Olife

Lead free automotive SLI power

SLI Starting Lighting Ignition

Revolution in Evolution of Car Batteries

Introduction

Car Battery (R)evolution
Our patented technology is based on the combination of Li-ion batteries and supercapacitors in one unit. This ensures its 100% operation in freezing temperatures and its reserve energy provides the necessary ranking current for the start-stop system. It is the first real substitute for the old lead-acid batteries.

Infinite Source of Energy
The Li-ion Batteries continuously refill the supercapacitors thus serving as a source of Reserve Capacity. The battery has low value of self-discharge and it will stay ready to start even two years after staying out of operation.

Modern Battery for Modern Vehicle
Olife operates reliably even if the electronic car accessories are on and the engine is not running. Therefore it is ideal for the start-stop system and thanks to its light weight it reduces CO_2 output. Furthermore it is safe and reliable in any outdoor temperature.

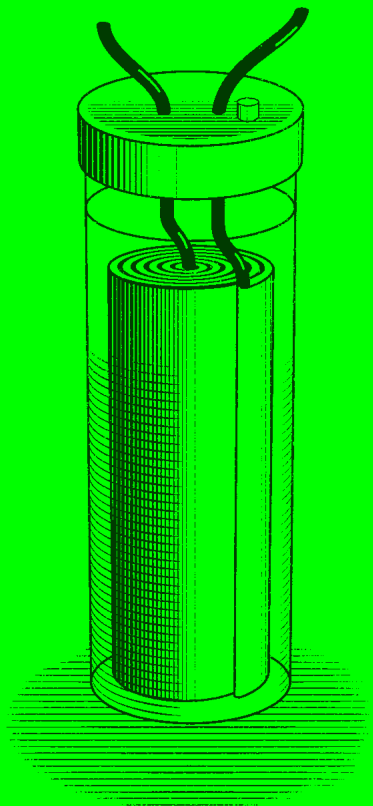
First Real Substitute for Lead-Acid Batteries
Olife contains no toxic materials. It consists of aluminum, copper, nickel, plastics and organic compounds used as electrolyte in the Lithium cells and the supercapacitors. It is fully recyclable and it has extremely long cycle life.

Patented Trade Mark
We have decided to protect this unique technology with a patent. Olife's trade mark registrations have been already submitted to cover all EU countries, USA and Russia.

Advantages of Olife Batteries

The first real substitute for lead-acid car batteries
The combination of supercapacitors and safe Li-ion batteries in one unit
It operates in freezing temperatures
It contains no toxic lead
It is ideal for the start-stop system
It has half the weight compared to a conventional battery
Infinite source of power

The Olife SLI system now provides the first realistic alternative to the Lead Acid Battery



First lead acid battery 1860

Modern version of the Plante Cell
used in a car starter battery

150 year old technology

In 1860 the Frenchman **Gaston Plante** invented the first rechargeable Lead Acid Battery (LAB). The success of the LAB is due largely to the abundance and ease of processing of the main constituent (lead) and its relatively low cost. For these reasons lead has been a favourite material used for thousands of years for such diverse products as lead piping, drinking vessels, roofing, paints, childrens toys, anti-knock in petrol and even as a sweetener for wine in ancient Rome.

Until recently, it was not known just how poisonous lead is and the long term effects it may have, such as brain damage to children in particular. It is inconceivable now to imagine using lead in any of the sectors mentioned, and with the exception of batteries and roofing, alternatives have been found. It is batteries which now consume more than 90% of the world's lead usage and although lead is readily recycled, the process is not 100% efficient. There are emissions to atmosphere and drains which are absorbed into the environment, even in the most regulated countries of Europe and the EU. It is unavoidable.

Despite the alternative battery technologies which have been available (and are increasing), LAB for car starter batteries is considered irreplaceable. This is due mainly to its cold weather performance and high cranking current for engine starting. It is also the cheapest available technology. For these reasons the entire automotive world, since the advent of the electric starter motor, has been relying on the lead acid battery for the most essential of all of the automobiles functions: starting the engine.

For this one single purpose, the starting of cars, this commodity lead keeps mining companies, smelters, refineries, recycling plants, commodity traders, stock market exchanges and of course, in the end, the lead acid battery manufacturers, all working to ensure that single process, which lasts less than two seconds: the start of the Internal Combustion Engine.

This situation has been tolerated and concessions have been made in EU legislation to exempt lead acid batteries from handling of toxic materials regulations (End-of-Life Vehicle Directive). This situation has arisen due to the insistence by the industries concerned that there is no credible alternative. However, it is possible that the less obvious shortfalls of lead acid have not been considered. This is becoming more apparent as the automotive industry tries to keep up with public demand for more environmentally friendly vehicles. In order to reduce exhaust emissions, new engine management techniques and technologies are being developed. LAB is striving to provide the characteristics needed to fully utilize these modern developments. Perhaps It is time to recognize that we need a cleaner and more efficient alternative.

The Problems

Car manufacturers are faced with ever increasing environmental demands for the modern age.

Faster globalization and consumer pressure require automobiles to have far lower emissions and greater compliance with environmental legislation.

One of the factors which is impeding their progress is the reliance on a 160 year old piece of technology within the engine compartment. This is the traditional Lead Acid Battery (LAB) (pictures).

The latest environmental improvements from automobile manufacturers utilise a technology which switches off the engine automatically when the vehicle comes to a stop (start-stop technology).

LAB is not capable of accepting the rapid recharge currents necessary to fully utilize this new technology from the automotive manufacturers.

When deeply discharged (an increasing problem with on board electronics) it will not deliver the power needed to start an engine, particularly at low temperatures.

