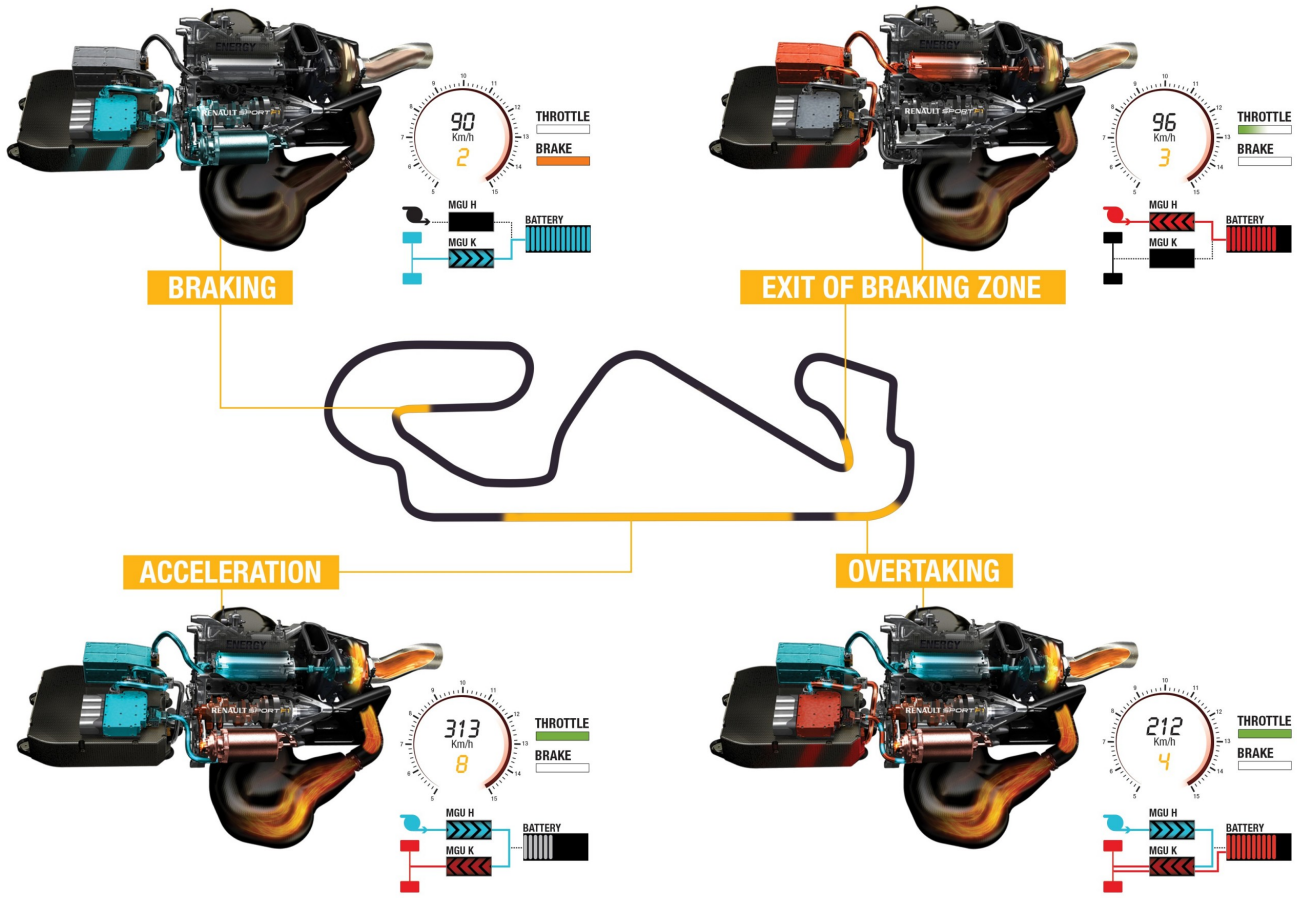
Turbocharging and advanced hybrid tech coming to Formula 1 for 2014

Unlike "trickle down economics" which forgot to trickle down, Formula One has been known to develop race technology that has meandered its way into the mainstream in consumer form. McLaren's carbon fiber monocoque, albeit an expensive design innovation reserved for high end exotics, was the direct result of F1 engineering. For the 2014 season, new hybrid technologies and requirements designed to make F1 racing more energized and eco-friendly are being introduced.

