Supercapacitor-Battery Breakthrough

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Qpacity is a U.S. based company that represents and distributes a breakthrough-battery product for the best solution—dare we say, only *real* solution—as an alternative to Lithium, Lithium hybrid and all sorts of "flow" batteries for energy storage. It's a ***Supercapacitor-Battery Breakthrough***. It has proven itself for over five years now and is in production for worldwide use. Three manufacturing plants in the world satisfy the current customer base. Demand is rapidly increasing as knowledge of our technology is spreading. By design, this technology has been kept quiet until now. We are planning for massive growth over the next couple of years. As you learn more about our technology, you will understand why.

Why The Need for a New Battery Technology

The energy storage industry is at major cross-roads. The green revolution is putting massive pressure on the world to move from carbon-based (aka fossil) fuels to electric energy produced by renewables, such as solar and wind. But even before we get to 100% renewable energy production, the industry is preparing for that inevitability by encouraging the population to move towards electric vehicles, all electric homes, solar powered homes, even electric airplanes, to mention only a few. Two results from this. The first is more stress on already burdened electrical grids. Second, a cause for a huge boom in the battery business and a push to develop and build better batteries. We are talking not just batteries for consumer use, but big backup batteries for utility companies.

Battery storage is of outmost importance and a major requirement as we move to an all-electric society. In recent years we have seen the Lithium battery, with all its various forms and hybrids, as the most advanced form of energy storage. But we are now learning of and witnessing serious ramifications of using lithium batteries. Fires, explosions, meltdowns, short battery lives and toxic waste from disposed batteries. Due to these problems scientists and engineers have been looking for better alternatives. Some Lithium hybrids seemed to have been the answer, but we are discovering they still fall short. One direction that has the attention of several universities and labs is the use of graphene in batteries. None of the well-known and published scientists have had any meaningful breakthrough yet.

Within very large batteries (shipping container size), commonly called Energy Storage Systems (ESS), not only is lithium being used (with great safety hazards) but also something called "Redox Flow". Flow batteries come in many forms with endless various liquid concoctions that flow through pumps to charge and discharge energy. While most of these seem to be immune from thermal runaway fires like lithium, they suffer many disadvantages. (See our ESS white paper and comparison chart.)

Most people think of Tesla as the leading technology company when it comes to energy storage. We think of their electric vehicles running on the Tesla Lithium battery, their Powerwall batteries used for home energy storage (also lithium). Tesla is also the leading manufacturer of ESS units (they call *Megapack*) being sold primarily as backup power storage for utility companies producing power for the national grid. These too are lithium based. All these Tesla batteries have been in the news with problems of overheating and fires. Their lithium batteries are not the only ones proven to be disastrous.

Lithium battery fires are caused by "thermal runaway." The fire is nearly impossible to extinguish. In Australia for example, a Tesla ESS Megapack took 7 days and 150 firefighters to put out. Due to the thermal runaway problem, there was a massive Hyundai Kona EV recall in 2021. At least 32 ESS fires in

Korea have occurred, causing the Korean Ministry of Trade, Industry and Energy to implement tougher regulations in 2020 due to this problem. The U.S. based National Fire Protection Association said in 2022, “While there’s little scientific data on how often ESS batteries overheat, catch fire, or explode in the US or globally, it does happen.” Lithium battery fires are becoming much more frequent in the news.

Many attempts are being made to use lithium with other elements to make batteries safer. However, when one solution is found other disadvantages arise. This is also true of the attempts being made for graphene-based batteries.

Industry Attempt with Supercapacitors

Tesla bought a company called Maxwell Technologies for $235 Million back in 2019 looking for answers to their lithium battery problems. Maxwell was in the business of building “Ultra-Capacitors” (same as Supercapacitors) and was known for developing dry electrode technology for battery cells, which Tesla used in one of its batteries. Tesla soon discovered the answers they sought were not with Maxwell’s technology and sold the company back to Maxwell’s former executives.