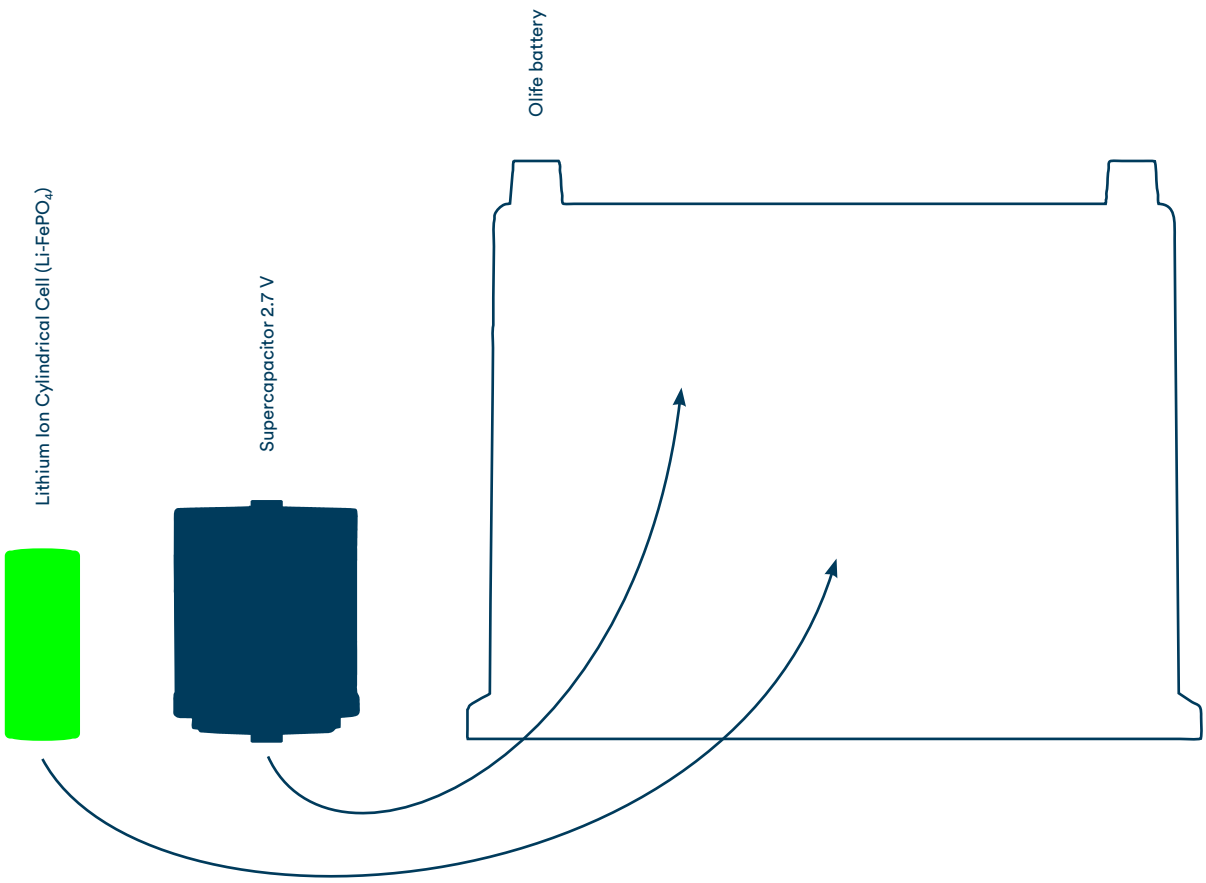
The LAB contains acid and lead, a poisonous and dangerous combination. This is only kept alive due to the exemptions granted from EU legislation, exemptions in place solely due to the lack of a viable alternative.

Other battery solutions are being tested but again are falling short of the new demands due to loss of starting power caused by low state of charge during micro hybrid type operation (start-stop).

Capacitors are also an alternative to the starting problem due to their power delivery, and their rapid recharge characteristics. However, this technology cannot address the energy requirement for the electronic devices and start-stop operations of modern vehicles.

What is required, but has not existed until now, is a solution which gives the starting power to crank the engine at low temperatures, with the energy required to operate the electronics during stop periods. And all this without the use of toxic materials.

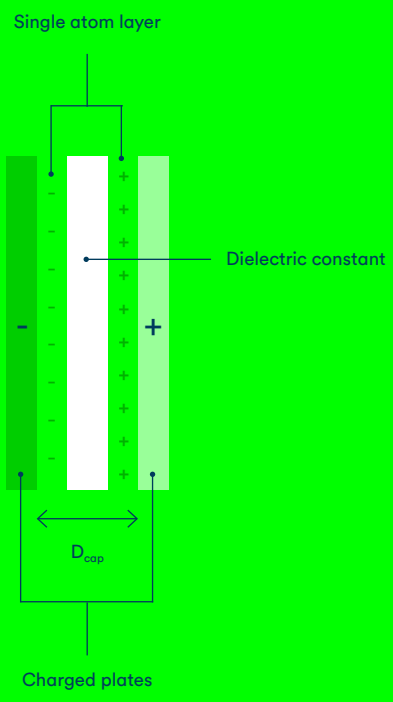
The Solution



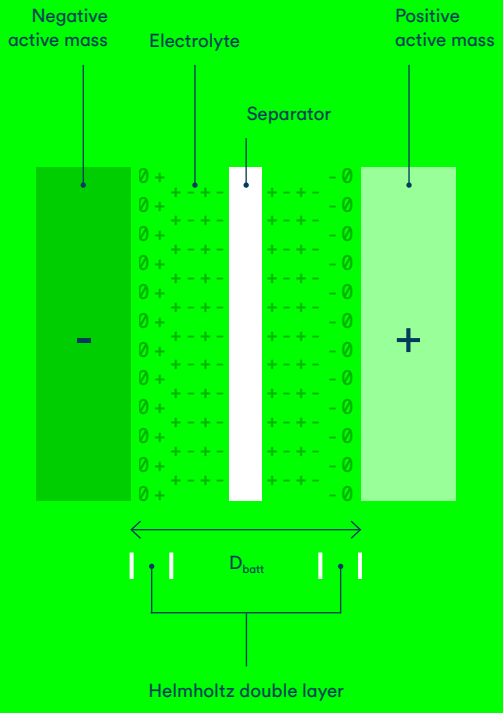
To combine the most advanced technologies for capacitors and batteries to produce the world's first, lead free, direct replacement SLI unit.

Patented technology which brings into play the latest and best from both the worlds of electronics and electrochemistry

Capacitor: faradic power



Battery: electrochemical power



The concept of Olife SLI

From the world of electronics:
power to start the engine in all conditions and over a wide range of temperatures. The most advanced supercapacitors, only recently commercialized, have been carefully chosen to compliment and exactly match the battery performance characteristics. This ensures a trouble free operation without the need for complex and expensive balancing and monitoring circuits.

