



Project 15 / Concept Car – Formula DGR Zero

Track performance study 1



v1.0
23 October 2025
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1 The concept

**The Formula DGR Zero car is a future concept, electrically-powered racecar, by Lucas Di Grassi.
The Formula DGR Zero car design is intended to define new boundaries in racecar laptime and efficiency.
This study suggests it can be comfortably quicker than a Formula 1 car around Monaco circuit.**

The cars design incorporates electrically powered-downforce as a key performance component.
As such, the car is capable of transformative aerodynamic capability around the lap.
Unlike traditional naturally-aspirated car aerodynamics, this powered-downforce can be decoupled from car speed and car state, to deliver aerodynamic force where it is most beneficial around the lap.

1 The concept



1 The concept



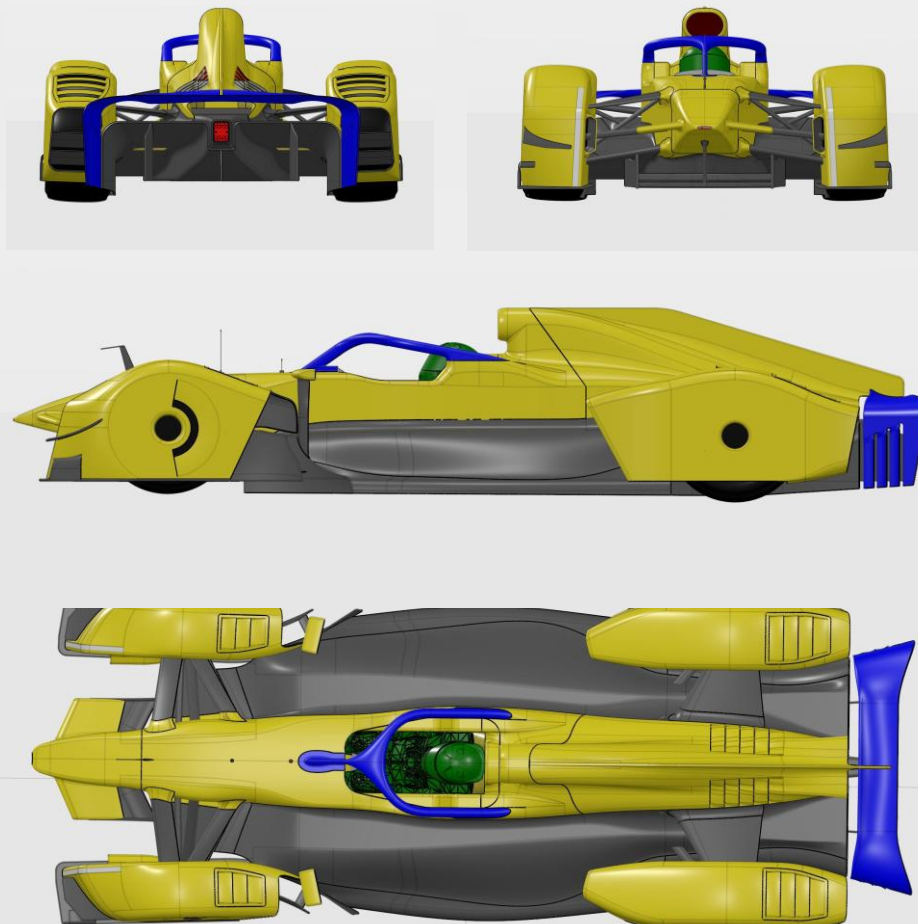
1 The concept



2 Design and specification

Key features

1. **Baseline** / the car base spec is a derivative of the FE Gen4 core specification
2. **Powered downforce** / 2 x 30kW fans and associated volumes for the complete system have been packaged
3. **Reduced Qualifying weight** / a novel modular battery layout, intended to enable optional removal of 200kg of battery mass for additional qualifying session performance
4. **Increased power** / +100kW by increasing deployment limit to 350kW on the front axle (w.r.t the 250kW FE Gen4)
5. **Reduced drag** / baseline package (with no powered downforce) has a CFD estimated ~-20% aero drag, relative to tunnel measured FE Gen4 car data



DIMENSIONS

Wheelbase	3000	mm
Front track width	1520	mm
Rear track width	1500	mm
Overall car length	4885	mm
Overall car width	1900	mm
Overall car height	950	mm
Front overhang	820	mm
Rear overhang	1016	mm

TYRES

Front tyres	295/45R18
Rear tyres	345/35R18

POWERTRAIN

Front electric motor max power (kW)	350	kW
Rear electric motor max power (kW)	350	kW
Front electric motor max torque (Nm)	300	Nm
Rear electric motor max torque (Nm)	300	Nm
Front electric motor weight (kg)	57	kg
Rear electric motor weight (kg)	57	kg
Battery race energy (kWh)	55	kWh
Battery volume (L)	320	L
Battery weight wet (kg)	380	kg

WEIGHT

Race config		
Car weight including driver (kg)	1100	kg
Car weight distribution (%front)	45	%Front
CoG height above ground	280	mm

Quali config (~200kg)

Car weight including driver (kg)	900	kg
Car weight distribution, %front	45	%Front
CoG height, above ground	300	mm

AERODYNAMICS

Frontal area (m2)	1.27	m2
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No powered downforce

CD	0.48	0
CL	2.65	0
CL/CD	5.58	0
Aero balance	32	%Front

With powered downforce

CD	Variable	0
CL	Variable	0

V1.3 - 06/10/2025

S.LAMOUR



3 The study



Objectives

1. Run simulations to provide an initial lap-time estimate of the car around Monaco
2. Benchmark performance against Lola's current FE Gen4 baseline car simulation
3. Compare lap-time against fastest track Formula 1; 69.9s, NOR/MCL 2025
4. Summarise key around-the-lap performance characteristics

Method

- All simulations were performed at Monaco circuit.
- This phase of study focuses on the performance delta due to the powered-downforce component, expecting this to be the performance dominant specification change.
- Total downforce is ~15kN, independent of vCar.
- This 15kN comprises both traditional (naturally-aspirated) bodywork downforce and powered-downforce components.
- 15kN is approximately equivalent to the downforce of the baseline FE Gen4.0 car at 320kph.
- In baseline downforce-mode, the car is designed to target constant total downforce around the lap by varying the powered-downforce component with vCar. The powered-downforce component reduces with vCar towards ~0N at 320kph.
- The car has technology packaged that is specified to be capable of delivering in excess of 15kN powered-downforce by around +30% margin.
- The 15kN aero load operating point means that, generally, max design loads (chassis, suspension, tyres) remain largely unchanged, to ease design evolution and retain underlying car mechanical integrity.
- Further 'development' downforce-modes can be devised to suite different objectives. The 'flat' baseline downforce-mode studied here demonstrates well the transformative effect of the powered-downforce package and is also a good track start point regarding drivability.
- Several variants, about the specified package, were also simulated to better understand base sensitivities and establish lap-time equivalence of the powered-downforce gains, against motor power and energy consumption.
- At this level of study, no detailed secondary optimisation of the car configurations has been performed (e.g. ride height, EMS, balance, racing line).
- For clarity, the mechanical spec differences (WD, CG height, wheelbase etc.) of the DGR car have not been included as these are considered secondary in magnitude.
- As always absolute lap-time estimates should be treated with caution, with error roughly estimated here at +/-2s.

4 Results / Lap times

The simulated DGR car can comfortably be quicker than the current fastest Monaco F1 track lap.

Adding the powered-downforce of the DGR car, to the FE G4.0 specification gives -13s, to a 65s lap.

Adding the further 3 main attributes of the DGR car spec (+100kW, -200kg, -16Pts CD) gives a further -5.6s, to under 60s (in black).

The current fastest F1 lap-time can be matched with the DGR p1 (+Fz only) car with just 400kW, and FE Gen4 lap-time matched with 200kW (in green).

The full spec DGR car (p4) matches F1 track-time with 250kW power (in blue).

