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NPV+ Analysis: Vehicles

In cooperation with the Maryland Department of Budget and Management

NPV+: Making the economic case for sustainable choices in capital project planning

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Executive Summary

With the support and assistance of the Department of Budget and Management (DBM), this Net Present Value Plus (NPV+) analysis compared two sets of Maryland state fleet vehicles:

- A 2013 Ford Focus vs. an all-electric 2013 Nissan Leaf for general duty use.
- A 2014 Chevrolet Caprice vs. a 2014 Chevrolet Tahoe SUV for state police use.

The analysis included the initial cost of the vehicles, fuel, maintenance, insurance, and the social cost of carbon emissions, as determined by the EPA's schedule.

The analysis sought to answer these questions:

- At what price would an electric vehicle (EV) become cheaper to own than a conventional gasoline alternative for general-duty, local use?
- How does the total cost of ownership compare for police use of sedans vs. SUVs?

The analysis found that:

- Taking a "business-as-usual" outlook on fuel prices could lead the state to buy vehicles that are more expensive to own. Under a forecast for gasoline prices likely to be paid by the state Department of General Services (DGS), electric vehicles like the Leaf would become cheaper for the state to own than gasoline vehicles in the same class within the next two years. Within three years, the same would be true for gasoline vehicles refueled at Maryland retail prices for gasoline.
- Using historical oil prices over the past 26 years to forecast DGS gasoline prices, the cost of owning a Leaf over 10 years is statistically indistinguishable from that of a Focus, despite costing more than twice as much to buy as the Focus.
- The results varied substantially under the three fuel price forecasts used in the analysis, as detailed in this report. But there were additional differences not discussed in this report. At the request of DBM, the main analysis was based on a forecast for retail Maryland gasoline prices (which are lower than DGS prices), and a DGS forecast for electricity prices (which are lower than retail prices). When modeling DGS prices for both electricity and gasoline, the cost difference between the Leaf and the Focus narrowed, and when using retail prices for both electricity and gasoline, the cost difference widened.
- In the future, selecting vehicles with higher fuel efficiency for police use could deliver significant savings. The Chevrolet Tahoe is more expensive to own over four years than the Chevrolet Caprice.

Maryland could save money and reduce the risk of the state's exposure to rising oil prices by choosing the Caprice over the Tahoe for state police use where practical now, and by choosing electric vehicles over gasoline vehicles for general use now, or in the near future.

About the NPV+ Project

When a state spends money – on vehicles, buildings, land, or anything else – one might think that budgeting authorities would consider spending decisions much as a household would: Is this a good investment? Have we considered all the ways that it might affect our lives? Have we taken into account how this investment will look twenty or thirty years from now?

And yet, states are not always able to approach spending decisions that way. Agencies are too often in a position that does not allow as much freedom we would hope. Contracts are often awarded to current lowest bidder; the process can be rigid; and long-term planning assumes the future will be exactly like the present. It is often assumed that economic growth will continue at historical rates for decades to come; that fuel prices will remain affordable and grow at a moderate rate; and that carbon pollution will continue to be externalized onto the environment and the public.

Part of the problem is that governments are beholden to current budgetary conditions, frameworks, and policies. Very real factors are left out and unvalued – like the true costs of carbon pollution, or the true benefits of storm water protection that we get from wetlands – simply because they don't have a market price. Another part of the problem is that since no one can predict the future, we believe we shouldn't even try. But failing to consider real possibilities – like a rapid tripling of oil prices sharply cutting into the disposable incomes of consumers – can have disastrous outcomes for state planners, like painful budget cuts, stranded assets, and unsustainable development.

Enter **NPV+**. With the support of Governor O'Malley, the financial support of the Rockefeller Foundation, and the cooperation of the State of Maryland, Global Footprint Network has co-developed an analytical framework to help make the economic case for sustainable choices in capital project decisions.

Traditionally, cost-benefit analysis uses the net present value (NPV) formula, which adds up revenue and expenditures over a period of time, and discounts those cash flows by the cost of money (an interest rate). The NPV calculation effectively states the lifetime value of an investment in present terms.

NPV+ expands on the familiar NPV analysis by including unpriced factors, such as the cost of environmental degradation and benefits like ecological resiliency. In the NPV+ framework, any investment may be a "capital project;" all costs and benefits – even those where no monetary exchange occurs – are "cash flows;" and those cash flows can be evaluated using the NPV formula.

NPV+ also uses scenario analysis to capture possible economic futures and create a more realistic context for capital decisions. Along with recognizing normally unaccounted-for factors, this approach offers a more accurate life-cycle accounting with more complete information (hence the "plus").

It is hoped that NPV+ will help policymakers and budget analysts to focus on maximizing long-term wealth for their states, and provide realistic guidance in a time of growing constraints, including higher resource costs, changing climate, and historically atypical economic performance.

The NPV+ Analysis

In a time of unprecedented resource pressures, rising energy costs, and increasingly strained environmental limits, it is more important than ever to understand the real context in which long-lived investments may be operating in the future. We should not assume that the future will be like the past, as conventional economic analysis does, but rather try to understand what possible futures may await us.

To establish the real socio-political contexts in which economies could be operating in the future, and to identify the economic dynamics that might play out, the NPV+ framework used four scenarios, outlined in a separate document, which present different views of the global economy over the next 40 years. This time frame was chosen because of the long-term nature of physical assets, the current discussions about 2050 CO_2 emission goals, and the fact that 40 years may still be within the lifespan of many decision-makers, and certainly within the lifetime of their children. All of the scenarios suggest significant shifts in energy supply in the future, with less fossil fuel availability.

