LANE TRANSIT DISTRICT

FLEET PROCUREMENT PLAN

PHASE I: SELECTION OF PRIORITY FUELS/TECHNOLOGIES REPORT – PARATRANSIT FLEET

February 2022

Final

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ACRONYMS AND TERMS

Acronym/Term	Description
BE	Battery-Electric
CNG	Compressed Natural Gas
EWEB	Eugene Water & Electric Board
E85	Ethanol Fuel (85% Ethanol; 15% Gasoline)
FPP	Fleet Procurement Plan
GHG	Greenhouse Gas
GH2	Gaseous Hydrogen
ICE	Internal Combustion Engine
kW	Kilowatt
kWh	Kilowatt-hour
LH2	Liquid Hydrogen
LTD	Lane Transit District
NFPA	National Fire Protection Association
O&M	Operations and Maintenance
RNG	Renewable Natural Gas
SME	Subject Matter Expert
SMR	Steam Methane Reform
SUB	Springfield Utility Board
ZEV	Zero-Emission Vehicle(s)

EXECUTIVE SUMMARY

The Phase I: Selection of Priority Fuels/Technologies Report – Paratransit Fleet documents the Fatal Flaws Analysis evaluation conducted to identify and select fuels/technologies that are deemed the most viable for Lane Transit District's (LTD) future paratransit fleet. The fuels selected in this report will be further evaluated and refined in Phase II, which will include the development of LTD's 15-Year Fleet Procurement Plan.

ES1 BACKGROUND

As the primary public transit provider for Lane County, OR, which serves the Eugene/Springfield metro area, LTD's mission is connecting our community. In all that we do, we are committed to creating a more connected, sustainable, and equitable community. In 2020, LTD adopted the Climate Action Policy Statement and Fleet Procurement Goals, which commits to three general goals: 1) retire and replace 25 of the existing fossil fueled transit buses with battery-electric buses (BEBs) by 2023, 2) a 75 percent tailpipe greenhouse gas (GHG) emission reduction from LTD's owned fleet vehicles by 2030 and phasing out fossil fuels by 2035, and 3) a deliberate exploration of emerging technology and fuels.

LTD has already taken the first steps to meeting its Climate Action Policy Statement and Fleet Procurement Goals by placing its first 11 BEBs in service (June 2021). The first 11 BEBs are New Flyer XE40s (with a 388 kilowatt-hour [kWh] capacity) and are charged by one of four 150 kilowatt (kW) ABB chargers. LTD is currently procuring an additional 19 longer-range BEBs – New Flyer XE40s (525 kWh) - that will bring their total BEB fleet to 30 vehicles, surpassing the Board's Climate Action Policy Statement and Fleet Procurement Goals of having procured 25 BEBs by 2023.

Pursuant to these goals, LTD plans to develop a 15-Year Fleet Procurement Plan that will provide the framework and actionable steps that need to be taken to procure and operate LTD's future fleet. The fuel/technologies that are selected will be informed by a two-phase project:

— Phase I: Selection of Priority Fuels/Technologies Report (this report)

— Phase II: 15-Year Fleet Procurement Plan

This report aims to evaluate the fuels/technologies that are most suitable for LTD's 54-vehicle paratransit fleet. LTD's Americans with Disability Act (ADA) paratransit service, RideSource, is operated with 54 vehicles. RideSource includes 47 cutaway shuttle buses, six modified vans, and one pickup truck used for non-revenue service.[1] Paratransit service, as required by the ADA of 1990, is an origin-to-destination transportation solution for people unable to use a fixed-route bus due to a disability. The service operates within approximately 3/4 miles of bus routes in the Eugene/Springfield metropolitan area and operates the same hours as fixed-route service.

Table ES-1 summarizes the fuels and technologies evaluated in this report.

Table ES-1. Fuels/Technologies Evaluated in Phase I

Fuel Type	Technology/Generation /Vehicle Type	Description
Gasoline (E10)	Internal Combustion Engine (ICE)	Existing LTD fuel/technology. Gasoline is used to power an ICE. All of LTD's existing paratransit vehicles are fueled with gasoline at a local gasoline station.
Propane	Fossil Propane/ ICE	Potential fuel. Fossil propane fuels modified ICEs. OEM-approved conversion packages can be purchased from Roush CleanTech or Blue Star Gas. Propane can be purchased offsite.

1 The fleet consists of a Chevrolet Pickup Truck, ElDorado Aerotechs, Dodge Grand Caravans, and Chevrolet Arbocs.

Fuel Type	Technology/Generation /Vehicle Type	Description
	Renewable Propane/ ICE	Potential fuel. Renewable propane fuels modified ICEs. OEM-approved conversion packages can be purchased from Roush CleanTech or Blue Star Gas. Propane can be purchased offsite.
Ethanol (E85)	ICE	Ethanol fuel is a blended gasoline with higher ethanol content (ethanol requires a Flex Fuel engine modification to operate properly). Ethanol fuel runs in ICE vehicles and can be purchased at the same station that LTD currently fuels paratransit vehicles.
Renewable Natural Gas (RNG)	ICE	Renewable natural gas, which is produced from the waste of plants and animals powers an ICE. This fuel/technology is gaseous and would require additional infrastructure on LTD's site, including compression and storage equipment.
Electricity	Battery-Electric	Electricity is stored in rechargeable battery packs that power an electric motor. This fuel/technology would require additional infrastructure on LTD's site, including charging and electrical equipment.

Source: WSP

ES2 EVALUATION APPROACH

It was determined that evaluation metrics align with LTD's Triple-Bottom-Line Approach to Sustainability to best capture the suitability of each fuel/technology. Three fuel/technology evaluation categories were developed based on this approach: Operational Impact, Social Equity/Environmental Impact, and Lifecycle Costs. The Operational Impact category evaluates metrics that focus on a fuel/technology's operational outcomes. Social Equity/Environmental Impact evaluates metrics that focus on a fuel/technology's impact to social equity and the environment – with a particular focus on LTD's Climate Action Statement and Fleet Procurement Goals. The third and final category, Lifecycle Costs evaluates the economic value and costs associated with adopting the fuel/technology.

Table ES-2 summarizes the fuel/technology evaluation categories and associated quantitative and qualitative metrics used to compare each fuel/technology.

Table ES-2. Fuel/Technology Evaluation Metrics Summary

Evaluation Category	Evaluation Metric
Operational Impact	– Vehicle Range – Physical Space Requirements – Fueling or Charging Time
Social Equity/ Environmental Impact	– Lifecycle GHG Emissions – 75 Percent Reduction in Tailpipe GHG Emissions – Elimination of Fossil Fuel Vehicles by 2035 – Local Air Quality
Lifecycle Costs	– Vehicle Capital Costs – Infrastructure Capital Costs – Annual Fuel or Electricity Costs – Lifetime Operating and Maintenance Costs – Financial Incentives

Source: WSP

To evaluate each fuel/technology, data for each metric were collected, processed, and weighted based on criteria established with LTD. Each metric value was then assigned a score based on a zero to two scale. A zero (or "low") was assigned if the fuel/technology doesn't meet criteria or was dramatically lower than other scores (ex. if emissions exceed Policy goals), a one (or "medium") was assigned if the fuel/technology moderately meets the criteria, and a two (or "high") was assigned if the fuel/technology meets or exceeds the criteria. Some metrics use LTD's existing conditions as a baseline for comparison, whereas other metrics' scores are relative to the fuels/technologies being analyzed. Each score was rounded to the nearest whole number and presented as a Harvey ball symbol for ease of understanding and analysis. It should be noted that all values were rounded to the nearest whole number.

