Final Report Template – School Bus Fleet Electrification Plan

NYSERDA FlexTechProgram
Final Report
NYSERDA Client: **[Insert Client Name]**
Energy Service Provider: **[Insert Energy Provider]**

Instructions

1. Fill in the NYSERDA Client and Energy Service Provider lines above.
2. Use this Final Report template to complete the final deliverable for the Fleet Electrification Plan (FEP).
3. This Final Report template is considered a minimum requirement. The information you choose to add, plus the format, tasks, and layout of the SOW can be customized as long as the requirements of the template are still met.
4. Text that is bolded and in brackets **[like this]** should be populated with the information relevant to your application.

**Delete this list of Instructions (1-4), and instructions throughout, before submitting the Final Report.**

Thank you!

NOTE: NYSED [defines](https://www.p12.nysed.gov/schoolbus/regulations/html/section156.3_safety_regulations.html#:~:text=(2)%20A%20school%20bus%20shall,from%20school%20or%20school%20activities.) a school bus as “every vehicle owned, leased or contracted for by a public school, board of cooperative educational services or a nonpublic school and operated for the transportation of pupils, children of pupils, teachers and other persons acting in a supervisory capacity to or from school or school activities.” This definition includes vans, SUVs, and all other vehicles used for pupil transportation, not solely yellow buses.

Executive Summary

Instructions

The Executive Summary section should be an overview of all the report’s key takeaways. It is a high-level roadmap for how the District will achieve a 100% zero emission fleet by 2035.

This is an essential section and should be written with the School District as the key audience. The Executive Summary should function as a one-stop-shop for anybody who needs to see key conclusions and recommendations (i.e. A district representative who needs to present on possible budget changes or capital projects).

Tips for writing it:

Keep technical jargon to a minimum.

Focus the takeaways on cost, incentives, percent of routes that can be electrified, number of chargers, number of buses, and necessary infrastructure upgrades.

Limit background and context. That information will be found in later sections of the report.

Text that is bolded and in brackets **[like this]** should be populated with the information relevant to your application. Delete instructions before submitting your SOW.

**[Insert Executive Summary]**

**[Tables]**

**[Include a table that summarizes, at minimum, the following:]**

|  |
| --- |
| Example Table 1: Planned Electrified Fleet Information |
| **Buses** | **[Total # of electric buses planned for purchase]****[Specify # of buses by battery size]****[Indicate any spares]** |
| **Chargers** | **[Total # of recommended chargers:]****[Specify the number per power rating]****[Will these chargers be located on school district property? (if no, please specify where they will be located)]** |
| **Routes** | **[Number of routes that can be electrified with current technology and no re-blocking]****[Total number of routes]****[% of routes that can be electrified with current technology]****[Specific routes that cannot be electrified with current technology (reasoning and mitigations if available)]****[Mitigations can include re-blocking, multiple buses per route, etc.]** |
| **Bus Storage/Charging Locations****(repeat information for multiple locations)** | **[Depot Address assessed for electrification (please include street address, city, state, and zip)]****[Number of Buses at this depot location]****[Number of chargers at this location]****[Indicate the ownership of the depot (district owned or leased)]** |
| **Vehicle ownership** | **[Indicate if any buses/routes are contracted or leased]** |

**[Include text as needed to add context.]**

|  |
| --- |
| Example Table 2: Utility Requirements & Impacts |
| **Peak Demand** | **[Peak Demand/load without charge management]****[Peak Demand/load with charge management]****[% reduction in peak demand]** |
| **District-side Infrastructure** | **[List the key elements needed on the district-side (i.e. If a new service is needed after a certain number of vehicles or electrified, if they need a new transformer, or if depots need to be expanded or relocated)]** |
| **Utility-side Infrastructure** | **[List the key elements needed on the utility-side]****[Include a timeline for improvements if available]** |

Instructions for Example Tables 3, 4, and 5:

Include text that discusses any possible make-ready funding that could lower these costs or additional incentives from NYSBIP, EPA, or IRS.

