



FIA Institute

for Motor Sport Safety and Sustainability



# Driving Change – Why Motor Sport is taking the lead in Low Emission Technology and Sustainability

Garry Connelly, FIA Institute Deputy President



# Sustainability and motor sport

Low Emission Technology

If we want a low emission form of transport.....



# Sustainability and motor sport

Low Emission Technology

If we want a low emission form of transport.....





# Sustainability and motor sport

## Technologies

### Technical regulations – new fuel options

The 2005 model Audi R10 TDI was the first diesel powered car to win the 12 Hours of Sebring and the 24 Hours of Le Mans.

Diesel fuel consumer acceptance as a performance fuel has increase dramatically in recent years.





# Sustainability and motor sport

## Technologies

### **Technical regulations – new design**

The Delta Wing was designed to reduce aerodynamic drag dramatically, to allow a marginally faster straight and corner speed than a 2009-2011 Dallara IndyCar on both ovals and road/street courses with half as much weight, engine power and fuel consumption.





# Sustainability and motor sport

## Technologies

### **Technical regulations – hybrid / powertrain etc.**

The Toyota TS030 Hybrid became the first hybrid car to be entered in the FIA World Endurance Championship.

The car features the Kinetic Energy Recovery System (KERS) regenerative braking device.





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## Promoter formats

### **Environmentally focused series**

From year 2014 - Formula E series is intended to be the highest class of competition for one-make, single-seat, electrically-powered racing cars. Forty-two cars with McLaren providing the motor, transmission and electronics.

The championship will help foster consumer acceptance of electric vehicles

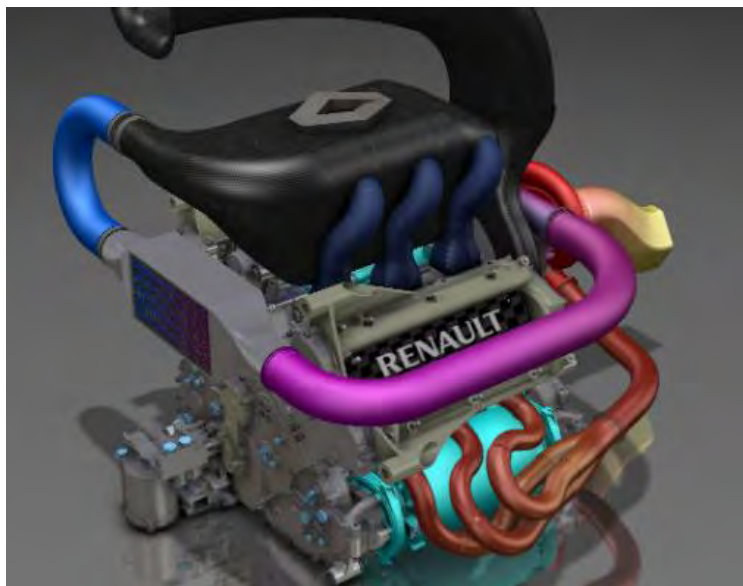




# Sustainability and motor sport Technologies

## Technical regulations – Formula One

In 2014, the 2.4 litre V8 engine configuration, previously used between 2006 and 2013, will be replaced with a new formula specifying a 1.6 litre turbocharged V6 engine that incorporates an energy recovery system into its build.







# Sustainability and motor sport Technologies

## **Energy Recovery**

KERS race development began in 2007 in preparation for a 2009 race debut.

First-generation system created with external partners, critical mass target.

For 2011, in-house system development: 9-month development cycle.

Nearly 10% weight saved and 10% improvement in system efficiency.



# Sustainability and motor sport Technologies

An accelerated development path:

- **2007** (development): **107 kg, 39% efficiency**  
(over 1000 kJ harvest for 400 kJ deployed)
  - **2008** (development): **36.5 kg, 54% efficiency**  
(over 700 kJ harvest)
  - **2009** (race): **25.3 kg, 70% efficiency** (570 kJ harvest)
  - **2012** (race): **< 24 kg, 80% efficiency** (500 kJ harvest)
- ≈ **80% weight saved, +41% system efficiency,**  
**Result: x12 “power density”**



# Sustainability and motor sport

## Technologies

### 2009 F1

- Battery Pack (ES or Energy Store)
- ECU
- MGU
- 500kJ but 80% deployed x 2 Double boost = 1000kJ





# Sustainability and motor sport

## Technologies

### 2013 F1

- Battery Pack (ES) now combined with ECU
- MGU
- Smaller radiator
- 500kJ but 80% deployed x 2 Double boost = 1000kJ





# Sustainability and motor sport

## Technologies

### 2014 F1 Power Unit Regulations

Racing will be shaped by a new Sporting Regulation: a maximum quantity of fuel.

