Z Λ P ∓ G O

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Zap&Go External Charger and Cordless Power Tools

Company Description

ZapGo Ltd ("Zap&Go" or the "Company") is a UK-based technology company that has developed a new category of energy storage device—the Carbon-Ion™ (C-Ion®) cell—that combines the capacity and slow discharge performance of **lithium-ion (Li-ion) batteries†** with the time to charge, safety, and environmentally friendly features of **supercapacitors**. The Company believes that its proprietary C-Ion® technology provides a better alternative to the current Li-ion batteries used in products such as mobile phones, cordless power tools, and electric cars. This is because C-Ion® charges much faster than current Li-ion batteries, eliminates Li-ion's flammable components (which can create a safety and fire risk), and is still able to deliver energy storage capacity that is more in line with Li-ion batteries. Following the debut of Zap&Go's technology at the 2017 Consumer Electronics Show (CES 2017) in January 2017, the Company expects the first Zap&Go-enabled products to be available for consumer purchase in early 2018. The first products, based on Zap&Go's proprietary Gen 3 technology, target the electric scooter, cordless power tools, and automotive after-markets. The Company's thinner, more energy dense proprietary Gen 4 technology, which is designed for consumer products, is expected to be market ready by early 2019. Zap&Go seeks to partner with manufacturers across a range of industries who may incorporate the Company's technology directly into their products and commercialize these products under their own names with the "Powered by Zap&Go" logo on the product (similar to the Intel Inside® initiative). The Company believes that this strategy shortens time to market (TTM) and allows Zap&Go to utilize the resources of its partners for market penetration efforts.

Key Points

- According to Zap&Go, its C-Ion® technology delivers four competitive technological advantages: (1) sub five-minute charging with slow discharge; (2) increased safety (less risk of fire or explosion); (3) greater charge/discharge cycles versus Li-ion; and (4) is easier to recycle than alternatives.
- During CES 2017, the Company showcased various functioning prototypes that incorporated its C-Ion® technology, including a Stanley Black & Decker cordless power drill, a Bissell® vacuum cleaner, and a Razor® E300 electric scooter.
- Zap&Go's intellectual property (IP) portfolio includes patents and patent applications within the field of nano-carbon supercapacitors—in part derived from Oxford University and in part developed independently.
- Zap&Go was selected for the third time as a winner of the 2017 Red Herring Europe Top 100 Company Awards, honoring the year's most promising private technology ventures.
- The global supercapacitor market, valued at $1.2 billion in 2014, is anticipated to reach $7.4 billion by 2023; the Li-ion battery market is expected to reach $140 billion by 2026.
- In September 2016, Zap&Go secured $7.4 million from U.S. private investors and in May 2017 was awarded a €1.43 million ($1.6 million) grant by Horizon 2020, the European Union Framework Program for Research and Innovation.

†**BOLD** WORDS IN CONTEXT ARE REFERENCED IN THE GLOSSARY ON PAGES 65-66. *See inside for applicable disclosures.*

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Investment Highlights

- ZapGo Ltd ("Zap&Go" or "the Company") is a British-based technology company that has developed a faster charging, environmentally friendly, safer alternative to the Li-ion batteries used today in a range of products, such as mobile phones, laptop computers, cordless power tools, and electric cars.

- Zap&Go's Carbon-Ion™ (C-Ion®) cell is a new category of energy storage device that incorporates patented advanced **nano-structured** carbons, a proprietary **ionic electrolyte**, and improved fabrication techniques for enhanced energy density. C-Ion® cells function in a manner similar to regular supercapacitors, maintaining their ability to provide rapid charging along with a long **cycle life**, while delivering energy storage capacities more in line with those of Li-ion batteries.

- The Company has developed what it believes to be the next-generation supercapacitor with the following advantages over current alternatives: (1) sub five-minute charging with slow discharge; (2) increased safety (less risk of fire or explosion); (3) greater charge/discharge cycles versus Li-ion; and (4) is easier to recycle.

- Zap&Go's strategy for the commercialization of its C-Ion® technology is to partner with manufacturers across a spectrum of sectors and industries who can incorporate the Company's technology directly into their own products. The manufacturers can then commercialize and sell the products under their own names with the "Powered by Zap&Go" logo on the product (similar to the Intel Inside® initiative). The Company believes that this strategy not only shortens time to market (TTM), but also allows it to utilize the resources of its partners for marketing and penetration efforts of its products.

- Following the debut of its technology at the 2017 Consumer Electronics Show (CES 2017) in January 2017, the Company expects the first Zap&Go-enabled products to be available during early 2018. The Company's first products are based on its proprietary Gen 3 technology and target the electric scooter, cordless power tools, and automotive after-markets. The Company's thinner and more energy dense Gen 4 technology is designed for consumer products and is expected to be available during early 2019.

- During CES 2017, the Company showcased various functioning prototype products that incorporated the C-Ion® technology, including a Stanley Black & Decker Cordless Power Drill, a Bissell® Vacuum Cleaner, and a Razor® E300 electric scooter.

- Zap&Go has a licensing business model similar to Qualcomm [QCOM-NASDAQ] and has partnered with existing producers and contract manufacturers (CMs) of Li-ion cells who manufacture the Company's C-Ion® cells on their current manufacturing lines. The cells are then sent to Contract Electronics Manufacturers (CEM's), such as Flextronics International (a subsidiary of Flex ltd [FLEX-NASDAQ]), who build them into the finished products. Zap&Go receives a license fee for each C-Ion® cell used or sold. The first CM relationship is with Li-Fun Technology Co Ltd (Li-Fun Tech) in China, and overall the Company has an initial CM capacity of approximately one million C-Ion® cells per month.

- The global supercapacitor market, valued at $1.2 billion in 2014, is anticipated to reach $7.4 billion by 2023 (Source: Transparency Market Research's *Supercapacitor Market Global Industry Analysis, Trend, Size, Share and Forecast 2015–2023*, April 2016).

- Zap&Go was selected as the winner for the 2017 Red Herring Europe Top 100 Company Award, honoring the year's most promising European private technology ventures. Additional awards and recognitions include: (1) Red Herring Global 100 list, 2016 (2) finalist Amazon Growing Business Awards, Innovator of the Year, 2016; (3) Scientific Breakthrough Award, Everline Future 50, 2016; (4) Red Herring Europe Top 100 Company, 2016; (5) Startups 100 Winner, 2016; and (6) London Product Innovation of the Year, 2015.

- In September 2016, Zap&Go secured $7.4 million from U.S. private investors and, in May 2017, was awarded a grant worth €1.43 million ($1.6 million) by Horizon 2020, the European Union Framework Program for Research and Innovation.

Executive Overview

ZapGo Ltd ("Zap&Go" or "the Company") is a technology company that has developed a faster charging, environmentally friendly, safer alternative to the lithium-ion (Li-ion) batteries that are used today in a range of products, including mobile phones, cordless power tools, and electric cars. The Company's technology—Carbon-Ion™ (C-Ion®)—combines the capacity and slow discharge performance of Li-ion batteries with the time to charge, safety, and environmentally friendly features of supercapacitors. ZapGo Ltd is the parent company and ZapGo Inc. is the U.S. subsidiary.

Batteries and Supercapacitors

Currently, two energy storage devices dominate the rechargeable battery market: Li-ion batteries and supercapacitors. These devices differ from each other in terms of the amount of energy that can be stored, the time it takes for storing and delivering energy, and the usable life of the devices. In general, devices such as batteries display high **specific energy** (the amount of energy a device type can store) but poor **specific power** (the amount of power a battery can produce and a measure of how fast a battery can recharge and deliver energy). Alternatively, energy storage devices such as capacitors, display high specific power but low specific energy. Improvement in any of these areas might come at the expense of battery life, cost, or other factors that can limit the device's applications.

Lithium-ion Batteries

Currently, the dominating rechargeable battery device is the Li-ion battery. Lithium-ion batteries are utilized where high-energy and minimal weight are important, and are widely used in mobile phones, laptop computers, cordless appliances and power tools, electric vehicles, and airplanes—a combined market expected to reach $140 billion by 2026 (Source: Zap&Go Ltd and the University of Oxford's Rutherford Appleton Laboratory's *Carbon-Ion: a new, safer and faster charging category of rechargeable energy storage devices,* 2016).

Despite their popularity, Li-ion batteries and other rechargeable batteries have limitations. Lithium cells are damaged when charged at high rates and have no capability to discharge quickly, thus they take a long time to charge. In addition, Li-ion batteries begin to decay after as few as 500 charge/discharge cycles and contain flammable chemical compounds that pose an environmental and safety risk. Lithium-ion batteries have caught fire inside smartphones, laptop computers, electric cars, hoverboards, and airplanes. Two of the highest profile Li-ion related safety issues have been the grounding of Boeing's 787 Dreamliners in 2013 after a Li-ion battery caught fire in Boston; and the Samsung Galaxy Note 7 product recall during 2016, in which 2.5 million Galaxy Note 7 smartphones were recalled after finding a flaw in the battery cell that resulted in fires (Source: *New York Times'* Samsung's Recall: The Problem with Lithium-Ion Batteries, September 2016). These concerns resulted in legislation and guidelines for the transportation of Li-ion battery products, including **UN 38.3**, which lists the required tests and acceptance criteria needed in order to ship lithium metal or Li-ion cells and batteries, and has been widely adopted worldwide.

Supercapacitors

Supercapacitors, devices used for storing and delivering electrical energy, use static electricity (electrostatics) to store energy rather than the chemical reactions used by batteries. Since charging a supercapacitor does not require chemical reactions, they can charge and discharge much faster than batteries, leading to very high power density—delivering electrical energy much faster than batteries. In addition, because supercapacitors do not experience the same wear and tear as chemical reaction-based batteries, they have long lifetimes—they can be cycled hundreds of thousands of times with minimal change in performance. Furthermore, supercapacitors generally do not contain harmful chemicals or toxic metals, eliminating the safety concerns prevalent with the Li-ion technology. However, the main shortcoming of supercapacitors is their low energy density, meaning that the amount of energy supercapacitors can store per unit weight is very small, particularly when compared to batteries. This drawback prevents current supercapacitors from replacing Li–ion batteries as the main energy storage device for many applications, including consumer devices.

Zap&Go's Carbon-Ion™ Cell

Zap&Go's C-Ion® cell is a new category of energy storage device that incorporates patented advanced nano-structured carbons, a proprietary ionic electrolyte, and improved fabrication techniques for enhanced energy density. C-Ion® cells work in a manner similar to regular supercapacitors, maintaining their ability to provide rapid charging and long cycle life. However, C-Ion® employs different carbon and electrolyte materials, which enables the technology to operate at higher voltages, delivering energy densities that are more in line with current Li-ion batteries but without any of the fire risk and safety concerns.

Zap&Go's C-Ion® cell technology is currently in its third generation (Generation 3 [Gen 3]), with the fast charging alternative to Li-ion batteries making its debut at the 2017 Consumer Electronics Show (CES 2017) in Las Vegas this past January. Having made it through the first two generations of product development (as described on pages 17-18), the Company believes that it has developed the next-generation supercapacitor with four technological advantages: (1) sub five-minute charging with slow discharge; (2) increased safety (less risk of fire or explosion); (3) greater charge/discharge cycles versus Li-ion; and (4) easier to recycle. The Company is at the proof-of-concept stage with a number of prototype demonstrators and expects the first Zap&Go-enabled products to be available for consumer purchase during early 2018.

Carbon-Ion™ Technology

The ability to increase the energy that a supercapacitor is able to store can be improved either by increasing the surface area of the metal plates (electrodes) and/or by using a better electrolyte material. In terms of the plates, the **capacitance** of a supercapacitor increases as the surface area of the plates increases and as the distance between the plates decreases. C-Ion® cells work in a very similar way to other supercapacitors but use different carbon and electrolyte materials that enable the devices to deliver higher energy densities.

By using highly porous nano-carbons (such as **graphene**) as an alternative to activated carbon, and higher voltage ionic electrolytes instead of organic electrolytes, Zap&Go has constructed C-Ion® cells displaying voltages higher than existing competitors, with a theoretical voltage window of up to 6V, translating into a device capable of holding 30% to 80% of the energy density of Li-ion batteries. Despite the increase in capacitance, C-Ion® cells are still able to deliver the fast charge and discharge normally associated with supercapacitors. In addition, the non-flammable ionic-based electrolyte gives C-Ion® cells a more favorable safety profile than Li-ion batteries and make it easier to recycle. According to the Company, once the 6V target is achieved, the C-Ion® cell is projected to be the size and approximate power density of existing Li-ion batteries—which Zap&Go believes could expand the application of its technology to markets such as mobile phones and personal electronics.

Zap&Go Product Pipeline and Target Markets

Zap&Go is currently focused on three key factors as it analyzes potential market opportunities: revenue potential; competitive landscape; and time to market (TTM). While the Company believes that there are many potential applications for the Zap&Go technology, the current Gen 3 products have been optimized for commercial deployment in targeted sectors within industrial markets. Specifically, Zap&Go's business model for the commercialization of its C-Ion® technology is to partner with prominent manufacturers in the following industries—electric power tools, cordless cleaners, toys, mobile phones, and personal transportation—who may incorporate the Company's technology directly into their products. The manufacturers can then commercialize and sell the products under their own names but with Zap&Go's technology as a key selling point, akin the Intel Inside® initiative. The Company believes that this strategy not only shortens TTM, but also allows it to utilize the resources of its partners for the marketing and penetration efforts of its products. As such, Zap&Go is not planning to sell its C-Ion® cell technology directly to consumers.

Following the debut of its technology at CES 2017, the Company expects for the first Zap&Go-enabled products (incorporating its Gen 3 technology) to be available for consumer purchase during early 2018. The thinner and more energy dense Gen 4 products designed for consumer products are expected to be ready in early 2019.

Instant Charging Technology

According to the Company, Zap&Go's C-Ion® battery technology can be used to achieve instant charging of electronic devices. A plug socket can deliver a maximum of about 3kW. In theory, plugging a phone that has a 3,000mAh battery could result in a full charge in 15 seconds. However, limitations of Li-ion batteries restricts the speed at which the battery can be safely charged, with the charge adaptors designed to slow down charging to protect the batteries. C-Ion® technology does not have the limitations on charge and discharge speed. If C-Ion® cells are added in both the charger and the device, the recharge time (and therefore the down time of products) can be reduced to a few seconds. This works by buffering the required charge in the C-Ion®-equipped charger. A stored charge is built up in the C-Ion® cells in the charger using a standard 3kW plug socket so a large energy transfer can happen almost instantly once the device is plugged into the smart charging station.

Near Term Opportunities

There are many potential applications for Zap&Go's technology. Within each target market, the Company is partnered or seeks to partner with a major manufacturer/retailer that is able to provide support in the form of capital, joint development, and eventually purchase orders. The market verticals that the Company believes could represent a significant near-term opportunity for its products—personal transportation, cordless power tools and appliances, and automotive aftermarket products—are highlighted below and further described within the Executive Informational Overview (EIO), on pages 37-39.

Personal Transportation and Autonomous Vehicles

Since 2011, a fleet of 21 electric-powered driverless vehicles (PODs) at the Heathrow International Airport in London have ferried as many as 1,000 passengers each day on a 2.4 mile-long closed course between terminal 5 and the Business Car Park. Zap&Go was awarded two grants from Innovate UK, the British Government innovation agency (in association with partners including a supplier of Nissan Li-Ion batteries), to install a bank of C-Ion® cells to provide support for the existing battery array in a hybrid system.

In addition, the PODs are used in the GATEway (Greenwich Automated Transport Environment) project, a £8m research project, led by UK Transport Research Laboratory (TRL), which aims to understand and overcome the challenges of implementing automated vehicles in an urban environment. In terms of the energy source to power the GATEway's PODs, Zap&Go is working with Westfield Sportscars and Hyperdrive Innovations to develop a hybrid energy storage system for the driverless POD project. Innovate UK has provided £300,000 of funding to match Hyperdrive's British-sourced Li-ion battery system with the C-Ion® power pack developed by Zap&Go.

The Company is also targeting the recreational transportation market. At CES 2017, Zap&Go showcased a Razor® E300 electric scooter prototype incorporating the Company's technology, which reduces the charge time from over eight hours to five minutes. The Zap&Go hybrid solution would extend the range from 30 miles to 50 miles before recharge. Currently, this e-bike is powered by a lead acid battery with a one-year life, and a replacement cost of approximately $300.

Cordless Power Tools and Appliances

One of the first products the Company plans to bring to market is a cordless power drill that uses Zap&Go's C-Ion® technology as the power source. The Company's strategy is to partner with manufacturers who incorporate the Zap&Go technology directly into their product, which is a key element in Zap&Go's development of cordless power tool and appliance products. According to the Company, it has secured an agreement with a U.S. brand-name company to develop a new type of ultra-fast charging power pack for a cordless range of power tools. The power pack will be compatible across a range of different tools and be available in stores in 2018. During CES 2017, the Company showcased two key functioning products that incorporate C-Ion® technology: (1) a Stanley Black & Decker cordless power drill, and (2) a Bissell® vacuum cleaner. In both of these products the recharge time had been reduced to less than five minutes. On May 2017, Zap&Go announced that it was awarded a grant worth €1.43 million ($1.6 million) by Horizon 2020, the European Union Framework Program for Research and Innovation. Zap&Go plans to use the grant to perfect the prototypes it has already developed.

<u>Hopkins ZapStart™ Emergency Car Starter</u>

Zap&Go is developing a product designed to start a car battery if it goes flat, in partnership with Hopkins Manufacturing Corporation. Current emergency products are lithium-based, which can lose their charge and take a long time to recharge. The Hopkins ZapStart™ emergency car starter works by harvesting the remaining power in a battery, can charge in as little as five minutes, holds the charge longer, and works immediately.

Mid-Term Opportunities

Zap&Go's Gen 4 technology is specifically designed for the consumer electronic market. The Company believes that its Gen 4 technology's improved product performance can lead to accelerated volumes in new target markets. Zap&Go's end goal is to embed its supercapacitors inside a phone in order for the phone to charge itself in five minutes. Discussions are on-going with handset manufacturers to achieve this in 2019/2020. In the meantime, the Company is analyzing the application of its technology to the following sectors: (1) consumer electronics—including a phone case that could be fully charged in 5 minutes, as well as wearables and portable electronic devices; (2) electric vehicles and transportation; (3) solar energy solutions; and (4) emergency and back-up solutions (emergency lighting), among others.

Corporate History and Employees

Zap&Go was founded in 2013 in Oxford, UK with intellectual property (IP) from the University of Oxford in advanced nano-carbon materials. The Company is based at the Harwell Research Campus outside Oxford, UK (shown in Figure 1) with research and development (R&D) facilities in Sunnyvale, California and at the Rutherford Appleton Laboratory near Oxford, UK. The staff of 22 includes 6 Ph.D.'s in materials science, chemistry, or electronics.

Figure 1
ZAP&GO FACILITY

Source: ZapGo Ltd.

Zap&Go has a licensing business model similar to Qualcomm and has partnered with existing contract manufacturers (CMs) of Li-ion cells who manufacture the Company's C-Ion® cells on their current manufacturing lines. The cells are then sent to Contract Electronics Manufacturers (CEMs) or branded manufacturing companies—such as Flextronics International (a subsidiary of Flex ltd [FLEX-NASDAQ])—who build them into the finished products. Zap&Go receives a license fee for each C-Ion® cell used or sold.

The first CM relationship is with Li-Fun Technology Co Ltd (Li-Fun Tech), a large-scale manufacturer of rechargeable Li-ion batteries in China. The partnership agreement with Li-Fun Tech would allow the Company to begin producing its Gen 3 cells, which are designed to be manufactured using the same production lines used for Li-ion cells, thereby enabling high yield and quality levels without the need to design or install new production lines.

Recognition and Awards

Zap&Go has been selected as the winner for the 2017 Red Herring Europe Top 100 Company Award, a prestigious list honoring the year's most promising private technology ventures from the European business region. In addition, the Company was the only European energy storage company to make the Red Herring Global 100 list in 2016, highlighting the top 100 technology companies in Europe, Asia, and the Americas. Additional awards and recognitions include (1) finalist Amazon Growing Business Awards, Innovator of the Year, 2016; (2) Scientific Breakthrough Award, Everline Future 50, 2016; (3) Red Herring Europe Top 100 Company, 2016; (4) Startups 100 Winner, 2016; and (5) London Product Innovation of the Year, 2015.

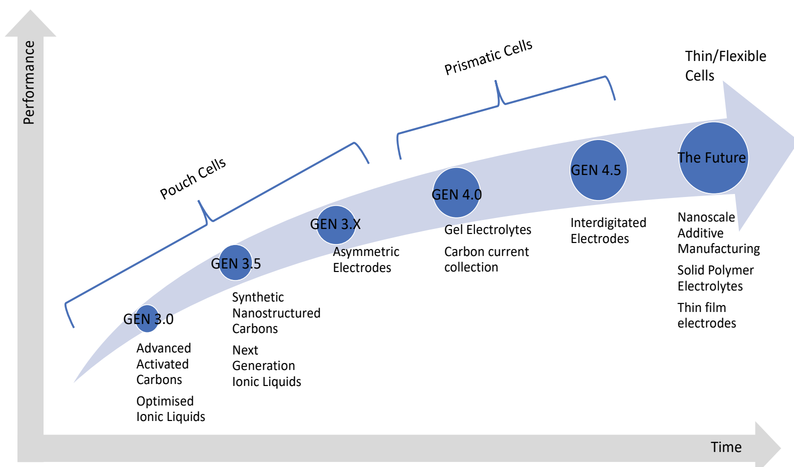
Growth Strategies

Zap&Go's Carbon-Ion™ (C-Ion®) cell technology is currently at the pre-production stage. Gen 3 cells are being produced on a pilot production line in the UK, with full production expected to begin in Q4 2017. The Company expects the first Zap&Go-enabled products to be available for consumers to purchase during early 2018.

Development of the Company's third generation (Gen 3) technology aims to optimize materials science and the performance of the materials within the C-Ion® cell. Gen 4 development focuses on the nano-engineering of materials, doing away with conventional thinking in pursuit of improved performance. The Company believes that as its C-Ion® technology development continues to move forward, the improved product performance and reduced size of its energy cells, as illustrated in Figure 2, can lead to accelerated volumes in new target markets.

Figure 2

ZAP&GO PRODUCT DEVELOPMENT ROADMAP



Source: ZapGo Ltd.

Manufacturing Efficiencies

The design of Zap&Go's C-Ion® cells enables the Company to use the existing supply chain and widely available battery grade materials for the production of its products. In addition, Zap&Go's C-Ion® cells can be manufactured using the existing standard battery production machinery and production lines used for Li-ion cells. This enables high quality levels and quick production scale-up without the need to design or install new production lines, maintaining C-Ion® price points competitive with Li-ion technology and speeding time to market (TTM).

In addition, Zap&Go has a licensing business model similar to Qualcomm and has partnered with existing contract manufacturers (CMs) of Li-ion cells who manufacture the Company's C-Ion® cells on their current production lines. The Company has recently announced that it will begin manufacturing their Gen 3 cells through a collaborative partnership agreement with Li-Fun Technology Co Ltd (Li-Fun Tech), a Chinese large-scale manufacturer of rechargeable Li-ion batteries, under which the Company has an initial CM capacity of approximately one million C-Ion® cells per month.

The cells are then sent to Contract Electronics Manufacturers (CEM's) or branded manufacturing companies—such as Flextronics International (a subsidiary of Flex ltd)—who then build these cells into the finished products. Zap&Go receives a license fee for each C-Ion® cell used or sold.

Business Model and Market Penetration

Zap&Go's business model for the commercialization of its C-Ion® technology is to partner with prominent manufacturers across a spectrum of industry verticals—electric power tools, cordless cleaners, toys, mobile phones, transportation, and the military—who may incorporate the Company's technology directly into their products. The manufacturers can then commercialize and sell the products under their own names but with Zap&Go's technology as a key selling point—akin to the Intel Inside® initiative. The Company believes that this strategy not only shortens TTM, but also allows it to utilize the resources of its partners for the marketing and penetration efforts of its products. As such, Zap&Go has no plans to sell the C-Ion® cell technology directly to consumers.