Add columns to the tables where necessary

|  |
| --- |
| Example Table 3: Cost Summary - Buses |
| Bus Type & Battery Size | Number of Buses | Cost per Bus | Possible Incentive | Cost per Bus with Incentive | Cost of Comparable Diesel/Gas Bus |
| **[155 kWh Bluebird]** | **[5]** | **[$400,000]** | **[$257,250]** | **[$142,750]** | **[$140,000]** |

**[Include text as needed to add context.]**

|  |
| --- |
| Example Table 4: Cost Summary - Chargers |
| Charger Power Rating | Number of Chargers | Cost per Charger | Possible Incentive | Cost per Charger with Incentive |
| **[XXkW]** | **[5]** | **[$XX]** | **[$XX]** | **[$XX]** |

**[Include text as needed to add context.]**

|  |
| --- |
| Example Table 5: Cost Summary - Infrastructure |
| Item or Phase | Cost |
| **[New Transformer]** | **[$XX]** |

**[Include text as needed to add context.]**

Instructions for Example Table 6

Include a year-by-year (phased) approach that summarizes when the school district or bus contractor should be purchasing buses, chargers, and infrastructure upgrades to achieve the transition to a zero-emission bus fleet by 2035

|  |
| --- |
| Example Table 6: Bus & Charger Timeline |
|  | **Phase 1** | **Phase 2** | **Phase 3** | **Total** |
| **2026** | **2027** | **2028** | **2029** | **2030** | **2031** | **2032** | **2033** | **2034** | **2035** |
| **Bus Type 1** | **[1]** | **[3]** | **[5]** | **[5]** | **[0]** | **[10]** | **[0]** | **[0]** | **[0]** | **[0]** | **[24]** |
| **Bus Type 2** | **[0]** | **[0]** | **[0]** | **[0]** | **[8]** | **[2]** | **[3]** | **[4]** | **[4]** | **[4]** | **[25]** |
| **Charger Type 1** | **[1]** | **[2]** | **[4]** | **[4]** | **[0]** | **[2]** | **[0]** | **[0]** | **[0]** | **[0]** | **[13]** |
| **Charger Type 2** | **[0]** | **[1]** | **[1]** | **[1]** | **[0]** | **[8]** | **[0]** | **[0]** | **[0]** | **[0]** | **[11]** |
| **Charger Type 3** | **[0]** | **[0]** | **[0]** | **[0]** | **[8]** | **[2]** | **[3]** | **[4]** | **[4]** | **[4]** | **[25]** |

Instructions for Example Table 7

If a phased approach is being recommended:

Summarize the actions in each phase as well as any relevant cost estimates.

Be sure to identify key stakeholders that the District will need to work with at each stage (ie Utility provider, charger and bus manufacturers, civil/electrical contractors, incentive providers, etc.)

Include the number of buses and chargers needed at each stage.

Include infrastructure requirements for each stage

Include an overall cost estimate per stage.

Clearly indicate how they will transition 100% of their fleet to zero-emission buses by 2035.

|  |
| --- |
| Example Table 7: Project Phase Summary |
|  | Description | Key Stakeholders | Years | Percent of Fleet Electrified |
| **Phase 1** | **[Short Routes and Utility Upgrades - tackling easy-to-electrify routes while making long-term upgrades to utility connections.]** | **[Utility Provider, Bus Dealer, Charger Dealer, Architect, Engineers, Contractors, NYSED]** | **[2026-2029]** | **[29%]** |
| **Phase 2** | **[Mid-Distance Routes and Larger Buses – addressing mid-distance routes, taking lessons learned from Phase 1 and improving operations, transitioning to majority electric fleet]** | **[Bus Dealer, Charger Dealer, Contractors, NYSED, BOCES]** | **[2030-2031]** | **[70%]** |
| **Phase 3** | **[Long-Distance Routes and Extracurriculars – electrify longest routes and hardest to electrify trips with the expectation larger battery sizes will be available on the market]** | **[Bus Dealer, Charger Dealer, Contractors, NYSED, BOCES, Neighboring Districts]** | **[2032-2035]** | **[100%]** |

**[Include additional tables and information as necessary]:**

**[Summary of incentives]**

**[Total Cost of Ownership]**

**[Anything else the District may request that is completed as part of the agreed upon SOW]**

Introduction

Instructions

The Introduction should be a brief overview of the parties involved in the Fleet Electrification Plan (FEP), including consultant, any sub-consultants, school district, and others. Provide any necessary context for completing the report in this section. Mention the reason for school bus electrification in New York State and the key dates for requirements. Also mention NYSERDA’s role in this project.

