Shell Eco-marathon

Bringing energy into the future

General Rules & Regulations 2008

FOREWORD

Shell Eco-marathon: challenging young people to design and build energy-efficient vehicles

The Shell Eco-marathon challenges teams to drive the furthest on the least amount of energy. It is an innovative educational project bringing together the values of sustainable development, protection of the environment and individual and cultural diversity.

Participants manage a project in totality and the Shell Eco-marathon encourages integration of vehicle design, finance and construction into the curriculum, as well as demonstrating the value of multi-disciplinary teams working together with industry towards a common goal.
Shell[1] organises energy-economy competitions on a real motor racing circuit in both the US and Europe. Known as the Shell Eco-marathon, this competition is governed by the rules and regulations presented herein.

Participants can design vehicles for the 'Prototype' or the 'UrbanConcept' category.

The vehicles may only use one of the following fuel or energy types:

- Shell Unleaded 95 (EU) / Shell Plus 89 (US) Petrol/Gasoline
- Shell Diesel
- Liquefied Petroleum Gas (LPG)
- Shell Gas To Liquid (GtL 100%)
- Fatty Acid Methyl Ester (FAME 100%)
- Ethanol E100 (100% of Ethanol)
- Hydrogen
- Solar Power

[1] The name "Shell" is used for the sake of simplicity when referring to one or more companies of Royal Dutch Shell plc.

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Chapter I

General rules
for all Shell Eco-marathon events in the world

1 - ORGANISATION

Article 1: Acceptance

The entry forms must be sent completed, with all necessary documents, to the Organisers who will accept teams based on the quality of the proposed entry packet. All decisions by the Organisers regarding the acceptance of teams are final.

By the simple fact of their entry, participants accept all the provisions of the present regulations and agree to abide by all decisions made by the Shell Eco-marathon Organisers. Organisers reserve the right to modify any article of the present regulations. In such an event, the participants shall all be personally notified. The Organisers shall be solely empowered to pronounce on cases not provided for in the present regulations.

Organisers reserve the right to modify, delay or even cancel the competition in the event of unforeseen circumstances, notably poor weather conditions. No claims for compensation shall be accepted.

In participating in the Shell Eco-marathon, you recognise the right of its Organiser, Shell, and more generally the companies of the Shell Group to use, if necessary, your image for publicity or materials promoting this project.

Article 2: Entries

For each entry, a Team Manager, a main driver and a reserve driver shall be designated.

The Team Manager shall be responsible for only one vehicle. He/she may also be a driver for that vehicle, but only for that vehicle.

The Team Manager shall be the team's sole official liaison with the Organisers. All information shall be addressed to him/her. For the purposes of the project, he/she shall be responsible for the team and shall speak on behalf of the team and must be able to understand and speak English.

The eligibility criteria for drivers are detailed in the relevant section of Chapter II. The main driver for one vehicle shall not be the main or reserve driver for another vehicle. The main and reserve driver must be affiliated with the educational organisation for which he / she is driving.

A reserve driver may be assigned to two vehicles. However, once he/she has driven one of those vehicles (during practice or in competition), he/she may no longer drive the other vehicle.

Each interested team must apply to compete in the regional Shell Eco-marathon event closest to their home country. The attendance at another Shell Eco-marathon event outside its home region is subject to decision of the relevant regional organising committee.

Article 3: Track Access Conditions

During both the practice runs and the competition, all vehicles must comply with the technical and safety rules and regulations of the event. Whenever the track is entered, the vehicle body shall be in place and shall bear all the competition numbers, partner streamers and Shell logos required by regulations.
Organisers will supply these numbers and logos upon entry confirmation.

Article 4: Identification

Logos, official partner streamers and racing numbers must be fixed to the vehicle body (in accordance with the diagram provided) such that they can be clearly read during any public presentation, in promotional films and on all photographs for team use, school use, press or promotional material.
Under no circumstances must the Shell logos, the partner streamers or racing numbers be modified, either on the vehicle or on any other documentation. It is prohibited to cut the stickers supplied by the Organisers. Their dimensions are as follow:

- For each side and for the front of the vehicle: a Shell logo, 20 x 20cm.
- For each side and for the front of the vehicle: racing numbers (stickers), with a different colour for each energy class, 20 x 26cm.
- For each side, on the lower part of the body: a partner streamer, 90 x 6cm.

A mandatory 10cm space shall be left free on either side of the Shell logo.

Any sponsor names/logos shall be smaller than the Shell logo. The sponsor stickers must fit within a surface of 400 cm^2 (empty space included)

In the event of a breach of this rule, the event Organisers reserves the right to remove any sponsor logos.
Furthermore, the trademarks or logos of other energy providers, Oil companies, direct competitors of event partners, tobacco companies and alcoholic drinks producers are prohibited.

All vehicles are subject to the Organiser's approval concerning these provisions.

Article 5: Compliance

Only those vehicles that comply with the present regulations are allowed to participate. No vehicle shall be allowed on the track for practice or competition until the Organisers have approved it. The decisions of the Organisers are final in all matters concerning the compliance of vehicle design and construction with the present regulations.
The Organisers reserve the right to rescind vehicle approval upon further or more detailed checks. The Organisers must be notified of any modifications to the vehicle after inspection. Non-compliance with this rule shall lead to vehicle disqualification.

Article 6: Timekeeping

All vehicles will be supplied with an extra-flat electromagnetic transponder at the circuit that must be fitted after vehicle inspection using adhesive tape or bolts & nuts, inside or outside the vehicle according to the vehicle's characteristics. A security deposit may be required for this transponder. The security deposit shall be returned upon presentation of the transponder at the end of the competition.

---------- *PROTESTS AND DISPUTES* ----------

Article 7: Protests

Team managers shall be the only persons authorised to lodge protests. Protests shall be addressed in writing to the Competition Director and shall be submitted to the Competition Secretariat. Depending on their nature, said protests shall be lodged within the following times:

- Vehicles: before the end of the competition.
- Team and driver behaviour: within 10 minutes following the end of the attempt.
- Results: within 15 minutes after the results of an attempt have been posted.

Article 8: Disputes

In the event of any disputes, all decisions made by the Competition Director are binding and final.

Article 9: Penalties

Non-compliance with the driving regulations will result in a warning, invalidation of the attempt or disqualification of the team, depending on the severity of the breach.

