Little Cottonwood Canyon ENVIRONMENTAL IMPACT STATEMENT
S.R. 210 | Wasatch Blvd. to Alta

Revised Life Cycle Cost Analysis

Little Cottonwood Canyon Environmental Impact Statement Wasatch Boulevard to Alta

Lead agency:
Utah Department of Transportation

February 22, 2023

Contents

Tables

Figures

Attachments

1.0 Introduction

With the State Route (S.R.) 210 Environmental Impact Statement Project, the Utah Department of Transportation (UDOT) is analyzing ways to address transportation issues on Wasatch Boulevard and on S.R. 210 in Little Cottonwood Canyon.

Over the course of the project, UDOT has prepared three life cycle cost analyses (LCCA) for the action alternatives that were analyzed as part of the project's Environmental Impact Statement (EIS). The purpose of these analyses is to compare both the initial capital expenditures and the annual operation and maintenance (O&M) costs for the action alternatives over a 30-year period (out to the year 2054).

The first version of the LCCA was released with the November 2020 *Draft Alternatives Development and Screening Report Addendum*, which described the five primary action alternatives that would be analyzed in the EIS for the project. These were the action alternatives that were presented in the Draft EIS in June 2021.

UDOT updated the LCCA for the Final EIS to account for refinements to Gondola Alternative B and the Cog Rail Alternative that were made between the release of the Draft and Final EISs. The second version of the LCCA was updated in February 2022, and the results were presented with the Final EIS released on August 31, 2022. As part of these refinements, UDOT increased the number of parking spaces at the Gondola Alternative B and Cog Rail Alternative base stations from 1,500 to 2,500. With the addition of these parking spaces, mobility hubs at the gravel pit and at 9400 South and Highland Drive were no longer needed for these alternatives. All users would drive directly to the base station and would not need to take a bus from a remote mobility hub to the gondola or cog rail base station.

The data presented in this report represents the third version of the LCCA. For this LCCA, UDOT revised the original assumptions in the February 2022 LCCA regarding the year of construction, inflation rates, and discount rates to capture fourth-quarter 2022 values. In addition, UDOT prepared updated capital and O&M cost estimates to account for inflation and material price increases observed from 2020 to the fourth quarter of 2022. See Section 2.3, *Major Assumptions*, for the capital and O&M LCCA inputs with these refined alternatives.[1,2]

2.0 Analysis Approach

The LCCA discussed in this report applies the revised capital cost estimates for alternatives that were presented in the Final EIS. Capital and O&M costs were updated to reflect market conditions in 2022 and were based on ongoing coordination with the Utah Transit Authority (UTA). Capital cost estimates were updated to account for observed inflation and material cost escalations (10% to 25%) that occurred between 2021 and 2022—inflation and cost escalations that were higher than historic average annual increases (2.75% to 3.5%).

The general approach of this LCCA was to take the updated capital and O&M costs and apply an inflationary factor to estimate the year-of-expenditure cost for both capital costs and winter-season O&M costs and then

[1] HDR, "Little Cottonwood Canyon EIS, Alternatives Cost Adjustments for Materials Price Escalation," January 27, 2023.

[2] HDR, "Little Cottonwood Canyon EIS, Approximate Cost for Phasing Final EIS Preferred Alternative (Components of Enhanced Bus and then Gondola)," January 27, 2023.

apply a discount rate to determine the present value of costs (in 2022 dollars) and sum those costs over a 30-year life cycle. The sum of the present value of future costs are also referred to as cumulative costs in this report.

This LCCA is an economic model that calculates capital and operating cost differences among alternatives but does not include any revenues generated by the alternatives. Similarly, the LCCA does not include any salvage value of assets or equipment (buses, light-rail vehicles, or trains, for example) or calculate the remaining service life of a fixed asset (roadway, snow shed, or rail track, for example) after the analysis period. The LCCA also does not quantify temporary user cost or the long-term benefits (travel time savings) from the alternatives, nor does it consider environmental benefits or detriments, nor calculate the monetary value of these factors and the differences among the alternatives.

Note that the LCCA relies on inflationary factors and discount rates that are dynamic over time. In addition, at the time of this report, the U.S. Federal Reserve was aggressively increasing interest rates. Monetary conditions could eventually lead to an economic slowdown, reduced demand, and a reduction in the rate of material price increases (or perhaps a reduction in prices). Therefore, year-of-expenditure costs may be different than what are estimated for this LCCA. See Section 2.3, *Major Assumptions*, for an example of how inflation and discount rates have changes since the first version of the LCCA.

2.1 Five Primary Alternatives Analyzed

The following are general descriptions of the primary alternatives analyzed in this LCCA.

- **Enhanced Bus Service Alternative.** The Enhanced Bus Service Alternative includes parking spaces for about 2,500 vehicles split between the gravel pit mobility hub (1,500 spaces) and the 9400 South and Highland Drive mobility hub (1,000 spaces) with direct bus service to the Snowbird and Alta resorts. Considering the needed bus frequency, dwell time, and end-of-line time, this alternative would require about 65 buses.
- **Enhanced Bus Service in Peak-period Shoulder Lane Alternative.** This alternative is the same as the Enhanced Bus Service Alternative except that the enhanced bus service would use peak-period shoulder lanes (PPSL) from the North Little Cottonwood Road/Wasatch Boulevard intersection to the Alta Bypass Road. This alternative would require about 45 buses. Fewer buses are required because the round-trip travel time, in a dedicated bus lane, would be less with this alternative than the Enhanced Bus Service Alternative.
- **Gondola Alternative A (Starting at Canyon Entrance).** Gondola Alternative A includes a gondola running from a base station at the entrance to Little Cottonwood Canyon to the Snowbird and Alta resorts. Gondola Alternative A includes parking spaces for about 2,500 vehicles split between the gravel pit mobility hub and the 9400 South and Highland Drive mobility hub (same distribution as enhanced bus service alternatives) with bus service between the mobility hubs and the gondola base station. This alternative would require about 26 buses.
- **Gondola Alternative B (Starting at La Caille).** Gondola Alternative B includes a gondola running from a base station, located about 0.75 mile northwest of the entrance to Little Cottonwood Canyon, to the Snowbird and Alta resorts. Gondola Alternative B includes a 2,500-space parking structure adjacent to the gondola base station at the La Caille property. Because all users would park at the gondola base station, no buses would be required with this alternative.

This alternative was selected by UDOT as the preferred alternative in the Final EIS. However, at the time the Final EIS was published, funding had not been identified for Gondola Alternative B. Because mobility is an issue today, UDOT would start operating an enhanced bus service until funding for this alternative is obtained and the gondola becomes operational. For more information, see Section 2.6, *Scaling and Phasing Implementation Scenarios (New Analysis)*.

- **Cog Rail Alternative (Starting at La Caille).** The Cog Rail Alternative includes a cog rail system (mountain rail or rack rail) starting near the entrance to Little Cottonwood Canyon at the La Caille property and running to the Snowbird and Alta resorts. The alignment would be side-running, primarily along the north side of S.R. 210 in Little Cottonwood Canyon. The Cog Rail Alternative includes a 2,500-space parking structure near the cog rail base station at La Caille. Because all users would park at the cog rail base station, no buses would be required with this alternative.

2.2 Implementation Scenarios

Three implementation scenarios are assessed in this LCCA report.

- **Implementation Scenario 1.** The first scenario assumes that any of the five primary alternatives would be constructed in 2024 and 2025 and operational by 2026. For this LCCA, UDOT assumes that the alternatives would be implemented in 2026 as they were sized (bus fleet and parking capacity, for example) to address the 2050 design-year demands.
- **Implementation Scenario 2.** The second scenario assumes scaled implementation of the Enhanced Bus Service Alternative starting with a smaller bus fleet and increasing the number of buses to address growing demand between now and 2050. This scaled implementation was identified as one advantage of the enhanced bus service alternatives in the Final EIS.
- **Implementation Scenario 3.** The third scenario represents the preferred alternative as described in the Final EIS: Gondola Alternative B starting with components of the Enhanced Bus Service Alternative. UDOT estimated the LCCA for a bus fleet that would be gradually increased according to transit demands until Gondola Alternative B is assumed constructed. This analysis assumes gondola would then become operational in 2033, and bus operations would cease. See Section 2.6, *Scaling and Phasing Implementation Scenarios (New Analysis)*, for details about the phased and scaled analysis.

2.3 Major Assumptions

Since the purpose of the LCCA is to compare costs among the alternatives, this LCCA excludes costs for Wasatch Boulevard improvements, noise walls, and tolling infrastructure, since these costs are common to all five alternatives. The costs for trailhead improvements and show sheds vary by alternative and are, therefore, included in this LCCA analysis.

The following are the other major assumptions used in this LCCA.

- **Construction.** Year 2024 was assumed as the first year of construction, and construction costs are assumed to occur over 2 years, starting in 2024 and finishing by December 31, 2025. Construction costs include materials, equipment, construction labor, project management, engineering, permitting, and construction management.
- **30-year Life Cycle Cost.** Assuming a start of construction in 2024, completion in 2025, and start of operations in 2026, year 2054 was used as the end date to capture a 30-year life cycle.
- **Inflation Rate.** Cost estimates are based on 2022 dollars (2022$). A 3.25% annual inflation rate[3] was used to estimate the year-of-expenditure cost. The inflation rate was increased from the first LCCA, which used 1.98%.[4]
- **Discount Rate.** A 0.5% nominal discount rate was used to determine the present value (2022$) for year-of-expenditure costs.[5] The discount rate used in the first LCCA was 2.4%.[6]
- **Days of Operation.** All alternatives assume 140 days of winter operation. UTA currently operates buses about 140 days per winter season.
- **Bus Operations (Enhanced Bus Service Alternative and Enhanced Bus Service in Peak-period Shoulder Lane Alternative).**
  - Each bus has a 14-year service life. Purchasing all new buses is assumed 14 years after the initial purchase at $600k per bus (2022$).
  - The alternatives include a bus maintenance facility sized for the number of buses needed for each alternative. The assumed cost of the maintenance facility is $850k (2020$) per bus, which was inflated 25% to $1,063k per bus (2022$).
  - O&M costs for buses include a mid-life bus transmission overhaul ($50k per bus[7]) in 2020$, adjusted for the year of expenditure.
  - Operating costs include labor for drivers, mechanics, and back-office staff. These costs were provided by UTA in 2021[8] and inflated by 10% to reflect 2022$ as recommended by UTA.

[3] Recommended by UTA based on historic averages. Communication with UTA, December 22, 2022.
[4] ENR Construction Index, calendar year 2019.
[5] White House Office of Management and Budget, OMB Circular No. A-94, published June 2022.
[6] White House Office of Management and Budget, OMB Circular No. A-94, published December 2019.
[7] Communication with UTA, January 25, 2021.
[8] Communication with UTA, April 22, 2021.

- Includes snow sheds and minor realignments to S.R. 210 in three higher-risk avalanche paths in the mid-canyon segment of Little Cottonwood Canyon.[9]
- The Enhanced Bus Service in Peak-period Shoulder Lane Alternative includes additional O&M costs to remove snow ($220k annually, 2022$) and to repave the peak-period shoulder lanes in the canyon every 8 years ($5M per repave, 2022$).

