IN CONFIDENCE

Report: PHEV evaluation

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INTERNAL AFFAIRS
Te Tari Taiwhenua

New Zealand Government

Disclaimer

This evaluation was designed to ensure that a fair and unbiased evaluation was completed on the BMW 740Le Plug in hybrid electric vehicle (PHEV).

Results may vary depending on different evaluators, weather conditions, traffic conditions, road works or any other unforeseen events.

Information gathered in this report is as accurate as possible; evaluators have tried to ensure that results are as close as practicable to the evaluation that took place on the day.

Foreword

In January 2017 BMW New Zealand supplied VIP Transport Service with a BMW 740Le Plug in Hybrid Electric 7 series (PHEV) to evaluate.

The evaluation was commissioned to appraise the operational effectiveness of the PHEV against the currently used BMW 7 series (G12) diesel.

The PHEV was evaluated by a number of personnel within VIP Transport Service to ensure that the vehicle is fit for purpose.

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Executive Summary

Over the first half of 2017 VIP Transport (VIPT) conducted a performance evaluation on a BMW 740Le Plug in Hybrid Electric Vehicle (PHEV).

The overall evaluation results determined that the PHEV's performance was very similar to the current BMW 7 series (G12) in relation to fuel economy within an urban environment.

The G12 diesel was more fuel efficient when utilised on the open road. General feedback from the evaluators on the performance of the PHEV was positive; however a recurring theme emerged around the range of the electric motor. Most of the evaluators enjoyed the electric motor experience but stated that the range was disappointing. Generally the electric motor operated for a range of between 30-35kms.

A few of the evaluators commented about the noise of the petrol engine being noisier than the diesel engine.

At the conclusion of the evaluation there were some outstanding questions that needed to be addressed (refer page 28) before the PHEV was considered for operational use in the VIPT fleet. Subsequent engagement with BMW New Zealand & internal stakeholders addressed these issues to the satisfaction of the reviewers.

Overall the PHEV was an impressive vehicle, it handled exceptionally well, partly due to the inclusion of the XDrive system. The smaller 2.0L engine, while a little down on power compared with the 7 series (G12), had ample power for what is required for operational use

The overall conclusion is that the BMW 740Le Plug in Hybrid Electric Vehicle (PHEV) is suitable for inclusion into the broader limo fleet as an enhancement of the existing diesel powered vehicles, rather than a complete replacement. This is due to the need for vehicles with ranges greater than the PHEV can currently deliver, offset against the desire to have a more environmentally sustainable long-term solution.

Evaluation Methodology

Four evaluations were conducted using the PHEV which included.

1. **Open road testing**

   This evaluation tested the PHEV's performance and dynamics on the open road. A fuel comparison evaluation between the BMW 7 series G12 and the BMW 740Le was also conducted during this phase.

2. **Urban environment testing**

   This evaluation tested the PHEV's ability to perform within a city environment. The vehicle was tested over a number of drives both with and without an electric motor recharge.

   A fuel comparison evaluation between the BMW 7 series G12 and the BMW 740Le was also conducted during this phase.

3. **Closed road testing**

   This evaluation tested the PHEV's ability to react to road hazards at high speeds as well as the vehicle's general handling characteristics. The ability for the vehicle to perform effectively during a security incident was also evaluated during this phase.

4. **VIP Transport Depot testing**

   This evaluation required a selected group of chauffeurs from the three main regions to test the PHEV on the front line. This evaluation was designed to assess the vehicles operational effectiveness compared to the current BMW 7 series (G12).

Results – Performance Testing 001

Open road

Objective

Evaluation 001 was designed to compare the handling performance and fuel usage between the BMW 7 series G12 (Diesel) currently used by VIP Transport Service and the BMW 740Le series Plug in Hybrid Electric vehicle (PHEV).

The evaluation was conducted using open road environments which comprised of motorway, open road and city areas.

001 - Test Methodology

Route

Two test routes were used for these evaluations. The first route began in Wellington and ended in Taihape; the second route began in Taihape and ended in Wellington.

The route was designed to evaluate the vehicle's performance over a number of different driving situations including;

1. A combination of different speed zones including 50, 70, 80 and 100km/h areas,
2. Roadworks,
3. Urban and open road environments.

Results disclaimer

The information contained in the evaluation 001 summary report is as accurate as possible, both evaluators ensured they followed the same evaluation route at all times and where possible were separated by an approx 5 minute time period.

Slight variations in the overall results may result from weather conditions, density of traffic and time of departure during each of the evaluations.

Information may also change slightly due to the altitude changes between Wellington and Taihape. According to *evevationmap.net* Wellington has an altitude of 13m above sea level, were as Taihape has an altitude of 438m. This being the case it would be expected that the fuel consumption will increase on the drive from Wellington to Taihape. Subsequently it would be expected that the fuel consumption will decrease on the return drive.