Event Organisers will exclude, disqualify or otherwise penalise any competitor who, in the judgement of the Competition Director, has gained an unfair advantage as a result of any breach of these regulations, hindrance of other participants, departure from the normal course, or any act or omission capable of misrepresenting performance, especially with regard to fuel consumption or method of propulsion.

During the competition, the driver or the team manager must report to the Organisers any movement made or attempted by means other than the vehicle's own motive power. In such an event, the attempt in question will not be taken into account. If this type of incident is not reported, all the team's attempts will be invalidated.

Organisers shall apply the following penalties for the following infractions:

- Non-use of the horn prior to overtaking.
- Non-compliance with safety or driving regulations (unsafe or unwise behaviour).

1st infraction:	Formal warning
2nd infraction:	Best overall attempt invalidated at the end of the competition
3rd infraction:	Immediate Team disqualification.

2 - SAFETY

Article 10: Safety Rules

As with any activity there should be an understanding that certain inherent risks will be present. Recognising and controlling the risks are vital for the well being of people and local surroundings. Safety is an essential consideration for the event Organisers. These Rules are to protect all individuals and surrounding area and are in no way intended to curtail the spirit of the competition. Any activity deemed unsafe or outside of the spirit of the event will be met with appropriate action by the event Organisers.

Therefore, compliance with safe driving and sporting rules will be mandatory for everyone. All team members will comply with the safety measures and must notify Organisers about any anomalies or incidents; and in the event that dangerous conditions are present leave areas immediately. During the event the Pit areas will be monitored by the Organisers to assist Teams to comply with safe practices.

Non-compliance with regulations may lead to disqualification from the competition.

---------- DRIVING REGULATIONS ----------

Article 11: Driving Knowledge Test

Only the registered main driver and the reserve driver will be authorised to drive the vehicle.
During vehicle inspection, drivers may be questioned to test their knowledge of the driving regulations.

Article 12: Driving under the Influence of Alcohol

Driving under the influence of alcohol is forbidden.

Before using the track either for test runs or competition, all registered drivers may be subject to random alcohol level checks. Such checks will be systematically conducted in case of serious incidents or accidents on the track. During the test runs, this measure will apply as well to the accompanying cyclists on the track.

Alcohol levels, measured with a breathalyser, must be below the value of 0.1 milligram of alcohol by litre of exhaled air (mg/l).

Any breach of the limit stated above will be penalized in line with Article 9 and the following additional penalties:

- Any alcohol related breach of the regulations will be treated at least as '2nd infraction' of the team, even if no prior violation has occurred.
- In addition, the affected driver (or cyclist) is immediately banned accessing the track as long as his/her alcohol level is above the stated limit. The reserve driver may substitute the main driver if he/she is eligible to drive.
- Any second alcohol related infraction will lead to the immediate disqualification of the entire team.

Article 13: Briefing and Test Lap

Race Control shall hold a briefing session each morning before the track is open. Team managers and drivers may request a familiarisation lap aboard a Race Control vehicle. The dates and times for these test laps must be arranged at the Reception Desk and will be posted in the track area.

Article 14: Access to the Track

Vehicles must pass a safety inspection prior to accessing the track for practice runs. A safety sticker will be clearly affixed once the vehicle has passed the inspection.

For practice runs, only vehicles with a safety sticker will be allowed on the track. For the competition, only vehicles with safety and technical inspection stickers will be allowed to compete.

Each team may have a single bicycle on the track, but only during the practice runs. The cyclist must wear a badge bearing the team's number and must ride in the racing direction, taking care not to disturb any of the other participants; bicycles only will be permitted. Each cyclist must wear a cycling helmet and appropriate footwear, i.e. no sandals, flip-flops, etc.

Article 15: Pushing the Vehicle

During the competition, the driver will not be allowed to push his/her vehicle or to have it pushed, including to start the run or to cross the finish line. Non-compliance with this rule may lead to disqualification of that run.

Article 16: Racing Direction

It is forbidden to drive in reverse gear or to drive against the normal race direction; any breach of this rule will lead to disqualification of the vehicle and of the team.

Article 17: Radio Communication

The use of hand-held communications is forbidden in the vehicle, however the use of a “hands-free” kit is allowed.

Article 18: Overtaking

Drivers are required to give clear passage for other competitors wishing to overtake.

- The driver in the overtaking vehicle must sound their horn and pass with caution. Attention: The driver of the overtaking vehicle is responsible for the safety of the manoeuvre.
- The driver of the vehicle being overtaken will use his/her rear – and side-view mirrors and must not change course suddenly.

Reminder: On the track, overtaking is authorised on both the right and the left, as long as the above-mentioned safety rules are followed.

Article 19: Breakdowns and Other Incidents

If a vehicle breaks down or is involved in an accident on the track, the driver will ensure that the vehicle is removed as quickly as possible to the shoulder of the track. If the vehicle cannot continue under its own power, the driver will wait for a Track Marshal, who will arrange for assistance. It is forbidden to carry out repairs on the track. In the event of a flat tyre, even when near the starting line, a new start will not be granted for the attempt in question.

Article 20: Parking

Off Race Track: All vehicles must be parked inside the pit area or directly in front of it. When off the track, vehicles will be moved without the use of the engine. They must be pushed or pulled. Race Marshals will notify Race Control of any breaches and any unsafe or unsportsman-like behaviour.

On Race Track:

(i) Intentional stopping on the track is forbidden. However, if a break down occurs during practice runs only parking is allowed on the inside shoulder of the track to enable repairs to be carried out. If repairs last more than two minutes, the vehicle must be towed back to the pit area by the safety services.

(ii) During the competition, the following will apply to a vehicle that comes to a full stop:

- With the engine running, the vehicle will have 30 seconds to start moving again. After this time has elapsed, the attempt will be terminated and invalidated. The vehicle will be towed back to the pit area by the safety services.
- If the engine stalls and cannot be restarted within 30 seconds, the attempt will be terminated and invalidated. The vehicle will be towed back to the pit area by the safety services.

---------- DRIVER EQUIPMENT ----------

Article 21: Driver Weight

Drivers must weigh at least 50 kg in full driving gear.
Ballast may be fitted to the vehicle in the event the minimum weight requirement is not met. This ballast must be provided by the team, and must be effectively tied down to the vehicle absolutely ensuring no danger for the driver in the event of collision or roll-over. The driver (in full driving gear) may be weighed before and after each official attempt. A 1kg disparity between these two weights will be tolerated in order to take into account weight loss by dehydration.