- **Gondola Alternatives.**
  - The winter O&M cost includes labor (operators, mechanics, electricians, and back-office staff), energy cost, and annual reserve for replacing major equipment (cable replacement, cabin refurbishments, and drive motor replacements).
  - Both gondola alternatives include road snow sheds in the three mid-canyon avalanche paths to reduce the use of artillery and reduce gondola closure times.
  - Gondola Alternative A includes bus service from mobility hubs (1,500 parking spaces at the gravel pit mobility hub and 1,000 spaces at the 9400 South and Highland Drive mobility hub). UTA estimated that 26 buses would be needed for Gondola Alternative A.
  - Gondola Alternative B would include 2,500 parking spaces at the gondola base station, and no auxiliary bus service from mobility hubs would be required.
- **Cog Rail Alternative.**
  - Includes a standalone operations and maintenance facility at the reconfigured park-and-ride lot at the entrance to Little Cottonwood Canyon.
  - Includes snow sheds over the tracks and the existing roadway in three mid-canyon avalanche paths. Includes rail-only snow sheds in four of the higher-risk avalanche paths in the upper-canyon segment.[10]
  - Cog rail vehicles would receive a major overhaul after 20 years of service at a cost of one-third the rail vehicle initial capital cost. This overhaul is recommended to extend the vehicle life.
  - Operating cost estimate is for winter service only and is based on the cost per revenue-mile for UTA's light-rail fleet.[11] Diesel-powered light-rail vehicles could be different.
  - UDOT assumed 15-minute headways during the peak hours and 30-minute headways during off-peak times. Each cog rail train would have three cars. Based on coordination with UTA, there would be a total of eight train sets.
  - UDOT added $3.45M (2022$) for purchasing snow-removal equipment associated with snow removal along the rail alignment. The O&M cost includes an allocation of $660k annually (2022$) for snow removal.

[9] White Pine Chutes 1–4, White Pine, and Little Pine.

[10] East Hellgate, Superior, Little Superior, and Hilton.

[11] UTA, *UTA's Comprehensive Annual Financial Report 2019*, June 2, 2020.

2.4 Capital Cost Estimates

Table 1 presents the estimated initial capital cost ($2022) of each primary alternative and sub-alternative used in this LCCA. The total capital costs for the five primary alternatives do not include Wasatch Boulevard improvements, noise walls, or tolling infrastructure, which are common to all five primary alternatives.

Table 1. Breakdown of Capital Costs for the Components of the Primary and Sub-alternatives

In millions of 2022 dollars

Component	Alternative				
	Enhanced Bus	Enhanced Bus in PPSL	Gondola A	Gondola B	Cog Rail
Gondola system	—	—	$328.9	$370.5	—
Cog rail and rail operations and maintenance facility	—	—	—	—	$651.0
Base station parking (2,500 spaces)	—	—	$99.0	$99.0	$99.0
North Little Cottonwood Road improvements	—	—	—	$45.9	$45.9
Wasatch Boulevard one-way access road (Izzo Way)	—	—	—	$5.6	$5.6
Rail snow removal equipment	—	—	—	—	$3.5
Buses and bus maintenance facility	$108.0	$74.8	$43.3	—	—
S.R. 210 widening in Little Cottonwood Canyon	—	$202.8	—	—	—
Resort bus stops	$11.8	$11.8	—	—	—
Mobility hubs (330 square feet and $39,600 per space)	$99.0	$99.0	—	—	—
Mobility hub interchange	$37.6	$37.6	$37.6	—	—
Mobility hub right-of-way	$17.3	$17.3	$17.3	—	—
Snow sheds (with realigned road)	$109.0	$109.0	$109.0	$109.0	—
Rail snow sheds (mid-canyon and upper canyon)	—	—	—	—	$335.6
Trailhead parking	$7.5	$7.5	$7.5	$7.5	$7.0
Reconfigured park-and-ride lot	—	—	$7.7	$7.7	$7.7
Total[a]	**$390**	**$560**	**$650**	**$645**	**$1,155**

[a] Excludes costs for Wasatch Boulevard improvements, noise walls, and tolling infrastructure, which are common to all five primary alternatives.

The Cog Rail Alternative has the highest initial capital cost ($1,155M), which is about $500M greater than the capital cost of the next-highest alternative, Gondola Alternative A ($650M). Gondola Alternative B ($645M) comes in third, followed by the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($560M) and lastly the Enhanced Bus Service Alternative ($390M).

Table 2 presents the estimated initial capital costs (2022$) used in this LCCA for the five primary alternatives and ranks each alternative from least to highest capital cost.

Table 2. Initial Capital Costs of the Five Primary Alternatives (Implementation Scenario 1) as Used in This LCCA

In millions of 2022 dollars

Alternative	Estimated Initial Capital Cost[a]	Rank (least to highest cost)
Enhanced Bus Service	$390	1
Enhanced Bus Service in Peak-period Shoulder Lane	$560	2
Gondola A (Starting at Canyon Entrance)	$650	4
Gondola B (Starting at La Caille)	$645	3
Cog Rail (Starting at La Caille)	$1,155	5

[a] Excludes costs for Wasatch Boulevard improvements, noise walls, and tolling infrastructure, which are common to all five primary alternatives.

2.5 Operation and Maintenance (O&M) Cost Estimates

The approximate winter-season O&M cost (in 2022$) for each alternative is as follows:

- Enhanced Bus Service – $15.9M
- Enhanced Bus Service in Peak-period Shoulder Lane – $12.4M
- Gondola A (Starting at Canyon Entrance) – $10.6M
- Gondola B (Starting at La Caille) – $4.4M
- Cog Rail (Starting at La Caille) – $3.7M

As mentioned in Section 2.3, *Major Assumptions*, 2024 and 2025 were assumed as the years of construction,[12] and operating costs start in 2026. For the LCCA for the five primary alternatives, which combines initial capital and O&M costs, see Section 3.0, *LCCA Results for* the 5 Primary Alternatives. Section 3.0 represents implementation scenario 1, which is initial full build-out.

[12] Half of initial capital costs were applied in 2024 and half in 2025.

2.6 Scaling and Phasing Implementation Scenarios (New Analysis)

The gondola system must be fully constructed in order to provide its primary benefits (scenario 1), whereas the enhanced bus service can be scaled to meet increasing demands over time (scenario 2). In the Final EIS, UDOT identified Gondola Alternative B (Starting at La Caille) as its primary preferred alternative. Because funding for the gondola is not secured and mobility is an issue today, UDOT's preferred alternative includes phased implementation using components of the Enhanced Bus Service Alternative until Gondola Alternative B is completed (scenario 3).

For this LCCA, UDOT developed implementation scenarios 2 and 3 to address the life cycle costs for how the Enhanced Bus Service Alternative could be scaled and how Gondola Alternative B could be phased starting with enhanced bus service as described in the Final EIS.

- **Implementation Scenario 2 – Scaled Enhanced Bus Service.** This scenario is a scaled implementation of the Enhanced Bus Service Alternative. The Scaled Enhanced Bus Service Scenario starts with about 22 buses, which are needed for initial ridership and adds 1 to 2 buses per year until the total 65 buses are needed for full build-out in 2050. O&M costs were also scaled accordingly.
- **Implementation Scenario 3 – Scaled Enhanced Bus Service then Gondola Alternative B.** UDOT would start with enhanced bus service (construction of mobility hubs in 2024–2025 and bus operation by 2026) with the intent to construct Gondola Alternative B when funding becomes available. This alternative starts with 22 buses and adds 2 per year until 2032. This LCCA assumes that construction for Gondola Alternative B would begin in 2031 and end in 2032, and operational costs for the gondola would begin in the fall of 2033. At that time, operational costs for the scaled enhanced bus service would cease, and the buses would be reallocated. Year 2033 was assumed for operation because it represents the approximate half-life of a bus (7 years out of 14), at which time a major transmission overhaul would be needed, but it would be avoided under this phased implementation scenario. ***These dates are assumed for this LCCA, the transition timeline has not been defined.***

For the LCCA of these scaled and phased scenarios, see Section 4.0, *Scaled and Phased Implementation Scenarios*.

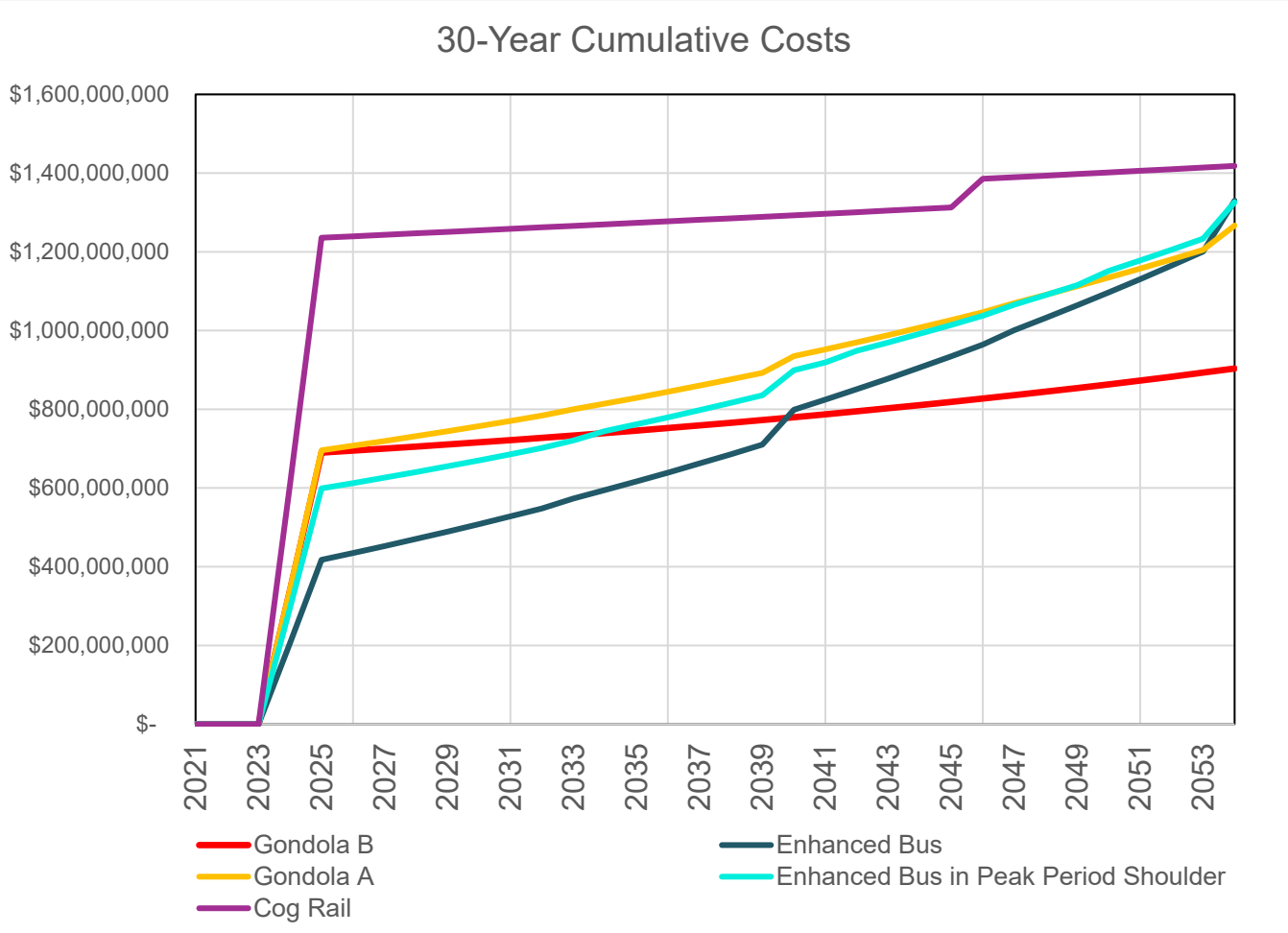
3.0 LCCA Results for the 5 Primary Alternatives (Implementation Scenario 1)

This section presents the results for the five primary alternatives. The LCCA results in this section represent implementation scenario 1, which is the full build-out of the primary alternatives sized for the 2050 design year and implemented starting with construction in 2024–2025 and in operation by 2026.