Table ES-3 presents the screening threshold for each metric.

Table ES-3. Evaluation Methodology

Symbol	Score	Description
●	2 (High)	A high score indicates that the fuel/technology satisfies LTD requirements or has a low potential for negative impacts.
◑	1 (Medium)	A medium score indicates that the fuel/technology moderately meets LTD requirements or has a moderate potential for negative impacts.
○	0 (Low)	A low score indicates that the fuel/technology does not meet LTD requirements or has a high potential for negative impacts.

Source: WSP

For each evaluation category, a fuel/technology's scores for each metric were summed and averaged (and rounded to the nearest whole number) to determine an overall score for that category. It is assumed that if a fuel/technology scores "high" for any category, it may be viable for further study in Phase II.

ES3 FINDINGS

Based on the analyzed Operational Impact metrics, gasoline appear to yield the most operational benefits. This is primarily due to the relatively high vehicle range, short fueling times, and no spatial impact. Propane fuels, ethanol, and RNG all scored "medium". Battery-electric had a "low" score in the category.

Based on the analyzed Social Equity/Environmental Impact metrics, battery-electric and renewable propane appear to yield the most Social Equity/Environmental Impact benefits (battery-electric received high scores for all metrics).

Based on the analyzed Lifecycle Costs metrics, all fuels provide a "medium" amount of Lifecycle Costs benefits – no metric scored "high." Gasoline and ethanol scored "high" in two of the five metrics; however, these were offset by low and medium scores in others.

Table ES-4 summarizes the Phase I evaluation category scores for each fuel/technology type.

Table ES-4. Phase I Score Summary

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Operational Impact Score	High ●	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Low ○
Social Equity/Environmental Impact Score	Medium ◑	Medium ◑	High ●	Medium ◑	Medium ◑	High ●
Lifecycle Costs Total Score	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Medium ◑
Selected to move into Phase II	Yes	No	Yes	No	Yes	Yes

Source: WSP

Based on the analysis, gasoline, renewable propane, and battery-electric all scored "high" on one or more of the evaluation categories. For this reason, they will all be considered in Phase II. RNG, will also be further evaluated in Phase II. There are several metrics and factors that warrant additional and refined analysis to fully gauge its viability as a long-term fuel.

As previously discussed, LTD currently uses gasoline for its paratransit fleet. Although this is not a sustainable solution in terms of LTD's long-term environmental goals, it appears to be the most advantageous as a transition fuel in terms of its relatively low costs and limited operational impact. Fossil propane and ethanol fuels had similar scores as gasoline in many categories but fail to meet LTD's long-term environmental goals. Fossil propane's relatively high vehicles acquisition costs as compared to gasoline (approximately an additional $30,000 per vehicle) and ethanol's higher annual fuels costs (approximately an additional $2,000 per vehicle, per year) may not be the most financially prudent choices, especially since the transition fuel will only be operated for a relatively short period of time.

Renewable propane, RNG, and battery-electric should be considered in Phase II as long-term alternatives for LTD's 15-year procurement plan. All of these fuels/technologies have some barriers that will be further evaluated, and if possible, mitigated in Phase II. For instance, renewable propane paratransit vehicles aren't as prominent in the market at this time, RNG vans typically require special conversion kits to run off the fuel, and battery-electric has range constraints that may impact LTD's operation. Nonetheless, all of these fuels have promise – especially as technology continues to prove.

Therefore, it is recommended that Phase II considers gasoline as a transition fuel for LTD's paratransit vehicles and either renewable propane, RNG, or battery-electric as a long-term solution.

Table ES-5 summarizes each analyzed fuel/technology and the justification for why or why it will not be considered during Phase II.

Table ES-5. Selected Fuels/Technologies Summary

Fuel/Technology	Considered in Phase II?	Justification
Gasoline (E10)	Yes	E10 is the existing fuel and scored high for its Operational Impact. E10 will be considered as the transition fuel to a future fuel/technology. At this time, it does not have long-term applicability because it is still a fossil fuel.
Propane/ Fossil	No	Propane sourced by fossil fuel would only be considered as a transition fuel. Due to the relatively expensive costs of the vehicles, as compared to gasoline, it would not be suitable for LTD to incur these additional costs for a relatively short transition period.
Propane/ Renewable	Yes	Propane sourced by renewables scored high for its Social Equity/Environmental Impact. Its scores warrant additional analysis in Phase II.
Ethanol (E85)	No	Ethanol fuel would only be considered as a transition fuel (it does not meet LTD's 75% reduction in emissions or elimination of fossil fuels requirement). Ethanol is also more expensive to operate than gasoline, it would not be suitable for LTD to incur these additional costs for a relatively short transition period.
RNG	Yes	RNG has several qualities that make it a suitable fuel for LTD's long-term operations. It did not score as high as renewable propane or battery-electric (overall) based on the preliminary analysis, but Phase II will refine assumptions to determine its applicability.
Battery-electric	Yes	Battery-electric technology scored highest for the Social Equity/Environmental Impact score. While there are some constraints with range, battery-electric scored well for other metrics that warrant additional analysis in Phase II.

Source: WSP

ES4 NEXT STEPS

In Phase II, further refinements and research will be conducted to ensure that both the transition fuel/technology (gasoline) and selected fuel/technology types (renewable propane, RNG, or battery-electric) are fully understood. This includes the sourcing and long-term outlooks of the market and greater detail with respect to the facility requirements and how the transition will impact LTD's maintenance and operations. This information will then inform the development of 15-year planning scenarios that present the paths that LTD can take to meeting its goals. Phase II will conclude with an actionable Fleet Procurement Plan that will guide LTD through the next 15 years of its transition.

1 INTRODUCTION

This report (Phase I: Selection of Priority Fuels/Technologies Report – Paratransit Fleet) documents the Fatal Flaws Analysis evaluation conducted to identify and select fuels/technologies that best meet Lane Transit District's (LTD) paratransit fleet's service needs and are consistent with LTD's Climate Action Policy Statement and Fleet Procurement Goals, Long-Range Transit Plan, and Sustainability Policy. The fuels/technologies screened, analyzed, and selected in this report will be further evaluated and refined in Phase II, which will be the development of LTD's 15-Year Fleet Procurement Plan.

1.1 STUDY BACKGROUND

In 2020, LTD adopted the Climate Action Policy Statement and Fleet Procurement Goals, which commits to three general goals: 1) retire and replace 25 of the existing fossil fuel fleet with battery-electric buses (BEBs) by 2023, 2) a 75 percent tailpipe greenhouse gas (GHG) emission reduction from LTD's fleet vehicles by 2030 and phasing out fossil fuels vehicles by 2035, and 3) a deliberate exploration of emerging technology and fuels.

Pursuant to these goals, LTD plans to develop a 15-Year Fleet Procurement Plan that will provide the framework and actionable steps that need to be taken to procure and operate LTD's future fleet. The fuel/technology that is selected will be informed by a two-phase project:

— Phase I: Selection of Priority Fuels/Technologies Report (this report)

— Phase II: 15-Year Fleet Procurement Plan

The 15-Year Fleet Procurement Plan will support LTD's ongoing commitment to providing high-quality transit service and increasing ridership in the most sustainable manner possible (financially, environmentally, and socially).