For 2014 not only will technology and energy recovery systems play an integral role in the car's power makeup, but the engine size itself will be significantly reduced. In 2013, F1 teams were allowed a 2.4-liter naturally-aspirated V8 engine with power output of 750 bhp, but for the 2014 season, engines will lose two cylinders and almost a liter of displacement. At 1.6 liters, the new turbocharged V6 engines will generate 600 bhp, down 150 hp from the previous season. However, the loss of power through the gas powerplant will now be subsidized by new Energy Recover Systems (ERS).

The new ERS system for F1 is a next generation uptake on the previous Kinetic Energy Recovery System (KERS). For those unfamiliar with KERS, it involves capturing waste energy during braking, which is then transformed into electrical energy. When activated, energy stored in a small capacitor-like device provided teams with a sort of "electric nitrous oxide" shot to the tune of 60kW (80 bhp) for up to 6.67 seconds per lap. With the new ERS system for 2014, drivers will not only have access to longer power bursts of 33 seconds, but double the power to the tune of 120 kW (160 bhp). An "electronic rear brake control system" will also be introduced into all cars in order to cater for the extra power generated by the ERS system during

braking.



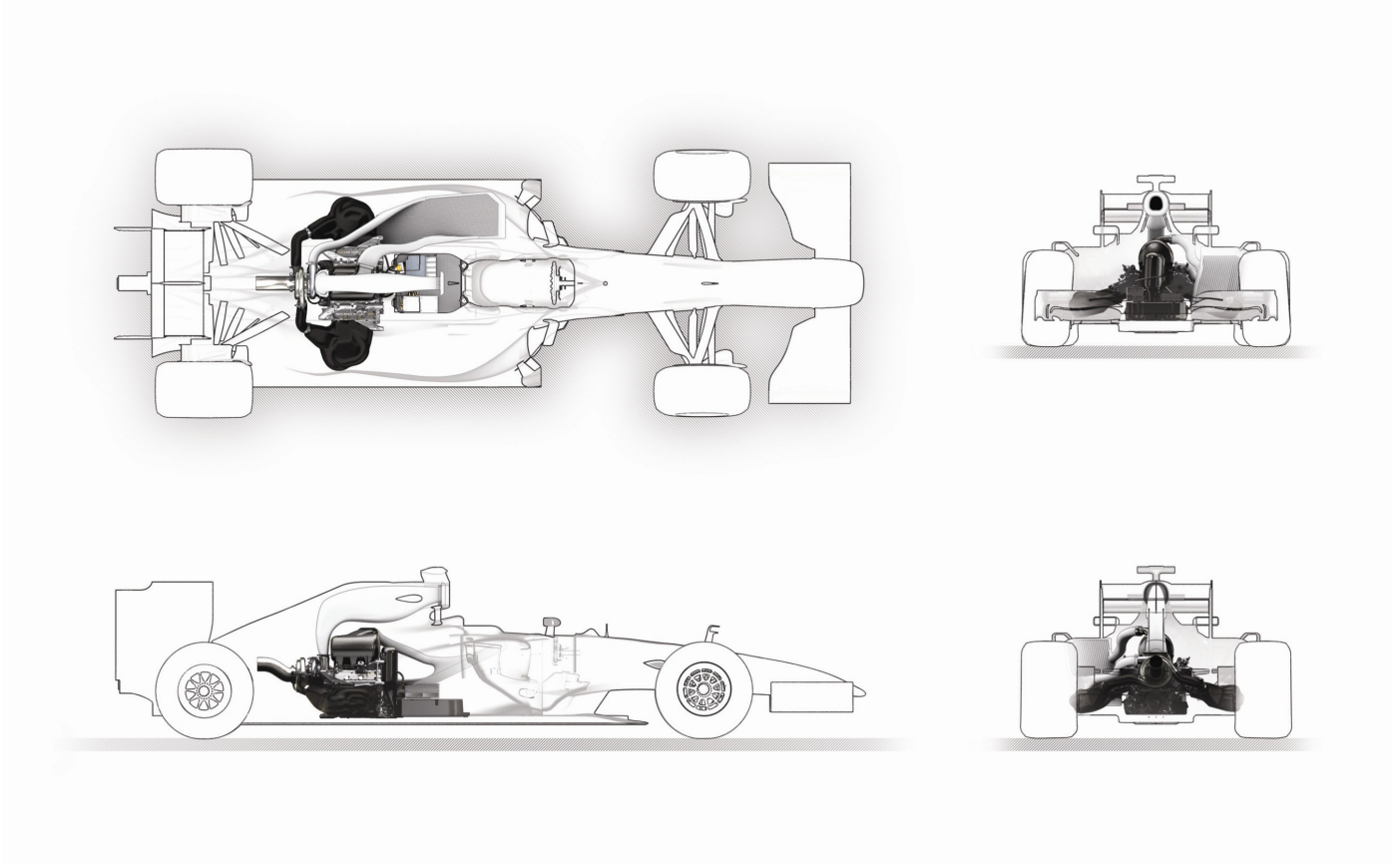
F1 teams will be required to adjust their racing strategies as a result of the new hybrid technologies and new 100-kg fuel limitations

