#130598B

Alternative Fuel Cost Study

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Outline

- Introduction
- Annual Cost Differential Analysis
- 30-Year Cost Analysis
  - Fixed Maximum Age Scenario
  - Fixed Capital Scenario
- Financial Investment Analysis
- Conclusion

Introduction

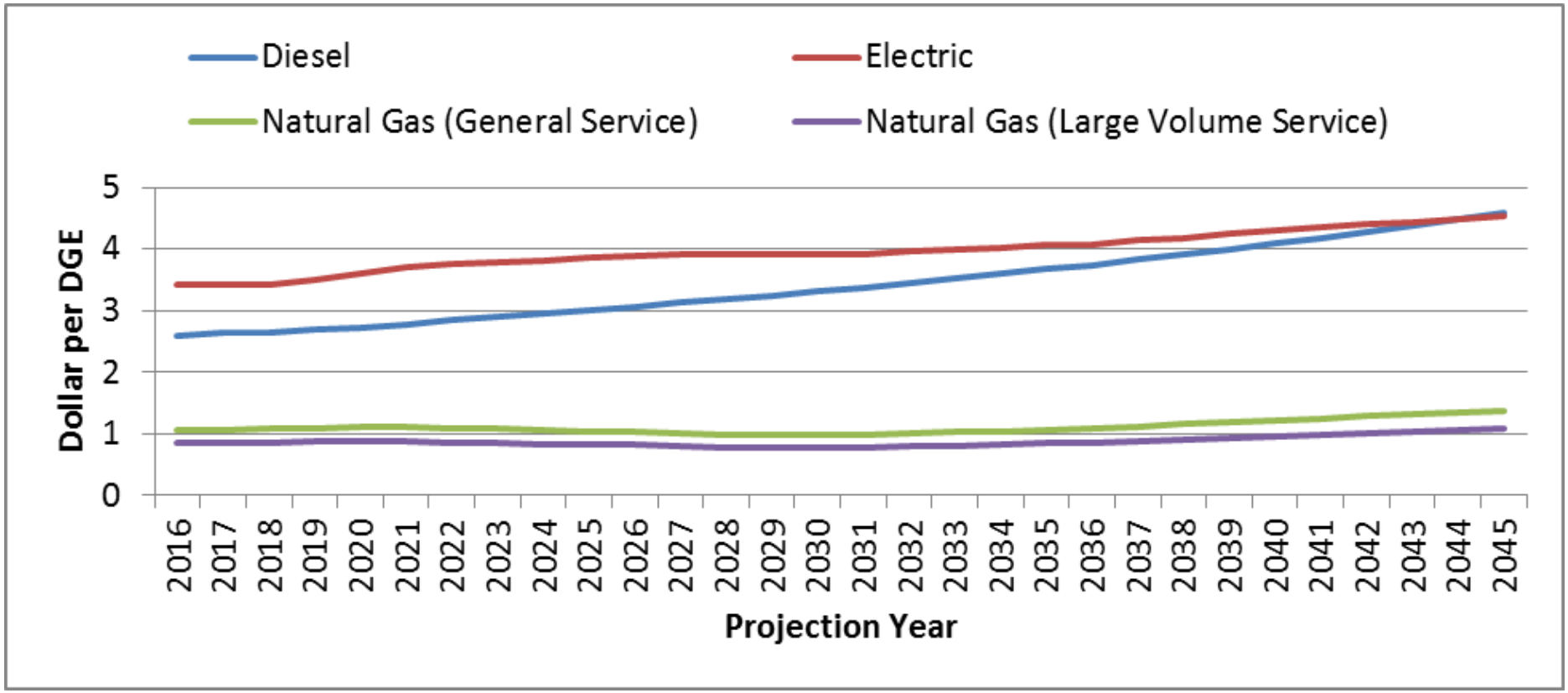
- *About*:
  - This study examines the financial feasibility of pivoting the RTS fleet from diesel to an alternative fuel source.
- *Scope*:
  - 40-ft heavy-duty buses
    - Annual mileage (30,200)
    - Useful life (17 years)
  - Three alternative fuel options (plus the base diesel scenario)
    - Compressed Natural Gas (CNG)
    - Hybrid electric
    - Battery electric
  - 30 year project length
  - Primary expansion scenario of 150 buses by year 2045

Annual Cost Differential Analysis - Parameters

Parameter	Fuel Type			
	Diesel	Hybrid	CNG	Electric
Capital Cost Parameters				
Bus Price ($)	447,613	668,334	498,114	800,598
Battery Price ($)	0	0	0	80,160
Battery Service Life (years)	0	0	0	6
Operation and Maintenance (O&M) Cost Parameters				
Average Fuel Price ($ per diesel gallon equivalent (DGE))	3.31	3.31	1.01	3.97
Fuel Economy (miles per DGE)	3.66	4.01	4.40	18.80
Vehicle and Facility O&M Rate ($ per mile)	0.91	0.91	1.05	0.77
Fueling Rate (DGE per minute)	40	40	15	0

Note: All figures unless otherwise noted in this presentation are in real 2016 dollars.

Annual Cost Differential Analysis – Fuel Price Projections



Source: Derived from the U.S. Energy Information Administration and adjusted using RTS data.

Annual Cost Differential Analysis – Cost Differential (compared to diesel buses)

	Hybrid	CNG	Electric
Annualized Capital Cost Differential ($)	12,984	2,971	30,194
O&M Cost Differentials ($)			
Vehicle + Facility O&M Cost	0	4,236	-4,236
Fuel Cost	-2,420	-20,416	-20,971
Fueling Cost	-4	52	-43
Annual Cost Differential ($)	**10,560**	**-13,156**	**4,944**

- Only CNG buses are more cost effective than diesel buses.
- Therefore it is the only fuel source considered in subsequent analysis.

