion performance, power, and energy consumption of battery-electric and trolley buses using the drive cycles specific to each route. Developed a schedule simulator to simulate the daily operations of trolleybuses and to calculate the demand charges.

Battery-Electric Bus Feasibility Analysis, Redwood Coast Transit Authority (RCTA), Washington, DC.
Lead Engineer. Lead modeler assessing the feasibility of converting gasoline- and diesel-powered buses to battery-electric ones on the existing routes. Developed a novel methodology to generate drive cycles representing the speed profiles of the existing buses. Developed model to simulate propulsion performance and energy consumption of battery-electric buses using the drive cycles specific to each route and evaluated the feasibility of battery-electric bus operations in terms of range and cost.

Zero/Low Emission Locomotive Modernization, Southern California Regional Rail Authority (SCRRA), Los Angeles, CA.
Lead Engineer. Lead modeler assessing the feasibility of zero or low emission locomotive propulsion systems including battery, fuel cell-battery hybrid, and diesel-battery hybrid architectures. Developed the physics-based train models with different propulsion architectures and evaluated the capability of each architecture in terms of range, infrastructure modifications, and durability.

Los Angeles Microgrid Assessment, Los Angeles County Metropolitan Transportation Authority (LACMTA), Los Angeles, CA.
Engineer. Modeled the wayside energy storage device in TrainOps® simulation software and assessed its effect on the power demand on the existing power stations during peak and off-peak times.

Electric Bus Simulation Model Development, Hatch LTK, Ambler, PA.
Lead Developer. Developed physics-based electric bus simulation model in Matlab/Simulink to evaluate the performance of an electric bus, to calculate the consumed battery energy for a trip including accessory loads (heating, cooling, air compressor, etc.), and to design the battery pack for the required life cycle. Integrated the bus simulation model with Google Maps to visualize the operations of an electric bus fleet.

Battery Powered Locomotive Feasibility Study, NJ TRANSIT (NJT), Newark, NJ.
Vehicle Electrical Engineering Support. Lead modeler assessing feasibility of a Battery Train Pilot and Diesel Battery Hybrid Locomotive contemplated to be run NJT's catenary and catenary-less lines. Developed model to simulate propulsion performance and energy consumption during battery-electric operations. Developed the simulation model to simulate the power demand on the electrical network for catenary rail systems.

M-9 Design of New MU Electric Cars, Long Island Rail Road (LIRR), Jamaica, NY.
Vehicle Electrical Engineering Support. Software document review according to IEEE 1558 Standard.

R211 and R188 New Vehicle Procurement/Conversion Program, New York City Transit (NYCT), New York, NY.
Vehicle Electrical Engineering Support. Key areas of responsibility include train modeling for propulsion performance evaluation, electrical system modeling for EMI/EMC compliance, train power and energy consumption modeling for battery-electric operations, and software document review according to IEEE 1558 Standard.

Technical Papers

- Oguz H. Dagci, Huei Peng, Jessy Grizzle, "Hybrid Electric Powertrain Design, Optimization, and Control with Planetary Gear Sets for Performance and Fuel Economy," IEEE Access, Vol. 6, 2018
- Oguz H. Dagci, Huei Peng, "A Method for the Exploration of Hybrid Electric Powertrain Architectures with Two Planetary Gearsets," SAE International Journal of Alternative Powertrains, May 2016 Issue
- Yaodong Pan, Umit Ozguner, Oguz H. Dagci, "Variable-Structure Control of Electronic Throttle Valve," IEEE Transactions on Industrial Electronics, Vol. 55, No. 11, November 2008

Employment

- Hatch LTK (previously LTK Engineering Services)
  (2020-Present) Principal Engineer
  (2018-2020) Principal Consultant
- AVL Powertrain Engineering
  (2011-2017) Technical Specialist
- Otokar Automotive and Defense Industry Incorporation
  (2009-2011) R&D Project Manager
- General Motors Inc.
  (2006-2009) Senior Researcher
  (2002-2006) Research Engineer
- The Ohio State University
  (2000-2002) Graduate Research and Teaching Assistant

Presentations and Patents

A listing can be made available upon request.

