Assessed Coursework Submission

Module No:	**P04708**	**Module title:**	**Lap time simulation and vehicle performance**
Assignment title :	**Lap Sim Analysis of Hybrid vs Non-Hybrid LMP1 Cars**	**Due date :**	**15/03/19**
Estimated total time spent on assignment: (total man-hours)	**60 hours**		

Student No:	
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Statement of Compliance *(please tick and sign)*

☑ I declare that the work submitted is my own and that the work I submit is fully in accordance with the University regulations regarding assessments (*www.brookes.ac.uk/uniregulations/current*)

Student Signature:	Date:
Shreyas Ravi	8 March, 2019

IMechE UK Spec LOs assessed:	
EL8m	Awareness of the need for a high level of professional and ethical conduct in engineering
EL9m	Awareness that engineers need to take account of the commercial and social contexts in which they operate
P9m	A thorough understanding of current practice and its limitations, and some appreciation of likely new developments
P12m	Advanced level knowledge and understanding of a wide range of engineering materials and components

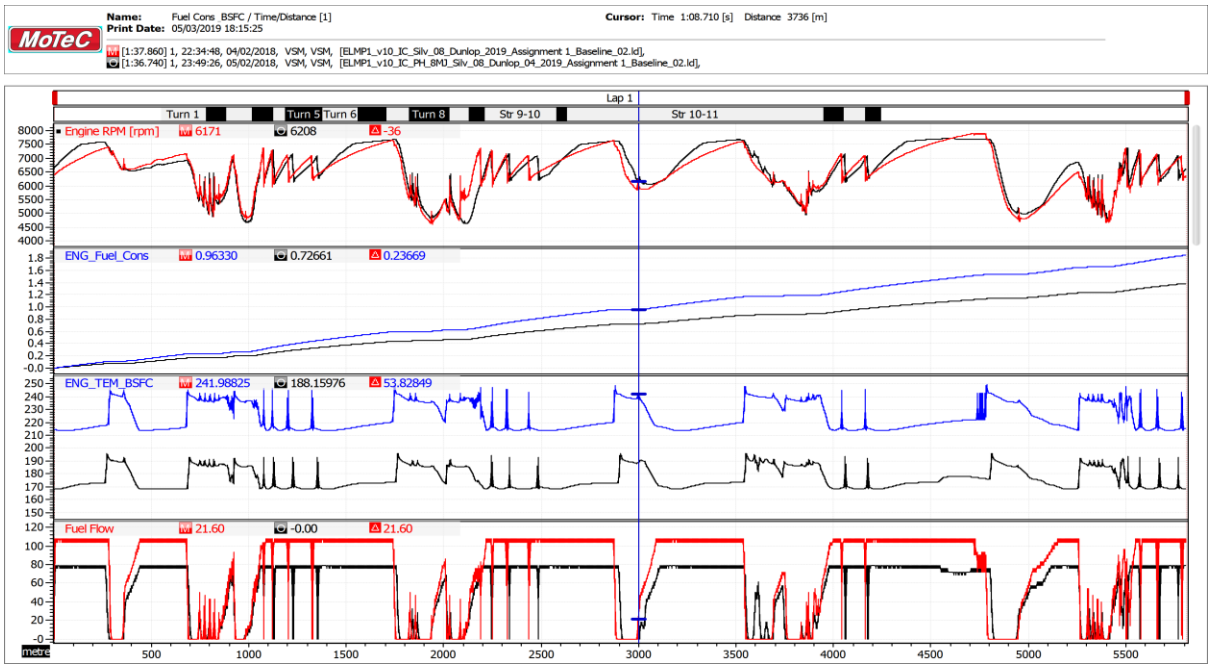
MARKING SCHEME

Module P04708		**Student name**		Shreyas Ravi
Assignment 1 Marking scheme		**Student number**		18029106
Question	**Analysis**	**Marks available**	**Marks achieved**	**Feedback**
1	Fuel Consumption Comparison	10		
2	Tyre Saturation Vs Tyre Temperature (Comparison of both cars)	20		
3	Fuel Consumption Vs Stints Vs Total Race Time	20		
4	Aero Balance and Mechanical Balance Comparison – Where does it matter?	15		
5	Driving Style comparison between Hybrid and non-Hybrid drivers	15		
6	Energy used during the race – Hybrid Vs Non Hybrid	20		
	Total	100		

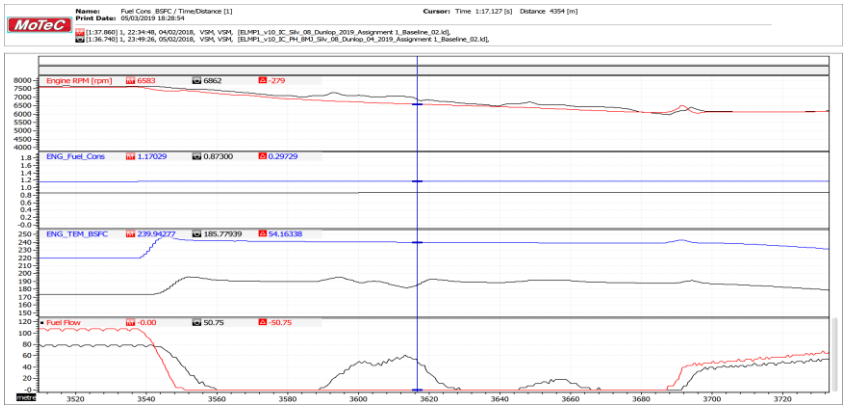
Contents

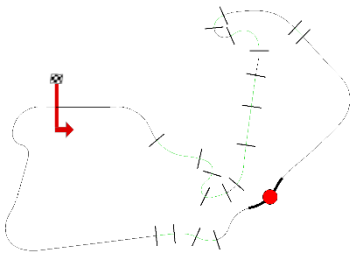
Fuel Consumption

- Trend of BSFC is similar for both cars, however hybrids naturally have lower values. Black lines are representative of hybrid vehicles.

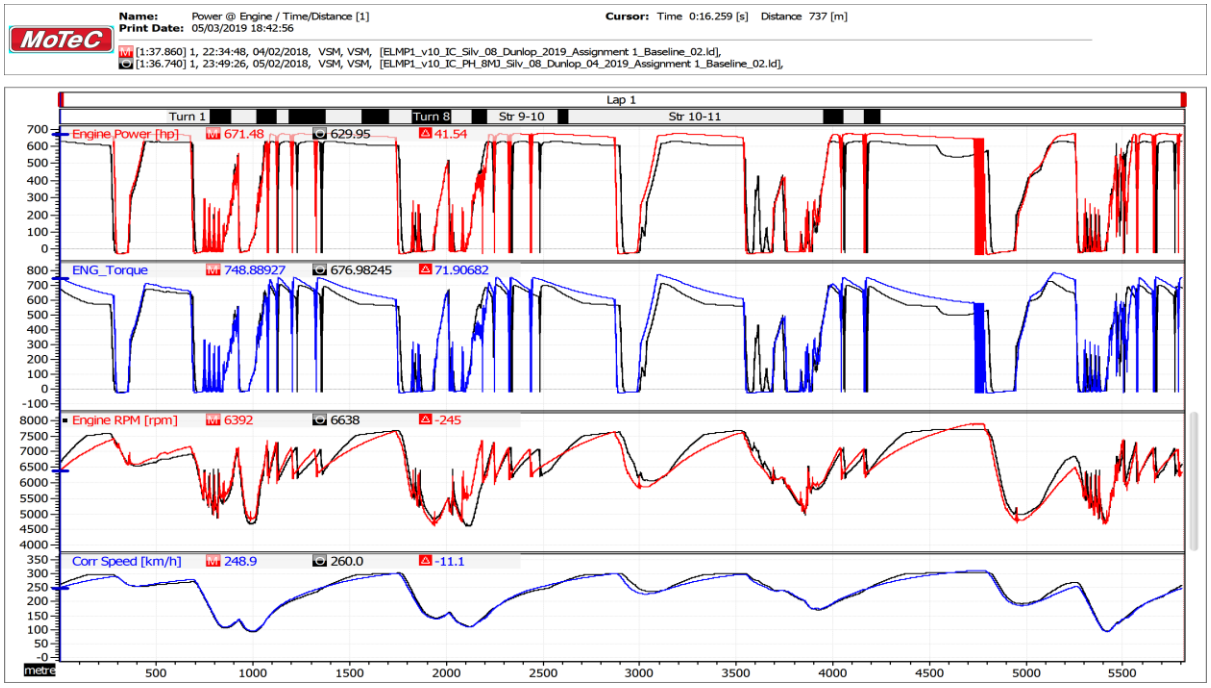


- Graphs above is used to compare engine rpm, fuel consumption, and BSFC and fuel flow for each of the cars. Hybrids are capable of being driven around at slightly higher rpms even though they consume less fuel.