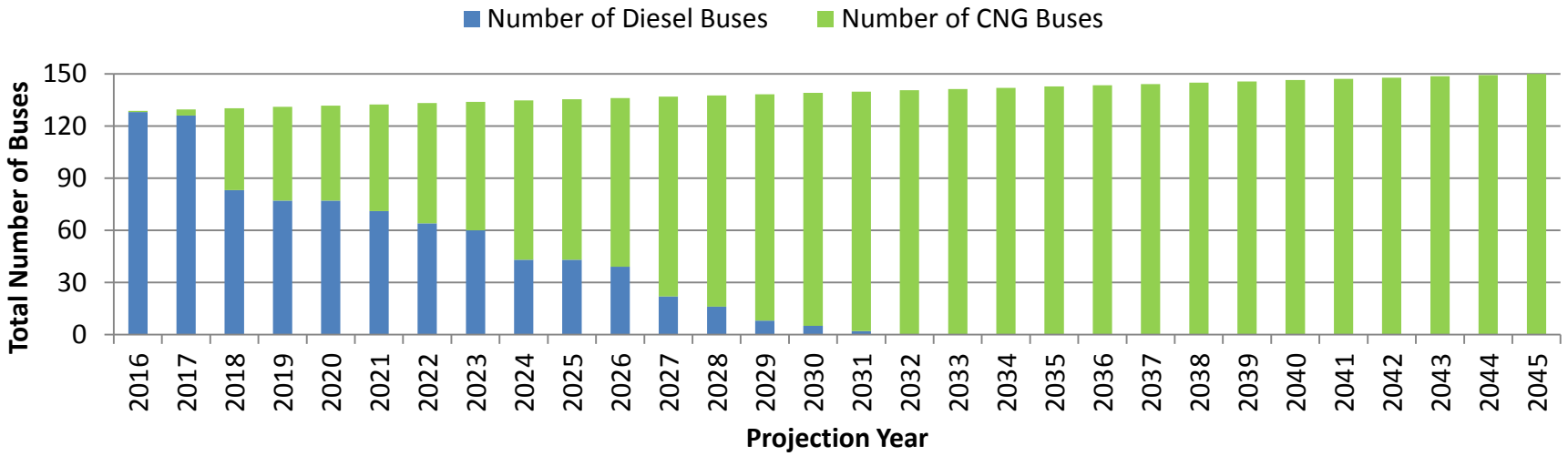
30-Year Cost Analysis - Scenarios

- *Fixed Maximum Age Scenario*:
  - Procurement occurs in such a manner that buses are replaced automatically when they reach the average useful life of RTS buses. This follows an aggressive replacement schedule which ensures a reasonable fleet age but is unlikely in the face of current funding streams.

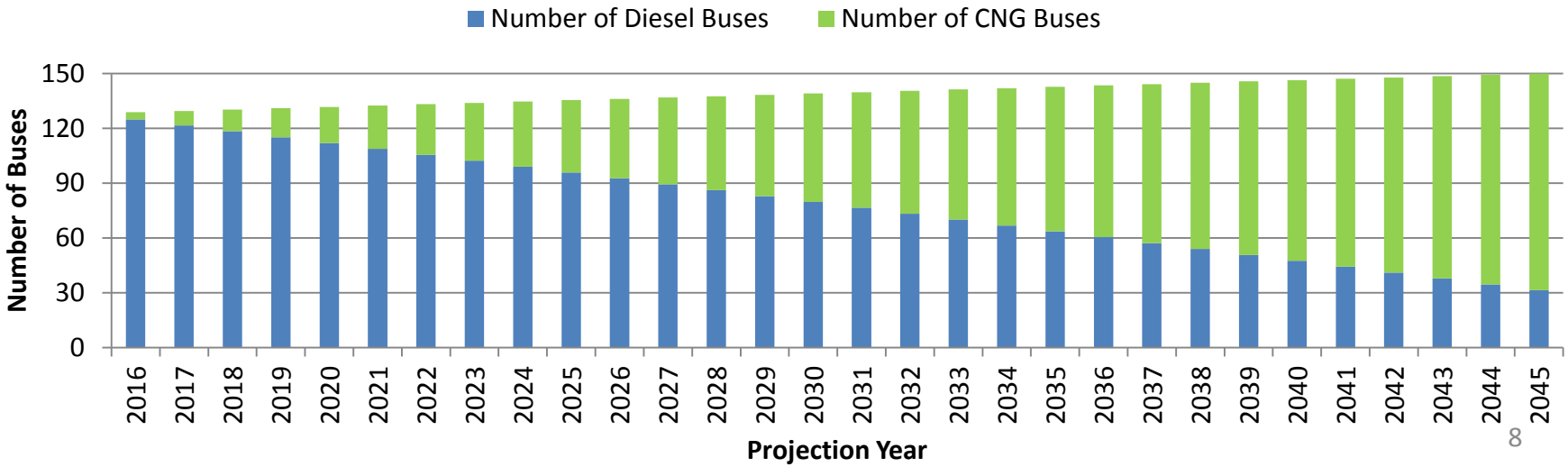
- *Fixed Capital Scenario*:
  - Bus procurement quantity occurs commensurate with historic acquisition behavior (average number of buses purchased annually in the past five years [$1.95 million]). The fixed capital scenario is financially pragmatic but occurs at the expense of an aging fleet.