Article 22: Helmets

For practice and competition, drivers must wear protective helmets (Motorcycle style is recommended) that comply with national safety standards. (For the US) The standards must be certified through (Snell or DOT) and their label clearly attached to the exterior of the helmet. Helmets worn by both the main and reserve drivers will be subject to Inspector's approval. There are several styles of helmets that are permitted, for example full-face or three quarter. Generally the full-face and three quarter style helmets can be affixed with face shields and are highly recommended. If a face shield is not utilised, safety goggles will be required. The helmets must correctly fit the drivers; otherwise they will not be approved for the event.

Article 23: Driver Clothing

All drivers must wear a flame retardant racing suit as the outermost layer of clothing. Casual clothing and street wear are not permitted. Chapter II provides further guidelines regarding the racing suit quality and where / how to obtain them. Wearing synthetic clothes or synthetic underwear is strictly forbidden for drivers when on board of their vehicle.
Gloves and shoes are required; barefoot or socks only are prohibited.

---------- TEAM SAFETY EQUIPMENT ----------

Article 24: Equipment and Materials

Teams will share responsibility for safety matters and are required to provide the following for use at the event:

- Gloves for general work: leather or canvass material.
- Gloves for fuel or motor oil handling: Chemical resistant.
- Safety glasses for all Team members. (Disposable type are permitted).
- Hearing protection for all Team members. (Approved Ear plugs or muffs).
- Duct tape to secure any cords or cables lying on the pit floor.
- Lift stands or appropriate raised platform for vehicle turning and repairs.
- Operational 6 kg dry-chemical (powder) extinguisher suitable for "ABC" class of fires, of which the maintenance date is later than 31/5.2008 (to be placed in the garage).

---------- ATTENTION ----------

Please review all sections of the Rules & Regulations as they may contain additional safety matters specific to the topic.

3 – VEHICLE DESIGN

A - Prototype Group

Article 25: Vehicle Design

During vehicle design/construction and competition planning, participating teams must pay particular attention to all aspects of safety, i.e. driver safety, the safety of other participants and spectator safety.

Vehicles must have three or four running wheels, which under normal running conditions must be all in continuous contact with the road. Mobile aerodynamic appendages are forbidden.

Vehicle bodies must not include any sharp external appendages that might be dangerous to other participants. The vehicle must not contain any sharp objects that might injure the driver during a collision.

Article 26: Dimensions

The maximum height must be less than 100 cm

The maximum height measured at the top of the driver's compartment must be less than 1.25 times the maximum track width between the two outermost wheels. The track width must be at least 50cm, measured between the midpoints where the tyres touch the ground. The wheelbase must be at least 100cm. The maximum total vehicle width must not exceed 130cm, the maximum total length shall be 350cm and the maximum vehicle weight, without the driver, shall be 160kg.

Article 27: Driving Position

For safety reasons, the head-first driving position is prohibited.

Article 28: Cockpit - Ventilation

Participating teams shall note that high temperatures can be attained inside the vehicle, thus negatively affecting driver comfort. The cockpit shall therefore be properly ventilated and equipped with a sunscreen. It is recommended that drivers consume sufficient amounts of water to avoid dehydration.

Article 29: Roll Bar

Participants must ensure that the vehicle shell and/or chassis are solid. The cockpit must be equipped with an effective roll bar that extends in width beyond the shoulders of both authorised drivers. The roll bar shall be included in the chassis and also extend 5 cm above the top of the driver’s helmet in the normal driving position. This roll bar shall be capable of withstanding a 70kg static load applied to its centre without bending. The vehicle cockpit must be wide enough in order to ensure that the driver would not be directly exposed in the event of a lateral collision.

A 5cm-thick layer of polyurethane foam with a minimum density of 28kg/m^3 shall be placed on the inside wall of the front of the vehicle body in order to protect the driver's feet in the event of a frontal collision.

Any vehicle not equipped with the above safety features shall be subject to disqualification.

Article 30: Visibility

The driver must have direct visibility in front and on each side of the vehicle and be able to turn his or her head 90° on each side of the longitudinal axis of the vehicle. This field of vision shall be achieved without aid of any optical devices such as mirrors, prisms, periscopes, etc. Moreover, the vehicle must be equipped with a rear-view mirror on each side of the vehicle, each with a minimum surface area of 25cm^2. The visibility provided by these mirrors, and their proper attachment, will be subject to inspection.

An electronic device must not replace rear-view mirror

An Inspector sitting in the driver's seat will check visibility in each of the vehicles in order to assess on-track safety. This Inspector shall check good visibility with seven 60cm high blocks spread out every 30° in a half-circle, with a 5m radius in front of the vehicle. Note that the driver must be able to move his/her head in order to see any "blind spots".

Article 31: Safety Belts

The driver's seat must be fitted with an effective safety belt having at least five mounting points ("child seat" type) to maintain the driver in his/her seat. The fifth point must be between the legs of the driver to prevent it from slipping in case of frontal accident. The belt must be firmly attached to the vehicle's main structure and be fitted with a buckle specifically designed for this purpose. Safety belt buckles and attachments must be made of metal. The safety belt must be worn and fastened at all times when the vehicle is in motion. The fitness for purpose of the belt and its fitting will be evaluated during technical inspection by raising the vehicle with the driver on board using the safety harness for suspension. The safety belt must withstand a force of at least 1.5 times the driver's weight.

Article 32: Vehicle Access

It is imperative for drivers to be able to vacate their vehicles at any time without assistance in less than 10 seconds. Vehicles with closed bodywork must be equipped with a sufficiently large opening for the cockpit. The driving position must be designed so that emergency services can easily extract the driver from his/her vehicle, if necessary.

Said opening may be enclosed wholly or partly by means of hinged, detachable and/or folding doors, provided that a release mechanism is easily operable from inside and that the method of opening from the outside is clearly marked by a red arrow and does not require any tools.

It is forbidden to attach or to reinforce the closing mechanism or cockpit with adhesive tape.

The Race Marshals reserve the right to extract the driver from the vehicle by opening and/or closing that vehicle, whenever they deem this to be necessary. Any intervention by the Race Marshals will not be subject to protest and will not lead to any penalties for the team in question.

Article 33: Horn

Each vehicle must be equipped with the authorised horn that can be purchased on the Shell Eco-marathon Website's e-shop centre.

Article 34: Clutch

Vehicles must be equipped with a clutch system, so that they can be immobilised on the starting line without any outside assistance.

Article 35: Wheels, Axles and Wheel Hubs

All types of wheels are allowed.