HATCH LTK

Rachel Bramwell, AICP

Cost Analyst

Education

MS, Regional and Urban Planning Studies, London School of Economics, UK, 2010 BA, Urban Studies, University of California - Berkeley, Berkeley, CA, 2009

Professional Affiliations

Certified Planner (29936), American Institute of Certified Planners, 2017-Present Member, Urban Land Institute (ULI)
Chartered Planner, Royal Institute ofTown Planners (RTPI), 2013-2015

Selected Experience

Presidio Yard Redevelopment, San Francisco Municipal Transportation Authority, San Francisco, CA
Project Manager and Economic Planner. Bus yard design and development services to evaluate potential viable joint uses on the site of a San Francisco Municipal Transportation Agency (SFMTA) bus maintenance facility. Hatch is the real estate advisor to SFMTA, helping it model and advance commercial, highest and best uses, and affordable housing uses through real estate, land use, and market analysis.

Sound Transit Transit-Oriented Development Advisory Services, Seattle, WA
Contract Manager and Economic Planner. Hatch is advising Sound Transit to create a Transit Oriented Development Strategic Plan to prioritize the development and disposition of surplus land across the agency's real estate portfolio. This work includes financial analysis along with triple-bottom line holistic analysis is helping to identify development scenarios. The objective is to provide sufficient financial returns while meeting the highest aspirations for total sustainability including affordable housing and carbon.

Port Master Plan 2050, Port Authority of New York and New Jersey, New York, NY
Urban Planner and Stakeholder Engagement. Hatch was engaged by PANYNJ to develop a 30-year master plan for their marine terminal assets. Rachel was responsible for map production coordination, land use analysis support, and deliverable design and production for the final report, combining analysis, recommendations, and implementation roadmap. Rachel helped to manage an internal and subconsultant team to assist the PANYNJ in its stakeholder outreach efforts, and directed the design of an online, interactive StoryMap platform, which brings G.I.S. maps and static images to life through a graphically rich web interface. This enabled the client to easily share the Plan with the public, and in turn allows the public to engage with the Plan's results and findings.

Competitive Landscape Analysis, Confidential Offshore Wind Developer, Atlantic City, NJ
Report Review and Quality Control. A market analysis was conducted for a confidential Offshore Wind Developer, focused on actions taken by competitors to bring their developments to construction. Supply chain activity, social and environmental actions, and community partnerships were examined to provide the client with a thorough understanding of its necessary path to project development.

Staten Island Local Needs Assessment, Staten Island, NY
Urban Planner and Project Manager. Local Needs Assessment produced for the Staten Island Economic Development Corporation (SIEDC) to develop a boroughwide strategic concept plan. Scope included

demographics, economics and real estate, land use, transportation and infrastructure, identification of strategic development sites, and a robust stakeholder engagement program to provide a set of recommendations for future growth across the borough. Rachel designed and lead the stakeholder outreach element, including website design, information dissemination, and interviews with over 50 key stakeholders and community members. She also developed and designed the final deliverable report, including map and graphic design.

Urban Gondola Feasibility Study, Staten Island, NY & Bayonne, NJ
Urban Planner and Project Manager. Developed a feasibility study, as a subconsultant to SE Group, for a gondola (aerial ropeway) to connect Staten Island, NY to Bayonne, NJ for the Staten Island Economic Development Corporation (SIEDC). Evaluated three alternative alignments for the gondola, and detailed analysis of a selected alternative. Hatch evaluated financial structuring alternatives to the feasibility study, which included engineering constraints and considerations, and gondola system and station design. Rachel completed socio-economic and demographic analysis and a land use and real estate assessment of the areas surrounding the proposed landing pads.

Nassau Hub Economic Impact Study, Nassau County, NY
Economic Planner and Project Manager. Evaluated the fiscal and economic impact associated with RXR's development concept for the site surrounding the Nassau Veterans Memorial Coliseum. Rachel evaluated sales tax revenues accruing to Nassau County and to the State of New York upon buildout of the development, as well as impacts on local economic activity realized during construction and operations phases.

Employment Zoning and Land Use Policy Research, Toronto Board of Trade, Toronto, ON
Researcher. Hatch was commissioned by the Economic Blueprint Institute (EBI) of the Toronto Board of Trade to conduct case study research on employment zoning policies across international cities. The purpose was to provide the EBI with evidence about practice elsewhere to assist the organization in making representations on the emerging Provincially Significant Employment Zone (PSEZ) policy of the Ontario Government and how to apply the PSEZ policy to the Greater Toronto Metropolitan Area. Rachel undertook research and analysis that provided insight into the best practice of global cities around the protection, designation, and development of employment land uses in light of economic and housing pressures.