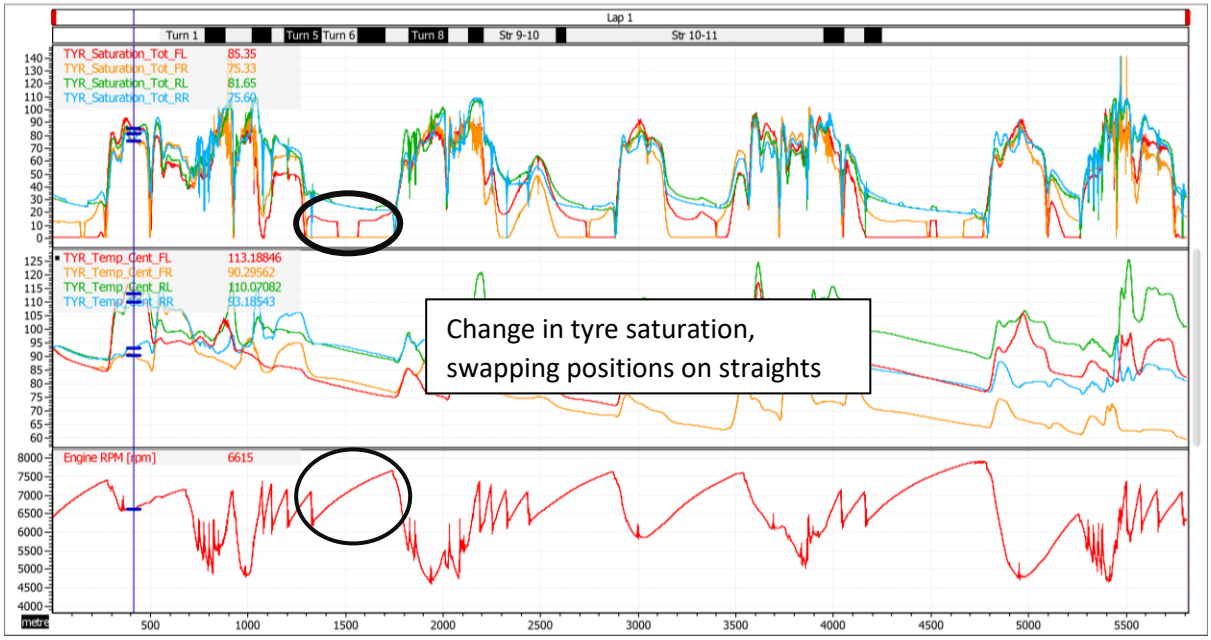
- A more careful examination of ‘maggots’ corner tells us that hybrid vehicle is revved mid-turn, giving it advantage over the other by carrying more cornering speed.
- In the graph below engine power, torque, engine rpm and cornering speed is used for comparison. It can be noted that, because the power produced from hybrids is less as an electric motor covers for the deficit in engine power, the fuel required to run the car is also less. This gives an advantage in terms of longer life of the engine as well.
- Even with lesser power and torque produced, the engine rpm is higher for hybrids than non-hybrid, also the maximum rpm is achieved quicker compared to non-hybrids, and this is because the torque delivery of electric motor is way more efficient than IC engine. This helps the car reach higher rpm quickly, while the non-hybrid car with no motor support lacks the advantage.



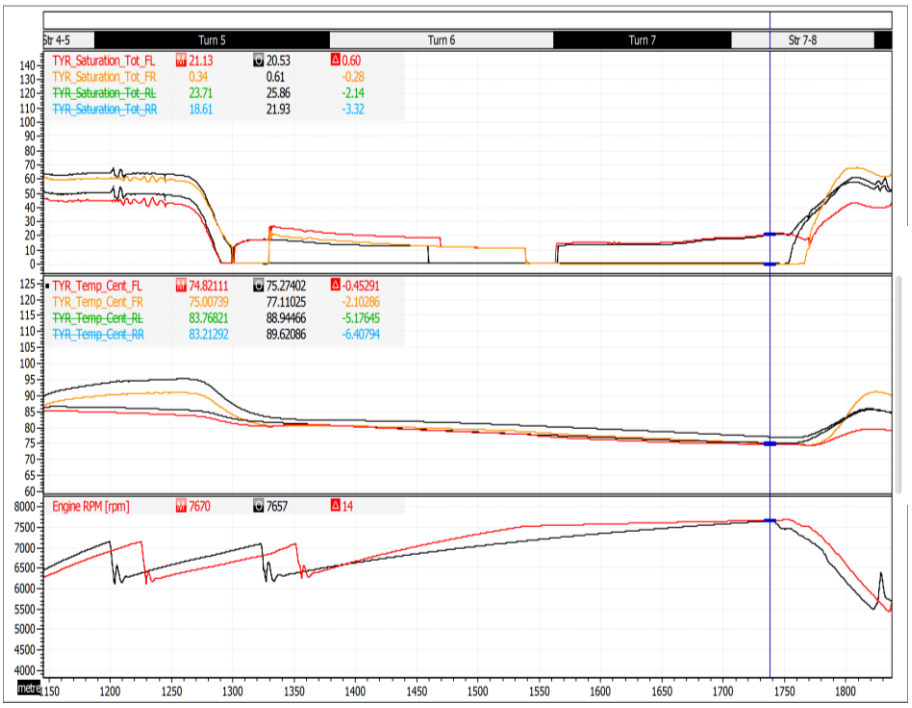
- The cornering and straight-line speed of the hybrid remains unaffected and is better than non-hybrid even though the engine produces less power and torque hence consuming less fuel in the process.

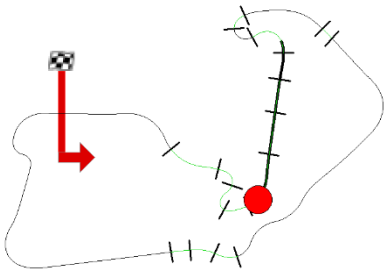
Tyre Saturation vs. Tyre Temperature

- Tyre saturation increases with increase in temperature. Tyre saturation over a period needs to be linear for better lap time results.
- Both the hybrid and non-hybrid cars have shown similar trends that is highlighted in the image below.

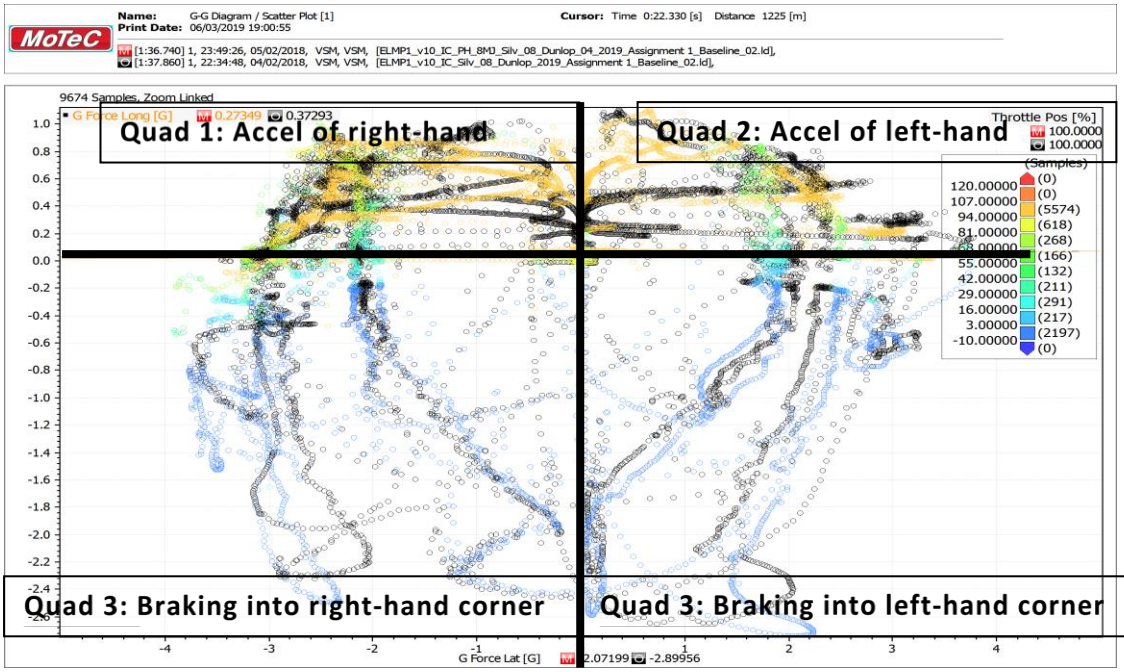


- In the above image, tyre saturation of all 4 tyres is compared against tyre temperatures of all 4 tyres with engine rpm and distance as reference.
- It can be noted that even in straights there is tyre saturation change between front tyres.





