25 26

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2014

25 26

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The Team

Scuderia Toro Rosso has been competing in the Formula 1 World Championship since 2006. The team was created with a view to finding two extra cockpits for the stars of the future coming through the ranks of the Red Bull Junior Driver Programme. Nine years down the road, that is still very much the team's raison d'etre in 2014 with a graduate of that programme, Jean-Eric Vergne competing in his third full season of Formula 1. The French driver is teamed with the Russian rookie, Daniil Kvyat, another graduate of the Red Bull Junior "finishing school" and winner of the 2013 GP3 Championship. When the team was first established it operated partly as a satellite to Red Bull Racing running a car designed mainly by Red Bull Technology. However, for several years now Scuderia Toro Rosso has run completely independently, doing all the car design and manufacturing work in-house in Faenza. This necessitated a major expansion programme for the factory, which is still on-going and the Italian side of the operation is supported by the team's wind tunnel facility in Bicester, England. A recent addition was a new building housing all the composites side of the operation meaning the team produces virtually every component in house with the obvious exceptions of parts such as the engine. On the engine front, after seven years being powered by Ferrari, for 2014 Scuderia Toro Rosso has switched to Renault, just as the technical rules go through a major change, featuring 1.6 litre turbocharged Power Units equipped with potent energy recovery systems. Team Principal Franz Tost has been at the helm since 2005, while the technical side is managed by Technical Director James Key. Currently the team has one win and one pole position to its name, both courtesy of Sebastian Vettel, who produced the fairytale result at the team's home race, the Italian Grand Prix in Monza, back in 2008.

25 26

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FRANZ TOST

The 2014 season represents a very interesting challenge for all the Formula 1 teams, with the sport facing the biggest change to the technical regulations that it has seen over the past few decades. Here at Scuderia Toro Rosso we regard the coming months and 19 Grands Prix not only as a challenge but also as a fantastic opportunity to step up in the team hierarchy. Continuity is a key factor when it comes to making progress and that applies to revenue streams as much as it does to the technical side of the organisation, therefore I am pleased to say that sharing that opportunity with us will be our long-term partners and sponsors, Red Bull, Cepsa and Nova Chemicals. In addition, I'm delighted to welcome on board a new sponsor, the investment group Sapinda. We at Toro Rosso thank them all for their support and the trust they have shown in us.

The new rules have required a completely new design philosophy, starting with a clean sheet of paper. Having invested in new staff and facilities over the past few years, we have been able to tackle the task of designing and building the STR9 with a group of engineers and designers that have been working on the project since Day 1, under the leadership of James Key. That stability has been of great benefit, while in other areas we hope that changes we have introduced will also bring a step up in performance.

Not only do we have a new engine configuration with the move to a 1.6 litre turbocharged V6 coupled to two energy recovery systems, here at Toro Rosso we also have a new engine supplier in the shape of Renault. The French company's credentials are impeccable, having won the World Championship titles for the past four years and we have already established an excellent working relationship with its engineers, since our partnership was announced at the 2013 Monaco Grand Prix. Joining forces with Renault also means that, within the framework of the Sporting Regulations, we can once again enjoy synergies on the technical front with our colleagues at Red Bull Technology.

At the end of last year, Daniel Ricciardo "graduated" to Infiniti Red Bull Racing and here at Toro Rosso we are pleased to be running Daniil Kvyat alongside Jean-Eric Vergne. The Frenchman is in his third year with us and will naturally be expected to use his experience to drive the team forward. However, the Russian rookie, the reigning GP3 champion, is clearly very talented and I believe it won't be long until our two drivers are pushing one another very hard. Jev has a new race engineer, Xevi Pujolar, who joined us at the start of the year, while Daniil will work with Marco Matassa who ran Ricciardo last year. In recent months, we have also taken on other engineers to strengthen our technical team, while also fine-tuning our organisational structure.

The new technical regulations alter the look of the cars for 2014 and combined with new sporting rules, the way the races evolve will also have a different flavour: restrictions on how much fuel can be used in a race and the speed at which it can be fed into the engine will give the strategists a new challenge as they balance performance against fuel economy, deciding how and when to make the most of the

energy recovery systems which will deliver far more power than their predecessors. Increased torque and different engine characteristics will also impact on tyre degradation and wear, two familiar parameters when it comes to picking the right strategy for Sunday afternoon. The characteristics of the recovery systems and the turbo chargers mean that cooling will be a major priority, while further restrictions on how many engines and gearboxes can be used in a season make reliability the most critical factor, especially in the early part of the season.

The purpose of the raft of changes to the rules is to make Formula 1 more environmentally friendly and to use technologies that have more relevance to road transport solutions of the future. However, the future of the sport itself depends on it delivering a good show to the end user, the spectator watching from the side of the track or in front of a screen somewhere. The fans just want to see exciting racing and hopefully that is what they will get in 2014. As for what role Scuderia Toro Rosso will play, it's too early to tell and even harder than usual to make any predictions. What I can say is that we must do better than in 2013 and move up the order.