Any type of wheel rim may be used. Rims must be compatible with the dimensions of the selected tyres in order to satisfy safety standards.

Teams must take into account the fact that bicycle and motorcycle wheels are not generally designed to support substantial lateral cornering forces, such as may be found in Shell Eco-marathon vehicles at certain speeds.

The wheel axles must be of a size more appropriate for loads distributed on both sides and not in a cantilever fashion. Care should be taken to distribute loads so as to avoid any deformation of wheels or their axles.

The wheels located inside the vehicle body must be isolated from the driver by a bulkhead. Any handling or manipulation of the wheels is forbidden from the moment the vehicle is at the starting line until it crosses the finish line.

Article 36: Turning Radius

The turning radius must be sufficient to enable safe overtaking. If Race Marshals observe that the turning radius of a vehicle is insufficient, the vehicle will be removed from the track for technical inspection.

Article 37: Vehicle Handling and Driver Position

A vehicle handling course may be set up in order to verify the following when the vehicle is in motion: turning radius, steering precision and the driver's position inside the vehicle. In particular, Inspectors will verify that steering is precise, with no extra play,

Article 38: Braking

Vehicles shall be equipped with two independently activated brakes or braking devices, each including command control, command transmission (cables or hoses) and activators (callipers or shoes). One device shall act on the front wheel(s), the other on the rear wheel(s). When breaking on two wheels at the front or the rear of the vehicles, two activators have to be used (one on each wheel) commanded by only one command control. In addition, the right and left brakes must be properly balanced.

It shall be possible to activate the two systems at the same time without losing control of steering. The commands shall be perfectly ergonomic (no contortion shall be allowed for handling of the commands).

The effectiveness of the two braking devices shall be tested during vehicle inspection. The vehicle shall be placed on an incline with a 20 percent slope. The brakes will be activated each in turn. In both cases, the vehicle must remain perfectly immobile.

The use of a hydraulically controlled braking system is recommended. If a bicycle-type brake shoe system is used, only the V-Brake system shall be authorised.

Article 39: Additional Inspections

At any moment, Organisers may perform unannounced inspections on the vehicles.

Article 40: Exhaust System

The exhaust gases must be evacuated outside the body

Under no circumstances will exhaust pipes extend beyond the rear of the vehicle body. During vehicle inspection, Inspectors will demand the modification, or even the removal, of any equipment they consider to be a danger to the safety of other participants. Their decision shall be final.

Article 41: Sound Level

The sound level for a Prototype vehicle shall not exceed 90dB when measured 4 metres away from the vehicle.

B - UrbanConcept Group

(In 2008 only available at the European Shell Eco-marathon)

Article 42: Definition

Under the name "UrbanConcept", Shell has decided to offer educational establishments an opportunity to design and build fuel-economy vehicles that are closer in appearance to normal cars than prototypes. UrbanConcept vehicles shall comply with the specific regulations of the Shell Eco-marathon for this group. One particular feature of this group is that vehicles competing in this group will require "stop & go" driving.

Article 43: Energies

All authorised types of energy for prototypes are permitted for UrbanConcept vehicles.

In addition, the use of hybrid technology is also allowed for the UrbanConcept Group.

Article 44: Vehicle Design

During vehicle design/construction and competition planning, participating teams must pay particular attention to all aspects of safety, i.e. driver safety, the safety of other participants and spectator safety.

UrbanConcept vehicles may be built from a chassis or single shell with four load-bearing wheels. The vehicle shall have a towing ring or hook on the front so that it can be towed with a cable by another vehicle. Mobile aerodynamic appendages shall be prohibited. Vehicle bodies must not include any sharp external appendages that might be dangerous to other participants. The vehicle must not contain any sharp objects that might injure the driver during a collision.

Article 45: Dimensions

- The total vehicle height shall be between 100cm and 130cm.
- The total vehicle width shall be between 120cm and 130 cm.
- The total vehicle length shall be between 220cm and 350cm.
- The track width shall be at least 100cm for the front axle and 80cm for the rear axle.
- The wheelbase shall be at least 120cm.
- The driver's compartment shall have a minimum height of 88cm and a minimum width of 70cm at the driver's shoulders.
- The ground clearance shall be at least 10cm.
- The maximum vehicle weight (excluding the driver) shall be 160kg.

Article 46: Vehicle Body

- The body shall cover all mechanical parts, whether the vehicle is viewed from the front, the rear, the sides or from above. When seen from above, the body shall cover the wheels.
- It is prohibited to use a commercial vehicle body (e.g. mini-car).
- The vehicle shall be equipped with a side door enabling easy access, this door shall be easy to open from both the inside and the outside of the vehicle.
- The vehicle shall have a roof.
- A windscreen is mandatory.
- Space shall be reserved for a suitcase-like object with dimensions of 40 x 50 x 20cm (LxWxH).
- The vehicle must not have any sharp edges on its exterior.

- A towing hook or ring is mandatory on the front of the vehicle, it must resist a traction force of 200kg.

Article 47: Shell/Chassis Solidity

Participants shall ensure that the vehicle shell and/or chassis are solid. The cockpit shall be equipped with an effective roll bar that extends in width beyond the shoulders of both authorised drivers. The roll bar shall extend 5cm above the top of the driver's helmet in the normal driving position. This roll bar shall be capable of withstanding a 70-kg static load applied to its centre without bending. Moreover, all sides of the compartment shall be sufficient to protect the driver from possible lateral and frontal shocks. Any vehicle not equipped with the above safety features shall be subject to disqualification.

A 5cm-thick layer of polyurethane foam with a minimum density of 28kg/m^3 shall be placed on the inside wall of the front of the vehicle body in order to protect the driver's feet in the event of a collision.

Article 48: Visibility

The driver must have adequate direct visibility in front and on each side of the vehicle and be able to turn his or her head 90° on each side of the longitudinal axis of the vehicle. This field of vision shall be achieved without aid of any optical devices such as mirrors, prisms, periscopes, etc. Moreover, the vehicle shall be equipped with a rear-view mirror on each side of the vehicle, each with a minimum surface area of 25cm^2. The visibility provided by these mirrors, and their proper attachment, shall be subject to inspection.

An electronic device must not replace rear-view mirror

An Inspector sitting in the driver's seat will check the visibility in each of the vehicles in order to assess on-track safety. This Inspector shall check good visibility with seven 60cm high blocks spread out every 30° in a half-circle, with a 5m radius in front of the vehicle. Note that the driver must be able to move his/her head in order to see any "blind spots".