- The said straight portion of the track is zoomed in in the above image shown for both hybrid and non-hybrid cars. Lines in black represent the non-hybrid car. Only front tyre saturation is compared against the temperature.
- Possible explanation for this is that initially car is coming out of a left turn and therefore the right tyres are carrying more temperature and are more saturated. The driver is then following racing line and even though it's a straight the car switches from one edge of the road to the other and therefore the left tyre is more saturated, as weight transfers to the left side.
- The car does travel absolutely straight for a brief period and the left and right tyre saturation is constant for a moment.
- The next part of the track is another left turn and so the driver moves the car ever so lightly to take racing line and hence the right most edge of the track in order to hit the apex at the theoretical maximum speed. It can be noted that at this point front left saturation increases.



- The above image gives out the friction circle comparison between the cars. The black dots represent the non-hybrid cars in here. It can be noted that hybrid cars shell out higher G-values during braking while the non-hybrid cars have slightly higher G-values in straight line.

Fuel Consumption vs Stint vs Total Race Time

- The hybrid and the non-hybrid being different with their power units also had to have different strategies and fuel consumption as discussed above.
- Hybrids are consuming less fuel per lap, are faster overall and are also doing more laps at the end of the race.

LMP1 Comparison Table - Silverstone

Le Mans		<8 MJ	Non Hybrid
Silverstone	Units	<5.37 MJ	Non Hybrid
Lap Time	Seconds	96.740	97.860
ΔLap Time	Seconds		-1.120
Top Speed	Km/h	303.1	310.9
ICE Power	HP (kW)	600 (447.4)	670 (499.6)
e-Power	kW	300	
KERS (Front only)	kW	300	
Strategy	# (sec.)	62_06 (16.05)	
Fuel Flow	Kg/h	79.20	108.00
Fuel Flow Rule	*Kg/h*	*80.20*	*110.00*
Fuel Cons.	Kg/lap	1.390	1.850
Fuel Energy	MJ/lap	55.0	73.2
Fuel Energy Rule	*MJ/lap*	*60.0*	*101.4*
ERS Energy	MJ/lap	5.363	
ERS Energy Rule	*MJ/lap*	*5.369*	

Overall Race Performance - Silverstone

Fuel Tank Capacity	Lts	46.6	70.0
Fuel Tank Capacity	Kg	35.2	52.9
Laps per Stint	laps	25	28
Fuel Stops	#	8	7
Stints	#	9	8
Pit Stop Time (Average) (**)	sec	62	68
Fuel laps after 6 Hrs. (*)	laps	6	8
Fuel in on last Pit Stop	Kg	35.2	52.9
Time Last Refueling	sec	62.0	68.0
Race Time	hrs	6.01220	6.00140
Overall Distance	**laps**	**219**	**216**
Δ Time behind fastest c	**secs**		**254.70**

(*) Number of laps you could do after the race finshes if in the last refueling you fill the tank
(**) For simplicity of this exercise we take an average of pit stops time

ANNEXE B / APPENDIX B

VALEURS D'ENERGIE ET DE PUISSANCE POUR LE CIRCUIT DU MANS
VALUES OF ENERGIES AND POWER FOR LE MANS CIRCUIT

LE MANS TRACK		Hybrid	No Hybrid **	
Released Energy	MJ/Lap	8	0	0
ICE Specification	-	-	TC	NA
Released Power	kW	300	0	0
Car Mass	kg	878	833	
Petrol Energy	MJ/Lap	124.9	210.9*	210.9*
Max Petrol Flow	kg/h	80.2	110.0	110.0
Petrol per stint (maximum)	kg	35.2	52.9	52.9

VALEURS D'ENERGIE ET DE PUISSANCE POUR LES CIRCUITS AUTRES QUE LE MANS
VALUES OF ENERGIES AND POWER FOR CIRCUITS OTHER THAN LE MANS

The amount of releasable energy per lap will be limited in the proportion of length of circuit relative to the length of Le Mans circuit multiplied by factor 1.55.
The amount of fuel allocation per lap will be limited in the proportion of length of circuit relative to the length of Le Mans circuit multiplied by factor 1.11.

- From the above image we can see that the hybrid car consumes less fuel at around 1.390kg/lap, while the non-hybrid car consumes 1.850kg/lap of fuel.

- Hence the fuel tank capacity on hybrids is less at 35.2kg while the non-hybrid car needs a bigger tank and has 52.9kg of fuel carrying capacity.
- To calculate the stints and the number of stops, a spreadsheet was developed. Each for hybrids and non-hybrids

Lap	lap time	overall time	fuel at start (kg	fuel at end (kg	fuel consumed (kg	pit stop time (sec)	stints	stops
1	96.74	00:01:37	35.2	33.81	1.39			0
2	96.74	00:03:13	33.81	32.42	2.78			0
3	96.74	00:04:50	32.42	31.03	4.17			0
4	96.74	00:06:27	31.03	29.64	5.56			0
5	96.74	00:08:04	29.64	28.25	6.95			0
6	96.74	00:09:40	28.25	26.86	8.34			0
7	96.74	00:11:17	26.86	25.47	9.73			0
8	96.74	00:12:54	25.47	24.08	11.12			0
9	96.74	00:14:31	24.08	22.69	12.51			0
10	96.74	00:16:07	22.69	21.3	13.9			0
11	96.74	00:17:44	21.3	19.91	15.29			0
12	96.74	00:19:21	19.91	18.52	16.68			0
13	96.74	00:20:58	18.52	17.13	18.07	62	1	0
14	96.74	00:22:34	17.13	15.74	19.46			0
15	96.74	00:24:11	15.74	14.35	20.85			0
16	96.74	00:25:48	14.35	12.96	22.24			0
17	96.74	00:27:25	12.96	11.57	23.63			0
18	96.74	00:29:01	11.57	10.18	25.02			0
19	96.74	00:30:38	10.18	8.79	26.41			0
20	96.74	00:32:15	8.79	7.4	27.8			0
21	96.74	00:33:52	7.4	6.01	29.19			0
22	96.74	00:35:28	6.01	4.62	30.58			0
23	96.74	00:37:05	4.62	3.23	31.97			0
24	96.74	00:38:42	3.23	1.84	33.36			0
25	96.74	00:40:19	1.84	0.45	34.75			0
26	158.74	00:42:57	35.2	33.81	36.14			1
27	96.74	00:44:34	33.81	32.42	37.53			1
28	96.74	00:46:11	32.42	31.03	38.92			1
29	96.74	00:47:47	31.03	29.64	40.31			1
30	96.74	00:49:24	29.64	28.25	41.7			1
31	96.74	00:51:01	28.25	26.86	43.09			1
32	96.74	00:52:38	26.86	25.47	44.48			1
33	96.74	00:54:14	25.47	24.08	45.87			1
34	96.74	00:55:51	24.08	22.69	47.26			1
35	96.74	00:57:28	22.69	21.3	48.65			1
36	96.74	00:59:05	21.3	19.91	50.04			1
37	96.74	01:00:41	19.91	18.52	51.43			1
38	96.74	01:02:18	18.52	17.13	52.82			1
39	96.74	01:03:55	17.13	15.74	54.21	62	2	1
40	96.74	01:05:32	15.74	14.35	55.6			1
41	96.74	01:07:08	14.35	12.96	56.99			1
42	96.74	01:08:45	12.96	11.57	58.38			1
43	96.74	01:10:22	11.57	10.18	59.77			1
44	96.74	01:11:59	10.18	8.79	61.16			1
45	96.74	01:13:35	8.79	7.4	62.55			1
46	96.74	01:15:12	7.4	6.01	63.94			1