Market Opportunities

Although the Company believes that there are many potential applications for the Zap&Go technology, the current Gen 3 products have been optimized for commercial deployment in targeted sectors within the industrial markets. According to Zap&Go, within each vertical the Company is partnered or seeks to partner with a major manufacturer/retailer who can provide support in the form of capital, joint development, target market and commercial requirements, and eventually purchase orders.

In analyzing potential market opportunities, the Company is focused on the following key factors: revenue potential, competitive factors, and TTM. Specifically, the Company's first target market focuses on personal transportation applications (electric e-bike), cordless cleaners and power tools, and automotive aftermarket products. In addition, the Company is also assessing the use of its C-Ion® technology either on its own or in a hybrid configuration in combination with Li-ion batteries for a range applications, such as cordless power tools or appliances (that charge in minutes); mobile phones or laptop computers (where the charge time could be reduced from hours to minutes); infrastructure energy storage, such as in building emergency lights or solar panels (where the long life time of C-Ion® means there is no requirement to replace them every few years); and electric vehicles.

In parallel with the development and commercialization of its Gen 3 technology, Zap&Go is conducting a research and development plan to achieve steep increases in performance for its Gen 4 technology. The plan enables Zap&Go to generate early revenue from end-users who are willing to adopt the cell technology at the Gen 3 stage, while creating manufacturing efficiencies that enable Gen 4 to reach the market in the shortest time possible. According to the Company, this model is in contrast to the traditional linear product development model adopted by many start-up companies.

The Company believes that its Gen 4 technology's improved product performance can lead to accelerated volumes in new target markets. Zap&Go's end goal is to embed its supercapacitors inside a phone in order for the phone to charge itself in five minutes. Discussions are on-going with handset manufacturers to achieve this in 2019/2020. In the meantime, the Company is analyzing the application of its technology to the following sectors: (1) consumer electronics—including a phone case that could be fully charge in 5 minutes, transferring that charge to the phone at the normal rate—as well as wearables and portable electronic devices; (2) electric vehicles and transportation; (3) solar energy solutions; and (4) emergency and backup solutions (emergency lighting), among others.

Beyond the industries being targeted by the Company, there are other sectors and markets that may offer opportunities but have not yet been assessed by Zap&Go. For example, low speed electric cars in China or powering small satellites in low earth orbit, in conjunction with its solar panels. Determining the respective value and feasibility of these potential markets may be a target for the Company's technology at some point in the future.

Milestones

Over the past 12 months, the Company has achieved significant milestones as described below, and aims to accomplish additional key milestones in the near term.

Recent Milestones

- Introduced its technology at the 2017 Consumer Electronics Show (CES 2017) in Las Vegas in January 2017, presenting a number of working prototypes
- Secured $7.6 million from U.S. private investors to support growth
- Selected as a winner of the 2017 Red Herring Europe Top 100 Company Award, a prestigious list honoring the year's most promising private technology ventures from the European business region
- Awarded a grant worth €1.43 million ($1.6 million) by Horizon 2020, the European Union Framework Program for Research and Innovation
- Announced a collaborative partnership agreement with Li-Fun Technology Co Ltd (Li-Fun Tech), a large-scale manufacturer of rechargeable Li-ion batteries to manufacture Gen 3 cells in scale in China
- Finished construction and testing of its ZapStart™ emergency car starter product, which was subsequently shipped to Hopkins for customer evaluation
- Built and demonstrated its 60x C-Ion® 200Amp battery array pack designed for POD autonomous vehicles

Potential Milestones

Going forward, the Company aims to achieve the following milestones, as outlined below.

- Begin large scale manufacturing of its Gen 3 products with its manufacturing partner, Li-Fun, at its production facility by the end of 2017
- Deliver the first Gen 3 cells to Flex for integration into finished products
- Deliver the Gen 3 prototypes for final customer testing: Hopkins ZapStart™ and Razor E300 scooter
- Introduce its Gen 3 products to market through partnerships with prominent manufacturers in early 2018

Intellectual Property

Zap&Go's intellectual property (IP) portfolio includes patents and patent applications that relate to the field of nano-carbon supercapacitors. Zap&Go's technology and its growing patent portfolio (as shown in Figure 3) is partially derived from Oxford University and partially developed independently by Zap&Go's own scientists. The Company's patent portfolio includes the patents licensed from Oxford University, two patents acquired from Ultora Inc. (USA), and over 30 patents filed by the Company. In addition, Zap&Go relies on substantial know-how in the following areas: carbon inks, Ionic electrolytes, electronics design and integration, and manufacturing processes, among others.

After receiving a UK Government grant, the Company began to conduct research into advanced energy storage applications (including supercapacitors) and in early 2014 licensed patents from the Materials Science group at Oxford University in **chemical vapor disposition (CVD)** graphene. CVD produces very high quality graphene (significantly more conductive than copper), enabling Zap&Go to develop supercapacitor applications. The Company has continued to develop this technology.

Figure 3

INTELLECTUAL PROPERTY

Reference #	Country	Application #	Publication/ Registration	Case Status	Description of subject matter claimed in application
P45166TW	TW	104135101	201626681	Pending	The patent application is directed to a rechargeable battery charger comprising a supercapacitor comprising graphene; a power module to provide up to 40 amps to the supercapacitor from a source of AC rated at 100 volts or above; an output converter adapted to deliver DC power from the supercapacitor to an output port for connecting to a battery-powered electrical device; and a control module adapted to control the charger's various functions and manage output from the supercapacitor. Also directed to a portable electronic device for connecting to a rechargeable battery charger as discussed above.
P45166US	USA	14/936871	2016/0141900	Pending	
P45166EP-PCT	EP	15784445.7		To be filed	
P45166KR-PCT	KR	10-2017-7013964		Pending	
P45166JP-PCT	JP	2017-525828		Pending	
P45166IN-PCT	IN	Not yet known		Pending	
P45166CN-PCT	CN	Not yet known		Pending	
P45166WO	PCT	PCT/GB2015/053003	WO2016/075431	Pending	
P47507GB	UK	1520868.9	2544775	Pending	The patent application is directed to a portable battery powered electronic device, including a battery, a microprocessor and a display screen, characterised in that it further includes an integral rechargeable battery-charging unit connected to the battery. The rechargeable battery unit is as described above for the Zapgo ref ZG001A series.
P47507TW	TW	105138419		Pending	
P47507US	USA	15/358,570	2017/0155265	Pending	
P47507WO	PCT	PCT/GB2016/053717	WO2017/089824	Pending	
P46819WO	PCT	PCT/GB2017/050632		Pending	
P46819TW	TW	106107582		Pending	
P46819US	USA	15/454058		Pending	
P46819GB	UK	1604056		Pending	The patent application is directed to a method of reducing outgassing in a supercapacitor comprised of carbon-containing electrodes and at least one ionic liquid by treating the carbon-containing electrodes with a tetrafluoroborate salt. Also directed to a supercapacitor comprised of carbon-containing anodes and cathodes, intermediate porous membranes and an ionic liquid electrolyte characterised in that the water content of the anode and cathode is less than 100 ppm water.
P46837WO	PCT	PCT/GB2017/050662		Pending	The patent application is directed to a supercapacitor assembly comprising a supercapacitor, electrical heater and thermostat. The supercapacitor contains a carbon containing electrode and an ionic liquid. The inventive concept is heating the ionic liquid such that its viscosity remains low.
P46837US	USA	15/454063		Pending	
P46837TW	TW	106107782		Pending	
P46837GB /	UK	1604133.7		Pending	

Source: ZapGo Ltd.

Figure 3 (cont.)
INTELLECTUAL PROPERTY

Reference #	Country	Application #	Publication/ Registration	Case Status	Description of subject matter claimed in application
P46846EP-PCT	EPO	10842694.1	2517219	Pending	The patent application is directed to a method for forming a portion of an energy storage device. The method comprises forming carbon nanotubes onto a metal substrate; removing amorphous carbon from the nanotubes; and coupling the nanotubes to an electrolytic separator. The application also contains claims directed to forming a capacitor by following this method.
P46846JP-D1-PCT	JP	2016-100781		Pending	
P46967US-01	USA	US2011-0157770	US8817452	Granted	
P46967US-01-C1	USA		2014/0349216	Pending	
P46737EP-PCT	EPO	12/973798	8817452	Pending	
P46737US-01	USA	14/208989	2014/0321027	Pending	The patent application is directed to a composite structure comprising a metal substrate coated with a metal oxide layer containing at least two different metals; and carbon nanotubes disposed on the surface of metal oxide layer.
P48843GB	GB	1702635.2		Pending - PCT filing in Feb 2018	The patent application is directed to a wearable device such as a smart watch with an integrated supercapacitor in the strap to power the watch direct or provide trickle charge to a battery.
P49067GB-01	GB	1707364.4		Pending	The patent application is directed to a self-supporting carbon electrode composition for use in lightweight supercapacitors. The application also contains claims directed to a method of forming the electrode.
P49066GB	GB	1708225.6		Pending	The patent application is directed to an energy storage device including a charge-storing supercapacitor cell, which is embedded in a flexible or rigid matrix.
P49262GB	GB	1706975.8		Pending	The patent application is directed to an electrical device containing a supercapacitor which is adapted to transmit a data stream to a remote location and receive instructions from the remote location based on an analysis of the data.
P49588GB	GB	1710562.8		Pending	The patent application is directed to a device suitable for harvesting triboelectric charge from aerodynamically-generated frictional forces acting on the outside of a moving vehicle. The device includes a supercapacitor, a first charge-collecting element, a second element, a voltage modification or impedance conversion circuit, and a controller.
P49586GB	GB	1710558.6		Pending	The patent application is directed to an electrical charging system which is capable of rapidly recharging a portable power source. The electrical charging system includes a portable power source including first supercapacitor and a docking station including a second supercapacitor, where the portable power source is charged by transference of electrical charge from the second to the first supercapacitor.

Source: ZapGo Ltd.

Leadership

Figure 4 summarizes the Company's executive leadership, including its management and Board of Directors, followed by biographies.

Figure 4

LEADERSHIP AND BOARD OF DIRECTORS

Stephen Voller C Eng	Founder & Chief Executive Officer, Board Member
Simon Harris MA	Investment & Marketing Director, Board Member
David McTurk	Chief Operating Officer, Board Member
Charles Resnick BSc MBA	President U.S. Operations, Board Member
Tim Walder	Chief Financial Officer, Board Member
Paul Blackmore C Eng	Chief Manufacturing Engineer
Dr. Edward G. Tiedemann, Jr.	Board Member
Dr. David Welch	Board Member

Source: ZapGo Ltd.

Stephen Voller C Eng, Founder & Chief Executive Officer, Board Member

Mr. Voller is an experienced business leader and a recognized authority on energy storage technologies. He is the inventor of Carbon-Ion™ and he founded Zap&Go Ltd in 2013 to produce the next generation of energy storage devices based on this technology platform with four core values: to be faster charging, safer, longer lasting, and more recyclable than lithium batteries. Mr. Voller has taken several technology businesses through concept, design, and then into production. He launched the first ever CE-marked hydrogen fuel cell product and was co-founder of the hydrogen storage company, Cella Energy. He previously ran a $1 billion business unit at IBM. He is a member of the Institute of Electrical and Electronic Engineers (IEEE).

Simon Harris MA, Investment & Marketing Director, Board Member

Mr. Harris joined the Board in April 2015 from corporate finance house Envestors, where he raised millions in equity, loans, and grants for high-tech companies. He is also leading Zap&Go's drive into China and the Asia-Pacific region. His former career was in international advertising with Saatchi & Saatchi.

David McTurk, Chief Operating Officer (COO), Board Member

An electronics engineer by training, Mr. McTurk has particular experience of high technology procurement and manufacture in North America and Asia Pacific. He was previously COO of optical processor company Bookham Technology (now Oclaro, Inc.), and has since held Board positions with both start-ups and LSE- and NASDAQ-quoted companies.

Charles Resnick BSc MBA, President, U.S. Operations, Board Member

Mr. Resnick has 30 years of global management experience in financial, technical, and consumer corporations. He was founder and Managing Partner of Inflexion, an early-stage VC fund, and has been involved in over 100 M&A deals. Under the Bush and Clinton administrations, he assisted the Presidents in negotiating with G-7 Finance Ministers.

Tim Walder, Chief Financial Officer (CFO), Board Member

An experienced CFO with an Electric Vehicle, National ID, and Secure Smart Card background, Mr. Walder has worked as managing director or finance director with innovative engineering and manufacturing businesses, helping to improve their productivity and performance. In addition to financial management, he leads on the specification, design, and build of Zap&Go's manufacturing facility at Harwell.

Paul Blackmore C Eng, Chief Manufacturing Engineer, Board Member

Mr. Blackmore is a recognized authority on energy storage technologies. He has built teams to research, develop, and manufacture energy storage devices in multinational defense companies, universities, and start-ups. Most recently, he designed and constructed the $20 million lithium-ion battery and supercapacitor pilot facility at WMG at the University of Warwick, which supports projects for customers such as Jaguar, Land Rover, and Nissan.

Dr. Edward G. Tiedemann, Jr., Board Member

Dr. Tiedemann is Sr. Vice President, Engineering of Qualcomm Technologies, Inc. and is Qualcomm Fellow. He has been with Qualcomm for over 28 years. Dr. Tiedemann was responsible for starting Qualcomm's involvement in standards and industry organizations, and leading that aspect of Qualcomm since its beginnings in the early 1990s. He holds many patents related to cellular communications technology. Previously, he was a Member of the Technical Staff of Massachusetts Institute of Technology (MIT) Lincoln Laboratory. Dr. Tiedemann holds a Ph.D. from MIT in Electrical Engineering and Computer Science. He sits on the Boards of the Open Connectivity Foundation and the Open Mobile Alliance. He is also on the Board of Overseers of the Peabody Essex Museum.

Dr. David Welch, Board Member

Dr. Welch co-founded Infinera in 2010 and has served as its president since June 2013. Previously, he served as chief technology officer (CTO) of the Transmission Division of JDS Uniphase Corporation, an optical component company and CTO and vice president of Corporate Development of SDL, an optical component company. He currently serves on the board of directors of AntriaBio, Inc., a biopharmaceutical company. Dr. Welch holds a B.S. in Electrical Engineering from the University of Delaware, and a Ph.D. in Electrical Engineering from Cornell University.

Core Story

ZapGo Ltd ("Zap&Go" or "the Company") is a British-based technology company that has developed a faster charging, environmentally friendly, and safer alternative to the lithium-ion (Li-ion) batteries used today in a range of products from mobile phones, laptop computers, cordless power tools, and electric cars. Currently, two energy storage devices dominate the rechargeable battery market: Li-ion batteries and supercapacitors. Li-ion batteries are used where high-energy and minimal weight are important, and power nearly every portable electronic device, as well as almost every electric car. However, Li-ion batteries and other rechargeable batteries have limitations. Lithium cells are damaged when charged at high speed rates and have no capability to discharge quickly; thus they take a long time to charge and are limited in terms of the amount of power they can deliver instantly. In addition, Li-ion batteries contain volatile and flammable chemical compounds that pose an environmental and safety risk, and begin to decay after as few as 500 charge/discharge cycles, which may result in a 25% reduction in effective storage capacity. Supercapacitors, on the other hand, can recharge instantly and can discharge quickly, but the amount of energy supercapacitors can store per unit weight is very small, particularly when compared to batteries. This drawback prevents current supercapacitors from replacing Li-ion batteries as the main energy storage device for many applications, including consumer devices. A full review of the different types of energy storage devices, including advantages, shortcomings, and applications, can be found in the accompanying section on pages 21-27.

Zap&Go's technology—Carbon-Ion™ (C-Ion®) cell—is a new type of energy storage device that combines nano-carbons and ionic electrolytes to provide higher energy densities that are more analogous to current Li-ion batteries, while recharging and delivering a charge much faster than Li-ion alternatives. In addition, C-Ion® cells eliminate the flammable chemical compounds that pose a safety risk and, unlike today's lithium batteries (which have a limited number of charge/discharge cycles), can sustain up to 100,000 charge/discharge cycles.

Rechargeable Battery's Technology Unmet Need

Instant or fast charging is a concept that Zap&Go believes can have a positive impact in a wide range of industries through changes in consumer behavior. Mobile phone users, for example, rely on their devices and are constantly aware of the state of charge of their phone. A survey conducted by LG found that nearly 9 out of 10 people suffer from the fear of losing power on their phone—a condition it named "Low Battery Anxiety"—with 32% of users indicating they would drop everything and head back home to charge their phone (Source: *Daily Mail*'s Do you have 'low battery anxiety'? May 2016).

Despite advances in battery technology, the problem seems to be getting worse. Data indicates that users of 4G phones were less satisfied with the battery life and performance of their devices than were users of 3G phones, apparently due to the increased power demand of the new smartphones (Source: *Systems Design Engineering Community*'s The Power Treadmill). Power consumption of smartphones has increased dramatically, almost doubling from 2009 to 2011, as shown in Figure 5. For perspective, a single Apple iPhone 5 has 2.7 times the processing power than the 1985 Cray-2 supercomputer. Considering that this data does not take into account some of the most recent smartphone models having even larger displays, better resolution, and larger apps, the energy gap between battery performance and battery requirements might be getting wider.

Figure 5

POWER CONSUMPTION OF SMARTPHONES

	2009	2011	% Change
Display	300 mW	900 mW	300%
Peripherals	400 mW	1,500 mW	275%
Processor	800 mW	1,620 mW	200%
Audio	300 mW	400 mW	30%
RF	1,200 mW	1,330 mW	11%
Total	**3,000 mW**	**5,750 mW**	**92%**

Sources: Microwave Journal, 2012; and Experts Exchnage's Processing Power Compared.

Similar issues can be encountered in other market segments. Cordless appliances, such as drills, are often only used for 15 minutes the entire time people own them. The so called trigger time, which is the time the motor turns to drill a hole, is very short, less than 10 seconds. Yet the current batteries can take 30-60 minutes to recharge. If the drill battery could be recharged in a few seconds, then it could change the way most people use these types of products. Battery technology improvement can also have a significant effect in the electric vehicle (EV) market, where market penetration and adoption of the technology is currently limited. Electric cars are quick and quiet, with a range more than long enough for most commutes, while avoiding the pollution associated with conventional cars. Yet they account for a tiny fraction of automotive sales, mainly because the batteries that propel them are expensive and need to be recharged frequently (Source: MIT Technology Review, 2015).

ZAP&GO'S CARBON-ION™ CELL

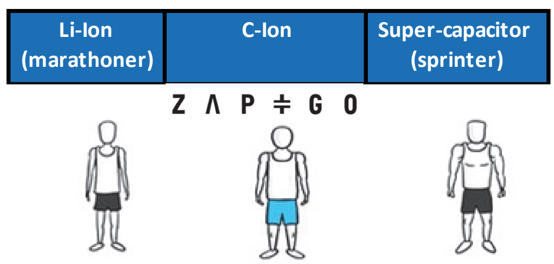
Li-ion batteries and supercapacitors, the most common rechargeable energy storage solutions used today, differ from each other in terms of the amount of energy that can be stored, the time it takes for storing and delivering energy, and the usable life of the devices. In general, devices such as batteries display high specific energy (the amount of energy a battery type can store) but poor specific power (the amount of power a battery can produce and a measure of how fast a battery can recharge and deliver energy). Alternatively, energy storage devices such as capacitors display high specific power but low specific energy.

Zap&Go's C-Ion® cell is a new category of energy storage device that maintains a supercapacitor's ability to provide rapid charging and long cycle life, while delivering energy densities that are more in line with current Li-ion batteries, but without any of the fire risk and safety concerns. While Li-ion's high energy densities allow them to provide energy over long periods of time, they can do so at slow charge/discharge speeds, akin to a marathoner running long distances, as illustrated in Figure 6. On the other hand, supercapacitors are built like sprinters, capable of providing bursts of energy at high charge/discharge speed, but depleting its energy storage rapidly. C-Ion® cells provide a unique combination of storage capacity and speed, resulting in the possible use of the Company's technology in a wide range of applications as an alternative to both Li-ion and supercapacitors.

Figure 6

RECHARGEABLE BATTERY COMPARISON

	Li-Ion	Super-capacitor	C-Ion
Energy Density	High	Low	Medium
Speed of charge	Slow	Fast	Fast
Cycle life	Thousands	Hundreds of Thousands	Hundreds of Thousands
Recycle	Difficult	Difficult	Easy



Source: ZapGo Ltd.

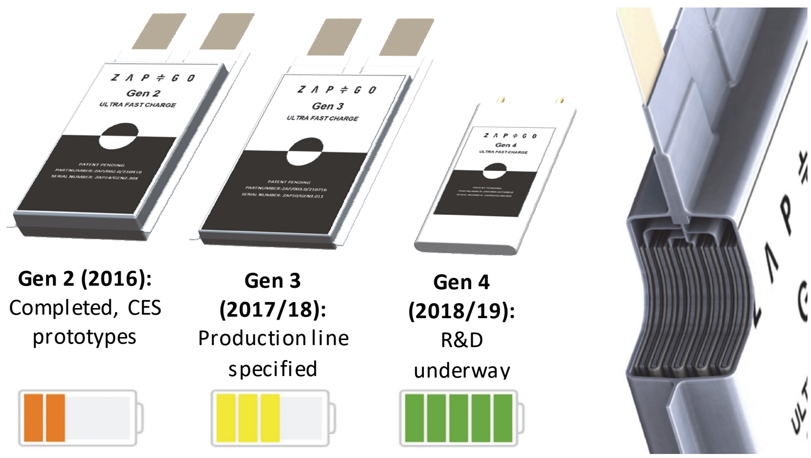
Zap&Go's technology is, in part, derived from Oxford University, and, in part, developed independently by the Company's own scientists. In 2013, Zap&Go began to conduct market research into advanced energy storage applications and in early 2014 licensed patents from the Materials Science group at Oxford University in advanced nano-carbon materials, specifically chemical vapor disposition (CVD) graphene. CVD produces very high quality graphene (a type of nano-carbon structure), significantly more conductive than copper, enabling Zap&Go to develop supercapacitor applications.

Zap&Go's C-Ion® cell technology is currently in its third generation (Gen 3), with the fast charging alternative to Li-ion batteries making its debut at the 2017 Consumer Electronics Show (CES 2017) in Las Vegas in January 2017. Having made it through the first two generations of product development (as described on pages 17-18), the Company believes that it has developed the next-generation supercapacitor with four technological advantages: (1) sub five-minute charging with slow discharge; (2) increased safety (less risk of fire or explosion); (3) greater charge/discharge cycles versus Li-ion; and (4) easier to recycle. The Company finished the proof-of-concept stage with a number of prototype demonstrators and expects to enter the production phase in early 2018.

Following a proof of concept stage (Gen 1), Zap&Go completed work on its Gen 2 products, the final pre-commercial version of the technology. Development of its Gen 3 technology is due for completion at the end of 2017 and is expected to store more energy and deliver more power, as illustrated in Figure 7. Gen 4 plans to bridge the gap between supercapacitors and Li-ion cells, addressing many of the limitations of both.

Figure 7

ZAP&GO TECHNOLOGY ROADMAP



Source: ZapGo Ltd.

Generation 1 (Gen 1)

The first generation of Zap&Go's C-Ion® cells were focused on testing and optimizing the present and future capabilities of different chemical formulations, as well as developing a defined roadmap to deliver high performance technology platforms for different key target markets.

As part of the initial development, Zap&Go was also able to modify the shape of its product from a cylindrical shape to a rectangular flat packet, or pouch. Figure 8 shows a comparison between Zap&Go's flat pouch cell format supercapacitor (on the left) and an industry standard 2.7V soda-can-sized supercapacitor (on the right). This change in form factor makes the Zap&Go supercapacitor eligible for a greater range of applications than what was possible with the old cylindrical shape, including smartphones, tablets, and other personal electronic devices.