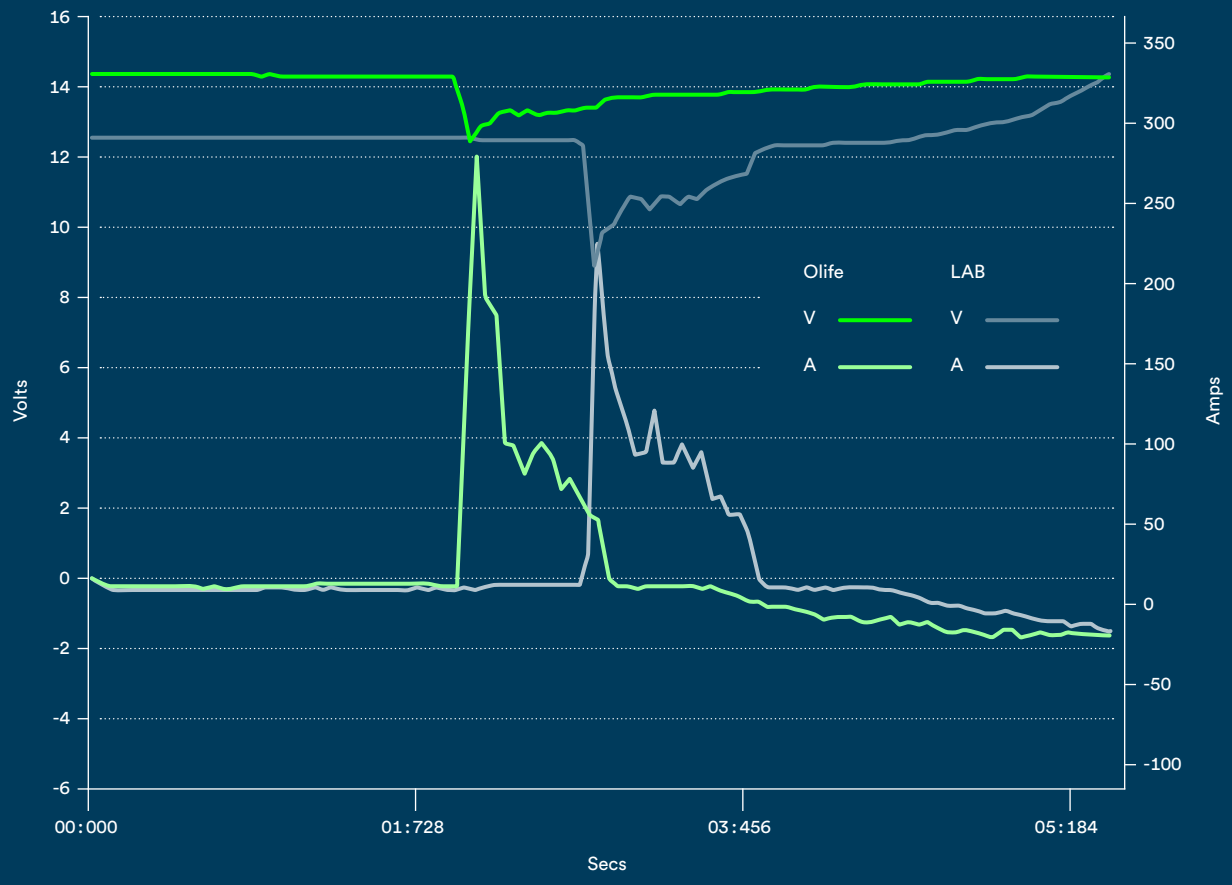
From the world of electrochemistry:
energy to keep the capacitors charged and to operate the on board electronic systems during engine shut off periods. Lithium iron phosphate batteries have evolved over the last decade to become the optimum and only viable solution for safe, advanced energy storage requirements. Abuse resistant, they perform well over a wide temperature range.

The main difference between a capacitor and a battery is the quantity of material which transfers the electrons to create a current and the distance the species have to cover in order to transfer the charge. A capacitor has a single layer of charged atoms separated by a dielectric constant such as a ceramic material. Charge transfer is almost immediate. However, the total charge transfer (number of coulombs) is small due to the limited number of charged particles available for transfer from the single layer of charged particles on the capacitor plate surfaces. The battery however has the charge stored in the active material mass of the plates as different chemical species. The reactions at the positive and negative plates release electrons and consume electrons respectively to form the products of discharge. There must be sufficient material in the plates and the electrolyte which provides and carries the ions for the reactions, in order to provide the coulombs required for sustained operation.

Compared with the single atom electrostatic discharge and the short distances between the plates of the capacitor, the power delivery from the battery is provided from relatively slow chemical reactions. This is further reduced by the distance that the chemicals and ionic species in the electrolyte can diffuse to the active masses of the plates.

Another important feature relating to the lack of chemical reactions in the capacitors is that their function is not greatly influenced by temperature. This is in sharp contrast to all electrochemical systems which have reduced output at low temperatures and reduced life at higher temperatures.

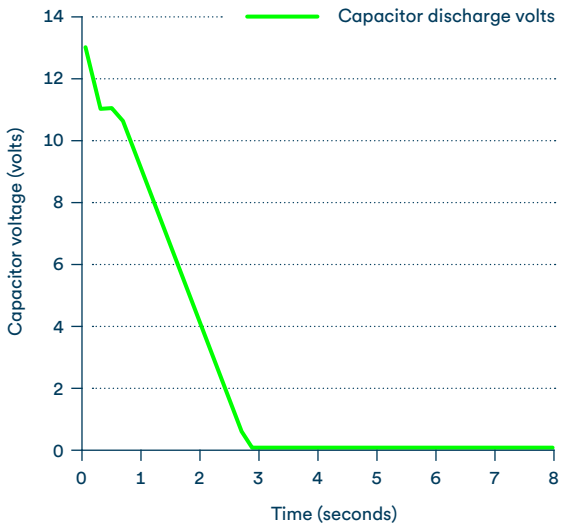
The Olife SLI technology uses supercapacitors to provide the instantaneous power needed to support the battery in the first fraction of a second



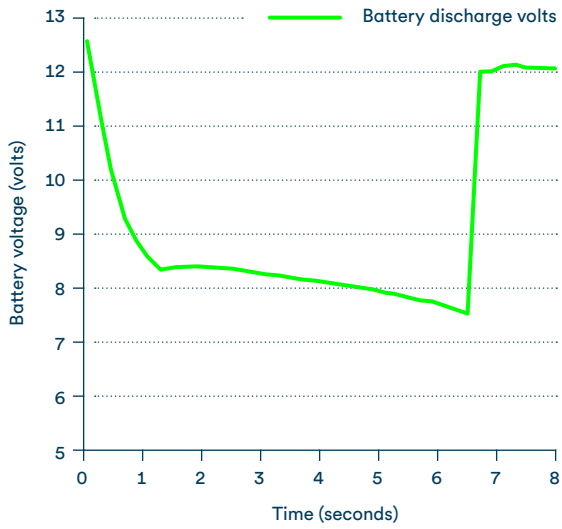
The graphs show actual data from an oscilloscope measuring on how Olife handles the start of a 3.0 l turbo diesel (Iveco) engine compared to a LAB (60 Ah AGM) starting the same engine under the same conditions. (Fully charged batteries, warm engine, ambient temp 20 °C). Mention the minimum voltage drop from a higher initial voltage level for Olife.

How does it work

Supercapacitor discharge volts



Li-$FePO_4$ battery discharge volts



It combines the electronic characteristics of the capacitors for power delivery (cold crank and engine starting) with safe lithium iron phosphate (Li-$FePO_4$) batteries to store the energy which drives the electronics and charges the capacitors.