Pre- evaluation administration

Prior to the commencement of the testing evaluators were instructed to ensure that the vehicles were formatted in the following configuration;

BMW 740Le

- The PHEV had a 100% full electric charge,
- The vehicle had a full tank of fuel,
- The trip computer and odometer was reset to zero,
- The vehicle was set in "comfort mode",
- Tyre pressures had been set to the manufacture's specification.

BMW 7 series G12

- The vehicle had a full tank of fuel,
- The trip computer and odometer was reset to zero,
- The vehicle was set in "comfort mode",
- Tyre pressures had been set to the manufacture's specification.

Testing

Three tests were carried out on the PHEV, 2 from Wellington to Taihape and 1 from Taihape to Wellington. The BMW 7 Series G12 was also driven over the same route in order to gain some fuel use information which was used when comparing the two vehicles.

Test 1

Test 1 departed Wellington for Taihape with the PHEV set in "Max eDrive" mode. This mode means that the vehicle is exclusively electrically driven. The petrol engine will only engage when the electric charge has been fully depleted. The vehicle had a full (100%) charge prior to departing the start location.

Test 2

Test 2 departed Wellington for Taihape with the PHEV set in "Auto eDrive" mode. This mode allows the vehicle to change between electric and petrol power sources depending on the driving situation. The vehicle had a full (100%) charge prior to departing the start location.

Test 3

Test 3 departed Taihape for Wellington with the PHEV set in "Auto eDrive" mode. This mode allows the vehicle to change between electric and petrol power sources depending on the driving situation. The vehicle had a zero (0%) charge prior to departing the start location.

Performance

The PHEV handled very well during the evaluation. Even when the vehicle was set in "Comfort" mode it still handled very well. There was no reduction in performance with the smaller 2.0L petrol engine.

Fuel Consumption

The BMW G12 had a slightly better fuel consumption on the journey from Wellington to Taihape averaging an average 6.2 L/100km compared to the PHEV which recorded a 6.7 and 6.5 L/110km during its two tests.

Out of the two evaluations conducted on the PHEV it appears that the vehicle performed better in the "Auto eDrive" setting on the open road with an average of 6.2L/100km fuel consumption.

Zero Fuel Kilometres

Test 1 (Max eDrive)
The PHEV used zero fuel for a total of 23.5k which equates to approx 10% of the total journey.

Test 2 (Auto eDrive)
The PHEV used zero fuel for a total of 43.1k which equates to approx 19% of the total journey.

Test 3 (Auto eDrive)
The PHEV used zero fuel for a total of 26.5k which equates to approx 11% of the total journey.

Fuel Usage

On the test route from Wellington to Taihape the BMW G12 used less fuel than the PHEV

BMW G12	14.82L	
PHEV	15.83	(Test 1 Max eDrive)
	16.12L	(Test 2 Auto eDrive)

Likewise on the journey from Taihape to Wellington the BMW G12 proved to use less fuel

BMW G12	11.24L	
PHEV	13.35L	(Test 3 Auto eDrive)

Total Cost of Fuel

After refuelling the vehicles the evaluators were asked to record the cost of the fuel.

Once Road user charge (RUC) was added to the overall cost of the diesel fuel the vehicle fuel cost between vehicles was significantly different.

The BMW G12 was the most cost effective vehicle out of the two vehicles that were tested however over a distance of approx 229 kilometres the maximum dollar amount between the two vehicles was $14.54.

RUC Calculation

To add RUC charge to the diesel fuel dollar amount the evaluator used the Ministry of Transport online calculator.

http://www.transport.govt.nz/land/roadusercharges/online-ruc-calculator/

Evaluation 001 – Results table

Evaluation route	Wellington to Taihape			Taihape to Wellington	
Vehicle type	**BMW 7 series G12** ***3.0 Diesel***	**BMW 740Le** ***2.0L Petrol/electric***	**BMW 740Le** ***2.0L Petrol/electric***	**BMW 7 series G12** ***3.0 Diesel***	**BMW 740Le** ***2.0L Petrol/electric***
Level of battery charge prior to commencement	N/A (Diesel)	100%	100%	N/A (Diesel)	0%
Vehicle setting	N/A (Diesel)	Max eDrive *The vehicle is exclusively electrically driven. Engine only engages when electric charge is fully depleted.*	Auto eDrive *This setting allows the vehicle to change between electric and petrol engine depending on the driving situation.*	N/A (Diesel)	Auto eDrive
Fuel consumption (L/100km)	6.2	6.7	6.5	5.4	6.2
Kilometres travelled	228.2	229.8	229.7	230.7	231.8
Number of kilometres achieved using zero fuel *(electric drive only)*	N/A (Diesel)	23. 5	43.1	N/A (Diesel)	26.5
Remaining kilometres until the fuel tank is empty	1033 *fuel tank size = 78Litres*	368 *fuel tank size = 46 Litres*	370 *fuel tank size = 46 Litres*	1227 *fuel tank size = 78Litres*	453 *fuel tank size = 46 Litres*
Type of fuel used when refuelling	Diesel	98 Octane	98 Octane	Diesel	95 Octane
Total litres used for evaluation	14.82L	15.83L	16.12L	11.24L	13.35L
Cost of fuel per litre at the fuel pump	$1.21.9	$2.25.9	$2.25.9	$1.38.9	$2.17.9
Cost to refuel the vehicle to full tank of fuel	$18.07 excluding RUC	$35.77	$36.41	$15.61 excluding RUC	$29.09
Including RUC	$21.87			$19.46	

