PRESS KIT NANOFLOWCELL HOLDINGS LTD

nanoFlowcell® Flow Cells are the Energy of the Future, Which Will Change Electric Mobility Worldwide

nanoFlowcell Holdings Ltd at the
87th Geneva International Motor Show, 2017

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FROM VAGUE IDEA
TO WORLD-CHANGING INNOVATION

Foreword

"Society, the economy and the environment exist in a complex and highly fragile interrelationship. Those who, like us, conduct research into shaping an environmentally future that nurtures life, do not allow themselves to be impressed by technology itself, but instead forge ahead with forward-looking research and development in full awareness of just and sustainable progressive thinking that never loses sight of the need to reconcile the interests of society, the economy and the environment.

Thinking ahead to our future means making the right decisions in the here and now. We are working on realities where others are formulating visions. With nanoFlowcell®, we have developed an energy technology that not only brings new perspectives to electric mobility and thus our future individual mobility, but also demonstrates a practicable solution within the context of a global energy transition for reliably predictable energy supply.

At this year's Geneva International Motor Show, we are celebrating the world premiere of the first low-voltage sports cars powered by flow cell energy. Ostensibly. But the QUANT 48VOLT is more than just one of many. It is the expression of our entrepreneurial quest and offers a view of a possible future in which energy is produced in an environmentally compatible manner, is harmless to health in use and is also safe and practical to work with. QUANT 48VOLT is a dazzling ambassador for our outstanding energy technology. We want to make people curious, stir emotions, provide food for thought – we want to invite people to follow our ideas with the help of tangible technology and to mentally usher themselves out of our "fossil" age.

As a research and development company, we are well aware of our responsibility – as a pioneer and shaper of future thinking in mobility and as a mentor for energy that is environmentally compatible and can be sustainably structured.

nanoFlowcell® offers clean and safe energy – wherever, whenever."

Nunzio La Vecchia
Chief Technology Officer nanoFlowcell Holdings Ltd

Time of Change – We are Shaping the Energy of the Future

We are breaking with our fossil-fuelled past by laying the foundations for an ecologically and economically sustainable, as well as reliably predictable, energy transition. We see electric mobility as the vanguard – the means to an end.

The invention of the internal combustion engine 130 years ago marked the start of mass mobility borne by the automobile. There are currently around 1.2 billion vehicles registered worldwide and roughly 90 million new vehicles produced every year. The annual CO_2 emissions from internal combustion engines stands at approximately three billion tonnes, with collateral damage to the environment and society simply unfathomable.

The initial blessing of the internal combustion engine has become a curse for humanity and the environment. Dependence on vehicles powered by fossil fuels presents enormous challenges not only to manufacturers, consumers and politics, but also to humanity as a whole. How can our mobility needs be brought into step with the environment? The alternative drive concepts currently under discussion for electric vehicles merely transfer the environmental problem elsewhere. The manufacture of hydrogen needs enormous reserves of energy, while lithium-ion batteries cause environmental damage both in the extraction of the raw material and in recycling.

While the automotive industry is lacking a flash of brilliance, consumers are uncertain and hesitant – electric mobility is awaiting its breakthrough. But a breakthrough is urgently required in many respects.

New Thinking

We are a young company. Our corporate structure is lean and efficient, free from the innovation-hostile structures of large, established corporations. We don't have a technology history to shackle our thinking. Instead, we function in a manner that is fully flexible, questioning established views and thinking in completely new ways. The result is groundbreaking technologies like nanoFlowcell®, the bi-ION electrolyte and the nanoFlowcell® 48VOLT low-voltage electric drive.

With nanoFlowcell® based on flow cell technology, we have developed a proprietary energy technology that will supply energy to a new generation of electric vehicles – on land, on water and in the air – in a manner that is practical, environmentally compatible and safe.

Unique Innovations

Our nanoFlowcell® technology and the bi-ION electrolytes we have developed give us a USP in the growing market for mobile and stationary energy carriers and make us the world-leading independent research and development company for flow cell technology.

In the field of energy technology, we also offer services across the entire product development process – from concept to application. Examples of this are our QUANT prototypes, fully homologated low-voltage electric vehicles with nanoFlowcell® drive. 100 percent electric, 100 percent safe, 100 percent environmentally friendly.

Shaping the Future

nanoFlowcell® and the corresponding bi-ION electrolyte liquid are in the final stages of testing. Our QUANTiNO 48VOLT and QUANT 48VOLT prototypes, both nanoFlowcell® technology showcases with different user profiles, provide an impressive demonstration of what a nanoFlowcell® drive can achieve in an electric vehicle:
Mobility without restrictions in speed, range and practicality that is also cost-effective and free from harmful emissions and system components that are damaging to the environment.

Our technology is mature, the time has come, nanoFlowcell® is ready to help electric mobility attain its breakthrough. nanoFlowcell® will be a crucial, if not downright decisive, technology in shaping sustainable individual mobility.

Right now, we are showing our flow cell technology almost exclusively in the form of striking electric vehicles. For many people, our QUANT prototypes are desirable sports cars and the world's most advanced electric cars. Visionaries will recognise the small power plant, which could also easily supply several households or a whole community fully autonomously with electricity, as the future of environmentally compatible yet reliably predictable energy supply."

World Premiere: QUANT 48VOLT

For nanoFlowcell, the 87th Geneva International Motor Show is all about flow-cell based low-voltage drive. The latest EV dream car to celebrate its world premiere in Geneva is the QUANT 48VOLT electric sports car. And with it, the brand new nanoFlowcell® 48-volt low-voltage drive, engineered from scratch, with highly innovative, powerful, lightweight electric motors that work consistently at low voltages coupled to an improved nanoFlowcell® with a higher power output.

Technology

Intelligently designed performance. In the new QUANT 48VOLT, engineers have combined nanoFlowcell's classic characteristics such as environmental compatibility, sustainability and practicability with the inherent safety of an electric drive system running at low voltages across the board. This marks the first time that sports-car performance has been paired with a high degree of everyday usability in an electric vehicle.

The performance of the QUANT 48VOLT with low-voltage drive speaks for itself. Four low-voltage electric motors, each generating 140 kW (560 kW / 760 hp), give the QUANT 48VOLT the superlative performance and handling of a variable all-wheel drive. The acceleration from zero to 100 km/h in 2.4 seconds is a best time for a low-voltage electric sports car, as is the electrically limited top speed of 300 km/h. With a tank volume of 2 x 250 litres of bi-ION, the range stands at an anticipated 1,000 kilometres. By being able to deactivate one of the two flow cell blocks, the drive is highly efficient and able to adapt its power output to the respective situation. Torque distribution ensures the maximum 8,000 Nm is intelligently disseminated and guarantees optimum traction in all road conditions.