30-Year Cost Analysis - Fleet Composition

Fixed Maximum Age Scenario:

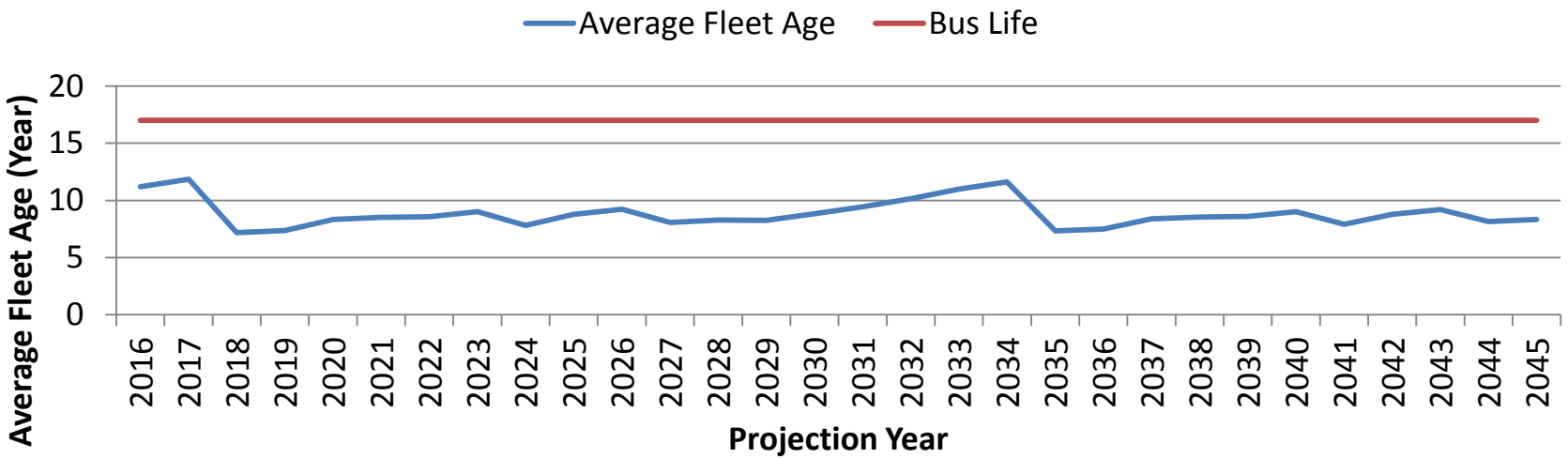


Fixed Capital Scenario:

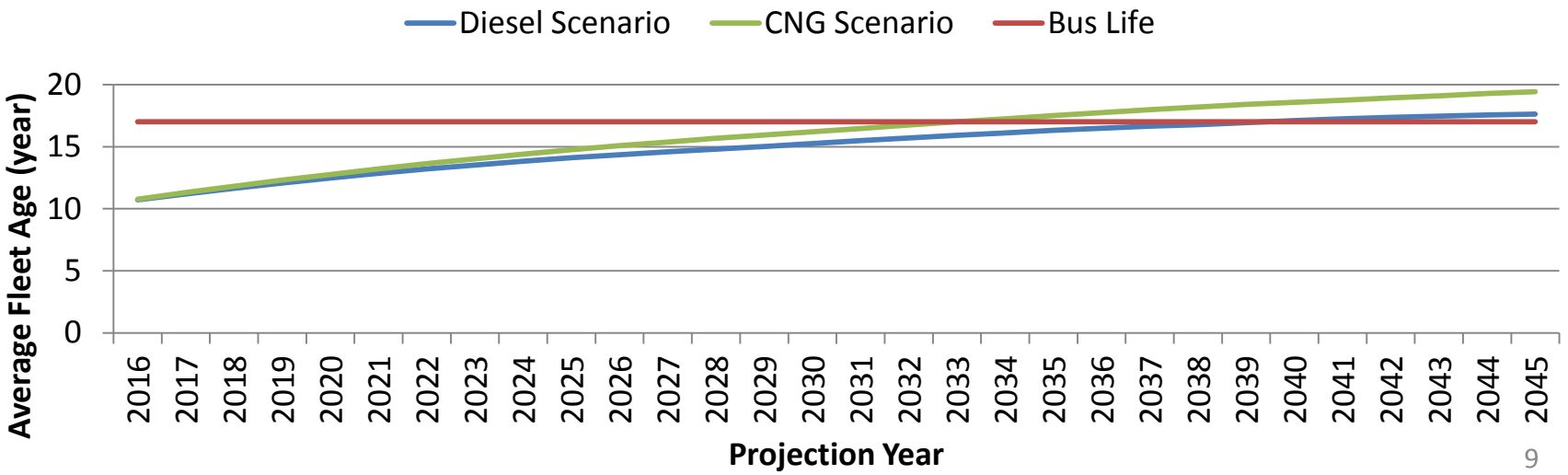


30-Year Cost Analysis - Average Fleet Age

Fixed Maximum Age Scenario:



Fixed Capital Scenario:



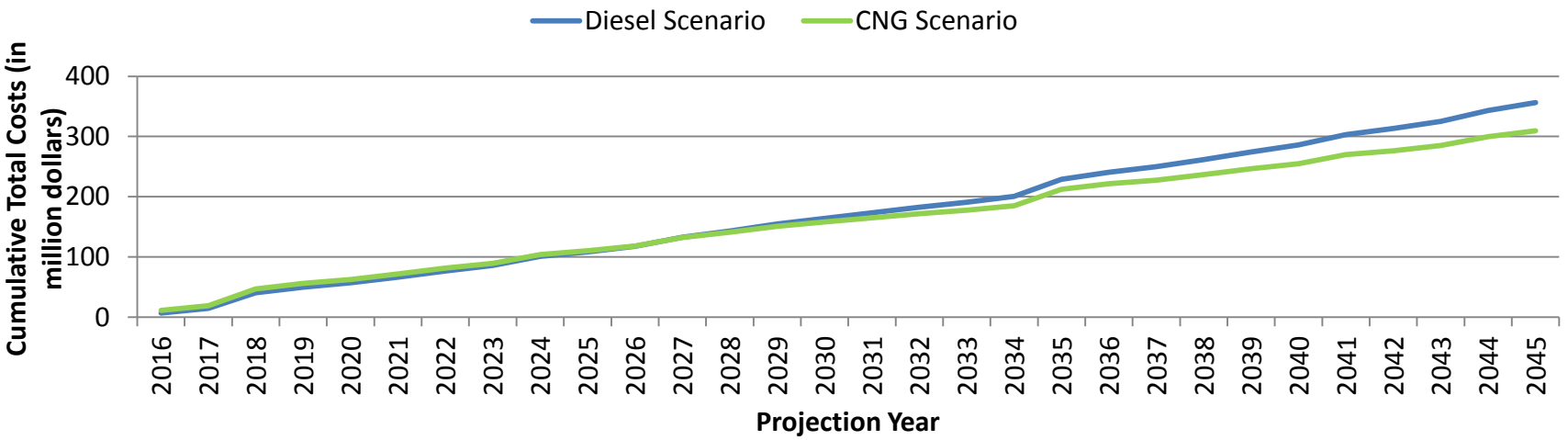
30-Year Cost Analysis – Cost Categories

- *Capital costs*:
  - Fleet expansion
  - Fleet replacement
- *O&M costs*:
  - Vehicle and Maintenance facility O&M costs
  - Fuel costs
  - Fueling costs
- *Upfront lump sum costs*:

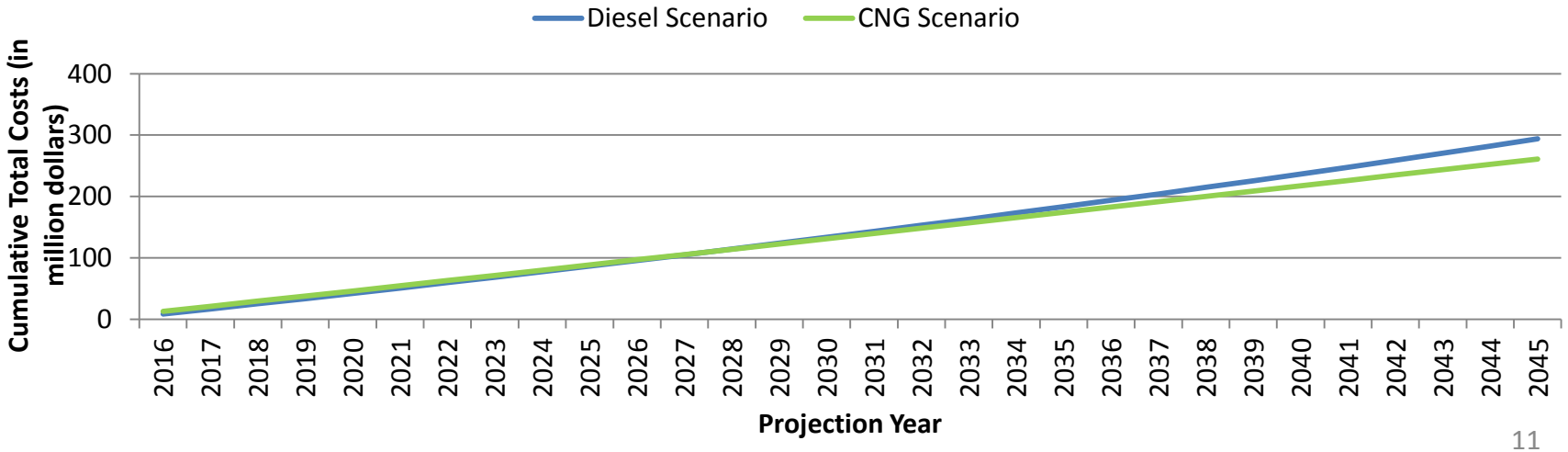
Parameters	Values
Staff Training ($)	5,767
External Pipeline ($)	169,538
Facility Conversion ($)	4,364,355
Total ($)	**4,539,660**

30-Year Cost Analysis - Cumulative Total Costs

Fixed Maximum Age Scenario: Difference in 2045 - $47M



Fixed Capital Scenario: Difference in 2045 - $33M



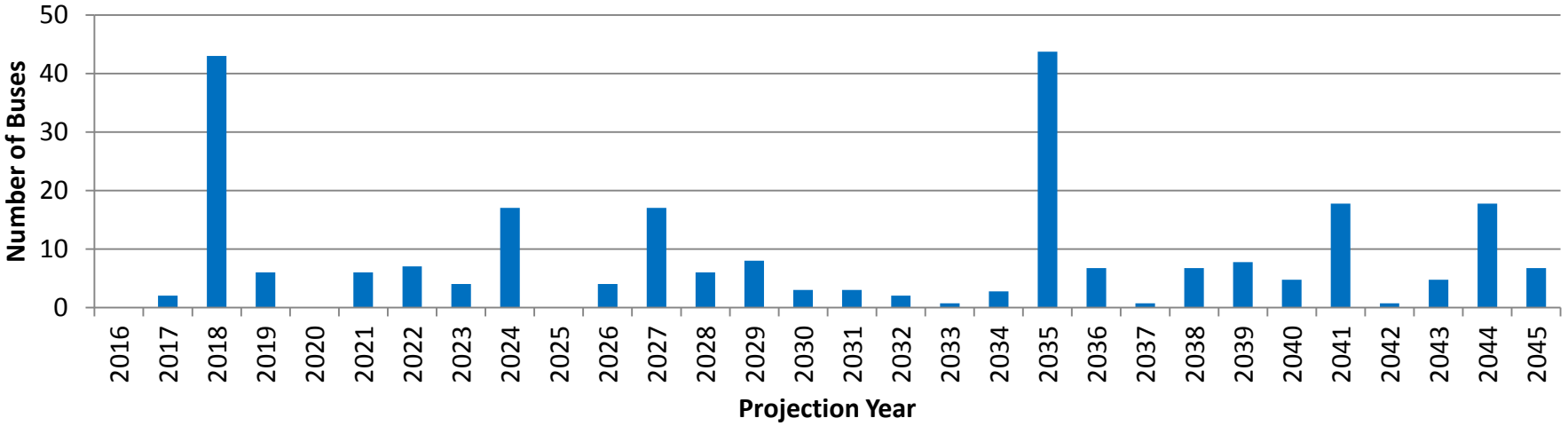
Financial Investment Analysis – Comparison of Loan Payment