The ERS system will also employ not one but two energy recovery sources. Regenerative braking technology for the season will remain relatively the same with minor updates. The Motor Generator Unit - Kinetic (MGU-K) in partnership with the Energy Store (ES), takes braking and heat energy from the brake rotors during the race, then converts it back out into the system in the form of that 160 hp electric burst through the generator unit. One of the main drawbacks to this system is that in the event of a breakdown, teams would lose a significant chunk of available power. Unlike V8 systems from last year, where teams still had reasonable power to continue and remain

competitive, the loss of KERS and 160 hp in 2014 would most likely translate into a DNF (did not finish).

But all is not lost, as there is another ERS device on board to supplement the power-hungry diet. The second addition for 2014 is the introduction of a thermal capture device. The similarly named Motor Generator Unit - Heat (MGU-H), attached directly to the turbocharger shaft, captures exhaust heat and coverts it, like the kinetic system, into electrical energy. This capturing device has the ability to dump power straight into the system on demand or store it in the Energy Store for later use. When activated, the MGU-H gives drivers another electric power shot to the drive wheels via the dedicated generator unit. And unlike the MGU-K, the thermal recovery unit can provide unlimited supplemental power throughout the race. For 2014, Formula 1 has limited energy recovery from the MGU-K to 2 megajoules (MJ) per lap with the ability to release stored energies to a maximum of 4 MJ per lap.

Another fancy power management trick is the way in which the MGU-H thermal unit manages turbo speed. Contrary to a conventional turbocharger system where a wastegate is used to vent out excess engine pressures derived from the turbocharger, the new unit actually controls the speed of the turbocharger impeller. The ability to speed up or slow down the turbo allows teams to not only better manage wastegate pressures in the engine but to spin up the turbocharger low in the rev cycle. As boost is enabled sooner, power comes on quicker, and that power procrastination thing known as turbo-lag essentially disappears from the equation.



The compact ERS system, that fits within the race car's tight space requirements, brings with it a unique set of cooling challenges

Other technical changes and challenges for teams this year will include a fuel limit of 100 kg (220 lb) per race. For 2013, teams on average used around 160 kg (353 lb) during a normal race. This means that teams will need to carefully consider where and when the ERS system is engaged. Since hybrid technology brings with it the unfortunate side effect of weight gain, Formula 1 teams will now be able to plump up their cars from a minimum weight of 642 kg (1,415 lb) to 690 kg (1,521 lb). The car's exhaust systems will also change from a two-pipe setup to a single pipe, which according to F1, "must be angled upwards to prevent exhaust flow from being used for aerodynamic effect." The entire exercise should be interesting to follow, to see how teams react to the new hybrid technologies and whether or not faster laps will be a result.

According to Renault, a typical lap using the new ERS systems will look something like this:

"Under acceleration the internal combustion engine (ICE) will be using its reserve of fuel. The turbocharger will be rotating at maximum speed (100,000 rpm). The MGU-H, acting as a generator, will recover energy from the exhaust and transfer it to the MGU-K (or battery). The MGU-K, which is connected to the crankshaft of the ICE, will act as a motor and deliver additional power to pull harder or save fuel, dependent on the chosen strategy. At the end of the straight the driver lifts off for braking for a corner, at which point the MGU-K converts to a generator and recovers energy from the braking event. Under braking the rotational speed of the turbo drops due to the lack of energy in the exhaust which leads to turbo lag. To prevent this lag, the MGU-H acts as a motor for a very short time to instantaneously accelerate the turbo to its optimal speed, offering the driver perfect driveability."

Engine development will also be frozen during the season, and only five Power Units will be permitted per driver for the year. The 2014 Formula One season begins March 14 in Melbourne, Australia.

Sources: Renault, Formula One