

20 March 2015

Shane Melotte
Director
Moreland City Council
smelotte@moreland.vic.gov.au

Dear Shane

Subject: Moreland City Council – Alterations to Electric Vehicle Cost Benefit Analysis

As outlined in our discussions of 24-25 February, please find below additional analysis as requested to the electric vehicle feasibility study for Moreland City Council (Council).

Key Findings

The analysis found that the net present value (NPV) of a Leaf at five years for operation within Councils fleet is higher than that of a Hybrid or standard Camry (\$2,300 and \$18,600 respectively at 7% discount rate).

In the scenario modelled, the NPV of the Leaf option is positive in comparison to the Hybrid and Camry options even if electricity prices were to rise to 16c/kWh.

Assumptions

I have maintained the previous assumptions, as per the original report and as provided by Council's Fleet manager, including:

- Annual kilometres travelled 20,000km
- Capital cost of Nissan Leaf to Council \$36,000
- Capital cost of Hybrid Camry to Council \$26,000
- Capital cost of Camry to Council \$30,490
- Conventional vehicle annual cost of maintenance \$670
- Nissan Leaf annual maintenance as per Appendix B of the original report, where Council receive the first year complimentary
- Price of petrol as per the average price Council is currently paying \$1.48 per litre
- Council's price of electricity \$0.10/kWh
- Average Hybrid fuel consumption of 7.76L/100km
- Average Camry fuel consumption of 14.4L/100km
- Average Leaf consumption of 150W/hr

In addition to assuming the following:

- Based on Glass's guide for a 2015 vehicle having travelled 100,000km in five years:
 - Trade in value for Nissan Leaf \$13,700
 - Trade in value for Hybrid Camry \$10,800
 - Trade in value for Camry \$5,700
- Premium price for Camry registration of \$100 (electric vehicles and hybrids receive \$100 discount with VicRoads)
- Cost of an eligible NCOS offset at \$1.50 (as per the current price Council pays). It has been assumed that this applies to any offset requirement, greenpower has not been included.
- Recharge infrastructure cost of \$14,000 as advised by Council

Updated Cost Benefit Analysis

Table 1 and Table 2 below provide an update on Table 9 and Table 10 provided in the report titled '*Electric Vehicle Feasibility Study August 2014*' – extending them to be for a five-year period and including a comparison to a standard Camry.

To conduct a comparative cost benefit analysis all parameters are assumed equal, accordingly the below analysis assumes all vehicles travel 20,000km and are traded in at year 5. As per the original report a

conservative approach is used (i.e. the true NPV is likely to be higher than estimates), as it does not take into consideration increasing fuel prices, the cost of carbon (which is included in the following section), any avoided health costs to society, or the corporate social responsibility image benefit to Council from its constituents.

Table 1 – Updated Table 9 from Report to be for five years (vs. three years) and include a comparison to a standard Camry

	2015	2016	2017	2018	2019
BASE 1 (Camry Hybrid)					
Costs (Money Out)					
Capital	\$26,000				
Maintenance	\$670	\$670	\$670	\$670	\$670
Fuel	\$2,297	\$2,297	\$2,297	\$2,297	\$2,297
Benefits (Money In)					
Income & convenience	Assumed equal				
Re-sale value					\$10,800
BASE 2 (Camry)					
Costs (Money Out)					
Capital	\$30,490				
Maintenance	\$670	\$670	\$670	\$670	\$670
Fuel	\$4,262	\$4,262	\$4,262	\$4,262	\$4,262
Rego Premium	\$100	\$100	\$100	\$100	\$100
Benefits (Money In)					
Income & convenience	Assumed equal				
Re-sale value					\$5,700
Nissan Leaf					
Costs (Money Out)					
Capital	\$36,000				
Maintenance		\$438	\$358	\$438	\$358
Fuel	\$300	\$300	\$300	\$300	\$300
Benefits (Money In)					
Income & convenience	Assumed equal				
Re-sale value					
Extra Cost of Leaf to Hybrid	\$7,333	(\$2,229)	(\$2,309)	(\$2,229)	(\$2,309)
Extra Benefit of Leaf to Hybrid	\$0	\$0	\$0	\$0	\$2,900
Net Present Value	\$4,641				
Extra Cost of Leaf to Camry	\$778	(\$4,294)	(\$4,374)	(\$4,294)	(\$4,374)
Extra Benefit of Leaf to Camry	\$0	\$0	\$0	\$0	\$8,000
Net Present Value	\$24,558				

Table 2: Updated Table 10 from the Report to be for a five year (vs three years) NPV comparison of Leaf to Hybrid and Camry

NPVs	5%	7%	10%
Leaf v Hybrid	\$2,946	\$2,392	\$1,666
Leaf v Camry	\$20,161	\$18,693	\$16,744

Carbon Abatement Projections

Moreland City Council is carbon neutral and accordingly, the cost of carbon offsets required to be purchased for the above vehicles should be included.

Adopting the above parameters (i.e. 20,000km and the recorded fuel consumption rates), and using the National Greenhouse Accounting Factors, Table 3 below provides the comparative tonnes of carbon dioxide equivalent (CO_{2-e}), and the corresponding cost to offset.