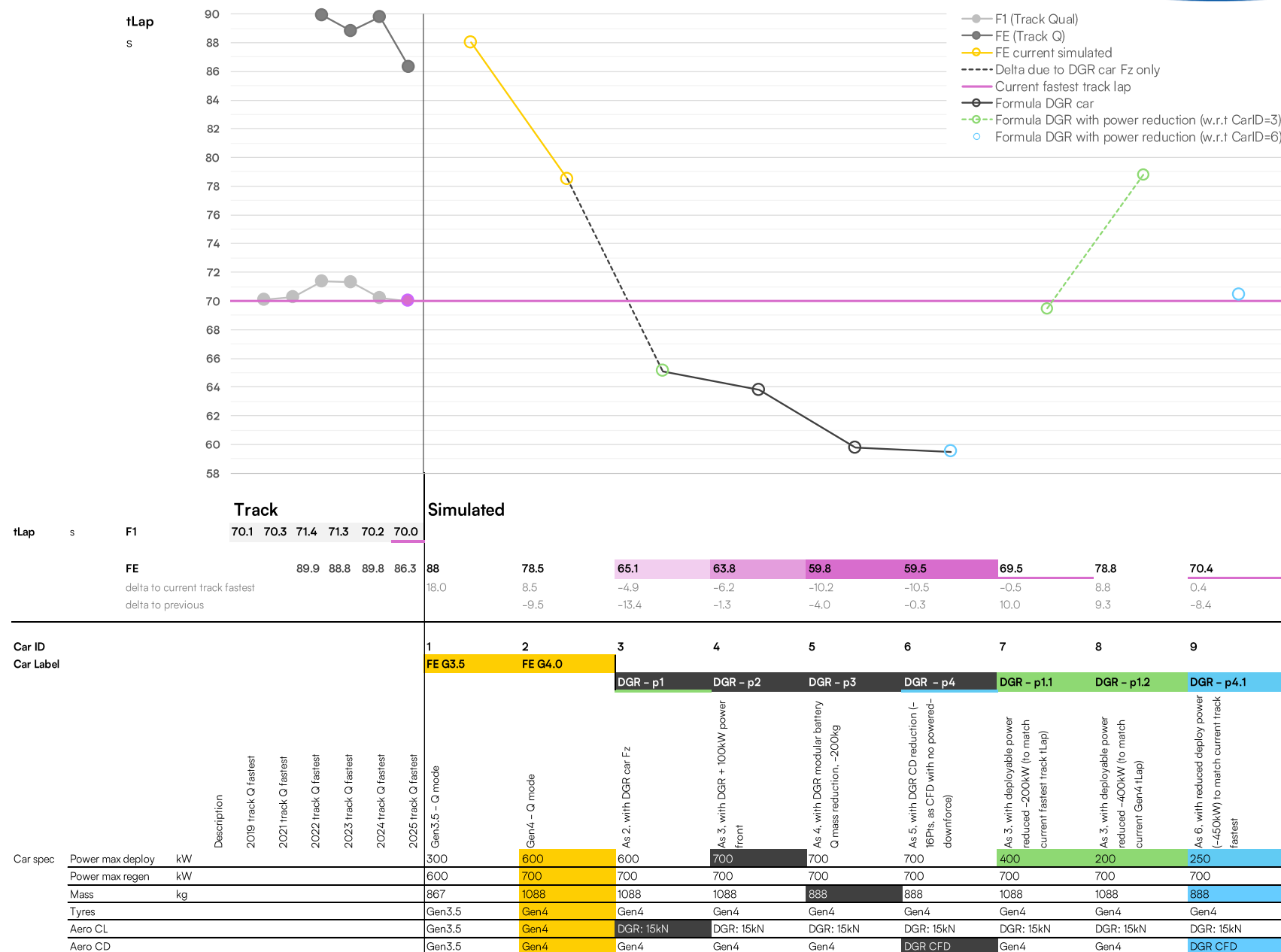


Figure 1, right
Shows lap-times for key configs in this study. Recent F1 and FE recorded track times are shown left. To the right of the vertical line follows: 1. Baseline reference simulations for FE Gen3.5 and Gen4 cars. 4 DGR car configs (black), which incrementally add the primary DGR attributes (+powered-Fz, +power, -mass, -CD) from left to right. Finally (in green and blue), deployable power is reduced relative to DGR p1 (+Fz only) and DGR p4 (full), to roughly match fastest F1, and current simulated FE Gen4 lap-times. Coloured car spec values highlight spec changes w.r.t previous column.



4 Results / The Lap

Car comparison /

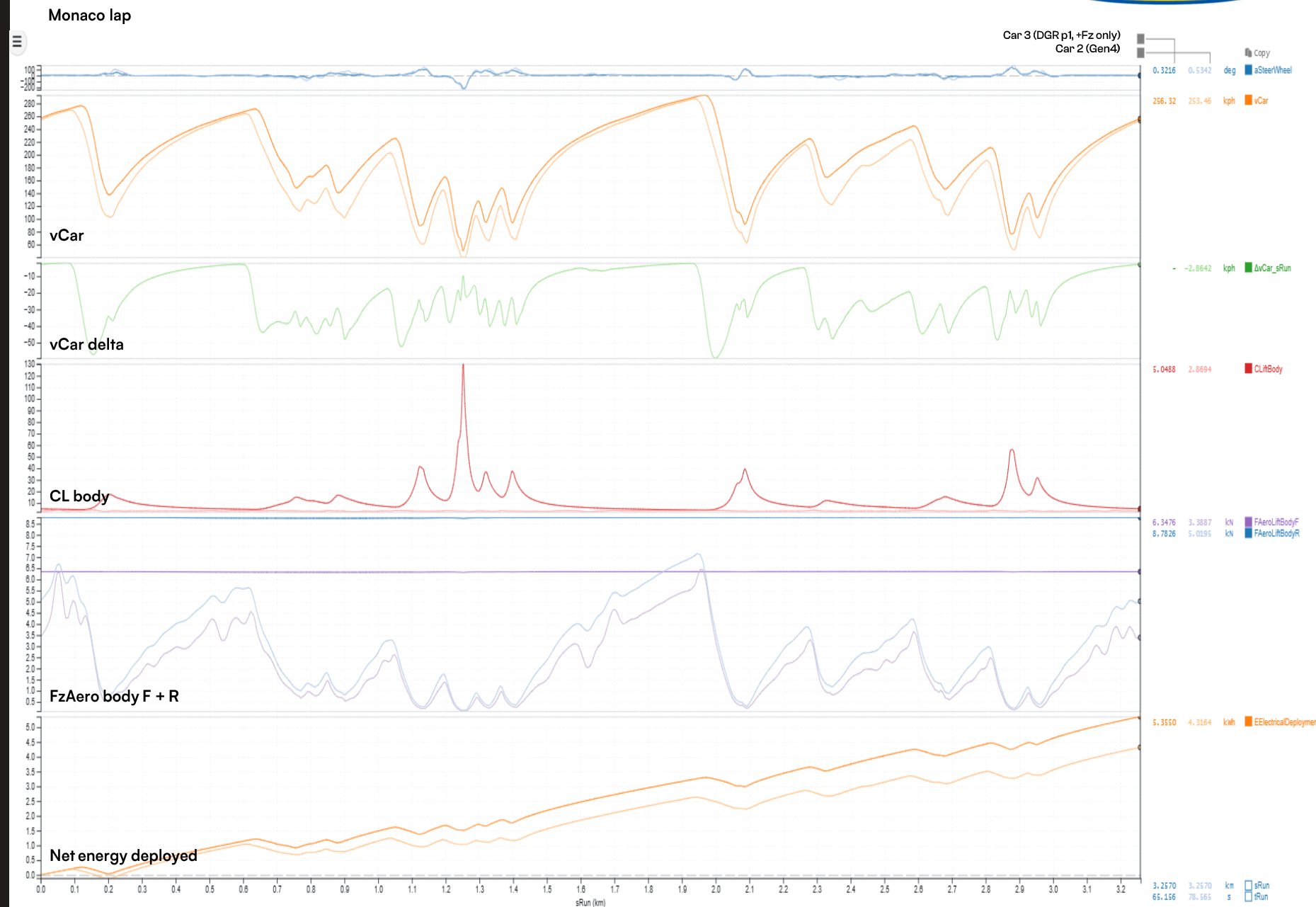
Car 2, 78.5s – FE G4.0 vs
Car 3, 65.1s – DGR p1 (+Fz only)

Right shows lap performance changes due to the DGR car's powered-downforce component only, relative to FE Gen4.0.

The DGR car is shown in bold lines.

The number values, shown far right, correspond to the cursor position, positioned here at end-of-lap.

Note that the 'Net energy deployed' shown, results from motor power only — it does not include additional energy required for the powered-downforce component at this stage. Please refer to section 6 for more information on overall energy considerations.



4 Results / The Lap

Car comparison continued /

Here looking at the same lap comparison in terms of corner apex performance:

With DGR powered-downforce, apex speeds are increased by 33kph on average, with medium speed corners showing the highest apex speed increases of close to 50kph.

The plotted CL factor curve shows the transformative effect the DGR car provides to traditional aerodynamics around-the-lap.

For context, a typical F1 car may have a corresponding CL of roughly 6. A typical seasons aero development may yield around +50Pts CL.