Lap	lap time	overall time	fuel at start (kg	fuel at end (kg	fuel consumed (kg	pit stop time	stints	stops
1	97.86	00:01:38	52.9	51.05	1.85			0
2	97.86	00:03:16	51.05	49.2	3.24			0
3	97.86	00:04:54	49.2	47.35	4.63			0
4	97.86	00:06:31	47.35	45.5	6.02			0
5	97.86	00:08:09	45.5	43.65	7.41			0
6	97.86	00:09:47	43.65	41.8	8.8			0
7	97.86	00:11:25	41.8	39.95	10.19			0
8	97.86	00:13:03	39.95	38.1	11.58			0
9	97.86	00:14:41	38.1	36.25	12.97			0
10	97.86	00:16:19	36.25	34.4	14.36			0
11	97.86	00:17:56	34.4	32.55	15.75			0
12	97.86	00:19:34	32.55	30.7	17.14			0
13	97.86	00:21:12	30.7	28.85	18.53			0
14	97.86	00:22:50	28.85	27	19.92			0
15	97.86	00:24:28	27	25.15	21.31	68	1	0
16	97.86	00:26:06	25.15	23.3	22.7			0
17	97.86	00:27:44	23.3	21.45	24.09			0
18	97.86	00:29:21	21.45	19.6	25.48			0
19	97.86	00:30:59	19.6	17.75	26.87			0
20	97.86	00:32:37	17.75	15.9	28.26			0
21	97.86	00:34:15	15.9	14.05	29.65			0
22	97.86	00:35:53	14.05	12.2	31.04			0
23	97.86	00:37:31	12.2	10.35	32.43			0
24	97.86	00:39:09	10.35	8.5	33.82			0
25	97.86	00:40:46	8.5	6.65	35.21			0
26	97.86	00:42:24	6.65	4.8	36.6			0
27	97.86	00:44:02	4.8	2.95	37.99			0
28	97.86	00:45:40	2.95	1.1	39.38			0
29	165.86	00:48:26	52.9	51.05	40.77			1
30	97.86	00:50:04	51.05	49.2	42.16			1
31	97.86	00:51:42	49.2	47.35	43.55			1
32	97.86	00:53:20	47.35	45.5	44.94			1
33	97.86	00:54:57	45.5	43.65	46.33			1
34	97.86	00:56:35	43.65	41.8	47.72			1
35	97.86	00:58:13	41.8	39.95	49.11			1
36	97.86	00:59:51	39.95	38.1	50.5			1
37	97.86	01:01:29	38.1	36.25	51.89			1
38	97.86	01:03:07	36.25	34.4	53.28			1
39	97.86	01:04:45	34.4	32.55	54.67			1
40	97.86	01:06:22	32.55	30.7	56.06			1
41	97.86	01:08:00	30.7	28.85	57.45			1
42	97.86	01:09:38	28.85	27	58.84			1
43	97.86	01:11:16	27	25.15	60.23			1
44	97.86	01:12:54	25.15	23.3	61.62	68	2	1
45	97.86	01:14:32	23.3	21.45	63.01			1
46	97.86	01:16:10	21.45	19.6	64.4			1

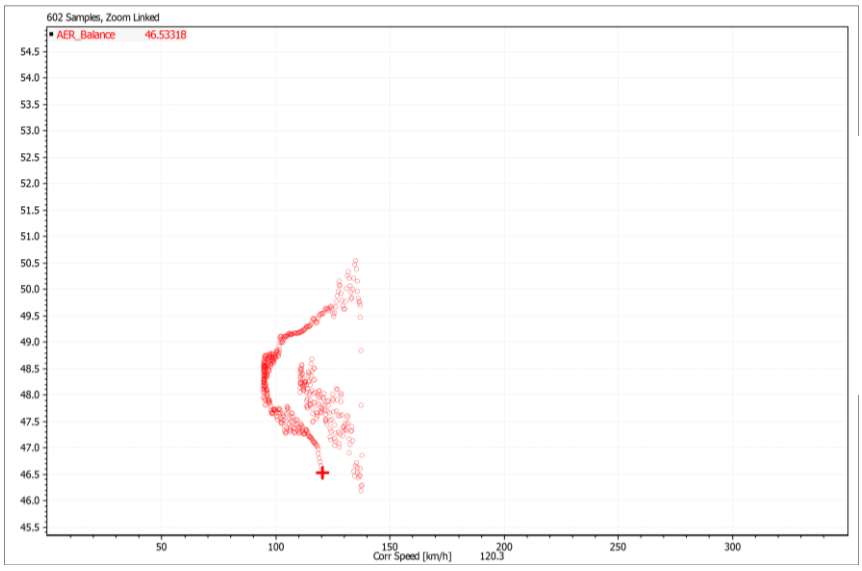
- It is assumed that the cars are refuelled to full capacity at each stop and going by the averages of previous years, the hybrid cars take about 62 seconds for each refuelling stop while the non-hybrid cars take around 68 seconds in the pits
- The image below is the end of the spreadsheet shown above. The total laps done by the hybrid car is 219 while the best non-hybrid car could manage 216. This three lap deficit also satisfies the result of the previous year where there was a 4 lap gap between the hybrid and the best non-hybrid car.
- Total run time of the hybrid car is 6hrs 1min and 22secs. While the non-hybrid car have a total run time of 6hrs 14secs
- The spreadsheet is used to calculate the number of stints and the number of refuelling stops. The hybrid car makes 8 refuelling stops while the non-hybrid makes one stop less, making the number of stints 9 and 8 respectively.
- Even though the non- hybrid makes one stop less, total number of laps is higher for the hybrid and the hybrid car consumes 304.41 kg of fuel, 4 kg more than the non-hybrid at the end of the race.

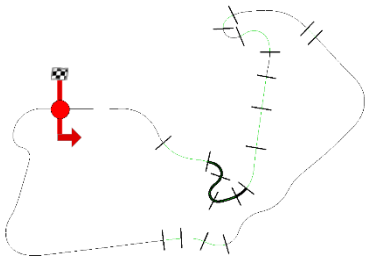
187	96.74	05:08:44	19.91	18.52	259.95				7
188	96.74	05:10:21	18.52	17.13	261.32				7
189	96.74	05:11:58	17.13	15.74	262.71	62	8		7
190	96.74	05:13:35	15.74	14.35	264.1				7
191	96.74	05:15:11	14.35	12.96	265.49				7
192	96.74	05:16:48	12.96	11.57	266.88				7
193	96.74	05:18:25	11.57	10.18	268.27				7
194	96.74	05:20:02	10.18	8.79	269.66				7
195	96.74	05:21:38	8.79	7.4	271.05				7
196	96.74	05:23:15	7.4	6.01	272.44				7
197	96.74	05:24:52	6.01	4.62	273.83				7
198	96.74	05:26:29	4.62	3.23	275.22				7
199	96.74	05:28:05	3.23	1.84	276.61				7
200	96.74	05:29:42	1.84	0.45	278				7
201	158.74	05:32:21	35.2	33.81	279.39				8
202	96.74	05:33:57	33.81	32.42	280.78				8
203	96.74	05:35:34	32.42	31.03	282.17				8
204	96.74	05:37:11	31.03	29.64	283.56				8
205	96.74	05:38:48	29.64	28.25	284.95				8
206	96.74	05:40:24	28.25	26.86	286.34				8
207	96.74	05:42:01	26.86	25.47	287.73				8
208	96.74	05:43:38	25.47	24.08	289.12				8
209	96.74	05:45:15	24.08	22.69	290.51				8
210	96.74	05:46:51	22.69	21.3	291.9				8
211	96.74	05:48:28	21.3	19.91	293.29				8
212	96.74	05:50:05	19.91	18.52	294.68				8
213	96.74	05:51:42	18.52	17.13	296.07				8
214	96.74	05:53:18	17.13	15.74	297.46	62	9		8
215	96.74	05:54:55	15.74	14.35	298.85				8
216	96.74	05:56:32	14.35	12.96	300.24				8
217	96.74	05:58:09	12.96	11.57	301.63				8
218	96.74	05:59:45	11.57	10.18	303.02				8
219	96.74	06:01:22	10.18	8.79	304.41				8
220	96.74	06:02:59	8.79	7.4	305.8				8
221	96.74	06:04:36	7.4	6.01	307.19				8
222	96.74	06:06:12	6.01	4.62	308.58				8
223	96.74	06:07:49	4.62	3.23	309.97				8
224	96.74	06:09:26	3.23	1.84	311.36				8
225	96.74	06:11:03	1.84	0.45	312.75				8
226	96.74	06:12:39	0.45	-0.94	314.14				
TOTAL	219		06:01:22		304.41	496	9	8	