***Note**- RUC costs of 0.6c per kilometre was added to the fuel cost based on the figures obtained by http://www.transport.govt.nz/land/roadusercharges/online-ruc-calculator/*

Results – Performance Testing 002

Urban environment evaluation

Objective

Evaluation 002 was designed to compare the performance and fuel usage between the BMW 7 series G12 (Diesel) currently used by VIP Transport Service and the BMW 740Le series plug in hybrid (PHEV).

The evaluation was conducted within the greater Wellington area using 20, 50 and 70kph speed zones.

The evaluation was conducted during daylight hours starting at 0730 on all allocated evaluation days. The start time enabled the evaluators to test the vehicles within both light and medium traffic conditions.

Test Methodology

Route

Both vehicles were tested using the exact same route.

Both vehicles completed a total of six circuits of the route pausing for a period of 30 minutes in between circuits (where necessary) to allow for a short electrical charge for the plug in hybrid vehicle (PHEV).

The start point of the evaluation was Zealandia wildlife reserve, 53 Waiapu Rd, Karori. This point was selected due to having x3 Electric Vehicle (EV) charging stations available for use.

Pre-evaluation administration

Prior to the commencement of the testing evaluators were instructed to ensure that the vehicles were formatted in the following configuration;

BMW 740Le

- The PHEV had a 100% full electric charge,
- The vehicle had a full tank of fuel,
- The trip computer and odometer was reset to zero,
- The vehicle was set in "Comfort" mode,
- Tyre pressures had been set to the manufacture's specification.

BMW 7 series G12

- The vehicle had a full tank of fuel,
- The trip computer and odometer was reset to zero,
- The vehicle was set in "Comfort" mode,
- Tyre pressures had been set to the manufacture's specification,
- The "Auto Stop" function is activated.

Testing

Two tests were carried out on the PHEV.

Test 1

Replicated a scenario where a vehicle was required to complete six journeys with only a short time *(30 minutes)* to recharge the vehicle between journeys. Evaluators ensured that the vehicle had a full (100%) electrical charge prior to departing the first location.

On the first six journeys the vehicle was set in "Auto eDrive" and for the second set of six journeys the vehicle was set in "Max eDrive".

Test 2

Replicated a scenario where a vehicle was required to complete six journeys and did not have an opportunity to recharge the vehicle in between.

On the first six journeys the vehicle was set in "Auto eDrive" and for the second set of six journeys the vehicle was set in "Max eDrive".

Both evaluators followed the allocated route identified in their instruction sheet prior to returning to Zealandia.

Detailed route outline

Route 1, 3 and 5

- Depart Zealandia and turn right onto Chaytor St
- Turn right at the roundabout onto Glenmore St continues into Tinakori Rd
- Turn right of Tinakori Rd on Bowen St
- Continue along Bowen onto Whitmore St
- Turn right from Whitmore onto Waterloo Quay which becomes Customhouse Quay then Jervois Quay
- Turn left onto Cable St
- Turn left onto Oriental Parade which becomes Evans Bay Parade until Cobham Drive
- Turn Left onto Cobham Drive; turn right at the second major roundabout onto Calabar Rd
- Follow Calabar Rd and turn left at the roundabout onto Stewart Duff drive
- Enter the Wellington airport through the Northern ticket booth
- Loop around the Wellington airport drop off route and exit the airport through the Northern exit gates onto Stewart Duff Drive
- Turn right from Stewart Duff drive onto Calabar Rd
- Turn left at the major roundabout onto Cobham drive
- Turn right onto Evans Bay Parade and continue around Oriental Bay to Wakefield St
- Turn right onto Wakefield St
- Continue along Wakefield St which turns into Jervois Quay then Waterloo Quay
- Turn left into Whitmore St continue straight ahead onto Bowen St
- Turn left from Bowen St onto Tinakori Rd which becomes Glenmore St
- Turn left at roundabout onto Chaytor St
- Turn first left after tunnel into Waiapu Rd
- Finish at Zealandia carpark