1.2 PARATRANSIT FLEET BACKGROUND

LTD's Americans with Disability Act (ADA) paratransit service, RideSource, is operated with 54 vehicles. RideSource includes 47 cutaway shuttle buses, six modified vans, and one pickup truck used for non-revenue service. Paratransit service, as required by the ADA of 1990, is an origin-to-destination transportation solution for people unable to use a fixed-route bus due to a disability. The service operates within approximately 3/4 miles of bus routes in the Eugene/Springfield metropolitan area and operates the same hours as fixed-route service. This service is available to Lane County residents who qualify for transportation benefits under the Oregon Health Plan. All of LTD's paratransit-serving vehicles are fueled by gasoline (E10) at a local gas station. While RideSource vehicles are owned by LTD, they are operated and maintained by a contracted service provider at the LTD-owned Garfield Facility[2].

LTD will transition away from E10 gasoline over the next 15 years. Paratransit vehicles have a lifespan of 7 to 10 years. As vehicles come to retirement age, they will be replaced with alternatively fueled vehicles.

1.3 REPORT PURPOSE AND STRUCTURE

The purpose of this report is to identify the most viable fuels/technologies for LTD's transition to a 100 percent fossil fuel-free paratransit fleet. The findings of this report – and selected fuels/technologies - will serve as the foundation for further refinements, evaluation, and development of the 15-Year Fleet Procurement Plan in Phase II. The technologies studied in

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this report are dynamic and the market conditions are rapidly changing. This report provides a snapshot of existing conditions with the understanding that LTD will need to update this information periodically as conditions change.

This report is organized into six main sections:

1 **Introduction** – Overview of the Study Background and LTD's paratransit fleet.

2 **Evaluation Approach –** Overview of the fuels/technologies under consideration, evaluation metrics, and evaluation methodology.

3 **Operational Impact –** Compares the metrics of each analyzed fuel/technology with consideration to operational impacts.

4 **Social Equity/Environmental Impact –** Compares the metrics of each analyzed fuel/technology with consideration to social equity and environmental impacts.

5 **Lifecycle Costs –** Compares the metrics of each analyzed fuel/technology with consideration to lifecycle costs.

6 **Findings, Selected Fuels/Technologies, and Next Steps** – Summarizes the evaluations and identifies the fuels/technologies that will be considered and further analyzed in Phase II.

2 EVALUATION APPROACH

The following section provides an overview of the fuel/technology selection process, evaluation criteria, and evaluation methodology.

2.1 FUEL/TECHNOLOGY SELECTION

To meet the Climate Action Policy Statement and Fleet Procurement Goals, LTD identified several fuel/technology types that should be analyzed and considered in their long-term fleet procurement plans. In advance of a detailed fatal flaws analysis, initial screening analyses were conducted to eliminate the fuels/technologies that did not meet the Climate Action Statement and Fleet Procurement Goals Policy. Table 2-1 describes each of these fuels/technologies initially considered for analysis.

Table 2-1. Fuels/Technologies Considered for Evaluation

Fuel Type	Technology/Generation/Vehicle Type	Description
Gasoline (E10)	Internal Combustion Engine (ICE)	Existing LTD fuel/technology. Gasoline is used to power an ICE. All of LTD's existing paratransit vehicles are fueled with gasoline at a local gasoline station.
Propane	Fossil Propane/ ICE	Potential fuel. Fossil propane fuels modified ICEs. OEM-approved conversion packages can be purchased from Roush CleanTech or Blue Star Gas. Propane can be purchased offsite.
	Renewable Propane/ ICE	Potential fuel. Renewable propane fuels modified ICEs. OEM-approved conversion packages can be purchased from Roush CleanTech or Blue Star Gas. Propane can be purchased offsite.
Ethanol (E85)	ICE	Ethanol fuel is a blended gasoline with higher ethanol content (ethanol requires a Flex Fuel engine modification to operate properly). Ethanol fuel runs in ICE vehicles and can be purchased at the same station that LTD currently fuels paratransit vehicles.
Renewable Natural Gas (RNG)	ICE	Renewable natural gas, which is produced from the waste of plants and animals powers an ICE. This fuel/technology is gaseous and would require additional infrastructure on LTD's site, including compression and storage equipment.
Hydrogen (H2)	Steam Methane Reformation (SMR)	Gaseous hydrogen (GH2), generated by SMR is used to power a fuel cell that powers an electric motor. This fuel/technology is gaseous and would require additional infrastructure on LTD's site, including compression and storage equipment.
	Electrolysis	GH2, generated by electrolysis, is used to power a fuel cell that powers an electric motor. This fuel/technology is gaseous and would require additional infrastructure, including compression and storage equipment.
Electricity	Battery-Electric	Electricity is stored in rechargeable battery packs that power an electric motor. This fuel/technology would require additional infrastructure on LTD's site, including charging and electrical equipment.

Source: WSP, LTD

2.1.1 INITIAL SCREENING

The fuels/technologies that LTD selected were initially screened to determine if they met two criteria: 1) whether they had a “Proven Record of Performance”, which was defined as being currently available on the market and in being used in transit operations, and 2) whether they met the Climate Action Policy Statement and Fleet Procurement Goals' requirements. Based on these criteria, it was determined that hydrogen fuel be eliminated from further evaluation. Currently, there are no large deployments of hydrogen-powered paratransit vehicles (cutaways or vans). While there are some in development, there is limited data available, and it is assumed that it is unlikely that they'll be market-ready in time to meet LTD's goals. The remaining fuels/technologies: gasoline, propane (renewable and fossil), ethanol, RNG, and battery-electric, were all selected for further evaluation.

Table 2-2 summarizes the fuels/technologies evaluated in Phase I.

Table 2-2. Fuels/Technologies Evaluated in Phase I

Fuel Type	Technology/Generation/Vehicle Type	Description
Gasoline (E10)	Internal Combustion Engine (ICE)	Existing LTD fuel/technology. Gasoline is used to power an ICE. All of LTD's existing paratransit vehicles are fueled with gasoline at a local gasoline station.
Propane	Fossil Propane/ ICE	Potential fuel. Fossil propane fuels modified ICEs. OEM-approved conversion packages can be purchased from Roush CleanTech or Blue Star Gas. Propane can be purchased offsite.
	Renewable Propane/ ICE	Potential fuel. Renewable propane fuels modified ICEs. OEM-approved conversion packages can be purchased from Roush CleanTech or Blue Star Gas. Propane can be purchased offsite.
Ethanol (E85)	ICE	Ethanol fuel is a blended gasoline with higher ethanol content. Ethanol fuel runs in ICE vehicles and can be purchased at the same station that LTD currently fuels paratransit vehicles.
Renewable Natural Gas (RNG)	ICE	Renewable natural gas, which is produced from the waste of plants and animals powers an ICE. This fuel/technology is gaseous and would require additional infrastructure on LTD's site, including compression and storage equipment.
Electricity	Battery-Electric	Electricity is stored in rechargeable battery packs that power an electric motor. This fuel/technology would require additional infrastructure on LTD's site, including charging and electrical equipment.

Source: WSP, LTD

2.2 EVALUATION METRICS

To develop evaluation metrics and an analysis approach that would best suit LTD's goals, two groups of industry experts were established. The first group was comprised of subject matter experts (SMEs) from LTD's staff in transit operations heavy-duty vehicle maintenance, service planning, and delivery. This group was tasked with developing a detailed evaluation matrix that would be used to measure the performance of each fuel/technology type. The second group consisted of external regional stakeholders, including utility service providers, fuel distributors, local jurisdictions, social equity organizations, and other SMEs that would ensure that the technical analysis conducted during Phase I was sound. A comprehensive list of internal and external project stakeholders can be found in Appendix A.