Figure 8

FLAT CELL FORMAT

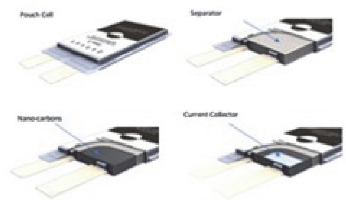
Source: ZapGo Ltd.

Generation 2 (Gen 2)

Early development also included studies to test the second generation of product stability in terms of both chemistry and manufacturing, resulting in stable pouch cells with a fast charge, but limited power delivery. Zap&Go's Gen 2 development was designed to be a springboard for developing Gen 3 products, with the goal of optimizing the pouch cell format, with production runs in the hundreds for product and manufacturing capability demonstration. The first applications of this product generation included a 5-minute charger, a cell for a Stanley Black & Decker 18v power drill, and a cell for the Razor® e-scooter, as shown in Figure 9 (page 18).

Figure 9

ZAP&GO GENERATION 2 PRODUCTS

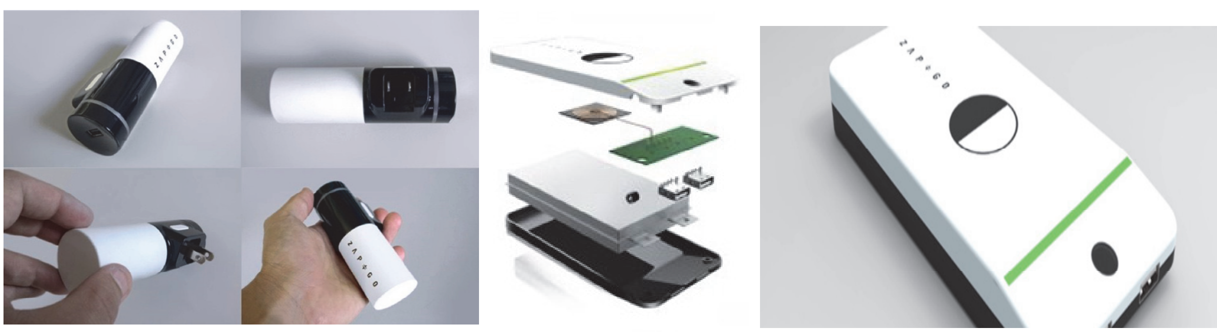
Zap&Go Charger	Cell for Power Drill	Razor e-scooter
		

Source: ZapGo Ltd.

The first consumer product developed by the Company was the Zap&Go 5-minute charger, a test-of-concept supercapacitor-based non-lithium external charger for smart phones and other electronics, shown in Figure 10. The graphene-enabled Zap&Go powerbank style phone charger is designed to accept and deliver a charge much faster than batteries, such that it can be completely charged from empty-to-full in less than five minutes. The Zap&Go Charger can then transfer that charge to a mobile device roughly at the same speed as a regular Li-ion battery recharger. The Zap&Go 5-minute charger development included the creation of a miniature circuit board that could be made in high volume and at low cost and could cope with the very high currents (Amperes) required for future product generations, as well as a power supply that was miniaturized and fully certified.

Figure 10

ZAP&GO CHARGER



Source: ZapGo Ltd.

Completing the first two generations of product development, the Company believes that it has achieved the next-generation supercapacitor with four technological advantages over alternative options:

(1) sub-five-minute fast charging with slow discharge;

(2) increased safety (less risk of ignition);

(3) dramatically greater charge/discharge cycles than Li-ion; and

(4) easier to recycle (environmentally friendly).

Gen 3 development—due for completion during 2017—optimizes materials science and Gen 4 utilizes nano-engineer technology to maximize efficiency, addressing many of the limitations of Li-ion cells and supercapacitors. A description of the Company's Gen 3 and Gen 4 development efforts is provided on pages 29-33.

MANUFACTURING AND LICENSING BUSINESS MODEL

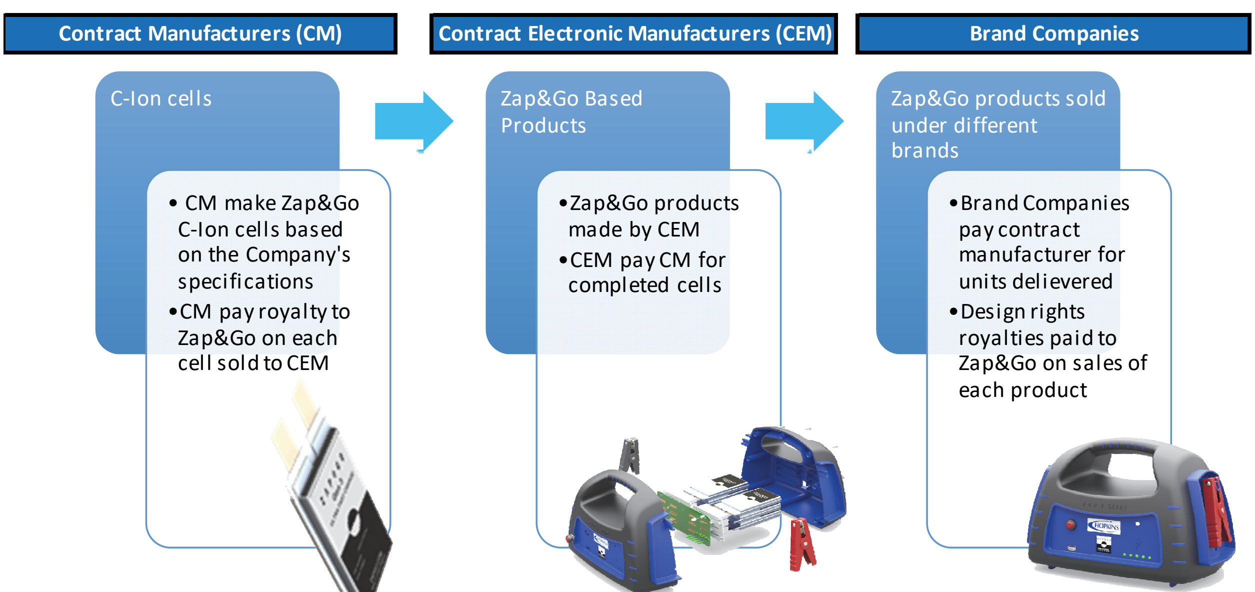
Zap&Go intends to keep manufacturing costs down by designing its C-Ion® cells in a way that enables the Company to use the existing supply chain and widely available battery grade materials. In addition, Zap&Go's C-Ion® cells can be manufactured using the existing standard battery production machinery and production lines used for Li-ion cells, thereby enabling high yield and quality levels without the need to design or install new production lines. The ability to use existing manufacturing lines enable Zap&Go to quickly scale-up production and to use manufacturing capacity already in existence in many locations, especially China, maintaining C-Ion® price points competitive with Li-ion technology and speeding time to market (TTM).

Zap&Go's business model for the commercialization of its C-Ion® technology is to partner with prominent manufacturers and brand-based companies across a spectrum of industry verticals—e.g. electric power tools, cordless cleaners, toys, mobile phones, transportation, and the military—who may incorporate the Company's technology directly into their products. The manufacturers then can commercialize and sell the products under their own names but with Zap&Go's technology as a key selling point—similar to the Intel Inside® initiative. The Company believes that this strategy not only shortens TTM, but also allows it to utilize the resources of its partners for the marketing and penetration efforts of its products. As such, Zap&Go has no plans to sell the C-Ion® cell technology directly to consumers.

Zap&Go has a licensing business model, depicted in Figure 11, similar to Qualcomm and has partnered with existing contract manufacturers (CMs) of Li-ion cells who manufacture the Company's C-Ion® cells on their current manufacturing lines. The cells are then sent to Contract Electronics Manufacturers (CEM's) or branded manufacturing companies—such as Flextronics International (a subsidiary of Flex ltd)—who build them into the finished products. Zap&Go receives a license fee for each C-Ion® cell used or sold. The first CM relationship is with Li-Fun Technology Co Ltd (Li-Fun Tech) in China, and the Company has an initial CM capacity of around one million C-Ion® cells per month.

Figure 11

ZAP&GO BUSINESS MODEL



Source: ZapGo Ltd.

Li-Fun Technology Agreement

The Company has recently announced that it plans to begin manufacturing their Gen 3 cells through a collaborative partnership agreement with Li-Fun Tech, a large-scale manufacturer of rechargeable Li-ion batteries. The Li-Fun Tech produced cells are anticipated to be used in electric scooters, cordless power tools, and automotive after-market products. The cells are to be configured into finished products by Flextronics International and other CEM's. These products powered by Zap&Go's C-Ion® cells are expected to be available in stores and online in early 2018. The Company expects to introduce further products as manufacturing capacity grows throughout 2018.

Energy Storage Devices

Electrical energy storage devices such as Li-ion batteries, supercapacitors, and C-Ion® cells differ from each other in terms of the amount of energy that can be stored, the time it would take for storing and delivering energy, and the usable life of the devices.

BATTERIES

Batteries serve as a mobile source of power, allowing electricity-operated devices to work without being directly plugged into a power outlet. While many types of batteries exist, the basic concept by which they function remains similar: one or more electrochemical cells convert stored chemical energy into electrical energy. Batteries have two electrical terminals (electrodes)—a positive terminal and a negative terminal—that are isolated by a separator and soaked in electrolyte designed to promote the movement of ions. The electrode that releases electrons during discharge is called the anode; the electrode that absorbs the electrons is the cathode.

When the power is switched, the battery produces electricity through a series of electrochemical reactions involving both the electrodes and the electrolyte. These reactions convert the chemicals inside the battery into other substances, releasing electrical energy as they go. The anode experiences an oxidation reaction, combining with ions from the electrolyte and producing electrons, while the cathode undergoes a reduction reaction, absorbing the electrons. The buildup of electrons on the cathode creates a voltage potential between the cathode and the anode, which is released in the form of electric current.

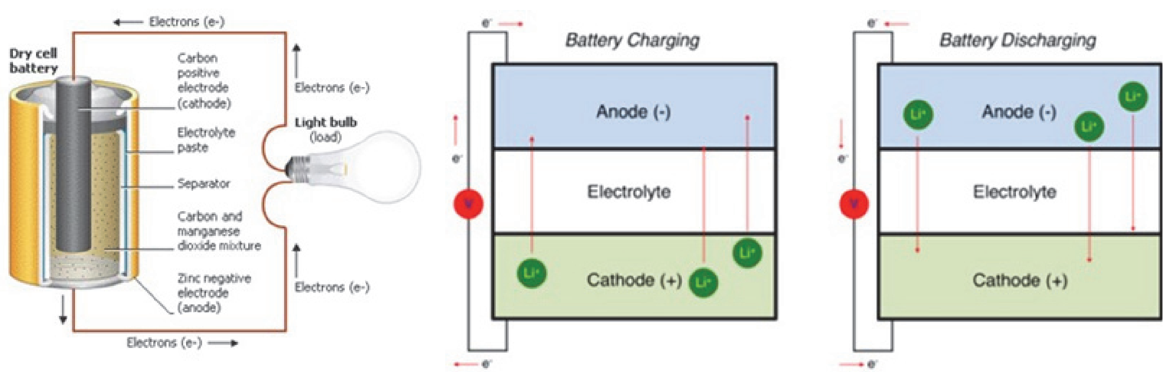
The battery will continue to produce electricity until it runs out of necessary substance to create the chemical reaction. Once the chemicals have all been depleted, the reactions stop and the battery is flat (dead). In a rechargeable battery, such as a Li-ion power pack, the reactions can run in either direction—allowing the possibility to charge and discharge the battery hundreds of times. As illustrated in the right side of Figure 12, during discharge, the energy-containing Li-ion travels from the anode to the cathode, through a separator. The movement of the lithium releases energy, which is extracted into an external circuit. When the battery is charged, energy is used to move the lithium ions back to the anode compound. However, the charge and discharge process in batteries is a slow process and can degrade the chemical compounds inside the battery over time. As a result, batteries have a low power density and lose their ability to retain energy throughout their lifetime due to material damage (Source: Berkeley Energy and Resources Collaborative).

Figure 12

BATTERY CONFIGURATION

DRY CELL BATTERY

CHARGING/DISCHARGING



Sources: North Carolina State Univeristy and Batterybro.com.

Battery Types and Characteristics

Different kinds of batteries have their own advantages and disadvantages. Improving one characteristic of a battery may not automatically strengthen the other; there is often a compromise. Two key measures that have a direct relationship on a battery type's applications are specific energy and specific power, as described below.

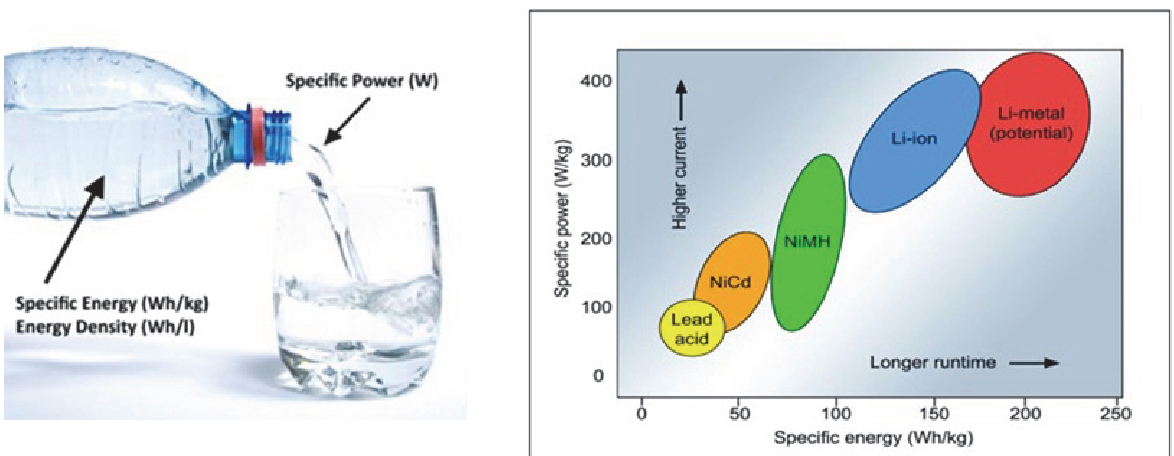
Specific Energy

Specific energy, or energy density, defines battery capacity in weight (Wh/kg). It is a measure of the amount of energy a battery type can store. Products requiring long runtimes at moderate load are optimized for high specific energy.

Specific Power

Specific power indicates loading capability and is a measure of how fast a battery can recharge and deliver energy. Batteries for power tools are made for high specific power and come with reduced specific energy (capacity). Figure 13 illustrates the relationship between specific energy and specific power. The water in the bottle represents specific energy (capacity); the spout pouring the water governs specific power (loading). For example, energy storage devices can have high specific energy but poor specific power, as is the case with the alkaline battery. Alternatively, they can have low specific energy but high specific power, as with the supercapacitor (Source: Battery University).

Figure 13
BATTERY COMPARISON



Source: Battery University.com.

Batteries are divided into two main types: primary and secondary. Primary batteries (disposable)—such as the alkaline battery used in toys, flashlights, and a multitude of portable devices—are used once and rendered useless as the electrode materials in them irreversibly change during use. High specific energy, long storage times, and instant readiness give primary batteries a unique advantage over other power sources. Alternatively, primary batteries normally display low specific power, limiting their use to light loads such as remote controls, flashlights, and portable entertainment devices (Source: Battery University).

Secondary batteries (rechargeable)—such as lead-acid batteries used in vehicles and Li-ion batteries used for portable electronics—can be discharged and recharged multiple times. The prevalent existing rechargeable battery technologies are lead acid, nickel-metal hydrides, and Li-ion batteries. The right side of Figure 13 provides a comparison between the different technologies.

- Lead-acid batteries are the oldest and most economical option. They are bulky and heavy, rugged, long lasting and low cost, displaying low specific energy and limited cycle count (Source: Battery Council International 2005). Lead-acid batteries play an important role in large power applications, where weight is not of the essence but price is. They are widely-used in hospital equipment, emergency lighting, wheelchairs, golf cars, personnel carriers, emergency lighting, and uninterruptible power supply (UPS).

- Nickel-Cadmium (NiCd) batteries are relatively low in energy density and are used where long life, high discharge rate, extreme temperatures, and enhanced safety is required. NiCd is one of the only combination of elements that produce ultra-fast charging with minimal stress, and its safety has made it a mainstay in aviation applications, as well as power tools and medical devices. However, NiCd batteries contain toxic metals and are environmentally harmful. As such, NiCd is being replaced with other chemistries, such as Nickel-Metal Hydride (NiMH) batteries, which has only mild toxic metals and provides higher specific energy. NiMH are smaller but also have a higher cost. In addition, NiMH batteries are prone to memory effect, which is a power-loss phenomenon by which a rechargeable battery begins to lose its charge the more it is used (Source: the *New York Times'* "Building Better Batteries for Electric Cars," March 30, 2011).

- Lithium-ion dominates the secondary battery space (as described in greater detail below). Li-ion batteries are used where high-energy and minimal weight are important. As such, they power nearly every portable electronic device, as well as almost every electric car. As illustrated in Figure 13 (page 22), Li-ion batteries provide the best performance and range in addition to being smaller in size, improving energy density by two to three times that of the NiMH battery. However, the technology is fragile and a protection circuit is required to assure safety. Li-ion is more expensive than most other batteries, but its high cycle count, no memory loss effect, and low maintenance reduce the cost per cycle over many other chemistries.

Lithium-ion (Li-ion) Batteries

Lithium-ion batteries are widely used in mobile phones, laptop computers, cordless appliances and power tools, electric vehicles, airplanes, and e-cigarettes—a combined market expected to reach $140 billion by 2026 (Source: Zap&Go Ltd and the University of Oxford's Rutherford Appleton Laboratory's *Carbon-Ion: a new, safer and faster charging category of rechargeable energy storage devices*, 2016).

Lithium provides the largest energy density for weight. Attempts to develop rechargeable lithium metal batteries, however, have failed due to safety problems. Because of the inherent instability of lithium, especially during charging, research has shifted to a non-metallic lithium battery using lithium ions. Lithium ion particles in the batteries move back and forth between a negative and positive electrode as they are charged and discharged (Source: Battery University.com). Although slightly lower in energy density than lithium metal, Li-ion batteries are lightweight and small. Lithium-ion is a low maintenance battery, can be charged and discharged repeatedly with minimal wear, and requires no scheduled cycling to prolong the battery's life. In addition, the self-discharge is less than half compared to NiCd, making Li-ion well suited for modern applications.

Despite its overall advantages, Li-ion has its drawbacks. To ensure that the Li-ion particles can move easily between electrodes, volatile and flammable chemical compounds are pressurized inside the battery cells. Used correctly they are perfectly safe; however, if charged incorrectly, Li-ion batteries can become volatile and even catch fire. The problem occurs when a battery is charged and recharged, because it generates heat. If that heat is not controlled properly, it can cause the compounds inside the battery to burst into flames or even explode. In addition, battery compounds can become unstable if something punctures the battery cell. Figure 14 (page 24) provides a list of key advantages and limitations of Li-ion batteries.

Figure 14

LITHIUM-ION BATTERY PROPERTIES

Advantages
High energy density - potential for even higher capacities
Relatively low self-discharge - self-discharge is less than half that of nickel-based batteries
Low Maintenance - no periodic discharge is needed
Specialty cells can provide very high current to applications such as power tools
Limitations
Requires protection circuit to maintain voltage and current within safe limits
Subject to aging, even if not in use - storage in a cool place at 40% charge reduces the aging effect
Transportation restrictions - shipment of larger quantities may be subject to regulatory control
Expensive to manufacture - about 40% higher in cost than nickel-cadmium

Source: Battery Univeristy.com.

Recent Issues with Lithium-ion Batteries

Having been prominently reported in the news relatively recently, Li-ion batteries have caught fire inside smartphones, laptop computers, electric cars, hoverboards, and airplanes, among other devices. Boeing's 787 Dreamliners were grounded in 2013 after a Li-ion battery caught fire in Boston. That same year, the batteries in Tesla's electric cars came under scrutiny after at least two fires. In 2016, the U.S. Transportation Department banned the use of battery-powered e-cigarettes on flights and their inclusion in checked baggage, while more than a half-million battery-powered hoverboards were recalled after at least 60 fires.

However, the highest profile Li-ion related safety issue was the Samsung Galaxy Note 7 product recall. During 2016, Samsung Electronics announced that it would recall 2.5 million Galaxy Note 7 smartphones after finding a flaw in the battery cell that resulted in fires, costing billions of dollars (Source: *New York Times*' Samsung's Recall: The Problem with Lithium-Ion Batteries, September 2016).

Lithium-Ion Batteries Shipping Restrictions

The shipping and transportation of Li-ion batteries in bulk is subject to the following transportation regulations, which cover domestic and international shipments by land, sea, and air:

- Lithium-ion cells whose equivalent lithium content exceeds 1.5 grams or 8 grams per battery pack must be shipped as "Class 9 miscellaneous hazardous material."
- For packs that contain less than 8 grams of lithium content, if a shipment contains more than 24 lithium cells or 12 Li-ion battery packs, special markings and shipping documents are required.
- All Li-ion batteries must be tested in accordance with specifications detailed in UN 3090 regardless of lithium content (UN manual of Tests and Criteria, Part III, subsection 38.3). This precaution safeguards against the shipment of flawed batteries.
- Cells and batteries must be separated to prevent short-circuiting and packaged in heavy duty boxes.

There are efforts underway to improve the performance of lithium batteries using different chemistries, such as lithium titanate, which improves the rate of charge, and solid state lithium batteries, which can improve energy density. But for every drawback that is addressed, there is another downside. For example, higher cost, lower voltage, temperature of operation, shorter lifetime of use, or the expansion and contraction of electrodes in the batteries during charging and discharging, all represent significant issues.

CAPACITORS AND SUPERCAPACITORS

Capacitors are devices used for storing and delivering electrical energy. Capacitors use static electricity (electrostatics) to store energy rather than chemical reactions, which are used by batteries. Inside a capacitor, there are two conducting metallic plates with an insulating material between them, called a **dielectric**. The dielectric is normally made from materials such as mica (a ceramic), a thin plastic film, or even air (in capacitors that act as the tuning dial inside a radio). When the capacitor is charged, positive charges form on one plate and negative charges on the other. The insulator disturbs the natural pull of the negative charge towards the positive, preventing the charges from coming in contact and creating an electric field between them and storing the energy. Once electrons are given a path to the other side, discharge occurs (Source: Graphene-Info).

Since charging a capacitor does not require a chemical reaction, a typical capacitor charges instantly and can discharge quickly but usually cannot hold a great deal of charge. However, supercapacitors (also known as ultra-capacitors, electrochemical capacitors, or electrical double layer capacitors [EDLCs]) can partially overcome this shortcoming.

Supercapacitors

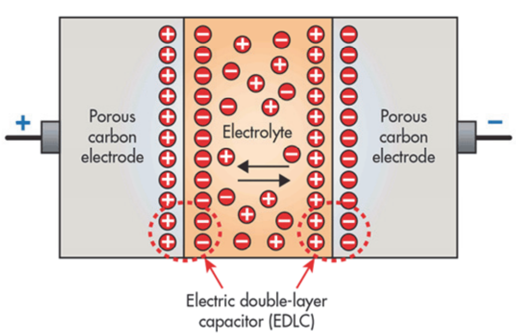
Supercapacitors have attracted considerable attention due to their high power density, high charge/discharge rates, and long cycle life. They are considered as one of the most promising electrochemical energy storage devices, having the potential to complement or eventually replace batteries for energy storage applications (Source: *Journal of Materiomics*, Vol. 2 (1): 37-54, March 2016).