187	97.86	05:11:48	19.6	17.75	260.59				6
188	97.86	05:13:26	17.75	15.9	261.78				6
189	97.86	05:15:04	15.9	14.05	263.17				6
190	97.86	05:16:41	14.05	12.2	264.56				6
191	97.86	05:18:19	12.2	10.35	265.95				6
192	97.86	05:19:57	10.35	8.5	267.34				6
193	97.86	05:21:35	8.5	6.65	268.73				6
194	97.86	05:23:13	6.65	4.8	270.12				6
195	97.86	05:24:51	4.8	2.95	271.51				6
196	97.86	05:26:29	2.95	1.1	272.9				6
197	165.86	05:29:14	52.9	51.05	274.29				7
198	97.86	05:30:52	51.05	49.2	275.68				7
199	97.86	05:32:30	49.2	47.35	277.07				7
200	97.86	05:34:08	47.35	45.5	278.46				7
201	97.86	05:35:46	45.5	43.65	279.85				7
202	97.86	05:37:24	43.65	41.8	281.24				7
203	97.86	05:39:02	41.8	39.95	282.63				7
204	97.86	05:40:39	39.95	38.1	284.02				7
205	97.86	05:42:17	38.1	36.25	285.41				7
206	97.86	05:43:55	36.25	34.4	286.8				7
207	97.86	05:45:33	34.4	32.55	288.19				7
208	97.86	05:47:11	32.55	30.7	289.58				7
209	97.86	05:48:49	30.7	28.85	290.97				7
210	97.86	05:50:27	28.85	27	292.36				7
211	97.86	05:52:04	27	25.15	293.75	68	8		7
212	97.86	05:53:42	25.15	23.3	295.14				7
213	97.86	05:55:20	23.3	21.45	296.53				7
214	97.86	05:56:58	21.45	19.6	297.92				7
215	97.86	05:58:36	19.6	17.75	299.31				7
216	97.86	06:00:14	17.75	15.9	300.7				7
217	97.86	06:01:52	15.9	14.05	302.09				7
218	97.86	06:03:29	14.05	12.2	303.48				7
219	97.86	06:05:07	12.2	10.35	304.87				7
220	97.86	06:06:45	10.35	8.5	306.26				7
221	97.86	06:08:23	8.5	6.65	307.65				7
222	97.86	06:10:01	6.65	4.8	309.04				7
223	97.86	06:11:39	4.8	2.95	310.43				7
224	97.86	06:13:17	2.95	1.1	311.82				7
225	97.86	06:14:55	1.1	-0.75	313.21				
TOTAL	216		06:00:14		300.7	476	8	7	

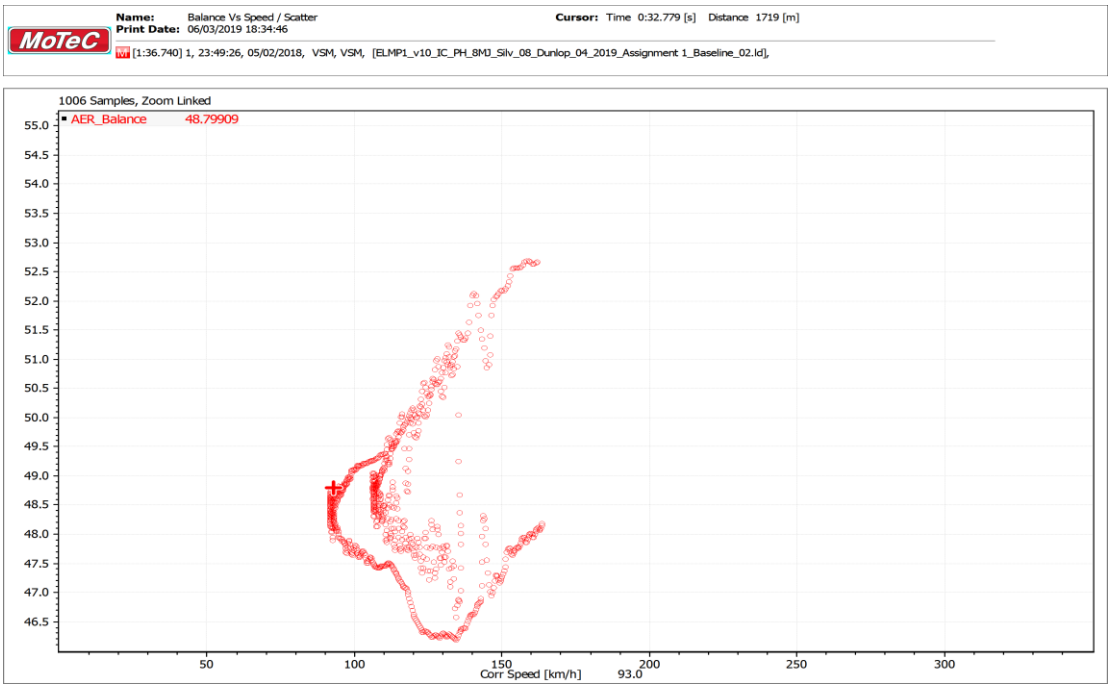
Aero Balance and Mechanical balance Comparison

- Aero balance and mechanical balance can be best checked on the corners of the track. ‘Arena’ corner is explored in this case.
- It is desired to have the aero and mechanical balance at the exact mid-point that is 50% of the car.
- Arena curve of the track is highlighted in the image below of the non-hybrid car. It can be seen that the car is fairly balanced as the lowest aero balance value dips to 44% in mid curve.