25 26

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JEAN-ERIC VERGNE

Birthday:	Apr. 25, 1990
Place of birth:	Pontoise, France
Now lives:	Geneve, Switzerland
Hobbies:	Extreme sports, cinema

For Jev, this will be his third season in Formula 1, all of them spent with us. He was born in Pontoise, a Parisian suburb, but despite the fact his father owned a kart track, he didn't get behind the wheel of a go-kart until he was ten, which is very late by today's standards, but he wasted no time in making his mark, winning a junior championship in 2001 and coming second the following year. By now karting was getting serious for young Jean-Eric and he took second spot in the 2004 French Rotax Max series and the following year's European championship. He did one more year in karts, before trying his hand at single-seaters for the first time in 2007 in the Formula Campus series that has a history of discovering French talent. He was a runaway champion with six wins and that attracted the attention of Red Bull so he found himself part of the Young Driver Programme. In 2008, he took part in not one but two series, the Eurocup Formula Renault 2.0 and Formula Renault 2.0 West European Cup and took the accolade of best rookie driver in both of them. He did one more year in the European Formula Renault 2.0, taking the runner-up slot.
2010 was the year when he was the dominant force in the highly regarded British Formula 3 series, that has produced F1 greats for decades: the Frenchman won 13 times and started from pole on 20 occasions. This was the year when he first got a taste of Formula 1, driving for us in an end of season test. 2011 saw him take another runner-up championship position, this time in the Formula Renault 3.5 series. It was enough to secure him a 2012 seat alongside Daniel Ricciardo at Toro Rosso. The Australian opened the scoring at Round 1 in Melbourne and Jev scored points in only his second race one week later in Malaysia, by finishing eighth in the rain. He out-pointed Ricciardo over the course of the year, retaining his drive for 2013. Last year was a difficult season, with the Frenchman having more than his fair share of bad luck, although when everything came together, he drove with panache, coming eighth in Monaco and sixth in Canada. This year, he will be expected to fulfill the role of team-leader alongside our Russian rookie, Daniil Kvyat.

25 26

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Jean-Eric Vergne - Career Highlights

2014	Formula 1 with Scuderia Toro Rosso
2013	Formula 1 with Scuderia Toro Rosso – 13 points scored
2012	Formula 1 with Scuderia Toro Rosso – 16 points scored
2011	Formula Renault 3.5 WSR – 2nd
	Friday practice driver for Scuderia Toro Rosso in 3 Grands Prix
	Karting - Winner of the ERDF Masters Kart in Paris
2010	British Formula 3 – 1st
	Test drives with Red Bull Racing and Scuderia Toro Rosso
2009	European Formula Renault – 2nd
2008	French Formula Renault – 1st
2007	French Formula Campus – 1st
2006	Karting - France Elite Championship – 2nd
	Karting – World Championship – 7th (1st French driver)
2005	Karting - European ICA Championship – 2nd
2004	Karting - France Junior Rotax Championship - 2nd
2002	Karting – Minime French Championship - 2nd
2001	Karting - Minime French Championship – 1st
2000	Start in Karting

25 26

SCUDERIA Toro Rosso

Daniil Kvyat

Birthday:	Apr. 26, 1994
Place of birth:	Ufa, Russia
Now lives:	Rome, Italy
Hobbies:	Table-tennis, soccer, wakeboarding, skiing, billiards, cycling, tennis

Whatever awaits Daniil in the next few years, he is unlikely to forget the last few months of 2013, during which he found out, to the surprise of many, that he would be replacing Daniel Ricciardo at Scuderia Toro Rosso and shortly after that, he secured the GP3 championship title in Abu Dhabi, with the world of Formula 1 watching.
An eight year old Kvyat was on holiday when he asked to take a turn around a go-kart track and it didn't take long before he was competing seriously in his native Russia. When it became clear that this could be the start of a career, the Kvyat family moved to Rome to be nearer to the heart of European karting. He finished third in the KF3 European series and runner-up in the WSK international series, before switching to single-seaters in 2010, courtesy of the Red Bull Young Driver programme, that found him a berth in Formula BMW. He was one of the youngest competitors and over the winter, he honed his skills in the Toyota Racing Series in the Antipodes. After that, he moved up to Formula Renault 2.0 in 2011. The Russian youngster came third in the Eurocup and second in the North European Cup that year, sticking with the same series for 2012. He was second this time in the Eurocup, but won the Alps title, with a host of wins to his name. Last year, apart from his fulltime commitment to GP3, he also found time to try his hand at Formula 3, able to cope with racing two very different types of car. He had not looked like a contender for a move to Formula 1 in the early stages of last year, but a strong showing in the second half of the season saw him edge out the other contenders for the role. He got some F1 cockpit time by testing for us at the Young Driver Test at Silverstone, carried out a further run to ensure he qualified for his superlicense and took part in Friday morning practice at the last two Grands Prix of the season.