- *Loan Parameters*:
  - 4.5% interest rate.
  - Variable replacement schedule.
  - Payment schedule uses annual fuel savings to pay off loan.
  - In years where the annual total cost of the CNG scenario is higher than the cost of the diesel scenario, the differential is treated as an additional loan needed in that year.

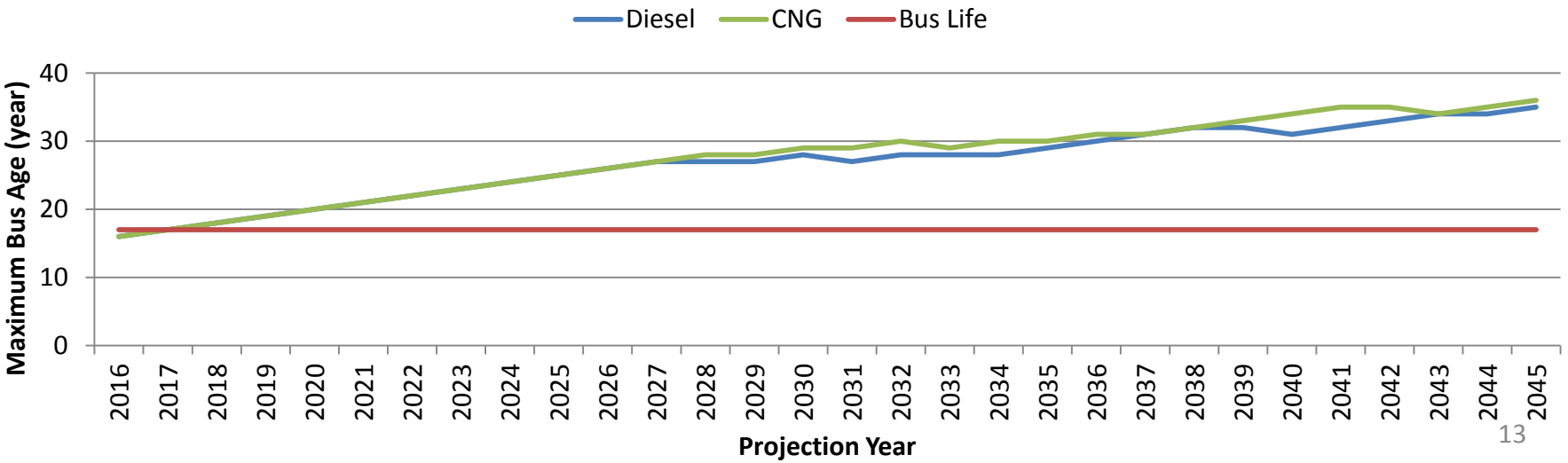
	Fixed Maximum Age Scenario	Fixed Capital Scenario
Total Loan Principal ($)	6,335,000	4,540,000
Total Loan Interest ($)	3,350,000	2,843,000
Total Loan Cost ($)	9,682,000	7,383,000
Total Savings ($)	53,055,000	37,351,000
Total Net Savings (savings less full loan cost) ($)	43,373,000	29,968,000
Project Payoff Year	2029	2031
Bus Deficit Resolution Year	N/A	2034

Financial Investment Analysis – Outstanding Issues

Fixed Maximum Age Scenario: Unrealistic capital funding levels



Fixed Capital Scenario: Severely aging fleet



Financial Investment Analysis – Modified Fixed Capital Scenario

- *Modifications to address issues of each scenario*:
  - An additional loan is taken at the beginning of the project to purchase CNG buses (controlling for short-term aging issues).
  - In the years following loan pay off, savings are used to purchase new CNG buses (controlling for longer-term aging issues).
- *Two loan payment methods:*
  - Variable: annual savings from employing CNG buses are used to pay off the loan amount.
  - Fixed: fixed payments are set over a 30-year period to pay off the loan amount.