COVER SHEET

Proposer Information

Company Name	Hatch Associates Consultants, Inc.
Address	1600 West Carson Street, Suite 1
City, State, Zip	Pittsburgh, PA 15219
Main Phone	412-497-2000

Contact Person Information

Name	Daniel Lang
Job Title	Manager, System Assurance
Phone	215-641-8840
Alt. Phone	215-431-2442
Email	daniel.lang@hatch.com

Signature 

Dominic A. DiBrito, P.E.

Date: January 12, 2022

PRICE QUOTE

Price to Complete Electric Vehicle Fleet Study $ 135,964.92

Additional Charges: $_____

_____

_____

_____

_____

_____

Total: $ 135,964.92

List all applicable charges on the price quote. Any charge other than those listed on the price quote will not be paid.

Topeka Metro is tax exempt. Do not include sales tax in your proposed price

DISADVANTAGED BUSINESS ENTERPRISES (DBE) CERTIFICATION

This contract is subject to the requirements of Title 49, Code of Federal Regulations, Part 26, *Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs*. The national goal for participation of Disadvantaged Business Enterprises (DBE) is 10%. Metro's overall 2019-2021 goal for DBE participation is 2.00%; the race neutral goal is 1.12%, and the race conscious goal is 0.88%. There is no contract goal for this procurement.

The contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of this DOT-assisted contract. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as Metro deems appropriate. Each subcontract the contractor signs with a subcontractor must include the assurance in this paragraph (see 49 CFR 26.13(b)).

The contractor is required to pay its subcontractors performing work related to this contract for satisfactory performance of that work no later than 30 days after the contractor's receipt of payment for that work from Metro.

The contractor may not hold retainage from its subcontractors.

The contractor must promptly notify Metro, whenever a DBE subcontractor performing work related to this contract is terminated or fails to complete its work, and must make good faith efforts to engage another DBE subcontractor to perform at least the same amount of work. The contractor may not terminate any DBE subcontractor and perform that work through its own forces or those of an affiliate without prior written consent of Metro.

Signature: _____

Name and Title: Dominic A. DiBrito, P.E.
Global Managing Director – Transit

Company Name: Hatch Associates Consultants, Inc.

Date: January 12, 2022

FLY AMERICA CERTIFICATION

The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and sub-recipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

Signature: 

Name and Title: Dominic A. DiBrito, P.E.
Global Managing Director – Transit

Company Name: Hatch Associates Consultants, Inc.

Date: January 12, 2022

LOBBYING CERTIFICATION

The undersigned contractor certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions. See 49 CFR 20.100.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 USC. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure. [Note: Pursuant to 31 USC 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such expenditure or failure. See 49 CFR 20.400.]

The undersigned contractor certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 USC 3801, et seq, apply to this certification and disclosure, if any.

Signature: 

Name and Title: Dominic A. DiBrito, P.E.
Global Managing Director – Transit

Company Name: Hatch Associates Consultants, Inc.

Date: January 12, 2022

NON-COLLUSION CERTIFICATION

This is my sworn statement to certify that this proposal was not made in the interest of or on behalf of any undisclosed entity. This proposal is not collusive.

This proposer has not been a party to any agreement or collusion in restraint of freedom of competition by agreement to bid a fixed price, to refrain from bidding, or otherwise. This proposer has not, directly or indirectly, by agreement, communication or conference with anyone, attempted to induce action prejudicial to the interest of Topeka Metropolitan Transit Authority, or of any proposer, or anyone else interested in the proposed contract.

Signature: 

Name and Title: Dominic A. DiBrito, P.E.
Global Managing Director – Transit

Company Name: Hatch Associates Consultants, Inc.

Date: January 12, 2022

SUSPENSION / DEBARMENT CERTIFICATION

In regard to 2 CFR Parts 180 and 1200

In accordance with 2 CFR Parts 180 and 1200, the contractor is required to verify that none of its principals or affiliates:

1) is included on the federal government's suspended and debarred list;
2) is proposed for debarment, declared ineligible, voluntarily excluded or disqualified;
3) within three years preceding this proposal, has been convicted of or had a civil judgment rendered against them for (a) commission of fraud or criminal offense pertaining to performing a public transaction, (b) violation of any federal or state antitrust statute, or (c) embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements or receiving stolen property;
4) is indicted or charged by a governmental entity for any of the charges in 3) above; and
5) has had any public transaction terminated for cause or default within three years preceding this proposal.