Article 49: Safety Belts

The driver's seat must be fitted with an effective safety belt having at least five mounting points ("child seat" type) to maintain the driver in his/her seat. The fifth point must be between the legs of the pilot to prevent it from slipping in case of frontal accident. The belt must be firmly attached to the vehicle's main structure and be fitted with a buckle specifically designed for this purpose. Safety belt buckles and attachments must be made of metal. The safety belt must be worn and fastened at all times when the vehicle is in motion. The fitness for purpose of the belt and its fitting will be evaluated during technical inspection by pulling on the safety belt with the driver on board. The safety belt must withstand a force of at least 1.5 times the driver's weight.

Article 50: Vehicle Access

It is imperative for drivers to be able to vacate their vehicles at any time without assistance in less than 10 seconds.

The door opening may be enclosed wholly or partly by means of hinged, detachable and/or folding doors, provided that a release mechanism is easily operable from inside and that the method of opening from the outside is clearly marked by a red arrow and does not require any tools.

It is forbidden to attach or to reinforce the bodywork or cockpit with adhesive tape.

The Race Marshals reserve the right to extract the driver from the vehicle by opening and/or closing that vehicle, whenever they deem this to be necessary. Any intervention by the Race Marshals shall not be subject to protest and shall not lead to any penalties for the team in question.

Article 51: Steering

Vehicle steering shall be controlled by means of a steering wheel. It shall be precise, with no extra play. The maximum turning diameter shall be 12m.

Article 52: Wheels

The rims shall be 16 or 17 inches in diameter.

The wheels located inside the vehicle body must be made inaccessible to the driver by a bulkhead. Any handling or manipulation of the wheels is forbidden from the moment the vehicle arrives at the starting line until it crosses the finish line.

Teams shall take into account the fact that bicycle and motorcycle wheels are not generally designed to support substantial lateral cornering forces, such as may be found in Shell Eco-marathon vehicles at certain speeds.

The wheel axles are also of a size more appropriate for loads distributed on both sides and not in a cantilever fashion. Care should be taken to distribute loads so as avoid any deformation of wheels or their axles.

Article 53: Tyres

All tyre types shall be allowed. The tyre shall have a minimum width of 90mm, measured from sidewall to sidewall.

Article 54: Lighting

The vehicle shall have a lighting system in proper working order for automobile road use, including:

Two front headlights

Two front blinkers

Two combined red blinker/stop lights in the rear

The centre of each headlight beam shall be located at least 30cm to each side of the longitudinal axis of the vehicle.

Article 55: Horn

Each vehicle shall be equipped with the authorised horn that can be purchased on the Shell Eco-marathon Website's e-shop centre.

Article 56: Vehicle Handling and Driver Position

A vehicle handling course may be set up in order to verify the following when the vehicle is in motion: turning radius, steering precision and the driver's position inside the vehicle.

Article 57: Braking

The vehicle shall be equipped with a four-disc hydraulic brake system, with a pedal control, which has a minimum surface area of 5 x 5cm.

The brakes shall act independently on the front and rear axles or in an X pattern (i.e. right front wheel with left rear wheel, and left front wheel with right rear wheel).

A single master cylinder may be used, provided that it has a dual circuit (two pistons and dual tank).

The effectiveness of the braking system shall be tested during vehicle inspection for both drivers. For testing purposes, the vehicle must remain immobile when it is placed on a 20 percent incline with the main brake in place. Moreover, a dynamic inspection shall be performed on the vehicle-handling course.

Race Inspectors shall check the brakes again just prior to the start. The vehicle shall be placed on an incline a few metres before the starting line.

Article 58: Additional Inspections

At any moment, Organisers may perform unannounced inspections on the vehicles.

Article 59: Clutch

Vehicles shall be equipped with a clutch system, so that they can be immobilised on the starting line without any outside assistance.

Article 60: Exhaust System

The exhaust gases shall be evacuated outside the body.

Exhaust pipes shall under no circumstances extend beyond the rear of the vehicle body. During vehicle inspection, Inspectors shall demand the modification, or even the removal, of any equipment they consider to be a danger for the safety of other participants. Their decision shall be final.

Article 61: Sound Level

The sound level for an UrbanConcept vehicle shall not exceed 90dB when measured 4 metres away from the vehicle.

4 – ENERGY SOURCES

Article 62: General

The vehicles may only use the following fuel or energy types:

- Shell Unleaded 95 (EU) / Shell Plus 89 (US) Petrol/Gasoline.
- Shell Diesel.
- Liquefied Petroleum Gas (LPG).
- Shell Gas to Liquid (GtL 100%).
- Fatty Acid Methyl Ester (FAME 100%).
- Ethanol E100 (100% of Ethanol).
- Hydrogen.
- Solar Power

Results will be expressed in kilometres per litre (i.e. theoretical distance covered) corrected to a temperature of 15°C.

Regardless of the fuel or energy type used, the ranking will be determined from the equivalent consumption of Shell Unleaded 95/Shell Plus 89 Petrol/Gasoline. This calculation shall be performed using the net calorific value (NCV), which represents the quantity of energy released per unit mass or volume of fuel during complete combustion yielding steam and carbon dioxide.

The NCV values (mass basis) for different fuels are given in the table below. The NCV values (vol.) at 15ºC are calculated on the day of competition by multiplying the mass-based NCV by the fuel density at 15ºC.

For example, if a distance of 1,000km is covered with one litre of Shell Diesel, whose corresponding energy is 35,663kJ (if we assume a fuel density of 0.83716kg/l at 15ºC), this represents 0.0280km covered per kJ. Since the energy from one litre of Shell Unleaded 95/Shell Plus 89 Petrol/Gasoline is 32,010kJ (if we assume a fuel density of 0.74616kg/l at 15ºC), this corresponds to a corrected distance of 896km (rounded to the nearest unit). The final result for a vehicle having covered 1,000km with one litre of diesel fuel (at the reference temperature of 15ºC) will thus be 896km for the equivalent of 1 litre of Shell Unleaded 95/Shell Plus 89 Petrol/Gasoline (also at the reference temperature of 15ºC).

Fuel	NCV by mass (kJ/kg)
Shell Unleaded 95 (EU)	42,900
LPG (Gepel)	46,000
Shell Diesel	42,600
Fatty Acid Methyl Ester	37,700
Gas to Liquid Diesel	44,000
Ethanol E100	26,900
Hydrogen	119,930

Article 63: Authorised Fuels

With the exception of Solar powered vehicles, only the fuels listed in Article 62, as provided to the participants by the Organisers during the event, are authorised.

