Business Case for CNG in Municipal Fleets

Clean Cities Webinar

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July 27, 2010

NREL/PR-7A2-48981
Innovation for Our Energy Future

Agenda

• Why municipal fleets?
• Assessing investment profitability
• VICE model
• Base-case scenario
• Pressing questions for fleet owners
Why municipal fleets?

- Transit buses, refuse trucks, and school buses
- Circular routes lead to CNG station!
- Municipal governments value some CNG attributes that many businesses don’t
  - Long-term cost-effectiveness (instead of just short-term)
  - Consistent operating costs
  - Increased energy and climate security
  - Reduced local air and noise pollution
- Future report to cover delivery trucks and taxi cabs
Assessing project profitability

- Look at discounted cash-flow of initial investment and future payback/savings
- Discount expenses and savings incurred in the future because money is worth more now than later (because you can invest it now)
- Discount rate is set at what you could make from alternative investments at similar risk

<table>
<thead>
<tr>
<th>Discount Rate</th>
<th>6%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year</strong></td>
<td>0</td>
</tr>
<tr>
<td>Annual Cash Flow</td>
<td>-$1,000,000</td>
</tr>
<tr>
<td>Discount Factor</td>
<td>1.00</td>
</tr>
<tr>
<td>Discounted Cash Flow</td>
<td>-$1,000,000</td>
</tr>
<tr>
<td>NPV</td>
<td>$472,017</td>
</tr>
</tbody>
</table>
Assessing project profitability 2

• Most common metrics are payback period, net present value, or percent return on investment (ROI)
• ROI = discount rate when NPV = 0
Vehicle and Infrastructure Cash-Flow Evaluation (VICE) Model

- Contrasts the cash flow for CNG infrastructure, vehicles, and fuel with that of a diesel fleet
- Determines discounted payback period, NPV, and ROI
- Assesses finances for transit, refuse, school fleets, and mixes thereof
- Discount rate for municipal governments is assumed to be 6% because that is what municipal bonds cost them
- Excel-based and I can send you a copy
<table>
<thead>
<tr>
<th>Fleet Inputs</th>
<th>1 Transit Buses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>Fleet Type</td>
</tr>
<tr>
<td>1 Transit Buses</td>
<td>35,206</td>
</tr>
<tr>
<td>2 School Buses</td>
<td>12,000</td>
</tr>
<tr>
<td>3 Trash Trucks</td>
<td>25,000</td>
</tr>
<tr>
<td>4 1/2 Transit, 1/2 School</td>
<td>23,643</td>
</tr>
<tr>
<td>5 1/2 Transit, 1/2 Trash</td>
<td>30,143</td>
</tr>
<tr>
<td>6 1/2 School, 1/2 Trash</td>
<td>19,000</td>
</tr>
<tr>
<td>7 1/3 Each</td>
<td>24,095</td>
</tr>
</tbody>
</table>

### No_Vehicles

<table>
<thead>
<tr>
<th>No_Vehicles</th>
<th>199 Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax_Incentive</td>
<td>0% % of Inc</td>
</tr>
<tr>
<td>Realized_Incentive</td>
<td>$ 92,000</td>
</tr>
</tbody>
</table>

### Scenario Fleet Type NPI Payback Period

<table>
<thead>
<tr>
<th>Scenario Fleet Type</th>
<th>NPI</th>
<th>Payback Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Transit Buses</td>
<td>$ 16,309,283</td>
<td>3.6</td>
</tr>
<tr>
<td>2 School Buses</td>
<td>$ 743,277</td>
<td>11.5</td>
</tr>
<tr>
<td>3 Trash Trucks</td>
<td>$ 11,035,736</td>
<td>2.6</td>
</tr>
<tr>
<td>4 1/2 Transit, 1/2 School</td>
<td>$ 5,458,700</td>
<td>5.5</td>
</tr>
<tr>
<td>5 1/2 Transit, 1/2 Trash</td>
<td>$ 14,356,471</td>
<td>2.9</td>
</tr>
<tr>
<td>6 1/2 School, 1/2 Trash</td>
<td>$ 4,034,214</td>
<td>5.4</td>
</tr>
<tr>
<td>7 1/3 Each</td>
<td>$ 6,769,920</td>
<td>4.4</td>
</tr>
</tbody>
</table>