Other scientists and companies also moved towards the idea of using supercapacitors instead of batteries. However, that research has fallen short for them. Supercapacitors have many advantages, such as the ability to take a charge very fast and to provide a tremendous amount of power quickly when needed. They also seem to have a near endless lifespan with the ability to go through hundreds of thousands, perhaps millions, of charge/discharge cycles. Typical batteries do not enjoy that technology.

Still, it would seem capacitor technology would be the answer if the pitfalls could be solved. While pure capacitors or even supercapacitors have the advantages we cited, they suffer one particular major problem when it comes to energy storage. Unlike batteries, they are not designed or capable of slow energy release. They are meant to release electricity very, very quickly. That’s what they were designed to do. The rate at which a typical capacitor releases its energy is much greater than a battery can handle.

There is a Solution. Announcing the Qpacity SuperCapacitor-Battery.

There is great news. The problem of trying to use the capacitor as a battery has been solved through an all-graphene based supercapacitor-battery.

The solution was engineered after years of R&D. It’s not brand-new technology that still needs time for field testing. This technology has already undergone several years of laboratory R&D, testing, third-party testing and verifications, certifications from the leading and respected agencies such as UL and CE, and even the MSDS chemical testing finds it safer than any other battery known. For example, our “battery” (we will use that term for simplicity even though it’s a supercapacitor-battery) can be transported by air as it will never explode or ignite.

The Qpacity battery has been in service for over five years in the field for many applications (from small golf cart sizes to very large ESS units). No battery has ever overheated, burned, or otherwise failed. Not one has reached its end-of-life cycle. Our batteries will outperform **any** and **all** specs desired for an energy storage system.

Testing results and certifications are available on request. Installed systems can be made available for examination and review. A visit to the secure R&D lab in Florida is also available on request.

Uniqueness of Qpacity Batteries

Size and Weight: Let's start with one very exciting breakthrough. For a given amount of stored energy, Qpacity batteries are approximately 1/10th the size of other batteries depending on the application. This also means weight is drastically reduced. One can expect a 75-85% reduction in weight when comparing the same energy storage need. Note an example in the photo to the left of a golf cart with its typical array of 6 batteries weighing in at 470 pounds.

Compare that to our battery that will replace all those batteries and weigh only 77 pounds. The energy density is a whopping min. 280 kW/kg. See photo below.

Qpacity batteries are not only much smaller and lighter weight, but easily accessible for servicing in that rare event it is needed. Our batteries never need to be discarded. Even the electronics and controller can be updated over time. Note the easily removable lid in the photo to the right. The size for the golf cart battery replacement is only 680mm Length x 420mm Width x 120mm Height (26.77 x 16.5 x 4.7 inches).

As can be seen in the photos to the left and right, each graphene cell is a soft, self-healing, pouch about the size of a 5x8 inch photo and only 5/6" thick. Easily accessible for inspection and replacement if needed.

Non-Toxic and Non-Flammable: Our batteries are non-chemical based. Graphene is one of the main ingredients and is a substance that presents zero toxicity if put into any waste facility, such as landfills. There is no acid to be concerned with or that will cause corrosion. ***Nothing in the Qpacity battery will overheat, catch fire, or explode even if penetrated or put near extreme heat.*** Unlike lithium batteries, ***our batteries are certified to be transported on aircraft and in closed spaces.***

Operates in Extreme Temperatures: Our batteries will function down to minus 40 degrees Celsius and as high as 70˚C (158˚F). These very high or low temperatures do not affect charging or discharging. There is no other battery in the world like this. This was a requirement for a U.S. military battery backpack to be worn by soldiers. (The defense department has decided to use our battery technology for all the reasons cited in this paper.)

More Cycles: Our batteries can go through more charge/discharge cycles than any battery in existence. This is due to the supercapacitor aspect of our batteries. ***Our batteries will go through tens of thousands of cycles, perhaps even into the millions.*** (A current life cycle test underway has a battery with over 1,000,000 cycles and still going strong.) Compare that to other batteries. For example, a typical automotive lead acid battery will last a few hundred to a maximum of 1,000 cycles. Tesla's EV battery warranty accounts for only 1,500 cycles. Their home Powerwall through their huge Megapack ESS batteries are only expected to last 4-6,000 cycles, having a 3,200 cycle warranty. We warranty our batteries for a minimum of 20,000 cycles.