- Every competitor will have a fixed quantity of energy : 100 kg fuel ( $\approx$  140 litres).
- Competitors need a  $\approx$  30 % improvement in efficiency to maintain power outputs.
- Improving efficiency of energy conversion will be a first-order factor for performance.
- The package extracting **the most performance from the fuel energy will perform best**



# Sustainability and motor sport

## Technologies

### 2014 F1 Power Unit Regulations

Target – to achieve comparable power output  
~750 bhp through:

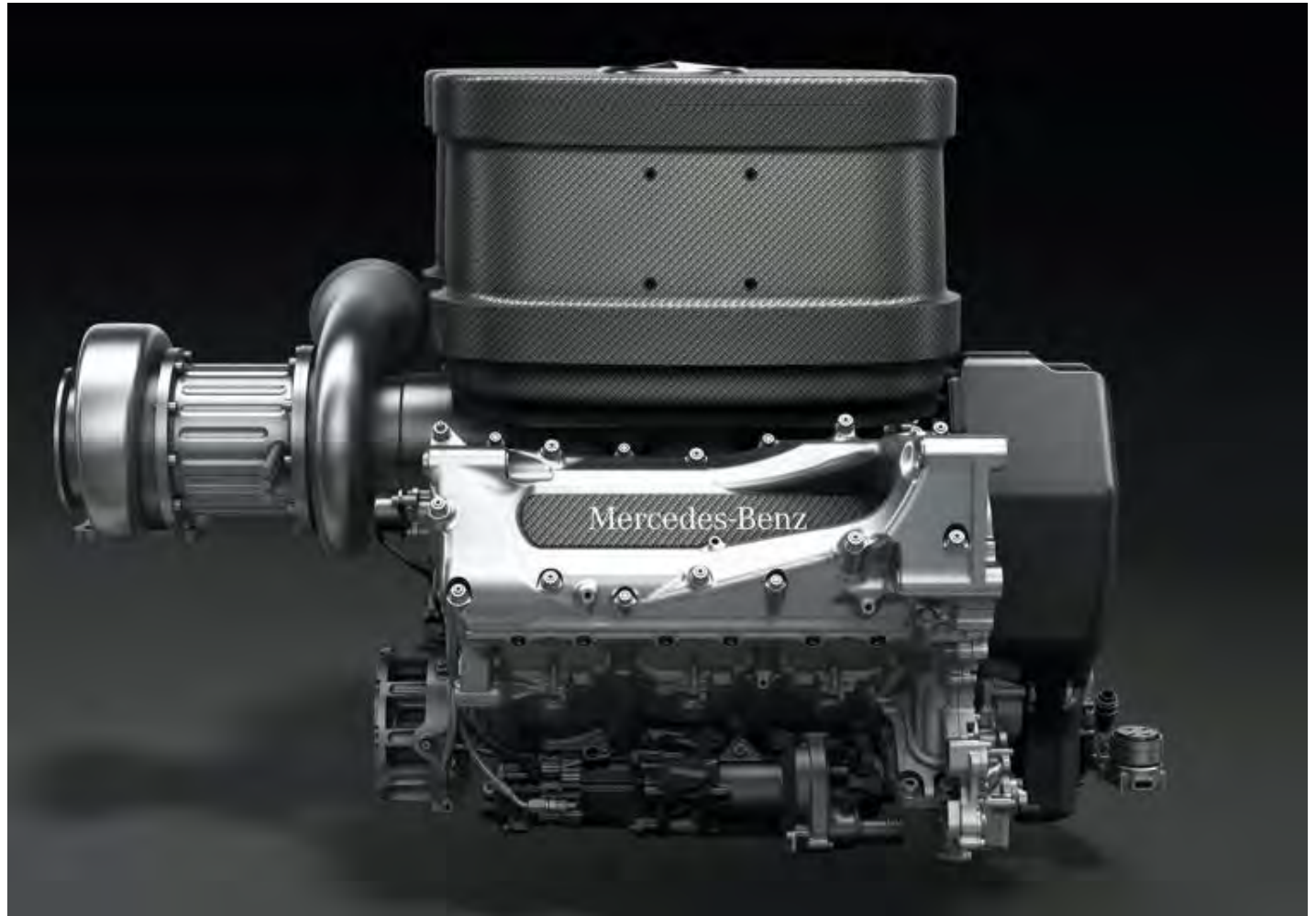
- Downsize ICE to 1600cc with rev limit 15,000 rpm
- Turbo-charge ICE (pressure charging with sole single stage compressor)
- Use integrated energy recovery system (new terminology for the sport) “ERS” where;  
ERS = KERS + HERS
- Now have two sources of energy recovery so two MGU – MGUH and MGUK
- “Power unit” replaces the traditional “engine”