25 26

SCUDERIA Toro Rosso

Daniil Kvyat - Career Highlights

2014	Formula 1 with Scuderia Toro Rosso
2013	GP3 Series winner, 168 points
2012	1st Formula Renault 2.0 Alps, 7 wins, 4 pole positions, 8 podiums, 4 fastest laps 2nd Formula Renault 2.0 Eurocup, 7 wins, 4 pole positions, 9 podiums, 5 fastest laps
2011	3rd Formula Renault 2.0 Eurocup 2 wins. 2 pole positions. 6 podiums. 3 fastest laps Formula Renault 2.0 NEC 7 wins. 2 pole positions. 13 podiums. 5 fastest laps
2010	10th Formula BMW Europe Championship 4th Michelin Formula Renault Winter Cup
2009	1st South Garda Winter Cup (KF3) 2nd WSK International Series (KF3)
2008	2nd Asia-Pacific Championship (KF3) 3rd European Championship (KF3) 2 times winner of Trofeo Top Driver (KF3) 1st Torneo Industry (KF3) 1st Bridgestone Cup Europe (KF3) 1st Silver Cup (KF3)
2007	1st 10° Trofeo del Grifone (100 junior) 1st 8° Trofeo Rambo Racing 1°pr. (100 junior) 1st Pista Cogis Kart (100 junior) 1st 8° Trofeo Rambo Racing 3°pr. (100 junior) 4th Valle del Pantano (100 junior) 1st Trofeo Caro Rosario 1 Prova (100 junior) 3rd 4 Coppa Internazionale del Vesuvio (KF3) 1st Trofeo Caro Rosario 2 Prova (100 junior) 1st Trofeo Internazionale Concorrente (100 junior)

KEY TO THE FUTURE

James Key joined Scuderia Toro Rosso as Technical Director in September 2012. His first thought skipped a year, because with 2013's STR8 car already well underway when he arrived in Faenza, the Englishman focussed on the major challenges for 2014, starting with the aerodynamic aspect of the project.

"The aero side was by far our biggest priority, as we wanted to put that department into a much more current and competitive shape," says Key. "Over the past twelve months, we've been working on increasing the size of the aerodynamics department. It's grown significantly, and we now have many new people with very relevant F1 experience. We have more people joining us this year too, so I would describe it as a work in progress, but the group is developing very well and becoming increasingly close to the blueprint that we have in mind of what an aero department of a team of this size and budget needs to be. We're still getting there but it's certainly heading in the right direction. It's been a big project, helped by the arrival of a new head of Aerodynamics in Bicester, Brendan Gilhome last June, while we worked on 2014 without neglecting the task of making the most of the 2013 car as well. It's still going on but it's developing very much in the direction it needs to be right now and we're making good progress."

The switch to a 1.6 litre turbo engine for next year has been the biggest talking point when it comes to this year's major rule change and at Scuderia Toro Rosso, this has also involved a change of partner, with Renault supplying what is now referred to as the power unit (PU), primarily due to the significant mix of IC engine and Energy Recovery Systems. "Changing your engine partner is always a bit of a step into the unknown for both parties, until that working relationship is established and everyone understands how best to operate together," reckons Key. The agreement with Renault was announced at last year's Monaco Grand Prix and work begun immediately to ensure things would go smoothly this year. "Renault were very supportive from the outset, making sure we had a very good overview of what they've been up to with the PU and their plans for development, so we were able to get up to speed very quickly with it," maintains Key. "To switch from a process where you've got a well-established and understood way of working with the previous engine supplier to a situation where you have not only a new engine supplier but also a totally different type of power unit that we're not familiar with at all, is quite a big leap. Not only are you trying to establish the relationship, you're doing it through what is a very complex project for both sides. I have to say, Renault has been excellent at recognising that and helping us out a great deal. They are very proactive and we have daily discussions between our design team and theirs. We have already built up a good working relationship with them.

One of the most commonly held myths in the F1 paddock is that Scuderia Toro Rosso is just a satellite team to Infiniti Red Bull Racing, an incorrect assumption that dates back to the first couple of years of the team's existence, when the rules were different. Today, with the exception of very few components, such as the gearbox internals and the engine, the cars are entirely designed and manufactured in-house. This year's

switch to Renault power, as used by Infiniti Red Bull Racing, means that once again, the two teams can enjoy some technical synergies. “It makes sense, given that fundamentally we are under the same ownership, to have the same power unit as Red Bull, particularly with the arrival of such a complicated new set of regulations,” continues Key. “Immediately, there’s a synergy there because we are using the same power unit, we’ve been able to join with Red Bull Technology in using their gearbox internals. They have a well-engineered solution to 2014 regulations for these components, so again, it makes sense for us to join with them in using those common internals while running the same power train. Otherwise, obviously, the rest of the car is entirely an STR design.”