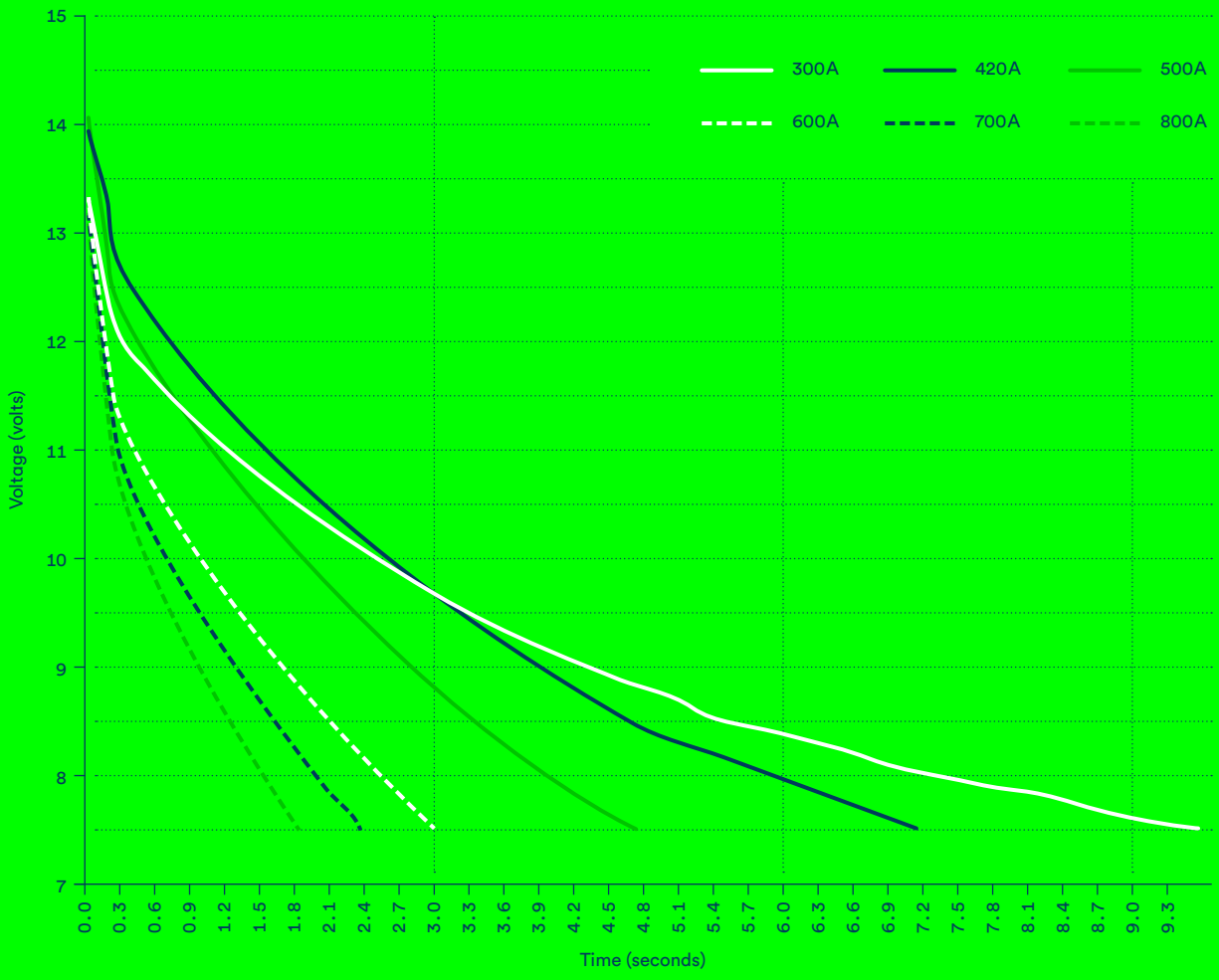
Olife use supercapacitors which are orders of magnitude more powerful than standard capacitors. This gives high cold cranking power for a longer period during the critical first seconds of engine starting.

The Li-$FePO_4$ batteries represent the latest development in high energy density lithium based technology which stores and delivers around five times more energy than lead acid batteries for the same weight of battery. These batteries are also capable of high charge acceptance rates without damage. This is important for start-stop applications, particularly when regenerative braking is utilized in battery charging.

The capacitors deliver high discharge rates instantly even when the battery is at a low state of charge. The battery will recharge the capacitors in seconds even when the engine is switched off.

The above graphs are for illustrative purposes only. They portray the difference in discharge characteristics between supercapacitors and batteries. They are not intended to represent actual data for components of the Olife technology.