The vehicles will be ranked in terms of their fuel consumption.

Supplies adequate for practice and competition will be available by the officials in charge of measuring fuel consumption (Fuel Marshals).

No additives may be added to the fuel. Only the power derived from the combustion of the fuel in the presence of air alone within the engine system may be used for forward propulsion, with the exception of any natural influences such as wind and gradient. No other material that could serve as engine fuel may be used at any time during the competition.

Any participant handling fuel must wear safety glasses and chemically resistant gloves.

Competitors may use a two-stroke fuel supplied by Event Organisers containing two percent of high-performance synthetic oil. This lubricant will be supplied on the practice day. This addition shall be considered as fuel consumed by the engine. Adding friction modifiers is prohibited.

Article 64: Authorised Lubricants

The Event Organisers will provide the engine oils for use by the competitors.

Article 65: Propulsion

For vehicles with combustion engines, exclusively the combustion engine must achieve forward propulsion. The type or design of said engine is not restricted, except as concerns conformity with the present regulations.

Event Organisers reserve the right to verify engine compliance during the two days prior to the competition. If a team decides to change engines after inspection, the team shall notify the Race Inspectors, who shall perform a new inspection. Unannounced inspections may be performed following the competition.

The use of hybrid technology is only allowed for Urban Concept vehicles and hence not allowed for Prototype vehicles.

Article 66: Emergency Stops

An emergency shutdown mechanism, accessible from the exterior, shall be installed on all vehicles. A red arrow at least 10cm long and 3cm wide at the widest point shall be positioned on the vehicle body to indicate clearly the position of this emergency shutdown mechanism from the exterior.

Article 67: Make-Up

For all type of energy classes, stored electrical or pneumatic energy not replaced during the competition by the engine or the fuel cell may be used only for the self-starter, the ignition, the injector, the instrumentation and electronic management systems. Energy for mechanically driven injection systems must be provided by the engine. Any other use shall require the written consent of the Event Organisers.

Auxiliary energy sources (chemical, latent energy from phase changes, etc.) are not permitted.

If the engine temperature is regulated, said regulation should be limited to the use of pure, un-pressurised water as coolant. The external regulation temperature of the engine (for engines thus equipped) shall be limited to 100°C.

It is forbidden to use a battery-powered electrical pump to ensure oil or water circulation in the engine. However, the use of such a pump shall be tolerated if it runs only when the engine is being started. In the event or need for the normal operation of the engine these function must be actuated by this engine (mechanical transmission).

Article 68: On-Board Battery

Only one battery will be allowed. All additional sources of electricity (with the exception of hydrogen fuel cells) are forbidden.

For the fuel cells, the battery will be used only for the horn as well as the safety element of this one (Hydrogen Detector Emergency Shutdown valve / Relay, see article 76 Hydrogen).
To restrict unauthorised conversion of the electrical energy supplied by the vehicle's battery into mechanical energy, entrants are requested to provide the main characteristics of the battery in their technical documentation: maximum voltage that can be supplied, capacity in ampere-hours (i.e. the quantity of electricity that the battery can theoretically provide when new), dimensions and weight.

On the basis of the statistical results obtained from all entrants, the Event Organisers reserve the right to request additional information from teams using high-capacity batteries. The Organisers also reserve the right to verify the information provided in the technical documentation.

For Urban Concept vehicles using hybrid technology, the use of a Super-Capacitor to store recovered electricity is strongly recommended (the storing of recovered electricity being permitted for hybrid vehicles). If a team chooses to use an electrical battery, it must be emptied before each attempt. In each case, two connectors will have to be installed outside the vehicle to allow the voltage measurement on the starting line.

The battery inspection shall be performed using light indicators (light bulb 21 W, 12 or 24 V) as a function of the battery, in association with a voltmeter, which must show a significant drop in voltage when the bulbs are connected to the battery.

The Organisers reserve the right to request of the teams, which achieved the highest performances, the installation of one joulemeter intended to measure the quantity of electricity consumed by the battery. This electricity consumption will be then converted into an equivalent consumption of Shell Gasoline and added to the engine consumption. This calculation shall be performed using the net calorific value for this fuel, i.e. 42,900 kJ/kg.
All details regarding the supply and the installation of the joulemeters will be provided to the concerned teams when their candidacy is accepted.

Article 69: Starter

Competitors shall provide the Event Organisers with a precise description and diagram of the vehicle's electrical circuitry.
An electric self-starter may be used during the competition, provided that it can operate only when the ignition and fuel systems are functioning normally. It must be clearly established that the starter is never capable of providing any forward propulsive force to the vehicle. A red indicator light equivalent in luminosity to a car brake light shall be installed on the rear of the vehicle and shall be clearly visible from both sides of the track in order to signal any restarting of the vehicle (electrical interlock).
In the event that Track Marshals report the repeated or intensive use of the self-starter by a team, the Organisers reserve the right to order an immediate inspection of the vehicle. If any non-compliance is observed, one of the following penalties shall be applied:
Invalidation of the attempt during which the violation was observed;
Invalidation of all the team's attempts for the day in question;
The Team will be disqualified.

Article 70: Engine and Fuel System Isolation from the Driver

A permanent, rigid, fire resistant bulkhead shall be mounted between the engine compartment and the cockpit. Thus preventing any manual access to the engine compartment by the driver.

The whole fuel system, from the tank to the engine, shall be placed behind this bulkhead or in a compartment completely separated from the cockpit.

Article 71: Replacement of Major Parts

After passing the technical inspection, any replacement of major engine components shall be subject to approval from Race Inspectors.

Article 72: Fire Extinguisher

Each vehicle shall be fitted with a fire extinguisher (ABC or BC type) in perfect working order. All drivers shall be trained in the use of said fire extinguisher. This extinguisher shall have a minimum capacity of 1kg, be full and shall have a certificate of validity bearing the manufacturer's number, the date of manufacture, and the expiry date.

Plumbed in extinguishers may be located in the engine compartment and should discharge into the engine compartment. Triggering systems must be located within the cockpit and be operable by the driver in his normal driving position.

Hand held extinguishers must be located within the cockpit and be accessible to the driver once they have vacated the vehicle. In the event of a fire, drivers should first exit the vehicle and then if possible, remove the extinguisher and attempt to extinguish the fire if safe to do so.

Article 73: Fuel System (combustion engine)

The participants shall provide a description and a precise diagram of the fuel supply system from the tank to engine intake. This system shall be translucent and designed in such a way that it can be completely drained and refilled before the competition.