### Comments

- ROR: 6%
- Diesel_tax exempt: 5.5% per gallon
- Monthly_diesel_used: 89,524 gallons
- GGE_DGE_Conv: 90.98 DGEs per 100 DGEs
- CVG_Station_Solv: 20% of origins
- Garage_Cost: $ -
- Hassler_Cost: $ 4,157
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Base Case- Fleet Parameters

- Base case is an average or common value
- Allows a benchmark from where we can test the effect of changing one parameter.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fleet Type</th>
<th>Avg. VMT</th>
<th>FE Diesel (mpg)</th>
<th>FE CNG (mpDGE)</th>
<th>Incremental Cost</th>
<th>Vehicle Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transit Buses</td>
<td>35,286</td>
<td>3.27</td>
<td>3.02</td>
<td>$50,502</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>School Buses</td>
<td>12,000</td>
<td>7.00</td>
<td>6.13</td>
<td>$31,376</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Refuse Trucks</td>
<td>25,000</td>
<td>2.80</td>
<td>2.51</td>
<td>$30,295</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>1/2 Transit, 1/2 School</td>
<td>23,643</td>
<td>5.14</td>
<td>4.57</td>
<td>$40,939</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>1/2 Transit, 1/2 Refuse</td>
<td>30,143</td>
<td>3.04</td>
<td>2.76</td>
<td>$40,399</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>1/2 School, 1/2 Refuse</td>
<td>18,500</td>
<td>4.90</td>
<td>4.32</td>
<td>$30,836</td>
<td>14</td>
</tr>
<tr>
<td>7</td>
<td>1/3 Each</td>
<td>24,095</td>
<td>4.36</td>
<td>3.88</td>
<td>$37,391</td>
<td>14</td>
</tr>
</tbody>
</table>

- Numerous data sources
  - Most published, a few from interviews
  - Tried to get multiple sources and take average
  - Mixed fleets are simply averaged
Base Case - Station Parameters

- Equations developed from Rob Adams’ (Marathon Technical Services) cost calculator
- Replicates buffered fast-fill station
  - Applicable to time-fill scenarios because compression (not storage) is the bulk of the cost
- Fleets determine refueling window and expected throughput

![Cost/Size Relationship for CNG Stations](image-url)

- Transit Station
- School Station
- Refuse Station
Base Case - Fuel Costs

- Savings from fuel costs are what pays back the investment in a station and vehicles
- Per-DGE saving increase further into the future
Profitability of Base Case

Payback Period by Fleet Size

Minimum Number of Vehicles to Have a Positive NPV or 6% ROR

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th># of Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit Buses</td>
<td>11</td>
</tr>
<tr>
<td>School Buses</td>
<td>68</td>
</tr>
<tr>
<td>Refuse Trucks</td>
<td>14</td>
</tr>
<tr>
<td>1/2 Transit, 1/2 School</td>
<td>26</td>
</tr>
<tr>
<td>1/2 Transit, 1/2 Refuse</td>
<td>12</td>
</tr>
<tr>
<td>1/2 School, 1/2 Refuse</td>
<td>32</td>
</tr>
<tr>
<td>1/3 Each</td>
<td>22</td>
</tr>
</tbody>
</table>
With the base case established, we can see what effect specific changes have on project profitability.

Most important question is wrapped up into all answers:
• How many vehicles do I need to make the project profitable?

Three question categories:
• Variations in fuel expenditures
• Changes in Upfront Costs
• Changes in Operating Costs
How many miles per year do I need to drive my vehicles to break even?
What if diesel prices change?