Olife cranking current 300 A–800 A at -18 °C

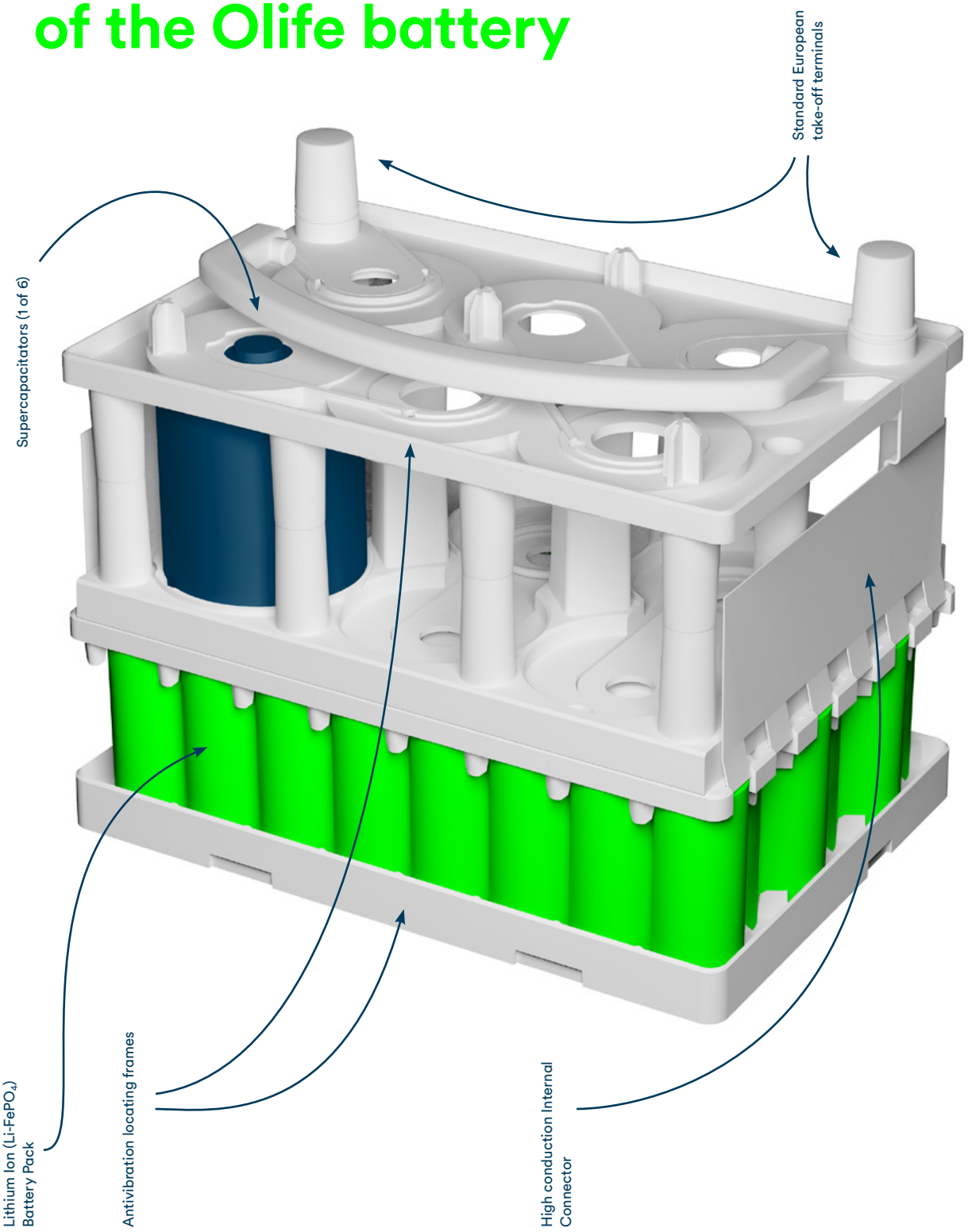


Technical specifications

Parameter	Data
Capacity C20 (Ah)	30
Reserve capacity, RC (mins)	72
Dimensions L×W×H (mm)	242 × 175 × 190
Specific power (Watts/kg)	94.5
Cold cranking amps CCA (amps) EN	300
Weight (kg)	7.2
Specific energy (Watt hrs/kg)	47

(As an SLI replacement battery, Olife is equivalent to a 55 Ah to 60 Ah LAB).

Construction of the Olife battery



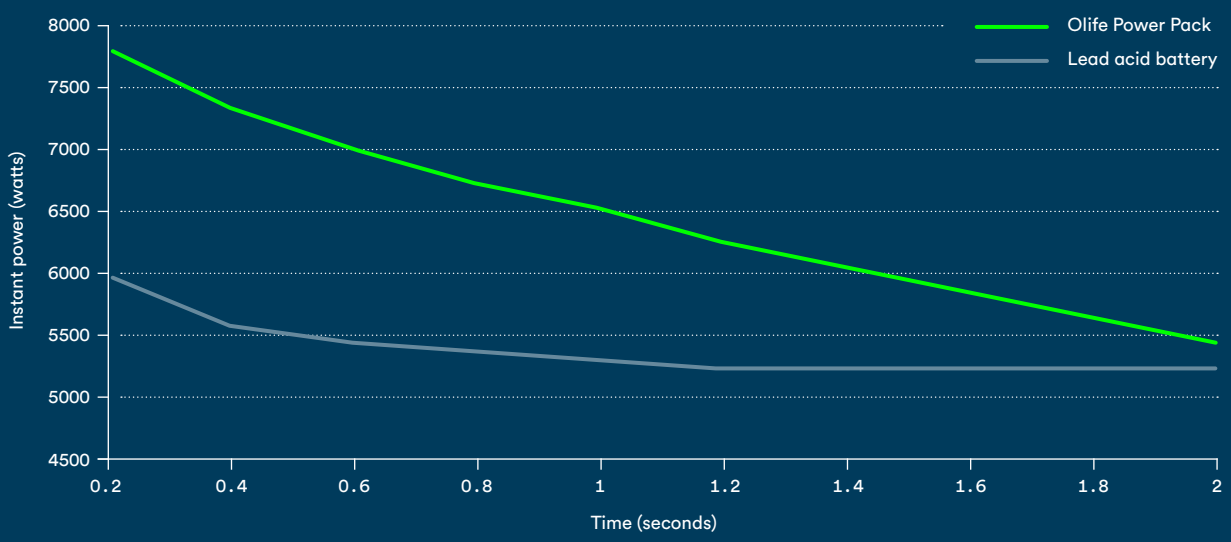
Advantages of Olife

The Olife PowerPack provides some significant advantages when compared with LAB technology in following areas:

Cold cranking power Engine starting
Dynamic charge acceptance State of charge
Ideal solution for Start-Stop technology
Weight
Cycle life
Calendar life
Power and Energy density
Minimal Environmental impact
Design and logistics flexibility

This means that almost the entire capacity of the battery is available in the form of high-voltage cold cranking current

Car starting power
680 amps at -18 °C
Olife vs LAB



The graph taken from real test results. This compares the Olife power pack with an advanced high performance lead acid AGM starter battery (60 Ah) from a world leading supplier.

Cold Cranking power Engine starting

When the car ignition is switched on and the starter motor is engaged , typically several hundreds of amps are drawn from a battery until the engine is started. This requires high power which is the product of the applied voltage and the current draw, i.e **Power (watts) = amps × volts.**

The higher the voltage during the current discharge the higher the power provided and the faster the starter motor turns. The more power, the more quickly the engine starts.

The starter motor which turns the engine does not operate at a constant current when it is initially activated. Within the first second of starting, in fact between 200 and 500 milliseconds after the ignition is switched on, the power draw can be up to 4 times the rating of the motor.

It is during this critical period that a battery must supply the power to start the engine. The Olife SLI technology uses supercapacitors to provide the instantaneous power needed to support the battery in the first fraction of a second. This unique combination of supercapacitors and Lithium ion batteries is designed to provide the highest power delivery when it is most needed – within the first second of starting. The Olife technology has proven to provide approximately 30% more cranking power at -18 °C, during the critical first seconds of starting, than the most advanced lead acid battery from a world market leader.

The 680 A cold cranking performance as illustrated in the graph opposite, can be repeated without loss of performance even for many start attempts, due to the immediate recharging of the supercapacitors from the lithium cells. This means that almost the entire capacity of the battery is available for high voltage cold cranking current irrespective of its state of charge. This is a benefit which is hidden by the now outdated EN test standards currently used for lead acid batteries.


The supercapacitors
are charged almost
immediately

Dynamic Charge Acceptance

A critical feature of a battery is its ability to recharge from the alternator during the time the car is being driven. Frequent stops and discharges from restarting can drain a battery in a short time, particularly in sub zero temperatures.