Flow cell doping. The variably controllable fuel cell facilitated the realisation of the very first high-performance drive in the low-voltage range. While the QUANT FE still drew its performance from a high-voltage system, the drive system in the QUANT functions throughout on a maximum of 48 volts. Because supercapacitors are no longer used as buffer storage, the energy necessary for acceleration and top speeds is now delivered directly from the flow cell. To achieve a high power output, the new design features for the first time six equally sized flow cells able to run simultaneously. In the QUANT 48VOLT, the thus augmented nanoFlowcell® generates a maximum power output of 300 kWh and around 9,000 A (1,500 A per flow cell) for scenarios such as extreme acceleration or driving at top speed.

The flow cell in the nanoFlowcell® 48VOLT drive is the first to operate with an all-new cell membrane design. After two-and-a-half years of development work, engineers succeeded in developing a nano-technology procedure for processing the membrane surface to achieve many times the surface area within almost the same dimensions. This means that more bi-ION electrolyte can be discharged in a shorter period of time, thus providing more energy for the drive. In future, this new membrane design will enable the nanoFlowcell® to process electrolyte solutions with higher energy density. The average energy density of the bi-ION electrolyte solution currently stands at 600 Wh/l. nanoFlowcell's development engineers believe the upper limit of energy density has yet to be attained.

Low-voltage electric motors. The new motors in the nanoFlowcell 48VOLT drive improve on typical QUANT performance and thus underpin our aim in all aspects of the drive to lead the field in electric vehicles. One crucial new feature in the nanoFlowcell 48VOLT drive is the innovative 45-phase low-voltage motors that deliver high power paired with a minimal cross-section for the electric wiring. Four of these 140 kW low-voltage motors make the QUANT 48VOLT the most powerful all-wheel drive low-voltage electric sports car on the planet.

The USP of these low-voltage motors is their solid aluminium mesh structure, which replaces the complicated copper windings found in conventional electric motors. This reduces the physical volume of the motor relative to its power, leading to a reduction in weight and cost and a simplification of any potential series production.

The electric motor's low induced voltage means that cost-effective MOSFETs (Metal-Oxide Semiconductor Field-Effect Transistor) can be used in the QUANT 48VOLT instead of the expensive HV IGBTs (High-Voltage Isolated Gate Bipolar Transistors) in the QUANT FE. The absence of inverters, HV control units and other HV electronics delivers substantial reductions in weight and cost for the QUANT 48VOLT relative to the QUANT FE.

Moreover, a nanoFlowcell® 48VOLT low-voltage drive does not require any expensive measures for high-voltage safety, which lowers not only the cost of development and production but also the price of the electric vehicle itself. Maintenance benefits arise from the fact that a QUANT with nanoFlowcell® 48VOLT low-voltage drive can be serviced by personnel without high-voltage training, significantly reducing (financial) outlay.

The nanoFlowcell® 48VOLT drive has revolutionary options for control. For instance, the magnetic field in the low-voltage motors can be shaped to suit, with electronic fading between different pole-pair numbers effectively

constituting the integration of an electromagnetic transmission within the motor. The maximum efficiency of the low-voltage motors can thus be extended across the entire rev/torque map and the correct “gear” selected depending on driving conditions. This makes the nanoFlowcell® 48VOLT drive extremely efficient, especially in driving cycles relevant to everyday use. Compared to electric drives with asynchronous motors, losses with the nanoFlowcell® 48VOLT low-voltage drive were reduced by around 50 percent on the same driving cycle.

Further benefits of the low-voltage motors used in the nanoFlowcell® 48VOLT are in overload scenarios. The vertex familiar from conventional, wound electric motors is not present, as a voltage reserve is maintained at all times. This means that maximum torque is still available even at high revs.

A torque limiter is necessary for conventional high-voltage electric vehicles, primarily to conserve the traction battery. After extremely heavy acceleration, electric cars often have to drive throttled for several minutes to allow the electric motor and traction battery to cool down. However, this only applies to electric vehicles that are not equipped with nanoFlowcell® 48VOLT low-voltage drive.

Design

QUANT prototypes are both athletic and aesthetic. Both of these characteristics have now been emphasised even further in the QUANT 48VOLT. For its appearance as a premiere version, the QUANT design has been largely retained with a little extra flair added to certain elements to express the leading position of the QUANT 48VOLT within the electric sports car segment; an assertion also embodied in the interior of the new QUANT 48VOLT.

Outside. The QUANT 48VOLT’s forward-looking technology is wrapped in a stunningly sporty package. The distinctive and unmistakable QUANT design language of its bodyshell immediately conveys the advanced character of the prototype vehicles. The powerfully dynamic design of the front end is dominated by the grille and the plunging lines of the bonnet with the QUANT logo right in the centre. The front air intakes underscore the sporty look without actually being functional, as the concept underpinning the QUANT 48VOLT doesn’t require air intakes for cooling purposes.

The 20-inch alloy wheels are likewise aerodynamically optimised. Special low-friction tyres reduce rolling resistance.

The distinctive sills along the flanks generate a highly dynamic side line and emphasise the overall fluidity of the QUANT design, which was revised and further developed for the QUANT 48VOLT. The crouched profile, typical QUANT gullwing doors, the long, taut bonnet and the powerful sweep of the wings accentuate the sporty appearance of this unique electric sports car. Its look is highly distinctive, yet the muscularity of the QUANT 48VOLT does not convey an air of aggression. It maintains the tense stance of a highly trained athlete awaiting the command to release his power and surge forward.

The bodyshell of the QUANT 48VOLT bristles with dynamic performance and power. The redesigned rear end is particularly distinctive, with the double curvature of the rear windscreen and the retractable spoiler. The rear end communicates the dynamic performance of the QUANT 48VOLT. This is based on the broad stance conveyed by the wide track and accentuated by the rearward extension of the wings as they continue the flow of the lines along the flanks and into the rear, where they encompass the rear diffuser with its enormous air intakes. In the centre of the lower section of the diffuser is a horizontal brake light with classic motorsport overtones.

The transparent rear hatch is made from lightweight but extremely stiff Lexan and affords a view of the normally hidden nanoFlowcell technology. The light lines indicate the flow of power from the nanoFlowcell unit, a lighting design that is also picked up in the interior and that illuminates the originality of the new nanoFlowcell 48VOLT electric drive concept.

Inside. The interior of the QUANT 48VOLT features QUANT's typical, progressive design language. The lines flow in subtle, sweeping movements through the organic surfaces, clad in genuine wood and leather. A special element of the QUANT design is the controls hidden beneath genuine wooden surfaces. Initially, all that can been seen is the pure, smooth surface of natural ash. When the ignition is switched on, the controls, in the form of capacitance switches, become clearly visible through the wood. With the new sensorFLOW® technology, the QUANT 48VOLT offers a visual highlight the likes of which has never before been seen in a car.

Looking forward, the eye is drawn to the 1.25-metre by 16-centimetre front display. The instrument cluster, EV status display and entertainment are integrated across its entire width, melding into a single unit. Instead of classic instruments, the driver and passengers are kept informed via state-of-the-art display technology. For instance, the full functionality of the energy management can be monitored on the display in real time.

Incorporated into the curved centre tunnel are the main tanks for the bi-ION electrolyte liquids, the liquid fuel that powers the nanoFlowcell®. The

unconventional configuration of the tanks delivers a very low centre-of-gravity.