The fuel system shall not include any additional elements, such as valves, monitors, gauges, etc., between the tank and the engine intake system (nozzle, carburettor or pump), apart from a filter (transparent) or, in the case of a diesel engine, a cut-off solenoid valve. Any fuel system including a float chamber (carburettor) must be fitted with a valve enabling Inspectors to partially drain the chamber and to ensure that the fuel level goes down in the tank.

Similarly, the air intake manifolds shall not contain any fuel or blowby gas* when the vehicle is on the starting line prior to departure. Blowby gas shall not be recycled during the competition.

The entire fuel system shall be made inaccessible to the driver by means of a bulkhead, through which only the instruments may pass. The fuel system shall be easily accessible for inspection and measurements.

Attention: fuel is a volatile product. Therefore, it is recommended to avoid any increase in fuel system temperature, which would lead to the formation of vapour lock. Conversely, cooling or refrigeration of the fuel below ambient temperature is prohibited.

* *Blowby* gas: gas inside the engine (in particular, oil vapours, unburnt gas or gas in the combustion chamber that has not been evacuated in the exhaust). This gas is usually recovered at the intake manifold. This is known as blowby gas re-circulation.

Article 74: Fuel Tanks (Combustion engine with the exception of LPG/Hydrogen)

The fuel tank must remain visible at all times from the outside of the vehicle. The vehicle must be equipped with only one Shell supplied and approved fuel tank.

Tank capacities: Prototype group: 30, 100 or 250cc
UrbanConcept group: 30, 100, 250 or 350cc

It is permitted to pressurise the tank, in order to feed the engine, only under the following conditions:

The tank has a capacity of 30, 100, 250 (only the new 2008 models!) or 350cc and bears a clearly visible stamp proving its "APAVE"* certification compliance.

Pressurisation is done by means of a compressed air bottle fitted with a safety valve set to 5 bars maximum. This bottle shall be translucent. It shall include a standard valve as used for car tyres in order to enable verification/control of the pressure setting for the safety valve.

Said pressurisation is done in the starting area by means of a pump. The driver shall not modify the pressure during the competition.

It must be possible to set the fuel supply system to atmospheric pressure for measurement of the fuel level. The vehicles shall be equipped with a pressure gauge. Normal running pressure shall be clearly indicated by a mark on the gauge. The fuel tank cap, whether it is leak proof or not (drilled), shall be in place at all times during official attempts.

All the hoses of the fuel supply system shall be made of semi-rigid and translucent materials of the Rilsan/Nylon type. This rule shall apply to all participants, whether they use a pressurised fuel tank or not.
Hoses to tank tops should be flexible to allow easy connection and in order to prevent application of excessive side loading to the tank necks.

* *APAVE*: This organisation tests fuel tanks and attests to their capacity to withstand a pressure of 5 bar.

Article 75: LPG Cartridge

The LPG cartridge shall be visible at all times from the outside of the vehicle.
A standard LPG cartridge containing approximately 230g of LPG (plus fittings) is required by competition rules and cannot be modified.

Exclusively Race Control shall fill each LPG fuel set.
A cartridge.
A standard valve to select use of LPG in the liquid or gas phase.
A safety valve set to 1,500 kPa (15 bar) that discharges LPG outside the vehicle and towards the ground.
An automatic (solenoid) valve. This solenoid valve shall enable isolation of the cartridge from the fuel system. This valve must be closed when the engine stalls, even if the ignition is still on. A timer is allowed.

The electric installation associated with the LPG fuel circuit shall be protected with a fuse. The components of this installation shall not be exposed to friction or to shocks, particularly the cartridge.
For safety reasons, the cartridges shall at no time reach a temperature of 50°C. The layout of the exhaust system as well as the choice of cartridge placement shall take this requirement into account.

The entire fuel system shall be made inaccessible to the driver by means of a bulkhead, through which only the instruments may pass. The fuel system shall be easily accessible for inspection and measurements.

At the start of the race, the system between the solenoid valve and the engine shall be purged. This system shall be pressurised by the competitor's cartridge, after weighing.

At the end of the race, it shall be possible to drain the hoses between the solenoid valve and the engine.

It is forbidden to pressurise the LPG cartridge.

Hoses transporting LPG shall be LPG-compatible (proof of compatibility shall be required).
Hoses carrying gaseous LPG at a pressure greater than 120 kPa (1.2 bar) shall resist a pressure twice the maximum operating pressure (proof shall be required). They shall be equipped with threaded fittings.
Hoses carrying liquid LPG shall resist a pressure of 3,000 kPa (30 bar).

Under no circumstances shall hoses with a pressure greater than 5 kPa (0.05 bar) pass through the cockpit.

For Liquid Injection Systems:
A fuel tank (built in accordance with good manufacturing practices) may be used with an integrated or external pump.

The entire system may be tested under nitrogen pressure at 3,000 kPa (30 bar) during the technical inspection (in all cases, proof of testing shall be required). To enable testing, a plug will replace the safety valve.
The total system volume shall be limited to 1 litre. It shall not be filled past 80%. A standard filling connection shall be provided.

Note: In this case, a safety valve set to 1,800 kPa (18 bar) shall be allowed, instead of 1,500 kPa (15 bar).

A filling station with LPG cartridges shall be used to fill the tank during the Shell Eco-marathon.

An LPG sample shall be taken from the systems using a refillable tank. An LPG analysis may be conducted at the end of the race upon request from Shell Eco-marathon Organisers (chromatography, pressure, etc.).

Article 76: Hydrogen for Fuel Cells (FC)

The participants must provide a description and a precise diagram of the fuel supply system
The entire fuel system must be made inaccessible to the driver by means of a bulkhead, through which only the instruments may pass. The fuel system shall be easily accessible for inspection and measurements.

Cartridge, cylinder, filling
The technical documentation provided in the entry packet of a FC-powered vehicle must specify whether the vehicle uses a metal hydride cartridge, known hereafter as a cartridge, or a compressed hydrogen cylinder, referred to hereafter as a cylinder.

Cartridge
Only one cartridge may be fitted to each vehicle.
For prototypes, the cartridge capacity must not exceed 70 Nl of hydrogen.
For Urban Concept vehicles, the cartridge capacity must not exceed 160 Nl of hydrogen.
Either way, a label specifying the refilling pressure and time must be stuck on the cartridge. (Nl is normal litre of gas at 0 °C and 1013.25 hPa.)