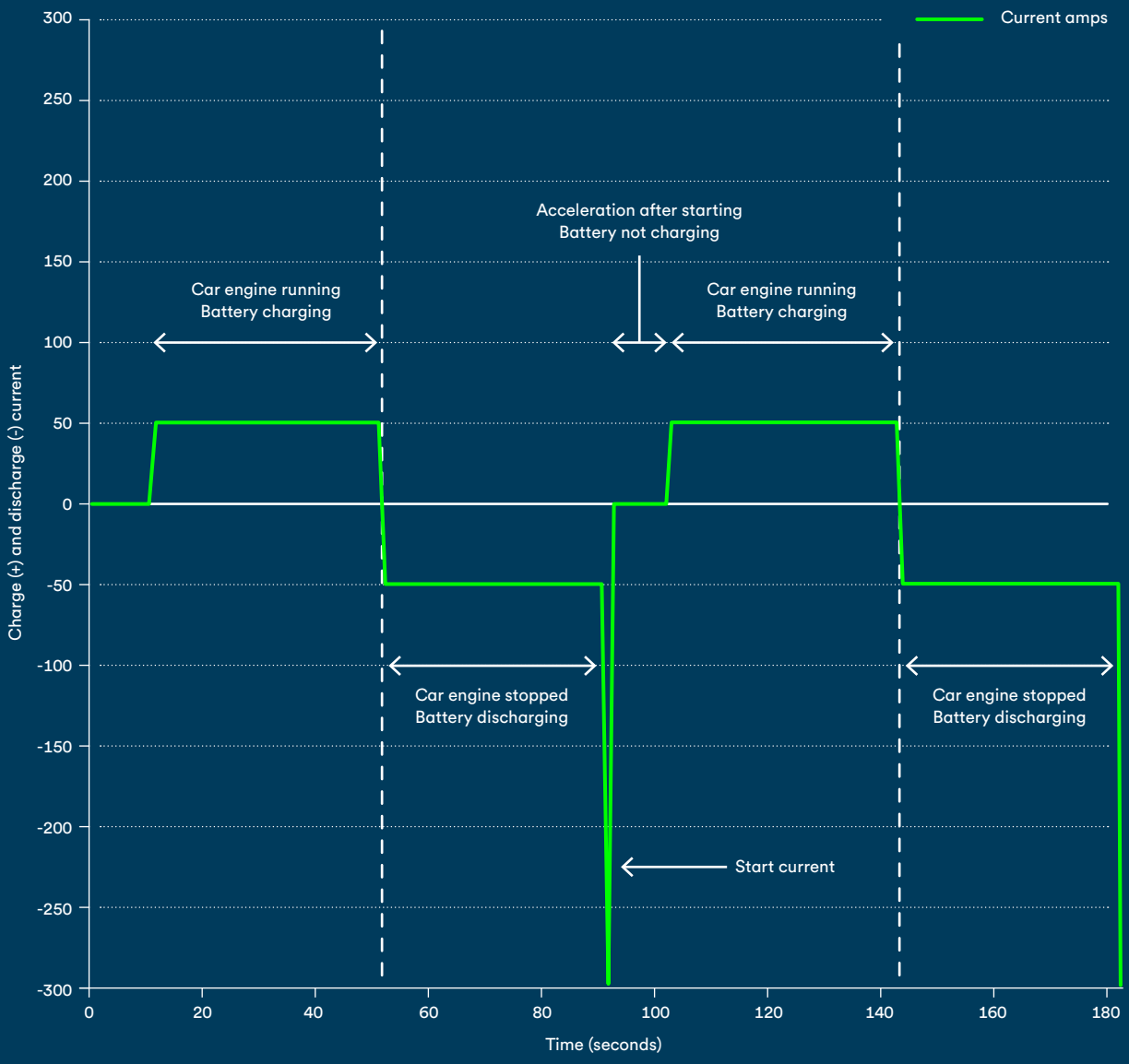
If the car journey is short and the number of starts is frequent, the battery may not be able to draw a high enough current to recharge from the car alternator. The electrochemical reactions needed to recharge the battery slow down as the temperature drops, so the ability of the battery to accept a recharge current is also reduced as it gets colder.

This is a major cause of failure in SLI batteries. The gradual run down in the state of charge during use is a direct result of the electrochemistry of the conventional battery. The relatively slow response is due to the diffusion processes which are required to carry the reacting chemicals to the plate surfaces.

The Olife technology removes this problem by using supercapacitors combined with Li-$FePO_4$ batteries. The lithium batteries have approximately 3 times the charge acceptance of lead acid batteries whilst the supercapacitors are charged almost immediately. Using this combination of batteries and capacitors provides the best available technologies to ensure that the maximum charge possible can be stored and made available for use.

Traditional batteries have been found to be unsuitable for the start-stop technology application. Not the Olife battery

Typical micro hybrid cycles based on prEN 50342-6



Start-Stop technology

The latest energy saving technology for automobiles is the system known as start-stop technology: the automobile engine switches off automatically whenever the car stops, in order to reduce fuel consumption. During the period when the engine is switched off the battery has to supply sufficient energy to run the on board electronics and climate systems. This can draw around 48 amps from the battery for several minutes. The battery then has to start the engine when the traffic conditions allow.

Traditional (with liquid acid) and even state of the art (AGM, Absorbed Glass Matt) lead acid batteries have been found to be unsuitable for stop start application. Battery rundown within weeks and early failure within months have been the main problems experienced by automotive manufacturers.

The main problem is that a battery has to recharge from the alternator and braking systems as quickly as possible while the vehicle is being driven to the next traffic stop. A critical factor in ensuring that the battery is sufficiently recharged to provide the power not only to restart the engine but to avoid eventual failure, is the ability to accept a charge as quickly as possible. The use of capacitors which within seconds are recharged to provide starting power, coupled with the charge acceptance characteristics of Li-FeO_4 batteries, ensure that the Olife battery will always perform.

New international battery cycle tests based on typical start-stop patterns in normal urban driving are being devised. The provisional EN test procedure prEN 50342-6 is to be introduced by September 2015.

With Olife the weight of the SLI battery is reduced by about 7 kilos

Fuel Economy Improvement (%) per 45 kg (100 lb.) Weight Reduction – Gasoline Engines

Downsized engines	City FTP75	Highway HWFET	EPA Combined	Euro ECE	30 Mph	45 Mph	60 Mph	75 Mph
Small Car	2.7%	1.7%	2.3%	2.9%	2.2%	1.7%	1.3%	0.9%
Mid-Size Car	2.1%	1.5%	1.9%	2.2%	2.0%	1.4%	1.1%	0.9%
Small SUV	1.6%	1.1%	1.5%	1.9%	1.5%	1.2%	0.6%	0.3%
Large SUV	1.4%	0.9%	1.2%	1.6%	1.2%	1.0%	0.7%	0.5%
Truck	0.9%	0.6%	0.8%	0.8%	0.6%	0.5%	0.3%	0.2%

Source: Ricardo research for the Aluminum Association (FB769 – RD.07/71602.2)

Weight

With Olife the weight of the SLI battery is reduced by aproximately 50%. 50% sounds of course impressive, but in the case of an SLI battery it is not only an impressive percentage, but an impressive amount of mass as well. Every vehicle with an Internal Combustion Engine is equipped with a lead acid battery weighing from 10 kg to 25 kg, the bigger the car, the bigger the battery. So in general you have one percent of the vehicle's weight coming from this one component: the battery.

If you are just a little familiar with the automobile industry, you will know how important weight reduction is in the battle for improved fuel economy and CO_2 reduction. Large investments have been made to facilitate the replacement of steel, other metals and glass with the lighter aluminum, plastics, carbon fibers and optical fibers.