Briefly summarize the tasks that were completed for this work, as well as any key sections in the Final Report that are worth summarizing.

# Data Collection/Existing Conditions (parallels SOW Task 2)

Instructions

This section should contain a summary of all baseline data collected for the purposes of the analysis. This includes utility data, bus data, route information, etc.

The following table includes the minimum information that should be summarized in this section. A summary table at the start of this section is useful, although formatting and presentation is ultimately at the discretion of the consultant.

It is likely beneficial to create separate tables for many of these items to provide more table (i.e. fleet information, route information, etc.)

|  |
| --- |
| Example Table 8: Current Fleet Information |
| **Utility**  | **[What utility provides energy? (ex: Con Edison)]** |
| **Contractor(s)** | **[Is a contractor used to supply buses: yes/no]****[How many contractors are used]** **How many buses/routes does each contractor have]****[Please list all contractors used (if applicable)]****[Are any buses owned/operated by the school district: yes/no]****[How many buses/routes does the school district have:]** |
| **Depot(s)****(repeat information for multiple depots)** | **[Depot Address (please include street address, city, state, and zip)]** **[Number of Buses at this depot location]****[Does this depot address belong to a contractor? (if yes, please specify which contractor): ]** |
| **Routes** | **[# of routes ]****[Average route distance]****[Max and minimum route distances]** |
| **Buses** | **[Total # of buses in current fleet]****[# of Type A buses]****[# of Type B buses]****[# of Type C buses]** **[# of Type D buses]****[# of Non-buses (please specify vehicle type)]****[How many electric school buses are operating in current fleet?]** |

**[Include text as needed to add context.]**

Instructions

We would also like to collect information on the existing service capacity at each depot location. Here is an example of how this information can be laid out. If there are multiple depot locations, it would be beneficial to break each depot out into their own tables.

|  |
| --- |
| Example Table 9: Existing Service Capacity  |
| Depot Location  | **[123 Road Ln]** |
| Fleet Size at this Depot | **[23 Buses (20 Type C, 3 Type A)]** |
| Existing Service Capacity | **[XX kVh]** |
| Existing Voltage  |  |
| Available Breaker Space |  |
| Recommendations for Immediate Electrification |
| Route #/ Bus # | Bus Type/Battery Size | Charger Size |
| **[23]** | **[Type X XX kWh]** | **[XX kW]** |

**[Include text as needed to add context.]**

# Route Analysis (parallels SOW Task 3)

Instructions

The Route Analysis section is all about determining which buses/routes can be electrified based on their expected energy consumption. Due to the complex nature of the analyses, it is expected that a summary table of assumptions will be included at the start of this section. This information can be presented in the form of a table, see example below. It is up to the consultant’s discretion how they want to display this data. It may include, but is not limited to, the following:

Include text as needed to add context to the information provided. If any formulas were used to calculate the numbers, please provide them for clarity.

The Routing Section also covers the energy requirements of each bus route. The table includes information on each route’s bus size and maximum energy usage. This table provides insight into the energy requirements for each route, but formatting and presentation is ultimately at the discretion of the consultant. For maximum energy usage, please provide the formula used to calculate the values.

If multiple routes are driven by the same buses, this should be noted. Similarly, if buses are specific to individual routes, please note this. Other assumptions should be mentioned that are specific to the school district, such as any routes that were removed from the analysis for any reason, if spares are included in this list of buses, if any of the buses are contracted out, any specific requirements around charging or dwell times, etc.

Routes that cannot be electrified need to be clearly identified and the primary reason for their ineligibility for electrification needs to be stated. In this chapter, or in following chapters, recommendations should be made for how to electrify these routes.

|  |
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| Example Table 10: Route Analysis Charging Variables and Assumptions |
| **Temperature Scenarios** | **[Cold temperature used]****[Temperate temperature used]** **[OPTIONAL Extreme Cold temperature used]** |
| **Safety Factor** | **[Route Safety Factor %]****[Efficiency Safety Factor %]** |
| **Deadhead Mileage** | **[Deadhead Miles %]****[Included in routes? Or is it an assumption made for all routes?]** |
| **Battery Information**  | **[Maximum Battery Level %]****[Minimum Battery Level %]****[Anticipated Battery Degradation %]**  |
| **Midday Charging** | **[Routes that would currently require midday charging %]****[Is midday charging a possibility? Elaborate on any restrictions]**  |
| **State of Charge (SOC)** | **[What is the minimum SOC allowed?]**  |