The sporty design of the individual seats both front and back incorporates visual inlays in the upholstery with dynamically formed backrests. Their overall look is light and slender, giving the vehicle interior a noticeably more open feel. As a 2+2-seater, the prototype offers the flexibility and functionality of a modern sports saloon.

nanoFlowcell designers also made use of colour to emphasise the consistently high standards of the technologically leading electric vehicle concept – selecting metallic silver overlayed with translucent white. In the QUANT 48VOLT, nanoFlowcell Holdings has built a prototype that is utterly unique in the automotive industry to convey an image of the future of electric driving that is as tangible as possible.

NANOFLOWCELL HOLDINGS LTD

Our Company

We are a Swiss research and development company specialising in the research and development of new forms of energy. We are world leaders in the field of advanced fuel cell technology and its applications. With the further development of the familiar principles of flow cell technology, we are setting new standards in forward-looking and environmentally compatible energy carriers and their applications.

We began researching and developing new forms of energy in the mid-nineties and quickly concentrated on flow cell technology, which we saw as the most promising technology in the field of controllable and ecologically sustainable energies.

With the nanoFlowcell® developed by us and its bi-ION "electrolyte fuel", we are setting new standards in forward-looking energy technologies and conducting pioneering work in the research of environmentally compatible and non-harmful energy carriers that will revolutionise mobile and off-grid energy supply.

Under the umbrella of nanoFlowcell Holdings Ltd, we offer comprehensive and integrated R&D expertise in the development of hardware, software, service and technology solutions in the field of flow-cell based energy carriers.

The development of energy storage solutions for mobile and stationary applications is not an isolated process, calling instead for the cooperation and intermeshing of a variety of different disciplines. We master the complexity of advanced flow cell technology in its various areas of application, in terms of the interaction of different physical, chemical and thermodynamic processes as well as the production and structural requirements.

And as an engineering company, we don't just deliver innovative technology, we also know how production and processes have to be configured to comply with the product and market demands of the future. This integrated approach and our interdisciplinary expertise enable us to deliver world-class performance in areas such as the evolution of electric mobility that is properly suited to the market, the environment and society,

and where we are mapping a way into the future with the development of our QUANT electric vehicles.

Although we apply enormous passion to illustrating our technology in the form of cars, we don't see ourselves as manufacturers of electric vehicles, but as a research and development partner to industry for environmentally compatible and forward-looking energy carriers and innovative drive technologies.

Our Structure

nanoFlowcell Holdings Ltd. nanoFlowcell Holdings Ltd and its subsidiaries (referred to in the interests of simplicity as "nanoFlowcell") are active in the research and development of innovative forms of energy. The focus of our work lies in the further development of the familiar principles of flow cell technology and its applications. The object of our corporate activity is the design, manufacture and marketing of nanoFlowcell® technology, bi-ION electrolyte liquid and the design and marketing of their associated software, service and technology solutions.

The company was originally founded 30 December 2013 under the name nanoFlowcell AG as a publicly traded company in Vaduz (Liechtenstein). With a view to future company development, an administrative restructuring took place in March 2016 that resulted in the formation of nanoFlowcell Holdings Ltd based in London (Great Britain). In the same month, nanoFlowcell AG transferred its administrative functions to nanoFlowcell Holdings, was renamed nanoFlowcell IP AG and relocated to Kilchberg (Switzerland).

nanoFlowcell Holdings Ltd administers the business activities of the individual subsidiaries:

- nanoFlowcell IP AG
- nanoFlowcell Management AG
- nanoFlowcell Production GmbH

nanoFlowcell IP AG. With the move from Liechtenstein to Switzerland, nanoFlowcell IP AG took over the task of patent and copyright administration associated with nanoFlowcell® technology, the bi-ION electrolyte solutions and QUANT electric vehicles with nanoFlowcell® 48VOLT low-voltage drive.

nanoFlowcell IP AG is the contact point for all questions relating to licensed production and potential business cooperation. With the formation of nanoFlowcell Holdings Ltd, all the administrative tasks of the original nanoFlowcell AG were transferred to this company as part of the process of diversification.

nanoFlowcell Management AG. nanoFlowcell Management AG was founded in mid-2016. It coordinates all interdisciplinary research and development tasks within the nanoFlowcell Group, as well as the work done by DigiLab, a

digital research lab that deals largely with the digital simulation and physical and numerical modelling of modern flow cells.

nanoFlowcell Management AG is also responsible for the building plans in respect of the future leading international research and development centre for flow cell technology located in Switzerland.

nanoFlowcell Production GmbH. nanoFlowcell Production GmbH (founded in Switzerland in 2014) coordinates the prototype build of the nanoFlowcell® as well as the various QUANT electric vehicles. It is a vehicle manufacturer with its own WMI code and certified for series production.

Based on our companywide development expertise, nanoFlowcell Production GmbH functions as an interface between digital product development, physical production and vehicle registration.

The expertise of nanoFlowcell Production GmbH means we are able to work with our clients to a high degree of precision at the production planning stage to establish the production processes for the integration of our technology and its implementation in respect of quality assurance.

Our Research

We are convinced that technology cannot be allowed to compromise, particularly when it comes to energy supply. Energy carriers of the future must be powerful yet safe to use, environmentally compatible and sustainable. They must also be straightforward to access without political implications. Simple requirements perhaps, but nanoFlowcell® is currently the only energy storage technology that can assert all of these claims.

As a research and development company specialised in flow cell technology, we are working on the future of energy supply – practicable energy for mobile applications, predictable energy for stationary energy supply.

The comparatively high energy density of the bi-ION energy carrier that we have developed and the high efficiency of the nanoFlowcell® open up the perspectives of our technology to a wide range of different applications. Our aim is to make these accessible for our technology.

nanoFlowcell®. nanoFlowcell® marks the start of the modern age of mobile energy carriers. nanoFlowcell® converts the electro-chemical energy stored in bi-ION into electricity. A compact flow cell superior to all battery technologies currently available. Scalable in output for a wide variety of applications. Powerful enough to drive even sports cars on electricity alone. Cost-effective, making e-mobility affordable. Environmentally compatible, enabling sustainable use. It is also practical and safe to handle. nanoFlowcell® is the power station of the future.

bi-ION. bi-ION is a liquid energy storage solution comparable in its energy density with the very latest lithium-ion batteries yet – unlike these – offering safety and environmental compatibility. bi-ION is the first source of mobile drive energy that conserves resources, is environmentally compatible and non-harmful to health, opening up new perspectives for electric mobility – on land, on water and in the air.

nanoFlowcell® 48VOLT. The low-voltage driveline architecture that we have developed is unique in the automotive industry. QUANT prototypes with nanoFlowcell 48VOLT demonstrate the potential of nanoFlowcell® low-voltage technology compared with common high-voltage systems. They are powerful and environmentally compatible, while delivering a high degree of functional safety, low production costs and straightforward vehicle homologation.