Route 2, 4 and 6

- Depart Zealandia and turn right onto Chaytor St
- Turn right at the roundabout onto Glenmore St continues into Tinakori Rd
- Turn right of Tinakori Rd on Bowen St
- Continue along Bowen onto Whitmore St
- Turn right from Whitmore onto Waterloo Quay which becomes Customhouse Quay then Jervois Quay
- Follow the road left onto Cable St
- Turn right onto Kent Terrace
- Turn left at Basin reserve and proceed through the Mount Victoria tunnel
- Follow the road to the right onto Ruahine St
- Follow the road to the left and merge with Cobham drive
- Turn right at the second major roundabout onto Calabar Rd
- Follow Calabar Rd and turn left at the roundabout onto Stewart Duff drive
- Enter the Wellington airport through the Northern ticket booth
- Loop around the Wellington airport drop off route and exit the airport through the Northern exit gates onto Stewart Duff Drive
- Turn right from Stewart Duff drive onto Calabar Rd
- Turn left at the major roundabout onto Cobham drive
- Turn right onto Ruahine St and through the Mount Victoria Tunnel
- Follow SH 1 around the Basin reserve taking the forth exit on the left onto Cambridge Terrace
- Turn left onto Wakefield St
- Continue along Wakefield St which turns into Jervois Quay then Waterloo Quay
- Turn left into Whitmore St continue straight ahead onto Bowen St
- Turn right into Museum St
- Conduct a U turn in dock way on right hand side before barriers
- Turn right from Museum St onto Bowen St
- Turn left from Bowen St onto Tinakori Rd which becomes Glenmore St
- Turn left at roundabout onto Chaytor St
- Turn first left after tunnel into Waiapu Rd
- Finish at Zealandia carpark

Evaluation 002 – Results table

Figures presented in this table are an average over 6 separate journeys.

		100% full electric charge at start of evaluation ***30 minute charge in-between evaluations***		100% full electric charge at start of evaluation ***No charge in-between evaluations***	
	BMW G12	**PHEV**	**PHEV**	**PHEV**	**PHEV**
		Auto eDrive	**Max eDrive**	**Auto eDrive**	**Max eDrive**
Average fuel consumption L/100k	7.75 L/100k	5.03 L/100k ***Special note:*** *with a full electric charge prior to the first journey the PHEV used 0 litres of fuel*	5.03 L/100k ***Special note:*** *with a full electric charge prior to the first journey the PHEV used 0.5 litres of fuel*	6.21 L/100k ***Special note:*** *with a full electric charge prior to the first journey the PHEV used 0 litres of fuel*	6.65 L/100k ***Special note:*** *with a full electric charge prior to the first journey the PHEV used 0 litres of fuel*
Average speed	31.28 kph	31.75 kph	32.05 kph	30.09 kph	32.85 kph
Total drive time	5.06 hours	5.25 hours	5.06 hours	5.15 hours	4.85 hours
Total drive distance	155.7 Kilometres	156.9 kilometres	154.6 kilometres	152.5 Kilometres	156.8 kilometres
Total amount of fuel used	11.41 Litres	7.94 Litres	8.36 Litres	9.8 Litres	9.92 Litres
Type of fuel	Diesel	98 Octane	98 Octane	98 Octane	98 Octane
Cost of fuel per litre.	$1.36 per litre	$2.23 per litre	$ 2.23 per litre	$2.23 per litre	$2.23 per litre
Cost $ of fuel for the evaluation (excluding RUC)	$15.63	$17.78	$18.72	$21.96	$22.21
Including RUC	$18.26				

General comments

- With the vehicle set in "Max eDrive" mode and having the vehicle fully charged (100%) the evaluator was able to complete journey 1 using 0.5 Litres per 100k, and on the second journey no fuel was used.
- The above results would change dramatically if the PHEV was fully charged prior to each journey, potentially no fuel would be used.
- With the vehicle set in "Auto eDrive" mode and having the vehicle fully charged (100%) the evaluator was able to complete the both first journeys using no fuel
- To add RUC charge to the diesel fuel dollar amount the evaluator used the Ministry of \Transport online calculator, 0.06c per kilometre. http://www.transport.govt.nz/land/roadusercharges/online-ruc-calculator/

Results – Performance Testing 003

Closed road evaluation

Objective

The PHEV was tested using a closed road being Manfield Auto course located in Fielding. The evaluation had a twofold purpose being;

. 1 To evaluate all the safety features such as ABS, ESC and traction control,

. 2 Evaluate the PHEV's overall ability to performance the role satisfactorily during a security incident.

The weather on the evaluation day was fine which meant that all of the results listed below were completed on a dry road surface.

The evaluation followed the same format as the all of Government tender process carried out in 2015. The following areas were evaluated during the day;

1. Electronic Stability control
2. ABS Braking
3. Reversing
4. Transmission evaluation
5. Hazard avoidance exercise evaluation
6. Cornering / vehicle dynamics.

Test Methodo ogy - E ectronic Stabi ity Control (ESC)

The PHEV was tested using four scenarios where the ESC may activate

Methods 1 and 2 – Understeer correction

This method was designed to evaluate the performance of the ESC system in the event the driver becomes distracted and enters the corner at a speed higher than the safe corner speed.

Method 1 and 2 will test the PHEV's ability to negotiate the corner with and without the use of the braking system; this is to take into account differing driver reactions during an emergency.

Method 3 – Oversteer correction

Method 3 was designed to evaluate the performance of the ESC system in the event the driver's acceleration application exceeds the vehicles grip level when exiting the corner.

Method 4 – Driver error (vehicle drifts off the road)

The fourth method has been designed to evaluate the performance of the ESC programme in the event that the driver temporally drops the left side wheels of the vehicle onto a grass or any other such low friction surface.

