Formula E – the evolution towards all wheel drive, or not?

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Part of the Andretti Formula E team from the beginning
Press PLAY!
What is Formula E?

From a debut in the grounds of the Olympic Park in Beijing in 2014, FIA Formula E has grown into a global entertainment brand with motorsport at its heart.

11 teams and 22 drivers on the grid, 9 manufacturers on board – from Jaguar, Nissan, BMW, Audi to DS and Mahindra - Formula E serves as a competitive platform for global car manufacturers and mobility providers to test and develop road-relevant technologies.

Racing on the streets, the series acts as a catalyst, helping to refine the design of electric vehicles and improve the driving experience for everyday road car users.

Building on five seasons of racing, the championship features 13 races in 12 of the world's most progressive cities covering five continents.
The powertrain technology behind Formula E – pushing the boundaries

The current (Gen 2) Formula E Car

- 900kg all up weight including driver
- 250kW, (single or twin) Motor / Generator unit
- 52kWhr traction battery by McLaren
  - 890v, 500A output
  - 380kg
- SiC MOSFET Invertor
- Single speed transmission driving rear axle only
- Open control systems and software
- Brake by wire

Comparing to a Road car
BMW Racing eDrive01 vs. electric drive in the BMW i3:

<table>
<thead>
<tr>
<th>Feature</th>
<th>BMW Racing eDrive01</th>
<th>BMW i3 electric drive</th>
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</thead>
<tbody>
<tr>
<td>Weight of drive</td>
<td>-50 percent</td>
<td>+50 percent</td>
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<tr>
<td>Performance of drive</td>
<td>+100 percent</td>
<td>-50 percent</td>
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<tr>
<td>Size of drive</td>
<td>-66 percent</td>
<td>+50 percent</td>
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<tr>
<td>Energy density of drive</td>
<td>+300 percent</td>
<td>-50 percent</td>
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<tr>
<td>Torque density of drive</td>
<td>+100 percent</td>
<td>-50 percent</td>
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The evolution toward AWD – brake regeneration

In Season1→4, heavy cars, low-downforce, two wheel drive, treaded all-weather tyres and sensitive brakes. Lap by lap manual brake bias adjustment as regenerative system performance varied with state of charge and battery temperature. All being managed on a bumpy low-grip street circuit with closely lined with walls. That’s a lot of things to get right!

Driving mistakes are common up and down the grid adding to the unpredictability and excitement of FE races.

Glowing red brake discs and no regeneration capability from the front axle means approx. 50% of the braking energy wasted and not converted to electrical energy.
Active braking and regen systems are an integral part of electric road car technology – “It’s probably important to have it in order to show the technology for the road,” – so the use in FE makes sense. The problem is keeping the balance between entertaining racing and engineering-driven excellence that makes things predictable.
Motor racing is entertainment, isn’t the driver the real star?

BMW i Andretti driver Antonio Felix da Costa warned that “we have to find a way to make races really entertaining next year, the car will be easier to drive”.

[Diagrams and images related to motorsports and audience engagement]
A cornerstone of Formula E is racing on street circuits in the heart of the world’s great cities. Racing Formula E cars on a purpose-built circuit racing would dilute the message it promotes regarding sustainability and the environment. But street circuits do bring limitations regarding car performance related to the safety and circuit homologation aspects. Will too much technology leading to too much speed mean the loss of some city circuits...?
“For a start, the right approach for an electric racing car is to make it all-wheel drive, with electric motors connected to each wheel - not individually, as we want to control torque vectoring ability, but using a differential.” “It will make things less driver relevant, It’s part of the evolution, we have to find other ways to make the show better.” – de Grassi
The third generation of Formula E – AWD and where does this take us?

Pros – the view of the OEM / Manufacturers
Stronger relevance to the road car direction – OEM justification for racing
Increase in the technical content
Likely increase in on track performance
More efficient use of braking systems

Cons – the view of the FIA / FEO
Highly likely to increase costs to develop and compete – does this mean fewer manufacturers?
Technology moves away from the realm of the “privateer” manufacturers
Do the cars become “too fast” for the city streets?
Less emphasis on the driver with more automated systems
Thank you