Our Perspectives

nanoFlowcell® is shaping the world of tomorrow. As an energy source for a diverse array of electrical applications, there is virtually no industry that cannot benefit from our nanoFlowcell technology. The unique combination of nanoFlowcell® and bi-ION electrolyte liquid is superior to all currently available battery technologies and will end our dependency on fossil energy carriers.

We are researching and developing flow-cell based energy storage solutions as well as mobile and stationary applications for our nanoFlowcell technology.

QUANT is the brand for our prototype applications. Although the QUANT brand is initially appearing almost exclusively in the automotive sector, this should not detract from the fact that individual mobility represents just one small usage area for our nanoFlowcell technology.

When it comes to innovative energy storage solutions for mobile or stationary applications, we think in holistic terms. We conduct our research with passion and develop without compromise from a sense of conviction. Our focus is on a high level of system competence and the networking of individual components. This results in product applications and system functions that make us what we are – R&D experts and partners of industry for innovative flow-cell based energy solutions on land, on water and in the air.

We assist manufacturers in the development of new product concepts, in the technical adaptation of our technologies and in matters relating to series production. It is important to us that technical innovations can also be transferred to series production.

Automobile. The social and political pressure on automotive manufacturers is increasing rapidly. Be it lithium-ion batteries or hydrogen fuel cells – the energies used in current electric vehicle concepts are far from being sustainable and environmentally compatible, neither in production nor in recycling and, furthermore, they are extremely costly or plagued by substantial safety concerns. However, we are not seeking to reinterpret electric mobility. The fact is that nanoFlowcell® will change electric mobility fundamentally. It is a vehicle drive that has zero harmful emissions, is environmentally compatible and harmless to health as well as cost-effective and sustainable to produce.

Aviation. Modern aircraft are equipped with a whole lot of batteries – the same lithium-ion batteries used in mobile phones and laptops. Experience shows that these types of battery have a tendency for thermal runaway – the battery overheats, melts and starts to burn. From an electrical standpoint, nanoFlowcell® would make aviation inherently safe. The bi-ION electrolyte solution is neither flammable nor explosive and has an almost unlimited shelf life. nanoFlowcell® has virtually no self-discharge and its very nature makes thermal runaway impossible.

Shipping. Shipping has a major influence on our environment – with exhaust emissions, engine noise and water pollution caused by escaping fuel at the top of the danger list. According to estimates by the International Maritime Organization (IMO), the CO^2 emissions caused by shipping – not including the substantial amounts of SOx/NOx/PM emissions – make up around 2.2 percent of all manmade CO^2 emissions. IMO experts forecast that the proportion of CO^2 emissions attributable to shipping will double or even treble by 2050. nanoFlowcell® supports efforts to achieve sustainable shipping without harmful emissions and with minimal noise pollution.

Rail. Railway travel and transportation is environmentally friendly, but only where trains are powered by electricity. However, many railway lines are not electrified, and running on them are diesel locomotives that generate noise and considerable amounts of harmful emissions. Using nanoFlowcell technology can deliver rail traffic that generates zero emissions and – electrically powered – less noise, too.

Stationary energy. nanoFlowcell® is a compact power station that produces environmentally friendly electricity, is individually scalable and can be called on as required. nanoFlowcell® can be integrated flexibly into the domestic electric infrastructure – be it as a complementary energy supplier in a hybrid solution (together with solar or wind energy) or as a standalone solution to cover the electricity needs of a household, a community or even a whole town. As a redundant electricity source, nanoFlowcell® can be particularly useful for protecting critical infrastructure equipment in the event of a grid failure or power outage.

Mobile energy. The need for mobile energy is constantly rising. Primary or secondary batteries or even diesel-powered generators are being used in many places as energy sources to supply electricity to mobile applications. To-date, the downsides of these energy providers have had to be accepted as a compromise. nanoFlowcell® is a mobile energy source that offers an uncompromising alternative in many respects and that can be closely adapted to a wide range of requirement profiles.

In Competition with Alternative Energies

If we compare current driveline concepts, we quickly establish that there is no such thing as a zero-emissions car. Problems are transferred but not addressed. There are a large number of approaches competing on the market, without any of them being able to provide a forward-looking perspective. Technically feasible, yes, but neither ecologically nor economically sustainable. With nanoFlowcell®, we are showcasing a solution for individual mobility that is environmentally compatible, sustainable, practical and affordable.

LPG, CNG and LNG

LPG (Liquefied Petroleum Gas) is a fossil energy carrier that is a by-product of the crude oil refining process and also derived from the extraction of crude oil and natural gas. LPG is a mixture of propane and butane and is stored under pressure (2-8 bar at ambient temperature). LPG has been established in most European countries since the 1980s. Due to its low taxation, LPG has a cost benefit over petrol and diesel, which is why it always gains in popularity during periods of rising petrol prices.

LPG is more environmentally friendly in its combustion than petrol. Depending on the ratio of propane/butane, a vehicle running on LPG lowers CO^2 emissions by around 15 percent compared with burning petrol.

Natural gas enjoys tax benefits (varying from country to country) and has been used increasingly as a vehicle fuel over the last few years. Storage, transport and refuelling takes place either as Compressed Natural Gas (CNG) – whereby the gas is compressed to around 200 bar – or as Liquefied Natural Gas (LNG), where natural gas is liquefied by cooling it to around minus 160 °C and kept in a liquid state by storing it in pressure vessels.

Natural gas consists largely of methane, which is more environmentally friendly than petrol in combustion. The CO^2 emissions of vehicles running on natural gas are from five to 25 percent less than burning petrol. However, the energy-intensive liquefication processes requires ten to 25 percent of the gas' energy content.

LPG, CNG and LNG are fossil fuels, the extraction, transportation, processing and combustion of which releases CO^2. They are thus not environmentally friendly – aside from the fact that these fuels are also not sustainable. Vehicles able to run on CNG and LNG are also more technically complex and therefore more expensive. Furthermore, there are concerns relating to the

risk of explosion in the event of an accident and restrictions in access to the likes of parking structures, garages and ferries. Compared with conventional fossil fuels, their transport and storage is technically, and thus financially, more onerous.

Hydrogen

Unlike fossil fuels, hydrogen is not a primary energy, which means that energy must be used to manufacture hydrogen in the first place. This leads to transmission losses, i.e. energy is lost. The benefit of hydrogen as an energy carrier is that it doesn't generate any harmful emissions, particularly carbon dioxide. However, this only works if the hydrogen itself is generated using renewable energies. The problem is that hydrogen is currently produced almost entirely with fossil primary energies. Thus, hydrogen drive in the form of a fuel cell offers no environmental benefit relative to the direct combustion of fossil energy carriers.

Fuel cell vehicles are classified as climate-hostile cars and their environmental compatibility hotly disputed. Moreover, the energy density of hydrogen based on its volume is very low (approx. 1/3 that of natural gas, but has more than double its energy density based on mass). Storing an equivalent amount of energy requires a tank three times bigger or pressure three times greater than for natural gas. For use as a fuel, hydrogen is therefore often very heavily compressed (to around 700 bar) or liquefied (-253 °C). Both are not only onerous and fraught with the potential of additional risk, they also call for further energy consumption (compression ca. 12 percent, liquefication ca. 20 percent). As a consequence, hydrogen is not a particularly efficient energy carrier.