Test Methodology - Anti-Lock Braking System (ABS)

Evaluation Objective

To evaluate the PHEV's ability to negotiate a hazard during an emergency ABS braking situation.

The PHEV was evaluated at three different speeds 100kph, 110kph and 120kph. The PHEV was tested at higher than road legal speeds due to the exception under the Land Transport (Road User) Rule 2004, clause 5.1 3 (c).

In the unlikely event that this clause is invoked VIPT must be satisfied that the PHEV is able to stop safely at higher speeds.

Test Methodology - Reversing

Evaluation objective

To assess the PHEV's stability and performance while reversing at speed also ensuring that the vehicle can complete a U-turn within a tight radius.

Test Methodology - Transmission Evaluation

Evaluation objective

To assess the transmission's ability to rapidly change gear from drive (D) to reverse (R).

Test Methodology - Hazard Avoidance Evaluation

Evaluation objective

To assess the ability and stability of the PHEV when negotiating a road hazard at different speeds.

Test Methodology - Cornering / Vehicle Dynamics

Evaluation objective

To assess the PEV's ability to safely negotiate a series of corners at increasing speeds. To assess the braking steering, seating and stability over a set period of time.

Evaluation Feedback

Electronic stability control (ESC)

Method 1 & 2	The PHEV performed very well with this method. The ESC immediately activated at the appropriate time and the driver was able to control the vehicle well. When using the ABS and ESC the driver was able to keep the vehicle on the correct side of the road.
Method 3	The ESC programme performed as expected, the system activated promptly allowing the driver maintain control of the vehicle easily.
Method 4	The PHEV performed well on this evaluation. The driver was able to easily maintain a straight path. The vehicle was able to identify that the left wheels were on a lower friction surface than the right wheels and allocated the correct amount of ABS /ESC to the affected areas.

Anti-lock braking system (ABS)

The evaluator noted that the BMW740Le does not react as effectively as the BMW G12. Partly this could be associated with the additional 130kgs of weight that the 740Le has over the G12 (740Le = 2,000 compared to the G12s 1,870).

The evaluator was able to complete the exercise successfully using the BMW 740Le at 100kph and 110kph however could not complete a consecutive successful stop at 120kph within the exercise perimeters.

The evaluator did note that the vehicle appeared to be a little less responsive than the BMW G12.

Reversing

The evaluator was able to complete the evaluation within the required 1 minute 10 second time limit on three consecutive attempts.

Transmission evaluation

The vehicle passed this evaluation. The evaluator did notice that the vehicle needed to be almost stationary before the change of gears took place. While in normal driving conditions this is more than acceptable, during an emergency scenario any delay in the transmission means the VIP vehicle is staying in the contact area for longer.

Hazard avoidance evaluation

No issues were identified with this evaluation, the vehicle performed well and completed the evaluation easily at 80kph and 90kph.

Cornering / Vehicle dynamics

The vehicle performed well during this evaluation. The evaluator did notice a reduction in power between the 740Le petrol/electric engine and the G12 diesel engine.

This being said the BMW 740Le had ample power to deal with any situations that VIPT would require it to perform.

Results - Performance Testing 004

VIP Transport Depot testing

Objective

Performance testing 004 required the PHEV to be utilised during normal operating circumstances.

Chauffeurs were asked to use the PHEV on the front line rather than the BMW 730L G12.

The testing was conducted over a four day period and looked at fuel economy, comfort, handling / vehicle dynamics and effectiveness for operational duties.

Test Methodology

Chauffeurs were asked to complete four days of testing;

Day 1 & Day 2	The evaluation took place in an urban environment and required chauffeurs to complete three deployments on each day, on completion they were asked to record specific details relating to the vehicles performance. Chauffeurs were asked to complete the first day using the "Auto eDrive" position and the second day to change the vehicle to "Max eDrive".
Day 3	On the third day Chauffeurs were asked to repeat either day one or two exactly the same however the BMW730L G12 was to be utilised. Completing this evaluation would provide an opportunity to get a fuel usage comparison between the two vehicle models.
Day 4	Day four required the Chauffeurs to complete an open road evaluation on the PHEV.

Christchurch Feedback

Note

- Comments below are recorded as they are written in the Chauffeurs record book; they have not been adjusted or corrected.
- Some context around the answer has been added to clarify the feedback.
- Only questions that generated a response have been recorded in the feedback below.