The new type of Power Unit has inevitably had an effect on other areas of the STR9 design. “The installation of the PU is in itself a big challenge, dealing with the cooling circuits and other related elements, but the chassis and bodywork regulations have gone through quite a big change as well and the cars look quite different this year in some areas. So a big part of the chassis development has involved redeveloping the aerodynamic philosophies in line with the new regulations and getting them to work with all the other challenges that come along for 2014. Although certain areas of the car will not look particularly different the subtle changes with the 2014 bodywork regulations have had a surprisingly big effect, so we have had to re-evaluate some significant areas of the cars aerodynamics”

Apart from the specific tasks aimed at being ready for action in Melbourne in mid-March, work continues on improving the infrastructure and facilities and working practices in the Faenza factory. “As far as the team is concerned, the summary is - it’s a work in progress,” concludes Key. “We were quicker than the points scored suggested in 2013, if you could look behind the numbers, but we didn’t make the most of our opportunities. Therefore, we’re putting all our efforts into ensuring we have a better situation for this year.”

25 26

SCUDERIA Toro Rosso

BLUE SKY THINKING FOR A GREENER CAR

'Saving the planet,' 'going green;' it's hard to avoid these topics in the modern world and even Formula 1 and motor sport in general is being steered towards a less profligate technology with the threat of the world's supplies of fossil fuels running out one day. Therefore, whether or not they are interested in these socio-political issues, Formula 1 designers have faced a very busy couple of years when it comes to drawing up the blueprints for the 2014 Grand Prix car. In the case of Scuderia Toro Rosso, that task rests on the shoulders of Chief Designer **Luca Furbatto.**

"It has been a fantastic challenge but very hard work," reckons Furbatto. "Pretty much all the systems on the car are brand-new and that's certainly a concern from a reliability point of view as the season progresses, because we won't have known reference points from the past few years. Everyone in Faenza and Bicester has worked very hard and we have invested in different technologies and simulations in order to be as best-prepared as possible. We started STR9 in the summer of 2012, initially just purely on the simulation side. When James Key arrived in late 2012, he focused mainly on the 2014 car in terms of planning, simulation targets and internal resourcing whilst we were still designing the STR8. To his credit we were able to perform the first STR9 wind tunnel test shortly before Christmas 2012, much earlier than previous Toro Rosso projects."

"The biggest change to the regulations involves switching from a normally aspirated 2.4 litre V8 to a 1.6 V6 turbocharged engine, which is only one component of what is now referred to as the power unit, or power plant. "The new power unit consists of an engine which is turbo-charged, a new and much powerful version of the Energy Recovery System, operating as an electric motor/generator connected to the crankshaft (MGU-K), and another electric motor/generator connected to the turbo (MGU-H), running at a much higher speed" explains Furbatto. "The combination of these two energy recovery systems is the hybrid part of the new power unit package, the 'green' effect of the next generation of Formula 1 cars. The engine, although it's smaller and more compact, requires a fairly complicated energy management with all those motors and controllers working at the same time and exchanging energies between a battery pack and the two electric motors".

The cooling side has been a massive challenge for us as we have also had to deal with the added factor of changing our engine supplier. In 2014 the hybrid proportion is much more significant and therefore it generates more heat, that needs to be cooled too. Furthermore, using a turbocharger means the engine requires intercoolers, which we haven't had on F1 cars since the mid-80s. Certainly, the radiator layout plays an important role in the overall car layout and we had a few moving targets during the design phase, which means we ended up sizing 17 different layouts for cooling on STR9 and eventually committing to just one!
In doing so we relied on the work of several departments within Scuderia Toro Rosso and we have invested heavily in doing dyno testing and core measurements to ensure that we are as optimised as possible in terms of cooling. I am sure that activities related to cooling refinements will continue over the course of this season"

While new engine rules have dominated the headlines, other aspects of car performance have also been affected by the regulations, starting with aerodynamics, where further restrictions have been imposed for 2014. Even if the emphasis has been on power unit packaging, the aero side is still very important and will in fact have an effect on how the new PU is run, specifically because of the 100 kg per race limit on fuel. "Clearly, we are packaging things in a way that will allow us some development flexibility ~~also~~ from the aerodynamic side because ultimately, we need to find a performance sweet spot between aero, PU performance, fuel consumption and cooling capability" continues Furbatto. "With this latest regulation there a finer balance between downforce and drag due to the fuel consumption effect which has not been such a big factor until this season."

Apart from engine and aero changes, the new rules also allow for an interesting new braking technology. "Braking By Wire, or BBW is another new system that we will race in 2014," continues Furbatto. "In order to open up energy harvesting strategies during the braking phase the FIA will allow a semi active electronic control of the rear braking pressure line. The BBW will allow the braking load to fluctuate from pure engine braking to pure friction braking or any combination in between without the driver noticing it on the brake pedal! The exact amount of brake pressure on the rear line will be mapped against engine braking that will then be used to recharge the on-board batteries."

Another change in the rules is that the minimum weight of the car has gone up by 50 kg. That sounds a lot, but much of it is simply absorbed by the fact the new power unit weighs more than the V8 it replaces. "In addition, there are enhanced safety structures for side impact and the chassis has been made significantly stronger than last year so the weight of the survival cell will go up in this area too," adds Furbato. We will only be able to carry a very limited amount of ballast or no ballast at all, depending of the driver's weight. The possibility of running without ballast could be a limitation, both in terms of weight distribution, tune ability or simply tipping over the edge of being overweight."