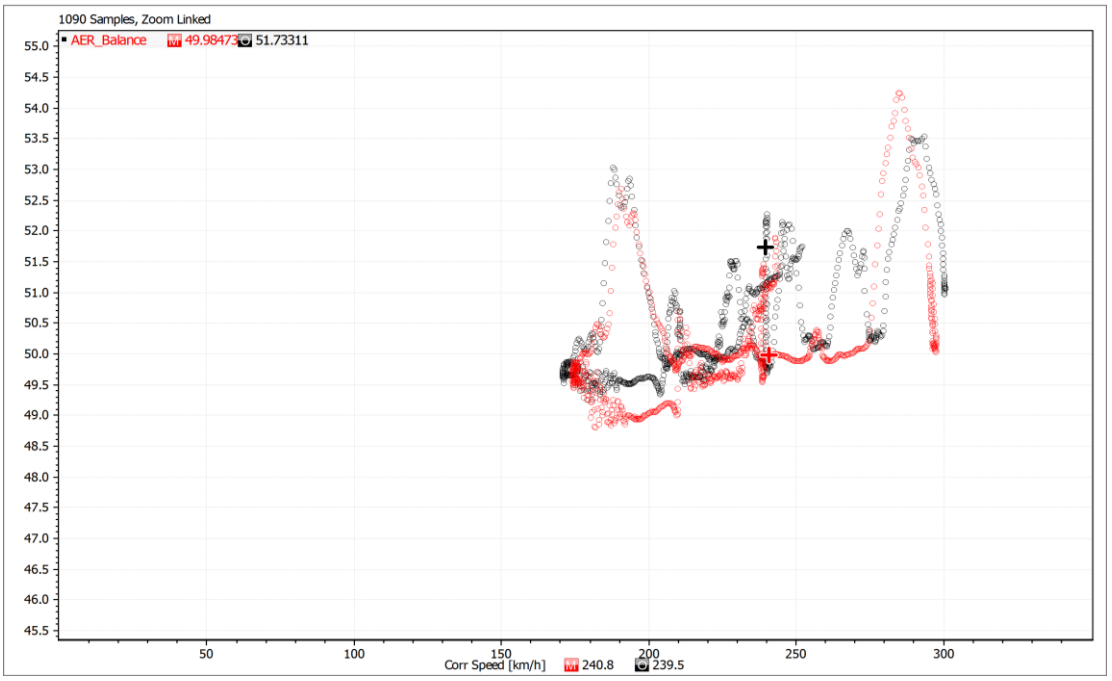




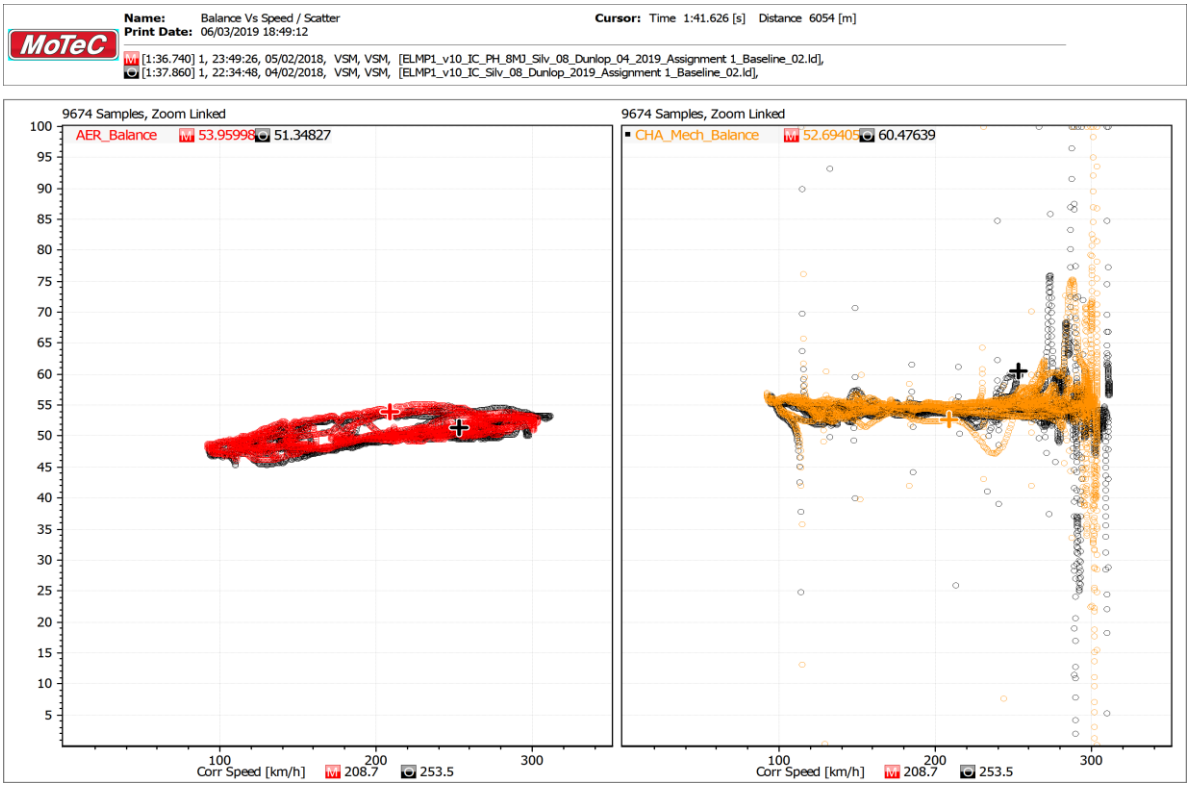
- The hybrid car looks more balanced across the arena curve as can be seen in the image below with the lowest being 46% in the mid curve.



- Through the chicane, i.e. maggots-becketts-chapel section the hybrid is found to be more stable and aero balance is slightly better than that in the non-hybrid car.



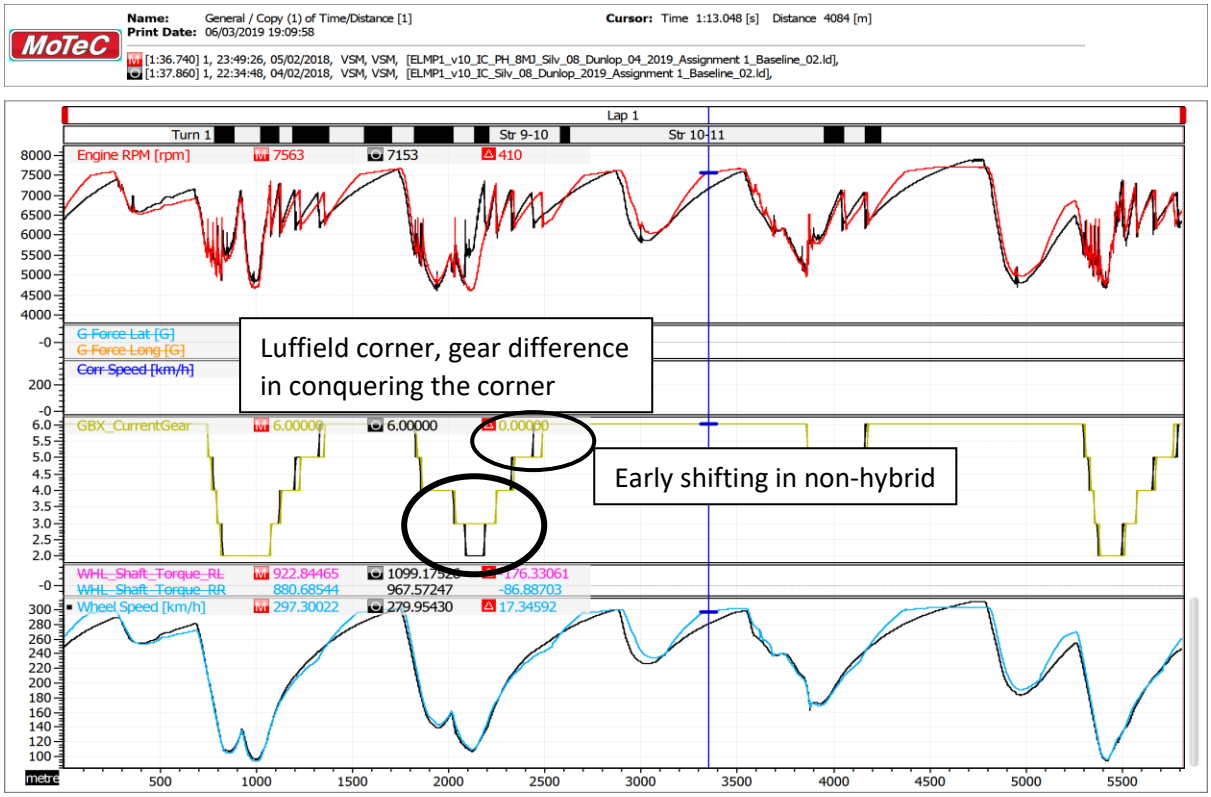
- In the above graph black lines represent hybrid vehicle while the red one represents non-hybrid. There is very little to choose from between both cars in terms of aero balance.
- Comparing the cars' aero balance vs mechanical balance, we find that the hybrid car is ever so slightly more unstable mechanically and aerodynamically.



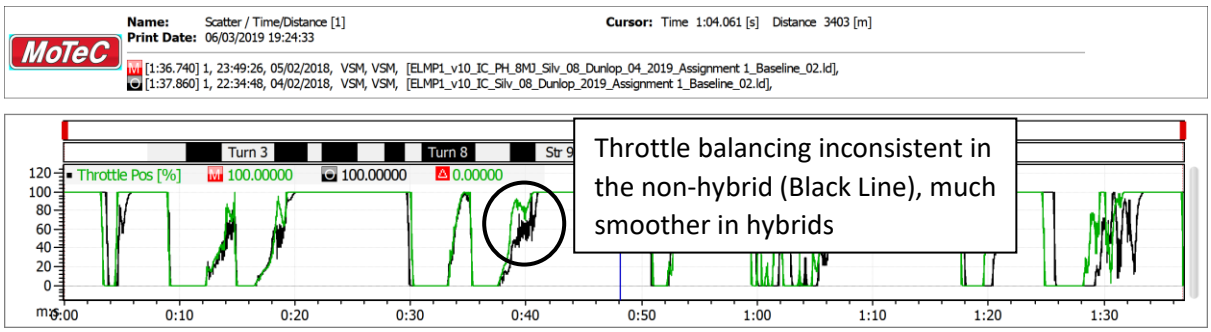
- Non-hybrid car is also an understeering car which wold be discussed in later sections but is worth mentioning here as that accounts for mechanical balance of the car.
- Vehicle's aero balance and mech balance should go hand-in-hand. It is desirable to have them both at 50% all the time especially through the corners.
- In the straights it barely matters where aero and mech centres are but during corners, it is essential that the balance lies at mid-point for achieving neutral steer.
- The responsiveness of the car increases if the mechanical and aero balance lie at the 50% mark.