To test their validity, the scenarios were reviewed by six professors from the University of Maryland with expertise in ecological economics and resource valuation. The majority of the reviewers thought Scenario 3 was the most likely of the four scenarios. In this scenario, starting in 2015, world oil production will decline to 1970s levels by 2050 and stifle economic activity, restricting investment and forcing governments to make do with existing assets. While a detailed discussion of the scenarios is outside the scope of this document, elements of the NPV+ forecast — such as future prices for electricity and gasoline — were informed by that scenario.

About the Net Present Value Calculation

The capital investments analyzed with the NPV+ methodology use the standard net present value (NPV) formula. This formula calculates the value of a series of future cash flows in present-day dollars by applying a discount rate to accommodate the effects of inflation.

The formula is:

$$NPV = \left[\frac{R_1}{(1+i)^1} + \frac{R_2}{(1+i)^2} + \frac{R_3}{(1+i)^3} + \ldots \right] - \text{Initial Investment}$$

Where:

i is a discount rate;
R_1 is the net cash inflow during the first period;
R_2 is the net cash inflow during the second period;
R_3 is the net cash inflow during the third period, and so on ...

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Oil Price Models

We used three models for future oil prices to represent the effects of the scenarios. The models are more conceptual than empirical expressions, as we have not yet developed a formal methodology to derive prices from the scenarios' energy supply forecasts. All three models are for the global "Brent" oil price benchmark.

Trend Model

The Trend oil price model uses a simple polynomial trendline extension of actual historical oil prices from 1987 through 2013.

This trendline shows a good fit to the historical data (r^2 = 0.93), and suggests that on current trends, oil prices could increase 600% to $600 a barrel by 2040.

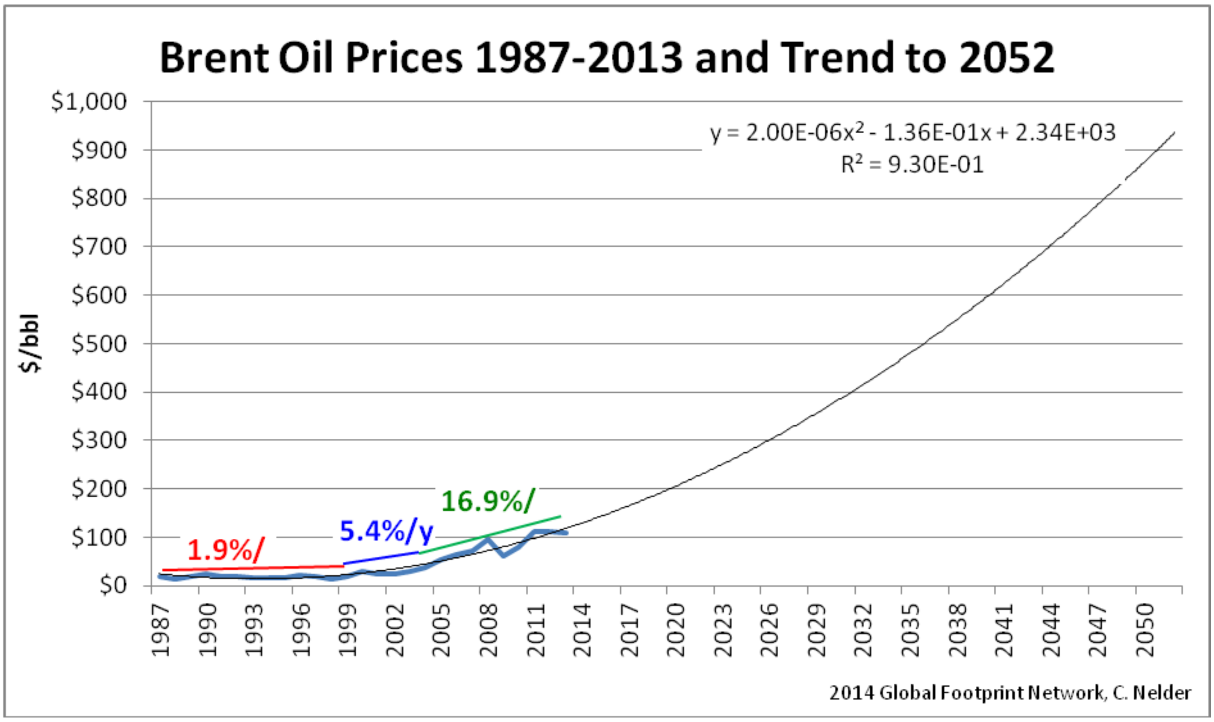

Figure 1 Trend Model for Oil Prices

However, a key consideration of Scenario 3 is that at some point the global consumer will be unable to pay such steeply-rising prices for fuel. Therefore we developed a second forecast to express what might really happen in Scenario 3.

Nelder Model

The Nelder model attempts to take into account a range of likely events, and would correspond most closely to Scenario 3. In this model:

- Global oil extraction reaches a maximum in 2015 and goes into a long decline phase.
- As supply is constrained and demand remains strong, prices for gasoline and diesel become too high for consumers to pay around 2017. Like an echo of 2008, an economic slump follows this price spike, and oil consumption falls sharply, dragging prices lower.
- A recovery period follows from 2018-2020, in which consumers adapt to the higher fuel price regime. Economic contraction reduces commercial and industrial oil demand; vehicle efficiency improves; and many people simply give up their cars in favor of urban transit options.
- Oil prices begin climbing again to accommodate the continually-rising cost of oil production.