It was determined that evaluation metrics align with LTD's Triple-Bottom-Line Approach to Sustainability to best capture the suitability of each fuel/technology. Three fuel/technology evaluation categories were developed based on this approach: Operational Impact, Social Equity/Environmental Impact, and Lifecycle Costs. The Operational Impact category evaluates metrics that focus on a fuel/technology's operational outcomes. Social Equity/Environmental Impact evaluates metrics that focus on a fuel/technology's impact to social equity and the environment – with a particular focus on LTD's Climate Action Statement and Fleet Procurement Goals. The third and final category, Lifecycle Costs, evaluates the economic value and costs associated with adopting the fuel/technology. Table 2-3 summarizes the fuel/technology evaluation category and evaluation metrics used to screen each fuel/technology type.

Table 2-3. Fuel/Technology Evaluation Metrics Summary

Evaluation Category	Evaluation Metric
Operational Impact	– Vehicle Range – Physical Space Requirements – Fueling or Charging Time
Social Equity/ Environmental Impact	– Lifecycle GHG Emissions – 75 Percent Reduction in Tailpipe GHG Emissions – Elimination of Fossil Fuel Vehicles by 2035 – Local Air Quality
Lifecycle Costs	– Vehicle Capital Costs – Infrastructure Capital Costs – Annual Fuel or Electricity Costs – Lifetime Operating and Maintenance Costs – Financial Incentives

Source: WSP, LTD

Note: Metrics associated with Social Equity/Environmental Impact and Lifecycle Costs categories align with the mission of LTD's Triple-Bottom-Line Approach to Sustainability. The Social Equity/Environmental Impact category aims to evaluate a fuel/technology's ability to ensure that LTD is "Caring for people including the communities in which we operate, our stakeholders, and our employees." and "Using natural resources efficiently and protecting our physical environment." The Lifecycle Costs category aims to evaluate a fuel/technology based on LTD's goal of "Being responsible stewards of financial resources."

The following subsections provide a summary of each fuel/technology evaluation category, including a description of each metric, its data type, classification, and source(s).

2.2.1 OPERATIONAL IMPACT

The Operational Impact category evaluates fuels/technologies based on the potential changes and adaptations that are needed to adopt the fuel/technology. Vehicle range considers the distance that the vehicle can travel on a single fuel or charge event – this informs infrastructure requirements and costs. Physical space requirements account for the spatial requirements at the operating facility for the storage of the vehicles and required infrastructure. Lastly, fueling or charging time analyzes the time it takes for a vehicle to refuel or charge. This also has a direct impact on operations at the facility. Table 2-4 summarizes the Operational Impact metrics considered in the fuel/technology evaluation.

Table 2-4. Operational Impact Metrics Summary

Evaluation Metric	Description	Data Type	Data Classification	Source
Vehicle Range*	The range of the fuel/technology type.	Quantitative	Number of miles per fueling/charging event	LTD, Blue Star Gas, Green Power, Ballard Power
Physical Space Requirements	The scale of the space required to accommodate new infrastructure at LTD's RideSource Campus.	Qualitative	Low, Medium, High	LTD, Blue Star Gas, Green Power, Ballard Power, NW Natural
Fueling or Charging Time**	The time it takes to fully fuel or charge the vehicle.	Quantitative	Time in hours	LTD

Source: WSP, LTD

Note: **It is assumed that gasoline, propane fuels, and ethanol will all be fueled offsite; whereas RNG and BEBs would be fueled and charged onsite, respectively. The fueling/charging time reflects the time spent fueling *and* the time spent traveling to the fueling locations. For gasoline or ethanol: Sequential Biofuels (86714 McVay Hwy.; Chevron 1033 Green Acres Rd.; Chevron 2340 Irving Rd.) – all of which are an 8-15-minute drive from the RideSource facility. Propane can be filled at Blue Star Gas (61 S. Danebo Ave.) – this site is an 8-10-minute drive from the RideSource facility. Battery-electric charge time is based on the 2:00 frame that is advertised on GreenPower's website for a 61 kW DCFC.

2.2.2 SOCIAL EQUITY/ENVIRONMENTAL IMPACT

Several metrics aligned with LTD's Social Equity/Environmental Impact goal of "caring for people including the communities in which we operate, our stakeholders, and our employees." and "using natural resources efficiently and protecting our physical environment."

Metrics include Lifecycle GHG emissions and the fuel/technology's ability to meet the Climate Action Policy Statement and Fleet Procurement Goals of achieving a 75 percent reduction in lifecycle GHG emissions and an elimination of fossil fuel vehicles by 2035. The local air quality metric analyzes the negative externalities and impacts to the community that may occur with the adoption of the new fuel/technology. Table 2-5 summarizes the Social Equity/Environmental Impact metrics considered in the fuel/technology evaluation.

Table 2-5. Social Equity/Environmental Impact Metrics Summary

Evaluation Metric	Description	Data Type	Data Classification	Source
Lifecycle GHG Emissions	A measure of GHG emissions.	Quantitative	Gram of CO2e/mile	Oregon Clean Fuels Program (OCFP)
75 Percent Reduction in Tailpipe GHG Emissions	Whether or not the fuel type/technology would reduce at least 75 percent tailpipe emissions when compared to the standard five-year carbon intensity average.	Qualitative	Yes or No	OCFP, AFLEET
Elimination of Fossil Fuel Vehicles by 2035	Whether or not the fuel/technology will result in an elimination of fossil fuel vehicles by 2035	Qualitative	Yes or No	OCFP, LTD
Local Air Quality*	A measure of tailpipe emissions, categorized by six pollutants: CO, Nitrogen Oxides, PM10, PM2.5, VOCs, and Sulfur Oxides	Quantitative	Grams per mile	OCFP, AFLEET Tool

Source: WSP, LTD

Note: *Criteria pollutants vary in their adverse effects and toxicity; therefore, WSP used Caltrans' B/C Sketch Model v7.2 to develop a weighted score to more accurately account for these effects.

2.2.3 LIFECYCLE COSTS

The Lifecycle Costs evaluation category reflects LTD's goal of "being responsible stewards of financial resources." The lifecycle cost factors studied included vehicle capital costs, infrastructure capital costs, annual fuel/electricity costs, lifetime operating costs, and financial incentives. Table 2-6 summarizes the Lifecycle Costs metrics considered in the fuel/technology evaluation.