A further complication is that the construction of an adequate hydrogen fuelling infrastructure demands considerable additional investment. Building a hydrogen fuel station infrastructure is expensive – just one hydrogen fuel station costs around 19 million euros.

Hydrogen-powered fuel cell vehicles themselves are also considerably more expensive than comparable vehicles with internal combustion engines. The technology for mobile storage of hydrogen is costly, as it has to guard against insulation losses that can lead to outgassing. A fuel cell incorporates relatively expensive materials such as yttrium, platinum and palladium, which, from an environmental standpoint, are not sustainable in their extraction and processing.

Lithium-Ion Accumulators

Lithium-ion accumulator is the generic term applied to accumulators based on lithium compounds. Compared with other types of battery, lithium-ion accumulators have a high specific energy, but are sensitive to deep discharging and overcharging. The problem of thermal runaway suffered by lithium-ion batteries, which has been responsible for fires in Tesla vehicles and Boeing 787 Dreamliners, remains an issue. Nevertheless, they are the preferred energy storage medium for electric mobility as conventional nickel-cadmium and nickel-metal hydride are simply too heavy, too toxic or too big.

The main benefit of electric vehicles versus vehicles with internal combustion engines is certainly the absence of local emissions. However, this does not mean that battery-powered electric vehicles are environmentally friendly. Right now, the emissions are simply being transferred elsewhere.

Poorly conceived incentive programmes and political initiatives miss the point. Environment politicians who promote the provision of buying incentives, widespread installation of electric charging stations and social favouritism to push the market introduction of electric drives seem not to recognise that current electric vehicles are in no way climate-neutral. The primary energies used and the raw materials that go into the production of lithium-ion batteries certify modern electric vehicles as anything but environmentally neutral. If one considers the total lifecycle of a lithium-ion accumulator, the environmental risks quickly come to light – depending on cell chemistry – in relation to extracting the raw materials and recycling them (Handbook of Clean Energy Systems – Volume 5 Energy Storage, Edition: 2015).

Forced by subsidies, recent years have seen repeated, unsuccessful attempts to promote electric vehicles. But it's not only the high sticker prices, the unrealistic reduction in running costs and the above-average drop in residual values that put many consumers off buying an electric vehicle. The low range and lengthy charging times associated with lithium-ion batteries dulls enthusiasm for electric vehicles, and that is unlikely to change as long as the performance of these vehicles keeps them unsuitable for everyday use.

Not exactly cheaper. While higher production capacities may have caused the price per kWh of lithium-ion batteries to fall by double figures in recent years, bringing them to current levels of around 265 euros per kWh (for the battery alone, minus the connected HV systems), the cost of raw materials accounts for roughly 70 percent of battery pricing.

The construction of a suitable charging infrastructure has to account for the compatibility of the various different battery and charging systems used by the respective manufacturers of electric cars. A single public charging stations costs around 25,000 to 50,000 euros. These are the infrastructure costs that must be borne by the general public. Individual car drivers pay another 800 to 2,500 euros for a domestic charging station, while drivers of electric cars who have to use public parking facilities will have to compete for charging stations.

Manufacturers currently guarantee a battery life of around five years or 50,000 to 100,000 km. According to literature, they can undergo around 5,000 charge cycles with a capacity loss of 20 percent, which equates to an anticipated total battery life of approximately eight years.

However, a key factor impacting battery life is the type of charging – powerful charging currents of the type required for rapid charging (<30 min) shorten battery life immensely.

Industry and politics know that lithium-ion batteries are not the final word. Research work is underway worldwide on a new generation of energy storage media. Industry focus is, however, more on performance optimisation than on the environmental aspect. All future concepts are based on the fundamentals of a lithium compound. But growing demand could see this raw material become scarce by 2050.

nanoFlowcell® Flow Cells

nanoFlowcell Holdings Ltd has therefore adopted a very different route, conducting research into an energy solution for mobile use that permits full flexibility, is suitable for everyday use and also 100-percent environmentally neutral.

On the basis of research into flow cell technology conducted over many years, nanoFlowcell Holdings Ltd has developed a compact flow cell using bi-ION electrolyte, which has many times the energy density of the electrolyte solutions used by conventional redox flow cells and is comparable with the energy density of modern lithium-ion accumulators. In contrast to the conventional electrolyte solutions in redox flow cells, bi-ION is not rechargeable. However, bi-ION is not harmful either to health or the environment and is neither flammable nor explosive. bi-ION makes nanoFlowcell® a sustainable energy source with zero harmful emissions.

The cost of producing the nanoFlowcell® on an industrial scale is estimated at around 600 euros. Thus, in selecting the ideal energy storage for electric vehicles, it would be possible to save not only weight, but also substantial costs. A car powered by a nanoFlowcell is more cost-effective to run than those using fossil and other alternative fuels – one litre of bi-ION contains around 600 Wh and can be manufactured for approximately 0.10 euros.

The product properties mean that no special requirements are necessary for transporting and storing the electrolyte liquids. It would also be inexpensive to re-equip or upgrade the existing fuel station infrastructure, as described by Simon Funke and Martin Wietschel in "Bewertung des Aufbaus einer Ladeinfrastruktur für eine Redox-Flow-Batterie-basierte Elektromobilität" [English: Evaluation of Establishing a Charging Infrastructure for Electric Mobility Based on Redox Flow Batteries]. Drivers would not have to relearn the process, instead being able to fill up a nanoFlowcell vehicle in the same way as a conventional petrol or diesel-powered car in a little more than four minutes.

Based on flow cell technology, nanoFlowcell® represents a new generation of energy carriers distinguished by its optimum performance and environmental credentials. nanoFlowcell® shows, above all, how uncompromising electric mobility can actually be, how attractive it can be to consumers, even without subsidies, and how economically it can be implemented for manufacturers, without additional cost to the general public.

OUR PRODUCTS – BEYOND TECHNOLOGICAL ORIGINALITY

We are convinced that technology cannot be allowed to make compromises, particularly when it comes to energy supply. Energy carriers of the future must be safe to use, environmentally compatible, sustainable and easy to access all over the world. These may be simple requirements, but nanoFlowcell® is currently the only energy storage technology able to assert such claims.

The combination of nanoFlowcell® and bi-ION, our proprietary electrolyte solution, is superior to every other energy carrier on the market: It is compact but with a high energy density, suitable for mass production yet sustainable and fully environmentally compatible, non-toxic and thermally safe, cost-effective and flexible in its configuration.

As a research and development company, we constantly strive to go one step further. In the adaptation of the nanoFlowcell® to an electric vehicle, we succeeded in combining flow cell technology with a low-voltage drive system and thus engineer the world's first road-legal, homologation-ready, low-voltage electric vehicle – the QUANTiNO 48VOLT. Not only its performance is outstanding, but also the functional safety of its nanoFlowcell® 48VOLT low-voltage drive system.