"The 2014 rules have meant a completely new car this year and Furbatto reckons around 98% of STR9 is brand new. "We started an aggressive weight saving programme on STR8 in order to get prepared for 2014. The only thing we kept of STR8 is the pedal set, although even here we managed to reduce the weight of it last summer" he reveals.

"Looking at the STR9 project as a whole, I believe that all the departments in Faenza and also in Bicester have worked together more closely than ever before". That has been challenging at times but helped us to gel further as a Team.

PERFORMANCE ENHANCEMENT

At the start of 2013, **Laurent Mekies** took on the new role of Head of Vehicle Performance, however, circumstances dictated that he also continued to oversee engineering at the races. Now with Phil Charles taking on the role of Chief Engineer, Mekies can concentrate fully on his new position, once he has explained what Vehicle Performance is all about!

"Effectively, if you accept that the work of the designers and engineers is to bring the lap time down for your car, then the work of the Vehicle Performance Department is to look for the less obvious ways of doing it," begins the Frenchman. "Everyone knows that if you add downforce on the car, it will go faster, if you reduce the drag on the car, it will go faster. That's the job of the aero department. If you make a lighter car, it will go faster. That's one of the jobs of the design office. We in Vehicle Performance are looking at all the less obvious aspects of changing the lap times. It starts from all the simulation work which is used to decide what kind of characteristics we want to target, what we want in terms of the suspension or what we are looking for in terms of aero-performance and so on. From that point, we try to convert our ideas all the way through the chain, up as far as the race engineering side at the race track, in working to find the best possible set-up for the car."

The staff of the Vehicle Performance department do not possess skills that cannot be found elsewhere in the company. The difference is that, with Vehicle Performance, people from each of those groups now spend all their working time together, rather than just coming together for meetings. "Therefore the group is responsible for a very large part of all the potential performance," continues Mekies. "In the one department you have all the guys who are able to alter the car to do what it's supposed to do. For example, if you are surprised at the race track by differences between what you have simulated and what you have found, you have the person that's designing the simulations there with you. It's about trying to put all the guys doing the lap time in the same room. At the end of the day, it's six small groups that are interacting and overlapping all the time to make sure we squeeze as much as possible out of the car's performance potential."

The demands of 2014 will provide a good test of the effectiveness of this new structure, as the first year of a major rule change always sees cars change very rapidly throughout the season. "It will help us to keep in line with the kind of development rate that is now needed to lead the mid-field, so we needed this additional firing power," concludes Mekies. "It's especially true now that we also have the return of some in-season testing, which will mean the pace of development will be even higher."

THE RULE BOOK

The rules relating to Formula 1 are constantly evolving with the regulations being tweaked from year to year. However, the technical changes introduced for this year are the most significant the sport has seen for decades. Leading the engineering team in dealing with the changes at the track for 2014 is **Phil Charles**, who was Vergne's race engineer in 2013 and is now Chief Race Engineer. Here he takes us through the most significant changes:

"Externally at the front of the car, the most obvious changes are to the front wings, which must be 15cm narrower overall and to the nose which must be lower. The front wing width change is a particularly interesting problem for the aero department who are used to moving the air flow from the endplate around the front wheels. This will now be more difficult as the endplate is moved inwards, more towards the centre of the tyre.

"The rules also mandate that the affectionately-named 't-tray', the part of the floor which extends forward under the drivers legs, must be twice as stiff as in 2013. As the t-tray deflects up a little, this will mean we will be more limited on how low we can set the front ride height and this is a very strong factor on aero performance.

"At the rear of the car the most striking change is to the exhaust, which must now be a single exit up high in the middle of the rear wing. This rule change is particularly important as it stops us using the exhaust gases to improve the floor performance either side of the car towards the rear and around the rear tyres. The particularly eagle-eyed will also spot that there is no longer a lower 'beam' wing allowed. In addition, the maximum allowable height of the top wing elements is slightly reduced. These external changes mean that, in theory, everyone starts 2014 with less downforce than 2013, but the biggest changes are the ones you can't see from the outside…

"The 2.4 litre naturally aspirated engines we have been using since 2006 are being changed for 1.6 litre turbo charged variants with lower maximum revs (15000rpm in 2014 / 18000 rpm in 2013) but with more power coming from Energy Recovery Systems (ERS).

"We still have the motor generator unit (MGU) we had with the 2013 KERS, but it is renamed the MGU-K (K for kinetic) and it can be used more and has greater power than before (around 160bhp for 33 seconds a lap compared to around 80 bhp for 6.5 seconds per lap in 2013). There is no longer the KERS button on the steering wheel for the driver to activate the extra power, but instead there is more scope for the Engineers to setup the control systems for the automatic, more optimum power release considering the response from the Internal Combustion engine and the turbo. On top of all of this, there is a second energy recovery system – the MGU-H ('H" for heat) which recovers the waste heat from the exhaust.