Table 2-6. Lifecycle Costs Metrics Summary

Evaluation Metric	Description	Data Type	Data Classification	Source
Vehicle Capital Costs	The purchase price of a vehicle, inclusive of LTD's preferred options, contingency, and service preparation.	Quantitative	Dollar value, per bus	LTD, Blue Star Gas, Green Power, Ballard Power
Infrastructure Capital Costs	The capital costs of infrastructure to support 54 vehicles of the fuel/technology at LTD's RideSource Campus.	Quantitative	Dollar value, for 54 vehicles	LTD, Blue Star Gas, Green Power, Ballard Power
Annual Fuel or Electricity Costs	The annual costs to fuel or charge each vehicle. Adjusted to include Federal and State incentives, such as OCFP and RIN Credits.	Quantitative	Dollar value, per vehicle	LTD, Blue Star Gas
Lifetime Operating and Maintenance Costs	The annual costs to operate and maintain a vehicle, inclusive of preventative maintenance, retirement, and overhaul costs.	Quantitative	Dollar value, per vehicle	LTD, Morongo Basin Transit Authority
Financial Incentives	The availability of competitive grants and other funding.	Qualitative	Low, Medium, High	LTD, WSP, OCFP, RIN Credit Program

Source: WSP

2.3 EVALUATION METHODOLOGY

To evaluate each fuel/technology, data for each metric were collected and analyzed. Each metric value was then assigned a score based on a zero to two scale. A zero (or "low") was assigned if the fuel/technology doesn't meet criteria or was dramatically lower than other scores (ex. if emissions exceed Policy goals), a one (or "medium") was assigned if the fuel/technology moderately meets the criteria, and a two (or "high") was assigned if the fuel/technology meets or exceeds the criteria. Some metrics use LTD's existing conditions as a baseline for comparison, whereas other metrics' scores are relative to the fuels/technologies being analyzed. Each score was rounded to the nearest whole number and presented as a Harvey ball symbol for ease of understanding and analysis. It should be noted that all values were rounded to the nearest whole number.

In this report, each score is represented by a Harvey ball symbol for ease of understanding and analysis. Table 2-7 presents the screening threshold for each metric.

Table 2-7. Evaluation Methodology

Symbol	Score	Description
●	2 (High)	A high score indicates that the fuel/technology highly supports and satisfies the metric or has a low potential for negative impacts.
◑	1 (Medium)	A medium score indicates that the fuel/technology moderately supports and satisfies the metric or has a moderate potential for negative impacts.
○	0 (Low)	A low score indicates that the fuel/technology does not support or conflicts with the metric or has a high potential for negative impacts.

Source: WSP

For each evaluation category, a fuel/technology's scores for each metric were summed and averaged (and rounded to the nearest whole number) to determine an overall score for that category. It is assumed that if a fuel/technology scores "high" for any category, it may be viable for further study in Phase II.

The following sections summarize the scores for each fuel/technology type by evaluation category and metric.

3 OPERATIONAL IMPACT

The following section summarizes the Operational Impact evaluation and scores for each fuel/technology type.

3.1 VEHICLE RANGE

Vehicle range refers to the maximum distance that can be achieved on a single fill or charge. Fuels/technologies with higher ranges are the most advantageous to LTD. Based on the evaluation, gasoline has the highest range (440 miles), followed by ethanol, propane, and RNG with between 300 and 330 miles of range. Battery-electric provides the lowest range (100 miles). Table 3-1 summarizes the estimated vehicle ranges and associated scores by fuel/technology type.

Table 3-1. Vehicle Range Evaluation (miles per vehicle, per charge event)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Vehicle Range	440	320	320	330	300	150
Vehicle Range Score	●	◑	◑	◑	◑	○

Source: LTD, Blue Star Gas, Green Power, Ballard Power

Note: The presented range is representative of a cutaway vehicle for each fuel/technology.

3.2 PHYSICAL SPACE REQUIREMENTS

Physical space requirements refer to the amount of real estate required for the infrastructure that supports the fuel/technology. Fuels/technologies with no or low physical space requirements are the most advantageous to LTD and score the highest. Based on the evaluation, gasoline, propane, and ethanol fuels require no additional physical space – it is assumed that they would fuel offsite. RNG and battery-electric would be fueled onsite and require new infrastructure, yielding a "medium" score. Table 3-2 summarizes the physical space requirements and associated scores by fuel/technology type.

Table 3-2. Physical Space Requirements Evaluation

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Physical Space Requirements	High	High	High	High	Medium	Medium
Physical Space Requirements Score	●	●	●	●	◑	◑

Source: LTD, Blue Star Gas, Green Power, Ballard Power, Northwest Natural

3.3 FUELING OR CHARGING TIME

Fueling or charging time is the time it takes to replenish an empty tank or battery from empty to full. Fuels/technologies that have shorter fueling or charging times are the most advantageous to LTD. Based on this analysis, RNG requires the shortest time to fuel (five minutes). Gasoline, propane, and ethanol provide the second shortest fuel times (30 minutes), and battery-electric takes the longest time to recharge, two hours (varies based on charger, battery state-of-charge, and battery capacity). Table 3-3 summarizes the estimated fuel or charging times and associated scores by fuel/technology type.

Table 3-3. Fueling or Charging Time Evaluation (time, per vehicle)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Fueling or Charging Time*	00:30	00:30	00:30	00:30	00:05	02:00
Fueling or Charging Time Score	◑	◑	◑	◑	●	○

Source: LTD

Note: *Gasoline, propane, and ethanol are all assumed to fuel offsite and local fill stations.

3.4 OPERATIONAL IMPACT SUMMARY

Based on the analyzed Operational Impact metrics, gasoline appear to yield the most operational benefits. This is primarily due to the relatively high vehicle range, short fueling times, and no spatial impact. Propane fuels, ethanol, and RNG all scored "medium". Battery-electric had a "low" score in the category. Table 3-4 summarizes the Operational Impact evaluation metrics and scores.

Table 3-4. Operational Impact Evaluation Summary

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Vehicle Range	440 ●	320 ◑	320 ◑	330 ◑	300 ◑	150 ○
Physical Space Requirements	High ●	High ●	High ●	High ●	Medium ◑	Medium ◑
Fueling or Charging Time	00:30 ◑	00:30 ◑	00:30 ◑	00:30 ◑	00:05 ●	02:00 ○
Total Operational Impact Score (Avg.)	High ●	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Low ○

Source: LTD, Blue Star Gas, Green Power, Ballard Power, Northwest Natural

Note: Total Score is rounded to the nearest whole number.

4 SOCIAL EQUITY/ENVIRONMENTAL IMPACT

The following section summarizes the Social Equity/Environmental Impact evaluations and scores for each fuel/technology type.

4.1 LIFECYCLE GHG EMISSIONS

Lifecycle GHG emissions refers to both the tailpipe and upstream emissions from production and delivery of the fuel/technology (grams). Fuels and technologies with fewer grams of emissions are the most advantageous for LTD. Based on this analysis, battery-electric yields the fewest amount of lifecycle GHG emissions (80 grams/mi.). Renewable propane provides the second fewest (791 grams/mi.) – followed by RNG, ethanol, and gasoline (1,108, 1,290, and 1,418, respectively). Fossil propane provides the highest amount of lifecycle GHG emissions (1,524). Table 4-1 summarizes annual lifecycle GHG emission metrics and associated scores by fuel/technology type.

Table 4-1. Lifecycle GHG Emissions Evaluation (g of CO2e/mil per vehicle)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Lifecycle GHG Emissions	1,418	1,524	791	1,290	1,108	80
Lifecycle GHG Emissions Score	◑	○	◑	◑	◑	●

Source: Oregon Clean Fuels Program

4.2 75 PERCENT REDUCTION IN TAILPIPE GHG EMISSIONS

A 75 percent reduction in tailpipe GHG emissions is a goal of the Climate Action Policy Statement and Fleet Procurement Goals. If a fuel/technology achieves this, it is in compliance. A fuel/technology that is in compliance is the most advantageous to LTD. Based on the analysis, renewable propane, RNG, and battery-electric meet this requirement. Since this requirement is essential in meeting LTD's goals, gasoline, ethanol, and fossil propane can only be considered as transition fuels – not a permanent solution. Table 4-2 summarizes the 75 percent reduction in tailpipe GHG emissions metric and associated scores by fuel/technology type.