Financial Investment Analysis – $5 Million Bus Loan

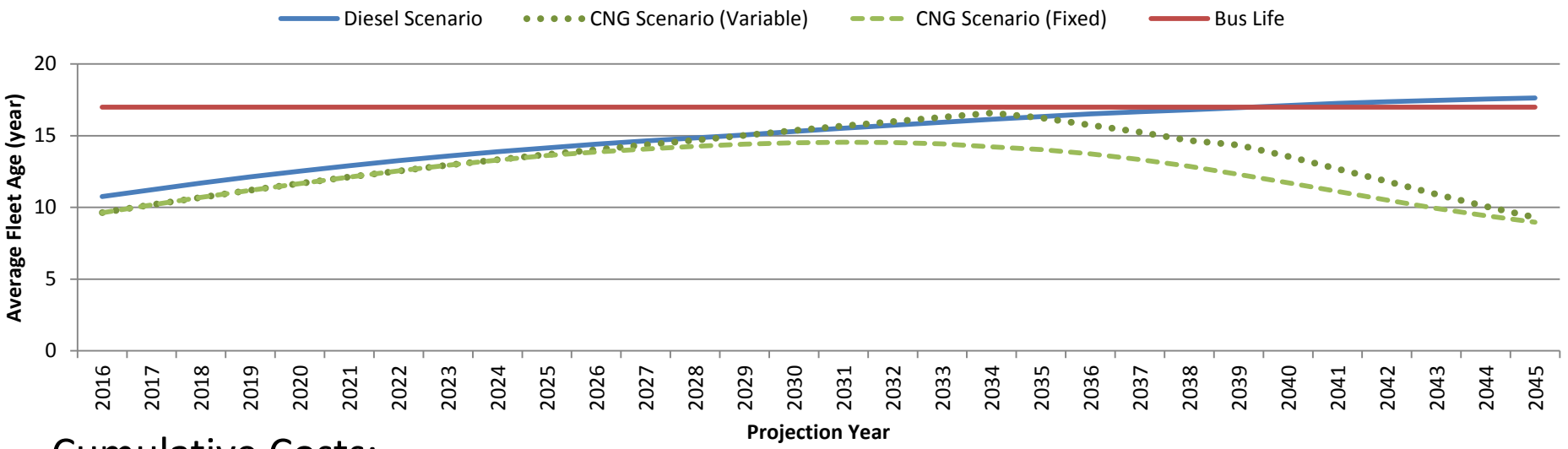
	Variable Loan	Fixed Loan[1]
Total Loan Principal ($)	9,540,000	9,540,000
Total Loan Interest ($)	6,199,000	6,691,000
Total Loan Cost ($) [2]	13,427,000	13,722,000
Total Savings ($)	47,753,000	50,452,000
Total Net Savings (savings less full loan cost) ($)	34,326,000	36,730,000
Project Payoff Year	2034	2045
Year to Start Reinvesting in Buses	2034	2023
Total Additional Buses from Savings and Initial Loans	79 (66 more than diesel)	88 (74 more than diesel)

Notes:

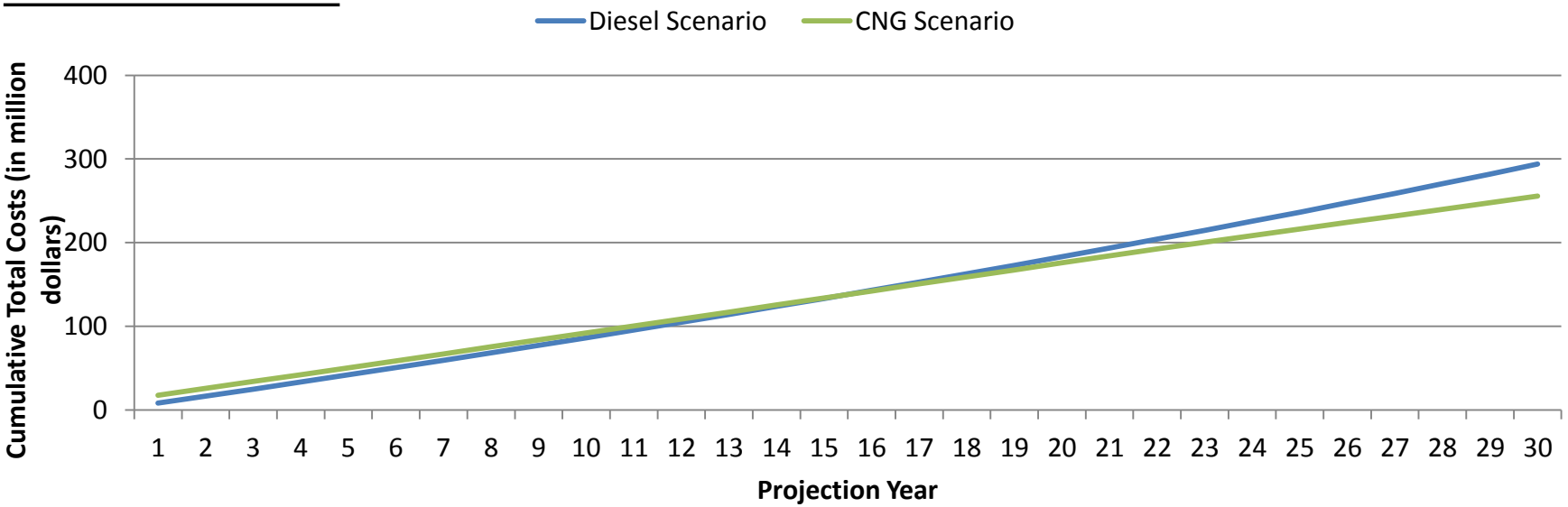
1. Requires $1.9 million in additional funding in first seven years to cover fixed loan payments before yearly fuel savings would be sufficient to cover them.
2. Loan cost does not equal principal + interest in this scenario since it includes the affects of inflation and is derived from the loan payment schedule. Specifically, (the nominal value of) loans do not change with inflation and given the duration and timing of payments a large share of the loan will be paid with "less valuable" money, i.e., a $1 today may equal $0.80 ten years later.