Supercapacitors differ from the typical capacitor in three key areas: (1) the plates that supercapacitors use provide significantly larger surface area; (2) the distance between the plates is much smaller; and (3) the separator between the plates works differently than a conventional dielectric.

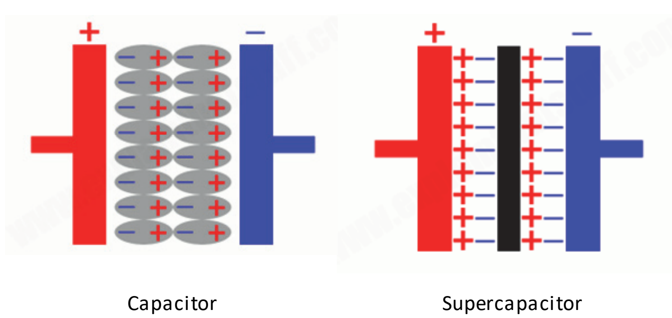
Similar to an ordinary capacitor, a supercapacitor has two plates that are separated. The plates are made from metal coated with a porous substance, such as activated charcoal, which effectively gives them a bigger surface area for storing much more charge. The metal porous coated surface allows the plates to act as a sponge, allowing them to retain more energy than normal plates of the same size. In addition, instead of having a dielectric material between them, the plates of a supercapacitor are soaked in an electrolyte made of positive and negative ions dissolved in a solvent and separated by an extremely thin insulator (which may be made of carbon, paper, or plastic), as shown in Figure 15.

Figure 15
SUPERCAPACITORS

Supercapacitors



Capacitors vs Supercapacitor Comparison



Sources: electronicdesign.com (In Tech) and explainthatstuff.com.

Similar to capacitors, when a supercapacitor is charged, energy is stored at the surface of the electrodes through the accumulation of charges. The ions from the electrolyte migrate to the electrodes and accumulate on the surface of each carbon-coated plate. In addition, supercapacitors store energy in an electric field that is formed between two oppositely charged particles. When the plates are charged up, an opposite charge forms on either side of the separator, creating an “electric double-layer,” resembling two ordinary capacitors side by side. This is why supercapacitors are often referred to as electric double-layer capacitors (EDLCs), providing supercapacitors the ability to store much more charge than ordinary capacitors.

Advantages and Shortcomings of Supercapacitors

Two key advantages of supercapacitors over batteries are (1) their ability to charge in seconds and (2) their long life. Furthermore, supercapacitors weigh less, generally do not contain harmful chemicals or toxic metals, and can operate in a wide range of temperatures, delivering energy in temperatures as low as –40°C. Supercapacitors’ ability to store energy without the need for chemical reactions enables them to charge and discharge much faster than batteries, leading to very high power density and high load current—delivering electrical energy much faster than batteries. In addition, a supercapacitor does not suffer the same wear and tear as a chemical reaction-based battery. Because of this, they maintain a long cycle life—they can be cycled hundreds of thousands of times with minimal change in performance and do not lose their storage capabilities over time (Source: Electronicdesign.com).

Alternatively, the main shortcoming of supercapacitors is their low energy density, where the amount of energy supercapacitors can store per unit weight is very small, particularly when compared to batteries. Supercapacitors boast a high energy storage capacity compared to regular capacitors, though still lag behind batteries. Technically, it is possible to replace the battery of a cell phone with a supercapacitor, and while it will charge much faster, it will not keep a charge for long. By contrast, Li-ion charge slowly but have higher energy densities (Source: Graphene-Info).

Supercapacitors are also typically costlier per unit than batteries. The cost of supercapacitor materials often exceeds the cost of battery materials due to the increased difficulty in creating high-performing supercapacitor materials, such as graphene (Source: Berkeley Energy and Resources Collaborative). Figure 16 compares key performance metrics between supercapacitors and Li-ion batteries.

Figure 16

SUPERCAPACITOR AND LITHIUM ION BATTERY COMPARISON

Function	Supercapacitor	Lithium-ion (general)
Charge time	1–10 seconds	10–60 minutes
Cycle life	1 million or 30,000h	500 and higher
Specific energy (Wh/kg)	5 (typical)	120–240
Specific power (W/kg)	Up to 10,000	1,000–3,000
Cost per kWh	$10,000 (typical)	$250–$1,000 (large system)
Service life (industrial)	10-15 years	5 to 10 years

Source: Battery University.

Supercapacitor Applications

Supercapacitors are used in many power-management applications that require rapid charge/discharge cycles for short-term power needs. Figure 17 list some of the most common applications used for supercapacitors.

Figure 17
SUPERCAPACITOR APPLICATIONS

• Voltage stabilization in start/stop systems	• Electronic door locks in the event of power failures
• Regenerative braking systems	• Distribution microgrid
• Medical devices	• Energy harvesting
• Consumer electronics	• Kitchen appliances
• Real-time clock backup	• Utility meters
• Backup power	• Grid stability
• Wind energy	• Energy efficiency and frequency regulation
• Remote power for sensors, LEDs, switches	• Memory-backup SRAM
• Burst-mode power delivery	• Forklift hybridization

Source: Electronicdesign.com.

The global supercapacitor market, valued at $1.2 billion in 2014, is anticipated to grow at a CAGR of 22.3% to reach $7.4 billion by 2023. The primary growth driver for the global supercapacitor market is the ongoing green revolution intended to reduce the usage of fossil fuels due to the hazardous impact of rising carbon emissions, and the accompanying stance of many governments to bring down carbon dioxide (CO_2) emissions by encouraging sustainable energy consumption (Source: Transparency Market Research Supercapacitor Market's *Global Industry Analysis, Trend, Size, Share and Forecast 2015 – 2023*, April 2016).

Double layer capacitor is the major contributor to this market, holding the largest share and is expected to continue to exhibit high growth. Its applications vary from portable electronics and medical devices to hefty hybrid and other transportation uses, with the automotive vertical expected to grow at the highest rate (Source: Markets and Markets' *Supercapacitor Market by Type (Double Layer, Pseudocapacitor, and Hybrid), Application (Laptop, Camera, Power Backup, Memory, UPS, Aircraft, Solid-State Disc Drives) Vertical, and Geography - Global Forecast to 2022*, November 2016).

A key factor for the use of supercapacitors in the automotive industry is the ability of supercapacitors to deliver a sudden surge of energy and fast recharging times. Primary energy sources, such as internal combustion engines, fuel cells, and batteries work well as a continuous source of low power. However, these energy sources cannot efficiently handle peak power demands or recapture energy because of their slow discharge and recharge times. For example, supercapacitors are able to act as a compliment to the primary energy source of electric cars, delivering quick bursts of energy during peak power demands (such as providing needed power for acceleration), with the main battery providing range and recharging the supercapacitor between surges.

Additional uses for supercapacitors in the automotive, transportation, and energy markets include: (1) harvesting of power from **regenerative braking** systems and releasing of power to help hybrid buses accelerate; (2) providing cranking power and voltage stabilization in start/stop systems; (3) assisting in train acceleration; (4) opening of aircraft doors in the event of power failures; (5) capturing energy and providing burst power to assist in lifting operations; (6) providing energy to data centers between power failures and initiating backup power systems; and (7) providing energy storage for firming the output of renewable energy installations and increasing grid stability (Source: Graphene-Info).

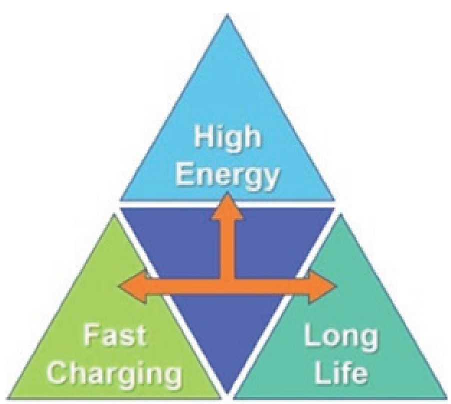
Zap&Go's Carbon-Ion™ Cells

Zap&Go's technology—Carbon-Ion™ (C-Ion®) cell—is a new category of energy storage device that combines a patented nano-technology for its base carbon as well as proprietary ionic electrolytes to provide higher energy densities. C-Ion® cells work in a similar way to regular supercapacitors, maintaining the ability to provide the rapid charging and long cycle life of supercapacitors, but use different carbon and electrolyte materials that enable the devices to operate at higher voltages but without any of the safety concerns of Li-ion batteries.

Limitations of current supercapacitors, batteries, and other energy storage devices are reflected in the energy storage "trilemma," depicted in Figure 18. There are three key properties that provide the functionality of energy storage devices: (1) high energy (specific energy) refers to the energy capacity of the device; (2) fast charging refers to the specific power and charge/discharge speed; and (3) long life refers to the ability of an energy storage device to hold its storage capabilities over the course of multiple charge/discharge cycles. Energy storage devices have normally been able to achieve any two of these goals but not all three.

Figure 18

ENERGY STORAGE TRILEMMA



Source: IDTechEx.

In general, devices with high specific energy display poor specific power, such as batteries, while those with high specific power display low specific energy, such as supercapacitor. In addition, improvement in any of these areas might come at the expense of battery life, cost, or other factors that can limit the device's applications.

Recent advances in new supercapacitor materials and production methods may soon bridge the energy density gap for some commercial applications (Source: Berkeley Energy and Resources Collaborative). The ability to increase the energy a supercapacitor is able to store can be improved by either increasing the surface area of the metallic plates and/or by using a better electrolyte material. In terms of the plates, the capacitance of a supercapacitor increases as the surface area of the plates increases and as the distance between the plates decreases (because it improves the effectiveness of the double layer).

Different materials, such as various carbon materials, mixed-metal oxides, and conducting polymers, have been used for supercapacitor electrodes. Regular carbon-based supercapacitors can provide high electrical power but do not have sufficient energy density to directly compete with batteries. In order to increase the surface area to provide an energy density that can compete directly with batteries, researchers are exploring the use of graphene. The use of graphene can result in high charge and discharge rates with better affordability, and may lead to improved performance that eliminates the conventional line of distinction between supercapacitors and batteries (Source: Graphene-Info).

GRAPHENE SUPERCAPACITORS

Graphene is a thin layer of carbon atoms arranged in the form of a two-dimensional, atomic-scale, hexagonal honeycomb lattice, depicted in Figure 19 (page 29). Graphene is the thinnest compound known, at one atom thick, but yet is incredibly strong (about 200 times stronger than steel). In addition, graphene is an excellent conductor of heat and electricity. Graphene is also an extremely diverse material that can be combined with other elements (including gases and metals) to produce different materials with various superior properties. Moreover, it is considered ecologically friendly and sustainable as carbon is widespread in nature and part of the human body.

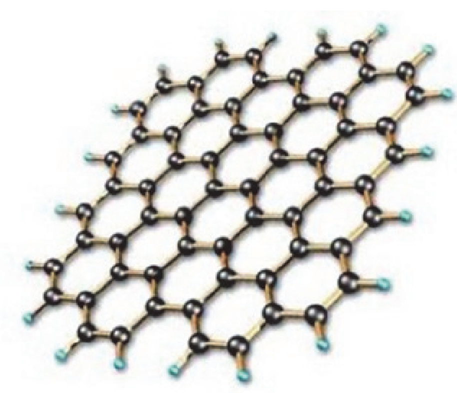
Graphene-based materials are promising for applications in supercapacitors and other energy storage devices due to these four key attributes: (1) highly tunable surface area; (2) outstanding electrical conductivity; (3) good chemical stability; and (4) excellent mechanical behavior (Source: *Journal of Materiomics*, Vol. 2 (1): 37-54, 2016).

Commercial Graphene-enhanced Capacitors

Graphene is essentially a form of carbon. Its surface area is greater than activated carbon, a commonly used material for the constructions of the supercapacitor's metal plates. One of the limitations to the amount of energy a supercapacitors can store is the surface area of the electrodes. If a material in a supercapacitor has a higher relative surface area versus another, it will be better at storing electrostatic charge. In addition, graphene is made of one single atomic layer, resulting in a material that is lighter. As well, since graphene is a form of carbon, it is ecologically friendly. Due to the lightweight dimensions of graphene-based supercapacitors and the minimal cost of production, coupled with graphene's elastic properties and mechanical strength, graphene-based supercapacitors may eventually be utilized in a number of different applications. To achieve this, research efforts must continue to increase the current energy storage limits for supercapacitors (Sources: Graphene-info and Graphenea Inc.).

Figure 19

GRAPHENE



Source: Graphene-Info.

The efficiency of the supercapacitor is important. Though some carbon materials have been made to exhibit a high capacitance in theory, they are not able to translate those gains into real-world applications. For example, graphene supercapacitors exhibit a theoretical capacitance of 550 F/g but only have been able to reach 300 F/g when used in real-life applications (Source: *ARS Technica's* Beating graphene to push supercapacitors closer to batteries, December 2015). Thus, while graphene-based supercapacitors are currently a viable solution, further research is needed to fully benefit from the carbon-based materials' theoretical limits in order to bridge the capacitance gap between supercapacitors and Li-ion batteries.

ZAP&GO'S CARBON-ION™ CELLS

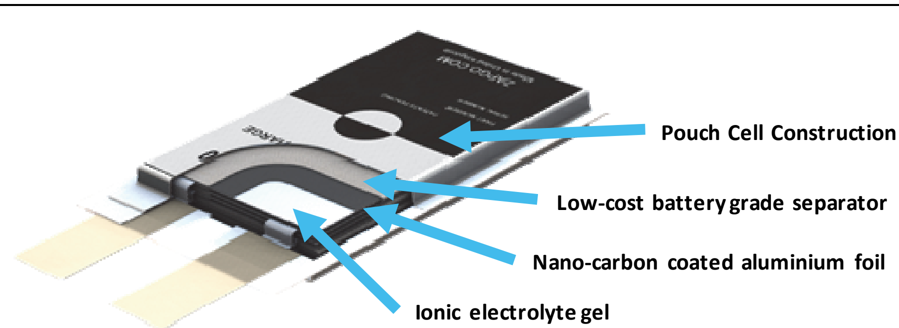
Zap&Go's C-Ion® cells combine advanced nano-structured carbons, new ionic electrolytes, and improved fabrication techniques for improved energy density. According to Zap&Go, this combination offers the potential to increase energy density and bring it closer to that of Li-ion batteries, while retaining the rapid charging capabilities, long life, and safety features of commercially available supercapacitors (i.e. the ability to work safely at higher voltages with no fire risk).

Generation 3 (Gen 3) Development

Zap&Go's Gen 3 development aims to optimize the performance of the materials within the C-Ion® cell. The Company's Gen 3 technology construction is based on a conventional superconductor architecture, as seen in Figure 20. Active materials are layered onto conducting foils and placed opposite each other in an electrolyte to form a number of cells, which are then packaged into a pouch.

Figure 20

ZAP&GO CARBON-ION CELL



Source: ZapGo Ltd.

However, during its Gen 3 development efforts, the Company has focused on optimizing the properties of the materials used to construct the energy storage cell in order to maximize its performance. These improvements included the use of new materials for the construction of the electrodes, the optimization of the structure and morphology of the electrode materials, and the use of an ionic solution as the electrolyte.

C-Ion® Electrode Construction

According to Zap&Go, the energy densities of commercial supercapacitors are below 10Wh/Kg as these cells are constructed using activated carbon and organic electrolytes. However, recent advances in producing a range of nano-structured carbons and non-flammable ionic liquid-based electrolytes have significantly enhanced the performance of supercapacitors. The amount of energy that can be stored in a supercapacitor is determined by the following factors:

(1) the surface area of the electrodes, in particular the electrode/electrolyte interfacial area;

(2) the concentration and size of the ions in the electrolyte; and

(3) the operating voltage, which depends on the electrochemical stability of the electrolyte.

Electrode Surface Area

Supercapacitors normally use activated carbon as the material for the electrodes. Activated carbon electrodes have relatively large surface areas and inter-connected pore-structure. However, since this material is made from roasted coconut or a similar feedstock (naturally occurring materials), there is limited control over the size or shape of the pores which make up that surface area, or the characteristics of the surface itself. The pore structure of activated carbon is directly related to its energy storage capabilities. Activated carbon normally has three types of pores: macropores (>50nm); mesopores (2-50nm); and micropores (<2nm). The micropores are important for electrical double layer formation and hence for energy storage, but the presence of large diameter macropores and mesopores tend to reduce the electrode/electrolyte interface and the specific capacitance of the electrodes. In addition, activated carbon is blended with a conducting carbon and binders to produce a coating, which further reduces the active surface to some extent.

C-Ion® cells work in a very similar way to supercapacitors but use different carbon and electrolyte materials that are not only safer but easier to recycle at the end of life. They also enable the devices to operate at higher voltages, which result in higher energy densities. The specific capacitance of C-Ion® cells can be increased by using nano-carbons with an optimum surface area and pore-structure.

Different types of nano-carbons in the form of powders, microspheres, fibers, foils, and monoliths are commercially available. The physical and chemical properties of synthetic and nano-structured carbon materials, such as graphene, single walled carbon nanotubes (SWCNT), multi-walled carbon nanotubes (MWCNT), and fullerene are of interest as these materials have a large surface area and unique nano-structures. In recent years, there has been progress in closing the gap between graphene's theoretical capacitance of 550F/g and real life application level by developing new manufacturing techniques. One example is the ability to stack layers of graphene, which involves producing non-stacking 3D-graphene, making curved graphene platelets, and using spacers (such as carbon nano-tubes).

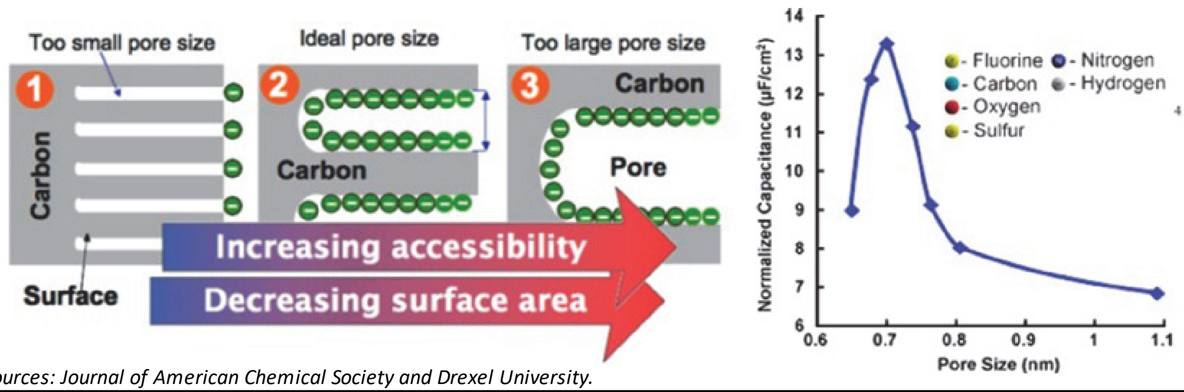
Zap&Go believes that the ever-increasing availability and lower cost of advance carbons, such as nanotubes and graphene, provide opportunities to boost energy storage and power density in an economical manner. Gen 3 development incorporates both carbon nanotubes and graphene in order to boost conductivity in electrodes, with no loss of energy storage capacity and increased voltage stability.

Electrode Pore Size

The traditional supercapacitor design relies on the transport of charge carriers and ions for the storage and release of energy. Thus, the thickness of the electrode and the separator, as well as the pore size of the electrode's material, are key elements in the optimization of a capacitor's ability to store and discharge electricity. For example, an ion in one of the electrodes located close to the current collector must migrate through the entire electrode and separator material to reach the other electrode to form the electrical double layer. However, as shown in Figure 21, a balance must be reached between increasing accessibility and ease of travel (by increasing pore size) and increasing surface area (by decreasing pore size), in order to maximize the amount of energy the device can store.

Figure 21

CAPACITANCE AND PORE SIZE RELATIONSHIP



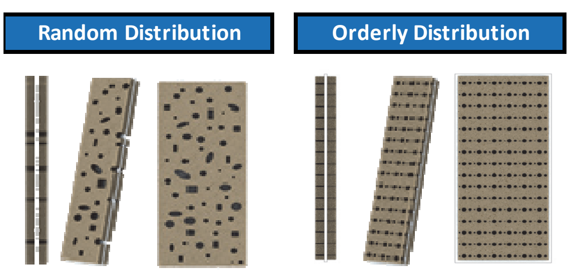
Sources: Journal of American Chemical Society and Drexel University.

The ability to control the size of the pores is important since the specific capacitance of C-Ion® cells can be increased by using nano-carbons with an optimum surface area and pore-structure. In particular, matching the pore-size of nano-carbon to the ion size has been shown to result in an increased capacitance of the device, as depicted in the right side of Figure 21. Studies have shown that engineering nano-carbon with a pore size roughly equal to the ion size (~0.7 nm) of a derived carbon electrode in a solvent-free ionic liquid resulted in maximum capacitance of 160F/g, while standard activated carbons with larger pores and a broader pore size distribution present capacitance values lower than 100 F/g. A significant drop in capacitance was observed in pores that were larger or smaller than the ion size by just an **angstrom**, suggesting that the pore size must be tuned with sub-angstrom accuracy when selecting a carbon/ion couple (Source: *Journal of the American Chemical Society*, Vol. 130(9):2730-2731, 2008).

In addition to optimizing pore size, Zap&Go is partnering with experts in carbon technology to design porous networks which match the characteristics of the electrolyte, as seen in Figure 22. By changing the feedstock and/or tailoring the activation process, materials can be made which provide a more efficient energy storage and electrolyte transport process, resulting in higher energy and power densities as well as improved voltage stability. The Company's development process achieves greater control of the activation process using unconventional atmospheres (pressure) and temperature programs and then applies them to synthetic, polymeric feedstocks.

Figure 22

PORE DISTRIBUTION



Source: ZapGo Ltd.

C-Ion® Electrolyte

Another limitation of conventional supercapacitor technologies is voltage stability. The energy density of a supercapacitor and C-Ion® cell can be improved by increasing the operating voltage. This relationship is given by the formula $E = ½ CV^2$, where "E" is the energy stored (Joules), "C" is the capacitance (F) and "V" is the operating voltage (V). The aqueous and organic electrolytes are stable up to ~1.2V and 3.0V respectively, and the lower operating voltage limits the amount of energy that can be stored in a supercapacitor.

Figure 23
ELECTROCHEMICAL WINDOWS

Ionic Liquid	Electrochemical Window (V)
EMIM BF4 - EMIM TFSI	4.6-4.7
PrMIM TFSI	4.7
$Bu_3NMeTFSI$	6
$BuNMe_3$	5.3
BuMePylTFSI	5.7
PrMePiTFSI	5.7
DEME BF4	6
DEME TFSI	6

Sources: ZapGo Ltd and the University of Oxford's Rutherford Appleton Laboratory.

Progress has been reported in improving the energy density by using nano-carbons and ionic liquids for devices operating at 3.5V and beyond. Ionic liquids are a new class of electrolytes, which are stable at higher operating voltages beyond 3.0V. Some ionic liquids exhibit wide electrochemical stability and these are potential electrolytes to increase energy density of a C-Ion® cell.

However, ionic liquids with a large electrochemical window tend to be several times more **viscous** compared to organic electrolytes. As a result, the conductivity of an ionic liquid-based electrolyte is often low, which contributes to higher internal resistance in the cell as well as a compromise in power characteristics. Due to this limitation, during a heavy power demand, the cell or a stack of cells can struggle to deliver huge power in a quick spurt of a few seconds. Thus, only ionic liquids with wider electrochemical stability, sufficient conductivity, and lower viscosity can be successfully used as electrolytes in C-Ion® cells.