However, the vision of its inventor Nunzio La Vecchia extends even further. The high energy density of the bi-ION energy carrier and the high efficiency of the flow-cell based nanoFlowcell® open up this technology to a vast array of different applications – from tiny to huge.

nanoFlowcell® – Eco-Powerhouse of the Future

Right now, people know flow cells only as garage-sized constructions for stationary energy storage in wind and solar power installations. With nanoFlowcell® we have succeeded for the first time in reducing a flow cell to the size of a briefcase and at the same time to increase tenfold the energy density of the electrolytes. The development of the nanoFlowcell® makes flow cell technology powerful and mobile – nanoFlowcell® opens up completely new technical perspectives in a vast number of applications.

Innovative Energy. nanoFlowcell® is currently the most innovative and powerful energy supplier for mobile and stationary electrical applications. Unlike conventional batteries, the energy for the nanoFlowcell® comes in the form of liquid electrolytes (bi-ION), which can be stored away from the cell itself.

Just like in regular flow cell batteries, the positively and negatively charged electrolyte liquids are stored separately in two tanks and, as in a traditional flow cell, pumped in separate circuits through a converter (the actual cell of the nanoFlowcell system).

Here, the two electrolyte circuits are separated only by a permeable membrane. As soon as the positive and negative electrolyte solutions pass on either side of the converter membrane, an ion exchange takes place. This converts the chemical energy contained in bi-ION into electricity, which is then directly available to the electrical consumers.

Scalable energy. With nanoFlowcell®, the separation of the energy converter and energy storage medium means the energy stored is no longer dependent on the cell size. This is where a flow cell differs from traditional types of battery. With the nanoFlowcell®, the amount of energy available is dependent on the concentration of electrolyte in the electrolyte liquid and on the volume of the electrolyte tank. Thanks to its unrestricted scalability, nanoFlowcell® can therefore be adapted to an extremely diverse range of applications.

Filling up with electricity. Unlike the electrolyte solution in conventional redox flow cells, bi-ION is not reversible, i.e. it cannot be recharged. As a result, what makes the nanoFlowcell® special is that it is no longer subject to an onerous recharging process like conventional batteries or flow cells. Instead, the spent bi-ION electrolyte liquids can simply be replenished. In mobile applications, such as the QUANT electric vehicles, the spent electrolyte liquid is first filtered to remove the dissolved salts and

electrolytes. The filter must be changed roughly every 10,000 kilometres, after which it can be harmlessly recycled. A generator powered by the energy of the driving vehicle now ensures that the remaining water is vaporised and released into the atmosphere – an environmentally neutral process. The electrolyte tanks empty while the car is driving, as in a conventional vehicle with an internal combustion engine. Refuelling the empty electrolyte tanks is likewise comparable with filling up a regular petrol or diesel vehicle.

Environmentally friendly energy. nanoFlowcell technology is fully environmentally compatible and harmless to health. The nanoFlowcell® is very efficient, cost-effective and environmentally compatible to produce using commonplace materials that are readily available in large quantities. Precious and rare-earth metals are not used in either the cell itself or in the bi-ION electrolyte solution. All the raw materials required for the nanoFlowcell® and its electrolytes can be sustainably acquired, used without harm to health and ultimately disposed of in an environmentally compatible manner.

Long-lasting and recyclable. The nanoFlowcell® is also exemplary in terms of raw materials recycling thanks to its extended lifespan. The nanoFlowcell® thus eliminates the problem of performance loss experienced by conventional batteries as the nanoFlowcell® concept does not suffer from memory effect. As far as the lifespan of the nanoFlowcell® is concerned, the hardware comes with a guarantee of more than 50,000 hours of operation. In a car running at a motorway cruising speed of 120 km/h, this would add up to a theoretical range of around 6,000,000 kilometres, vastly exceeding the lifespan of a modern car. Furthermore, the self-discharge of the cell and the electrolyte solution when not in use is negligible.

Safety with certainty. Another benefit of the nanoFlowcell® compared with other battery systems is that monitoring the battery-system charge status is straightforward to implement as there is only one positively charged and one negatively charged electrolyte. Equalisation charging of the kind required by conventional Li-ion or Li-po systems is not necessary. Also, the electrolyte solution is neither sensitive to vibration nor at risk of impulse discharging.

High efficiency. In contrast to an internal combustion engine, the efficiency of the nanoFlowcell® stands at more than 90 percent. When used in electric mobility applications, the operating temperature is a maximum of 96 °C. The entire nanoFlowcell system is also incredibly reliable and low-maintenance as it has no moving parts aside from the electrolyte pumps.

High reliability, low costs and long durability rightly place nanoFlowcell® front and centre when it comes to the development of forward-looking electric mobility concepts.

bi-ION – Liquid Energy for Modern Electricity

bi-ION is the liquid energy carrier for the nanoFlowcell®. The power density of the electrolyte is comparable with that of modern lithium-ion batteries, but its energy density is five times greater. bi-ION is the perfect fuel for environmentally compatible and sustainable electric drive. In road traffic alone, the widespread use of bi-ION could avoid 19,250 megatons of CO^2 emissions per year caused by burning fossil fuels. That equates to 75 percent of the CO^2 emissions generated worldwide by all transport and traffic.

Innovative charge carrier. bi-ION is one of our most important innovations and crucial to the power characteristics of the nanoFlowcell system. Through years of research, we have succeeded in developing special charge carriers that give our electrolyte liquid a significantly higher power and energy density than all fluid batteries currently available on the market.

In our digital simulation lab, we researched new molecular structures and mechanisms for charge transport. Our simulation options massively shortened the development time for bi-ION, enabling us to synthesise an initial physical model and test it in-vivo in the space of just five years.

bi-ION is an aqueous carrier liquid containing dissolved organic and inorganic salts to transport the actual charge carrier, the bi-ION electrolytes. The electrolytes were designed specifically for the nanoFlowcell® using nano-technology in order to be able to transport the high levels of charge.

MINI-MAX. The charge carrier we developed permits a significantly higher charge and concentration than the previous electrolytes in conventional redox flow cells (30 – 90 Wh/l).

At the current development status, we are achieving an energy density of 600 Wh per litre with bi-ION. Compared with lithium-ion batteries of the kind used in most modern electric vehicles, a nanoFlowcell® running on bi-ION delivers sufficient energy for five times the range of a conventional electric vehicle running at the upper range of its power output.

Not different, better. Compared with conventional energy carriers like petrol, diesel, hydrogen and lithium-ion batteries, bi-ION is not harmful to health or the environment and is neither flammable nor explosive. The bi-ION electrolytes contain absolutely no environmentally polluting substances. Moreover, bi-ION is sustainable and environmentally

compatible to produce. Industrial production of the electrolyte liquid is considerably less expensive than refining fossil fuels or the manufacture and use of lithium-ion batteries.

Non-politicised energy. In contrast to fossil fuels, the bi-ION electrolyte solution is not extracted and refined in just a few countries, but can theoretically be manufactured more-or-less in-situ all over the world (given the appropriate production equipment).