Table 3: Comparative Emission Productions

Vehicle	Tonnes CO _{2-e} /year (assumed 20,000km)	Estimated Cost of Offsetting
Nissan Leaf using 100% renewable	0	\$0
Nissan Leaf using Victorian Grid Power	3.54 tonnes	\$5.31
Camry Hybrid	3.69 tonnes	\$5.54
Camry	6.85 tonnes	\$10.28

Council avoids in the order of 6.85 tonnes CO_{2-e} per year for every standard Camry replaced by a Leaf using renewables, and in the order of 3.69 tonnes CO_{2-e} per year for every Camry Hybrid replaced with a Leaf using renewables (more if vehicles travel further than 20,000km), which will save Council between approximately \$5-10 per year per vehicle on carbon offsets.

Accordingly, the corresponding Net Present Value for the Leaf compared to the Hybrid and the Camry is given below, where the numbers have been generated for the Leaf using (a) renewables (direct from Councils photovoltaics), and (b) the grid.

Table 4: Five year NPV comparisons including offset purchases

NPVs	5%	7%	10%
Leaf V Hybrid			
Leaf on renewables	\$2,970	\$2,414	\$1,687
Leaf on Grid	\$2,947	\$2,392	\$1,667
Leaf V Camry			
Leaf on renewables	\$20,205	\$18,735	\$16,783
Leaf on Grid	\$20,182	\$18,713	\$16,763

The numbers above, indicate a financial saving for the purchase of a Leaf when compared to a Hybrid or Camry regardless of whether the Leaf is charged via renewables.

Scenario Model

A method for estimating the benefit of purchasing more than one Leaf in comparison compared to a Hybrid or standard Camry would be to multiply the number of vehicles replaced by the numbers provided above in Table 4.

The model below looks in more detail at the proposed scenario for introducing additional Nissan Leafs, no additional recharge station is deemed required, as the Leafs can be charged from the existing stations and through a standard power point if required..

Namely, if Council are wishing to introduce two new vehicles each year, a comparison has been made between the following scenarios:

- Two new Leafs purchased every year for five years, vehicles traded in after five years.
- Two new hybrids purchase every year for five years, vehicles traded in after three years (and replaced)
- Two new Camrys purchased every year for five years, vehicles traded in after three years (and replaced).

Table 5 below, presents the net present value comparing the leaf scenario to the Hybrid and Camry scenario for the Leaf using (a) renewables (Councils photovoltaics), and (b) the grid.

Table 5: Five year NPV comparisons for proposed scenario of 2 additional

NPV after 5 years	5%	7%	10%
Leaf v hybrid	\$13,991	\$10,390	\$5,828
Leaf v hybrid inc offsets			
Leaf on renewables	\$14,130	\$10,520	\$5,946
Leaf on Grid	\$13,997	\$10,396	\$5,833
Leaf v Camry	\$183,532	\$167,961	\$166,415
Leaf v Camry inc offsets			
Leaf on renewables	\$186,303	\$170,552	\$166,415
Leaf on Grid	\$186,170	\$170,427	\$149,754

Additionally, Council have requested that the above scenario be looked at if the price of electricity was 12c/kWh, 14c/kWh and 16c/kWh. This is presented in Table 6 below.

Table 6: Five year NPV comparisons without the purchase of the additional recharge infrastructure and electricity at 12c, 14c, 16c

NPV after 5 years	12c/kWh			14c/kWh			16c/kWh		
	5%	7%	10%	5%	7%	10%	5%	7%	10%
Leaf v hybrid	\$11,969	\$8,496	\$4,105	\$9,947	\$6,602	\$2,382	\$7,925	\$4,707	\$658
Leaf v hybrid inc offsets									
Leaf on renewables	\$12,108	\$8,626	\$4,223	\$10,086	\$6,732	\$2,500	\$8,064	\$4,837	\$776
Leaf on Grid	\$11,975	\$8,501	\$4,110	\$9,953	\$6,607	\$2,387	\$7,930	\$4,713	\$663
Leaf v Camry	\$181,509	\$166,066	\$164,692	\$179,487	\$164,172	\$162,968	\$177,465	\$162,278	\$161,245
Leaf v Camry inc offsets									
Leaf on renewables	\$184,281	\$168,657	\$148,144	\$182,259	\$166,763	\$146,421	\$180,237	\$164,869	\$144,698
Leaf on Grid	\$184,148	\$168,533	\$148,031	\$182,126	\$166,638	\$146,308	\$180,104	\$164,744	\$144,584

Conclusion

A Nissan Leaf operating in Council's fleet has a higher five year NPV than a Hybrid (in the order of \$2,300) or standard Camry (in the order of \$18,600).

When modelling the possible growth scenarios of increasing the fleet by two additional vehicles per year for five years:

- the option for these new vehicles to be Leafs produces a positive NPV in comparison to the option for the new vehicles to be Camrys (in the order of \$170,000); and
- the option for these new vehicles to be Leafs produces a positive NPV in comparison to the option for the new vehicles to be Hybrids (in the order of \$10,000).

An increase in the price of electricity, while lowering the benefit of the leaf, still results in a positive NPV for all scenarios, indicating that the investment in the Leafs relative to the Camry and Hybrid option is sound.

Should you have any additional queries please do not hesitate to contact me on 9865 1400.

Yours faithfully,



Hannah Meade
Principal
Ndevr Environmental
hannah.meade@ndevr.com.au