Chauffeur call sign 90 feedback		
	Question	**Chauffeur comment**
1.2	Question 1.2 asked if the driver was able to maintain a constant speed while negotiating corners.	*Felt lighter & better balanced in cornering.*
2.1	Question 2.1 asked the chauffeur to comment on the smoothness of the vehicles transmission as it progressed through the gear range.	Answer context • 'Trans' refers to vehicle transmission. • The G12 relates to the model of the BMW currently used by VIP Transport Service. *Found the trans smoother than the G12.*
4.1	Question 4.1 asked the chauffeur to assess the vehicles body roll when cornering.	*The vehicle has a better balance overall to the G12.*

Chauffeur call sign 88 feedback		
	Question	**Chauffeur comment**
1.4	Question 1.4 asked the driver to comment on how they were able to control the amount of acceleration when exiting corners.	*Not quite as smooth as diesel.*
3.1	Question 3.1 asked to evaluate the vehicles engine braking when descending hills.	*Very little engine braking.*
3.2	Question 3.2 asked the chauffeur to comment on how effective the braking system was when coming to a stop.	*Vehicle appeared to take longer to stop than normal, especially at lower speeds to stop signs.*
General comments chauffeur 88 - *Slight front push up-hill corners.* - *Slight lag out of corner.* - *Manual shift mode sporty & responsive.*		

Chauffeur call sign 86 feedback		
	Question	**Chauffeur comment**
1.1	Question 1.1 asked about the responsiveness of the accelerator.	*Acceleration was smooth and easy to use.*
1.2	Question 1.2 asked how easy it was to maintain a constant speed when cornering.	*Excellent.*
1.3	Question 1.3 asked to evaluate the engine power when moving between higher and lower speed zones and while negotiating hills.	*Used a very windy / hilly road. Excellent hill climb / descent.*
1.4	Question 1.4 asked the chauffeur to evaluate whether they were able to control the amount of acceleration when exiting corners.	*Excellent.*
2.1	Question 2.1 asked the chauffeur to evaluate the transmissions performance.	*Very good.*
2.2	Question 2.2 asked about the performance of the transmission when "kicking down" gears.	*I passed two vehicles at different times. Kick down was smooth and easy acceleration.*
2.3	Question 2.3 asked the chauffeur to assess the "hill descent assist".	*I used manual shift to slow car due to erratic brake, driver in front. Car handled well.* ***General comment:*** *Vehicle switched to petrol mode off and on throughout journey. First 25.9 ks electric. Hill work petrol. Recharged downhill / slowing down. (Found 3 charging station) wrong types or pay stations use own charger.*
3.1	Question 3.1 asked how effectively the vehicle braking system was when descending hills.	*Used manual shift due to erratic brake driver in front vehicle.*
3.2	Question 3.2 asked the chauffeur to evaluate the brake efficiency when coming to a stop.	*Excellent very smooth.*
4.1	Question 4.1 asked the chauffeur to comment on the vehicles body roll.	*Cornered well. No excessive body roll.*
4.2	Question 4.2 asked the chauffeur to evaluate the comfort and support provided by the driver's seat.	*Excellent.*

General comments chauffeur 86

- Very difficult to find correct fast charging stations. What type of plug does BMW have? Went to Akaroa Sunday could have used own charger at a charging doc if I had RCID membership so far haven't found any charging stations with BMW fittings.? Little River had 3 different type of plug but no match. Kaikoura has charging station same as Shell in CHC wrong plug there is also one with a commando plug charging $2.00 for 2 hour and the one opposite the council 0.25 per minute. Worth asking BMW if they plan to bring out an adapter?

- Found engine noise seems rattily when it switches on around town.

- Overall a very nice vehicle. Although I don't think it is very practical for South Island work. Unless the batteries last longer and more charging points are available.

- Also would need to be a quicker charging rate. I'm surprised the vehicle doesn't charge very much when using petrol.

Wellington Feedback

Note

- Comments below are recorded as they are written in the Chauffeurs' record book; they have not been adjusted or corrected.
- Some context around the answer has been added to the feedback.
- Only questions that generated a response have been recorded in the feedback below.
- During the Wellington phase we were able to get some fuel comparison reading from two evaluators. The results below are an average between the evaluators.

	PHEV (Auto eDrive)	PHEV (Max eDrive)	BMW G12
Average Speed (kph)	34.7	41.8	34.2
Average Fuel consumption (L/100K)	5.2	5.2	7.8
Average distance travelled (K'S)	30.3	31.8	31.7
Average litres used	5.94	5.59	9.41
Average cost to refuel ($)	11.39	10.75	12.8 Inclusive RUC

Chauffeur call sign 18 feedback		
	Question	**Chauffeur comment**
1.1	Question 1.1 asked about the responsiveness of the accelerator.	*I found it very smooth and responsive.*
2.1	Question 2.1 asked the chauffeur to evaluate the transmissions performance.	*Gear shift was smooth although the engine sounded harse.*
2.2	Question 2.2 asked about the performance of the transmission when "kicking down" gears.	*I found the kick better in sports mode.*
3.1	Question 3.1 asked how effectively the vehicle braking system was when descending hills.	*Braking excellent.*
3.2	Question 3.2 asked the chauffeur to evaluate the brake efficiency when coming to a stop.	*As above.*
4.1	Question 4.1 asked the chauffeur to comment on the vehicles body roll.	*Not excessive at all. Even better in sport mode.*

General comments chauffeur 18

- The PHEV was smooth and responsive, I found the time on full battery very limiting.
- When on hill work the petrol motor seemed harse (sic) and to be working hard.
- With the battery life only 27030ks I don't think this car is fit for purpose.
- I think with more development in battery life to sat 120-150 ks then this car would be ideal.