Filling up as usual. Distributing and selling bi-ION does not call for the construction of a dedicated fuel station network. Existing fuel stations can also be used for bi-ION with just a few minor modifications to the pumps and nozzles. Thanks to its properties, the bi-ION electrolyte liquid is not subject to any haz-mat obligations, unlike fossil fuels. The manufacture, transportation and distribution of bi-ION is therefore relatively straightforward.

Electric vehicles running on bi-ION are easy to “recharge”. Refilling the tank with bi-ION electrolyte liquid is almost identical to the refuelling process for vehicles with internal combustion engines, just that nanoFlowcell vehicles need two liquids (one positive and one negative electrolyte liquid) to be filled into two separate tanks simultaneously.

nanoFlowcell® 48VOLT – Driving Force of Modern Electric Mobility

The future of driving is low-voltage – and that's a promise! Right now, the nanoFlowcell® 48VOLT low-voltage drive is the most powerful, most environmentally compatible, safest and most cost-effective drive system there is for electric vehicles.

Until now, standard practice has been to fit electric vehicles with a high-voltage drive system of around 400 volts. People accept the intrinsic potential dangers of the high-voltage system as there is no other way of achieving the desired performance. In fact, the automotive industry is even currently considering increasing the voltage in future electric vehicles to 800 volts in the interests of higher vehicle performance.

Against the current. With the QUANT 48VOLT, we are placing a big question mark above this potential development in electric automotive technology and making a globally unique statement: Flow cell technology in the QUANT 48VOLT enables extreme performance (>560 kW) with a safe battery voltage (maximum 48 V).

But why are we going to such lengths as to build prototypes? We see nanoFlowcell® as much more than an innovative form of energy. Instead of focusing on nanoFlowcell® as a singular technology, we always look at the application – the overall system – into which our technology is incorporated. In the case of the QUANT 48VOLT and QUANTiNO 48 VOLT, we have consequently developed a completely new electric drive the likes of which does not exist on the market – the nanoFlowcell® 48VOLT low-voltage drive for electric vehicles. We are not a vehicle manufacturer, but an enthusiastic development team that would like to provide an impressive demonstration of the efficiency and modularity of the nanoFlowcell® by building prototypes of electric vehicles.

High performance. While many manufacturers think of low-voltage technology in terms of electric bikes and e-scooters, we have developed a dedicated low-voltage drive for the QUANTiNO 48VOLT and QUANT 48VOLT. It may sound succinct, but the QUANTiNO is currently the only road-legal electric vehicle in the world with low-voltage drive. But not for much longer. We will soon be bringing to the road the QUANT 48VOLT, the world's first super sports car with low-voltage drive. Its electric all-wheel drive generates 4 x 140 kW and develops a torque of 2,900 Nm to deliver arrowlike acceleration up to a limited top speed of 300 km/h. There won't be anything else like this anytime soon. But that doesn't matter. We merely want to demonstrate that high-performance electric mobility is possible at

low voltages and that high-voltage compromises are a thing of the past. With the QUANT 48VOLT, we want to draw attention to the fact that electric vehicles cannot be permitted to make compromises when it comes to “functional safety”.

More safety. With the nanoFlowcell® 48VOLT, we are also addressing the safety concerns associated with electric mobility. By executing the drive at low voltages across the board, the entire vehicle is inherently safe from an electrical standpoint. The full protection required for high-voltage electric vehicles against contact and arcing is not necessary for low-voltage vehicles. The nature of the flow cell’s poles mean they can be touched without any danger to life and limb. In contrast to conventional lithium-ion battery systems, there is no risk of electric shock to vehicles occupants, other road users and first responders, even in the event of a serious accident

Furthermore, the electrolyte liquids used by the nanoFlowcell® are neither flammable nor explosive.

Lighter and more cost-effective. The concept behind the low-voltage drive architecture in the QUANTiNO 48VOLT and QUANT 48VOLT marks a major development step in the design of production-feasible, low-voltage electric vehicles. The standardisation of the low-voltage components is a substantial benefit for the industrial series-production of a nanoFlowcell® electric vehicle. There is no need for expensive high-voltage safety measures as functional safety is easier to implement for low-voltage vehicles and leads to significant cost reductions in development, production and upkeep. With nanoFlowcell® 48VOLT, electric vehicles will thus not only be safer in future but also less expensive.

Moreover, the technical maintenance of a nanoFlowcell® 48VOLT electric car can also be carried out by personnel without high-voltage training.

With the move to nanoFlowcell 48VOLT low-voltage drive, we were able to save several hundred kilograms of weight in the design of the QUANT 48VOLT compared with the QUANT FE with the high-voltage system – weight that was attributable entirely to the high-voltage components.

One example of this is the innovative 45-phase low-voltage motors in the nanoFlowcell® 48VOLT drive, which facilitate high power paired with minimised cross-sections in the electrical wiring. The special feature of these low-voltage motors is their solid aluminium mesh structure, which replaces the complicated copper windings used in conventional electric motors. This reduces the volume of the motor relative to its power output, while lowering weight and cost, and simplifying series production.

Right now, we are the only manufacturer worldwide able to realise low-voltage drives in electric cars without making compromises in overall vehicle weight or performance. This marks an important design benefit that we will be making increased use of in future QUANT electric vehicle concepts.

QUANT PROTOTYPES – R&D FIT FOR THE ROAD

Research and development fit for the road as well as holistic product solutions – that's what we mean by *QUANT powered by nanoFlowcell*.

As an R&D company, it is important that we achieve clarity on the performance and potential of our technologies, and provide people with a concrete idea of what it means. This is why we always show our technologies in their application.

However, we do not want to present our technologies in the old, customary concepts of existing, branded vehicle models, but instead create something that is new and unprejudiced by established technology – inspiring approaches and self-supporting concepts for a new understanding of electric mobility.

The QUANT brand is the umbrella for close-to-production prototype electric vehicles that provide a highly impressive demonstration of nanoFlowcell technology. nanoFlowcell® is power for compact city sports cars and thoroughbred super sports cars.

The current QUANT electric vehicles with nanoFlowcell low-voltage drive are our technology ambassadors and provide business leaders and politicians orientation for responsible electric mobility with a future.

QUANT 48VOLT

“In the QUANT 48VOLT, the future of electric mobility is powered by a flow cell – at low voltages, of course! Because nanoFlowcell® 48VOLT stands not only for ultimate performance, but, in the QUANT 48VOLT, also presents its potential as the lightest, safest, most environmentally compatible and economical drive system for electric vehicles available anywhere today. An improved cell membrane, six flow cells running simultaneously, innovative low-voltage motors make sports car performance possible at low voltages for the first time ever. The extravagant bodyshell of the QUANT 48VOLT underscores the unique nature of this flow cell sports car and the naked facts offer an indication of what can be expected from this elite electric athlete.”