Cylinder
For prototypes, the maximum size allowed for hydrogen cylinder is the B04. A full B04 cylinder contains 0.4 litre of hydrogen at 200 bar.
For Urban Concept vehicles, the maximum size allowed for hydrogen cylinder is the B1. A full B1 cylinder contains 1 litre of hydrogen at 200 bar.
Either way, only one cylinder can be fitted in the vehicle.

Cylinders and cartridges must be filled under the supervision of Race Inspectors. Participants must not be authorised to keep cylinders or cartridges in storage. Upon arriving at the circuit, team managers must contact the Race Inspectors, who must organise the storage and filling of cylinders and cartridges.

Ventilation
The vehicle body must be perforated at the highest point of the hydrogen-processing compartment to make a ventilation orifice that has a minimum section of 5 cm^2. If the shape of the vehicle body enables hydrogen accumulation at or near the top of the cockpit, another 5 cm^2 openings must be included in these areas.

Hydrogen detector
A hydrogen sensor must be installed in the hydrogen-processing compartment, near the main ventilation orifice mentioned above. This hydrogen sensor must drive the emergency shutdown valve and relay mentioned in the next section. The trip level of the hydrogen sensor must be tuned to 25% of the LEL (Lower Explosive Limit) of hydrogen, i.e. 1% of hydrogen in air. A test will be carried out during the technical inspection.
The reset of the hydrogen detector, i.e., the hydrogen sensor and its electronics, must be done manually via a switch located in the hydrogen-processing compartment. This switch must not be accessible by the pilot from the cockpit.

Emergency shutdown valve and relay
The hydrogen supply circuit must be equipped with a solenoid emergency shutdown valve. This valve must be normally closed in the absence of electricity. This valve must be located upstream from the pressure regulator.

A normally open electrical relay must be mounted on the power supply of the drive motor(s).

These valve and relay must be controlled by:
An emergency push-button must be located, beside the cockpit, on the outside of the vehicle. This button must cut off the hydrogen supply and the drive motor(s) supply. A red arrow at least 10 cm long and 3 cm wide must be positioned on the vehicle body to clearly indicate the place of this emergency push-button.
Another emergency push-button, accessible by the pilot in driving position and the hydrogen detector, as described previously.

In case of activation of one of these three features, the valve and relay must act simultaneously.

These three features will be tested during the technical inspection and before each attempt.

Pipes and connections of the hydrogen circuit
Non-rigid and unscrewed connectors are only allowed if the hydrogen pressure is below 1.5 bar absolute. These pipes and connections must be designed for hydrogen use. The team leader must be able to deliver, during the technical inspection, the technical sheets of the manufacturer of these pipes and connections to show that they comply with hydrogen use.
For higher hydrogen pressure, only steel pipes and screwed connectors are allowed.

Purge pipe
If a purge pipe is needed, its end must be located outside the vehicle.

Measurements and Equivalencies
The consumption of hydrogen must be measured by an embedded flowmeter. Measurement by weighing the hydrogen tank before and after a run is not allowed. The flowmeter can be purchased on the Shell Eco-marathon website's e-shop centre. The volume of hydrogen consumed is posted in normal litres. The performance is expressed in kilometres per litre of Shell Unleaded 95 (EU) / Shell Plus 89 (US) (theoretical distance covered), at a temperature of 15 ºC.
The display of the flowmeter must be easy to read from outside the vehicle, when the vehicle body is closed.

Oxygen and air reserves
The use of non-replaced oxygen or compressed air reserves is forbidden.

Batteries or super-capacitors
If an embedded electric storage device is part of the powertrain, it must be of capacitor type, referred to hereafter as super-capacitors. Other types of embedded electric storage device (Pb, NiMh, etc. batteries) are forbidden. The state of charge of the super-capacitor will be checked before and after each run by measuring the super-capacitor voltage. The voltage registered after the run must be at least equal to the voltage registered before the run. In the event of the contrary, the super-capacitor must be re-charged until their voltage is equal to the voltage registered before the run. The figure displayed by the flowmeter will then be picked up.

An external battery can be used on the starting line to start the fuel cell system. As soon as the vehicle starts to move, this battery must be unplugged. The use of this external battery is permitted whether super-capacitors are used or not.

If super-capacitors are used, two connectors must be installed outside the vehicle to allow the voltage measurement of the super-capacitors on the starting line.

If an external battery is used, two connectors must be installed outside the vehicle to allow a quick connection and fuel cell system start on the starting line.

Only stand-alone external battery can be used to start the fuel cell system. Taking power from the main is not allowed.

It is allowed to feed the hydrogen detector, the emergency shutdown valve and the relay by one additional battery.

Electrical circuit / Electronic
All electrical/electronic cases must be made of transparent material or at least have a transparent top.

The maximum voltage on board must not exceed 50 V.

A fuse must be installed on the positive terminal of the fuel cell stack. Its melting current (expressed in Amps) must be inferior to 0.5 times the active area (expressed in square centimetres) of one cell of the stack. For instance, if the active surface of one cell of a 20 cell stack is 60 cm², the melting current of the fuse must not exceed 30 A.

If super-capacitors are used, a fuse must be installed on the positive terminal of the super-capacitors pack. Its melting current must be inferior to the intensity that corresponds to an electric power of 300 W for prototypes and 1000 W for Urban Concept vehicles, assuming that the super-capacitors are completely charged. For instance, on a prototype, if the super-capacitor pack has a maximum voltage of 15 V, the fuse set point must not exceed 300W/15V = 20 A.

Article 77: Solar-Powered Vehicles

Competition:

- All vehicles must be equipped with two, joulemeters, one to measure the electric motor energy consumption, the other one the solar panel energy production. Stickers, “SOLAR PANEL” and “MOTOR” must identify the two joulemeters.
- For safety reasons, the battery and solar panel voltage will have to remain under 48 volts in all conditions. To be in accordance with joulemeter technical specifications, the motor electric current must not exceed 50 amperes permanent and 150 amperes peak.
- The vehicles will go to the starting line with their batteries charged.
- On the starting line, race marshals will set to zero the two joulemeters, then the vehicles will have access to the track to start their performance run under the same distance and time conditions as specified for the prototype vehicles class.
- At the finish line, race marshals will read the two joulemeter displays.
- Ranking: only vehicles for which the energy production is higher than energy consumption will be ranked.
- The ranking will be determined as a function of energy consumption measured by “MOTOR” joulemeter (from the lower to the higher result).