The Nelder model only runs for 10 years. This is an appropriate time frame for the vehicle analysis, which runs for 10 years at most. We assume that consumers in Maryland will be able to acclimate to rising oil prices over this period, before total primary energy supply begins declining in 2025 as Scenario 3 suggests.

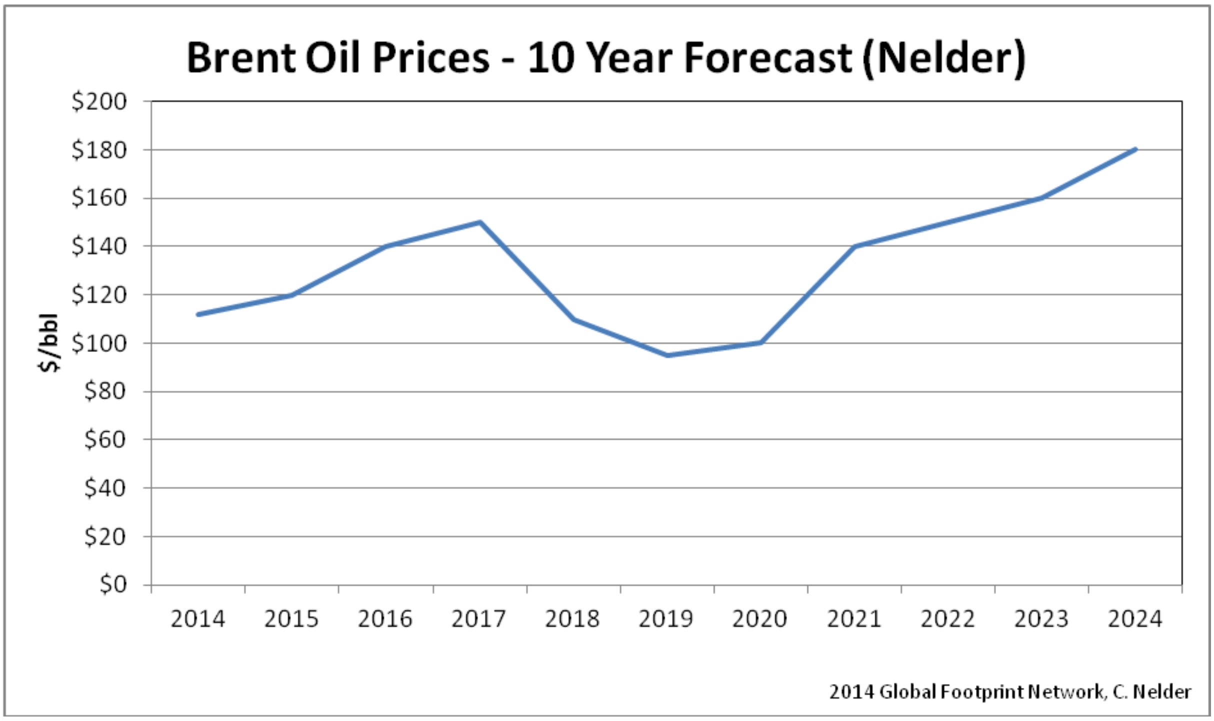

Figure 2 Nelder Model for Oil Prices

EIA Model

The third model is the Reference Case from the U.S. Energy Information Administration (EIA) *Annual Energy Outlook 2013*.[1]

This model represents a "business as usual" scenario in this analysis, in which oil prices rise modestly at a steady rate. This model would be a closer match to Scenario 1 in the NPV+ Scenarios, which was deemed by the reviewers as being unrealistically optimistic. However, we included it in this analysis for contrast and context.