Figure 1 presents cumulative cost curves for discounted (2022$) year-of-expenditure costs for the primary five alternatives analyzed in this LCCA. The LCCA inputs, year-of-expenditure cost, and future costs discounted to 2022$ for each alternative are provided in Attachment A, *Life Cycle Cost Inputs and Assumptions*.

Figure 1. Life Cycle Costs for the Five Primary Alternatives (Implementation Scenario 1)

In 2022 dollars



For the enhanced bus service alternatives and Gondola Alternative A, the bumps or upticks in years 2039 and 2053 are due to new bus purchases being required every 14 years. For the Cog Rail Alternative, the

uptick in 2045 captures the major cog rail vehicle overhaul (assumed to be one-third the initial capital cost), which is needed to extend the life of cog rail vehicles to 40 years or more.

Table 3 shows the present value of the 30-year life cycle cost for each primary alternative. These values are the discounted cumulative costs to 2054 from Figure 1. Table 3 also presents the ranking (least cost to highest cost) of the alternatives based on the present value of the estimated 30 year of costs. In addition, Table 3 presents the initial capital cost ranking (lowest to highest) for comparison.

Table 3. 30-year Life Cycle Costs of the Five Primary Alternatives (Implementation Scenario 1)

In millions of 2022 dollars

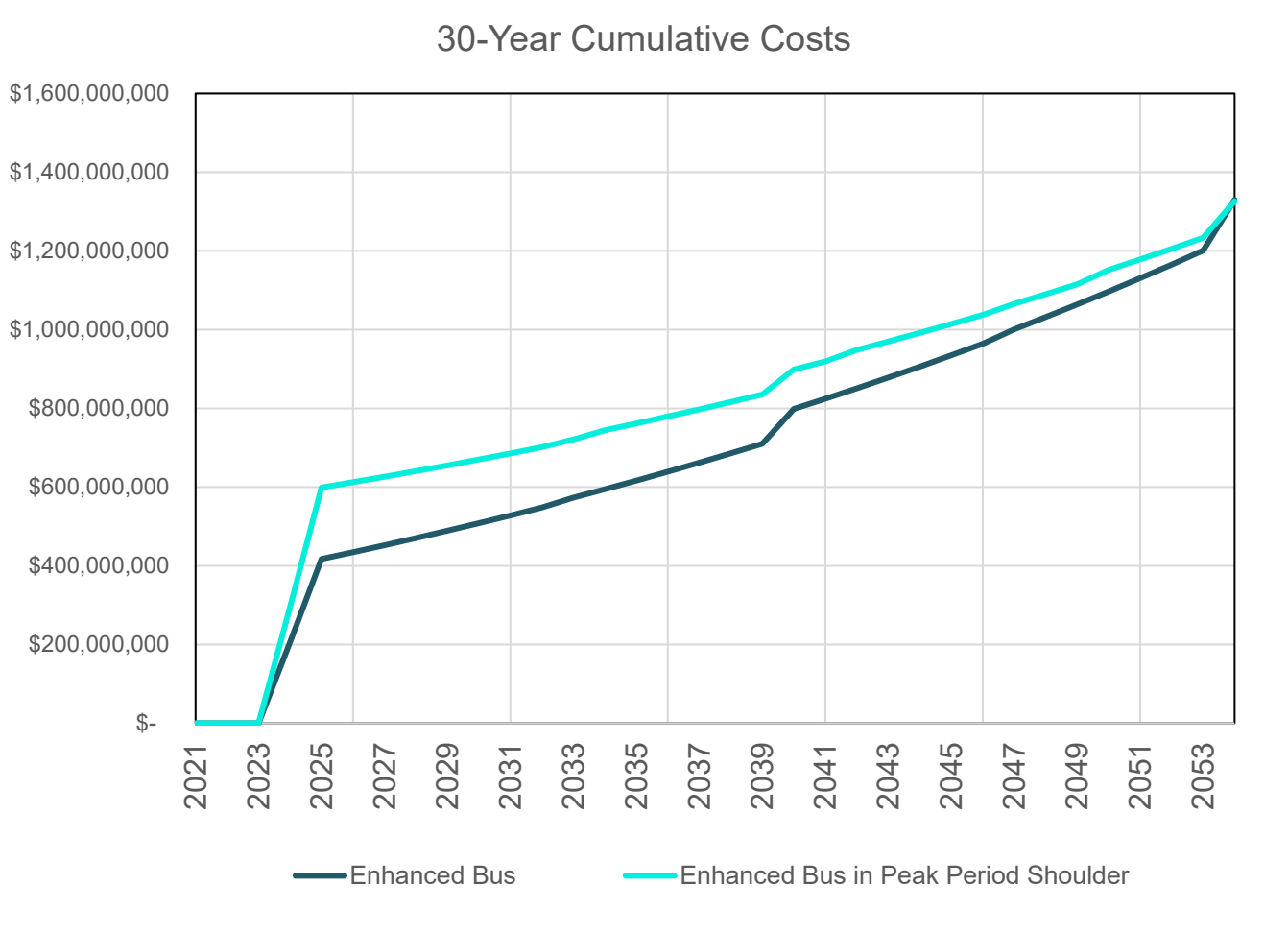
Alternative	Present Value, 30-year Costs	Present Value Rank (least to highest cost)	Initial Capital Cost Rank (least to highest cost)
Gondola B (Starting at La Caille)	$904	1	3
Gondola A (Starting at Canyon Entrance)	$1,267	2	4
Enhanced Bus Service in Peak-period Shoulder Lane	$1,326	3	2
Enhanced Bus Service	$1,330	4	1
Cog Rail (Starting at La Caille)	$1,419	5	5

3.1 Results for the Enhanced Bus Service Alternatives

Figure 2 presents the cumulative cost curves for the enhanced bus service alternatives for comparison.

Figure 2. Life Cycle Costs for the Enhanced Bus Service Alternatives (Implementation Scenario 1)

In 2022 dollars



The cost of constructing the peak-period shoulder lanes (about $202.8M) is the primary reason for the higher capital cost of the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($560M total) compared to the Enhanced Bus Service Alternative ($390M total). However, because of faster travel times provided by a dedicated lane, the Enhanced Bus Service in Peak-period Shoulder Lane Alternative requires fewer buses (45 buses at about $27M total) than does the Enhanced Bus Service Alternative (65 buses at about $39M total). A smaller maintenance facility would be needed with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative. Buses need to be replaced every 14 years, which would be a higher ongoing capital cost liability for the Enhanced Bus Service Alternative (65 buses replaced every 14 years).

Fewer buses also result in a lower annual O&M cost for the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($12.1M) compared to the Enhanced Bus Service Alternative ($15.4M). Therefore, the gap

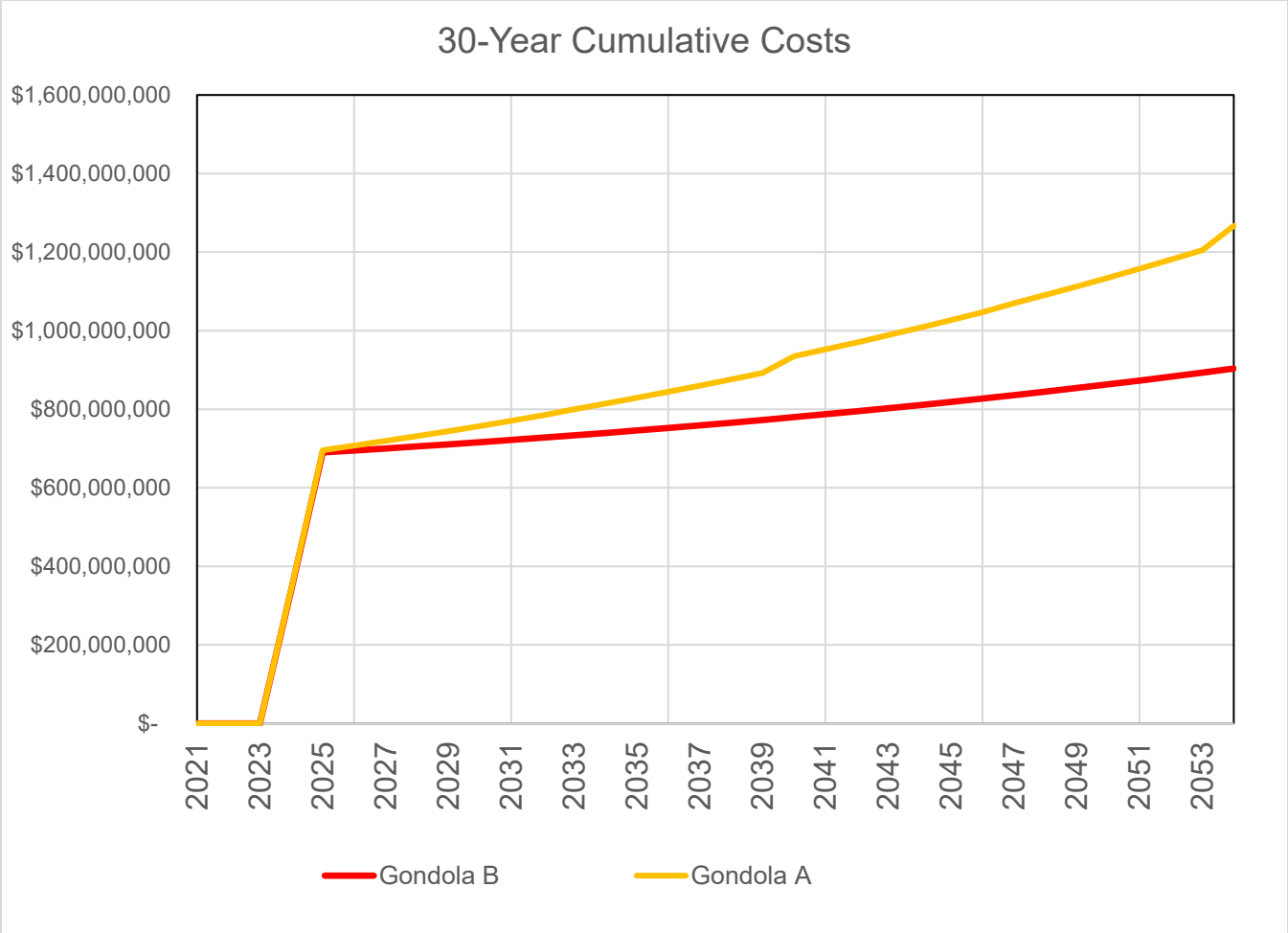
in cumulative cost curves between these alternatives narrows over time. By 2054, the 30-year life cycle cost for the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($1,326M) is about $4M lower than the life cycle cost for the Enhanced Bus Service Alternative ($1,330M) despite its higher initial cost.

3.2 Results for the Gondola Alternatives

Figure 3 presents the cumulative cost curves for the gondola alternatives.