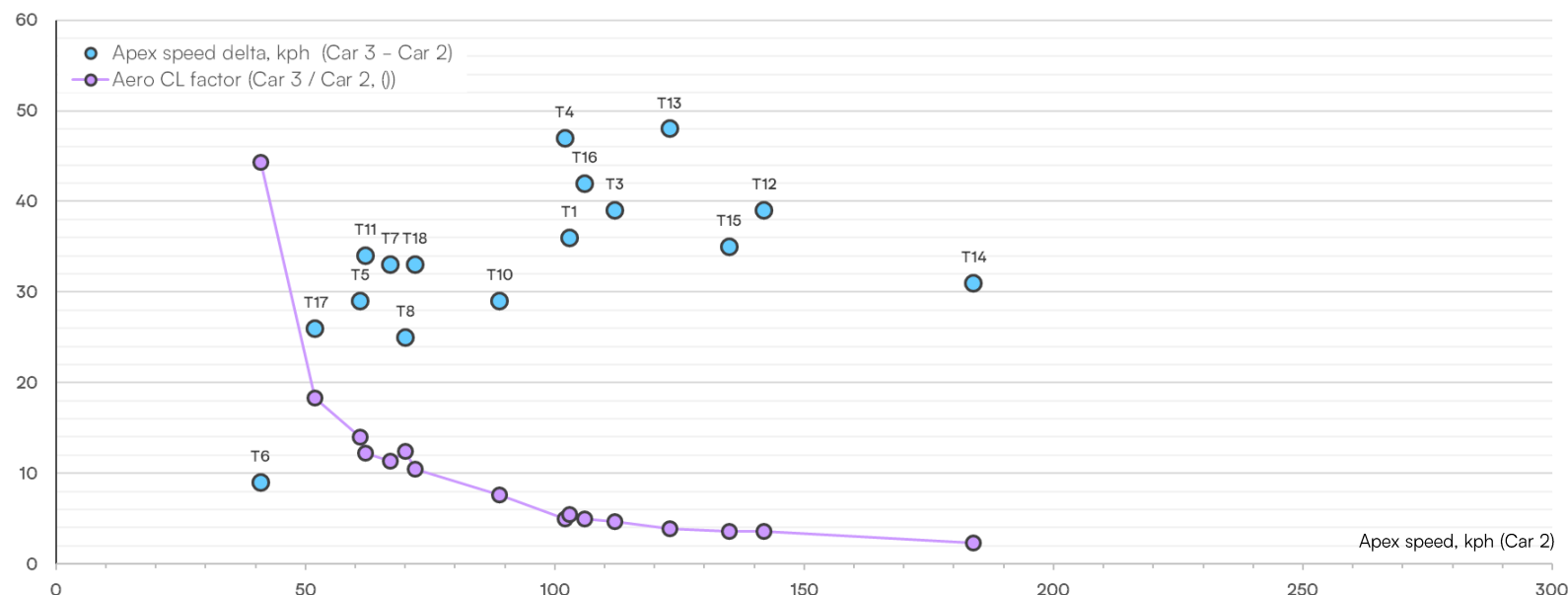
Even at the highest Monaco apex speed (T14 Piscine) CL is increased 2.4x, exceeding F1 CL levels, with gains equivalent to many seasons worth of development. Monaco is a low-speed circuit, but even at ~100kph, CL gain is equivalent to ~2000Pts (e.g. T4, T10)

This car unlocks a whole new space in around-the-lap aero performance delivery, by providing EOS speed magnitude aero Fz across the speed range, and importantly, with biggest increase in downforce at low speed, where it is most valuable for lap-time.

Figure 3, right

Turn apex values from the same lap comparison in the previous slide are shown right for guidance. Turns are ordered by increasing apex speed from left to right.

Corner apex values



		Turns in increasing apex speed order ->																
Turn #			T6	T17	T5	T11	T7	T8	T18	T10	T4	T1	T16	T3	T13	T15	T12	T14
Apex values																		
vCar	Car 2 - Gen4	kph	41	52	61	62	67	70	72	89	102	103	106	112	123	135	142	184
	Car 3 - DGR p1 (+Fz aero)	kph	50	78	90	96	100	95	105	118	149	139	148	151	171	170	181	215
	Delta (Car 3 - Car 2)	kph	9	26	29	34	33	25	33	29	47	36	42	39	48	35	39	31
	Multiple factor (Car 3 / Car 2)	()	1.22	1.50	1.48	1.55	1.49	1.36	1.46	1.33	1.46	1.35	1.40	1.35	1.39	1.26	1.27	1.17
CL	Car 2 - Gen4	()	2.9	3.0	2.9	3.0	2.9	3.0	2.9	3.1	3.0	3.1	3.0	3.1	2.9	3.2	2.8	3.0
	Car 3 - DGR p1 (+Fz aero)	()	130.2	54.3	41.2	36.3	33.1	37.1	30.1	23.8	15.0	17.1	15.1	14.5	11.3	11.5	10.1	7.1
	Delta (Car 3 - Car 2)	Pts	12726	5129	3821	3334	3018	3406	2722	2070	1197	1395	1205	1145	845	827	733	411
	Multiple factor (Car 3 / Car 2)	()	44.3	18.3	14.0	12.2	11.3	12.4	10.4	7.7	5.0	5.5	5.0	4.7	3.9	3.6	3.6	2.4
Fz	Car 2 - Gen4	kN	0.2	0.4	0.5	0.5	0.6	0.7	0.7	1.1	1.4	1.5	1.6	1.8	2.0	2.7	2.6	4.7
	Car 3 - DGR p1 (+Fz aero)	kN	15.0	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
	Delta (Car 3 - Car 2)	kgF	1511	1503	1485	1487	1479	1472	1472	1426	1390	1386	1384	1356	1339	1271	1282	1064
	Multiple factor (Car 3 / Car 2)	()	68.4	41.3	30.1	28.5	25.6	22.6	22.2	13.4	10.5	9.9	9.8	8.5	7.6	5.7	5.9	3.2
gLat	Car 2 - Gen4	g	1.4	1.5	1.5	1.6	1.4	1.6	1.5	1.6	1.7	2.0	1.8	1.9	1.7	1.9	1.6	2.1
	Car 3 - DGR p1 (+Fz aero)	g	2.5	3.1	3.1	3.1	2.9	3.1	2.8	2.9	3.1	3.4	3.1	3.2	3.1	3.0	2.9	2.9
	Delta (Car 3 - Car 2)	g	1.1	1.6	1.5	1.5	1.5	1.5	1.3	1.3	1.3	1.4	1.3	1.3	1.3	1.1	1.3	0.8
	Multiple factor (Car 3 / Car 2)	()	1.8	2.1	2.0	1.9	2.0	2.0	1.9	1.8	1.8	1.7	1.7	1.7	1.8	1.6	1.8	1.4

5 How?

1 / 3

A side note on aero force vs aero coefficients with car speed and why powered-downforce provides a transformative step in typical around-the-lap aero performance, and resulting lap-time.

Conventional aero forces and development:

- For fixed bodywork aero downforce generally increases as a function of v_{Car}^2
- e.g. $2x v_{Car} \rightarrow 4x F_{zAero}$, $F_z @ 300kph = 8x F_{zAero} @ 100kph$
- This is shown by the yellow line right and this parabolic increase with speed is typical for aero forces on all 'naturally-aspirated' racecars.
- So, $F_z = C * v_{Car}^2$ where C is generally constant as racecar speed varies.
- So, aero bodywork development is typically done in the C (coefficient) reference frame for convenience.

Powered-downforce (F_z) is decoupled from this v_{Car}^2 relationship and has scope to be applied around-the-lap where it is most beneficial.

When powered-downforce is implemented as with DGR car baseline mode, shown right, the equivalent relative increase in 'effective' aero CL at low speed is huge, with respect to the conventional aero development domain.