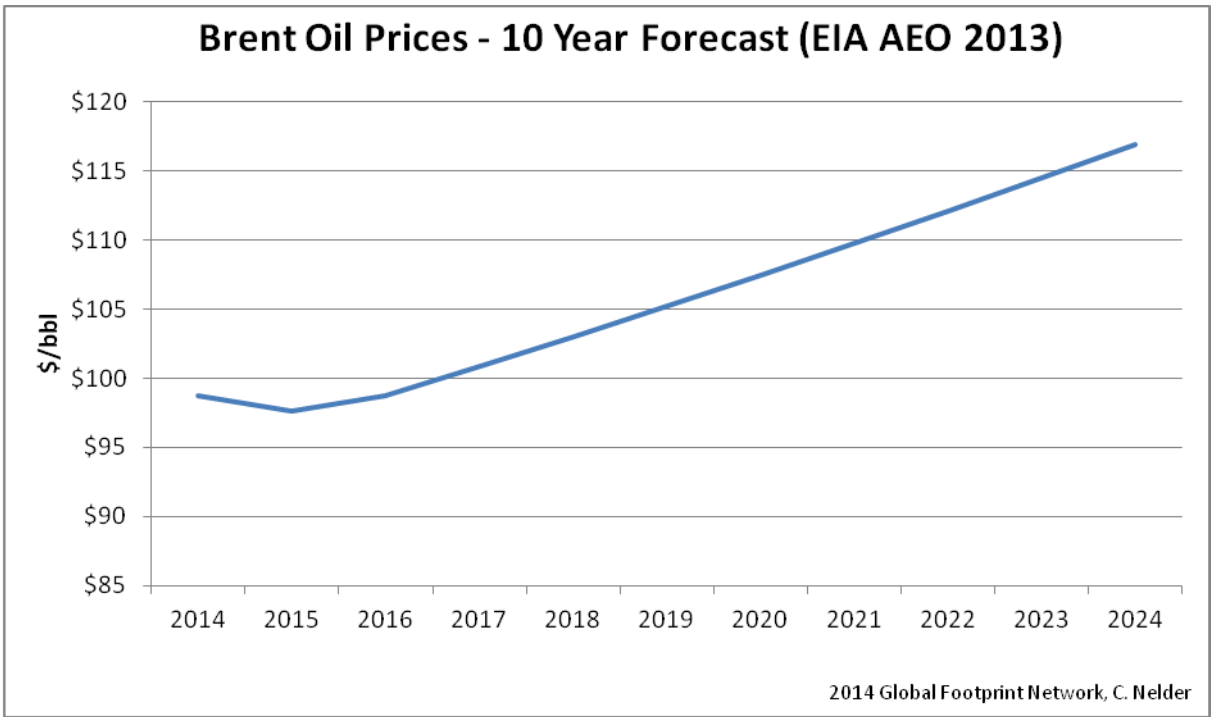

Figure 3 EIA AEO 2013 Model for Oil Prices

[1] Source: EIA Annual Energy Outlook 2013 (Full Report) http://1.usa.gov/P3VwXo

Gasoline Price Forecasts

Using the three oil price models, we derived three forecasts for retail gasoline prices in Maryland over the next 10 years, assuming a mix of 95% gasoline and 5% E85 (on the advice of DBM).

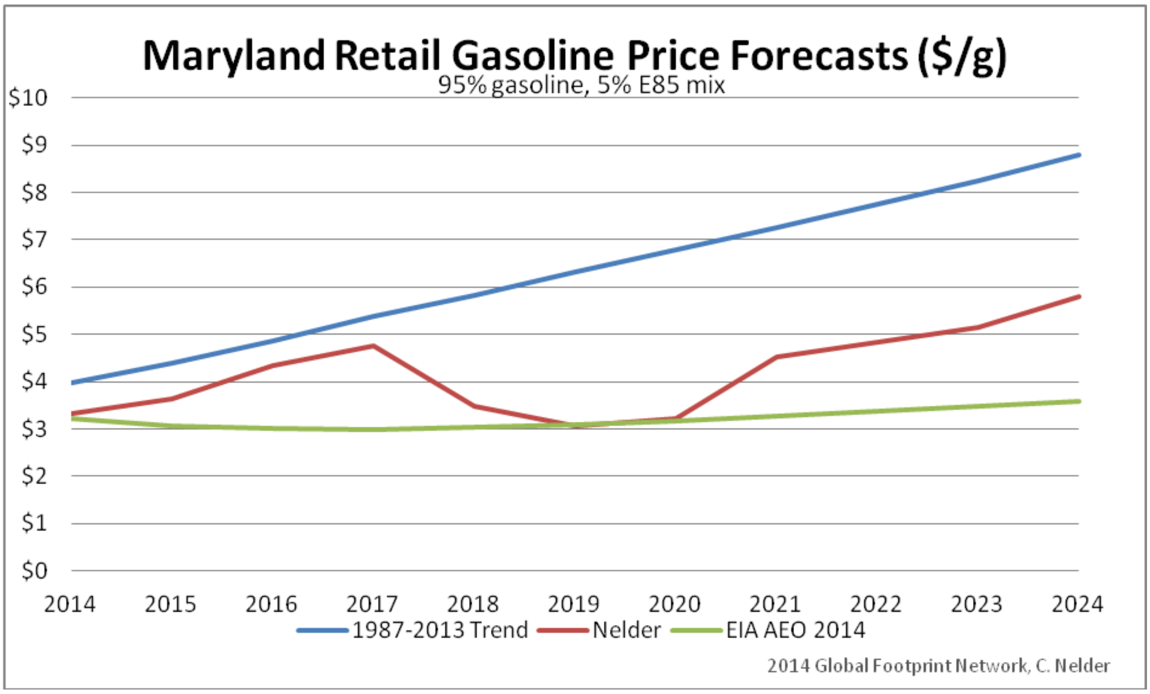

Figure 4 Maryland Retail Gasoline Price Forecasts

We also developed an equivalent set of forecasts for the actual prices the Department of General Services (DGS) is likely to pay for state gasoline purchases, which are higher than the retail prices in Maryland.