Figure 3. Life Cycle Costs for the Gondola Alternatives (Implementation Scenario 1)

In 2022 dollars



Gondola Alternative A would have a slightly higher initial capital cost ($650M) compared to Gondola Alternative B ($645M). Gondola Alternative B would have a longer gondola alignment and would require additional roadway improvements to S.R. 210 near the gondola base station to so that personal vehicles can more easily access the parking structure at the base gondola station. However, because all gondola riders could park at the base station with Gondola Alternative B, no buses or a bus maintenance facility would be

needed, unlike with Gondola Alternative A (26 buses).[13] The annual O&M costs for Gondola Alternative B ($4.4M) would be about $6M lower than for Gondola Alternative A ($10.6M). After 30 years of operation, the life cycle cost of Gondola Alternative B ($904M) would be about $363M less than that of Gondola Alternative A ($1,267M).

3.3 Results for the Cog Rail Alternative

The Cog Rail Alternative (see Figure 1 and Table 3) has the highest initial capital cost ($1,115M) of all five primary alternatives. However, this alternative has the lowest O&M cost ($3.7M), resulting in a relatively flat cumulative cost curve to 2054.

3.4 Comparisons among the Enhanced Bus Service, Gondola, and Cog Rail Alternatives

This section discusses some of the main differences in the 30-year life cycle costs among the primary alternatives, which are illustrated in Figure 1.

- The higher O&M costs of the enhanced bus service alternatives (about $12.4M to $15.9M annually) compared to the gondola alternatives ($4.4M to $10.6M annually) result in a higher 30-year cumulative cost for the enhanced bus service alternatives ($1,326M to $1,330M) compared to the gondola alternatives ($1,267 to $904M), despite the gondola alternatives' higher initial capital construction costs.
- Gondola Alternative B has the lowest 30-year life cycle cost at about $904M. This is primarily because no bus purchases or annual bus O&M costs would be required for this alternative. The cumulative cost curve for Gondola Alternative B (which has a higher initial capital cost) is overtaken by the Enhanced Bus Service in Peak-period Shoulder Lane Alternative in about 2035 and by the Enhanced Bus Service Alternative in about 2040, illustrating the effect of the higher O&M costs.
- The Enhanced Bus Service Alternative, which has the lowest estimated initial capital cost ($390M), becomes the fourth-ranked (second-highest-cost) alternative based on cumulative costs ($1,330M) over a 30-year life cycle. The Enhanced Bus Service Alternative would cost about $426M more than the first-ranked (lowest) cumulative cost alternative, Gondola Alternative B ($904M).
- The higher O&M cost of the Enhanced Bus Service in Peak-period Shoulder Lane Alternative causes its cumulative costs to overcome the cumulative costs of Gondola Alternative B, which has higher initial capital cost but a lower estimated annual O&M cost, in about 2035, or after about 9 years of operation.
- Gondola Alternative A ($650M initial capital cost) has a $102M-higher estimated capital cost than the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($548M initial cost). With the higher estimated O&M cost of the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($12.1M annually), the cumulative costs of this alternative exceed the cumulative costs of Gondola Alternative A in about 2049. Over 30 years, the cumulative cost to purchase and operate 45 buses

[13] See Table 1 for the capital costs of improvements to North Little Cottonwood Road ($45.6M) and for the new one-way access road from Wasatch Boulevard ($5.6M) compared to the buses and bus maintenance facility ($43.3M).

with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative ($1,326M) exceeds (+$59M, or +4.7%[14]) the cumulative cost of constructing and operating Gondola Alternative A ($1,267M) with its 26 buses.

- The cumulative cost of the Enhanced Bus Service in Peak-period Shoulder Lane Alternative overcomes the cumulative cost of Gondola Alternative A in about 2049, after about 23 years of operation.
- The lower annual O&M costs for the Cog Rail Alternative are not enough to compensate, over a 30-year period, for its initial construction cost. The cumulative, present value of costs out to 2054 for the Cog Rail Alternative is about $1,419M, which is about $89M higher than the second-highest life cycle cost alternative, the Enhanced Bus Service Alternative ($1,330M). With the assumptions used, the Cog Rail Alternative would have a life cycle cost about $515M more than that of Gondola Alternative B.

The enhanced bus service alternatives would require transit riders to transition from their personal vehicles to public transit (the transfer from a personal vehicle to transit would occur at mobility hubs that are located away from the entrance to Little Cottonwood Canyon). Gondola Alternative A would also require riders to park at mobility hubs and transfer from their personal vehicle to buses at the mobility hub, and then transfer from a bus to the gondola at the gondola base station at the entrance to Little Cottonwood Canyon. The base station for Gondola Alternative B and the Cog Rail Alternative would include parking at the base station and, like the enhanced bus service alternatives, would require one transfer from a personal vehicle to transit (either gondola or cog rail train).

Buses would be needed with the enhanced bus service alternatives and Gondola Alternative A. These buses have higher ongoing annual O&M costs due primarily to the labor force required to operate and maintain the buses. The higher O&M cost and the inflation applied (3.25%) to the O&M cost in future years have a substantial effect on the year of expenditure costs in this LCCA. In addition, the relatively low discount rate (0.5% in 2022 compared to 2.4% in 2019), has less effect when discounting future costs to present values. As mentioned in Section 2.0, *Analysis Approach*, inflationary factors and discount rates are dynamic. The comparisons above represent a snapshot in time by applying the major assumptions referenced in this LCCA.

[14] The percentage increase (4.7%) equals the cost difference ($59M) divided by the 30-year life cycle cost for Gondola Alternative A ($1,267M). The calculation is 59 ÷ 1,267 = 0.0465, or 4.7%.

4.0 Scaled and Phased Implementation Scenarios

The LCCA results discussed in Section 3.0, *LCCA Results for* the 5 Primary Alternatives, compare the primary alternatives assuming complete implementation (full build-out) of each alternative by December 2025, which is implementation scenario 1, as described in Section 2.2, *Implementation Scenarios.*

In the Final EIS, UDOT identified one advantage of the enhanced bus service, which is that components can be scaled to accommodate transit needs that grow over time to the ultimate 2050 design year. Therefore, for this LCCA, UDOT estimated the life cycle cost for starting with a smaller bus fleet (22 buses) and increasing the number of buses operating to address growing demand between now and 2050 (65 buses). Section 4.1, *Scaled Enhanced Bus Service (Implementation Scenario 2)*, presents the LCCA for scenario 2.

Scenario 3 represents the Final EIS preferred alternative. For this LCCA, UDOT assumes that 22 buses are purchased initially to meet near-term transit ridership needs. Three buses are added each year until 2030, resulting in a total of 34 buses operating through 2032. Gondola Alternative B construction would start in 2031 and would be completed in late 2032. The gondola would then become operational in 2033, and bus operations would cease. Section 4.2, *Scaled Enhanced Bus Service then Gondola Alternative B (Implementation Scenario* 3), presents the LCCA for scenario 3.

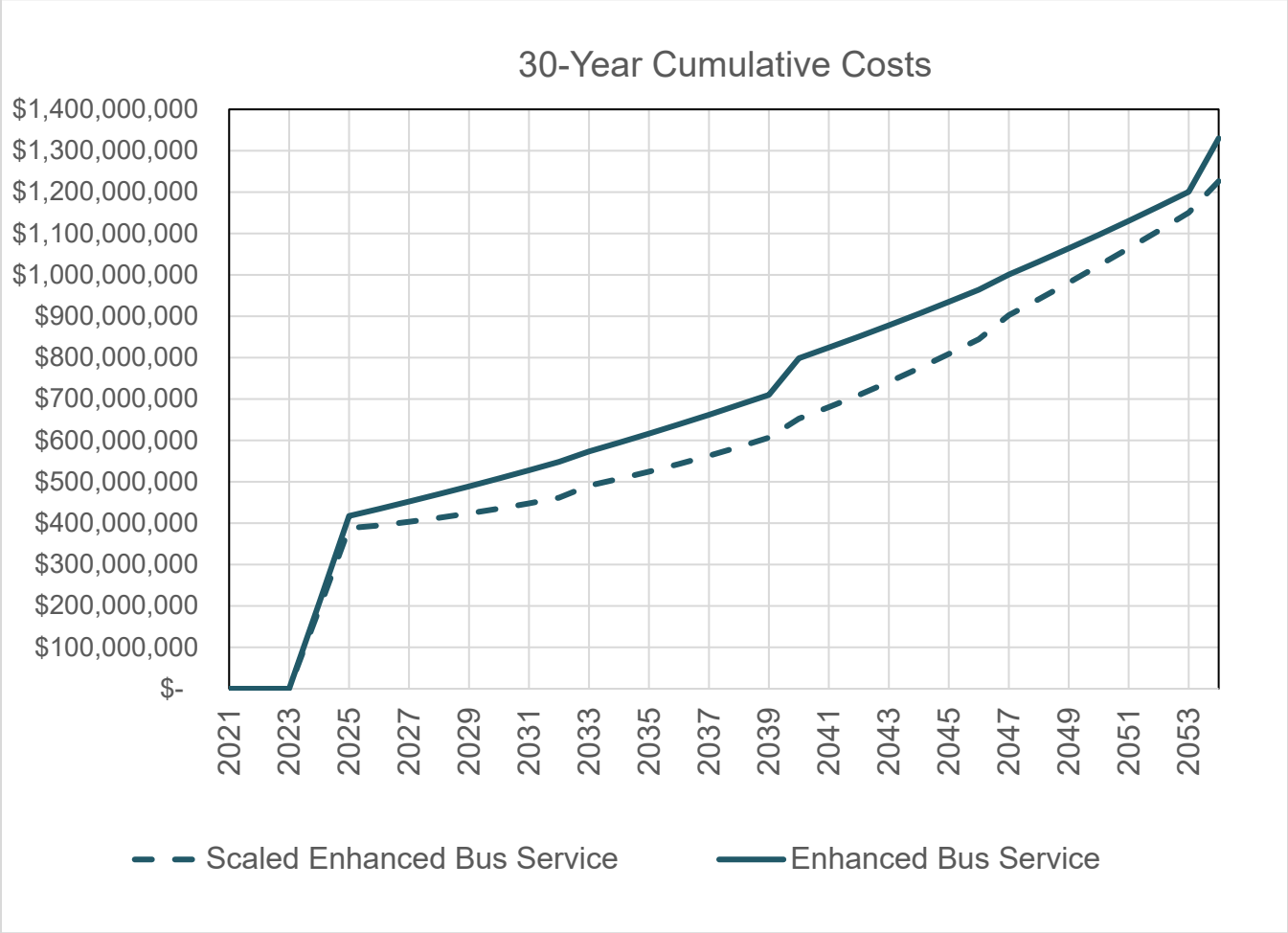
4.1 Scaled Enhanced Bus Service (Implementation Scenario 2)

With the Scaled Enhanced Bus Service scenario, the initial capital cost is nearly identical to that of the Enhanced Bus Service Alternative except for a reduced bus capital cost in which 22 buses are purchased initially instead of the full 65. Capital costs for bus purchases were added over time to account for purchasing 1 to 2 buses each year to reach 65 buses by 2050. The O&M costs were also scaled over time according to the number of buses in operation. The initial capital costs include a bus maintenance facility (sized for the full 65 buses), the mobility hubs (land and parking structure at both the gravel pit and at 9400 South and Highland Drive), resort bus stops, snow sheds, and trailheads, which are all assumed to occur during initial construction (2024–2025).

Figure 4 below compares the original Enhanced Bus Service Alternative with the Scaled Enhanced Bus Service implementation scenario. The life cycle cost of a Scaled Enhanced Bus Service implementation scenario is about $1,226M (in 2022$). The cumulative 30-year cost is about $104M less than that of the Enhanced Bus Service Alternative ($1,330M) discussed in Section 3.0, *LCCA Results for* the 5 Primary Alternatives. By reducing the initial number of buses from 65 to 22, the initial capital cost is reduced ($390M vs. $363M). The operation, maintenance, and replacement of buses starts with a smaller bus fleet and increases annually over the 30-year analysis period, resulting in a lower life cycle cost for this scaled approach.