"As the rules allow considerably more energy to be released around the lap, the FIA also had to allow more energy to be harvested. In fact, it is increased by a significant factor (2MegaJoules in 2014 / 400 KiloJoules in 2013). To harvest this amount of energy actually becomes quite difficult as it is done most significantly under braking giving large amounts of braking torque at the rear axle only. As a result, the FIA have further opened the scope of what we can do with the brakes by allowing electronic 'brake by wire' systems to help balance the recovery and the traditional brake torques

at the rear axle and maintain a good brake bias shape in conjunction with the front brakes.

"The setup of the control system maps, in order to achieve good brake performance with the recovery methods and optimum acceleration with the various power sources, will be the major task for the Car and Engine Engineers this year.

"One of the reasons behind the rule changes is to bring the 2014 'power unit' more in line with road car technologies to help the development flow from F1 to road car with a major emphasis on fuel efficiency. Therefore, the rules specify we can only use 100kg of fuel from green light to chequered flag on Sunday afternoon and we are limited to a fuel flow rate of 100kg / hour.

"This means we will need to work extremely closely with our Engine Engineers from Renault to ensure our race power unit settings are fuel efficient as well: Our race strategies will need to consider the amount of fuel we want to use per lap through the various stages of the race and the state of charge of the energy recovery system as well. For example, you may choose to use more fuel when you have new tyres or for a few laps to try to overtake a competitor, but you will then need to compromise your fuel usage in another part of the race and you may need to get your driver to adjust his mappings to recoup his energy storage levels.

"Other interesting changes;

- The minimum car weight is increased by a quite sizable 48kg (to 690kg) to give some margin for all the extra power unit ancillaries.
- Compared to 2013, 1 extra set of dry tyres will be allocated to each driver across the weekend but they must be used in the first 30 minutes of P1. Although engine mileage will still be a consideration, this will mean that we will be more likely to get running earlier on Friday to make use of this extra set of tyres.
- The drivers now have 8 forward gears (instead of 7 in 2013) but we can no longer select the best ratios specifically for each track as we have to nominate our ratios at the start of the year and we now only get the chance to change them at one time in the year instead of every weekend.

"One final note on the engineering tasks we must tackle in 2014 concerns reliability. This is an area where Scuderia Toro Rosso had room for improvement in 2013 and we simply must deliver that improvement in order to tackle the added complications of the 2014 regulations: The power unit giving more, and different rotational vibration sources trying to shake the car apart, extra cooling circuits to deal with, for the new power unit components, increased electronics and control systems and a very hot turbo and exhaust above the gearbox at the rear of the car, all make for a very tough task. Also increasing the importance of reliability are changes to the permitted life of engine and gearbox: the latter must now last for 6 races (5 in 2013) and drivers will only be able to use 5 'power unit packages' over the season (8 engines in 2013). Driver's using a sixth complete power unit will have to start the race from the pit lane. If more than 5 of the individual elements of the power unit are used (such as the ERS battery pack, the MGU-K or H or the turbocharger) then the driver will receive a 10 place grid penalty."

SCUDERIA Toro Rosso

IN THE PITS

As Sporting Director, **Steve Nielsen** has a very broad job description, liaising with the sport's officials and ensuring the team obeys all the rules on track and in the paddock and garage. He is also the link between the engineers and the guys in the garage and is in overall control of the team operationally at the race track. One of his key tasks is overseeing the pit stops and finding ways to make them faster. "When I joined the team last winter, I could see there was a good foundation already here and there's a lot of good work that's been done in the past, so it didn't need a complete knockdown or rebuild," says Nielsen. "What it needed was just some detail changes and modernising some work practices, concentrating on better operational planning and improving the sharp end of the business, which naturally included the pit stops. We now have better procedures in place this year. There's a place for repetitive training when it comes to changing wheels quickly, but we have approached this season with more finesse, with a look at the way people move and really studied in detail the equipment we've got. If you put all those things together and combine it with repetitive training, you will make progress."

The aim for 2014 is to speed up the tyre changes and there is a specific target in terms of how long the stopwatch can click by. "A good time for us would be 2.5 seconds," reveals Nielsen. "Bang for buck, for the budget we spend and the size of team we are, we're happy with that. And more important than a fantastically fast pit stop is being consistent, because when we stop the car in a race, our strategy programme tells us the optimum time to stop and it allows for a stationary time for the car, be it 2.5 or 3 seconds. It's much more important to have consistent stops that conform and fit with the strategy model than it is to have some pit stops that are 2.5 followed by one that's 4 seconds. So it's all about matching the performance of the guys in the pit lane to what the strategy model says."

All through 2013, the pit crew practised hard and the engineers kept coming up with new iterations of wheel nuts and other components aimed at speeding up the simple operation of changing four wheels. "For 2014, we will therefore start with known quantities in terms of the equipment we will use," continued Nielsen. "It's no accident that at the last race of 2013, we actually did our fastest pit stop of the year, the culmination of a lot of work that went on during the season. Obviously, it now becomes a steeper and steeper incline to find more and more performance.