The physical and chemical properties of ionic liquids depend on the nature of **cation**, **anion**, and the functional groups attached to these ions. Selected ion liquid electrolytes show electrochemical stabilities up to 6V (as shown in Figure 23), and it is possible to tune the stability window by changing the cation-anion combinations. For the ionic liquids that are used as electrolytes, the conductivity values range from 1.0mS/cm to 10mS/cm. In order to reduce the viscosity issue, physical properties such as viscosity, conductivity, and melting point can be varied by combining two or more ionic liquids (Source: Zap&Go Ltd and the University of Oxford's Rutherford Appleton Laboratory's *Carbon-Ion: a new, safer and faster charging category of rechargeable energy storage devices,* 2016).

Generation 4 (Gen 4) Development

According to Zap&Go, while Gen 3 started with a conventional supercapacitor infrastructure and improved performance through the selection of better materials and manufacturing processes, Gen 4 development focuses on the nano-engineering of materials, doing away with conventional thinking in pursuit of improved performance. The Company believes that this approach can result in a C-Ion® cell with increased energy density, long service life, and high levels of safety. Zap&Go has active collaborations with universities and research institutions to adopt novel manufacturing methods which can lead to high conductivity and improved energy storage.

Gen 4 focuses on three key improvements:

- Removing passive components: components of cells which only carry current take up space and add weight. The Company plans to remove passive components or replace them with components that could also store energy in addition to their normal function.
- Minimizing electrolyte material: only a very thin film of electrolyte is needed for energy storage; the rest acts as a resistor and impedes current. The Company plans to use the minimum quantity of electrolyte material necessary.
- Optimizing use of space: conventional electrodes contain unused pore volume. The Company plans to place one electrode inside another to maximize the use of space.

To remove passive components, Gen 4 is expected to replace aluminum foils with carbon-based current collectors, resulting in roughly 40% extra energy density. In March 2017, the Company announced that it had successfully demonstrated its aluminum-free Gen 4 style C-Ion® cell, incorporating its non-metallic electrodes (as shown in Figure 24). In addition, the use of carbon nanotubes and graphene current collection also provided additional energy storage capacity, boosting energy density still further. Furthermore, additive manufacturing is also able to be used to build structures with defined pore networks and reduce inactive areas of carbon, while also minimizing the quantity of electrolyte needed.

Figure 24

ZAP&GO ELECTRODES

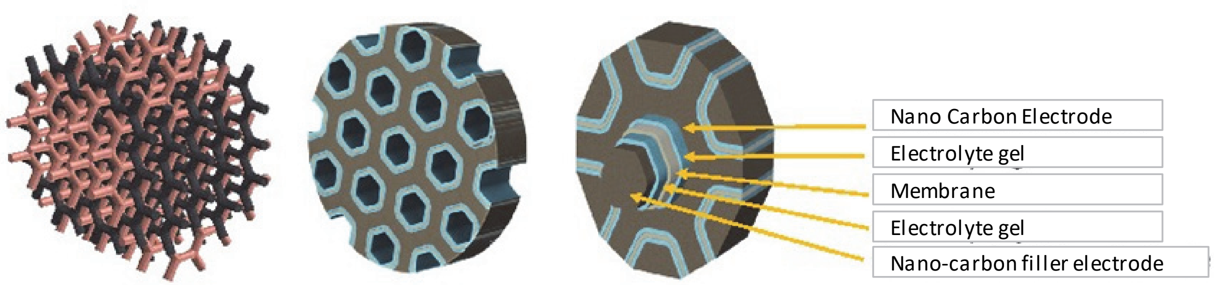
Source: ZapGo Ltd.

To minimize the electrolyte, gelation or polymerization is used. Gel or polymer electrolytes allow for a uniform coating of 3-dimensional structures, reducing the need for separator membranes and decreasing the gap needed between electrodes to prevent short circuits. According to the Company, these improvements increase the efficiency of charge transfer and give a boost to both energy storage and power density.

Polymer electrolytes not only improve stability and reduce the effects of solvent systems, improving electrolyte conductivity, but also enable the electrolyte to be specifically positioned in order to make the best use of space. The volume of cells (and thus the volumetric capacity) can be greatly reduced by moving away from a planar cell construction, embedding one electrode in gaps in the other with a thin layer of electrolyte in-between, as illustrated in Figure 25. This engineering solution (described as interdigitation), when applied at the nanoscale, can be used to greatly increase performance.

Figure 25

GRAPHIC REPRESENTATION OF GEN 4 ARCHITECTURE



Source: ZapGo Ltd.

C-Ion® Cell Capabilities

By using more highly porous nano-carbons instead of activated carbon, and higher voltage ionic electrolytes instead of organic electrolytes, Zap&Go has been able to construct C-Ion® cells capable of delivering 30% to 80% of the energy density of Li-ion batteries. As seen in Figure 26 (page 34), despite the increase of capacitance, C-Ion® cells were still able to deliver the fast charge and discharge normally associated with supercapacitors. In addition, the non-flammable ionic-based electrolyte gives C-Ion® cells an improved safety profile versus Li-ion batteries, and make it safer and easier to recycle at the end of their life cycle.

As a result of Zap&Go's use of its patented nano-technology for its base carbon as well as a proprietary electrolyte, the Company's C-Ion® cell operates today at higher voltage (3.4V versus 2.7V) than existing competitors with a target of 6V. Once the 6V target is achieved, the Company's product is projected to be the size and approximate power density of existing Li-ion batteries, which would expand its applications to markets such as mobile phones and personal electronics.

Figure 26

PERFORMANCE COMPARISON OF SELECT ENERGY STORAGE DEVICES

	Lithium-ion (Li-ion)	Supercapacitor (EDLC)	Nickel Metal Hydride (NiMH)	Carbon-ion™
Energy Density	150-250 Wh/kg	5-10 Wh/kg	60-120 Wh/kg	**30-130 Wh/kg**
Charging	Hours	Seconds	Hours	**Seconds**
Discharge rate	Slow	Fast	Slow	**Fast**
Cycle life	Low - 1,000	High - 100,000	Low - 1,000	**High - 100,000**
Safety	Flammable	Non-flammable	Flammable	**Non-flammable**
Recycle	Poor	Poor	Poor	**Good**
Voltage	3.6V – 4.2V	2.7V – 3.0V	1.2V	**3V – 6V**
Operating Temperature	-10°C to 60°C	-20°C to 60°C	-20°C to 65°C	**-40°C to 80°C**

Sources: ZapGo Ltd and the University of Oxford's Rutherford Appleton Laboratory.

This means that C-Ion® can be used either on its own or in combination with Li-ion batteries for a range of applications, such as cordless power tools or appliances (that charge in minutes); mobile phones or laptop computers (where the charge time could be reduced from hours to minutes); infrastructure energy storage, such as building emergency lights or solar panels (where the long lifetime of C-Ion® means there is no requirement to replace them every few years); and electric vehicles.

Zap&Go's C-Ion® cell will bring benefits over existing technologies to two types of users:

- Users of Li-ion batteries in applications where speed of charge/discharge, ease of transport, safety, and cycle life are key requirements.
    - Panasonic published specific power characteristics for their Li-ion technology of around 300 W/kg. The C-Ion® cell can provide specific power characteristics between one and two orders of magnitude higher.
    - The cell is made from materials which are inherently safe, with none of the flammable components present in Li-ion cells.
    - The Company's C-Ion® cell is designed to be classified as non-hazardous for transport, allowing the product to be shipped easily and to comply with both current and likely future regulations.
    - Due to the method of energy storage, the cell has fewer moving parts electrochemically and accordingly can withstand from tens to hundreds of thousands of charge/discharge cycles, unlike the one or two thousand cycles available with conventional Li-ion cells.
- Users of conventional supercapacitors where energy density and safety are key requirements.
    - Future generations of the Company's cells are designed to store more than 65 Wh/l and 50 Wh/kg, more than tripling storage capacity of present-day industry leading supercapacitor products.
    - The electrolyte used in the cell is non-flammable and chemically safer than the acetonitrile (also known as methyl cyanide) solvent used in many competitor products.

Transportation Advantages

Because of the non-flammable nature of its ionic liquid electrolytes, C-Ion® cells—and thus any finished product that contains Zap&Go technology—can be shipped by air freight without any special conditions. In view of the global concern about the safety of lithium battery transportation, many countries have introduced legislation and issued guidelines and standards for the transportation of lithium battery products. Among these is the section 38.3 of the UN Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, commonly known as UN 38.3, which has been widely adopted worldwide. UN 38.3 lists the required tests and acceptance criteria in order to ship cells, batteries, or battery systems that are lithium metal or Li-ion. International agencies, including the International Air Transport Association (IATA), International Maritime Organization (IMO) and the US Department of Transportation (DOT) have adopted the UN test procedures for their shipping regulations.

In spite of these precautions, the U.S. Federal Aviation Administration (FAA) recorded 138 airport and air incidents between 1991 and 2016 involving lithium batteries. They involved smoke-, heat-, and fire-related events to battery-operated devices such as e-cigarettes, laptops, and mobile phones. Among the most serious unresolved airplane crashes that were likely caused by batteries catching fire onboard during flight include the Asiana Airlines 747 near South Korea in July 2011, a UPS 747 in Dubai, UAE in September 2010, and a UPS DC-8 in Philadelphia, PA in February 2006. These events have prompted authorities to tighten the rules when transporting batteries, including the 2016 ban on lithium batteries as cargo in passenger aircraft. In addition, although lithium batteries get the most attention, other battery types also are subject to regulation that controls their shipping and transportation. For example, spillable lead acid batteries are regulated as dangerous goods under Class 8, controlled by UN 2794 (Source: Battery University).

Zap&Go's Markets and Product Pipeline

Following the debut of its technology at the 2017 Consumer Electronics Show (CES 2017) in January 2017, the Company expects the first Zap&Go-enabled products to be available for consumer purchase during early 2018. The first Zap&Go product ready for mass production will be based on its Gen 3 technology. Gen 3 products have been optimized for industrial markets, such as cordless power tools, electric scooters, and recreational vehicles. The thinner and more energy dense Gen 4 product is expected to be ready for mass production by early 2019, and extends the application of the Company technology to other markets, such as personal electronics, transportation, and solar energy, among others.

Flextronics has developed a miniature surface mount circuit board to work with an existing high current power supply for the Zap&Go 5-minute powerbank charger. According to the Company, the circuit board can be easily replicated for a range of other products, such as cordless cleaners and solar panels, allowing these products to be brought to market quickly and with minimal development costs.

INSTANT CHARGING TECHNOLOGY

According to the Company, Zap&Go C-Ion® battery technology can eventually be used to achieve instant charging of electronic devices. A plug socket can deliver a maximum of about 3kW. In theory, plugging a phone that has a 3,000mAh battery could result in a full charge in 15 seconds. However, limitations of Li-ion batteries restricts the speed at which the battery can be safely charged, with the charge adaptors designed to slow down charging to protect the batteries.

C-Ion® technology does not have the limitations on charge and discharge speed. If C-Ion® cells are added in both the charger and the device, the recharge time (and therefore the down time of products) can be reduced to a few seconds. This works by buffering the required charge in the C-Ion®-equipped charger. A stored charge is built up in the C-Ion® cells in the charger using a standard 3kW plug socket so a large energy transfer can happen almost instantly once the device is plugged into the charging station.

For example, as seen in Figure 27, if a phone requires 3,000 mAh of charge, the smart charger can store the full 3,000 mAh. Once the phone's batteries are depleted, the phone is plugged into the charger, delivering instant full charge transfer. According to the Company, the same strategy can be used with other small electronics, as well as larger systems, such as electric vehicles.

Figure 27

INSTANT CHARGE PROCESS

Phone needs 3,000 mAh of charge | **3,000 mAh of charge stored in charger** | **Plug phone into charger, delivering instant full charge**

Source: ZapGo Ltd.

NEAR TERM OPPORTUNITIES

There are many potential applications for the current Gen 3 technology. According to Zap&Go, within each sector, the Company is partnered or seeks to partner with a major manufacturer/retailer who will be able to provide support in the form of capital, joint development, target market and commercial requirements, and eventually purchase orders. The Company has identified several near-term market sectors that could represent a significant opportunity for its products, including personal transportation, cordless power tools and appliances, automotive aftermarket products, and emergency lightning and tools, as detailed in Figure 28. These products powered by Zap&Go's C-Ion® cells are expected to be available in stores and online in early 2018. The Company expects to introduce further products as manufacturing capacity grows throughout 2018.

Figure 28

ZAP&GO PRODUCT PIPELINE

Near Term Opportunities - 2017 / 2018	
Personal transportation	Electric scooters
Appliances	Cordless power tools, robot cleaners, emergency lighting, carstarters
Emergency and Back-up solutions	emergency lighting, carstarters
Mid and Long Term Opportunities - 2018/2019 and beyond	
Consumer electronics	Mobile phones, eBook readers, games consoles, blue tooth speakers, wearables, 3D headsets, laptops, notebooks, tablets, cameras
Appliances	Cordless power tools, robot cleaners
Personal transportation	E-Bike, golf-carts, autonomous and driverless electric vehicles (PODs)
Electric vehicles	Electric and hybrid cars and buses, commercial and industrial vehicles.
High availability systems	Military, Unmanned Autonomous Vehicles (UAVs and Drones), wind turbines, renewable energy systems, medical

Source: ZapGo Ltd.

Razor® Electronic Scooter

While at CES 2017, Zap&Go showcased a Razor® E300 electric scooter prototype incorporating the Company's technology (Figure 29), which reduces the charge time from 8 to 12 hours to five minutes. The Zap&Go hybrid solution would extend the range from 30 miles to 50 miles before recharge. Currently, this e-bike is powered by a lead acid battery with a one-year life (replacement $300).

Figure 29

ZAP&GO POWERED RAZOR® SCOOTER

Sources: ZapGo Ltd and Mashable.

Appliances and Cordless Tools

One of the first products the Company plans to bring to market is a cordless power drill that uses Zap&Go's C-Ion® technology as the power source. The Company has been working with manufacturers of cordless cleaners, power tools, and other consumer electronics to replace their current battery with Zap&Go's C-Ion® cells. The use of C-Ion® cells allows a recharge time for these devices to go from hours to under five minutes.

Zap&Go's strategy of partnering with manufacturers who may incorporate the Company's technology directly into their product is a key element for developing cordless appliances and tool products. According to the Company, it has secured four agreements with U.S. brand-name companies to develop products for market entry early 2018. On May 2017, Zap&Go announced that it was awarded a grant worth €1.43 million ($1.6 million) by Horizon 2020, the European Union Framework Program for Research and Innovation. Zap&Go plans to use the grant to perfect the prototypes it has already developed, integrating them with cordless tools and power drills to build units to conduct customer trials. According to the European Commission, less than one in twenty Horizon 2020 grant proposals succeed in getting funded, highlighting the program's selectivity.

A key issue for most cordless products, such as power tools, appliances, and robotic cleaners, is the performance of the batteries. The lithium-based battery products require long recharge times once depleted. For example, robotic vacuums and cleaners have a duty cycle based on the Li-ion batteries they use. Typically, a device will clean for 20-40 minutes and then return to a base station to recharge, a process that can take up to 8 hours. The Company believes that the incorporation of its C-Ion® technology into these products can reduce charging times from hours to minutes, increasing the functionality and performance of the products. This ability could become a competitive advantage for the product manufacturers and become a key selling point compared to alternative products.

As seen in Figure 30, during CES 2017, the Company showcased two key functioning products that incorporate the Company's C-Ion® technology: (1) a Stanley Black & Decker cordless power drill, and (2) a Bissell® vacuum cleaner, as described below.

Figure 30

ZAP&GO'S CORDLESS TOOLS AND APPLIANCES

Source: Devine Times Photography.

Stanley Black & Decker (SBD) Cordless Power Drills

During CES 2017, Zap&Go showcased an 18-volt power drill, in which the recharge time was reduced from 30 minutes to less than two minutes.

Bissell Vacuum Cleaner

As well, during CES 2017, the Company exhibited the Bissell® vacuum cleaner. Typically, cordless cleaners take two hours to four hours to recharge and provide roughly 20 minutes of cleaning time. Zap&Go has been working with Bissell to develop a prototype spot cleaner with the goal of reducing the charge time to five minutes while maintaining the 20 minutes of cleaning time.

Hopkins ZapStart™ Emergency Car Starter

The Company is developing a C-Ion®-based emergency car starter product—ZapStart™—in partnership with Hopkins Manufacturing Corporation. ZapStart™ is designed to start a car battery if it goes flat. Current emergency products are lithium-based, which can lose their charge and take a long time to recharge. The Hopkins ZapStart™ emergency car starter, shown in Figure 31, works by harvesting the remaining power in a battery, can charge in as little as five minutes, holds the charge longer, and works immediately. On April 2017, Zap&Go completed the construction and testing of the ZapStart™, which was shipped to Hopkins for customer evaluation.

Figure 31
ZAPSTART™

Source: ZapGo Ltd.

MID TERM OPPORTUNITIES

Zap&Go's Gen 4 technology–scheduled for market release at the beginning of 2019—is thinner and more energy dense than its current offering and is specifically designed for the consumer electronic market. The Company believes that its Gen 4 technology's improved product performance can lead to accelerated volumes in new target markets. Furthermore, Zap&Go's Gen 4 manufacturing process shares significant commonality with its current products, which can drive production costs down further.

Mophie Phone Case

The ultimate goal is to embed Zap&Go's supercapacitors within a phone so the phone itself can charge in 5-minutes. Discussions are on-going with handset manufacturers to achieve this by 2019. In the meantime, the Company is developing a phone case that wraps around the phone, shown in Figure 32. The phone case can charge in five minutes and would then be able to charge the phone at the normal rate. The plan is to launch this product, along with a leading accessory manufacturer, in 2018.

Figure 32
MOPHIE PHONE CASE

Source: ZapGo Ltd.

Personal Transportation and Autonomous Vehicles

A near-term opportunity for the current Gen 3 product is to offer a hybrid solution, whereby the Zap&Go's product works in conjunction with a Li-ion battery array. With a hybrid solution, the supercapacitor can charge within minutes and then trickle charge into the Li-ion battery array, extending the charge life of the Li-ion cells. The Company has been testing the battery technology to power autonomous shuttles used to transport passengers at Heathrow Airport in London. The C-Ion® batteries used in the Heathrow shuttles are roughly the size of a paint can, can be recharged in 35 seconds, and are used to recharge the onboard Li-ion batteries.

Heathrow International Airport—PODs

Since 2011, a fleet of 21 electric-powered driverless vehicles (PODs) at the Heathrow International Airport in London have ferried as many as 1,000 passengers each day on a closed course between terminal 5 and the Business Car Park, 2.4 miles away, logging well more than 1 million autonomous miles. The PODs, originally developed by Westfield Sportscars and shown in Figure 33, are real cars, with rubber tires that run on tracks via untethered, battery-driven powertrains. Although they offer space for as many as six people and their luggage, they are compact, measuring 12 feet long, 5 feet wide, and 6 feet tall, and achieve top speeds of 25mph. As well, they are lightweight, at just 1,870 lbs., including a 141 lbs. battery pack.

Operation of the PODs is simple. In the station, touch-screens (shown in the middle of Figure 33) allow riders to select their destination (Heathrow's system offers only two outbound options). The doors open and after the passenger presses the "Close doors" and "Start" buttons, the POD autonomously starts its trip towards the station. The system already meets Kyoto Protocol 2050 projections, delivering a 50% reduction in per-passenger carbon emissions compared with diesel-powered buses and 70% compared with cars. By Heathrow's estimate, the PODs can replace roughly 70,000 bus journeys each year. Unlike a shuttle bus, the average wait time for a POD is less than 10 seconds, with 80% of passengers having no wait at all (Source: BBC, November 2014).

Figure 33

HEATHROW POD

Source: your.heathrow.com.

The vehicles are powered by a Li-ion battery array manufactured by Nissan. However, the PODs self-monitor their battery level, regularly excusing themselves at station stops for "opportunity charging", as depicted on the right side of Figure 33. Zap&Go recently won a proof-of-concept grant from Innovate UK, the British Government innovation agency, in association with Nissan, to install a bank of supercapacitors to provide power for transportation, augmenting the existing Nissan Li-Ion batteries that would power guidance systems, lighting, heating ventilation and air conditioning (HVAC), and opening and closing the doors in a "hybrid system." During the journey, the vehicle is accelerated by the Zap&Go supercapacitors and the steady state running is provided by the Nissan batteries. The Zap&Go supercapacitors are recharged in just 35 seconds, under the 40 seconds that it normally takes for a group of people to sit themselves down in a vehicle and to press the button. In essence the value proposition for the Zap&Go solution for the POD is to provide a turbo-boost or range extender on electric vehicles.

The Heathrow PODs are a small-scale experiment, commissioned by Heathrow Airport Holdings Limited and built by UK-based Ultra Global PRT (for Personal Rapid Transit), but its success—measured by cost savings, environmental impact, and user-friendliness—could be easily expanded. Ultra Global PRT is currently working with investors in India, where the company intends to build a 4.8-mile elevated circuit in the city of Amritsar, about 285 miles north of New Delhi. This network is expected to include seven stations and more than 200 PODs capable of transporting some 50,000 passengers a day. In November 2013, Ultra Global PRT and Taiwan-based China Engineering Consultants completed a feasibility study for the implementation of a PRT system in New Taipei City.

The GATEway Project

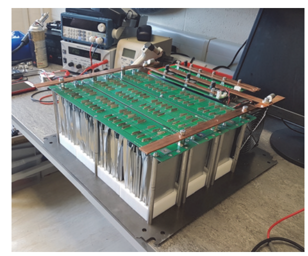
GATEway (Greenwich Automated Transport Environment) is an £8m research project led by UK's Transport Research Laboratory (TRL) and includes a group of other British-based companies and organizations, with the goal of understanding and overcoming the technical, legal, and societal challenges of implementing automated vehicles in an urban environment. Taking place in TRL's UK Smart Mobility Lab in the Royal Borough of Greenwich, the project aims to test and validate a series of different use cases for automated vehicles, including driverless shuttles and automated urban deliveries (Source: GATEway Project).

GATEway's key initiative is the development of an autonomous fleet of PODs capable of operating safely on the streets of London using laser-guided driverless vehicle technology with a public trial expected to be conducted in the Royal Borough of Greenwich. The project, led by Oxbotica (a spinoff from Oxford University robotics lab), Westfield Sportscars, and Heathrow Enterprises, aims to adapt the existing PODS currently in service at Heathrow Airport to navigate the streets of Greenwich without the need for dedicated tracks (Source: University of Oxford).

Zap&Go is working with Westfield Sportscars and Hyperdrive Innovations to develop a hybrid energy storage system for the GATEway driverless POD project. Innovate UK has provided £300,000 of funding to match Hyperdrive's British-sourced Li-ion battery system with graphene supercapacitors developed by Zap&Go. The battery pack has been designed to work with the supercapacitor to maximize the POD's efficiency in operation. The goal is for the Li-ion battery/supercapacitor combination to replace Heathrow POD's lead-acid batteries, speed up charging, and improve their overall usage. The new PODs could replace those currently used at Heathrow and elsewhere throughout England. The Company has successfully built and demonstrated its POD power pack (Figure 34), composed of 60x C-Ion® cells, and delivering over 200 Amps.

Figure 34

ZAP&GO POD POWER PACK



Source: ZapGo Ltd.

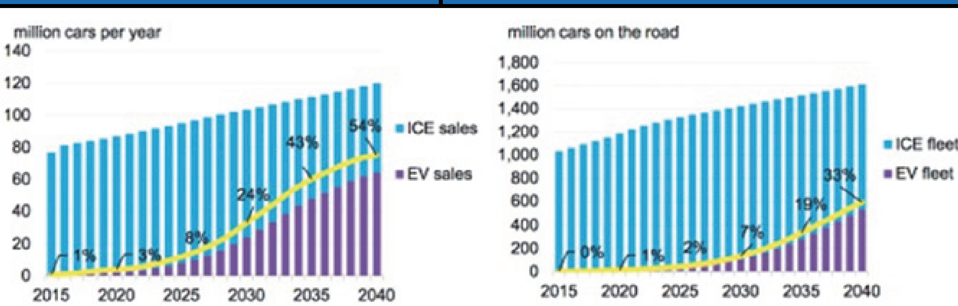
Electric Vehicles and Bikes

Electric vehicles (EVs) are expected to make up the majority of new car sales worldwide by 2040, accounting for 54% of new car sales and 33% of the global car fleet by 2040, as seen in Figure 35. This growth is driven by increasing concerns about internal combustion engine (ICE) vehicle's emissions and their effect on the environment, as well as the decrease in battery costs. Falling battery prices are expected to bring price-competitive EVs to all major light-duty vehicle segments by 2025, ushering in a period of strong growth for electric powertrain vehicles (Source: *Bloomberg*'s New Energy Finance Electric Vehicle Outlook 2017).