Figure 4. Life Cycle Costs for the Enhanced Bus Service (Implementation Scenario 1) and Scaled Enhanced Bus Service (Implementation Scenario 2)

In 2022 dollars



4.2 Scaled Enhanced Bus Service then Gondola Alternative B (Implementation Scenario 3)

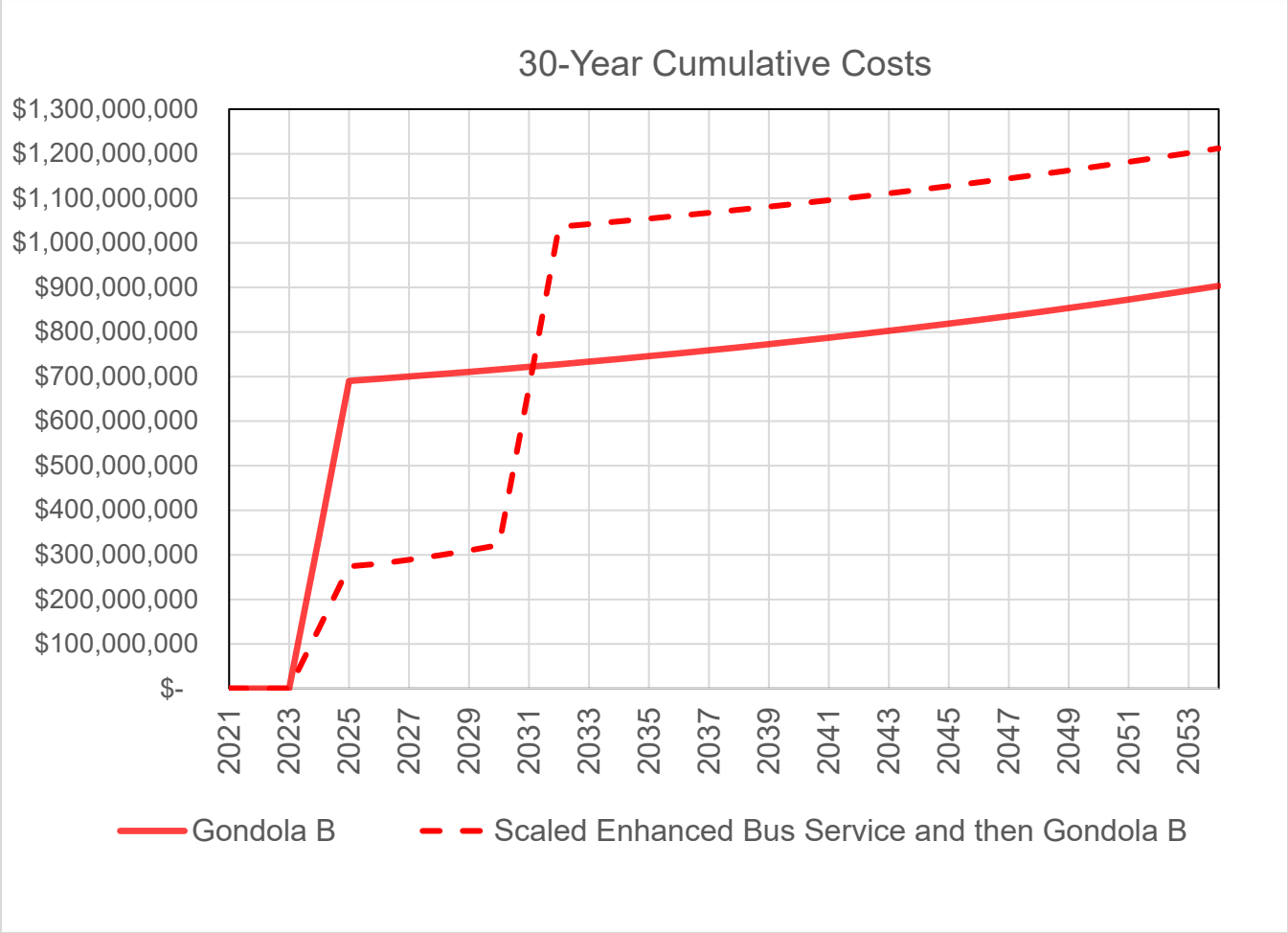
In the Final EIS, UDOT identified the preferred alternative as Gondola Alternative B starting with components of the Enhanced Bus Service Alternative. The LCCA for scenario 3 applies the Scaled Enhanced Bus Service scenario and then transitions operations to Gondola Alternative B.

In scenario 3, UDOT assumes that 22 buses are purchased for initial operation along with a maintenance facility (sized for 34 buses, the fleet size needed by about 3032), resort bus stops, and a 1,500-space parking structure at the gravel pit mobility hub, and that other improvements (snow sheds and trailhead parking) are also constructed in 2024–2025. Each year, 2 new buses are added to the fleet, which also incrementally increases the annual O&M cost.

This LCCA assumes that Gondola Alternative B is constructed in 2031 and 2032. Capital components for the gondola include a 2,500-space parking structure at the gondola base station and roadway improvements to access the parking structure. When the gondola is complete in 2033 (assumed), bus operations cease and gondola operations begin. Figure 5 below illustrates the difference between the scaled bus to gondola alternative and Gondola Alternative B.

Figure 5. Life Cycle Costs for Gondola Alternative B (Implementation Scenario 1) and for a Scaled Enhanced Bus Service then Gondola Alternative B (Implementation Scenario 3)

In 2022 dollars



The estimated 30-year life cycle cost for implementing a scaled enhanced bus service and then transitioning to Gondola Alternative B in 2033 is about $1,212M (in 2022$).

Implementing a scaled enhanced bus service then transitioning to Gondola Alternative B in 2033 results in a cumulative cost of about $308M more than constructing Gondola Alternative B in 2024–2025 and operating it to 2054 ($904M in 2022$).

4.3 LCCA Results for the Implementation Scenarios

This section compares the three implementation scenarios: Scenario 1 – complete construction of Gondola Alternative B (in particular) in 2024–2025; Scenario 2 – scaled enhanced bus service, increasing the bus fleet incrementally to the full build-out (2050 design year); and Scenario 3 – scaled enhanced bus service transitioning to Gondola Alternative B by 2033. Figure 6 below compares the cumulative costs (discounted to 2022$) of the implementation scenarios analyzed in this LCCA.

Figure 6. Life Cycle Costs for Gondola B (Implementation Scenario 1), Scaled Enhanced Bus Service (Implementation Scenario 2), and Scaled Enhanced Bus Service then Gondola B (Implementation Scenario 3)

In 2022 dollars

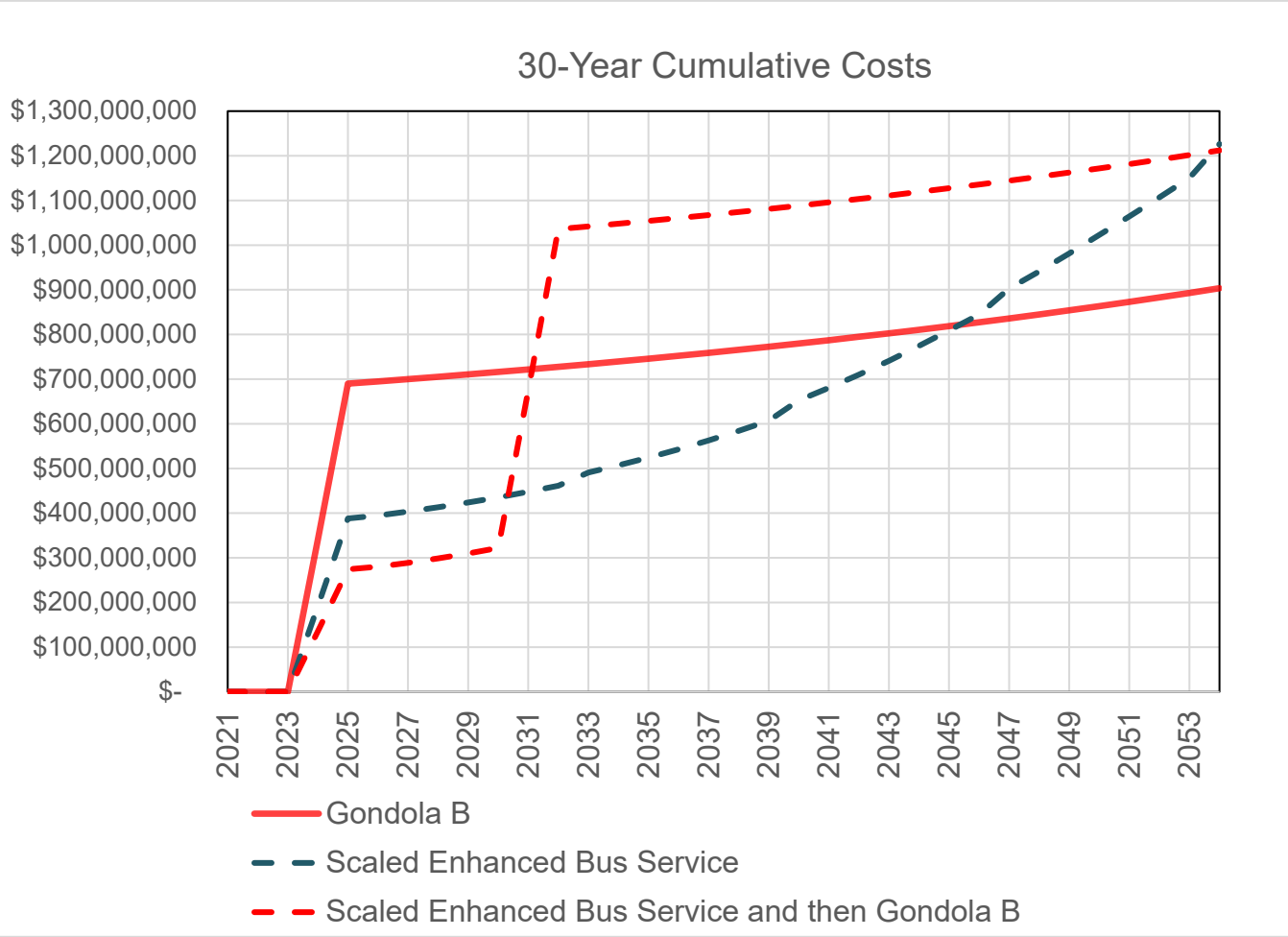


Figure 6 above demonstrates the advantages of lower O&M costs for Gondola Alternative B. The estimated 30-year life cycle cost for Gondola Alternative B ($904M in 2022$) is $322M less than for scenario 2 and $308M less than for scenario 3. When comparing scenarios 2 and 3, the life cycle cost of constructing components of the enhanced bus service (2024–2025), operating an incrementally increasing bus fleet for 7 years (assumed 2026–2033), and then building the gondola infrastructure and transitioning to gondola

operation in 2033 ($1,212M in 2022$ for scenario 3) is about $14M less than the life cycle costs of incrementally increasing the enhanced bus service operations until 2054 ($1,226M in 2022$ for scenario 2; see Section 4.1, *Scaled Enhanced Bus Service (Implementation Scenario 2)*).

Table 4 presents the 30-year life cycle costs for the scaled and phased implementation scenarios discounted to 2022$. The costs for the two individual primary alternatives (Enhanced Bus Service Alternative and Gondola Alternative B) that make up the preferred alternative are provided in Table 4 for comparison. The LCCA inputs and year-of-expenditure cost for each alternative are provided in Attachment A, *Life Cycle Cost Inputs and Assumptions*.