Driving Style Comparison Between Hybrid and Non-hybrid

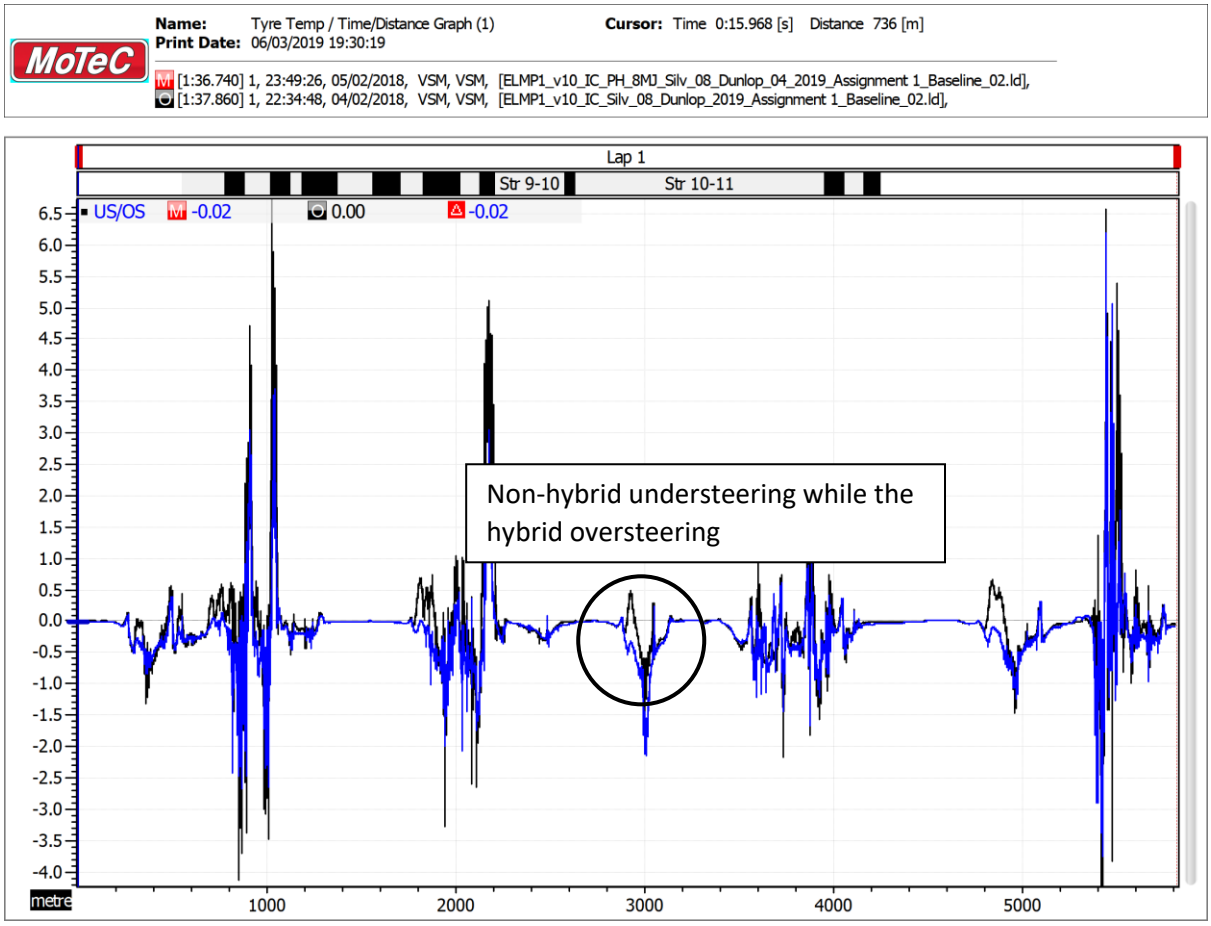
- The cars are fundamentally different from each other and hence there is a difference in driving styles between the cars.
- The first thing is attacking the corners at different speeds and also at different gear. This can be noted in the luffield corner of the track.
- The non-hybrid car is attacking the corner in second gear while the hybrid car has the electric motor to provide sufficient torque without downshifting till 2nd gear and conquers the corner in 3rd gear.



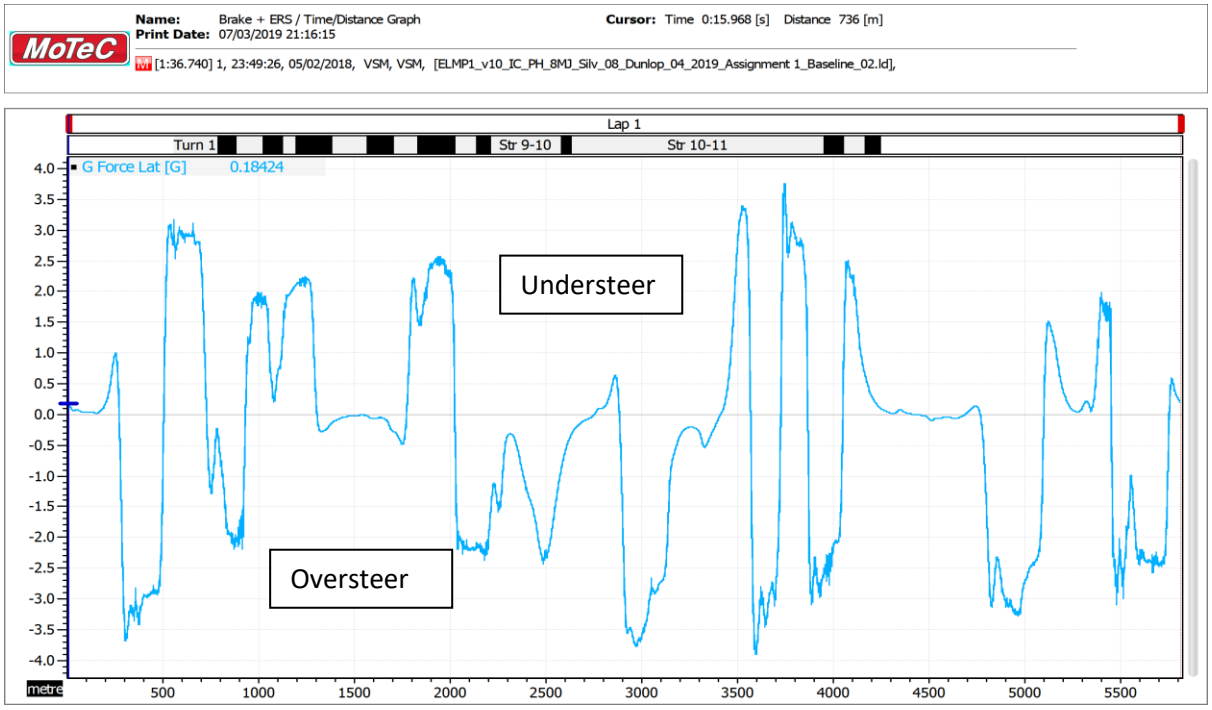
- The woodcote corner is also highlighted in the above image, it can be noted that on the exit of the wood cote corner the hybrid cars are running for longer duration on the same gear before upshift. This is to obtain more torque with the use of lower gears for better entry onto the straights.



- The understeer and oversteer characteristics can also be explored under driving style differences.



- The non-hybrid car can be said to be having more understeer characteristics while the hybrid is more of an oversteering car.
- A visual difference can be seen in the copse curve of the track highlighted in the image above.