Chauffeur call sign 09 feedback		
	Question	**Chauffeur comment**
1.1	Question 1.1 asked about the responsiveness of the accelerator.	*No comments, reacted as expected.*
1.2	Question 1.2 asked how easy it was to maintain a constant speed when cornering.	*Reacted well.*
1.3	Question 1.3 asked to evaluate the engine power when moving between higher and lower speed zones and while negotiating hills.	*Reacted well.*

General comments chauffeur 09

- No AM radio! Parliament is broadcast on AM*
- The vehicle drove well in the electric mode and in the petrol mode.
- Very nice open road drive. Responsive and powerful enough.

***The vehicle does have AM frequency capability**

Chauffeur call sign 19 feedback		
	Question	**Chauffeur comment**
1.1	Question 1.1 asked about the responsiveness of the accelerator.	*Very smooth accelerator response under rapid or conservative acceleration.*
1.2	Question 1.2 asked how easy it was to maintain a constant speed when cornering.	*Easily able to maintain a constant speed around left and right hand bends at sign posted recommended speeds.*
1.3	Question 1.3 asked to evaluate the engine power when moving between higher and lower speed zones and while negotiating hills.	*Absolutely adequate / sufficient power required for VIP usage of vehicle. Although ample power from the 2L engine for the style of driving VIP should be adhering to, under urgency the motor "sounds" tinny and light weight but this is purely "perception" as one may not expect a car like this to "sound" like this – but more than adequate power.*
1.4	Question 1.4 asked the chauffeur to evaluate whether they were able to control the amount of acceleration when exiting corners.	*Yes, absolutely no doubt.*
2.1	Question 2.1 asked the chauffeur to evaluate the transmissions performance.	*Very seamless gear changes through entire range.*
2.3	Question 2.3 asked the chauffeur to assess the "hill descent assist".	*Yes, vehicle held at programmed speed even on steep descent, 1-2 KM error at most, But I wasn't sure if holding speed on steep descent whether brake lights were activated. Purely as a safety for following vehicles (I am talking about when cruise control activated).*
3.1	Question 3.1 asked how effectively the vehicle braking system was when descending hills.	*Very easy to manage.*
3.2	Question 3.2 asked the chauffeur to evaluate the brake efficiency when coming to a stop.	*Wasn't able to always come to a complete stop without a "jerk" at the end, but did so 98% of the time, but this is more likely a driver rather than a vehicle shortfall.*
4.1	Question 4.1 asked the chauffeur to comment on the vehicles body roll.	*No problem in this area.*
4.2	Question 4.2 asked the chauffeur to evaluate the comfort and support provided by the driver's seat.	*No problem in this area.*

General comments chauffeur 19

I have made a few general observations which I just would like to bring to the teams attention:

- I think the fuel filler cap needs a high viz sign stating fill with petrol only. This could save major cost and hassle given that we all now days deal with vehicles that use diesel, petrol (98/95 or 91 octane) and it can be so easy for a mental mix-up at the petrol station.
- A reversing beeper, but with a manual override like the one in the 14 seater Mercedes van. s9(2)(g)(i)) A beeper could warn a lot of people that a vehicle is reversing and the driver needs to be careful enough to pick up the rest. A manual off switch is recommended to deactivate for when public speeches are in progress as happened at ANZAC dawn parade.
- I feel that the indicators are quite noisy especially if someone is on the phone or you get the wrong phasing at traffic lights and it's a long weight. E.g. on the corner of Vivian Street / Kent Terrace / Cambridge Terrace.
- Quite obvious, but the boot is relatively small, although the hide away compartment under the lift up flap is very good.
- Memory seat for the passenger side can be operated from the driver's side is a good feature.
- Instant heat from the heater is an amazing feature, especially on those cold mornings.

Summary:

In short I think it is a fabulous vehicle, good for someone living in the CBD and does a trip to the library and the supermarket then back home to recharge for the night, but for VIP purposes I'm not convinced. The problem is lack of K's on the electric charge (no even a full return Ngauranga gorge / airport trip is possible) but even as we complete this evaluation I feel that it is only a matter of time, and short space of time I think before it would become more suitable for our purposes as more k,s out of the electric motor will evolve.

Auckland Feedback

Note

- Comments below are recorded as they are written in the Chauffeurs' record book; they have not been adjusted or corrected.
- Some context around the answer has been added to the feedback.
- Only questions that generated a response have been recorded in the feedback below.