Figure 35

EXPECTED ADOPTION OF ELECTRIC VEHICLES

GLOBAL LIGHT DUTY EV SALES	GLOBAL LIGHT DUTY EV FLEET



Source: Bloomberg New Energy Finance

In addition, rising commitments from automakers and government-based financial incentives directed at electric car customers are also expected to drive the adoption of this technology. Governments around the world are encouraging the widespread adoption of EV's through tax and financial credits, as well as new regulations. For example, on July 2017, the U.K. became the latest European country to mark the end of the line for diesel and gasoline fueled cars, as it announced the ban of sales of ICE vehicles by 2040, with a goal of phasing out all cars with ICE by 2050. This initiative comes after France and Norway announced a similar plan, and is part of a growing global push to curb emissions and fight climate change by promoting electric cars (Source: *Bloomberg*'s U.K. Joins France, Says Goodbye to Fossil-Fuel Cars by 2040, July 2017). The environmental push comes as the U.K. plans to invest more than £800 million (~$1 billion) in driverless and zero-emission technology and outlined plans to invest £246 million in battery technology research and make available £255 million for local governments to take short-term action, such as retrofitting buses and other forms of public transportation.

However, there are roadblocks that need to be overcome for the adoption of EVs to accelerate. Issues currently preventing the adoption of EVs are primarily their high cost and limited range. However, even when EVs reach cost parity with ICE vehicles, the limited range and long recharge time of EV's creates a range anxiety amongst drivers that stops people from buying an EV as their everyday vehicle. And although improvements in battery technology to increase the range an EV can travel on a single charge are critical to sales growth, availability of EV infrastructure and a recharge/refuel user experience similar to those of conventional vehicles may be a more critical concern (Source: Grand View Research, Inc.'s *Electric Vehicle Charging Infrastructure Market Worth $45.59 Billion By 2025,* April 2017).

The billions of people driving gasoline and diesel vehicles every day are used to a conventional vehicle duty cycle, in which vehicles can travel long distances between refueling, and then refuel in approximately five minutes. Typically, EV use Li-ion batteries, and users of EVs experience a different duty cycle. They can drive reasonable distances between recharging, but when they need to recharge the batteries, this can take as long as 8 hours. Overnight charging at home, sometimes taking 6-12 hours, is insufficient for covering long distances, and spending hours to charge the vehicle during a trip encourages anxiety and discourages the use of electric vehicles (Source: Grand View Research, Inc.'s *Electric Vehicle Charging Infrastructure Market Worth $45.59 Billion by 2025,* April 2017).

Conventional Duty Cycle— New higher rate electric vehicle charging standards

To help overcome the range anxiety or duty cycle issue, new higher rate electric vehicle charging standards are being introduced. The idea is to reduce the time to recharge an EV fully from hours to a few minutes. There are some electricity grid infrastructure and engineering challenges to achieve this, because the amount of energy required is very large.

Current charge/battery technology still falls short of delivering the conventional duty cycle of ICE vehicles. EV chargers are broadly categorized as Type 1 and Type 2 chargers. While using a Type 1 charger that delivers 3kW of power, charging a Nissan Leaf (24kW battery) and a Tesla Model S (90 kWh) would take 8 hours and 30 hours, respectively. Using a Type 2 charger delivering 43kW reduces that to 30 minutes and 4 hours charging time. Even using the newer Tesla Supercharger, which provides high rate DC to DC charging, it would take 75 minutes to fully charge a Tesla S. Further compounding the issues is that different EV manufacturers use different standards. For example, the Tesla Superchargers use a different standard to the new CCS (170kW) and CHAdeMO (100kW) chargers that are being rolled out worldwide. Tesla is rumored to be working on the next generation of Superchargers that can deliver up to 350kW. Figure 36 shows a comparison between charging times. However, these speeds would not be possible with the current generation of on board batteries because the Li-ion batteries might not be able to absorb this amount of energy so quickly and in a safe manner.

Figure 36

MAXIMUM POSSIBLE CHARGE TIME

	CHAdeMO 100kW	CCS 170kW	Tesla Supercharger 350kW
Nissan Leaf 24kWh	14 minutes	8 minutes	4 minutes
Tesla Model S 90kWh	54 minutes	32 minutes	15 minutes

Source: ZapGo Ltd.

Zap&Go Solution

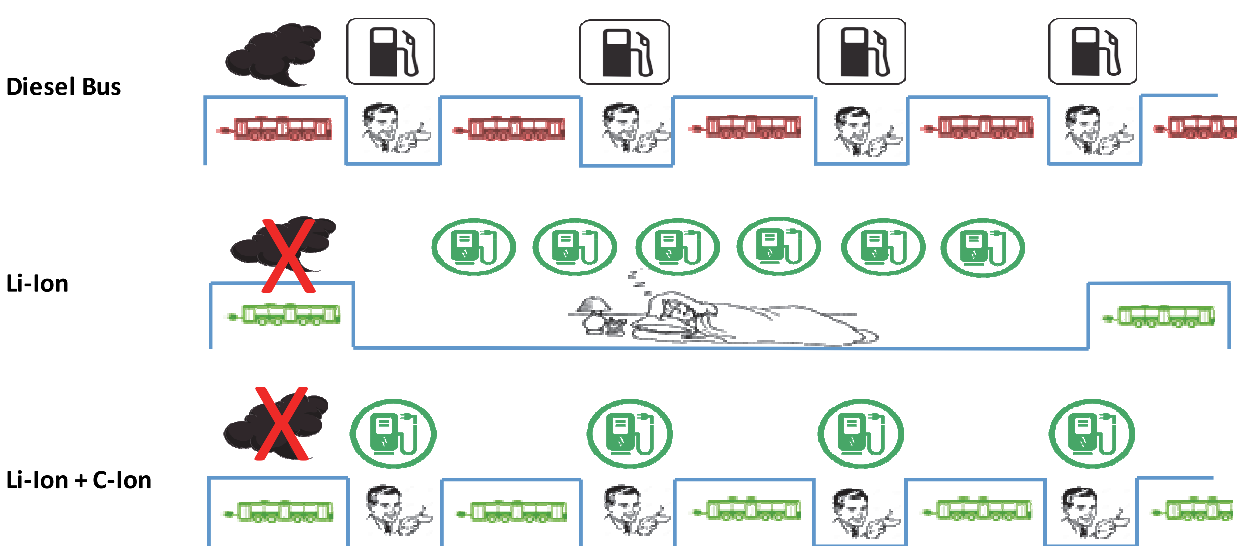
According to the Company, the use of Zap&Go C-Ion® technology can deliver a full charge to an EV in 5 minutes, achieving a duty cycle similar to that of gasoline or diesel vehicles, by using a combination of Li-ion and C-Ion® technology, and the new higher rate electric vehicle charging standards.

In 2015, the average annual electricity consumption for a U.S. residential utility customer was 10,812 kWh, an average of about 30kWh per day. This means charging a Tesla Model S 90kWh is like having 3 extra homes attached the grid for 24 hours. However, if a user attempts to recharge the Tesla Model S in 15 minutes, it is like having an additional 280 average U.S. homes suddenly attached to the power grid over that 15-minute period. This demand would almost certainly stress the local grid infrastructure. This is not actually good for the supplier of the electricity grid, nor for the driver of the car, because what the driver really wants is to charge their vehicle in five minutes. This would be like having 840 homes suddenly attached to the grid, and would almost certainly cause power outages.

According to the Company, most EV's already use software that allows them to navigate to an available charger. The arrival time at the charging point is predictable. Prior to arriving at the charger, the state of charge of the EV is known and therefore the energy required to recharge it to full capacity is also known. As the EV is travelling to the charge point, C-Ion® technology in the charger begins to charge with available energy from the grid. This operation could have been performed well in advance if off-peak electricity was available. In either case, there is no stress to the grid infrastructure. When the vehicle arrives at the charging point, it is recharged directly from the C-Ion® cells in the charger directly into corresponding C-Ion® cells on board the vehicle in five minutes or less. The driver can then detach from the charging cable and be on their way in the same time it would have taken a driver of an ICE vehicle to fill their tank with fuel. While the vehicle is being driven, the C-Ion® cells on board the vehicle discharge into the on-board Li-ion cells; but they do this at a slow rate. This preserves the life of the Li-ion cells. This approach would result in a duty cycle for EVs similar to that of regular ICE vehicles, as seen in Figure 37.

Figure 37

ZAP&GO DUTY CYCLE



Source: ZapGo Ltd.

The Company believes that the same strategy can be used with other forms of electric transportation, such as electric buses, golf carts, and electric bikes, as seen in Figure 38 (page 44). Furthermore, the ability of the Company to manufacture it C-Ion® technology cells in a flat configuration could allow for C-Ion® cells to be incorporated into the structure of the vehicle, with C-Ion® cells built into door panels, side panels, and other parts of the vehicle, as seen in Figure 39 (page 44).

Figure 38

ZAP&GO VEHICLE TECHNOLOGY APPLICATIONS

Source: ZapGo Ltd.

Figure 39

C-ION CELLS BUILT INTO CARS

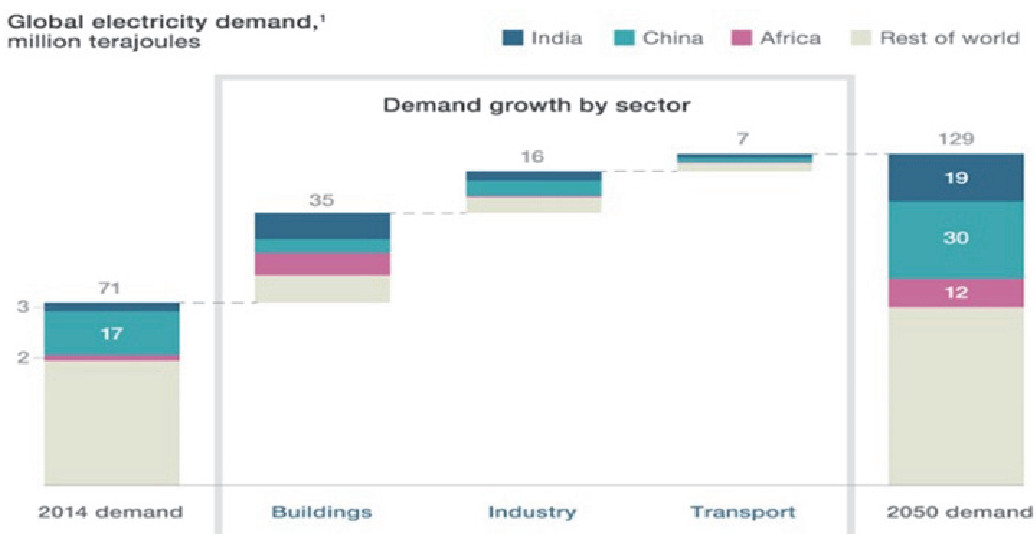
Source: ZapGo Ltd.

Solar Energy Solutions

Energy demand is increasing rapidly and the oil reserves are depleting. From 2014 to 2050, global electric demand is forecast to increase by over 81%, with most of the growth attributed to increased demand in the infrastructure, industry, and transportation sectors, as seen in Figure 40 (Source: McKinsey & Company's Global Energy Perspective, 2016).

Figure 40

GLOBAL ELECTRIC DEMAND



Source: McKinsey & Company.

The expected increase in electricity demand, the growing concerns about climate change, and the burden of non-renewable source of energy, such as coal, oil, and natural gas, on the environment have resulted in a significant interest in renewable sources of energy. One key technology that has profited from this environment is the **photovoltaic (PV)** market. The global PV market was estimated at $89.52 billion in 2013 and is expected to reach $345.59 billion by 2020 (Source: MarketsandMarkets' *Photovoltaic Market by Type, Component, applications, and Geography Analysis and Forecasts to 2013-2020*, February 2015).

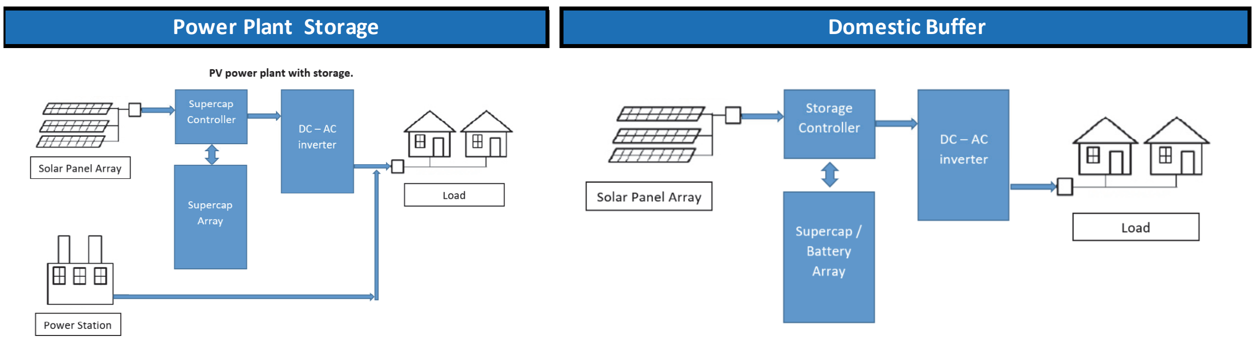
PV systems, which are used to convert sunlight into electricity, do not produce greenhouse gas (GHG) emissions during operation, do not emit other pollutants (such as oxides of sulphur and nitrogen), and consume little to no water (Source: *International Energy Agency Technology Roadmap—Solar Photovoltaic Energy*, 2015). Incentives and funding provided by the government towards the adoption of solar energy to generate electricity have further added to the interest in this technology. On the other hand, the major factor hindering the growth of the PV market is the demand for high quality and low priced products.

According to the Company, the ideal characteristics of a solar energy storage system would include the following parameters: (1) long service life (approximately 20 years); (2) large charge/discharge cycle life (more than 100,000 cycles); and (3) charge cycle between 10 and 100 seconds. These requirements align directly to the key differentiating characteristics of Zap&Go's supercapacitors. The Company believes that its C-Ion® technology's fast charge times (typically 30 seconds for a 50% charge), the ability to quickly discharge, and a life expectancy in excess of 100,000 cycles all add up to a perfect application fit. Alternatives, such as lead acid and Li-ion require regular maintenance and replacement every few years. Zap&Go supercapacitor solutions are maintenance-free and may outlast the life of the solar panels. If charged 10x a day, then 100,000 charge/discharge cycles would be reached in about 27 years.

The Company is assessing a dual usage strategy for the application of its C-Ion® cells in the solar energy and PV industry: (1) power plant storage and (2) domestic supply buffer. Figure 41 provides a schematic for both types of systems.

Figure 41

ZAP&GO PROPOSED USE IN SOLAR ENERGY SOLUTIONS



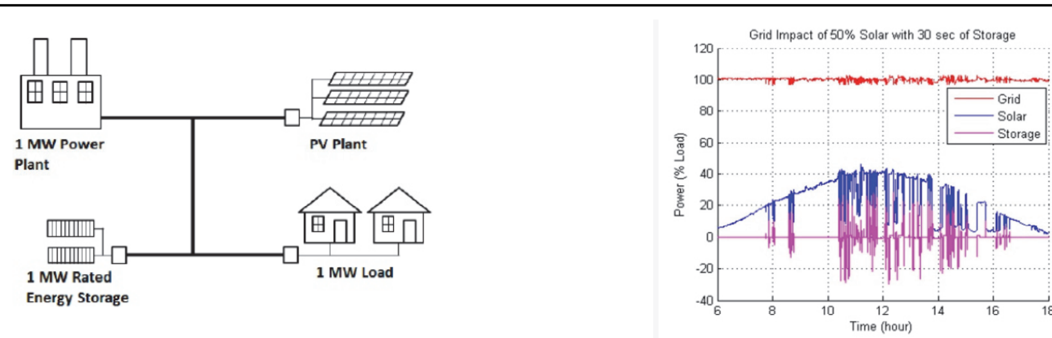
Source: ZapGo Ltd.

Power Plant Storage—On-Grid Peak Shaving

By introducing a short term "burst mode" energy storage to the grid architecture, fluctuations in generation and energy demand can be managed to provide a smoother and more stable supply to the consumer. This is known as "**peak shaving**" and acts to provide an energy buffer to the system. Even very small amounts of buffered energy can have a huge impact on grid stability. As seen in Figure 42, only 30 seconds of buffer capacity can prevent any system trip events over an entire day. According to Zap&Go, the use of the Company's C-Ion® technology and its fast charge/discharge capabilities may result in a solar panel system with twice the operational efficiency and half the pay-back period.

Figure 42

ENERGY BUFFER EFFECT ON ELECTRIC GRID



Source: ZapGo Ltd.

Domestic Supply Buffer

In circumstances where power is required though there is no solar generation available (e.g. at night), energy is stored in a hybrid array of supercapacitors and batteries. The supercapacitors buffer the peak solar daytime generation, allowing the battery charge rate to be kept low and constant, maximizing battery service life. Zap&Go is working with a utility in Florida on high efficiency, maintenance-free energy storage solutions for solar PV generation. The aim is to deliver solar panels with two times the operational efficiency and half the pay-back period.

Emergency and Back-Up Solutions

Security and safety in the modern workplace is watched over by numerous electronic systems: emergency lighting, fire alarms, and closed-circuit television (CCTV), among others. The lithium or lead-acid batteries that power these systems are prone to decay after repeated use and must be regularly checked to ensure they are functioning properly. Zap&Go's C-Ion® technology can tolerate thousands of charge/discharge cycles, resulting in greater security at much lower cost.

Emergency Lighting

Legislation around the world requires commercial building operators to provide battery back-up for emergency lighting systems designed to restore a building's lighting in a blackout. These batteries must be individually replaced on a regular basis, which is costly. On average, the mean time between servicing (MTBS) is two years. Zap&Go can increase the MTBS to up to 10 years, outlasting LED alternatives.

Consumer Products—Personal and Consumer Electronics

Zap&Go is further assessing the application of its Gen 4 technology to consumer electronics, as seen in Figure 43. The Company showcased some of the potential consumer products during CES 2017, including a Nyko Zap&Go powered bicycle energy pack, a Nyko Bluetooth speaker with a charge time of five minutes, and a virtual reality (VR) headset with recharge time reduced from 40 minutes to two minutes with no heat buildup during the charging process. The applications include the use of the Company's technology as a standalone, as well as its use in C-Ion®/Li-ion hybrid systems.

Figure 43

CONSUMER PRODUCTS

Source: ZapGo Ltd.

High Availability Systems and Military Applications, Aerospace, Drones

According to the Company, its C-Ion® cells' fast recharge time, long life, and safety profile can increase the operational efficiency of unmanned electric vehicles (UAV's) or drones by tenfold. This operational efficiency makes the Company's products attractive to operators of unmanned systems, both for military and commercial applications.

On the military front, the Company is assessing the use of its product on scouting drones for the U.S. Special Operations Command (SOCOM), which are excused from the usual and long military procurement practices. Additionally, the auxiliary products, such as helmets, handsets, and night-goggles, are also important markets. Zap&Go is further considering the marine and underwater (submarine) markets, where Zap&Go's safety advantage (i.e., non-flammable) over lithium batteries might come into play.

Figure 44

DRONES

Source: ZapGo Ltd.

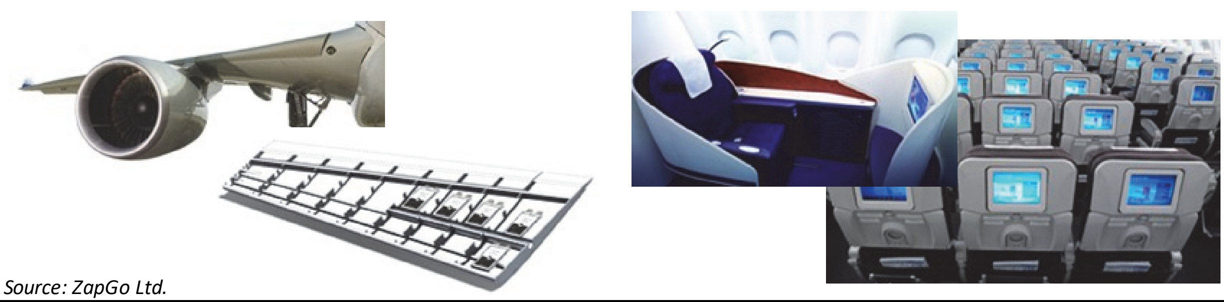
In terms of commercial applications, Zap&Go is exploring whether the Gen 4 would be able to meet the space and weight limitations on larger aerial drones, as seen in Figure 44, including the delivery drones currently in development by logistics and online retail companies, such as DHL and its Parcelcopters, and the drones in Amazon's development pipeline, which are being established via a recently announced partnership with the UK government. Zap&Go anticipates that its Gen 4 product may be three times the size and weight of lithium configurations onboard a drone, though this weight could be partially offset by being able to remove some of the protective materials that must be built into a drone platform to provide extra protection to lithium batteries from flame or other hostile elements.

Additional Opportunities for Zap&Go

In addition to the aforementioned industries, there are other sectors and markets which may offer potential opportunities but which Zap&Go has not yet assessed. For instance, aerospace applications in which C-Ion® technology can be incorporated into the wings of airplanes or power airline seats (as seen in Figure 45), low speed electric cars in China, or powering small satellites in low earth orbit in conjunction with their solar panels. Zap&Go believes that determining the respective value and feasibility of these potential markets could be worth pursuing.

Figure 45

AEROSPACE APPLICATIONS



Source: ZapGo Ltd.

Potential Competition

Zap&Go is seeking to capitalize on the market's desire to combine the density and slow discharge performance of lithium batteries with the time to charge, safety, and environmentally friendly features of supercapacitors, either as stand-alone technology or in conjunction with lithium batteries, in a properly functioning hybrid system. As the Company continues the development and commercialization of its technology, it may face competition from the following types of entities: (1) Li-ion technology companies; (2) other supercapacitor companies; and (3) companies developing battery-capacitor hybrid arrays.

Zap&Go believes that its technology provides significant competitive advantages over current Li-ion options. Nanocarbon supercapacitors charge and discharge much faster than Li-ion batteries, and do not represent a safety and flammable hazard. The non-flammable nature of the Company's C-Ion® cells means that Zap&Go products can be shipped by air freight without any special conditions outlined by UN 38.3 (described on page 35). However, the Company may face competition from companies developing new Li-ion chemistries, such as lithium titanium technology and the proposed commercial development of lithium-air batteries—both of which still appear to be a long way off in terms of commercial development and roll-out, as well as from companies such as Prieto Batteries, which is developing an ionic 3D lattice structure for lithium, which has similarities to the Zap&Go approach for Gen 4 with carbon 3D ionic structures.

In addition, there are other companies that produce nanocarbon or graphene supercapacitors. Zap&Go believes that its current technology exceeds the voltage capability of production-ready competitive alternatives, as presented in a more suitable form factor (rectangular). Leading participants operating in the supercapacitor market include Cap-XX Limited (Australia), Panasonic Corporation (Japan), Nesscap Energy Inc. (Canada), Murata Manufacturing Co., Ltd. (Japan), Maxwell Technologies, Inc. (U.S.), Axion Power International, Inc. (U.S.), AVX Corporation (U.S.), Graphene Laboratories, Inc. (U.S.), Nippon Chemi-Con Corporation (Japan), Mouser Electronics, Inc. (U.S.), and Evans Capacitor Company (U.S.). However, the majority of these companies do not compete in the same market sectors as those targeted by Zap&Go.