Table 4. Comparison of the 30-year Life Cycle Costs for Implementation Scenarios 1, 2, and 3

In millions of 2022 dollars

Alternative or Scenario	Present Value, 30-year Cost
Implementation Scenario 1 – Full implementation of primary alternative starting in 2024	
Gondola Alternative B	$904
Enhanced Bus Service Alternative	$1,330
Implementation Scenario 2 – Scaling Enhanced Bus Service Alternative to match the needed transit ridership over time	
Scaled Enhanced Bus Service	$1,226
Implementation Scenario 3 – Preferred alternative: scaled enhanced bus service transitioning to Gondola Alternative B	
Scaled Enhanced Bus Service then Gondola Alternative B	$1,212

Implementing the preferred alternative from the Final EIS, Gondola Alternative B starting with components of the Enhanced Bus Service Alternative with the assumed implementation timeline in this LCCA, would have a 30-year life cycle cost ($1,212M) that is about $118M less than the initial full implementation of the Enhanced Bus Service Alternative ($1,330M). Implementing the preferred alternative would have a life cycle cost ($1,212M) that is about $308M more than the initial full implementation of Gondola Alternative B ($904M).

5.0 Disclaimer

This LCCA is a simplistic analysis performed to compare the capital and operating cost differences among fundamentally different alternatives. The costs include many assumptions and uncertainties. Construction costs were based on planning-level design, and O&M costs were based on references that might not account for all aspects of operating the alternatives in the unique setting of Little Cottonwood Canyon. In addition, inflationary factors are dynamic, so year-of-expenditure costs should be expected to be different than what was estimated for this LCCA. Similarly, the discount rate is dynamic and, therefore, present value estimates of future expenditures will also change with a different discount rate assumptions. For this reason, the comparisons using the major assumptions referenced in this report represent a snapshot in time and will change over time.

Attachment A. Life Cycle Cost Inputs and Assumptions

Life Cycle Cost Analysis

Assumptions and Inputs

Discount Rate	**0.50%**	Nominal Discount Rate, 2023. Ref. 1
Inflation Rate	**3.25%**	Ref. 2

Notes:

Capital and operation and maintenance (O&M) costs updated in Dec 2022
Assume construction in 2024 - 25 and operation in 2026
Capital and O&M costs inflated to the year of expenditure
Present value is the sum of discounted annual cost
Assumes 30 year of costs
No revenues are included
No salvage value of the equipment
Excludes Wasatch Blvd improvements and tolling infrastructure, which are the same for all alternatives
Additonal assumptions are included under the individaul alternatives

References:

1. https://www.whitehouse.gov/wp-content/uploads/2022/06/M-22-13-Discount-Rates.pdf
2. Recommended by UTA considering historic operating cost increases

Enhanced Bus Service Alternative

Implementation Scenario 1 - Full Initial Build Out

	2022$	
Initial Bus System Costs	$ 108,062,500	Initial 65 bus purchase ($600k per) and maintenance faciliy ($1,062.5k per)
Mobility Hubs	$ 153,850,000	Mobility Hub ($99M), Interchange ($37.6M), and ROW ($17.25M)
Resort Bus Stops	$ 11,800,000	At Alta and Snowbird
Trailhead parking	$ 7,507,000	Trailheads
Road Snow Sheds	$ 109,000,000	Snowsheds with Re-aligned Road
Total Initial Capital	**$ 390,219,500**	
Future Bus Overhaul	$ 3,250,000	Mid-life bus transmission overhaul (65 buses at $50k per (2020$))
Future Bus Purchases	$ 39,000,000	Future bus repurchase (65 buses at $600k per)
Bus O&M	$ 15,422,000	per UTA 4/22/21, inflated 10% to 2022$
Total Maintenance	**$ 15,422,000**	
Net Present Value	**$ 1,329,926,128**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	Capital	Operating and Maintenance	Present Value	Cumulative 2022$
2021		$ -	$ -	$ -	$ -
2022	0	$ -	$ -	$ -	$ -
2023	1	$ -	$ -	$ -	$ -
2024	2	$ 207,997,968	$ -	$ 205,933,485	$ 205,933,485
2025	3	$ 214,757,902	$ -	$ 211,568,481	$ 417,501,966
2026	4	$ -	$ 17,526,732	$ 17,180,535	$ 434,682,502
2027	5	$ -	$ 18,096,351	$ 17,650,650	$ 452,333,151
2028	6	$ -	$ 18,684,482	$ 18,133,627	$ 470,466,779
2029	7	$ -	$ 19,291,728	$ 18,629,821	$ 489,096,600
2030	8	$ -	$ 19,918,709	$ 19,139,593	$ 508,236,193
2031	9	$ -	$ 20,566,067	$ 19,663,313	$ 527,899,505
2032	10	$ -	$ 21,234,464	$ 20,201,364	$ 548,100,869
2033	11	$ 4,620,341	$ 21,924,584	$ 25,127,821	$ 573,228,689
2034	12	$ -	$ 22,637,133	$ 21,322,036	$ 594,550,726
2035	13	$ -	$ 23,372,840	$ 21,905,475	$ 616,456,201
2036	14	$ -	$ 24,132,457	$ 22,504,879	$ 638,961,080
2037	15	$ -	$ 24,916,762	$ 23,120,684	$ 662,081,764
2038	16	$ -	$ 25,726,557	$ 23,753,339	$ 685,835,103
2039	17	$ -	$ 26,562,670	$ 24,403,306	$ 710,238,410
2040	18	$ 69,356,264	$ 27,425,957	$ 88,472,128	$ 798,710,538
2041	19	$ -	$ 28,317,300	$ 25,757,083	$ 824,467,620
2042	20	$ -	$ 29,237,612	$ 26,461,878	$ 850,929,499
2043	21	$ -	$ 30,187,835	$ 27,185,960	$ 878,115,459
2044	22	$ -	$ 31,168,940	$ 27,929,854	$ 906,045,313
2045	23	$ -	$ 32,181,930	$ 28,694,104	$ 934,739,416
2046	24	$ -	$ 33,227,843	$ 29,479,266	$ 964,218,682
2047	25	$ 7,229,943	$ 34,307,748	$ 36,668,302	$ 1,000,886,985
2048	26	$ -	$ 35,422,749	$ 31,114,631	$ 1,032,001,616
2049	27	$ -	$ 36,573,989	$ 31,966,027	$ 1,063,967,643
2050	28	$ -	$ 37,762,643	$ 32,840,719	$ 1,096,808,362
2051	29	$ -	$ 38,989,929	$ 33,739,346	$ 1,130,547,708
2052	30	$ -	$ 40,257,102	$ 34,662,562	$ 1,165,210,270
2053	31	$ -	$ 41,565,458	$ 35,611,040	$ 1,200,821,309
2054	32	$ 108,529,184	$ 42,916,335	$ 129,104,819	**$ 1,329,926,128**

Enhanced Bus Service in Peak-Period Shoulder Lane Alternative

Implementation Scenario 1 - Full Initial Build Out

	2022$	
Peak-Period Shoulder	$ 202,852,000	LCC Roadway widening
Initial Bus System Costs	$ 74,812,500	Initial 45 bus purchase ($600k per) and maintenance faciliy ($1,062.5k per)
Road Snow Sheds	$ 109,000,000	Snowsheds with Re-aligned Road
Mobility Hubs	$ 153,850,000	Mobility Hub ($99M), Interchange ($37.6M), and ROW ($7.25M)
Trailhead parking	$ 7,507,000	Trailheads
Resort Bus Stops	$ 11,800,000	At Alta and Snowbird
Total Intial Capital	**$ 559,821,500**	
Peak-Period Shoulder Repave	$ 5,000,000	Repaving shoulders every 8 years; $4M inflated 25% to 2022
Future Bus Overhaul	$ 2,250,000	Mid-life bus transmission overhaul (45 buses at $50k per (2020$))
Future Bus Purchases	$ 27,000,000	Future bus repurchase (45 buses at $600k per)
Bus O&M	$ 11,891,000	per UTA 4/22/21, inflated 10% to 2022$
Additional Snow Removal	$ 220,000	Estimated to clear PPSL annually
Total Maintenance	**$ 12,111,000**	
Net Present Value	**$ 1,326,133,358**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	Capital	Operating and Maintenance	Present Value	Cumulative 2022$
2021	0	$ -	$ -	$ -	$ -
2022	0	$ -	$ -	$ -	$ -
2023	1	$ -	$ -	$ -	$ -
2024	2	$ 298,400,604	$ -	$ 295,438,830	$ 295,438,830
2025	3	$ 308,098,624	$ -	$ 303,522,977	$ 598,961,808
2026	4	$ -	$ 13,763,860	$ 13,491,990	$ 612,453,797
2027	5	$ -	$ 14,211,185	$ 13,861,173	$ 626,314,971
2028	6	$ -	$ 14,673,049	$ 14,240,459	$ 640,555,430
2029	7	$ -	$ 15,149,923	$ 14,630,124	$ 655,185,553
2030	8	$ -	$ 15,642,296	$ 15,030,450	$ 670,216,004
2031	9	$ -	$ 16,150,670	$ 15,441,731	$ 685,657,735
2032	10	$ -	$ 16,675,567	$ 15,864,266	$ 701,522,001
2033	11	$ 3,198,698	$ 17,217,523	$ 19,326,298	$ 720,848,299
2034	12	$ 7,339,234	$ 17,777,092	$ 23,657,202	$ 744,505,501
2035	13	$ -	$ 18,354,848	$ 17,202,517	$ 761,708,017
2036	14	$ -	$ 18,951,380	$ 17,673,232	$ 779,381,250
2037	15	$ -	$ 19,567,300	$ 18,156,828	$ 797,538,078
2038	16	$ -	$ 20,203,238	$ 18,653,657	$ 816,191,735
2039	17	$ -	$ 20,859,843	$ 19,164,080	$ 835,355,815
2040	18	$ 48,015,875	$ 21,537,788	$ 63,581,518	$ 898,937,333
2041	19	$ -	$ 22,237,766	$ 20,227,210	$ 919,164,543
2042	20	$ 9,479,190	$ 22,960,493	$ 29,359,953	$ 948,524,496
2043	21	$ -	$ 23,706,709	$ 21,349,316	$ 969,873,813
2044	22	$ -	$ 24,477,177	$ 21,933,502	$ 991,807,314
2045	23	$ -	$ 25,272,685	$ 22,533,672	$ 1,014,340,986
2046	24	$ -	$ 26,094,048	$ 23,150,265	$ 1,037,491,252
2047	25	$ 5,005,345	$ 26,942,104	$ 28,202,308	$ 1,065,693,559
2048	26	$ -	$ 27,817,723	$ 24,434,529	$ 1,090,128,088
2049	27	$ -	$ 28,721,799	$ 25,103,135	$ 1,115,231,223
2050	28	$ 12,243,108	$ 29,655,257	$ 36,437,398	$ 1,151,668,621
2051	29	$ -	$ 30,619,053	$ 26,495,734	$ 1,178,164,355
2052	30	$ -	$ 31,614,172	$ 27,220,742	$ 1,205,385,097
2053	31		$ 32,641,633	$ 27,965,588	$ 1,233,350,686
2054	32	$ 75,135,589	$ 33,702,486	$ 92,782,672	**$ 1,326,133,358**

Gondola Alternative A (base station at canyon entrance w/ mobility hubs)