Chauffeur call sign 77 feedback		
	Question	**Chauffeur comment**
1.1	Question 1.1 asked about the responsiveness of the accelerator on the open road.	*Lag (slight) at take-off.*
1.4	Question 1.4 asked the chauffeur to evaluate whether they were able to control the amount of acceleration when exiting corners.	*See comment 1.1*
2.2	Question 2.2 asked about the performance of the transmission when "kicking down" gears.	*See comment 1.1*
4.1	Question 4.1 asked the chauffeur to comment on the vehicles body roll.	*Felt 'heavy' at times*

General comments chauffeur 77

- *Range of battery varied from 24km to 30km*
- *Really good when powered by battery but the limited range was frustrating.*
- *Having to plug the lead in frequently was frustrating.*

Chauffeur call sign 71 feedback		
	Question	**Chauffeur comment**
1.3	Question 1.3 asked to evaluate the engine power when moving between higher and lower speed zones and while negotiating hills.	*Had used battery so running on petrol power. Car was "OK" but noticeably less pick up on hills when accelerating.*
2.2	Question 2.2 asked about the performance of the transmission when "kicking down" gears.	*When engaging petrol engine I noticed a "jolt" as it kicked in. Petrol motor quite noisy under pressure.*
3.2	Question 3.2 asked the chauffeur to evaluate the brake efficiency when coming to a stop.	*You do have to allow for extra weight of car. With 2-3 pax and luggage needs to really allow for extra distance.*
4.1	Question 4.1 asked the chauffeur to comment on the vehicles body roll.	*All good.*

General comments chauffeur 71

- *Car is "nice" but I'm not in love with it.*
- *The limited battery is interesting – not sure why it's there!*
- *The petrol motor is quite noisy and around town & on the flat OK.*
- *Under pressure and quick acceleration is missing some of the get up and go an smooth power of current fleet.*
- *On electric – while it lasts car is nice – good, smooth and quiet. Just no staying power at 20-30 to use the battery up.*

Post Evaluation Questions & Concerns

1	Location of the PHEV charging dock
It is best practice for all VIP vehicles to park facing out of the parking bay, this allows for a quick and easy departure when required. It is noted that the 740Le's charging point is located on the front left fender of the vehicle. This could potentially become a trip hazard when a vehicle is being charged by having an exposed lead from the charging station to the vehicle.	***Recommendation*** – VIP Transport will need to find a solution to this issue. Potentially it may be as easy as installing an overhead beam which carries the charging cable above the vehicle rather than beside. ***Outcome*** It was determined that this could be accommodated within the depots to a satisfactory degree.

2	Engine performance when stationary
s6(d) 	
Outcome As the PHEV is in an "always on" status, this was determined to be operationally suitable in these specific circumstances.	

3	Charging point flap	
	The hinge controlling the charging point flap appears to be plastic	***Question*** - While the vehicles charging flap is secure at the moment, can we be assured that it will withstand repetitive usage of up to 5-6 times per day?. ***Outcome*** BMW have given their technical assurance that these flaps are manufactured to a robust standard, and do not pose an operational issue.
4	Charging stations	
	There appeared to be a lack of public charging stations around the Wellington region. Those that were available for public use were either engaged by other EV's or had a non-electric vehicle parked in the bay.	***Question*** – Is there an approx. timeline to when additional charging stations will be installed in the main centres. Failing to have the ability to recharge the PHEV while out of the depot may have an impact on the overall fuel costs. ***Outcome*** The question around charging infrastructure was addressed & answered. BMW will support installation of charging points in depot, and will work with Parliamentary Service to investigate installation of EV charging points in the Parliamentary Precinct.

5	Universal charging stations (pay stations)
During the evaluation a comment was made that at times it was difficult to find a charging station that had a connection that was compatible with the BMW PHEV. A comment made by a Christchurch evaluator noted that a couple of charging stations are now adding a cost for charging. If this is the way that New Zealand is going then it would add a significant cost to the operational effectiveness of any PHEV.	s9(2)(b)(ii)
6	Boot luggage compartment
During the 2015 all of Government tender process vehicle manufactures were asked to supply a vehicle with a boot size of no less than 500 litres. It should be noted that the BMW 740Le PHEV has a smaller boot space of only 420 litres,	***Question*** - is this an issue? ***Outcome*** This was determined to be operationally acceptable, and not an issue.
7	Electric Range
Evaluators have made comment around the available range when running on pure electric charge. Some have suggested it is unsuitable due to the limited range.	s9(2)(b)(ii)

8	Engine noise	
Evaluators have made some negative comments around the noise of the petrol engine.		***Question*** – Can the petrol engine noise be reduced? ***Outcome*** BMW advised that while the noise cannot be reduced, and is slightly louder that the 2016 BMW 7 series diesel variant, it is still quieter than the 2011 BMW 7 series diesel variant. It was concluded by VIPT that this was acceptable for operational needs.

Evaluation 003 Questions & Concerns

Anti-lock braking system (ABS)

The evaluator was unable to complete the exercise at 120kph within the exercise parameters. To ensure the vehicle was provided every chance of success at 120kph the evaluator completed approx. five attempts however was still unable to complete the exercise effectively.

To make a comparison the evaluator completed two 120kph successful concurrent attempts using the BMW G12.

Reversing

s6(d)

Transmission evaluation

s6(d)

Cornering / vehicle dynamics

The driver's seat will require more side support, during this phase the lack of side support meant that the driver was moving around more than acceptable. If the BMW 740Le trial proves to be successful VIPT will need to ensure that the driver's seat is upgraded to a more supportive seat.