As a context guide for the Aero coefficient y-axis scale shown in Figure 5 (bottom right):

Typical F1 car, $CL = \sim 4-6$

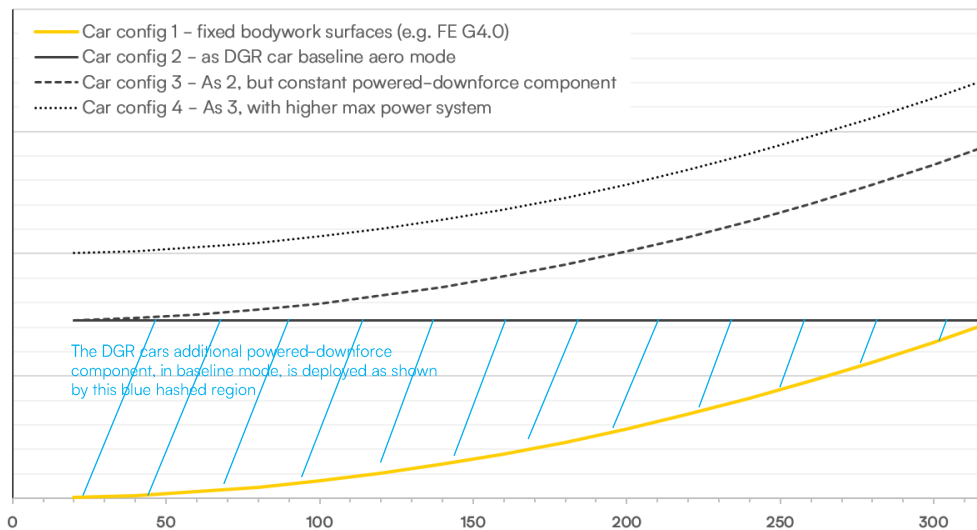
Typical F1 car season development $< +1 CL$

Typical tunnel component resolution: $CL = \pm 0.001$



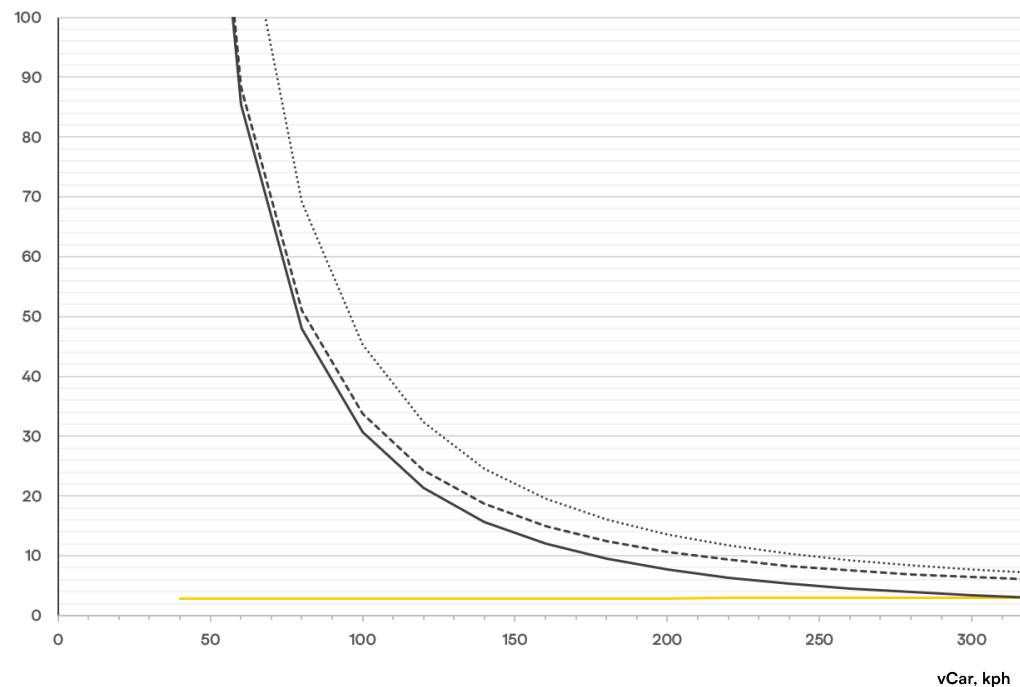
Aero F_z , N

Aero
FORCE



Aero CL , ()

Aero
COEFFICIENT



5 How?

2 / 3

Operating mode

The dashed black line right shows for reference an example of the resulting F_z Aero in a mode where the powered-downforce system is run constantly i.e independent of v_{Car} .

Increasing max F_z has several considerations. Aside from circuit and around-the-lap dependencies, importantly it would significantly increase max design loads (chassis, suspension, tyres) and hence introduce notable underlying car redesign work and uncertainty.

Further, generally, F_z added at speeds above max cornering speed is generally not that useful, and a constant F_z is also appealing from a drivability / understanding perspective in the early track development phases.

For the above reasons, the initial DGR cars baseline mode aims to achieve the flat solid black F_z line shown above right. There are of course many further development opportunities, for optimal deployment of this powered-downforce, to target lap-time, energy efficiency and raceability.

Powered-downforce gain

Adding more powered-downforce is limited by several factors, but essentially can be achieved by installing a more powerful system.

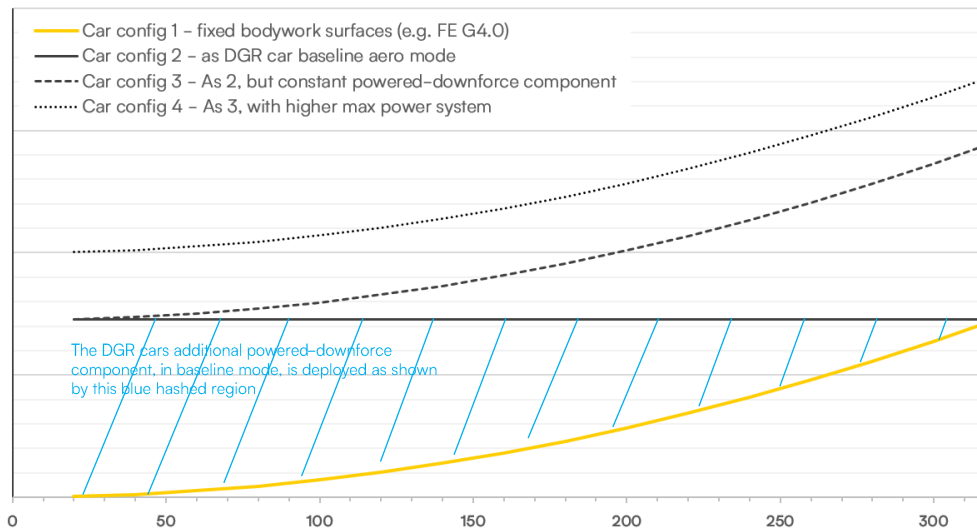
This would move the F_z envelope toward the dotted line shown right.

The DGR cars specified system (and packaged technology) is sized to have around +30% F_z margin. This additional F_z is available for dynamic compensation (e.g. control, excursion response, unexpected track sensitivities etc.)



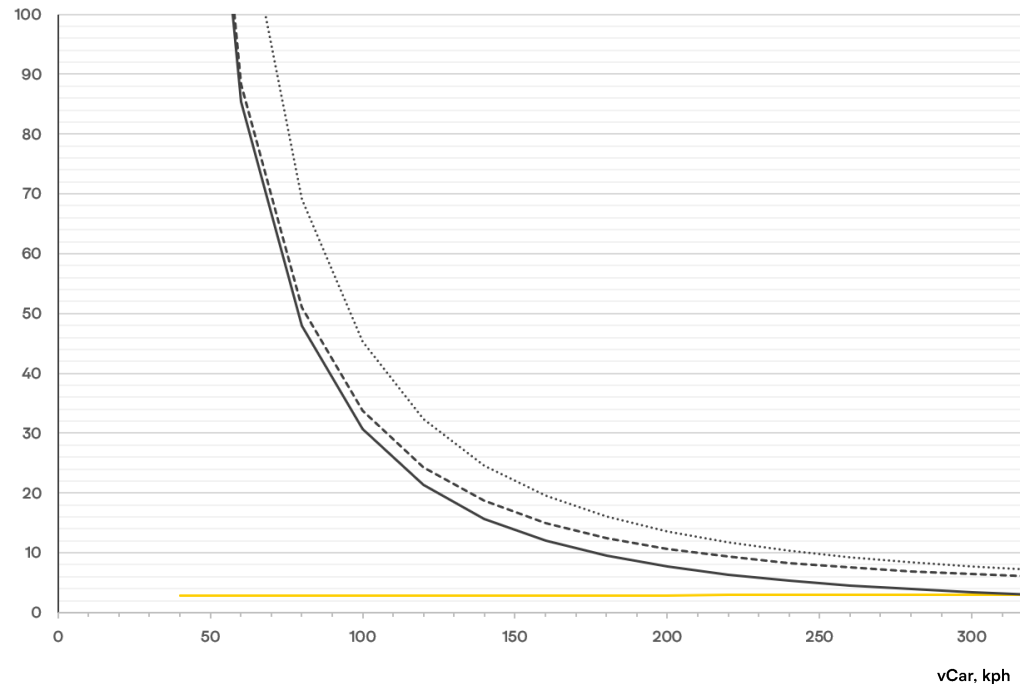
Aero F_z , N

Aero
FORCE



Aero CL, ()

Aero
COEFFICIENT



5 How?

3 / 3

Where downforce is most useful

The figures right show the distribution of where, in car speed, additional downforce will give lap-time benefit around Monaco.