**[Include text as needed to add context.]**

Instructions

Bus selection should also be included in this section. This should include information about what buses were analyzed, and what buses are recommended for each route. It is important to note if the district had a preference of make/model for these buses, as it likely affected the selection process. The chart below is a suggested way to organize this information, but formatting and presentation is ultimately at the discretion of the consultant.

|  |
| --- |
| Example Table 11: Recommended Buses by Route |
| Bus or Route # | Bus Type | Max Energy Usage on route (kWh) | Minimum Battery Size Required (kWh) | Proposed Bus Size/Manufacturer |
| **[23]** | **[Type C]** | **[110.52]** | **[153]** | **[155 kWh Bluebird]** |

**[Include text as needed to add context.]**

Instructions

After recommending the buses for each route, those buses should be analyzed for feasibility under the 2 required temperature conditions.

After the district has been presented with the route feasibility under different conditions, they should carry Scenario 1 (Cold) through the remainder of the study. This scenario will guide bus purchases, charger purchases, and infrastructure upgrades.

Sources for assumptions should be well-defined as technology will continue to improve and it is necessary that the District and future readers of report be able to identify when and if assumptions need to be updated.

|  |
| --- |
| Example Table 12: Route Feasibility Under Different Conditions  |
|  | Scenario 1: Cold (XX °F) | Scenario 2: Temperate (XX °F) | [OPTIONAL] Scenario 3: Extreme Cold (XX °F) |
| **[155 kWh Bluebird]** | **[Yes/No]** | **[Yes/No]** | **[Yes/No]** |
|  |  |  |  |

**[Include text as needed to add context.]**

Instructions

Rerouting should be considered as an option; please state if rerouting would reduce the number of buses/the amount of energy the routes would require. Additionally, if rerouting would not be beneficial to the district, please state that and include references to the analysis that was completed.

An overview of how many of each bus battery size is being recommended for purchase should be included in this section as well. This can be in a statement or included in a table like the one below.

It would be useful to break down the charging requirements for each route. While not a requirement, this information can be included here or it could be included in the Appendices section at the end of the report. The charging requirements would break down how long a bus would need to charge at numerous charger sizes in order to successfully complete their PM routes.

If there is any other relevant information about the route analysis, this would be the place to include it before moving on to the next section. If any of these charts are attached in the Appendix, be sure to reference their location in this section so that readers are able to easily locate them.

|  |
| --- |
| Example Table 13: Recommended Bus Purchase Summary |
| Proposed Bus Size/ Manufacturer | Bus Type | # Route Buses | # Spare Buses | # Contracted Buses (if applicable) | Total # Proposed Buses |
| **[155 kWh – Blue Bird]** | **[Type C]** | **[15]** | **[3]** | **[0]** | **[18]** |
|  |  |  |  |  |  |

**[Include text as needed to add context.]**

# Conceptual Charging Strategy (parallels SOW Task 4)

Instructions

The conceptual charging strategy section should outline charger recommendations along with any managed charging or demand reduction analysis that was included in the study. The charging strategy should include information about peak demand, recommended chargers, and battery state of charge (SOC).

Information about charging requirements should also be included in the Conceptual Charging Strategy section. The chart below serves to summarize the recommended chargers to purchase. This information does not need to be within a table, but it is recommended for clarity.

Please explain if these charger recommendations are based on the smallest charger size necessary, or any other considerations.

The information about the battery SOC should include assumed battery degradation, lower limit of SOC, and upper limit of SOC.

|  |
| --- |
| Example Table 14: Recommended Charger Purchase Summary |
| Charger Size | Route Bus Chargers | Spare Bus Chargers | Contract Bus Chargers | Total Chargers  |
| **[24kW]** | **[10]** | **[3]** | **[0]** | **[13]** |
|  |  |  |  |  |

**[Include text as needed to add context.]**

Instructions

If a specific charge management system is being recommended, please include details about what the system entails, the benefits (financial benefits, energy savings, battery life, etc.), and any costs associated with the specific system.

If there are any alternatives to consider (for example, purchasing larger chargers so that they may charge multiple buses at once) please include those alternatives, and information about why you are not recommending them as a first choice, in this section.