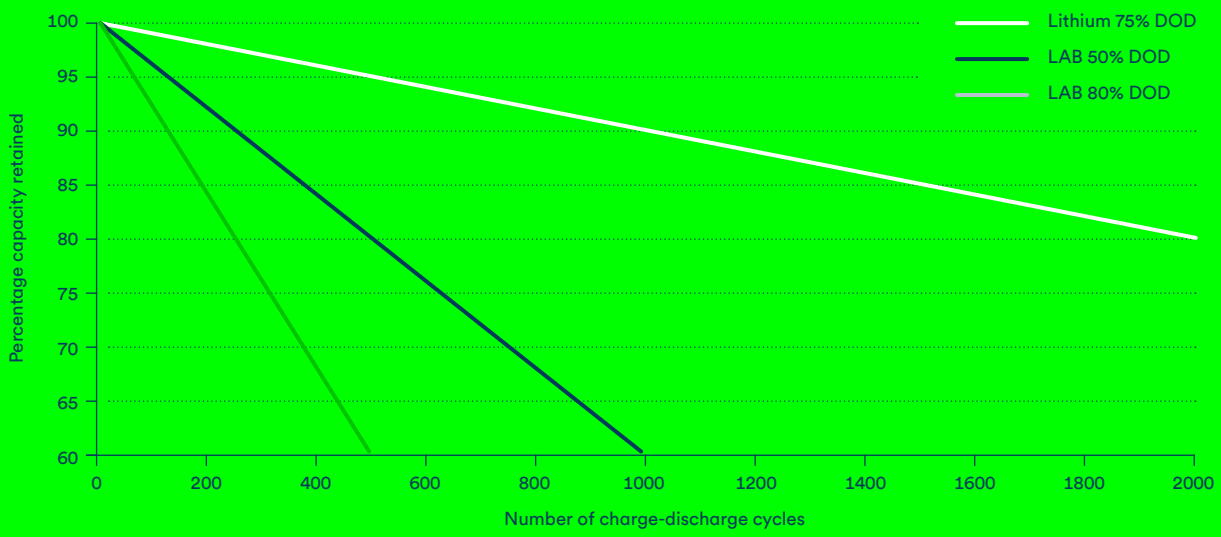
With Olife the weight of the SLI battery is reduced by about 7 kilos. This significant weight reduction is achieved simply by replacing the standard battery with the Olife battery, which in addition, will provide a whole range of other benefits, without compromise to any of the performance characteristics.

The precise calculation of the size of the fuel and CO_2 savings is very complex as it is to be made for the lifetime of the vehicle (for the lifetime of the Olife battery). Our preliminary calculations show that the extra cost of Olife will be almost off-set against the fuel savings alone, i.e. the other advantages come free of charge.

In the table on the opposite page (from Ricardo research for The Aluminum Association) you will get an impression of the actual impact of weight reduction on fuel consumption.

Olife's supercapacitors are designed to withstand more than 500,000 charge-discharge cycles

Life cycle vs DOD comparison tests for Lithium and sealed LAB



Cycle life

All electrical and electrochemical devices have a limit as to how often they can be used. The more often a device is operated the shorter its lifespan. In a performance guarantee, usually a specification is given on the number of times a device can be operated, or switched on and off (cycles). The number of cycles that occur until the device fails is called the cycle life. This is a number often defined by limitations of use and quoted on the product label.

Olife's integrated supercapacitors are designed to withstand more than 500,000 charge discharge cycles to 100% depth of discharge. The supercapacitors have a capacity that gives more power than required for one engine start. Potentially this provides a minimum of half a million starts.

Olife's Lithium ion batteries are known to complete more than 2,000 charge-discharge cycles to 75% depth of discharge. When compared with conventional lead acid batteries' expected life of 300–400 cycles at 75% depth of discharge, it is clear that the Olife technology will provide a high multiple of the service life of a conventional LAB.

It is highly unlikely that SLI batteries would be discharged to more than 30% depth of discharge even with start-stop operations. Thus, Olife powerpack shall provide tens of thousands of cycles.

For lead acid starter batteries the normal calendar guarantee is 1 to 3 years. The Olife battery shall provide 10 years life guarantee

Calendar life

Calendar life differs from cycle life as it provides a time period rather than a number of operations. The failure mechanisms are normally different, e.g. a car can be unused but become rusty and unable to operate. Usually, there is a substantial difference between projected calendar life and the calendar life obtained in real life. This is due to the fact that a product rarely goes through its real life having the prescribed operational conditions and without any abuse events.

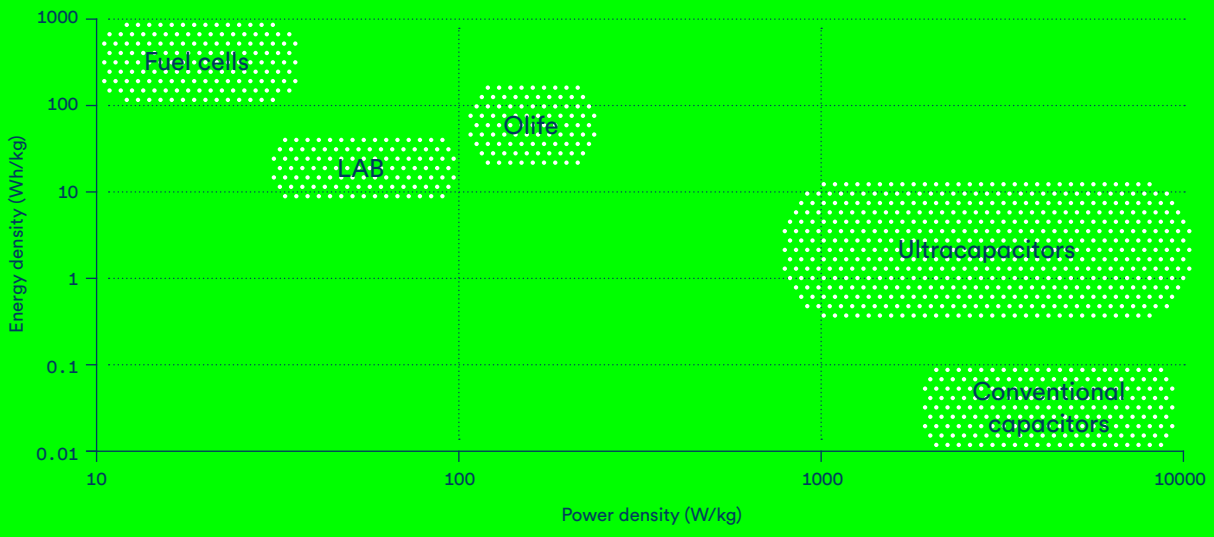
Olife's projected calendar lifetime is calculated to be about ten years. This is the result of the chemistry in the Lithium cells and of the estimated number of starts the battery is supposed to deliver in one year of normal operation. The real-life value is not yet known; the battery is currently undergoing accelerated life testing in order to obtain some accurate projection for the calendar life value.

The calendar life will also depend upon the type of application which the battery has to fulfill. For lead acid starter batteries the normal calendar guarantee is 1 to 3 years on replacement batteries and up to 5 years on OEM or new automobiles.

The Olife batterypack shall provide 10 years life guarantee.

Olife powerpack will be 50% lighter than a lead acid battery of equivalent performance

Comparison of specific power and energy values for current technologies



Power and energy density

Power and energy provided are the two most important features of a battery system. Together, they are often referred to as “battery performance”.

Power (flow) is the product of the current and the voltage **(amps × volts = watts)**. It is the power that cranks the engine (“how much it kicks”).