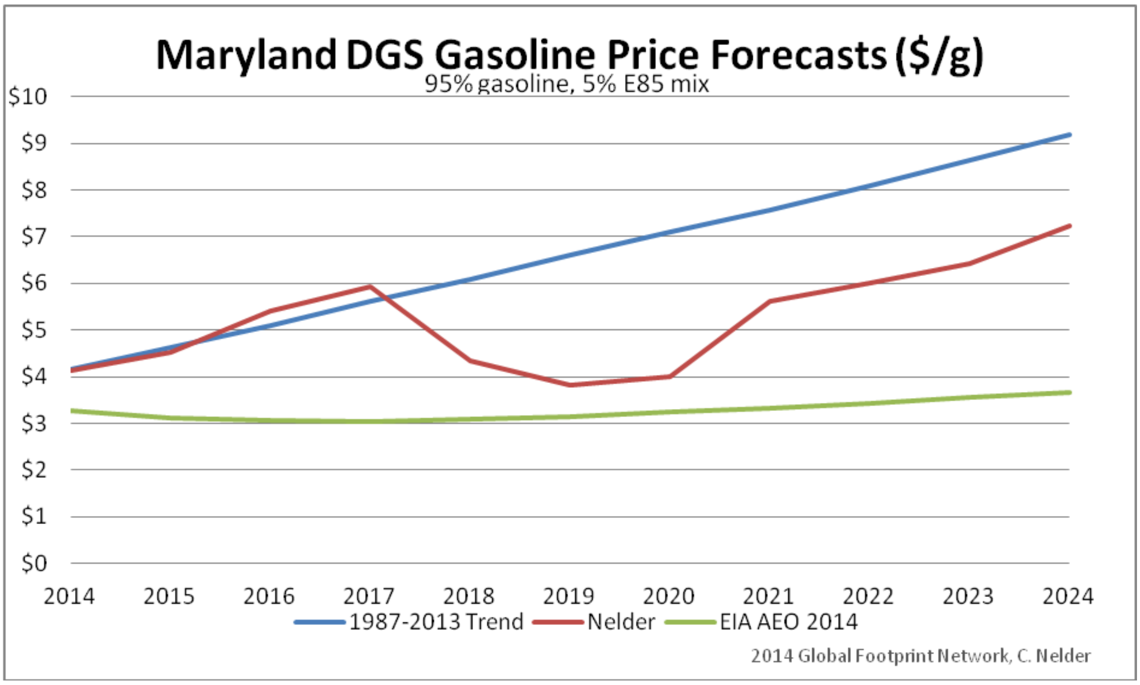

Figure 5 Maryland DGS Gasoline Price Forecasts

Electricity Price Forecast

In order to model the cost of ownership for the Leaf electric vehicle, we developed a forecast for electricity prices the State of Maryland Department of General Services might pay for its internal use (i.e., for recharging state-owned EVs) over the coming decades. This model was derived from the "Long-Term Electricity Report for Maryland" (May 2013)[2] developed by the Maryland Department of Natural Resources. A compound annual growth rate of 2.7% was derived from the forecast in the report, then applied to the historical data series from the U.S. Energy Information Administration (EIA) for Maryland electricity prices. In the resulting forecast, electricity prices climb from $0.117/kWh in 2014 to $0.154/kWh in 2024.

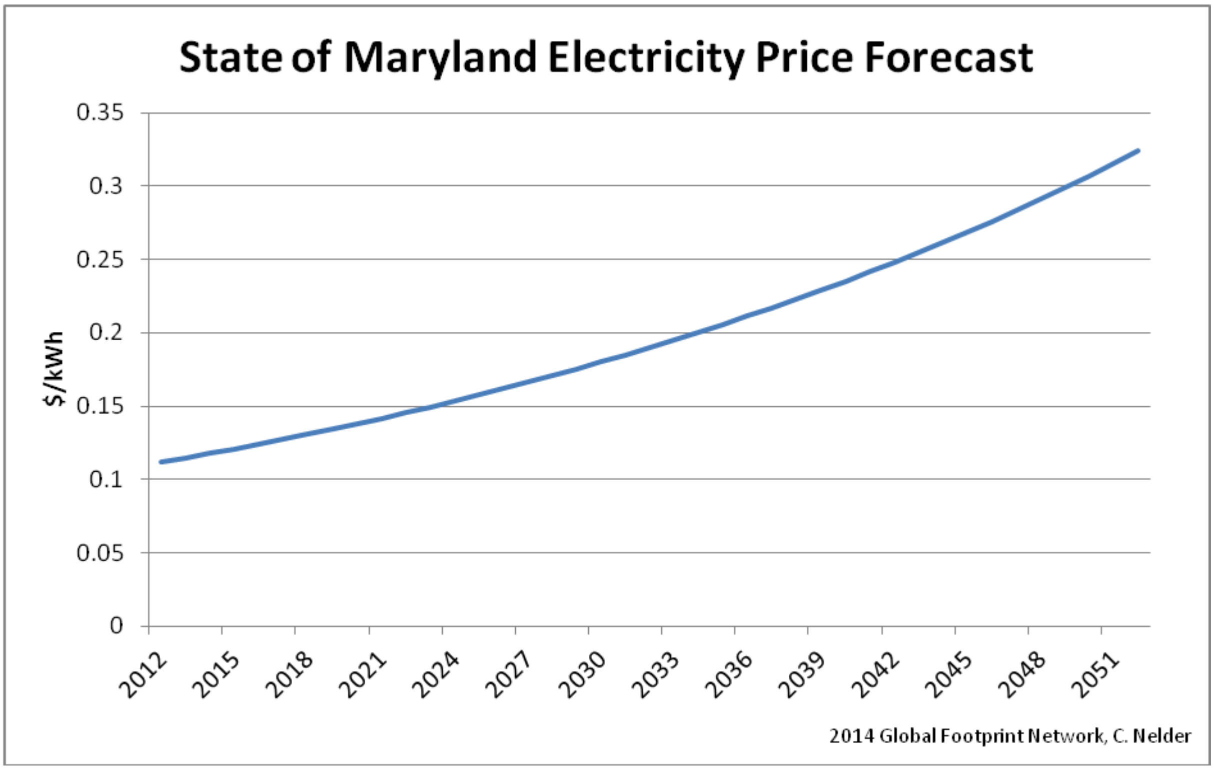

Figure 6 State of Maryland Electricity Price Forecast

[2] http://esm.versar.com/pprp/pprac/Docs/LTER_RCU_FINAL.pdf

Vehicle Analyses

Two sets of vehicles were compared:

- For general use, a conventional 2013 Ford Focus was compared to an all-electric 2013 Nissan Leaf. The Ford Focus is a common Maryland state fleet vehicle, with 745 units in the current fleet. There is currently only one Nissan Leaf in the fleet.
- For police use as specially-equipped pursuit vehicles, a 2014 Chevrolet Caprice was compared to a 2014 Chevrolet Tahoe SUV. Both have V8 engines, and are common Maryland state police vehicles, with 65 Caprice and 49 Tahoe units in the current fleet.