Please also include information about demand reduction, including what their demand would look like if no demand reduction/charge management systems were put in place. This should also include the % reduction in peak demand if a CMS is implemented. This could be included in table such as the following:

|  |
| --- |
| Example Table 15: Peak Demand Reduction with Charge Management |
| **Peak Demand without Managed Charging** |  |
| **Peak Demand with Managed Charging** |  |
| **% Reduction in Peak Demand with Charge Management** |  |

**[Include text as needed to add context.]**

# Electric Utility Analysis (parallels SOW Task 5)

Instructions

The Electric Utility Analysis section should clearly identify the district’s associated utility provider. This section will include information that has been gathered from the district’s utility, such as current energy usage and energy capacity at depot locations. This section will also identify any utility upgrades that need to be completed throughout this project.

This section should include existing electricity use data for the district/ depot location. This information should be provided by the utility and can be broken down by month for the past year with yearly averages available for reference. It may be helpful to include information on the current energy usage of the bus garage itself, so the demand can be analyzed. This information can be broken down in a table, such as the following:

|  |
| --- |
| Example Table 16: District Energy Usage 2024 |
| Month  | District Usage  | Bus Depot 1 Usage | Bus Depot 2 Usage | Bus Depot 3 Usage |
| **[January]**  | **[1500 kWh]** | **[150 kWh]** | **[75 kWh]** | **[N/A]**  |
|  |  |  |  |  |

**[Include text as needed to add context.]**

**[Include information about the utility grid connection at the depot location(s) in this section. This likely will involve attaching an ariel image of the depot location and identifying where the grid connections are on the property.]**

**[Please include any information about utility-side infrastructure upgrades that will be needed to complete this project. This includes upgrading the grid connections and increasing the load capacity at the depot location.]**

**[Any upgrades needed to customer-side infrastructure should also be included in this section. This includes purchasing new transformers, new conduit, and new meters.]**

# Concept Development and Phasing Plan (parallels SOW Task 6)

Instructions

The Concept Development and Phasing Plan section should be a culmination of all of the research done in this study. This section should outline the procurement schedule of buses and chargers, as well as any infrastructure upgrades that are needed. Essentially, the phasing plan should be a schedule for the district to follow throughout the process of fleet electrification.

Please clearly state any assumptions that are relevant to the procurement plan, as things may need to be adjusted if these assumptions are not accurate.

A table can be used to break down the bus procurement schedule, such as the table shown below. This table could be included directly in this section, or it could be included in the Appendices section and referenced here.

This section should also include the procurement plan broken down into phases. Each phase should specify the number of electric buses being purchased, the number of chargers being purchased, and any infrastructure updates that need to occur. Additionally, each phase should include the cost estimate. If any suggested, but not required, purchases are included (such as the installation of a fire protection system) please break these costs down separately from the main cost of the phase.

* At the end of the phasing plan, please include the total estimated costs for 100% implementation. Additionally, please include a tentative schedule of when this project will start and when it is estimated to be completed.

|  |
| --- |
| Example Table 17: Bus Procurement Schedule |
| Bus / Route Number | Proposed Bus Size (kWh) | Proposed Charger Size (kWh) | Notes  | Age of Current Bus | Estimated Bus Replacement Year | Proposed Electric Conversion Year |
| **[23]** | **[168]** | **[24]** | **[No Notes]** | **[2015]** | **[2025]** | **[2035]** |
|  |  |  |  |  |  |  |

**[Include text as needed to add context.]**

# Transition Plan Cost Estimates and Cost Comparisons (parallels SOW Task 7)

Instructions

This section should contain a budget breaking down the estimated costs of the project overall. This includes (but is not limited to):

Construction Costs

Equipment Costs

Material Costs

Labor Costs

A summary of the cost estimate can be included at the beginning of this section, breaking the project down into its various sections. A full cost estimate should also be included.

If any assumptions or exclusions were made in this cost estimate, please clearly state them in this section. For example, if this cost estimate excludes utility fees please make note of that in this section.

Appendices

Instructions

Documents included in the Appendices section could include (but are not limited to):

A list of any abbreviations used throughout the plan

Copy of Route Schedule provided by school district

* Any route analysis calculations

Any relevant meeting minutes

Full Bus Procurement Schedule

Site Plans

* Equipment Layout
* Charger Diagrams

Original Scope of Work

Cutsheets for Vehicles and/or chargers