The contractor is required to include this requirement in any subcontracts related to this contract.

By signing and submitting its proposal, the proposer certifies that the certification in this clause is a material representation of fact relied upon by Metro. If it is later determined that the proposer knowingly rendered an erroneous certification, in addition to remedies available to Metro, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The proposer agrees to verify that none of its principals or affiliates is included on the federal government's suspended and debarred list at any time throughout the period of this contract. The proposer further agrees to include a provision requiring the same compliance in its subcontracts related to this contract.

Signature: _____

Name and Title: Dominic A. DiBrito, P.E.
Global Managing Director – Transit

Company Name: Hatch Associates Consultants, Inc.

Date: January 12, 2022

SECTION 5 Contract Exceptions

We have carefully reviewed the contractual terms and conditions contained in the contract clauses in the Request for Bids. Our review has identified areas where we wish to propose, for Metro's consideration, further clarification to the language offered.

1. ***Article 16 Indemnification*** contains the following language:

> Contractor shall be responsible for and indemnify, defend and hold harmless Metro, its directors and employees from all demands, claims, suits and settlements for loss of or damages to property, or personal injuries, including death to persons, and from all judgments recovered, and from all expenses incurred in defending or settling said claims or suits, or enforcing this provision, including court costs and attorney fees and other expenses arising out of the errors, omissions or negligent acts of the Contractor, its employees, or agents in connection with the goods and/or services provided under this contract.

We request the following language:

> Contractor shall be responsible for and indemnify~~, defend~~ and hold harmless Metro, its directors and employee from all demands, claims, suits and settlements for loss of or damages to property, or personal injuries, including death to persons, and from all judgments recovered, and from all expenses incurred in defending or settling said claims or suits, or enforcing this provision, including court costs and **reasonable** attorney fees and other expenses**, to the extent, as determined by a court of competent jurisdiction, such are caused by**~~ arising out of~~ the errors, omissions or negligent acts of the Contractor, **or** its employees~~, or agents~~ in connection with the goods and/or services provided under this contract.

We request these modifications because the language as written would require Contractor to retain an attorney to defend Indemnified Parties against a claim as soon as the claim is filed and before any determination of negligence is found. Professional Liability Insurance policies will not cover this cost. Professional Liability Insurance policies do not cover the defense (the retaining of an attorney) of anyone other than the insured. In the event of a claim naming Metro and/or Contractor as allegedly negligent, Metro should defend themselves against such a claim of negligence and Contractor should defend itself. If it is determined through a judicial finding that Contractor was indeed negligent, Contractor would then, under the indemnification provision, reimburse Metro for reasonable defense costs and damages, to the extent caused by Contractor's negligence.

2. ***Article 17 Insurance*** contains the following language:

> Contractor shall maintain for the duration of the contract such insurance as will protect it and Metro from all claims, including Workers' Compensation, and will hold Metro harmless from, and indemnify Metro for, all claims and damages which may arise out of or result from the Contractor's operations under this contract, whether such operations are by Contractor, by a subcontractor, by anyone directly or indirectly employed by them, or by anyone for whose acts any of them may be liable. Contractor will submit certificates or other proof of insurance to Metro, naming Metro as an additional insured, upon notification of contract award.

We request the following language:

> Contractor shall maintain for the duration of the contract such insurance as will protect it and Metro from all claims, including Workers' Compensation, ~~and will hold Metro harmless from, and indemnify Metro for, all claims and damages~~ which may arise out of or result from the Contractor's operations under this contract, whether such operations are by Contractor, by a subcontractor, by anyone directly or indirectly employed by them, or by

anyone for whose acts any of them may be liable. Contractor will submit certificates or other proof of insurance to Metro, naming Metro as an additional insured, upon notification of contract award.

We request this modification to clarify that any indemnification obligation is addressed in *Article 16 Indemnification*.

3. We request the addition of the following language as ***Article 28 Standard of Care*:**

28. STANDARD OF CARE

The Contractor shall perform all services according to the standard of professional care, skill, and diligence normally provided in the performance of similar services in the same locality, at the same site, under the same or similar circumstances or conditions, and at the time such services are rendered ("Standard of Care").

We request this additional language to clarify the Standard of Care under which the services will be provided.