The following general assumptions were used in both analyses:

- The non-electric vehicles would burn 95% gasoline, and 5% E85.
- Insurance costs are $300/year.
- Vehicles have a $500 salvage value when retired.
- A 5% discount rate was assumed, matching a typical Maryland general obligation bond.

In addition to direct expenses like initial cost, fuel, maintenance, and insurance, the NPV+ analysis took into account indirect expenses using the EPA's "social cost of carbon" schedule.[3] On that schedule, CO2 costs climb from $36.34 per tonne (in adjusted 2013 dollars) in 2014 to $46.69 per tonne in 2024. CO2 emissions were calculated separately for gasoline using EPA's per-gallon equivalents, and for electricity using EPA's per-MWh equivalents for Baltimore Gas & Electric's grid power mix.

On the advice of DBM, the NPV calculations were performed using Maryland retail gasoline price forecasts, and DGS electricity price forecasts. For reference, the summary results using DGS (instead of retail) gasoline price forecasts are also given beneath each NPV table below. As a sensitivity analysis, the calculations were performed for each of the three oil price models.

[3] See http://www.epa.gov/climatechange/EPAactivities/economics/scc.html

Ford Focus vs. Nissan Leaf

A conventional gasoline engine 2013 Ford Focus was compared to an all-electric 2013 Nissan Leaf SV Hatchback.

The following assumptions were made for both vehicles:

- Local, general-duty use.
- Driven 12,000 miles per year.
- Retired at 120,000 miles (10 years).
- Fuel economy ratings were for combined city/highway driving per the EPA, and taken from manufacturer's specifications.
- Initial vehicle costs were supplied by DBM and reflect 2014 prices.
- Maintenance costs for the 2013 Ford Focus were based on DBM's average historical maintenance data for a 2006 Ford Focus.
- Maintenance costs for the 2013 Nissan Leaf using actual historical data are not available because the Nissan Leaf has only been available for two years. Maintenance costs for the analysis were taken from an average of the MotorTrend and Edmunds maintenance forecasts for the Leaf for the first five years (the extent of those forecasts) and then held constant at the Year 5 level for the remaining five years.

Trend model

The cash flows under the Trend retail gasoline price forecast comparison are as follows:

Discount rate	5%			
Make & model		**2013 Ford Focus**		**Nissan Leaf 2013 SV Hatchback**
Use type		Gen. Duty		Gen. Duty
Vehicle type		Sedan		Sedan
Initial cost		$13,979		$30,512
Miles/yr		12,000		12,000
Retirement age		120,000		120,000
Years of service		10		10
Maintenance/yr		$758		(per schedule)
Insurance/yr		$300		$300
MPG (combined)		31		129/102
fuel (gals/yr)		387		-
salvage value		$500		$500
Cash flows				
2014		$(2,723)		$(957)
2015		$(2,891)		$ (1,148)
2016		$(3,073)		$ (1,517)
2017		$(3,275)		$ (1,562)
2018		$(3,455)		$ (1,567)
2019		$(3,654)		$ (1,581)
2020		$(3,835)		$ (1,596)
2021		$(4,022)		$ (1,610)
2022		$(4,215)		$ (1,624)
2023		$(3,914)		$ (1,139)
NPV		$(40,544)		$ (41,437)
per mile		$ (0.34)		$ (0.35)

Table 1 NPV of Focus vs Leaf: Trend Model

Under the Trend-based retail gasoline price forecast, despite costing more than twice as much to buy, the total cost of ownership over 10 years for the Nissan Leaf is only $893 more than the Ford Focus, at $0.35/mile vs. $0.34/mile.

Under the Trend-based DGS gasoline price forecast, the total cost of ownership over 10 years for the Nissan Leaf is $92 more than the Ford Focus, at $0.34/mile vs. $0.35/mile. However, enough uncertainty exists in other parts of the model to make this difference statistically insignificant.

Nelder model

The cash flows under the Nelder retail gasoline price forecast are as follows:

Discount rate	5%			
Make & model		**2013 Ford Focus**		**Nissan Leaf 2013 SV Hatchback**
Use type		Gen. Duty		Gen. Duty
Vehicle type		Sedan		Sedan
Initial cost		$13,979		$30,512
Miles/yr		12,000		12,000
Retirement age		120,000		120,000
Years of service		10		10
Maintenance/yr		$758		(per schedule)
Insurance/yr		$300		$300
MPG (combined)		31		129/102
fuel (gals/yr)		387		-
salvage value		$500		$500
Cash flows				
2014		$(2,466)		$(957)
2015		$(2,598)		$(1,148)
2016		$(2,875)		$(1,517)
2017		$(3,037)		$(1,562)
2018		$(2,549)		$(1,567)
2019		$(2,388)		$(1,581)
2020		$(2,454)		$(1,596)
2021		$(2,958)		$(1,610)
2022		$(3,084)		$(1,624)
2023		$(2,712)		$(1,139)
NPV		$(34,844)		$(41,437)
per mile		$(0.29)		$(0.35)

Table 2 NPV of Focus vs Leaf: Nelder Model

Under the Nelder-based retail gasoline price forecast, the total cost of ownership over 10 years for the Nissan Leaf is $6,594 higher than the Ford Focus, at $0.35/mile vs. $0.29/mile.

Under the Nelder-based DGS gasoline price forecast, the total cost of ownership over 10 years for the Nissan Leaf is $3,673 higher than the Ford Focus, at $0.35/mile vs. $0.31/mile.