Financial Investment Analysis – $5 Million Bus Loan

Average Fleet Age:



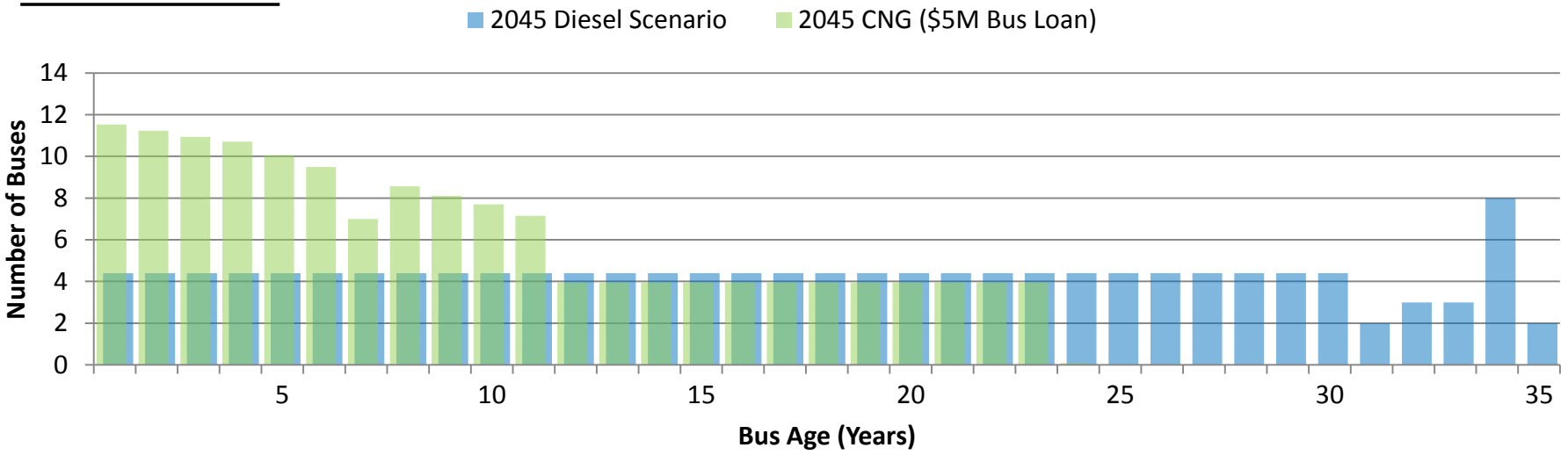
Cumulative Costs:



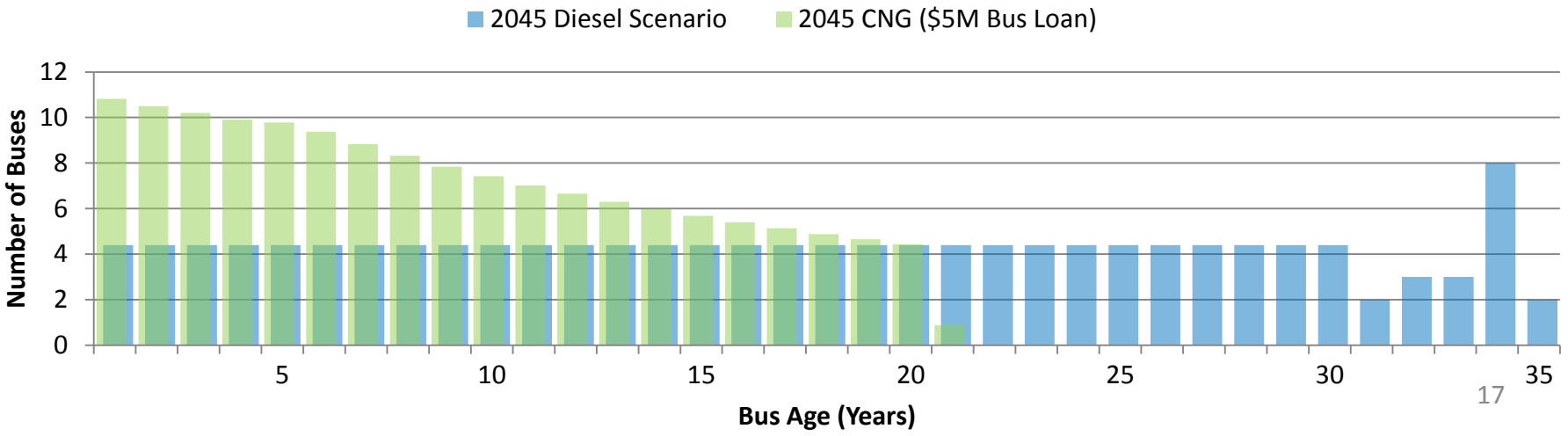
Note: Given scale differences between cumulative costs for fixed and variable loan repayment are indecipherable so a single line is presented.

Financial Investment Analysis – $5 Million Bus Loan

Variable Loan:

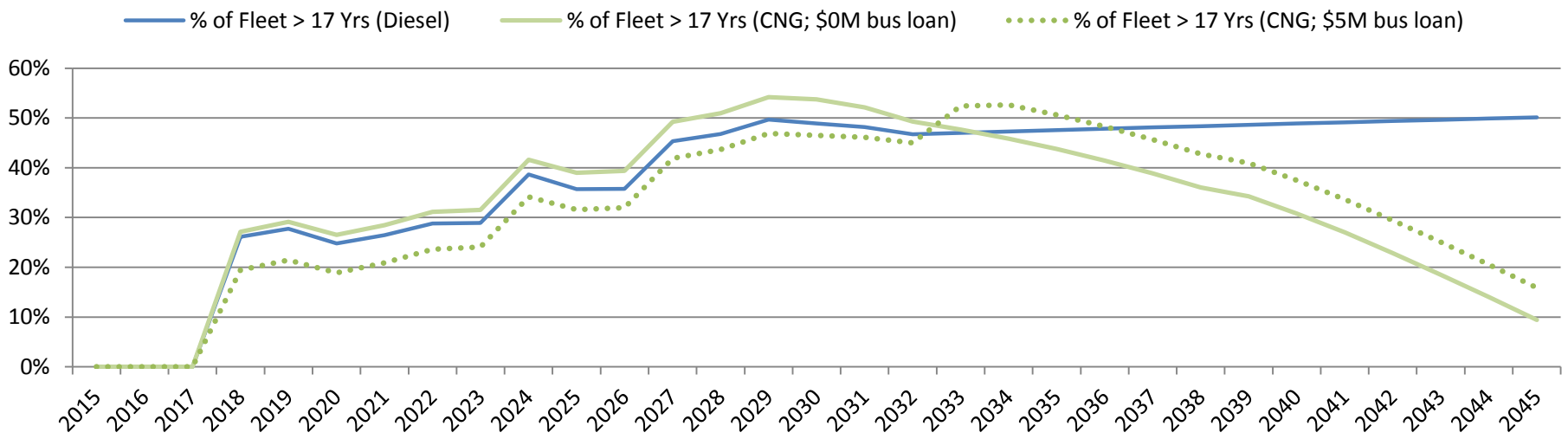


Fixed Loan:

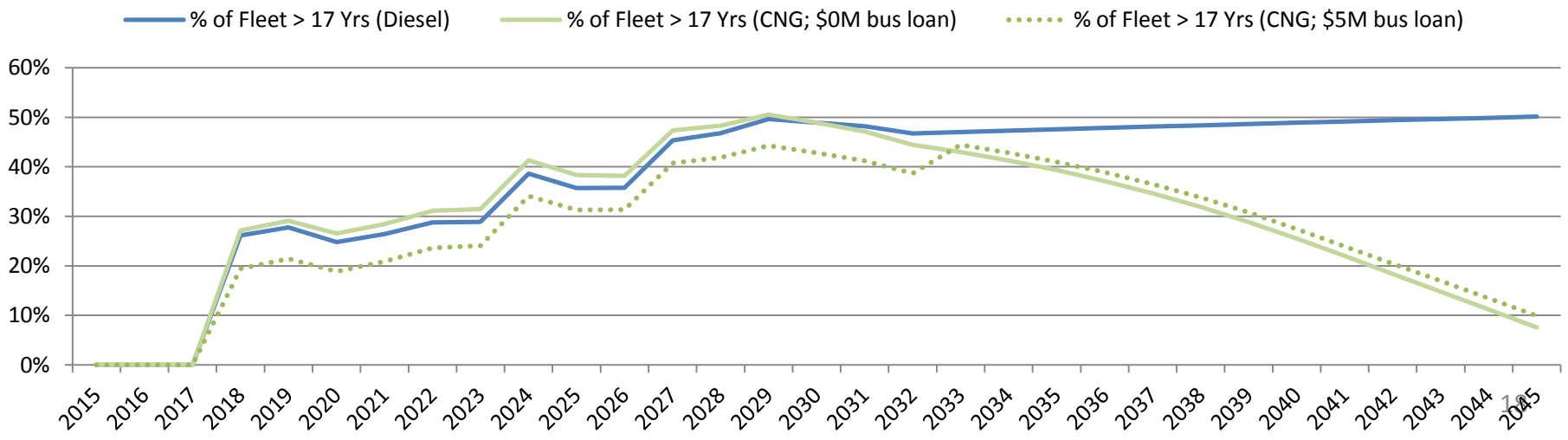


Financial Investment Analysis – % of Fleet > 17 Years

Variable Loan:



Fixed Loan:



Financial Investment Analysis – Financial Metrics

- *Net Present Value (NPV)*:
  - The sum of Present Values (both inflows and outflows) in all future years for a given scenario, including initial loan amount and repayment schedule.

- *Internal Rate of Return (IRR)*:
  - The discount rate that makes the NPV equal to zero.

- *Return on Investment (ROI)*:
  - The total gain (savings obtained by converting to CNG) minus the total cost (sum of loan payments) divided by the total cost.

- *Rate of Return (ROR)*:
  - The geometric mean of the ROI over the project duration (30 years).

Financial Investment Analysis – Financial Metrics

Variable Loan:

Loan Size (million $)	Average Change in Average Age (years)	NPV[1] (million $)	Adjusted[2] ROI (%)	Adjusted ROR (%)	Payback Period (years)
0	-1.6	25.25	647.6	6.9	14.2
5	-1.7	21.66	255.6	4.3	18.1
10	-1.9	18.45	140.3	3.0	20.6
15	-2.3	15.70	88.0	2.1	22.5

Fixed Loan:

Loan Size (million $)	Average Change in Average Age (years)	NPV (million $)	IRR (%)	Adjusted ROI (%)	Adjusted ROR (%)	Years to Annual Profit > Payment	Cost Before Savings Cover Payments (Real 2016 million $)
0	-2.1	26.43	28.9	619.6	6.8	6.0	0.7
5	-2.6	23.51	20.0	267.7	4.4	7.9	1.9
10	-3.0	20.55	15.8	157.4	3.2	9.0	3.2
15	-3.4	17.62	13.1	103.5	2.4	10.0	4.5

Notes:

1. The study used the City's weighted average cost of capital of 3.75% for the discount rate.
2. "Adjusted" means adjusted for inflation. The study used the 10-year average of 1.8%.

Conclusion

- CNG buses are the cost-effective alternative to the current diesel-dominant RTS fleet.

- Transitioning to this fuel source will also help to mitigate and eventually solve the aging fleet issue that will likely grow more severe as federal funding diminishes.

- The costs presented are an indication of the annual savings differential between scenarios. The savings in any one year critically depends on the reinvestment of prior savings into more CNG buses. If profits are not spent in this way, these savings will not occur.

Questions/Comments?