Deep Cycling / DoD: Depth of Discharge (DoD) is a big concern in the battery industry. Most know that lead acid batteries cannot be discharged 100% without damage. In fact, most recommend not discharging more than 50% of capacity. Lithium batteries can have a greater DoD, but seldom to 100%. Typical is 80-90%. Often this is hard to control and at least a nuisance. ***Our batteries do not lose longevity or have a need for deep cycling or shallow cycling to increase longevity. It matters not to what level our battery is charged or discharged.*** The other thing of note is to consider what the real capacity of a battery is if one cannot use 100% of capacity. For example, if a lithium battery claims it has 10 Kilowatt-hours (kWh) of storage, that does not mean one has 10 kWh of useful energy. The storage in our batteries, on the other hand, is 100% available.

Charging Time: Most batteries need to be charged at a relatively slow rate. Especially when the desire is to provide the maximum charge a battery can take. There have been some advances in this area, but even so, once a battery reaches 80% capacity the charging must slow to a trickle to avoid overheating. The battery industry can be a bit deceptive with their advertising when they make charging time claims. The claim they typically make is the time it takes to charge to 80%. The last 20% can take many hours even days as compared to perhaps 30 minutes to 4 hours for 80%. In addition, the traditional batteries (lead, nicad, lithium, etc.) can easily become overheated when attempting to charge too fast. ***Our batteries can take a charge as fast as there is power available. In other words, a "firehose" of electricity can charge it, at a super speed, and without any heating. This method can occur all the way to 100%*** **charge**. No other battery can claim that advantage.

Discharging Rate: Discharging most batteries too fast or too deep can damage the battery. ***The Qpacity battery can be discharged all the way to zero and the power can be used or drained from it as fast or slow as needed.*** Fast discharge is one of the characteristics of supercapacitors. However, the Qpacity battery can also allow very slow discharge, which is not an ordinary function of capacitors. Our battery does not suffer from the ***bell curve*** phenomenon where voltage is decreased as the battery gets closer to empty. The available voltage remains the same all the way to 100% discharge.

Imagine a battery of any size and application outperforming any other battery in the industry, lasting longer than any other battery, having a proven safety record like no other and completely non-toxic in the event of battery discard.

The environmentalists love our batteries. Not only are they non-toxic while operating and at the end of life, but they also last for so many years few will be discarded. There are NO landfill or dumping concerns as there are with lithium and other chemical batteries.

COMPARATIVE SPECS Primary Storage	Qpacity ESS 100% Graphene	Typical Competitor Lithium-Ion
Battery Cycle Life	20,000—1M	3-6,000
Round Trip Efficiency	99.1%	85-90%
Useable Voltage/Amps	100%	80-90%
Depth of Discharge (DOD)	100%	85-95%
Temperature Range	-40°C to 70°C	-20°C to 60°C
Charge Current Limitation	NO LIMIT	95% Recommended
Discharge Current Limitation	NO LIMIT	80% Recommended
Non-Flammable / Non-Toxic	YES	NO
Thermal Stability	YES	NO
Energy Density	280-300 Wh/kg	180-250 Wh/kg

<u>Qpacity Batteries Currently in Production</u>

Golf Cart Battery—5.2kW 100Ah Graphene: One battery replaces an entire array of standard batteries in golf carts and similar electric vehicles. Reduces cart weight by about 400 pounds (180 kg).

Graphene Home Battery (3 sizes): These batteries compete with the Tesla Powerwall and other similar home batteries typically installed with solar systems. Sizes include 5.2kW 100Ah—10kW 200Ah—14.7kW 300Ah.

ESS (Energy Storage System) for large commercial applications. There are two types of ESS's. One is strictly energy storage. These are most often used as a utility company's backup energy for the grid. There is also a "smart" ESS that is used to accept power produced off-grid (e.g., solar, wind, water, etc.) and deliver the energy to end users. These ESS batteries have controllers, inverters, etc. A Smart ESS often will have numerous storage-only ESS units based on demand needs. (See Qpacity's white paper on ESS for the latest information on worldwide needs and comparative analysis with other systems.)