Technical Information QUANT 48VOLT (2017)

Model	QUANT 48VOLT
Body type	Sports saloon
Top speed km/h	300 (electronically regulated)
Acceleration (0-100 km/h)	2.4 seconds
Transmission	Automatic
Drive	All-wheel
Number of doors	2
Number of seats	2+2

Flow Battery

Type	nanoFlowcell® (six cells)
Voltage (V)	48
Capacity (kWh)	300
Rated current (A)	max. 9,000

Motor

Type	4 x low-voltage synchronous motors
Maximum power kW (hp)	560 (760)
Maximum torque (Nm)	2,000 per wheel

Consumption

Fuel	Electricity
Energy consumption:	tbd
Tank volume (l)	2 x 250
Range (km)	> 1,000 (targeted)
Emissions	0

Dimensions

Length (mm)	5,257
Width (mm)	2,019
Height (mm)	1,357
Wheelbase (mm)	3,198
Kerb weight (kg)	1,820

Wheels and Tyres	Front 265/35 ZR22
	Rear 305/30 ZR22
	Friction optimised

QUANTiNO 48VOLT

“The QUANTiNO 48VOLT is the globally unique low-voltage, road-legal electric vehicle and technology showcase for the new nanoFlowcell® 48VOLT low-voltage drive. As a concept, the EV shows what the electric mobility of the future can look like – sporting performance and practicality stand side-by-side with safety in a vehicle that is harmless to both health and the environment. The QUANTiNO 48VOLT means that electric mobility no longer has to sacrifice emotionality and performance to have a clear conscience.”

Technical Information QUANTiNO 48VOLT (2016)

Model	QUANTiNO 48VOLT
Top speed km/h	200
Acceleration (0-100 km/h)	<5 seconds
Transmission	Automatic
Drive	Rear-wheel
Number of doors	2
Number of seats	2+2

Flow Battery

Type	nanoFlowcell®
Voltage (V)	48
Rated current (A)	300
Capacity (kWh)	15
Buffer system	Supercaps

Motor

Type	AC asynchronous motor
Maximum power kW (hp)	80 (108)
Maximum torque (Nm)	200

Consumption

Fuel	Electricity
Energy consumption:	12-14 kWh / 100 km
Tank volume (l)	2 x 95
Range (km) standard consumption	> 1,000
Emissions	0

Dimensions

Length (mm)	3,910
Width (mm)	1,930
Height (mm)	1,335
Wheelbase (mm)	3,198
Kerb weight (kg)	1,420

Wheels and Tyres	215/45 R20 95V XL Friction optimised

CORPORATE MILESTONES

1991

Nunzio La Vecchia commences research and development work in the field of energy recovery, energy storage and energy conversion; intensification of private studies in quantum mechanics and quantum physics.

2001

Digilab opens in Zurich. Systematic alignment of research and development work with the aid of digital modelling and simulation techniques.

The experience and findings acquired here will be decisive in optimising development time in later research given the increasing complexity of modern energy storage systems and their applications.

2003

First technical outline for an ecologically sustainable mobile energy conversion solution in an automobile.

2008

Cooperation with a Swedish sports car manufacturer to build an innovative electric sports car, the first Quant prototype. Innovative energy technology supplies power to the vehicle's electric consumers. Besides initial conceptional techniques for incorporating flow cell technology into an electric car, it also includes thin-film solar cells to feed power to the air conditioning while the car is parked outside during hot summer months.

2009

Presentation of the first QUANT prototype with thin-film solar technology, appearing as a design study at the Geneva Motor Show.

Over the years that follow, the decision is taken to focus research and development work on forward-looking flow-cell based energy technologies.

2010

First in-vivo lab version of bi-ION. Proprietary design of molecular nano-structures enables greater energy density than in conventional electrolyte solutions for flow cells. This was enabled by rethinking the requirements of electrolyte solutions and intentionally dispensing with the need to recharge bi-ION.

Because bi-ION is not regenerative (not rechargeable), it differs fundamentally from conventional electrolyte solutions in flow cells.

2012

Successful tests with an energy storage system based on flow cell technology.
The cell's compact construction and the high energy content of the electrolyte liquid predestine the new technology for mobile use in electric vehicles.

First technical plans for building a prototype vehicle powered by a flow cell.

2013

The company announces a breakthrough in flow cell research relating to the compact size and performance of its energy storage system. Flow cells are now finally feasible as energy storage systems for modern electric vehicles and innovative battery technology is given a name – nanoFlowcell.
Corporate direction is also agreed and the foundation of nanoFlowcell AG completed.

2014

February. Maiden drive of the world's first electric car powered by nanoFlowcell, QUANT E, the only truly environmentally friendly super sports car.

March. Official world premiere of the QUANT E at the Geneva Motor Show.

July. QUANT E prototype with nanoFlowcell drive is approved by Germany's TÜV for use on European roads.

October. Further development of the Quant prototype, development of a 2-speed transmission for electric sports cars; first technical studies for the QUANTiNO, an electric vehicle with a 48 V low-voltage drive system.

November. Foundation of nanoFlowcell Research SA based in Lugano, Switzerland.

December. Foundation of nanoFlowcell Production GmbH based in Waldshut/Baden-Württemberg, Germany

2015

Further development of the QUANT E, the new QUANT F, shows off electric mobility with style at the Geneva Motor Show. nanoFlowcell drive marks the symbiosis of environmental compatibility and a 1090 hp output.

In a second world premiere, the QUANTiNO is presented to the public for the first time – as the first and, to-date, only nanoFlowcell electric car with 48-volt low-voltage drive.

2016

February. The prototype of the QUANTiNO electric vehicle has been further developed to homologation level; QUANTiNO is approved by Germany's TÜV for use on European roads.

In an initial durability test, the QUANTiNO powered by nanoFlowcell drives for 14 hours non-stop without refuelling – a unique record for an electric vehicle.

March. QUANT FE ("E" for Evolution) and QUANTiNO are presented to the world at the Geneva Motor Show and call for a rethinking of electric mobility. Their mindset is electric mobility without compromise in environmental compatibility, range and performance as well as safety and comfort.

September. QUANT FE is approved for use on European roads. This means that all three nanoFlowcell test vehicles are not only fully road legal, they are also approved for possible low-volume production.

October. First official media test drives confirm the performance of nanoFlowcell technology as an energy source for electric vehicles.

nanoFlowcell engineers develop a technical option for making flow cells directly controllable. This makes superfluous the expensive and heavy supercapacitors previously used as electrical buffer storage in the nanoFlowcell drive.

November. The direct control of the flow cell opens up new technical options for powering electric vehicles, implemented with the construction of a new low-voltage prototype. It marks the start of construction for the QUANT 48VOLT, which will reflect the state-of-the-art in modern fuel cell technology and demonstrate the performance of low-voltage technology in electric vehicles.

2017

QUANT 48VOLT celebrates its premiere as the world's first low-voltage sports car at the Geneva Motor Show. The presentation of the new nanoFlowcell® 48VOLT low-voltage drive – currently the most powerful, lightest, safest, most environmentally compatible and economical drive system there has ever been for electric vehicles.

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