Table 4-2. 75 Percent Reduction in Tailpipe GHG Emissions Evaluation

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
75 Percent Reduction in Tailpipe GHG Emissions	No	No	Yes	No*	Yes	Yes
75 Percent Reduction in Tailpipe GHG Emissions Score	○	○	●	○	●	●

Source: Oregon Clean Fuels Program, AFLEET

Note: *Based on the analysis, the sources of ethanol can vary (and the renewable content), meaning it's not a certainty that the fuel source can meet the 75% threshold. For this reason, ethanol does not meet the requirement; however, if a permanent source can contractually meet this requirement, this can be changed to a "Yes."

4.3 ELIMINATION OF FOSSIL FUEL VEHICLES BY 2035

An elimination of all fossil fuel vehicles by 2035 is a goal of the Climate Action Policy Statement and Fleet Procurement Goals. If a fuel/technology achieves this, it is in compliance. A fuel/technology that is in compliance is the most advantageous to LTD. Based on the analysis, renewable propane, RNG, and battery-electric meet this requirement, whereas gasoline, fossil propane, and ethanol do not. Table 4-3 summarizes the elimination of fossil fuel vehicles by 2035 metric and associated scores by fuel/technology type.

Table 4-3. Elimination of Fossil Fuel Vehicles by 2035 Evaluation

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Elimination of Fossil Fuel Vehicles by 2035	No	No	Yes	No	Yes	Yes
Elimination of Fossil Fuel Vehicles by 2035 Score	○	○	●	○	●	●

Source: LTD, Oregon Clean Fuels Program

4.4 LOCAL AIR QUALITY

Local air quality refers to the annual tailpipe emissions of the six common criteria pollutants: carbon monoxide, nitrogen oxides, PM10, PM2.5, volatile organic compounds, and sulfur oxides (grams per mile, per vehicle). Fuels/technologies with fewer emissions are the most advantageous for LTD and its service area. Based on this analysis, battery-electric yields the least amount of tailpipe emissions (0.11 grams). Gasoline and propane fuels provide the second least amount of emissions (0.21), and RNG emits the relatively highest volume of emissions (0.29). Table 4-4 summarizes local air quality and associated scores by fuel/technology type.

Table 4-4. Local Air Quality Evaluation (g/mi, per vehicle)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Local Air Quality	0.21	0.21	0.21	0.19	0.29	0.11
Local Air Quality Score	◑	◑	◑	◑	○	●

Source: AFLEET, Oregon Clean Fuels Program

4.5 SOCIAL EQUITY/ENVIRONMENTAL IMPACT SUMMARY

Based on the analyzed Social Equity/Environmental Impact metrics, battery-electric and renewable propane appear to yield the most Social Equity/Environmental Impact benefits (battery-electric received high scores for all metrics). Table 4-5 summarizes the Social Equity/Environmental Impact evaluation metrics and scores.

Table 4-5. Social Equity/Environmental Impact Evaluation Summary

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Lifecycle GHG Emissions	1,418 ◑	1,524 ○	791 ◑	1,290 ◑	1,108 ◑	80 ●
75 Percent Reduction in Tailpipe GHG Emissions	No ○	No ○	Yes ●	No ○	Yes ●	Yes ●
Elimination of Fossil Fuel Vehicles by 2035	No ○	No ○	Yes ●	No ○	Yes ●	Yes ●
Local Air Quality	0.21 ◑	0.21 ◑	0.21 ◑	0.21 ◑	0.29 ○	0.11 ●
Total Social Equity/Environmental Impact Score (Avg.)	Medium ◑	Low ○	High ●	Medium ◑	Medium ◑	High ●

Source: LTD, Oregon Clean Fuels Program, AFLEET

Note: Total Score is rounded to the nearest whole number.

5 LIFECYCLE COSTS

The following section summarizes the Lifecycle Costs evaluations and scores for each fuel/technology type.

5.1 VEHICLE CAPITAL COSTS

Vehicle capital costs represent the purchase price of a vehicle (inclusive of LTD's preferred options). Fuels/technologies with the cheapest vehicles are the most advantageous to LTD. Based on the evaluation, gasoline and ethanol-powered vehicles are the cheapest ($56,800). Battery-electric vehicles are the most expensive – approximately $208,200 per vehicle. Table 5-1 summarizes the estimated vehicle capital costs and associated scores by fuel/technology type.

Table 5-1. Vehicle Capital Costs Evaluation (per vehicle)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Vehicle Capital Costs	$56.8K	$84.7K	$84.7K	$56.8K	$99.6K	$208.2K
Vehicle Capital Costs Score	●	◑	◑	●	◑	○

Source: LTD, Blue Star Gas, Green Power, Ballard Power

5.2 INFRASTRUCTURE CAPITAL COSTS

Infrastructure capital costs are the costs associated with constructing the infrastructure to operate and maintain the fuel/technology. Fuels/technologies with the cheapest infrastructure costs are the most advantageous to LTD. Based on the evaluation (and a 54-vehicle fleet), no infrastructure or additional costs would be required to support a gasoline-, propane-, or ethanol-fueled fleet because these fuels are readily available at nearby stations. Infrastructure to support battery-electric or RNG, however, would cost approximately $1 and $1.4 million, respectively. It should be noted that is assumed that infrastructure to support RNG fueling will be funded by the provider and the $1 million would support enhancements to the maintenance bays such as "explosion proof" lighting and electrical components. Table 5-2 summarizes the estimated infrastructure capital costs and associated scores by fuel/technology type.

Table 5-2. Infrastructure Capital Costs Evaluation (for 54 vehicles)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Infrastructure Capital Costs	$0	$0	$0	$0	$1.0	$1.4M
Infrastructure Capital Costs Score	●	●	●	●	◑	◑

Source: LTD, Blue Star Gas, Green Power, Ballard Power

5.3 ANNUAL FUEL OR ELECTRICITY COSTS

Fuel or electricity costs are the costs associated with operating the fuel/technology (annually). Fuels/technologies with the cheapest fuel or electricity costs are the most advantageous to LTD. Based on the evaluation, renewable propane has the cheapest fuel cost ($5,200), followed by fossil propane ($6,000), gasoline ($6,500), and RNG ($6,700). Ethanol and battery-electric are the most expensive with annual fuel and electricity costs estimated at $8,200 and $9,700, respectively. Table 5-4 summarizes the annual fuel or electricity costs and associated scores by fuel/technology type.

Table 5-3. Annual Fuel or Electricity Costs Evaluation (annual per vehicle)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Annual Fuel or Electricity Costs	$6.5K	$6.0K	$5.2K	$8.2K	$6.7K	$9.7K
Annual Fuel or Electricity Costs Score	◑	◑	◑	○	◑	○

Source: LTD, Blue Star Gas

5.4 LIFETIME OPERATING AND MAINTENANCE COSTS

Lifetime operating and maintenance costs are the costs associated with the operation and maintenance of the fuel/technology over the life of the vehicle. Fuels/technologies with the cheapest operating and maintenance costs are the most advantageous to LTD. Based on the evaluation, battery-electric, gasoline, propane, and ethanol are the relatively cheapest for LTD to maintain (approximately $23,000). RNG is the most expensive to maintain with approximately $26,200 in annual maintenance costs. Table 5-4 summarizes the estimated lifetime operating and maintenance costs and associated scores by fuel/technology type.