Great question, given the volatility of diesel prices.
What happens as my vehicle efficiency changes?

Effects of Change in Diesel/CNG Vehicle Efficiency

Change in Vehicle Efficiency on a BTU Basis

Payback Period (Years)

Not much, except for in school buses
What if I don’t get the tax incentives?

- Some of the tax incentives are under debate in Congress
- Tax incentives need to be passed along to municipal governments—an uncertain proposition

Payback Period (Years) with Various Tax Credits Missing

<table>
<thead>
<tr>
<th>Fleet (100 Vehicles)</th>
<th>All Credits</th>
<th>No Fuel Credit</th>
<th>No Vehicle Credit</th>
<th>No Station Credit</th>
<th>No Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit Buses</td>
<td>3.6</td>
<td>5.9</td>
<td>5.5</td>
<td>3.6</td>
<td>9.1</td>
</tr>
<tr>
<td>School Buses</td>
<td>11.5</td>
<td>≥15.0</td>
<td>≥15.0</td>
<td>11.8</td>
<td>≥15.0</td>
</tr>
<tr>
<td>Refuse Trucks</td>
<td>2.6</td>
<td>4.6</td>
<td>4.8</td>
<td>2.7</td>
<td>7.8</td>
</tr>
</tbody>
</table>

- Station tax credit ($50K) doesn’t matter much
- Fuel ($0.55/gal diesel) and vehicle (≤$32K/vehicle) credits make a big difference
  - Fuel credit matters most for transit buses
  - Vehicle credit matters most for refuse trucks
- There are synergies between the three credits
What happens if the price of my station changes?

Big difference for refuse/transit fleets less than 75 vehicles
Can bring school fleets to a reasonable payback period
What happens as my vehicle incremental cost changes?

- Grants effectively reduce the incremental cost
- Asymmetrical changes because subsidy covers most of difference between zero and base case
What happens if my vehicle maintenance costs change?

- Both CNG and diesel maintenance costs start at $0.50 per mile
- Asymmetrical—reducing CNG maintenance costs is more important if it is more expensive than diesel to begin with
- Can make school bus fleet profitable
Conclusion

**Very Profitable**

- **Resilient Fleets**
  - Large (>75 vehicle) transit or refuse fleets
  - Diesel drops below $2.25/gal
  - CNG vehicle maintenance costs increase 50%

- **Profitable* unless:**
  - VMT drops below 26,000 miles per year (transit) or 14,000 miles per year (refuse)
  - Vehicle incremental costs double
  - Various combinations of the above

**Marginal Fleets**

- All school bus fleets
- Small (<75 vehicle) transit or refuse fleets

- **Precipitous drop in profitability if:**
  - Transit or refuse fleet drops below 30 vehicles
  - School bus VMT drops below 10,000 miles per bus

**No-CNG Fleets**

- Low annual fuel use
- Access to unusually inexpensive diesel
- Exceptionally high CNG vehicle and infrastructure costs

Not Profitable

*Payback of less than 5 years

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Questions

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Business Case for CNG in Municipal Fleets report at:
www.afdc.energy.gov/afdc/pdfs/47919.pdf
Maintenance Costs for CNG Station

Station Size (KDGEs Throughput per Month)

| Contractor A | Contractor B | 8% to 5% | equation |

Thousand Dollars per Month

$0 $5 $10 $15 $20 $25 $30 $35 $40

0 50 100 150 200 250 300

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What if I receive an FTA grant?

• FTA can pay for 80% of a diesel bus or 83% of a CNG bus
Rate of Return for Two Refueling Windows

- **12-Hour Window**
- **6-Hour Window**

The graph shows the rate of return as a function of the number of buses for two refueling windows: a 12-hour window and a 6-hour window.
Payback Period by Garage Upgrade

Payback Period (Years)

Number of Vehicles

- School + Garage
- School No Garage
- Transit + Garage
- Transit No Garage
- Refuse + Garage
- Refuse No Garage