EIA model

The cash flows under the EIA retail gasoline price forecast are as follows:

Discount rate	5%			
Make & model		**2013 Ford Focus**		**Nissan Leaf 2013 SV Hatchback**
Use type		Gen. Duty		Gen. Duty
Vehicle type		Sedan		Sedan
Initial cost		$13,979		$30,512
Miles/yr		12,000		12,000
Retirement age		120,000		120,000
Years of service		10		10
Maintenance/yr		$758		(per schedule)
Insurance/yr		$300		$300
MPG (combined)		31		129/102
fuel (gals/yr)		387		-
salvage value		$500		$500
Cash flows		$(2,429)		$ (957)
2014		$(2,376)		$(1,148)
2015		$(2,354)		$(1,517)
2016		$(2,353)		$(1,562)
2017		$(2,371)		$(1,567)
2018		$(2,397)		$(1,581)
2019		$(2,438)		$(1,596)
2020		$(2,478)		$(1,610)
2021		$(2,520)		$(1,624)
2022		$(2,067)		$(1,139)
2023		$(2,429)		$(957)
NPV		$(32,367)		$(41,437)
per mile		$(0.27)		$(0.35)

Table 3 NPV of Focus vs Leaf: EIA Model

Under the EIA-based retail gasoline price forecast, the total cost of ownership over 10 years for the Nissan Leaf is $9,070 higher than the Ford Focus, at $0.35/mile vs. $0.27/mile.

Under the EIA-based DGS gasoline price forecast, the total cost of ownership over 10 years for the Nissan Leaf is $8,897 higher than the Ford Focus, at $0.35/mile vs. $0.27/mile.

Results Discussion

Performing the NPV+ analysis under the three different gasoline price forecasts illustrates the large influence of fuel prices on the results. Under the conventional EIA fuel price forecast, the inexpensive Ford Focus would seem to be a better value than the expensive Leaf electric vehicle. But under the Trend forecast – which simply extrapolates from the actual, historical oil prices of the past 26 years – the difference narrows to less than $900 when fuel is purchased at retail prices. When fuel is purchased at the real prices likely to be paid by the state (DGS), the cost of owning a Leaf over 10 years is statistically indistinguishable from owning a Focus, even though its initial cost is more than twice as much as the Focus.

Under other reasonable assumptions, the cost of the Leaf could turn out to be equal to, or even lower than, the cost of the Focus.

After fuel costs, maintenance costs are the next-largest cost. Because there is insufficient data on the actual maintenance costs for the relatively new Leaf, and since Leaf owners report very low maintenance costs due to the far fewer moving parts in an EV, the actual cost of owning a Leaf over 10 years could be lower than this analysis assumes.

Further, it is likely that Nissan will reduce Leaf prices soon, following a $2,523 price cut in Japan (effective March 28, 2014). In the past, Nissan has followed up price announcements in Japan with similar actions in the U.S.[4] With a price cut of that size in 2014, the Leaf would be $1,630 cheaper than the Focus under the Trend forecast for retail gasoline prices.

Additionally, we have reason to believe that the cost of EVs will continue to fall over the next several years. The majority of an EV's higher initial cost is due to its expensive lithium-ion battery pack, but lithium-ion battery costs have fallen by half since 2008, and are still falling rapidly. The electric car company Tesla has announced that it will raise up to $5 billion to build the world's biggest "Giga factory" to manufacture lithium-ion batteries, with a launch date in 2017. The factory is expected to produce more lithium-ion batteries in 2020 than were produced worldwide in 2013, and reduce battery costs by 30%. This will make EVs an even better investment than this analysis indicates.

For another point of reference, a Silicon Valley product manager with a Harvard MBA recently performed a very similar NPV analysis comparing 11 different vehicles, using substantially similar assumptions and a gasoline price forecast that is close to the "Nelder" price scenario. He found that over 8 years, a $93,000 Tesla Model S85 (an all-electric, high-performance vehicle with a range of 250 miles) costs $16,000 less to own than a $56,000 gasoline Odyssey minivan.[5]

The full set of results suggests that within the next two years, electric vehicles like the Leaf could become cheaper to own than gasoline vehicles in the same class, when the likely trajectory of fuel costs is properly considered. Taking a "business-as-usual" outlook on fuel prices could lead the state to buy vehicles that are more expensive to own.

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[4] http://insideevs.com/nissan-leaf-price-now-cheaper-japan/

[5] Summary: http://www.teslacost.com/home Spreadsheet model: http://bit.ly/1kqQ2SM

Chevrolet Caprice vs. Chevrolet Tahoe

A 2014 Chevrolet Caprice was compared to a 2014 Chevrolet Tahoe SSV (an SUV with 4WD). Both have conventional gasoline V-8 engines and are equipped with “PPV” police packages.

The following assumptions were made for both vehicles:

- Police pursuit use.
- Driven 25,000 miles per year.
- Retired at 100,000 miles (4 years).
- Fuel economy ratings were for combined city/highway driving per the EPA, and taken from manufacturer’s specifications.
- Initial vehicle costs were supplied by DBM, and are for 2014 vehicle prices.
- Maintenance costs were set at $1,767 per year, which is the average annual cost of maintenance in Years 2 - 5 for five Crown Victoria vehicles in the Maryland State Police fleet. A sufficiently large and accurate data set for the maintenance costs of Tahoe vehicles in the state police fleet was not available, so the same figures were used for the Tahoe analysis. However, it would be reasonable to assume that the real maintenance costs of the Tahoe SUV would be higher than those of sedans.