Force is even more useful at low speed:

Again, equivalent 'Force' and 'Coefficient' curves are shown to contrast. Monaco is a low-speed circuit and hence, even in the typical 'Coefficient' development reference frame, CL gains (top figures) in low speed give relatively high reward. However, when this distribution is re-normalised to gains per unit Force (bottom figures), as per the powered-downforce reference frame, this further tips this aero lap-time weight toward lower speed. Powered-downforce is able to add downforce in a very lap-time efficient way, where it is fundamentally most useful around a typical race circuit, and in a much greater magnitude than is possible with traditional 'non-powered' racecar aerodynamics.

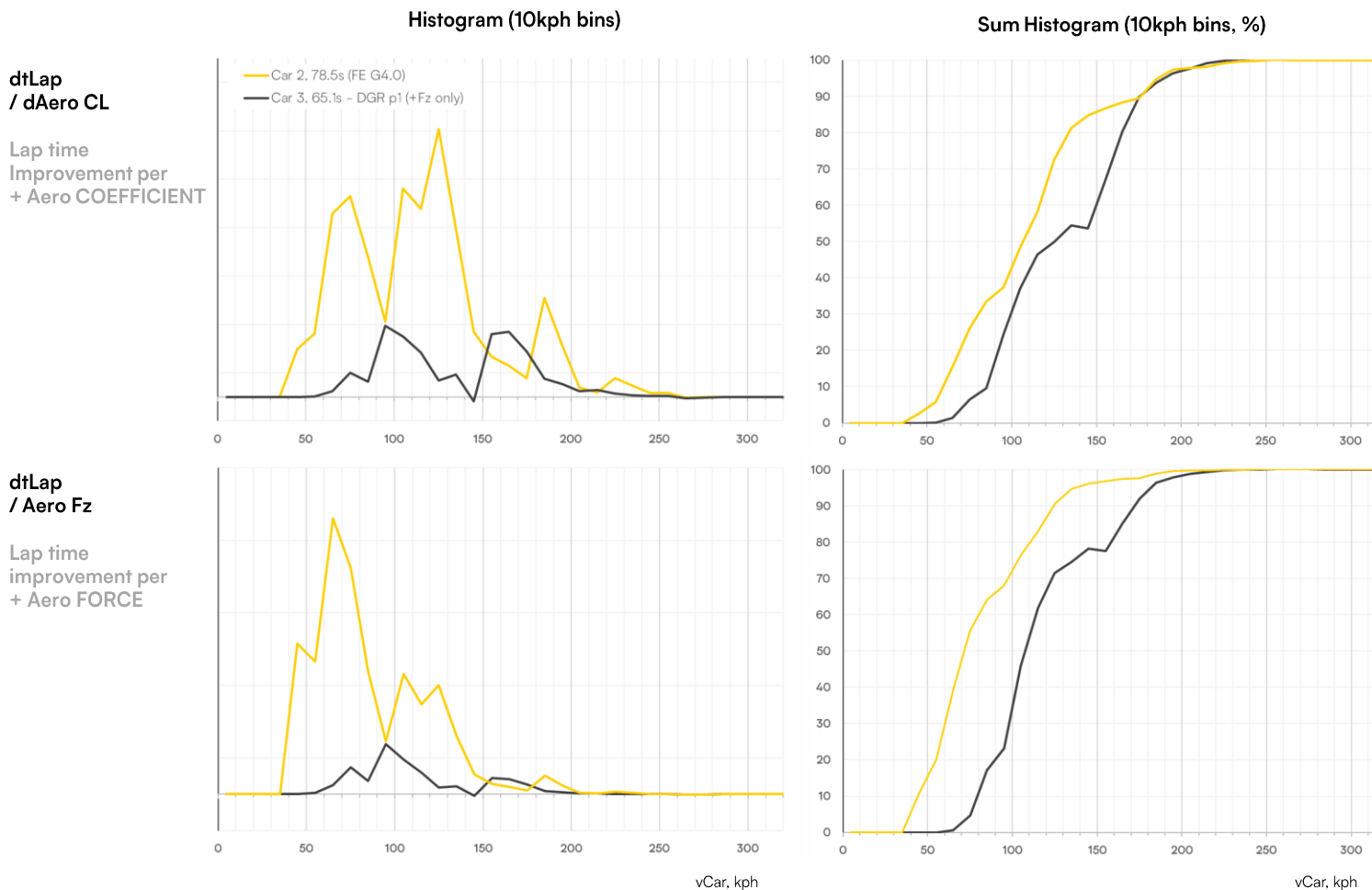
Approaching tyre limits

Note the much-reduced downforce lap-time sensitivity (area under curve) with the DGR car, relative to the FE G4.0 baseline.

There are several reasons for this absolute scaling, as grip:power limited regions and lap-times change as significantly as with the DGR car performance delta. However, in this case, with its specific tyre envelope (FE G4.0), this is thought mainly a symptom of Fz increasing sufficiently to approach the limits of max lateral grip. So, adding further Fz tends toward zero Fy returns, and hence adding 1N Fz gives a much smaller lap-time improvement. This is better shown by the powered-downforce sweep curve in section 6.



Around-the-lap aero downforce sensitivity;
Monaco lap
Distributions with car speed





6 Energy efficiency



The lap-time performance of the DGR car has now been established.

This section now considers the accompanying energy implications of the DGR car lap:

1. Lap-time equivalence of motor power vs downforce power
2. vCar profile comparisons, trading motor and downforce power (to help inform future car/race/event design)
3. Energy consumption comparison

6 Energy efficiency

1/ Considering the lap-time equivalence of motor power and downforce power

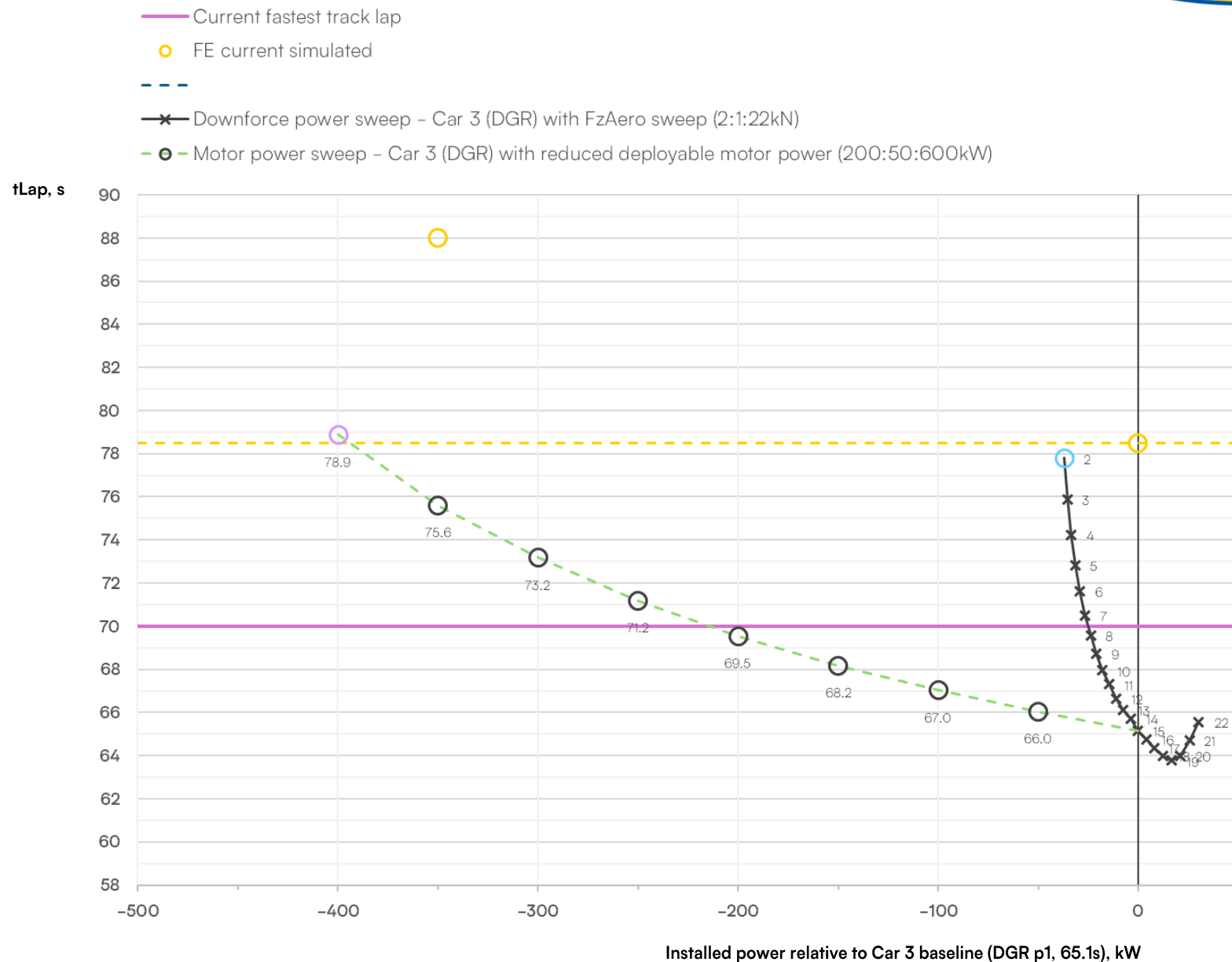
Relative to Car 3 (DGR p1), with 65.1s lap, the figure right shows lap-time sensitivity to:

1. Reduced motor max deployable power (circle markers)
2. Reduced downforce (x markers)

- Note that the powered-downforce is a much more efficient route to lap-time improvement.
- The isochronal ratio of installed motor : downforce power is roughly 10:1, across the sweep range.
- e.g. roughly 400kW motor, or 40kW downforce power can increase lap-time from 65s back to the FE G4.0 baseline, 78s
- The DGR car is capable of matching the current fastest (F1) lap-time of ~70s with around -200kW deployable motor power.

Aside, as another reference of how well the powered-downforce redistributes downforce around the lap: only 2kN flat downforce is lap-time equivalent to the FE G4.0 aero bodywork package which achieves 15kN @ 320kph

Figure 10, right — Lap-time sweeps in FzAero and deployable max motor power, relative to Car 3 (DGR p1) (When reducing downforce Fz was constant offset lower. In reality these lower values of aero downforce could be achieved as the sum of any combination of underlying NA bodywork, and powered-downforce components. E.g 2kN = 0 aero bodywork + 2kN constant powered downforce)





6 Energy efficiency

2.1/ Lap comparison of 2 cars each with ~78s lap time

(as an example of motor power spec vs lap performance trades made available by the DGR car) :

1. Car 2, FE G4.0, 78.5s

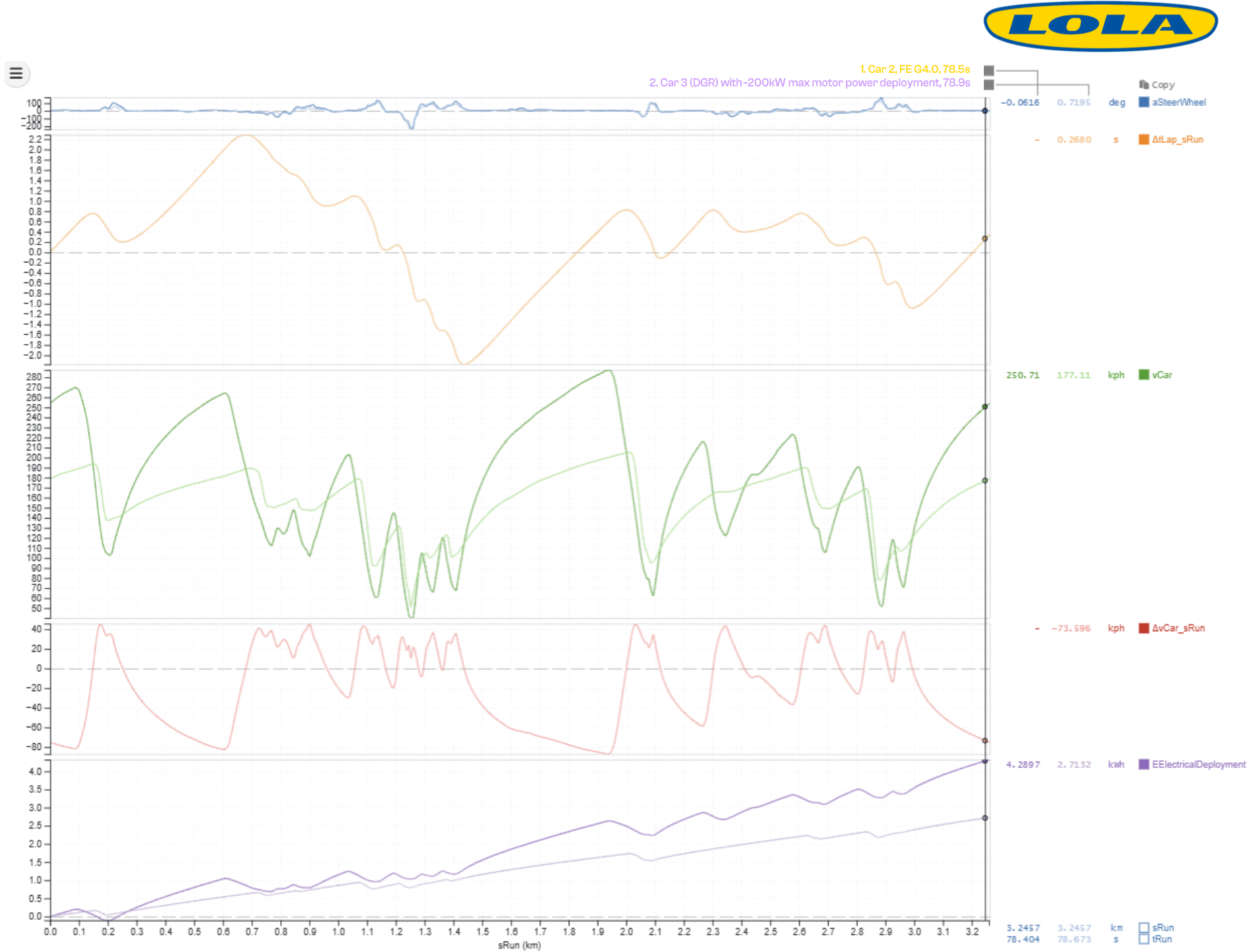
SHOWN IN BOLD LINES

2. Car 3 (DGR) with -400kW max motor power deployment, 78.9s

Note the lap energy spend (EElectricalDeployment):

- This data is motor power only — it DOES NOT include the additional powered-downforce power.
- Motor power energy spend, for the same lap-time, is reduced by 37% (= 1.6kWh / lap)
- The additional powered-downforce energy spend for this Car 3 lap is ~0.57kWh, giving 3.28kWh lap total
- With this powered-downforce energy included, the DGR package gives a net reduction in energy spend of 24%
- (This comparison does not include any compensation for secondary car spec effects (e.g. mass reduction) that could result from the efficiency improvement, for a given event scenario)

Figure 11 (right)
Compares Monaco lap simulation data for 2 key cars from Section 6.1. with roughly equivalent lap-time: Car 2 (FE G4.0) lap vs Car 3 (DGR) with 200kW deployable power





6 Energy efficiency

2.2 / Lap comparison of 2 cars each with ~78s lap time

(as an example of power-downforce distribution effectiveness) :