Furthermore, there is a select group of companies developing hybrid technologies that may compete with Zap&Go, such as StoreDot's lithium-ion capacitors (LiC), a hybrid of lithium batteries and capacitors. The following section summarizes the anticipated competitive landscape within Zap&Go's target market, noting a selection of companies that are directly competitive and other similar products that may be indirectly competitive. The list is not intended to be an exhaustive collection of potential competitors to Zap&Go; however, it is believed to represent the type of competition the Company may encounter as it seeks to further develop and commercialize its products and technology.

Eaton Corporation plc (ETN-NYSE)
www.eaton.com

Eaton is a power management company that provides solutions to help manage electrical, hydraulic, and mechanical power. Eaton's Cooper Bussman business unit develops and manufactures critical circuit protection, power management, and electrical safety products, including supercapacitor solutions, such as coin cells, large cells, small cylindrical cells, and modules. The company's XLR supercapacitor modules provide energy storage for high-power, frequent-charge/discharge systems in hybrid or electric vehicles, public transportation, material handling, heavy equipment, and marine systems. The XLR module is a self-contained energy storage device comprised of 18 individual Eaton XL60 supercapacitor cells (2.7V), resulting in a maximum working voltage of 48.6V. The XLR Supercapacitor can be applied as the sole energy storage or in combination with batteries to optimize cost, life time, and run time. Eaton, headquartered in Dublin, Ireland, has approximately 97,000 employees and sells products to customers in more than 175 countries.

Graphenea S.A
www.graphenea.com

Graphenea is a private European company focused on producing high quality graphene for industrial and research applications. The company specializes in producing CVD graphene films and liquid exfoliated graphene oxides used in integrated circuits, solar cells, ultracapacitors, batteries, airplanes, automobiles, conductive coatings, flexible displays, and touch panels. Graphenea aims to develop the potential of CVD graphene for electronic systems and other applications by means of combining large scale graphene synthesis and graphene technology integration into an industrial compatible process. In 2013, Graphenea received an investment from Repsol S.A., an integrated oil and gas company with a presence in more than thirty countries, employing over 23,000 people. The main aim of Repsol's New Energy unit is to identify opportunities and business initiatives in spheres such as biofuels, renewable generation, and sustainable transport. Headquartered in Donostia-San Sebastian, Spain, Graphenea employs 22 people and exports graphene materials to 60 countries. In addition, the company is establishing a large number of cooperation and partnership ventures with various organizations from academia and industry involved in graphene applications.

Lomiko Metals Inc. (LMR-TSX)
www.lomiko.com

Lomiko Metals is focused on the exploration and development of minerals for the new green economy, such a lithium and graphite. Its wholly owned subsidiary, Lomiko Technologies Inc. (www.lomikotechnologies.com), is an investor in graphene technology and manufacturer of electronic products. Lomiko Technologies is a 10% owner of Graphene 3D Lab, Inc. (focused on the development and manufacturing of graphene-enhanced materials for 3D printing), as well as a 40% owner of Graphene ESD Corp. Graphene ESD is applying its expertise in carbon materials and graphene platelets for the development of advanced energy storage, by designing electrode-electrolyte pairs that minimize parasitic barriers to the electric charge flow. In April 2017, Graphene ESD announced the successful completion of a development project undertaken jointly with the Research Foundation of Stony Brook University (SBU), resulting in a new patent application for a graphene supercapacitor. The SBU team assembled and tested a 10V Supercapacitor energy storage unit, proving feasibility of the high-voltage design. Currently, GESD is working to scale-up the technology and in-field evaluation of the energy storage unit. Lomiko Metals is headquartered in Surrey, British Columbia, Canada.

Maxwell Technologies, Inc. (MXWL-NASDAQ)
www.maxwell.com

Maxwell is a leader in developing, manufacturing, and marketing energy storage and power delivery solutions. The company's products include ultracapacitors and high voltage capacitors. Maxwell's primary focus is on ultracapacitors, which the company develops for applications in many industries, including automotive, heavy transportation, renewable energy, backup power, and wireless communications. Maxwell's ultracapacitor products include its K2 supercapacitors cells (in 2.7V, 2.8V, and 3.0V varieties) as well as supercapacitor modules, such as its Maxwell ESM truck starter product, the leading ultracapacitor-based engine starting product on the market. Maxwell Technologies is headquartered in San Diego, California, with manufacturing operations in Peoria, Arizona, and European operations in Switzerland. Maxwell employs nearly 400 people worldwide.

Prieto Battery Inc.
www.prietobattery.com

Prieto is an advanced 3D Li-ion battery technology company focused on the development and commercialization of a proprietary battery architecture intended to address the slow diffusion of lithium ions into and between the anode and cathode. The conventional Li-ion battery surface is two-dimensional, which limits the direction and speed at which energy can flow. The company's patent-pending Li-ion battery architecture is designed around a porous copper structure (copper foam), coated by an ultra-thin polymer electrolyte and then surrounded by a cathode matrix. The result is a three-dimensionally structured Li-ion battery with extremely short lithium ion diffusion distances and a power density that is orders of magnitude greater than comparable two-dimensional architectures in use today. Prieto's ionic 3D lattice structure for lithium has similarities to Zap&Go's carbon 3D ionic structures. According to Prieto, the technology results in products with higher power and energy densities than traditional Li-ion batteries, and can be manufactured in a wide variety of shapes. The company targets different markets, including wearables, tablets and personal electronics, power tools, military and industrial applications, and electric vehicles. On May 2016, Prieto announced a strategic investment from Stanley Ventures, the venture arm of Stanley Black & Decker intended to bring the innovative Li-ion technology to market. Prieto is headquartered in Fort Collins, Colorado.

Skeleton Technologies GmbH
www.skeletontech.com

Skeleton Technologies is a developer and manufacturer of high energy and power density graphene-based ultracapacitors and energy-storage systems. Skeleton Technologies' line of ultracapacitor cells, industrial modules, and energy storage systems are based on patented technologies of ultracapacitor design and an advanced nanostructured carbon process that uses silicon carbide to create nanoporous "curved graphene." The company provides energy storage solutions for the automotive, transportation, industrial, and renewable energy markets; with a client list that includes global engineering companies, the European Space Agency, and several Tier 1 automotive manufacturers. Skeleton's supercapacitors are set to be launched into orbit as part of a European Space Agency project. On August 2015, Skeleton entered the commercial truck fleet market when it launched a graphene-based device that helps truck drivers start their engines after long periods of inactivity or in cold weather. Skeleton's supercapacitor technology is also being utilized for a transport fleet trial in the UK, turning rigid diesel trucks into hybrids through power from regenerative braking. Furthermore, in July 2016, Skeleton announced that it will join French firm Flying Whales' program to build a 60-ton Large Capacity Airship, or LCA60T, for the global transport market. Skeleton Technologies, headquartered in Bautzen, Germany, has raised €26.7 million in financing, in addition to a February 2017 €15 million loan from the European Investment Bank.

StoreDot Ltd.
www.store-dot.com

StoreDot is developing a proprietary Li-ion capacitor (LiC) technology—a hybrid of lithium batteries and supercapacitors—for the consumer electronics (smartphones, tablets, etc.), electric vehicles (EV), and organic display markets. StoreDot's core technology is based on an innovative electrode structure containing proprietary electrolyte and chemically synthesized organic polymers with metal oxide compounds. By adding organic compounds to traditional Li-ion batteries, this new architecture enables ions to flow from a modified anode to a modified cathode at a speed that is much faster than existing technologies, resulting in enhanced energy density and high storage ability with the rapid-charging rate capability of capacitors. This combination of fast charging and energy density has paved the way for StoreDot's FlashBattery™ technology, a fast charge battery with applications in the consumer electronic and EV markets. The company currently offers the FlashBattery™ case for the iPhone 7, which can provide 8 hours of operation after a 5-minute charge, as well as a FlashBattery™ Power bank, compatible with smartphones, tablets, and laptops. In addition, StoreDot is developing a new type of electric-car battery based on the materials used in its FlashBattery™ for mobile devices. The EV FlashBattery™ enables full charge in 5 minutes, providing up to 300 miles (480 km) of driving distance, delivering a charging experience similar to fueling a gasoline car. The company was founded in 2012 and is based in Ramat-Gan, Israel.

Historical Financial Results

Figures 46, 47, and 48 provide a summary of Zap&Go's key historical financial statements: Consolidated Statement of Total Comprehensive Income, Consolidated Balance Sheet, and Consolidated Statement of Cash Flow.

In September 2016 the Company went on to secure $7.6 million from U.S. private investors to support growth (Source: Startups.com.uk). Furthermore, on May 2017, Zap&Go was awarded a grant worth €1.43 million ($1.6 million) by Horizon 2020, the European Union Framework Program for Research and Innovation.

Figure 46
CONSOLIDATED STATEMENT OF TOTAL COMPREHENSIVE INCOME
for the year ended December 31, 2016

	Year ended December 31, 2016	Year ended December 31, 2015	16 month period ended December, 31 2014
	£	£	£
Revenue	-	-	19,688
Cost of sales	-	-	(148)
Gross profit	-	-	19,540
Other operating income	37	27,900	40,595
Administrative expenses	(3,991,466)	(1,344,850)	(92,232)
Operating loss	(3,991,429)	(1,316,950)	(32,097)
Finance income	3,282	192	29
Finance expense	(1,293,241)	(5,685)	(1,065)
Loss for the year before income tax	(5,281,388)	(1,322,443)	(33,133)
Income tax credit	357,085	144,183	2,936
Loss for the year and total comprehensive loss	(4,924,303)	(1,178,260)	(30,197)

Source: ZapGo Ltd.

Figure 47
CONSOLIDATED BALANCE SHEET
as at December 31, 2016

	December 31, 2016	December 31, 2015	December 31, 2014
	£	£	£
Non-current assets			
Property, plant and equipment	**139,080**	80,562	-
	139,080	80,562	-
Current assets			
Trade and other receivables	**224,146**	50,145	6,104
Current tax assets	**366,867**	161,055	2,936
Cash and cash equivalents	**2,786,718**	569,102	40,124
	3,377,731	780,302	49,164
Total assets	**3,516,811**	860,864	49,164
Non-current liabilities			
Deferred tax liabilities	**(22,663)**	(13,936)	-
	(22,663)	(13,936)	-
Current liabilities			
Borrowings	**(5,662,380)**	(235,619)	(5,198)
Trade and other payables	**(539,299)**	(235,437)	(74,162)
	(6,201,679)	(471,056)	(79,360)
Total liabilities	**(6,224,342)**	(484,992)	(79,360)
Net assets / (liabilities)	**(2,707,531)**	375,872	(30,196)
Equity			
Share capital	**187**	158	1
Share premium	**1,849,554**	1,225,712	-
Other reserves	**1,581,368**	358,459	-
Accumulated losses	**(6,138,640)**	(1,208,457)	(30,197)
Total equity	**(2,707,531)**	375,872	(30,196)

Source: ZapGo Ltd.

Figure 48
CONSOLIDATED STATEMENT OF CASH FLOWS
for the year ended December 31, 2016

	2016	2015	16 month period ended December 31, 2014
	£	**£**	**£**
Cash flows from operating activities			
Cash inflow / (outflow) from operations	**(4,004,348)**	(814,157)	46,185
Interest paid	**12,291**	(1,650)	(1,065)
Income tax received	**158,829**	146	-
Net cash inflow / (outflow) from operating activities	**(3,833,229)**	(815,661)	45,120
Cash flows from investing activities			
Purchase of property, plant and equipment	**(98,413)**	(107,416)	-
Interest received	**3,282**	192	29
Net cash used in investing activities	**(95,131)**	(107,224)	29
Cash flows from finance activities			
Proceeds from issue of convertible loan notes	**5,867,223**	225,000	-
Proceeds from issue and conversion of shares	**486,255**	1,225,746	-
Repayment of convertible loan notes	**(156,809)**	-	-
Net cash flow generated from financing activities	**6,196,669**	1,450,746	-
Net increase / (decrease) in cash and cash equivalents	**2,268,309**	527,862	45,149
Cash and cash equivalents at beginning of year	**569,102**	40,124	-
Foreign exchange	**(50,694)**	1,116	(5,025)
Cash and cash equivalents at end of year	**2,786,718**	569,102	40,124

Source: ZapGo Ltd.

Risks and Disclosures

This Executive Informational Overview® (EIO) has been prepared by ZapGo Ltd ("Zap&Go" or "the Company") with the assistance of Crystal Research Associates, LLC ("CRA") based upon information provided by the Company. CRA has not independently verified such information. Some of the information in this EIO relates to future events or future business and financial performance. Such statements constitute forward-looking information within the meaning of the Private Securities Litigation Act of 1995. Such statements can only be predictions and the actual events or results may differ from those discussed.

The content of this report with respect to Zap&Go has been compiled primarily from information available to the public released by the Company through news releases, its website, and corporate presentations. Zap&Go is solely responsible for the accuracy of this information. Information as to other companies has been prepared from publicly available information and has not been independently verified by Zap&Go or CRA. Certain summaries of activities and outcomes have been condensed to aid the reader in gaining a general understanding. CRA assumes no responsibility to update the information contained in this report. In addition, CRA's compensation by the Company is cash of fifty thousand U.S. dollars and two hundred fifty thousand warrants for its services in creating this report and for updates. Investors should carefully consider the risks and information about Zap&Go's business described below. Investors should not interpret the order in which these considerations are presented as an indication of their relative importance. The risks and uncertainties overviewed in Zap&Go's materials may not be the only risks that the Company faces. Additional risks and uncertainties not presently known to Zap&Go or that it currently believes to be immaterial may also adversely affect the Company's business. If any of such risks and uncertainties develops into an actual event, Zap&Go's business, financial condition, and results of operations could be materially and adversely affected.

This report is published solely for information purposes and is not to be construed as an offer to sell or the solicitation of an offer to buy any security in any state. Past performance does not guarantee future performance. For more complete information, relating to the risks involved in an investment in Zap&Go, as well as to receive additional information about the Company, or to receive copies of this Executive Informational Overview®, either in paper or electronic format, please contact Zap&Go at (704) 552-3565.

COMPANY RISK FACTORS

Zap&Go's ability to grow and compete in the future will be adversely affected if adequate capital is not available or not available on terms favorable to the Company.

The ability of Zap&Go's business to grow and compete depends on the availability of adequate capital. The Company currently has no cash flow. Zap&Go cannot ensure that it will be able to obtain equity or debt financing on acceptable terms or at all to implement the Company's growth strategy. As a result, Zap&Go cannot ensure that adequate capital will be available to finance its current growth plans, take advantage of business opportunities, or respond to competitive pressures, any of which could harm the Company's business.

The Company may not receive needed capital.

The minimum offering amount is $0.5 million. The offering of the Company's securities will be conducted on a "best efforts" basis. No underwriter, placement agent, or other person has contracted with the Company to purchase all or any of the securities. Accordingly, the Company may accept subscriptions from investors without any assurance that it will have received enough capital to finance its operations and carry out its business plan.

Zap&Go operates in a highly competitive market. If the Company does not compete effectively, its business, prospects, financial condition, and results of operations could be adversely affected.

The supercapacitor and battery replacement market is highly competitive, with companies offering a variety of competitive products. Zap&Go expects competition in its market to intensify in the future as new and existing competitors introduce new or enhanced products that are potentially more competitive than the Company's products.

The supercapacitor and battery replacement market has a multitude of participants, including the established lithium-ion battery manufacturers, the large consumer electronics companies such as Apple, LG, Samsung, Sony and Toshiba, the established supercapacitor manufacturers such as Ioxus and Maxwell, and the specialized competitors who also address the nascent ultra-fast charge space such as Skeleton Technologies and StoreDot in Israel (profiled on page 50). Also new technologies, such as aluminum-ion and solid-state batteries, are under development.

Zap&Go believes many of its competitors and potential competitors have significant competitive advantages, including longer operating histories, the ability to leverage their sales efforts and marketing expenditures across a broader portfolio of products, larger and broader customer bases, more established relationships with a larger number of suppliers, contract manufacturers, and channel partners, greater brand recognition, the ability to leverage the routes to market in which they may operate, and greater financial, research and development, marketing, distribution, and other resources than the Company does. Zap&Go's competitors and potential competitors may also be able to develop products that are equal or superior to those made by the Company, achieve greater market acceptance of their products, and increase sales by utilizing different distribution channels than Zap&Go. Some of Zap&Go's competitors may aggressively discount their products in order to gain market share, which could result in pricing pressures, reduced profit margins, lost market share, or a failure to grow market share for the Company. If Zap&Go is not able to compete effectively against its current or potential competitors, the Company's business, prospects, financial condition, and results of operations could be materially adversely affected.

If Zap&Go is unable to anticipate and satisfy consumer preferences in a timely manner, its business may be adversely affected.

The Company's success depends on its ability to anticipate and satisfy consumer preferences in a timely manner. All of Zap&Go's products are subject to changing consumer preferences that the Company cannot predict with certainty. Consumers may decide not to purchase Zap&Go's products as their preferences could shift rapidly to different types of charging devices or away from these types of products altogether, and the Company's future success depends in part on its ability to anticipate and respond to shifts in consumer preferences. In addition, Zap&Go's newer products may have higher prices than many of its earlier products and the products of some of its competitors, which may not appeal to consumers or only appeal to a smaller subset of consumers. It is also possible that competitors could introduce new products that negatively impact consumer preference for Zap&Go's products, which could result in decreased sales and a loss in market share. Accordingly, if the Company fails to anticipate and satisfy consumer preferences in a timely manner, its business, prospects, financial condition, and results of operations may be adversely affected.

If Zap&Go is unable to successfully develop and introduce new products or enhance existing products, the Company may be adversely affected.

The Company must continually develop and introduce new products and improve and enhance its existing products to maintain or increase sales. The success of new or enhanced products may depend on a number of factors including, anticipating and effectively addressing consumer preferences and demand, the success of Zap&Go's sales and marketing efforts, timely and successful research and development, effective forecasting and management of product demand, purchase commitments and inventory levels, effective management of manufacturing and supply costs, and the quality of or defects in the Company's products.

The development of Zap&Go's products is complex and costly, and the Company typically has several products in development at the same time. Given the complexity, Zap&Go occasionally has experienced, and could experience in the future, delays in completing the development and introduction of new and enhanced products. Problems in the design or quality of Zap&Go's products may also have a material adverse effect on its brand identity, which may materially adversely affect its business, prospects, financial condition, and results of operations. Unanticipated problems in developing products could also divert substantial research and development resources, which may impair Zap&Go's ability to develop new products and enhancements of existing products, and could substantially increase the Company's costs. If new or enhanced product introductions are delayed or not successful, Zap&Go may not be able to achieve an acceptable return, if any, on its research and development efforts, and the Company's business, prospects, financial condition, and results of operations may be materially adversely affected.

Zap&Go could be materially harmed if it is unable to accurately forecast consumer demand for its products and adequately manage inventory.

To ensure adequate inventory supply, the Company must forecast inventory needs and expenses and place orders sufficiently in advance with its suppliers and contract manufacturers based on estimates of future demand for particular products. Zap&Go's ability to accurately forecast demand for its products could be affected by many factors, including an increase or decrease in customer demand for its products or for products of its competitors, product and service introductions by competitors, unanticipated changes in general market conditions, and the weakening of economic conditions or consumer confidence in future economic conditions. Due to the recent rapid growth in demand for Zap&Go's charger devices, and particularly in connection with new product introductions, the Company faces challenges acquiring adequate and timely supplies of its products to satisfy the levels of demand, which Zap&Go believes could materially adversely affects its revenue. This risk may be exacerbated by the fact that the Company may not carry a significant amount of inventory, either directly or with its contract manufacturers or logistics providers to satisfy short-term demand increases. If Zap&Go fails to accurately forecast customer demand, it may experience excess inventory levels or a shortage of products available for sale.

Inventory levels in excess of customer demand may result in inventory write-downs or write-offs and the sale of excess inventory at discounted prices, which would cause Zap&Go's gross margin to suffer and could impair the strength of its brand. Conversely, if the Company underestimates customer demand for its products, Zap&Go's contract manufacturers may not be able to deliver products to meet the requirements, and this could result in damage to the Company's brand and customer relationships and adversely affect revenue and operating results.

Zap&Go's quarterly operating results or other operating metrics may fluctuate materially.

The Company's quarterly operating results and other operating metrics have fluctuated in the past and may continue to fluctuate from quarter to quarter. Zap&Go expects that this trend will continue as a result of a number of factors, many of which are outside of the Company's control and may be difficult to predict, including:

- the level of demand for Zap&Go's chargers and its ability to maintain competitive pricing and maintain gross margins;
- the timing of product introductions by the Company's competitors;
- delays or disruption in Zap&Go's supply of raw materials or components;
- seasonal buying patterns of consumers;
- insolvency, credit, or other difficulties faced by Zap&Go's distributors, key customers, or suppliers;
- levels of product returns, stock rotation, and price protection rights;
- adverse litigation judgments, settlements, or other litigation related costs;

- product recalls, regulatory proceedings, or adverse publicity;
- fluctuation in foreign exchange rates;
- costs related to the acquisition of businesses, talent, or technologies; and
- general economic conditions in either domestic or international markets.

Any one of the factors above or the cumulative effect of some of the factors above may result in material fluctuations in Zap&Go's results of operations.

The variability and unpredictability of the Company's quarterly operating results or other operating metrics could result in Zap&Go's failure to meet its expectations or those of any analysts that cover the Company or investors with respect to revenue or other operating results for a particular period. If Zap&Go fails to meet or exceed such expectations for these or any other reasons, the market price of its stock could fall substantially, and the Company could face costly lawsuits, including securities class action suits.

Zap&Go relies on a limited number of suppliers, contract manufacturers, and logistics providers, and each of its products is manufactured by a single contract manufacturer.

The Company relies on a limited number of suppliers, contract manufacturers, and logistics providers. In particular, each of Zap&Go's products is manufactured by a single contract manufacturer. In the event of an interruption from a contract manufacturer, Zap&Go may not be able to develop alternate or secondary sources without incurring material additional costs and substantial delays. Furthermore, these risks could materially and adversely affect Zap&Go's business, prospects, financial condition, and results of operations if one of its contract manufacturers is impacted by a natural disaster or other interruption at a particular location because each of the Company's contract manufacturers produces products from a single location. In addition, some of Zap&Go's suppliers, contract manufacturers, and logistics providers may have more established relationships with competitors and potential competitors, and as a result of such relationships, such suppliers, contract manufacturers, and logistics providers may choose to limit or terminate their relationship with the Company.

If Zap&Go experiences significantly increased demand, or if it needs to replace an existing supplier, contract manufacturer, or logistics provider, the Company may be unable to supplement or replace such supply, contract manufacturing, or logistics capacity on terms that are acceptable to Zap&Go, which may undermine its ability to deliver products to customers in a timely manner. For example, for certain of the Company's products, it may take a significant amount of time to identify a contract manufacturer that has the capability and resources to build the product to Zap&Go's specifications in sufficient volume. Identifying suitable suppliers, contract manufacturers, and logistics providers is an extensive process that requires the Company to become satisfied with their quality control, technical capabilities, responsiveness and service, financial stability, regulatory compliance, and labor and other ethical practices. Accordingly, a loss of any key supplier, contract manufacturer, or logistics provider could adversely impact Zap&Go's revenue and operating results.

The Company has limited control over its suppliers, contract manufacturers, and logistics providers, which subjects Zap&Go to significant risks, including the potential inability to obtain or produce quality products on a timely basis or in sufficient quantity.