After talk of having as many as 22 races, there will be 19 rounds in the 2014 World Championship, just as in 2013. However, for a mechanic, it makes no difference what type of event he is working on and this year, apart from the three pre-season tests, there are a further four in-season test sessions, each lasting two days. It's a heavy workload. "We and all the teams are right at the limit of what can be done with a structure that was set up to deal with 16 races," reckons Nielsen. "If we go past this point, we may have to look at a completely different way of operating. One of the options, for example, is the race team only do the races, which is what they do in NASCAR. And then at the factory, you have a group of people that just build the cars. However, for a few years now, all teams are limited to a total of 60 people at the race

track for operational purposes, so the situation is the same for everyone."

The major changes to the technical regulations don't have much effect on the day to day to work in the garage at the race track, as special safety procedures to deal with KERS for example have been in place for a while now. However, one change specific to Scuderia Toro Rosso has meant some new lessons to learn, as Nielsen explains. "After many good years with Ferrari, the team switches to Renault as its engine partner. That's a huge change for us. It's different people to work with, a different engine, different procedures at the track. So a big, big part of our 2014 pre-season testing has focused on this aspect, getting to know the new people and learning to work with Renault. We have had to do that all in double quick time to be ready for the first race."

25 26

SCUDERIA Toro Rosso

CAR TECHNICAL SPECIFICATION (STR9)

Official car name:	STR9
Engine:	Renault Energy F1-2014
Energy Recovery Systems:	Renault Sport F1
Chassis material:	Composite monocoque structure
Front suspension:	Upper and lower carbon wishbones, pushrod, torsion bar springs, central damper and Anti roll bars, Multimatic/Penske dampers
Rear suspension:	Upper and lower carbon wishbones, pullrod, torsion bar springs, central damper and anti roll bars, Multimatic/Penske dampers
Assisted Steering Rack:	Scuderia Toro Rosso
Bellhousing:	Carbon fibre composite
Gearbox Maincase:	Scuderia Toro Rosso, Aluminium alloy
Gears:	Eight-speed sequential - hydraulically operated. Supplied by RedBull Technology
Hydraulic system:	RedBull Technology
Clutch:	AP Racing, pull-type
Exhaust:	Scuderia Toro Rosso, Inconel, with turbo heatshield
Calipers:	Brembo
Pads and discs:	Brembo
Brake By Wire:	Scuderia Toro Rosso
Cooling system (radiators, heat exchangers, intercoolers):	Scuderia Toro Rosso.
Cockpit instrumentation:	Scuderia Toro Rosso
Steering wheel:	Scuderia Toro Rosso
Driver's seat:	Carbon fibre construction, moulded to driver's shape
Seat belts:	OMP/Sabelt
Pedals:	Scuderia Toro Rosso
Extinguisher system:	Scuderia Toro Rosso/FEV
Wheels:	Apptech, Magnesium alloy
Tyres:	Pirelli
Fuel system:	ATL tank with Scuderia Toro Rosso internals
Bodywork material:	Carbon fibre composite
Overall weight:	690 kg (including driver and camera)

25 26

SCUDERIA Toro Rosso

STR9: POWERED BY RENAULT

In a change from last season, Scuderia Toro Rosso will be powered by Renault in 2014. The STR9 will be equipped with the Renault Energy F1-2014 Power Unit, a brand new power plant designed by the Renault Sport F1 team at Viry-Châtillon, France, in line with the radical new technical regulations applicable from this season.
The Energy F1 combines a powerful turbocharged internal combustion engine with potent energy recovery systems harvesting energy from exhaust and braking. For the first time, cars will be powered by both traditional fuel and sustained electrical energy.

The Renault Energy F1 in detail:

Internal combustion V6 engine

V6 is shorthand for an internal combustion engine arranged in two banks of 3 cylinders in a 'V' configuration over a common crankshaft. The Renault Energy F1 V6 has a displacement of 1.6 litres and will make around 600bhp. This year, all Power Units must have direct fuel injection (DI), where fuel is sprayed directly into the combustion chamber rather than into the inlet port upstream of the inlet valves. This is a key sub-system at the heart of the fuel efficiency and power delivery of the power unit.

Turbocharger

A turbocharger uses exhaust gas energy to increase the density of the engine intake air and therefore produce more power. Similar to the principle employed on roadcars, the turbocharger allows a smaller engine to make much more power than its size would permit if normally aspirated. The exhaust energy produced is converted to mechanical shaft power by an exhaust turbine. This mechanical power is then used to drive the compressor, and also the MGU-H. An intercooler is used to cool the engine intake air after it has been compressed by the turbocharger before it goes into the inlet duct. On conventional turbo engines, a wastegate is used in association with a turbocharger. It is a control device that allows excess exhaust gas to by-pass the turbine and match the power produced by the turbine to that needed by the compressor to supply the air required by the engine. On the Renault Energy F1, the turbo rotation speed is primarily controlled by the MGU-H (see below). However a wastegate is still needed to keep full control in any circumstance (such as quick transient or MGU-H deactivation).