Trend model

The cash flows under the Trend retail gasoline price forecast comparison are as follows:

Discount rate	5%			
Make & model		**2014 Chevy Caprice V8**		**2014 Chevy Tahoe SSV**
Use type		State police		State police
Vehicle type		3C - Police Sedan, Identified, MSP paint		10P - Full Size Utility, cert. police pursuit
Initial cost		$28,656		$28,861
Miles/yr		25,000		25,000
Retirement age		100,000		100,000
Years of service		4		4
Maintenance/yr		$1,767		$1,767
Insurance/yr		$300		$300
MPG (combined)		18		17
fuel (gals/yr)		1,389		1,471
salvage value		$500		$500
Cash flows				
2014		$(8,040)		$(8,391)
2015		$(8,643)		$(9,030)
2016		$(9,296)		$(9,721)
2017		$(9,520)		$(9,987)
NPV		$(60,014)		$(61,657)
per mile		$(0.60)		$(0.62)

Table 4 NPV of Caprice vs. Tahoe: Trend Model

Under the Trend-based retail gasoline price forecast, the total cost of ownership over four years for the Tahoe is $1,643 higher than the Caprice, at $0.62/mile vs. $0.60/mile.

Under the Trend-based DGS gasoline price forecast, the total cost of ownership over four years for the Tahoe is $1,707 higher than the Caprice, at $0.63/mile vs. $0.61/mile.

Nelder model

The cash flows under the Nelder retail gasoline price forecast are as follows:

Discount rate	5%			
Make & model		**2014 Chevy Caprice V8**		**2014 Chevy Tahoe SSV**
Use type		State police		State police
Vehicle type		3C - Police Sedan, Identified, MSP paint		10P - Full Size Utility, cert. police pursuit
Initial cost		$28,656		$28,861
Miles/yr		25,000		25,000
Retirement age		100,000		100,000
Years of service		4		4
Maintenance/yr		$1,767		$1,767
Insurance/yr		$300		$300
MPG (combined)		18		17
fuel (gals/yr)		1,389		1,471
salvage value		$500		$500
Cash flows				
2014		$(7,119)		$(7,416)
2015		$(7,592)		$(7,917)
2016		$(8,584)		$(8,968)
2017		$(8,666)		$(9,084)
NPV		$(56,867)		$(58,325)
per mile		$(0.57)		$(0.58)

Table 5 NPV of Focus vs Leaf: Nelder Model

Under the Nelder-based retail gasoline price forecast, the total cost of ownership over four years for the Tahoe is $1,458 higher than the Caprice, at $0.58/mile vs. $0.57/mile.

Under the Nelder-based DGS gasoline price forecast, the total cost of ownership over four years for the Tahoe is $1,740 higher than the Caprice, at $0.63/mile vs. $0.62/mile.

EIA model

The cash flows under the EIA retail gasoline price forecast are as follows:

Discount rate	5%			
Make & model		**2014 Chevy Caprice V8**		**2014 Chevy Tahoe SSV**
Use type		State police		State police
Vehicle type		3C - Police Sedan, Identified, MSP paint		10P - Full Size Utility, cert. police pursuit
Initial cost		$28,656		$28,861
Miles/yr		25,000		25,000
Retirement age		100,000		100,000
Years of service		4		4
Maintenance/yr		$1,767		$1,767
Insurance/yr		$300		$300
MPG (combined)		18		17
fuel (gals/yr)		1,389		1,471
salvage value		$500		$500
Cash flows				
2014		$(2,517)		$(2,543)
2015		$(2,530)		$(2,557)
2016		$(2,544)		$(2,572)
2017		$(2,059)		$(2,088)
NPV		$(37,239)		$(37,542)
per mile		$(0.37)		$(0.38)

Table 6 NPV of Focus vs Leaf: EIA Model

Under the EIA-based retail gasoline price forecast, the total cost of ownership over four years for the Tahoe is $303 higher than the Caprice, at $0.38/mile vs. $0.37/mile.

Under the EIA-based DGS gasoline price forecast, the total cost of ownership over four years for the Tahoe is $1,210 higher than the Caprice, at $0.54/mile vs. $0.53/mile.

Results Discussion

Under all six gasoline price forecasts, the Chevrolet Tahoe was more expensive to own over four years than the Chevrolet Caprice.

However, as discussed above, the maintenance costs for the Tahoe in this analysis were set at the same level as the Caprice due to a lack of sufficient maintenance data on Tahoes used by the Maryland State Police. MotorTrend and Edmunds do not offer maintenance costs forecasts for the Caprice, so it was not possible to obtain an alternative set of maintenance data from those sources. But it would be reasonable to assume that the real maintenance costs of the Tahoe would be higher than those of the Caprice, because maintenance is generally more expensive for SUVs than for sedans.

Due to the low fuel efficiency of both vehicles, the four-year total cost of ownership for both vehicles is particularly sensitive to the differences in the gasoline price forecasts, as shown in Table 7. The NPV cost of ownership over four years can be more than twice the initial cost of the vehicle.

Vehicle	Lowest cost (EIA-based forecast for Maryland retail gasoline prices)	Highest cost (Nelder-based forecast for Maryland DGS gasoline prices)
Caprice	$37,239	$61,664
Tahoe	$37,542	$63,404

Table 7 Caprice vs. Tahoe: Lowest and highest costs

Accordingly, the analysis suggests that:

1. Maryland could save money by preferring the Caprice over the Tahoe for state police use wherever possible.
2. In the future, selecting vehicles with higher fuel efficiency could deliver significant savings and reduce the risk of the state's exposure to rising oil prices.

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