1. Car 2, FE G4.0, 78.5s

SHOWN IN BOLD LINES

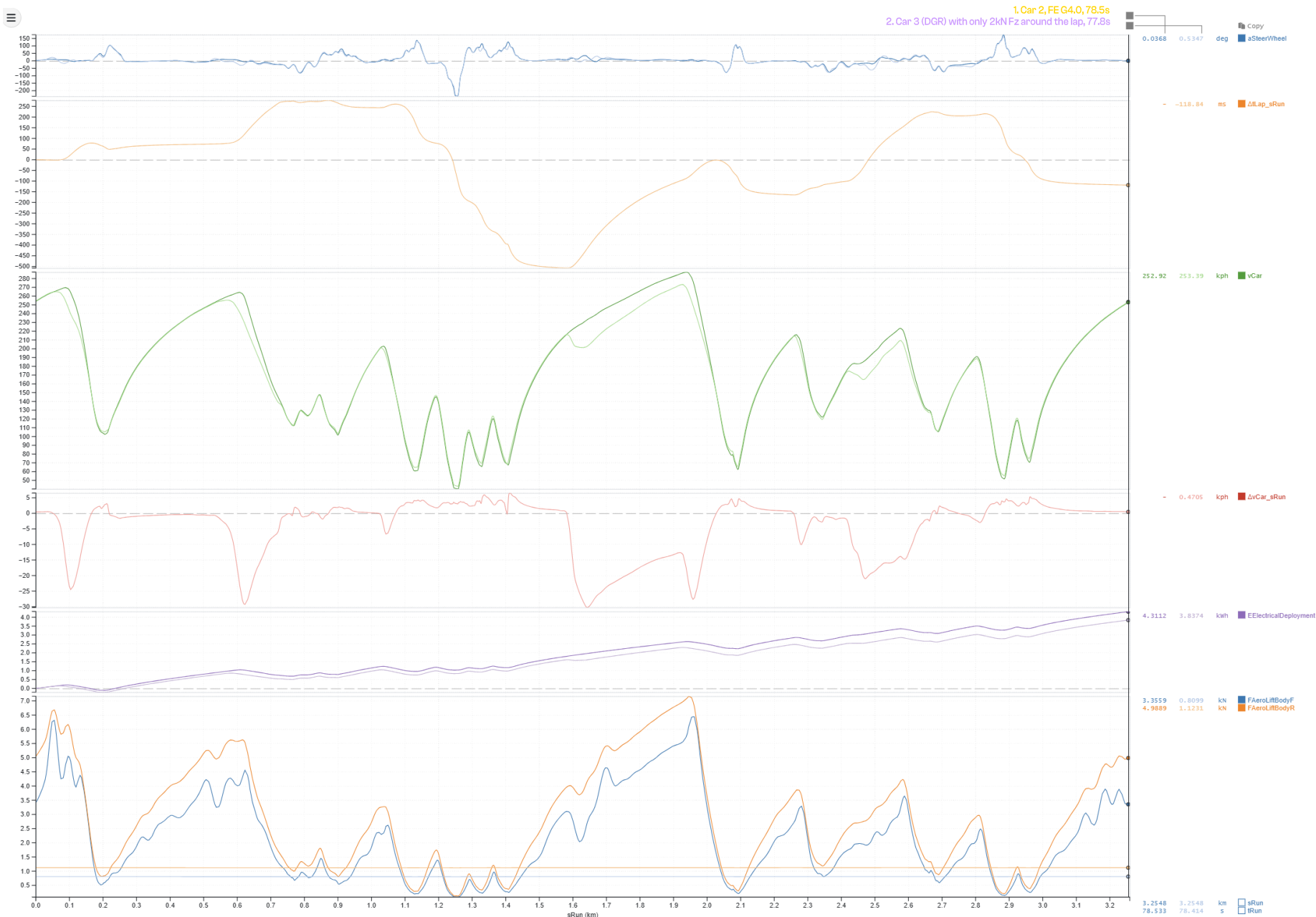
2. Car 3 (DGR) with only 2kN Fz around the lap, 77.8s

This example shows how effectively the powered-downforce system is able to redistribute aero Fz around the lap.

It is able to achieve the same lap-time with only ~13% of the peak downforce on the traditional aero car (2kN w.r.t 15kN). See section 5 for more information on how that is possible.

(As with 2.1, secondary effects and re-optimization to exploit this change in Fz, are not considered further in this initial study)

Figure 12 (right)
Compares Monaco lap simulation data for 2 key cars from Section 6.1. with roughly equivalent lap-time: Car 2 (FE G4.0) lap vs Modified Car 3 (DGR) with only 2kN of net FzAero (instead of 15kN)



6 Energy efficiency

3 / Energy spend comparison with lap-time, with the DGR car

Shows net lap energy usage for the max motor power out sweep shown in 6.1, for reference, in case useful with further car or event spec design.

By redeploying energy from motor power to downforce power the DGR car is able to go ~7s faster, to within 1s of the fastest F1 flap, for the same total energy spend (Car 3 ~200kW).

For the same lap-time, the DGR car offers ~20% reduction in energy consumption.

These relatively large factors in vCar, braking point, mass, range with the DGR car, also open up some potential config trades for car/event design.

The estimate for the lap energy usage of the powered-downforce is based on the baseline 65.1s lap. This is used as a constant offset for all configs shown. It is expected that, in reality, powered-downforce energy will increase slightly with slower lap-time due to the lower average speeds, but these more refined estimates for each config are not included here in this initial study. This would tend to make the reduction with the 78s lap not quite as big as 24% shown right.

Figure 13, right — Total net lap energy used = motor + powered-downforce, for Car 3 (DGR p1), 65s and reductions in max motor power out from that baseline.



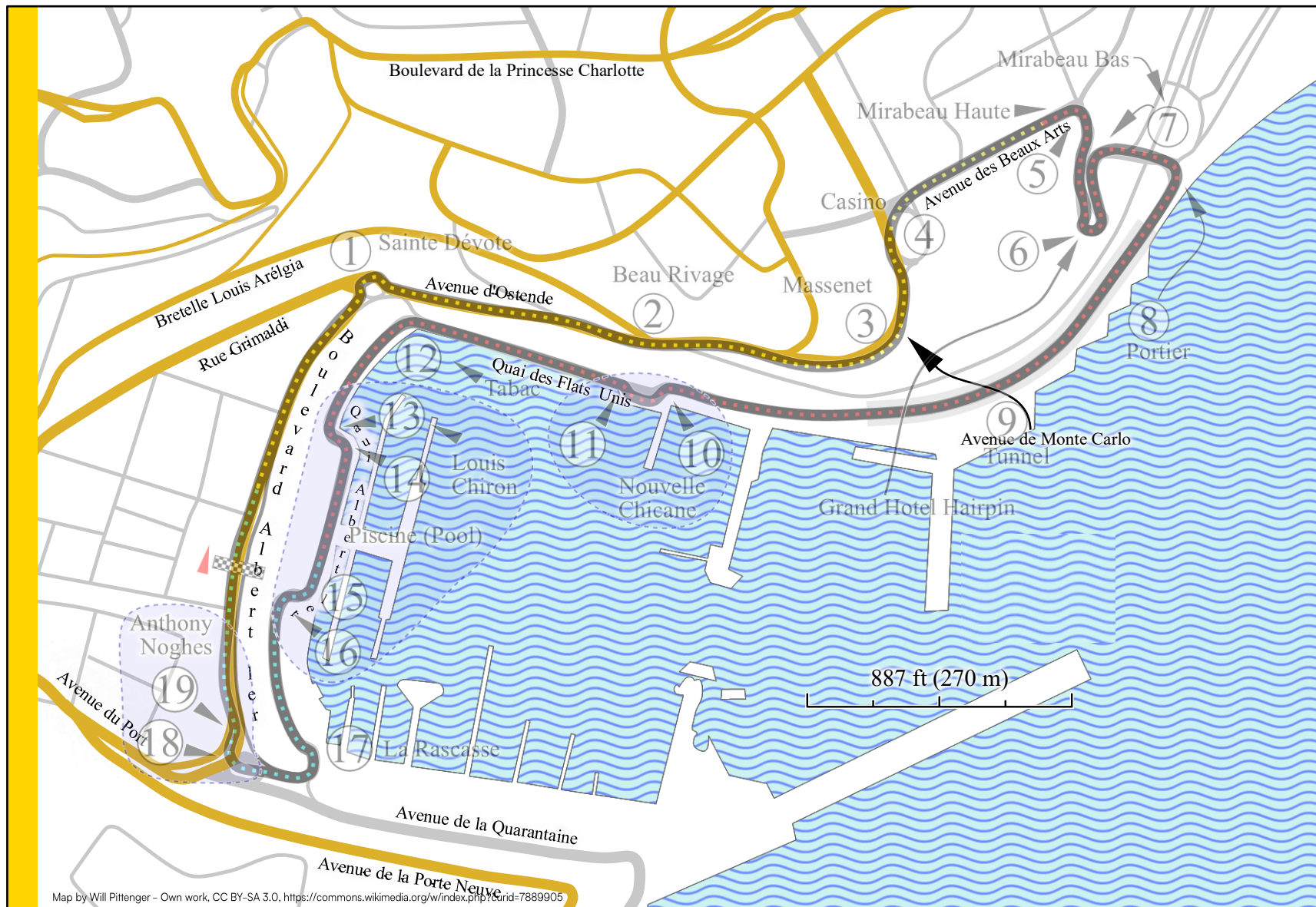
7 Conclusion

The section header "7 Conclusion" is positioned at the top left. It is preceded by a decorative graphic consisting of four vertical bars of increasing height from left to right, colored yellow, blue, yellow, and blue.

This study has made an initial assessment of the lap-time potential and around-the-lap performance of the Formula DGR Zero concept car, around Monaco, relative to current F1 and FE benchmarks.