Table 5-4. Lifetime Operating and Maintenance Costs Evaluation (per vehicle)

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Lifetime Operating and Maintenance Costs	$23.3K	$23.5K	$23.5K	$23.3K	$26.2K	$23.1K
Lifetime Operating and Maintenance Costs Score	◑	◑	◑	◑	○	◑

Source: LTD, Morongo Basin Transit Authority

5.5 FINANCIAL INCENTIVES

Financial incentives gauge the type of funding and grants available to support the transition to the fuel/technology. Fuels/technologies with a high level of financial incentives are the most advantageous to LTD. Based on the evaluation, renewable propane, RNG, and battery-electric fuels/technologies have a "high" amount of funding available. Ethanol has a "medium" amount of funding available, and gasoline and fossil propane has a "low" amount of funding available. Table 5-5 summarizes the estimated financial incentives and associated scores by fuel/technology type.

Table 5-5. Financial Incentives Evaluation

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Financial Incentives	Low	Low	High	Medium	High	High
Financial Incentives Score	○	○	●	◑	●	●

Source: LTD

5.6 LIFECYCLE COSTS SUMMARY

Based on the analyzed Lifecycle Costs metrics, all fuels provide a "medium" amount of Lifecycle Costs benefits – no metric scored "high." Gasoline and ethanol scored "high" in two of the five metrics; however, these were offset by low and medium scores in others. Table 5-6 summarizes the Lifecycle Costs evaluation metrics and scores.

Table 5-6. Lifecycle Costs Evaluation Summary

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Vehicle Capital Costs	$56.8K ●	$84.7K ◑	$84.7K ◑	$56.8K ●	$99.6K ◑	$208.2K ○
Infrastructure Capital Costs	$0 ●	$0 ●	$0 ●	$0 ●	$1.0M ◑	$1.4M ◑
Annual Fuel or Electricity Costs	$6.5K ◑	$6.0K ◑	$5.2K ◑	$8.2K ○	$6.7K ◑	$9.7K ○
Lifetime Operating and Maintenance Costs	$23.3K ◑	$23.5K ◑	$23.5K ◑	$23.3K ◑	$26.2K ○	$23.1K ◑
Financial Incentives	Low ○	Low ○	High ●	Medium ◑	High ●	High ●
Lifecycle Costs Total Score (Avg.)	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Medium ◑

Source: LTD, Morongo Basin Transit Authority, Blue Star Gas, Green Power, Ballard Power

Note: Total Score is rounded to the nearest whole number.

6 FINDINGS, SELECTED FUELS/TECHNOLOGIES, AND NEXT STEPS

The following section presents the findings of each evaluation category, the fuels/technologies selected based on the analysis, and the next steps to be carried out in Phase II.

6.1 PHASE I FINDINGS

Based on the analyzed Operational Impact metrics, gasoline appear to yield the most operational benefits. This is primarily due to the relatively high vehicle range, short fueling times, and no spatial impact. Propane fuels, ethanol, and RNG all scored "medium". Battery-electric had a "low" score in the category.

Based on the analyzed Social Equity/Environmental Impact metrics, battery-electric and renewable propane appear to yield the most Social Equity/Environmental Impact benefits (battery-electric received high scores for all metrics).

Based on the analyzed Lifecycle Costs metrics, all fuels provide a "medium" amount of Lifecycle Costs benefits – no metric scored "high." Gasoline and ethanol scored "high" in two of the five metrics; however, these were offset by low and medium scores in others.

Table 6-1 summarizes the Phase I evaluation category scores for each fuel/technology type.

Table 6-1. Phase I Score Summary

Metric	Gasoline (E10)	Propane		Ethanol (E85)	RNG	Battery-Electric
		Fossil	Renewable			
Operational Impact Score	High ●	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Low ○
Social Equity/Environmental Impact Score	Medium ◑	Medium ◑	High ●	Medium ◑	Medium ◑	High ●
Lifecycle Costs Total Score	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Medium ◑	Medium ◑
Selected to move into Phase II	Yes	No	Yes	No	Yes	Yes

Source: WSP

6.2 SELECTED FUELS/TECHNOLOGIES

Based on the analysis, gasoline, renewable propane, and battery-electric all scored "high" on one or more of the evaluation categories. For this reason, they will all be considered in Phase II. RNG, will also be further evaluated in Phase II. There are several metrics and factors that warrant additional and refined analysis to fully gauge its viability as a long-term fuel.

As previously discussed, LTD currently uses gasoline for its paratransit fleet. Although this is not a sustainable solution in terms of LTD's long-term environmental goals, it appears to be the most advantageous as a transition fuel in terms of its relatively low costs and limited operational impact. Fossil propane and ethanol fuels had similar scores as gasoline in many categories but fail to meet LTD's long-term environmental goals. Fossil propane's relatively high vehicles acquisition costs as compared to gasoline (approximately an additional $30,000 per vehicle) and ethanol's higher annual fuels costs (approximately an additional $2,000 per vehicle, per year) may not be the most financially prudent choices, especially since the transition fuel will only be operated for a relatively short period of time.

Renewable propane, RNG, and battery-electric should be considered in Phase II as long-term alternatives for LTD's 15-year procurement plan. All of these fuels/technologies have some barriers that will be further evaluated, and if possible, mitigated in Phase II. For instance, renewable propane paratransit vehicles aren't as prominent in the market at this time, RNG vans typically require special conversion kits to run off the fuel, and battery-electric has range constraints that may impact LTD's operation. Nonetheless, all of these fuels have promise – especially as technology continues to prove.

Therefore, it is recommended that Phase II considers gasoline as a transition fuel for LTD's paratransit vehicles and either renewable propane, RNG, or battery-electric as a long-term solution.

Table 6-2 summarizes whether the options evaluated herein will be evaluated in Phase II and a brief explanation of why.

Table 6-2. Selected Fuels/Technologies Summary

Fuel/Technology	Considered in Phase II?	Justification
Gasoline (E10)	Yes	E10 is the existing fuel and scored high for its Operational Impact. E10 will be considered as the transition fuel to a future fuel/technology. At this time, it does not have long-term applicability because it is still a fossil fuel.
Propane/ Fossil	No	Propane sourced by fossil fuel would only be considered as a transition fuel. Due to the relatively expensive costs of the vehicles, as compared to gasoline, it would not be suitable for LTD to incur these additional costs for a relatively short transition period.
Propane/ Renewable	Yes	Propane sourced by renewables scored high for its Social Equity/Environmental Impact. Its scores warrant additional analysis in Phase II.
Ethanol (E85)	No	Ethanol fuel would only be considered as a transition fuel (it does not meet LTD's 75% reduction in emissions or elimination of fossil fuels requirement). Ethanol is also more expensive to operate than gasoline, it would not be suitable for LTD to incur these additional costs for a relatively short transition period.
RNG	Yes	RNG has several qualities that make it a suitable fuel for LTD's long-term operations. It did not score as high as renewable propane or battery-electric (overall) based on the preliminary analysis, but Phase II will refine assumptions to determine its applicability.
Battery-electric	Yes	Battery-electric technology scored highest for the Social Equity/Environmental Impact score. While there are some constraints with range, battery-electric scored well for other metrics that warrant additional analysis in Phase II.