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Technologies

## 2014 F1 Power Unit





# Sustainability and motor sport

## Technologies

### ICE Specs

	Current	2014
Capacity	2,400 cc V8	1,600 cc V6
Max rpm	18,000 rpm	15,000 rpm
Fuel mass flow	No limit	max 100 kg / hour
Admission	Naturally aspirated	Single-stage compressor Single-stage exhaust turbine
Min weight	95 kg minimum for engine No limit for KERS	145 kg for Power Unit

- Maximum turbocharger speed of 125,000 rpm.
- 15% reduction in moving parts compared to the current V8 engine.
- Fewer units per season than currently: five versus eight.
- Mileage of  $\approx$  4,000 km for V6 versus  $\approx$  2,000 km for V8.





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## Technologies

### Tech Specs Comparision - Hybrid

	Current	2014
Components	MGU Energy Store	MGUK (kinetic) MGUH (heat) Energy Store
Power	max 60 kW	max 120 kW
Energy input	No maximum	max 2 MJ per lap from MGUK Effectively 4MJ per lap
Energy output	400 kJ	max 4 MJ to MGUK
Weight	No regulation	ES between 20 and 25 kg ES must be in survival cell

- KERS: a boost of up to 80 hp for 6.7 seconds a lap.
- ERS: a boost of up to 161 hp for 33.3 seconds a lap.
- Today, difficult to be quick without KERS; from 2014, impossible without ERS.



# Sustainability and motor sport Technologies

## Comparison to Formula One Power Unit 2014

Type of car	Fuel Consumption in kg	Distance in Km	Max Power in bhp	Fuel "efficiency" in g/km/bhp
Road car on a track	92	305*	550	.55

\*Actual distance travelled = 100 km and 144 km respectively but fuel consumption calculated on an equivalent race distance of 305 km



# Sustainability and motor sport

## Technologies

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GT3	152	305*	550	.91



# Sustainability and motor sport

## Technologies

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# Sustainability and motor sport

## Technologies

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2013 F1 V8	160	305	730	.72
2014 F1 V6 T	100	305	750	.44



# Sustainability and motor sport Technologies

## Outcomes – 2014 Energy Recovery System

2014 ERS can deliver twice the power to the rear wheels than current KERS.

- 2014 ERS can harvest x5 energy from the rear wheels.
- 2014 ERS can store up to x10 energy compared to current KERS.
- Energy recovered from two sources – from the turbocharger and from the rear axle



# Sustainability and motor sport Technologies

## KERS Technology Transfer

The SLS AMG Coupe Electric Drive benefits directly from the knowledge gained through the Formula One KERS Hybrid programme.

Brixworth has worked closely with AMG to develop the battery solution for the Electric Drive.

The battery modules are produced in Brixworth





# Sustainability and motor sport Technologies

## Technical regulations – Formula One

Technology transfer from track to the road.

### F1 fuel-saving flywheel to be fitted to London's buses

Go-ahead to fit technology, developed by Williams F1, to six prototype buses – with fuel savings estimated at up to 30%

[Leo Hickman](#)

[guardian.co.uk](#), Wednesday 18 April 2012 14.17 BST



Part of the flywheel energy storage system at Williams's factory in Wantage.  
Photograph: Simon Dawson/Getty Images





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## Public Policy

### Public policy positions

Motor sport advocates public policy positions to encourage the development of new technologies in the motoring market, reduce emission: both carbon and pollutants.

This was most recently done by the FIA in its publication Formula for the Environment.





# Sustainability and motor sport

## Environmental Management System

### Global certification – Environmental Management

The FIA Institute's Environmental Certification Programme is aimed at helping motor sport stakeholders worldwide to measure and enhance their environmental performance.

**Best Practice Framework  
(Guidance)**



**Accreditation Guidelines  
(Requirements)**



**Checklist  
(Self assessment tool)**





# Sustainability and motor sport

## Environmental Management System

### **Environmental Management System**

The Certification is specially designed for motor sport stakeholders with a three level approach to cover the broad range of different motor sport organisations.

The FIA Institute will assess stakeholders and award them accordingly

1. Achievement of Excellence
2. Progress towards Excellence
3. Commitment to Excellence





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Future scenario

## Summary

Motor sport stakeholders can develop a state of the art structure where environmental management will strength environmental performance and in combination with innovation and new technologies .

This will make motor sport one of the strongest Environmental Champions.