Implementation Scenario 1 - Full Initial Build Out

	2022$	
Gondola Capital	$ 328,900,000	Stations, towers, cabins.
Park & Ride and Trailhead	$ 15,200,000	Trailheads ($7.5M) and Reconfigured park and ride ($7.7M)
Initial Bus System Costs	$ 43,225,000	Initial 26 bus purchase ($600k per), maintenance faciliy ($1,062.5k per), and transit priorty equipment
Road Snow Sheds	$ 109,000,000	Snowsheds with Re-aligned Road
Mobility Hubs	$ 153,900,000	Includes parking ($99M), interchange ($37.6M) and land purchases ($17.3M)
Total Initial Capital	**$ 650,225,000.00**	
Future Bus Overhaul	$ 1,300,000	Mid-life bus transmission overhaul (26 buses at $50k per (2020$))
Future Bus Purchases	$ 15,600,000	Future bus repurchase (26 buses at $600k per (2022$))
Gondola O&M	$ 4,414,300	Winter Service. Includes annual equipment replacement reserves
Bus O&M	$ 6,017,000	per UTA 4/22/21, inflated 10% to 2022$
Total Maintenance	**$ 10,431,300**	
Net Present Value	**$ 1,266,773,444**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	Capital	Operating and Maintenance	Present Value	Cumulative 2022$
2021		$ -	$ -	$ -	$ -
2022	0	$ -	$ -	$ -	$ -
2023	1	$ -	$ -	$ -	$ -
2024	2	$ 346,588,213	$ -	$ 343,148,152	$ 343,148,152
2025	3	$ 357,852,329	$ -	$ 352,537,778	$ 695,685,931
2026	4	$ -	$ 11,854,921	$ 11,620,757	$ 707,306,688
2027	5	$ -	$ 12,240,206	$ 11,938,738	$ 719,245,426
2028	6	$ -	$ 12,638,013	$ 12,265,420	$ 731,510,846
2029	7	$ -	$ 13,048,748	$ 12,601,041	$ 744,111,887
2030	8	$ -	$ 13,472,833	$ 12,945,846	$ 757,057,733
2031	9	$ -	$ 13,910,700	$ 13,300,085	$ 770,357,818
2032	10	$ -	$ 14,362,798	$ 13,664,018	$ 784,021,836
2033	11	$ 1,848,136	$ 14,829,588	$ 15,787,382	$ 799,809,218
2034	12	$ -	$ 15,311,550	$ 14,422,031	$ 814,231,249
2035	13	$ -	$ 15,809,175	$ 14,816,663	$ 829,047,913
2036	14	$ -	$ 16,322,974	$ 15,222,095	$ 844,270,007
2037	15	$ -	$ 16,853,470	$ 15,638,620	$ 859,908,627
2038	16	$ -	$ 17,401,208	$ 16,066,542	$ 875,975,169
2039	17	$ -	$ 17,966,747	$ 16,506,174	$ 892,481,342
2040	18	$ 27,742,506	$ 18,550,667	$ 42,318,263	$ 934,799,605
2041	19	$ -	$ 19,153,563	$ 17,421,856	$ 952,221,461
2042	20	$ -	$ 19,776,054	$ 17,898,573	$ 970,120,034
2043	21	$ -	$ 20,418,776	$ 18,388,335	$ 988,508,369
2044	22	$ -	$ 21,082,386	$ 18,891,498	$ 1,007,399,867
2045	23	$ -	$ 21,767,564	$ 19,408,430	$ 1,026,808,297
2046	24	$ -	$ 22,475,009	$ 19,939,506	$ 1,046,747,803
2047	25	$ 2,891,977	$ 23,205,447	$ 23,038,071	$ 1,069,785,874
2048	26	$ -	$ 23,959,624	$ 21,045,653	$ 1,090,831,527
2049	27	$ -	$ 24,738,312	$ 21,621,529	$ 1,112,453,055
2050	28	$ -	$ 25,542,307	$ 22,213,163	$ 1,134,666,218
2051	29	$ -	$ 26,372,432	$ 22,820,985	$ 1,157,487,203
2052	30	$ -	$ 27,229,536	$ 23,445,440	$ 1,180,932,644
2053	31	$ -	$ 28,114,496	$ 24,086,982	$ 1,205,019,626
2054	32	$ 43,411,674	$ 29,028,217	$ 61,753,818	**$ 1,266,773,444**

Gondola Alternative B (all parking at the gondola base station at La Caille)

Implementation Scenario 1 - Full Initial Build Out

	2022$	
Gondola Capital	$ 370,500,000	Stations, towers, cabins
Parking Structure	$ 99,000,000	Bas Godola Parking ($99M)
Access Roads	$ 51,284,000	Road Improvements (N. LCR $45.9M and Access Rd $5.6M)
Park & Ride and Trailhead	$ 15,207,000	Trailheads ($7.507M) and Reconfigured park and ride ($7.7M)
Road Snow Sheds	$ 109,000,000	Snowsheds with Re-aligned Road
Total Initial Capital	**$ 644,991,000**	
Gondola O&M	$ 4,414,300	Winter, includes labor, power, and annual reserve for equipment replacement
Total Maintenance	**$ 4,414,300**	
Net Present Value	**$ 903,544,295**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	Capital	Operating and Maintenance	Present Value	Cumulative 2022$
2021		$ -	$ -	$ -	$ -
2022	0	$ -	$ -	$ -	$ -
2023	1	$ -	$ -	$ -	$ -
2024	2	$ 343,798,343	$ -	$ 340,385,974	$ 340,385,974
2025	3	$ 354,971,790	$ -	$ 349,700,018	$ 690,085,992
2026	4	$ -	$ 5,016,746	$ 4,917,653	$ 695,003,645
2027	5	$ -	$ 5,179,790	$ 5,052,215	$ 700,055,860
2028	6	$ -	$ 5,348,133	$ 5,190,460	$ 705,246,320
2029	7	$ -	$ 5,521,947	$ 5,332,487	$ 710,578,807
2030	8	$ -	$ 5,701,411	$ 5,478,401	$ 716,057,208
2031	9	$ -	$ 5,886,707	$ 5,628,308	$ 721,685,516
2032	10	$ -	$ 6,078,025	$ 5,782,316	$ 727,467,832
2033	11	$ -	$ 6,275,560	$ 5,940,539	$ 733,408,371
2034	12	$ -	$ 6,479,516	$ 6,103,091	$ 739,511,461
2035	13	$ -	$ 6,690,100	$ 6,270,091	$ 745,781,552
2036	14	$ -	$ 6,907,529	$ 6,441,660	$ 752,223,213
2037	15	$ -	$ 7,132,023	$ 6,617,925	$ 758,841,137
2038	16	$ -	$ 7,363,814	$ 6,799,012	$ 765,640,149
2039	17	$ -	$ 7,603,138	$ 6,985,055	$ 772,625,204
2040	18	$ -	$ 7,850,240	$ 7,176,188	$ 779,801,393
2041	19	$ -	$ 8,105,373	$ 7,372,552	$ 787,173,944
2042	20	$ -	$ 8,368,797	$ 7,574,288	$ 794,748,232
2043	21	$ -	$ 8,640,783	$ 7,781,545	$ 802,529,777
2044	22	$ -	$ 8,921,609	$ 7,994,473	$ 810,524,249
2045	23	$ -	$ 9,211,561	$ 8,213,227	$ 818,737,476
2046	24	$ -	$ 9,510,937	$ 8,437,967	$ 827,175,443
2047	25	$ -	$ 9,820,042	$ 8,668,856	$ 835,844,299
2048	26	$ -	$ 10,139,194	$ 8,906,064	$ 844,750,363
2049	27	$ -	$ 10,468,717	$ 9,149,762	$ 853,900,125
2050	28	$ -	$ 10,808,951	$ 9,400,129	$ 863,300,254
2051	29	$ -	$ 11,160,242	$ 9,657,346	$ 872,957,600
2052	30	$ -	$ 11,522,949	$ 9,921,602	$ 882,879,202
2053	31	$ -	$ 11,897,445	$ 10,193,089	$ 893,072,291
2054	32	$ -	$ 12,284,112	$ 10,472,004	**$ 903,544,295**

Cog Rail Alternative (all parking at base station at LaCaille)

Implementation Scenario 1 - Full Initial Build Out

	2022$	
Cog Rail Capital	$ 651,000,000	For rail infrastructure, cog rail vehicles, and an operations and maintenance facility (OMF)
Access Roadways	$ 51,284,000	Road Improvements (N. LCR $45.9M and Access Rd $5.6M)
Trailheads	$ 14,700,000	Park and Ride reconfig. ($7.7M) and Trailhead parking ($7M) improvements
Parking Structure	$ 99,000,000	Parking structure at base train station
Road + Rail Snowsheds	$ 335,600,000	Assumes the snow shed with berms (lengths: 2,465 ft mid-canyon) + upper-canyon (3,645 ft) snowsheds
Maintenance Equipment	$ 3,450,000	Equipment needed for snow removal from the tracks
Total Intial Capital	**$ 1,155,034,000**	
Rail Vehicle Overhaul	$ 36,036,000	Major rail vehicle overhaul after 20 years of service at 1/3 initial capital cost
Rail Operation & Maintenance	$ 3,080,000	Winter Service
Additional Snow Removal	$ 660,000	For staging snow removal from the rail then the road
Total Maintenance	**$ 3,740,000**	
Net Present Value	**$ 1,418,308,850**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	Capital	Operating and Maintenance	Present Value	Cumulative 2022$
2021		$ -	$ -	$ -	$ -
2022	0	$ -	$ -	$ -	$ -
2023	1	$ -	$ -	$ -	$ -
2024	2	$ 615,665,607	$ -	$ 609,554,820	$ 609,554,820
2025	3	$ 635,674,740	$ -	$ 626,234,181	$ 1,235,789,001
2026	4	$ -	$ 3,830,074	$ 3,754,421	$ 1,239,543,422
2027	5	$ -	$ 3,854,452	$ 3,759,519	$ 1,243,302,941
2028	6	$ -	$ 3,879,621	$ 3,765,243	$ 1,247,068,183
2029	7	$ -	$ 3,905,609	$ 3,771,606	$ 1,250,839,789
2030	8	$ -	$ 3,932,441	$ 3,778,625	$ 1,254,618,414
2031	9	$ -	$ 3,960,146	$ 3,786,314	$ 1,258,404,728
2032	10	$ -	$ 3,988,750	$ 3,794,689	$ 1,262,199,417
2033	11	$ -	$ 4,018,285	$ 3,803,768	$ 1,266,003,185
2034	12	$ -	$ 4,048,779	$ 3,813,566	$ 1,269,816,751
2035	13	$ -	$ 4,080,264	$ 3,824,102	$ 1,273,640,853
2036	14	$ -	$ 4,112,773	$ 3,835,393	$ 1,277,476,246
2037	15	$ -	$ 4,146,338	$ 3,847,457	$ 1,281,323,703
2038	16	$ -	$ 4,180,994	$ 3,860,313	$ 1,285,184,016
2039	17	$ -	$ 4,216,776	$ 3,873,981	$ 1,289,057,997
2040	18	$ -	$ 4,253,721	$ 3,888,481	$ 1,292,946,478
2041	19	$ -	$ 4,291,867	$ 3,903,832	$ 1,296,850,310
2042	20	$ -	$ 4,331,253	$ 3,920,056	$ 1,300,770,366
2043	21	$ -	$ 4,371,919	$ 3,937,176	$ 1,304,707,542
2044	22	$ -	$ 4,413,906	$ 3,955,212	$ 1,308,662,754
2045	23	$ -	$ 4,457,258	$ 3,974,188	$ 1,312,636,941
2046	24	$ 77,642,235	$ 4,502,019	$ 72,877,205	$ 1,385,514,146
2047	25	$ -	$ 4,548,235	$ 4,015,053	$ 1,389,529,199
2048	26	$ -	$ 4,595,952	$ 4,036,992	$ 1,393,566,191
2049	27	$ -	$ 4,645,221	$ 4,059,969	$ 1,397,626,160
2050	28	$ -	$ 4,696,090	$ 4,084,009	$ 1,401,710,169
2051	29	$ -	$ 4,748,613	$ 4,109,141	$ 1,405,819,310
2052	30	$ -	$ 4,802,843	$ 4,135,391	$ 1,409,954,700
2053	31	$ -	$ 4,858,836	$ 4,162,788	$ 1,414,117,488
2054	32	$ -	$ 4,916,648	$ 4,191,361	**$ 1,418,308,850**