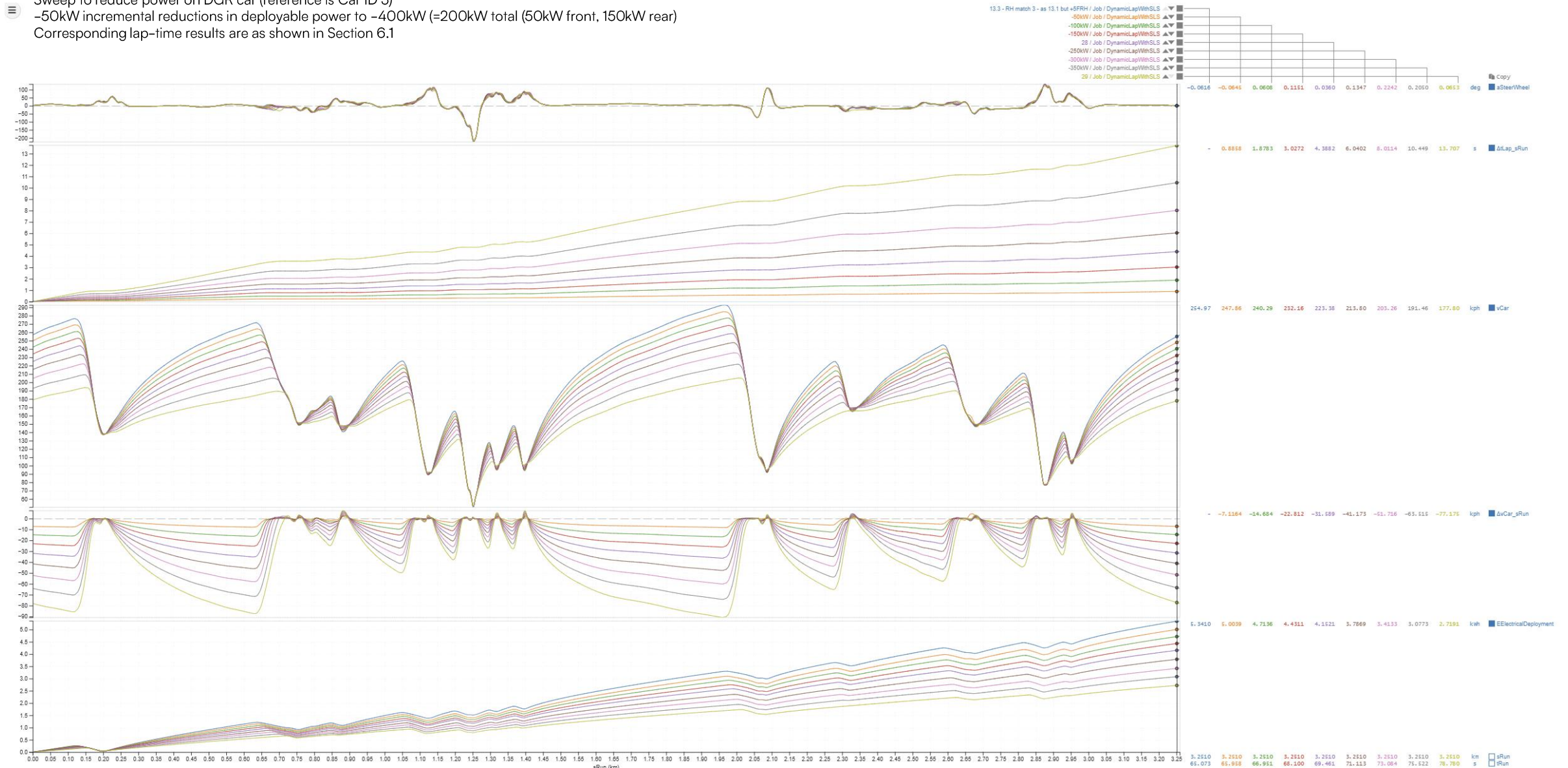
It is clear that this DGR car specification, which integrates powered-downforce with a top-tier racecar chassis, should be comfortably capable of unlocking new territory in lap-time, and the associated possibilities for both car and race event development are many.

Appendix 1 / Circuit map - Monaco



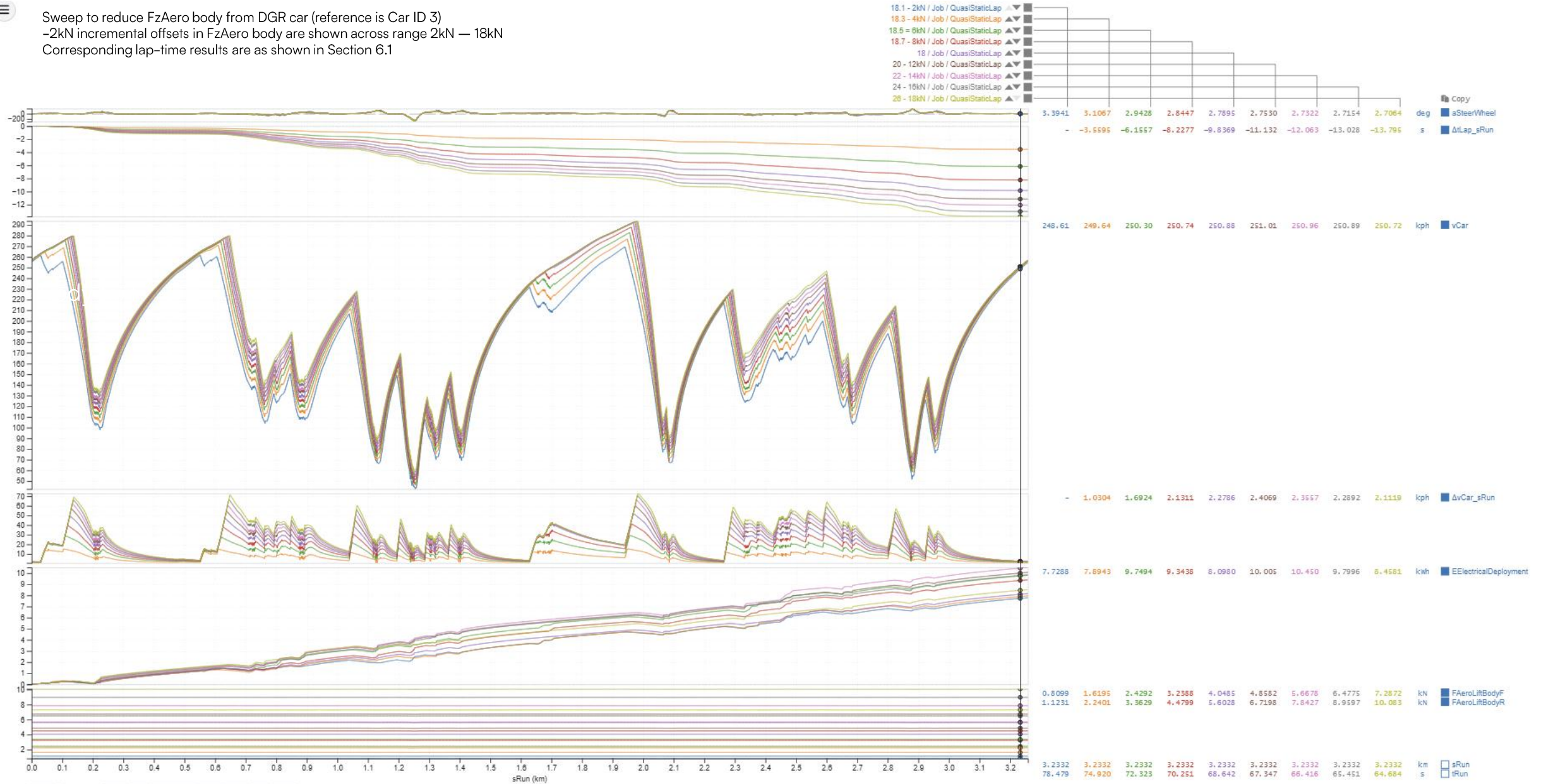
Appendix 2 / DGR Car – Sweep – Deployable motor power reduction

- Sweep to reduce power on DGR car (reference is Car ID 3)
- 50kW incremental reductions in deployable power to -400kW (=200kW total (50kW front, 150kW rear))
- Corresponding lap-time results are as shown in Section 6.1



Appendix 3 - DGR Car – Sweep – FzAero total reduction

Sweep to reduce FzAero body from DGR car (reference is Car ID 3)
 -2kN incremental offsets in FzAero body are shown across range 2kN — 18kN
 Corresponding lap-time results are as shown in Section 6.1





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