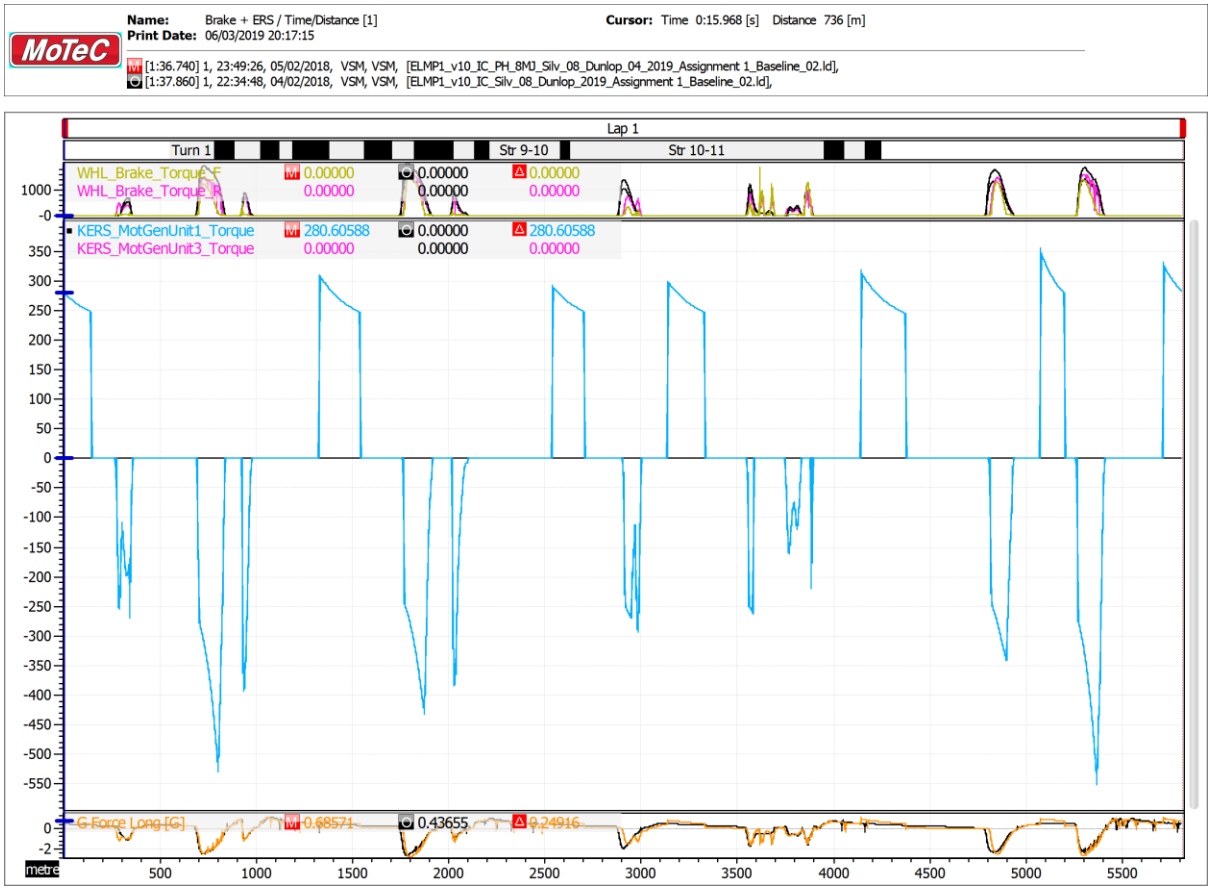
- While the understeering and oversteering trait is shown by one of the cars at almost every stage it might not necessarily be because of the drivetrain. Every driver prefers different setups and the driver in the hybrid might prefer oversteering car while the driver in the non-hybrid car prefers understeering.
- It is also noted that the hybrid car is driven around with an average of 68% throttle position over the lap while the non-hybrid averages 66% throttle position over the lap.

Energy Used During the Race: Hybrid vs Non-Hybrid

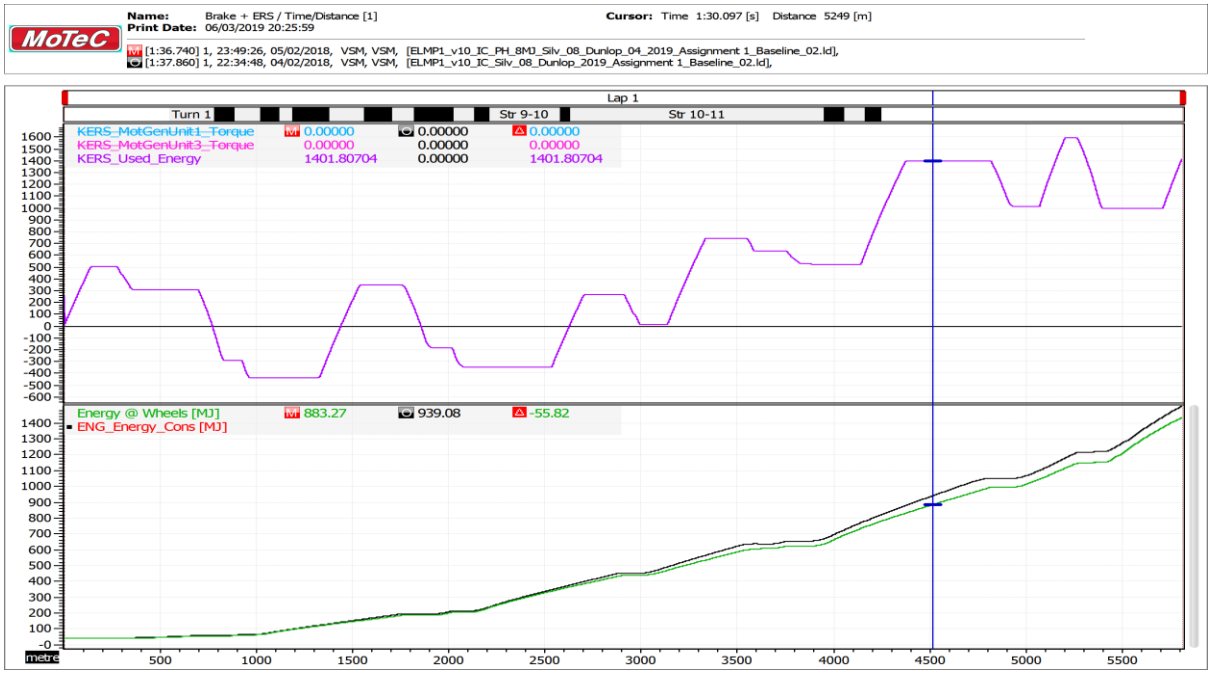
- Energy released is obviously different for each of the cars as the hybrids have motors which acts as an additional source for energy consumption. However, the presence of electric motor means the engine could be downgraded resulting in less petrol energy consumption.

2019 Silverstone TRACK 5.141 km (3.194 mi)			
		Hybrid	No Hybrid
Aero	% DF&Drag	100	100
Weight Distribution	% Front	53	53
Engine Power	HP (kW)	600 (447.4)	670 (499.6)
Released Energy	MJ/Lap	5.369	0
Released Power	kW	300	0
Car Mass	Kg	878	833
Petrol Energy	MJ/Lap	60.0	101.4
Max Petrol Flow	Kg/h	80.2	110
Petrol per stint (maximum)	Kg	35.2	52.9

- The energy consumed is compared in terms of CO_2 emissions for the IC engine, while the motor's energy consumption is added in the hybrid car. In the non-hybrid car petrol energy is 101.4 MJ/lap, while in the hybrid car petrol energy is a mere 60MJ/lap. Apart from the petrol energy another 5.369 MJ/lap is consumed by the electric motor.



- In hybrid one big advantage is regenerative braking. This means the energy during braking is stored and used on the straights. This technically reduces the energy used during the race in case of the hybrids as there is no or very little loss in energy.
- While the above graphs show the heat energy from braking being used, there is another type of energy being stored and used in the hybrid car, kinetic energy. The deployment of this system is called KERS (Kinetic Energy Recovery System).



- The energy at wheels in case of the non-hybrid car is higher ass can be noted in the image above.
- While in the above image it can also be seen that the kinetic energy is conserved and reused at every phase on the track. This essentially makes the hybrid car more energy efficient.
- The hybrid in all is able to make more use of the energy supplied and the waste is kept to minimum because of the deployment of energy recovery systems like the MGU-H and MGU-K units. These Motor Generative Units (MGU) are capable of providing the boost to the hybrid cars on the straights.
- The hybrid cars in all generates 402 hp more just with the motor system, which is essential to fulfil for the 50hp deficit in the IC engine.