MGU-K

The MGU-K is connected to the crankshaft of the internal combustion engine. Under braking, the MGU-K operates as a generator, recovering some of the kinetic energy usually dissipated during braking. It converts this into electricity that can be deployed throughout the lap (limited to 120 kW or 160bhp by the rules). Under acceleration, the MGU-K is powered from the Energy Store and/or from the MGU-H and acts as a motor to propel the car.

MGU-H

The MGU-H is connected to the turbocharger. Acting as a generator, it absorbs power through the turbine shaft coming from the conversion of the heat energy from the exhaust gases. The electrical energy can be either directed to the MGU-K or to the battery for storage for later use. The MGU-H is also used to control the speed of the

turbocharger to match the air requirement of the engine (eg to slow it down in place of a wastegate or to accelerate it to compensate for turbo lag.)

Battery (or Energy Store)
Heat and Kinetic Energy recovered can be consumed immediately if required or used to charge the Energy Store, or battery. The stored energy can be used to propel the car with the MGU-K or to accelerate the turbocharger with the MGU-H. Compared to 2013 KERS, the ERS of the 2014 power unit will have twice the power (120 kW vs 60 kW) and the energy contributing to performance is ten times greater.

Q&A with Rémi Taffin, Renault Sport F1 head of track operations

How has the partnership with Scuderia Toro Rosso developed since it was announced in May?
The partnership is already blossoming. The deal was concluded very early last year, which enabled us to build good functional working relationships at all levels of the team. The timing has actually been a major benefit since the team was entering into the closing stages of design for the STR9. As a result we have been able to contribute a great deal of information to optimize the engine housing and installation and advise the overall best decisions to take. James [Key] and his team are very open to new ideas that will make the car as competitive as possible.

How has the Energy F1 been adapted to fit the STR9?
In the current context of the regulations the Renault Energy F1 power unit (the ICE and ERS) supplied to our teams is identical. We can change some of the auxiliaries to facilitate greater integration into the STR9 so this is where the optimization comes in, principally to aid cooling and packaging. We think the STR-Renault package is a good challenger.

How will the trackside team be structured for STR?
STR will have the same structure of engine support team as our other partners: eight people consisting of two engineers, one performance engineer, two technicians, two electronic engineers and one mechanic. Signing the contract early meant both teams could get to know their opposite numbers and start discussing the parameters and operating procedures in a constructive way. In this respect it is an advantage that the team is closely connected to Red Bull Technology since we are already familiar with some of the methods, including the gearbox structure and housing and operating parameters.

Will any of the tracks pose any particular difficulties?
In essence no more than in previous years. Monza will still remain the hardest on the ICE and high speed, while Monaco and Budapest will be critical for energy recovery. However what we will see is that the turbo will serve as an equalizer between ambient and atmospheric conditions so circuits that were not considered 'difficult' may have to be reassessed. For example, in the past we always said that Brazil was relatively low impact as we could use an engine on the third race of its life due to the low

atmospheric pressure that placed less stress on the internals. However since the turbo greatly increases ambient pressure inside the engine, the internal stresses are always the same and the amount of oxygen in the air becomes largely irrelevant. Similarly, in Malaysia we could always count on the humidity to limit the effect of the long straights but now there will be no power loss due to the lack of oxygen in air as we are mastering the quantity of air in the engine at all times.

What are your goals for the STR-Renault partnership this year?
With the power unit technology being so new it would be premature to speculate on possible outcomes, but clearly our overall objective will be to make the package as competitive as it can be. The team is very ambitious and clearly wants to challenge for points and podiums, but Melbourne will be the acid test for everyone! We'll take one step at a time – the first being to accumulate as much testing mileage as possible over the winter. The second will of course be to make sure we cross the line at Melbourne!

25 26

SCUDERIA Toro Rosso

Renault Energy F1-2014 Power Unit Technical Specification

	ENERGY F1-2014
Engine	
Displacement	1.6L V6
Number of cylinders	6
Rev limit	15,000rpm
Pressure charging	Single turbocharger, unlimited boost pressure (typical maximum 3.5 bar abs due to fuel flow limit)
Fuel flow limit	100 kg/h (-40%)
Permitted Fuel quantity per race	100 kg (-35%)
Configuration	90° V6
Bore	80mm
Stroke	53mm
Crank height	90mm
Number of valves	4 per cylinder, 24
Exhausts	Single exhaust outlet, from turbine on car centre line
Fuel	Direct fuel injection
Energy Recovery Systems	
MGU-K rpm	Max 50,000 rpm
MGU-K power	Max 120kW
Energy recovered by MGU-K	Max 2MJ/lap
Energy released by MGU-K	Max 4 MJ/lap
MGU-H rpm	>100,000rpm
Energy recovered by MGU-H	Unlimited (> 2MJ/lap)
General	
Weight	Min 145 kg
Number of Power Units permitted per driver per year	5
Total horsepower	600hp (ICE) + 160hp (ERS)