Energy (stock) represents availability of the power in time (“how long it lasts”) and is expressed as product of power and time **(watts × time = watt hours)**.

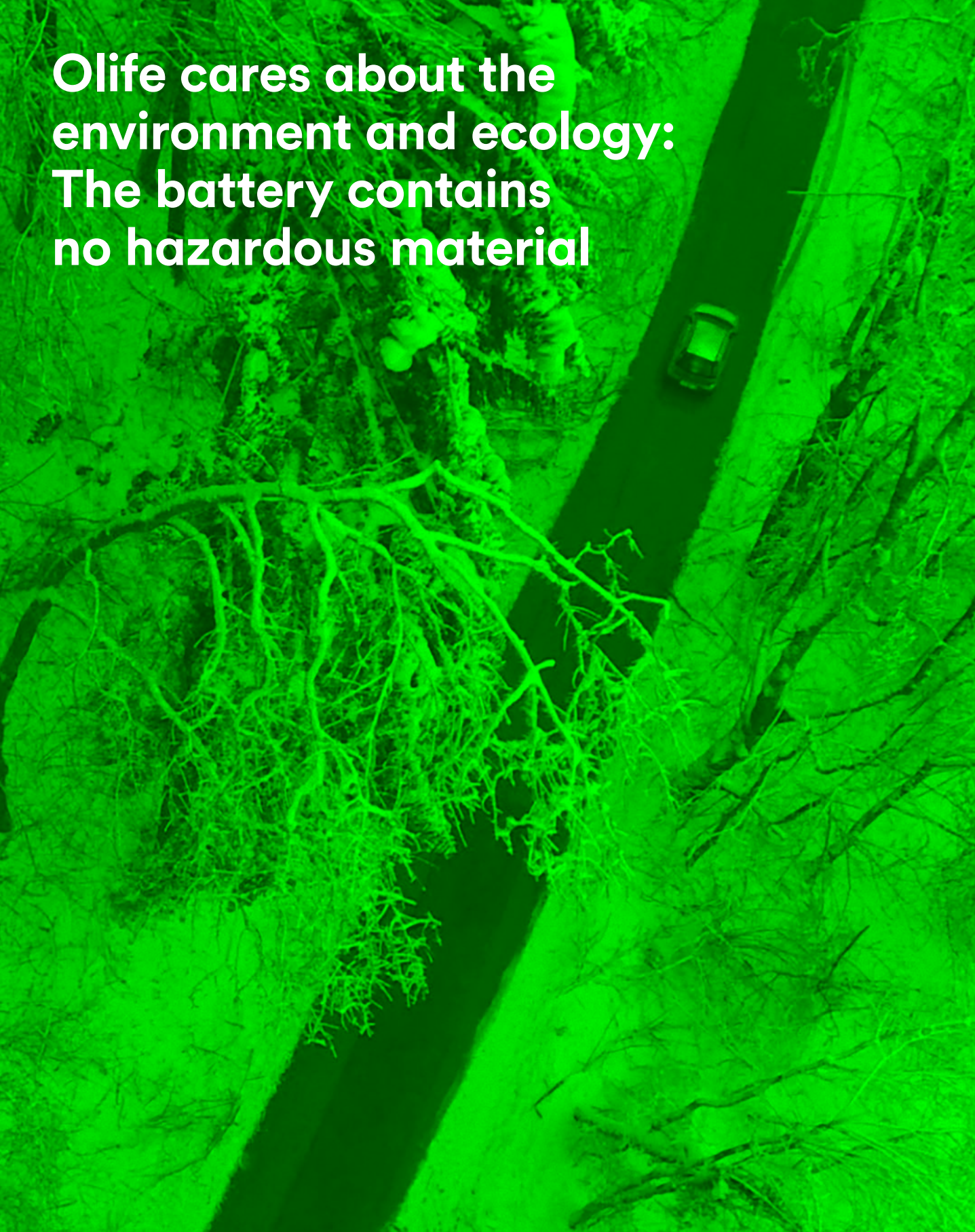
For a battery evaluation, both features as well as their combination is crucial.

The third key parameter of a battery is the weight, specifically weight measured per power and energy unit.

The weight efficiency or specific power and specific energy is the performance divided by the battery weight and is expressed as watts per kilo and watt hours per kilo for specific power and specific energy respectively.

From the table on the opposite side it is evident that lead acid falls very short in the provision of both power and energy per unit weight when compared with capacitors and Lithium Ion batteries.

The combination of both provides an enhancement which is still being measured and verified. However, at the very least the Olife battery will be 2 times lighter than a lead acid battery of equivalent performance, this gives around 50% weight saving.


Olife cares about the
environment and ecology:
The battery contains
no hazardous material

Environment

Olife is particularly proud of its environmental credentials. This is exemplified in the design and construction of the Olife power pack :

Fully compliant with the RoHS 2 directive it contains no hazardous materials

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The manufacturing processes do not create any health, safety or environmental dangers.

It contains no rare earth metals such as lanthanum used in NiMH batteries . (Prius batteries contain 10 Kg of Lanthanum)

It can safely be disposed of in landfill sites

By contrast, Lead acid Batteries contain lead in large amounts. Over 50% of their weight is lead and lead compounds.

Lead is a poisonous metal and is hazardous to health. It is associated with degenerative brain diseases even in minute levels in the bloodstream. This is particularly true for children and pregnant women.

Due to its dangerous impact on human health, lead has been banned and removed from use in virtually all areas of human life (construction, utilities, gasoline, household, all car parts except for batteries) Lead can be recycled but the recycling process is not 100% effective. Some atmospheric, liquid effluent and solid waste is generated.

In Europe, lead acid battery production and use is legal only due to an exemption from End-of-Life Vehicle Directive 2000/53/EC, (Annex II, exemption no. 5 – Batteries). The exemption shall be in place until a viable alternative to lead car starter batteries emerges. The time has come. Olife powerpack can replace lead in one of its last strongholds.

With Olife, you would be able to start your vehicle with the materials of your choice.

Olife takes away the need for restrictions

Design and logistics flexibility

From the perspective of the car manufacturer, the lead acid battery is a problem. Firstly it has to be replaced several times during the lifetime of the vehicle and secondly it has to be removed prior to the vehicle's disposal, in accordance with EU end-of- life regulations. In order to have easy access, the manufacturer is restricted in where to locate the battery within the engine compartment.

With the Olife power block these sorts of restrictions are history. The zero maintenance, extended calendar life and lower weight provide a component which removes these restrictions and gives more freedom of choice for automobile designers This also applies to logistics considerations, whereby the materials and components for production as well as the finished product pose no environmental hazard. There are no restrictions for transport which saves time and costs across the entire distribution chain.

And of course we should not forget the cost reductions from fuel saving and carbon reduction which arise from transporting and using a product which is half the weight.

Infinitely Better

Olife Corporation, a.s.
Lazarská 11/6, 120 00 Prague 2
Czech Republic
T: +420 255 341 002

www.olife-energy.com