Scaled Enhanced Bus Service (starting with 22 buses scaled up to 65 needed in the 2050 design year)

Scenario 2 - Scaled Enhanced Bus Service

	2022$	
Initial Bus System Costs	$ 82,262,500	Initial 22 bus purchase ($600k per) and maintenance faciliy ($1,062.5k per) for 65 buses
Mobility Hubs	$ 99,000,000	
Interchange	$ 37,600,000	
ROW	$ 17,250,000	
Resort Bus Stops	$ 11,800,000	At Alta and Snowbird
Trailhead parking	$ 5,800,000	Trailheads
Road Snow Sheds	$ 109,000,000	
Total Intial Capital	$ 362,712,500	
Bus Overhaul, Initial 22	**$ 11,000,000.00**	Overhaul initial 22 bus purchase in 2033 and in 2047 after repurchase in 2040
Bus Overhaul, Additional Buses	$ 100,000.00	
Future Bus Purchase, Initial 22	**$ 13,200,000**	Replace intial 22 in 2040 and 2054
Future Bus Purchases, per year	$ 600,000	Add 2 per year from 2026 to 2045, add 1 per year form 2045 to 2050
Bus O&M	$ 270,000	Approximate O&M per bus
Net Present Value	**$ 1,226,370,806**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	operating buses	Capital	Overhaul	Bus Repurchase	Operating and Maintenance	Net Present Value	Cumulative 2022$
2021		0	$ -			$ -	$ -	$ -
2022	0	0	$ -			$ -	$ -	$ -
2023	1	0	$ -			$ -	$ -	$ -
2024	2	0	$ 193,335,964			$ -	$ 191,417,008	$ 191,417,008
2025	3	0	$ 199,619,383			$ -	$ 196,654,787	$ 388,071,795
2026	4	22	$ -			$ 6,750,667	$ 6,617,325	$ 394,689,120
2027	5	24	$ 1,408,094			$ 7,603,706	$ 8,789,845	$ 403,478,965
2028	6	26	$ 1,453,857			$ 8,505,062	$ 9,665,310	$ 413,144,275
2029	7	28	$ 1,501,107			$ 9,456,974	$ 10,582,106	$ 423,726,381
2030	8	30	$ 1,549,893			$ 10,461,778	$ 11,541,837	$ 435,268,218
2031	9	32	$ 1,600,265			$ 11,521,905	$ 12,546,168	$ 447,814,386
2032	10	34	$ 1,652,273			$ 12,639,890	$ 13,596,820	$ 461,411,205
2033	11	36	$ 1,705,972	**$ 15,638,077**		$ 13,818,374	$ 29,498,813	$ 490,910,018
2034	12	38	$ 1,761,416	$ 293,569		$ 15,060,108	$ 16,120,798	$ 507,030,816
2035	13	40	$ 1,818,662	$ 303,110		$ 16,367,959	$ 17,328,933	$ 524,359,748
2036	14	42	$ 1,877,769	$ 312,961		$ 17,744,914	$ 18,591,114	$ 542,950,862
2037	15	44	$ 1,938,796	$ 323,133		$ 19,194,082	$ 19,909,395	$ 562,860,257
2038	16	46	$ 2,001,807	$ 333,635		$ 20,718,703	$ 21,285,900	$ 584,146,157
2039	17	48	$ 2,066,866	$ 344,478		$ 22,322,150	$ 22,722,830	$ 606,868,987
2040	18	50	$ 2,134,039	$ 355,673	**$ 23,474,428**	$ 24,007,938	$ 45,681,283	$ 652,550,270
2041	19	52	$ 2,203,395	$ 367,233	$ 2,203,395	$ 25,779,723	$ 27,791,328	$ 680,341,598
2042	20	54	$ 2,275,006	$ 379,168	$ 2,275,006	$ 27,641,317	$ 29,478,347	$ 709,819,945
2043	21	56	$ 2,348,943	$ 391,491	$ 2,348,943	$ 29,596,684	$ 31,236,883	$ 741,056,828
2044	22	58	$ 2,425,284	$ 404,214	$ 2,425,284	$ 31,649,954	$ 33,069,585	$ 774,126,412
2045	23	60	$ 2,504,106	$ 417,351	$ 2,504,106	$ 33,805,425	$ 34,979,195	$ 809,105,608
2046	24	61	$ 1,292,744	$ 430,915	$ 2,585,489	$ 35,485,836	$ 35,305,540	$ 844,411,148
2047	25	62	$ 1,334,759	**$ 24,915,496**	$ 2,669,517	$ 37,239,768	$ 58,403,776	$ 902,814,924
2048	26	63	$ 1,378,138	$ 459,379	$ 2,756,277	$ 39,070,222	$ 38,353,595	$ 941,168,519
2049	27	64	$ 1,422,928	$ 474,309	$ 2,845,856	$ 40,980,322	$ 39,962,715	$ 981,131,235
2050	28	65	$ 1,469,173	$ 489,724	$ 2,938,346	$ 42,973,310	$ 41,631,180	$ 1,022,762,415
2051	29	65	$ -	$ 505,640	$ 3,033,842	$ 44,369,943	$ 41,457,697	$ 1,064,220,112
2052	30	65	$ -	$ 522,074	$ 3,132,442	$ 45,811,966	$ 42,592,112	$ 1,106,812,224
2053	31	65	$ -	$ 269,521	$ 3,234,246	$ 47,300,855	$ 43,526,657	$ 1,150,338,880
2054	32	65	$ -	$ 278,280	**$ 40,072,314**	$ 48,838,133	$ 76,031,925	**$ 1,226,370,806**

Enhanced Bus Service to Gondola (Scaled Bus Fleet)

Scenario 3 - Scaled Enhanced Bus Transitioning to Gondola Alternative B in 2033

	2022$	
Initial Bus System Costs	$ 49,325,000	Includes initial bus purchase (22) and maintenance faciliy (for 34 buses)
Mobility Hubs	$ 59,400,000	1500-stall structure at $39,600 per stall
ROW	$ 17,250,000	
Intersection	$ 2,000,000	Intersection into Mobility Hub
Resort Bus Stops	$ 11,800,000	At Alta and Snowbird
Subtotal	$ 139,775,000	*Note sum is different than phasing memo ($153.3M) which assumes 34 buses purchased year1 and includes to*
Trailhead Parking	$ 7,507,000	
Road Snow Sheds	$ 109,000,000	Snowsheds with Re-aligned Road
Total Intial Capital	$ 256,282,000	
Future Bus Repurchase	$ 600,000	2022$
Future Bus Overhaul	$ -	No need to replace/overhaul buses for this time period
Bus O&M	$ 237,000	Approximate O&M per bus

Gondola Alternative Option B (LaCaille) with parking at the base station

	2022$	
Gondola Capital	$ 370,500,000	Stations, towers, cabins
Parking Structure	$ 99,000,000	Bas Godola Parking ($99M)
Access Roads	$ 59,100,000	Road Improvements (N. LCR $45.9M and Access Rd $5.6M)
Reconfigure Park & Ride	$ 7,700,000	
Total Intial Capital	$ 536,300,000	
Gondola O&M	$ 4,414,300	Winter, includes labor, power, and annual equipment replacement reserves
Net Present Value	**$ 1,212,106,225**	YOE Cost Discounted to 2022$

Year of Expenditure	Years	Capital	Operating Buses	Operating and Maintenance	Net Present Value	Cumulative 2022$
2021		$ -	0	$ -	$ -	$ -
2022	0	$ -	0	$ -	$ -	$ -
2023	1	$ -	0	$ -	$ -	$ -
2024	2	$ 136,605,514	0	$ -	$ 135,249,636	$ 135,249,636
2025	3	$ 141,045,193	0	$ -	$ 138,950,497	$ 274,200,133
2026	4	$ -	22	$ 5,925,585	$ 5,808,562	$ 280,008,695
2027	5	$ 2,112,141	25	$ 6,952,463	$ 8,841,372	$ 288,850,068
2028	6	$ 2,180,785	28	$ 8,039,828	$ 9,919,317	$ 298,769,384
2029	7	$ 2,251,661	31	$ 9,190,528	$ 11,049,633	$ 309,819,017
2030	8	$ 2,324,840	34	$ 10,407,532	$ 12,234,380	$ 322,053,397
2031	9	$ 357,592,453	34	$ 10,745,777	$ 352,169,938	$ 674,223,335
2032	10	$ 369,214,208	34	$ 11,095,014	$ 361,806,427	$ 1,036,029,762
2033	11	$ -	0	$ 6,275,560	$ 5,940,539	$ 1,041,970,301
2034	12	$ -	0	$ 6,479,516	$ 6,103,091	$ 1,048,073,391
2035	13	$ -	0	$ 6,690,100	$ 6,270,091	$ 1,054,343,482
2036	14	$ -	0	$ 6,907,529	$ 6,441,660	$ 1,060,785,143
2037	15	$ -	0	$ 7,132,023	$ 6,617,925	$ 1,067,403,067
2038	16	$ -	0	$ 7,363,814	$ 6,799,012	$ 1,074,202,080
2039	17	$ -	0	$ 7,603,138	$ 6,985,055	$ 1,081,187,134
2040	18	$ -	0	$ 7,850,240	$ 7,176,188	$ 1,088,363,323
2041	19	$ -	0	$ 8,105,373	$ 7,372,552	$ 1,095,735,874
2042	20	$ -	0	$ 8,368,797	$ 7,574,288	$ 1,103,310,162
2043	21	$ -	0	$ 8,640,783	$ 7,781,545	$ 1,111,091,707
2044	22	$ -	0	$ 8,921,609	$ 7,994,473	$ 1,119,086,179
2045	23	$ -	0	$ 9,211,561	$ 8,213,227	$ 1,127,299,406
2046	24	$ -	0	$ 9,510,937	$ 8,437,967	$ 1,135,737,373
2047	25	$ -	0	$ 9,820,042	$ 8,668,856	$ 1,144,406,229
2048	26	$ -	0	$ 10,139,194	$ 8,906,064	$ 1,153,312,293
2049	27	$ -	0	$ 10,468,717	$ 9,149,762	$ 1,162,462,055
2050	28	$ -	0	$ 10,808,951	$ 9,400,129	$ 1,171,862,184
2051	29	$ -	0	$ 11,160,242	$ 9,657,346	$ 1,181,519,530
2052	30	$ -	0	$ 11,522,949	$ 9,921,602	$ 1,191,441,132
2053	31	$ -	0	$ 11,897,445	$ 10,193,089	$ 1,201,634,221
2054	32	$ -	0	$ 12,284,112	$ 10,472,004	**$ 1,212,106,225**