Source: WSP

6.3 NEXT STEPS

In Phase II, further refinements and research will be conducted to ensure that both the transition fuel/technology (gasoline) and selected fuel/technology types (renewable propane, RNG, or battery-electric) are fully understood. This includes the sourcing and long-term outlooks of the market and greater detail with respect to the facility requirements and how the transition will impact LTD's maintenance and operations. This information will then inform the development of 15-year planning scenarios that present the paths that LTD can take to meeting its goals. Phase II will conclude with an actionable Fleet Procurement Plan that will guide LTD through the next 15 years of its transition.

Appendix A: List of Stakeholders

Table 1. Internal Stakeholders

Name	Title , Department
Ric Adams	Maintenance Supervisor, Fleet Management Department
Rebecca Bailey	Operations Supervisor, Operations Department
Eric Evers	Maintenance Manager, Fleet Management Department
Kelly Hoell	Sustainability Program Manager, , Fleet Management Department
Matt Imlach	Fleet Management Director, Fleet Management Department
Heather Lindsay	Service Planner, Planning and Development Department
Robin Mayall	Director of Information Technology and Strategic Innovation, IT Department
Steve Parrott	ITS Manager, IT Department
Cosette Rees	Director, Accessible and Customer Services Department
Allen Shipp	Journey-Level Mechanic, Fleet Management Department
Nash Siegrist	Bus Operator / Operations Training Assistant Supervisor, Operations Department
Randi Staudinger	Project Manager, Facilities Management Department
David Svendsen	Maintenance Supervisor, Fleet Management Department
Frank Wilson	Public Safety and System Security Manager, Operations Department

Table 2. External Stakeholders

Name	Organization
Joy Alafia	Western Propane Gas Association
Haley Case-Scott	Beyond Toxics/NAACP
Alex Cuyler	Lane County
Christina Grabo	Bluestar Propane
Michael Graham	Columbia Willamette Clean Cities Coalition
Chris Kroeker	NW Natural
Sydney Krueger	Ballard Power
Garrett Kruger	Rousch
Frank Lawson	Eugene Water & Electric Board (EWEB)
Ethan Nelson	City of Eugene
Aimée Okotie-Oyekan	Beyond Toxics/NAACP
Jeff Orlandini	Lane County
Bill Peters	Oregon Clean Fuels Program
Tracy Richardson	Springfield Utility Board
Alex Schay	Northwest Alliance for Clean Transportation
Matt Stouder	Metropolitan Wastewater Management Commission (MWMC)
Mark Van Eeckhout	Metropolitan Wastewater Management Commission (MWMC)
Cory Ann Wind	Oregon Clean Fuels Program
Various Representatives	Carson
	Tyree
	Christensen
	Petroleum Traders
	Wilcox and Flegel
	McCall
	Oregon Petroleum Transport Company

Appendix B: Matrix Data and Outputs

		PARATRANSIT FLEET - VALUES							
		Baseline	Future						
Weighting Criteria	Fleet Percentage Weighting	E10 Gasoline	Fossil Propane	Renewable Propane	Ethanol (E85)	Fossil CNG - (pipeline)	RNG - contracted (Wastewater)	RNG - Direct pipeline (Landfill)	Electric
Capital Cost (Vehicle)	**7%**	**$ 56,763**	**$ 84,728**	**$ 84,728**	**$ 56,763**	**$ 99,587**	**$ 99,587**	**$ 99,587**	**$ 208,206**
Cutaway	*87%*	*$ 58,167*	*$ 86,431*	*$ 86,431*	*$ 58,167*	*$ 100,664*	*$ 100,664*	*$ 100,664*	*$ 220,000*
Van	*11%*	*$ 50,230*	*$ 77,350*	*$ 77,350*	*$ 50,230*	*0*	*0*	*0*	*$ 139,273*
Pick up Truck	*2%*	*$ 30,000*	*$ 49,000*	*$ 49,000*	*$ 30,000*	*$ 49,000*	*$ 49,000*	*$ 49,000*	*$ 67,500*
Capital Cost - Infrastructure (per vehicle rate)	**7%**	*$ -*	*$ -*	*$ -*	*$ -*	*$ 78,519*	*$ 18,519*	*$ 18,519*	*$ 54,643*
Fuel Cost (per 22,000 mi)	**7%**	**$ 5,651**	**$ 6,323**	**$ 6,836**	**$ 8,241**	**$ 3,386**	**$ 6,740**	**$ 6,748**	**$ 9,679**
Cutaway	*87%*	*$ 6,050*	*$ 6,840*	*$ 7,395*	*$ 8,963*	*$ 3,434*	*$ 6,837*	*$ 6,845*	*$ 9,679*
Van	*11%*	*$ 2,847*	*$ 2,807*	*$ 3,034*	*$ 3,338*	*0*	*0*	*0*	*$ 9,679*
Pick up Truck	*2%*	*$ 3,723*	*$ 3,131*	*$ 3,385*	*$ 3,723*	*$ 1,108*	*$ 2,208*	*$ 2,208*	*$ 9,679*
Operating Cost (Maintenance Cost per 22,000 mi)	**7%**	**$ 23,326**	**$ 23,546**	**$ 23,522**	**$ 23,326**	**$ 26,203**	**$ 26,203**	**$ 26,203**	**$ 23,106**
Cutaway	*87%*	*$ 26,494*	*$ 26,714*	*$ 26,714*	*$ 26,494*	*$ 26,714*	*$ 26,714*	*$ 26,714*	*$ 26,274*
Van	*11%*	*$ 2,072*	*$ 2,292*	*$ 2,072*	*$ 2,072*	*0*	*0*	*0*	*$ 1,852*
Pick up Truck	*2%*	*$ 1,936*	*$ 2,156*	*$ 2,156*	*$ 1,936*	*$ 2,156*	*$ 2,156*	*$ 2,156*	*$ 1,716*
Financial Incentives	**5%**	Low	Low	High	Medium	Low	High	High	High
75% reduction Tailpipe GHG emissions (Meets LTD Climate Policy)	**9%**	**0%**	**18%**	**100%**	**36%**	**18%**	**100%**	**100%**	**100%**
Lifecycle GHG emissions (g/yr)	**7%**	**1,418**	**1,524**	**791**	**1,290**	**2,391**	**1,093**	**1,093**	**80**
Cutaway	*87%*	*1,518*	*1,649*	*855*	*1,403*	*2,425*	*1,108*	*1,108*	*80*
Van	*11%*	*715*	*677*	*351*	*523*	*-*	*-*	*-*	*80*
Pick up Truck	*2%*	*934*	*755*	*391*	*583*	*782*	*358*	*358*	*80*
0% Fossil Fuel (Meets LTD Climate Policy)	**7%**	**No**	**No**	**Yes**	**No**	**No**	**Yes**	**Yes**	**Yes**
Local Air Quality (Criteria Air Polutants) (g/mi)	**7%**	**0.21**	**0.21**	**0.21**	**0.19**	**0.29**	**0.29**	**0.29**	**0.11**
Cutaway	*87%*	*0.22*	*0.22*	*0.22*	*0.19*	*0.30*	*0.30*	*0.30*	*0.11*
Van	*11%*	*0.15*	*0.15*	*0.15*	*0.15*	*-*	*-*	*-*	*0.11*
Pick up Truck	*2%*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.11*
Vehicle Range & Duty Cycle	**15%**	**426.30**	**311.20**	**311.20**	**319.72**	**298.96**	**298.96**	**298.96**	**106.48**
Cutaway	*87%*	440	321.2	321.2	330	300	300	300	100
Van	*11%*	340	248.2	248.2	255	250	250	250	150
Pick up Truck	*2%*	300	219	219	225	250	250	250	150