Zap&Go has limited control over its suppliers, contract manufacturers, and logistics providers, including aspects of their specific manufacturing processes and their labor, environmental, or other practices, which subjects the Company to material risks, including the following:

- inability to satisfy demand for Zap&Go's products;
- reduced control over delivery timing and product delivery;

- reduced ability to oversee the manufacturing process and components used in production;
- reduced ability to develop comprehensive manufacturing specifications;
- price increases;
- the failure of a key supplier, contract manufacturer, or logistics provider;
- difficulties in establishing additional contract manufacturing relationships;
- shortages of materials or components;
- misappropriation of the Company's intellectual property;
- exposure to natural catastrophes, political unrest, terrorism, or labor disputes;
- changes in economic conditions in countries where Zap&Go's suppliers operate;
- imposition of new laws or regulations that change the way products or materials can be transported or used; and
- insufficient warranties and indemnities on components supplied.

If there are defects in the manufacture of Zap&Go's products by its contract manufacturers, the Company may face negative publicity, government investigations, and litigation and it may not be fully compensated by its contract manufacturers for any financial or other liability that it suffers as a result.

Because many of the key components in Zap&Go's products come from limited or sole sources of supply, the Company is susceptible to supply shortages, long lead times for components, and supply changes, any of which could disrupt its supply chain and materially adversely affect its business, prospects, financial condition, and results of operations.

Many of the key components used to manufacture Zap&Go's products come from limited or sole sources of supply. The Company's contract manufacturers generally purchase these components on Zap&Go's behalf, subject to certain approved supplier lists, and the Company does not have any long-term arrangements with its suppliers. Zap&Go is therefore subject to the risk of shortages and long lead times in the supply of these components and the risk that its suppliers discontinue or modify components used in its products. In addition, the lead times associated with certain components are lengthy and preclude rapid changes in quantities and delivery schedules. The Company has in the past experienced and may in the future experience component shortages, and the predictability of the availability of these components may be limited. While component shortages have historically been immaterial, they could be material in the future. In the event of a component shortage or supply interruption from suppliers of these components, Zap&Go may not be able to develop alternate sources in a timely manner.

Developing alternate sources of supply for these components may be time-consuming, difficult, and costly and the Company may not be able to source these components on terms that are acceptable, or at all, which may undermine Zap&Go's ability to meet its requirements or to fill its orders in a timely manner. Any interruption or delay in the supply of any of these parts or components, or the inability to obtain these parts or components from alternate sources at acceptable prices and within a reasonable amount of time, would harm the Company's ability to meet its scheduled product deliveries to customers and users. This could harm Zap&Go's relationships with its channel partners and users and could cause delays in shipment of products and materially adversely affect the Company's business, prospects, financial condition, and results of operations. In addition, increased component costs could result in lower gross margins. If Zap&Go is unable to buy these components in quantities sufficient to meet its requirements on a timely basis, the Company will not be able to deliver products to customers and users.

The market for supercapacitor based charger devices is still in the early stages of growth and if it does not continue to grow, grows more slowly than expected, or fails to grow as large as expected, the Company would be harmed.

The market for supercapacitor charger devices is relatively new and unproven, and it is uncertain whether Zap&Go's chargers will sustain high levels of demand and wide market acceptance. The Company's success will depend, to a substantial extent, on the willingness of people to widely adopt these products.

Furthermore, some individuals may be reluctant or unwilling to use supercapacitor-based charger devices because they have concerns regarding the risks associated with safety or harm to their phone or device they are charging, or some other concern. If the wider public does not perceive the benefits of supercapacitor chargers, then the market for these products may not further develop, it may develop more slowly than expected, or it may not achieve the growth potential the Company expects it to, any of which would adversely affect Zap&Go's business, prospects, financial condition, and results of operations. The development and growth of this relatively new market may also prove to be a short-term trend.

An economic downturn or economic uncertainty may adversely affect consumer discretionary spending and demand for the Company's products.

Zap&Go's products may be considered discretionary items for consumers. Factors affecting the level of consumer spending for such discretionary items include general economic conditions and other factors, such as consumer confidence in future economic conditions, fears of recession, the availability and cost of consumer credit, levels of unemployment, and tax rates. As global economic conditions continue to be volatile or economic uncertainty remains, trends in consumer discretionary spending also remain unpredictable and subject to reductions. Unfavorable economic conditions may lead consumers to delay or reduce purchases of Zap&Go's products and consumer demand for the Company's products may not grow as expected. Zap&Go's sensitivity to economic cycles and any related fluctuation in consumer demand for its products may have a material adverse effect on the Company's business, prospects, financial condition, and results of operations.

Zap&Go's current and future products may experience quality problems from time to time that can result in adverse publicity, product recalls, litigation, regulatory proceedings, and warranty claims resulting in significant direct or indirect costs, decreased revenue, and operating margin, and harm to the Company's brand.

Failure to detect, prevent, or fix defects could result in a variety of consequences, including a greater number of returns of products than expected from users and retailers, regulatory proceedings, product recalls, and litigation, which could materially adversely affect Zap&Go's business, prospects, financial condition, and results of operations. The Company generally provides a 45-day right of return for purchases through www.zapgocharger.com and a 12-month warranty on all of its products, except in the European Union, where Zap&Go provides a two-year warranty on all of its products. The occurrence of real or perceived quality problems or material defects in Zap&Go's current and future products could expose the Company to warranty claims in excess of its current reserves.

Moreover, Zap&Go offers limited stock rotation rights and price protection to its distributors. If the Company experiences greater returns from retailers or users in excess of its reserves, Zap&Go's business, prospects, financial condition and results of operations could be harmed. In addition, any negative publicity related to the perceived quality and safety of the Company's products could also affect its brand and materially decrease demand for its products, and materially adversely affect business, prospects, financial condition, and results of operations.

The Company's success depends on its ability to maintain the Zap&Go brand. If events occur that damage the brand, the Company's business and financial results may be harmed.

Zap&Go's success depends on its ability to maintain the value of the "Zap&Go" brand. The "Zap&Go" name is integral to the Company's business as well as to the implementation of its strategies for expanding its business. Maintaining, promoting, and positioning the brand will depend largely on the success of Zap&Go's marketing and merchandising efforts, the Company's ability to provide consistent, high quality products, and the ability to successfully secure, maintain, and defend the rights to use the "Zap&Go" and other trademarks important to the brand. The Zap&Go brand could be materially harmed if the Company fails to achieve these objectives or if its public image or brand were to be tarnished by negative publicity. Zap&Go also believes that its reputation and brand may be materially harmed if it fails to maintain a consistently high level of customer service. Maintaining, protecting, and enhancing the Company's brand may require it to make substantial investments, and these investments may not be successful. If Zap&Go fails to successfully maintain, promote, and position its brand and protect its reputation or if the Company incurs significant expenses in this effort, its business, prospects, financial condition, and results of operations may be adversely affected.

The failure to effectively manage the introduction of new or enhanced products may adversely affect the Company's operating results.

Zap&Go must successfully manage introductions of new or enhanced products. Introductions of new or enhanced products could materially adversely impact the sales of the Company's existing products to retailers and consumers. For instance, retailers might purchase less of Zap&Go's existing products in advance of new product launches. Moreover, consumers may decide to purchase new or enhanced products instead of existing products. This could lead to excess inventory and discounting of the existing products.

The labeling, distribution, importation, marketing, and sale of Zap&Go's products are subject to extensive regulation by various U.S. state, federal, and foreign agencies, including the CPSC, Federal Trade Commission, Food and Drug Administration, Federal Communications Commission, and state attorneys general, as well as by various other federal, state, provincial, local, and international regulatory authorities in the countries in which the Company's products are distributed or sold. If Zap&Go fails to comply with any of these regulations, it could become subject to enforcement actions or the imposition of significant monetary fines, other penalties, or claims, which could harm the Company's business, prospects, financial condition, and results of operations and its ability to conduct business.

The global nature of Zap&Go's business operations also creates various domestic and foreign regulatory challenges and subjects the Company to laws and regulations such as the U.S. Foreign Corrupt Practices Act, or FCPA, the U.K. Bribery Act, and similar anti-bribery and anti-corruption laws in other jurisdictions. Zap&Go's products are also subject to U.S. export controls, including the U.S. Department of Commerce's Export Administration Regulations and various economic and trade sanctions regulations established by the Treasury Department's Office of Foreign Assets Controls. If the Company becomes liable under these laws or regulations, it may be forced to implement new measures to reduce exposure to this liability. This may require Zap&Go to expend substantial resources or to discontinue certain products, which would materially adversely affect its business, prospects, financial condition, and results of operations. In addition, the increased attention on liability issues as a result of lawsuits, regulatory proceedings, and legislative proposals could harm the Company's brand or otherwise impact the growth of its business. Any costs incurred as a result of compliance or other liabilities under these laws or regulations could materially adversely affect business, prospects, financial condition, and results of operations.

The Company's operating margins may decline as a result of increasing product costs.

Zap&Go's business is subject to significant pressure on pricing and costs caused by many factors, including intense competition, the cost of components used in its products, labor costs, constrained sourcing capacity, inflationary pressure, pressure from users to reduce the prices the Company charges for its products, and changes in consumer demand. Costs for the raw materials used in the manufacture of its products are affected by, among other things, energy prices, consumer demand, fluctuations in commodity prices and currency, and other factors that are generally unpredictable and beyond Zap&Go's control. Increases in the cost of raw materials used to manufacture the Company's products or in the cost of labor and other costs of doing business in the U.S. and internationally could have a material adverse effect on, among other things, the cost of Zap&Go's products, gross margins, operating results, financial condition, and cash flows.

Zap&Go is dependent upon the efforts of its key executive officers and its ability to attract and retain skilled personnel.

The Company's future success depends on the continuing efforts of its key employees, including its founder Stephen Voller, Tim Walder (Chief Financial Officer), and its two key scientists, along with Zap&Go's ability to attract and retain highly skilled personnel and senior management.

Zap&Go's future success depends, in part, on its ability to continue to attract and retain highly skilled personnel. The loss of any key personnel could make it more difficult to manage operations and research and development activities, reduce employee retention and revenue, and impair the Company's ability to compete. Although Zap&Go has generally entered into employment offer letters with its key personnel, these agreements have no specific duration and provide for at-will employment, which means they may terminate their employment relationship with at any time.

Competition for highly-skilled personnel is often intense, and the Company may incur significant costs to attract them. Zap&Go may not be successful in attracting, integrating, or retaining qualified personnel to fulfill its current or future needs. The Company has, from time to time, experienced, and it expects to continue to experience, difficulty in hiring and retaining highly skilled employees with appropriate qualifications. In addition, job candidates and existing employees often consider the value of the equity awards they receive in connection with their employment. If the perceived value of Zap&Go's equity or equity awards declines, it may adversely affect its ability to retain highly skilled employees. If the Company fails to attract new personnel or fails to retain and motivate its current personnel, its business, prospects, financial condition, and results of operations could be materially adversely affected.

The Company's international operations subject it to additional costs and risks, and Zap&Go's continued expansion internationally may not be successful.

Zap&Go may incur significant operating expenses as a result of its international expansion, and it may not be successful. The Company has limited experience with regulatory environments and market practices internationally, and it may not be able to penetrate or successfully operate in new markets. Zap&Go may also encounter difficulty expanding into new international markets because of limited brand recognition in certain parts of the world, leading to delayed acceptance of its products by users in these new international markets. If the Company is unable to continue to expand internationally and manage the complexity of its global operations successfully, Zap&Go's business, prospects, financial condition, and results of operations could be adversely affected.

Changes in legislation in U.S. and foreign taxation of international business activities or the adoption of other tax reform policies, as well as the application of such laws, could materially impact the Company's financial position and operating results.

Recent or future changes to U.S., and other foreign tax laws could materially impact the tax treatment of Zap&Go's foreign earnings. The Company plans to conduct its international operations through wholly-owned subsidiaries, branches, or representative offices and report its taxable income in various jurisdictions worldwide based upon Zap&Go's business operations in those jurisdictions. Further, the Company is in the process of implementing an international structure that aligns with its financial and operational objectives as evaluated based on its international markets, expansion plans, and operational needs for headcount and physical infrastructure outside the U.S. In connection with the implementation of the international structure, Zap&Go plans to reorganize the structure of its existing direct and indirect subsidiaries and restructured the intercompany relationships with and amongst the subsidiaries within the Company group. Such intercompany relationships are subject to complex transfer pricing regulations administered by taxing authorities in various jurisdictions. Due to changes in the U.S. and other foreign taxation of such activities, Zap&Go will likely have to modify its international structure in the future, which will incur costs, may increase its worldwide effective tax rate, and may adversely affect the Company's financial position and operating results.

Significant judgment is required in evaluating Zap&Go's tax positions and determining its provision for income taxes. During the ordinary course of business, there are many transactions and calculations for which the ultimate tax determination is uncertain. For example, the Company's effective tax rates could be materially adversely affected by earnings being lower than anticipated in countries where it has lower statutory rates and higher than anticipated in countries where the Company has higher statutory rates, by changes in foreign currency exchange rates, or by changes in the relevant tax, accounting, and other laws, regulations, principles, and interpretations. As Zap&Go operates in numerous taxing jurisdictions, the application of tax laws can be subject to diverging and sometimes conflicting interpretations by tax authorities of these jurisdictions. It is not uncommon for taxing authorities in different countries to have conflicting views with respect to, among other things, the manner in which the arm's-length standard is applied for transfer pricing purposes, or with respect to the valuation of intellectual property.

Zap&Go's failure or inability to protect its intellectual property rights could diminish the value of the Company's brand and weaken its competitive position.

The Company currently relies on a combination of patents, pending patents, copyrights, trademarks, trade secrets, and unfair competition laws, as well as confidentiality agreements and procedures and licensing arrangements, to establish and protect its intellectual property rights. Zap&Go has devoted substantial resources to the development of its proprietary technologies and related processes. In order to protect the Company's proprietary technologies and processes, Zap&Go relies in part on trade secret laws and confidentiality agreements with its employees, licensees, independent contractors, commercial partners, and other advisors. These agreements may not effectively prevent disclosure of confidential information and may not provide an adequate remedy in the event of unauthorized disclosure of confidential information. Zap&Go cannot be certain that the steps taken by the Company to protect its intellectual property rights will be adequate to prevent infringement of such rights by others, including imitation of Zap&Go's products and misappropriation of its brand. Additionally, the process of obtaining patent or trademark protection is expensive and time-consuming, and the Company may not be able to prosecute all necessary or desirable patent applications or apply for all necessary or desirable trademark applications at a reasonable cost or in a timely manner. The Company has obtained and applied for U.S. and foreign trademark registrations for the "Zap&Go" brand and a variety of its product names, and will continue to evaluate the registration of additional trademarks as appropriate. However, Zap&Go cannot guarantee that any of its pending trademark or patent applications will be approved by the applicable governmental authorities. In addition, the Company has filed and obtained patent protection in the U.S. and certain other foreign jurisdictions. Moreover, intellectual property protection may be unavailable or limited in some foreign countries where laws or law enforcement practices may not protect Zap&Go's intellectual property rights as fully as in the U.S., and it may be more difficult for the Company to successfully challenge the use of its intellectual property rights by other parties in these countries.

Costly and time-consuming litigation could be necessary to enforce and determine the scope of Zap&Go's proprietary rights, and its failure or inability to obtain or maintain trade secret protection or otherwise protect the Company's proprietary rights could materially adversely affect its business. Zap&Go may in the future be subject to patent infringement and trademark claims and lawsuits in various jurisdictions, and it cannot be certain that the Company's products or activities do not violate the patents, trademarks, or other intellectual property rights of third-party claimants. Companies in the technology industry and other patent, copyright, and trademark holders seeking to profit from royalties in connection with grants of licenses own large numbers of patents, copyrights, trademarks, domain names, and trade secrets and frequently commence litigation based on allegations of infringement, misappropriation, or other violations of intellectual property or other rights. As the Company faces increasing competition and gains an increasingly high profile, the intellectual property rights claims against Zap&Go have grown and will likely continue to grow.

From time to time, the Company has received and may continue to receive letters from third parties that it is infringing upon their intellectual property rights. The Company's technologies and other intellectual property may not be able to withstand such third-party claims, and successful infringement claims against Zap&Go could result in significant monetary liability, prevent the Company from selling some of its products, or require Zap&Go to change its branding. In addition, resolution of claims may require Zap&Go to redesign its products, license rights from third parties at a significant expense, or cease using those rights altogether. The Company has also in the past and may in the future bring claims against third parties for infringing its intellectual property rights. Costs of supporting such litigation and disputes may be considerable, and there can be no assurances that a favorable outcome will be obtained. Patent infringement, trademark infringement, trade secret misappropriation, and other intellectual property claims and proceedings brought against the Company or brought by Zap&Go, whether successful or not, have in the past and could further result in substantial costs, material harm to its brand, and have a material adverse effect on its business, prospects, financial condition, and results of operations.

If Zap&Go is unable to protect its domain names, the Company's brand, business, and operating results could be adversely affected.

Zap&Go has registered domain names for websites, or URLs, that it uses in its business, such as www.zapgocharger.com. If the Company is unable to maintain its rights in these domain names, Zap&Go's competitors or other third parties could capitalize on its brand recognition by using these domain names for their own benefit. In addition, although the Company owns the www.zapgocharger.com domain name under various global top level domains such as .com and .co.uk, it might not be able to, or may choose not to, acquire or maintain other country-specific versions of the domain name or other potentially similar URLs. The regulation of domain names in the U.S. and elsewhere is generally conducted by Internet regulatory bodies and is subject to change. If Zap&Go loses the ability to use a domain name in a particular country, it may be forced to either incur significant additional expenses to market its solutions within that country, including the development of a new brand and the creation of new promotional materials, or elect not to sell its solutions in that country. Either result could materially harm the Company's business, prospects, financial condition, and results of operations. Regulatory bodies could establish additional top-level domains, appoint additional domain name registrars, or modify the requirements for holding domain names. As a result, Zap&Go may not be able to acquire or maintain the domain names that utilize the Company's name in all of the countries in which it currently conducts or intends to conduct business. Further, the relationship between regulations governing domain names and laws protecting trademarks and similar proprietary rights varies among jurisdictions and is unclear in some jurisdictions. Domain names similar to Zap&Go's have already been registered in the U.S. and elsewhere, and the Company may be unable to prevent third parties from acquiring and using domain names that infringe, are similar to, or otherwise decrease the value of, its brand or trademarks. Protecting and enforcing Zap&Go's rights in its domain names and determining the rights of others may require litigation, which could result in substantial costs, divert management attention, and may not be decided favorably to Zap&Go.

The Company's financial performance is subject to risks associated with changes in the value of the U.S. dollar versus local currencies.

Zap&Go's primary exposure to movements in foreign currency exchange rates relates to non-U.S. dollar denominated sales and operating expenses worldwide. Weakening of foreign currencies relative to the U.S. dollar adversely affects the U.S. dollar value of the Company's foreign currency-denominated sales and earnings, and generally leads Zap&Go to raise international pricing, potentially reducing demand for its products. In some circumstances, for competitive or other reasons, the Company may decide not to raise local prices to fully offset the dollar's strengthening, or at all, which would adversely affect the U.S. dollar value of its foreign currency denominated sales and earnings. Conversely, a strengthening of foreign currencies relative to the U.S. dollar, while generally beneficial to the Company's foreign currency-denominated sales and earnings, could cause Zap&Go to reduce international pricing and incur losses on its foreign currency derivative instruments, thereby limiting the benefit. Additionally, strengthening of foreign currencies may also increase the Company's cost of product components denominated in those currencies, thus adversely affecting gross margins.

Zap&Go intends to use derivative instruments, such as foreign currency forward and option contracts, to hedge certain exposures to fluctuations in foreign currency exchange rates. The use of such hedging activities may not offset the adverse financial effects of unfavorable movements in foreign exchange rates over the limited time the hedges are in place.

The forecasts of market growth included in the Company's business plan may prove to be inaccurate, and even if the markets in which it competes achieve the forecasted growth, Zap&Go cannot assure its business will grow at similar rates, if at all.

Growth forecasts are subject to significant uncertainty and are based on assumptions and estimates that may not prove to be accurate. The forecasts in Zap&Go's business plan may prove to be inaccurate. Even if these markets experience the forecasted growth described in its business plan, the Company may not grow its business at similar rates, or at all. Zap&Go's growth is subject to many factors, including the Company's success in implementing its business strategy, which is subject to many risks and uncertainties. Accordingly, the forecasts of market growth included in Zap&Go's business plan should not be taken as indicative of its future growth.

Zap&Go may need to raise additional capital required to grow its business, and the Company may not be able to raise capital on terms acceptable or at all.

Growing and operating Zap&Go's business will require significant cash outlays and capital expenditures and commitments. If cash on hand and cash from operating activities are not sufficient to meet the Company's cash requirements, Zap&Go will need to seek additional capital, potentially through debt or equity financing, to fund its growth. The Company may not be able to raise needed cash on terms acceptable to it, on a timely basis, or at all.

Financing may be on terms that are dilutive or potentially dilutive to the Company's stockholders, and the prices at which new investors would be willing to invest may be lower than the current valuation. If new sources of financing are required, but are insufficient or unavailable, Zap&Go will be required to modify its growth and operating plans based on available funding, if any, which could materially adversely affect the Company's business, prospects, financial condition, and results of operations.

Glossary

Angstrom—A unit of length equal to one hundred-millionth of a centimeter, 10–10 meter, used mainly to express wavelengths and interatomic distances.

Anion—A negatively charged ion, i.e., one that would be attracted to the anode in electrolysis.

Capacitance—The ability of a system to store an electric charge.

Cation—A positively charged ion, i.e., one that would be attracted to the cathode in electrolysis.

Cycle life—The number of complete charge/discharge cycles that a battery is able to support.

Chemical vapor disposition (CVD)—A chemical process used to produce high quality, high-performance, solid materials. The process is often used in the semiconductor industry to produce thin films.

Dielectric—A medium or substance that transmits electric force without conduction; an insulator. A dielectric material is a substance that is a poor conductor of electricity, but an efficient supporter of electrostatic field.

Electrolyte—A liquid or gel that contains ions and can be decomposed by electrolysis. A nonmetallic electric conductor in which current is carried by the movement of ions.

Graphene—A thin layer of pure carbon; it is a single, tightly packed layer of carbon atoms that are bonded together in a hexagonal honeycomb lattice in sheet form that is one atom thick.

Ionic electrolyte—An ionic liquid is a salt in the liquid state at near-ambient temperature. While ordinary liquids such as water and gasoline are predominantly made of electrically neutral molecules, ionic liquids are largely made of ions and short-lived ion pairs. Ionic electrolytes are powerful electrically conducting fluids with electric battery applications.

Lithium-ion (Li-ion) batteries—A lithium-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.

Nano-structured—A structure, especially a semiconductor device, that has dimensions of only a few nanometers.

Peak shaving—A technique that is used to reduce electrical power consumption during periods of maximum demand on the power utility.

Photovoltaics (PV)—A field of semiconductor technology involving the direct conversion of electromagnetic radiation as sunlight, into electricity.

Regenerative braking—A method of braking in which energy is extracted from the parts braked, to be stored and reused.

Specific energy—A measure of the energy of a substance or device per unit mass. It is used to quantify the stored energy or other thermodynamic properties of substances. Specific energy defines battery capacity in weight (Wh/kg)

Specific power—The amount of power (time rate of energy transfer) per unit volume. In energy transformers including batteries, fuel cells, motors, etc., power density indicates loading capability.

Supercapacitors—Also known as electric double-layer capacitor (EDLC) or ultracapacitors, supercapacitors are a high-capacity electric storage device with specific energy values—much higher than other capacitors—that bridge the gap between electrolytic capacitors and rechargeable batteries.

UN 38.3—UN 38.3 Transport of Dangerous Goods, Manual of Tests and Criteria lists the required tests and acceptance criteria in order to ship cells, batteries or battery systems that are lithium metal or lithium-ion. International agencies, including the International Air Transport Association (IATA), International Maritime Organization (IMO) and the US Department of Transportation (DOT) have adopted the UN test procedures for their shipping regulations.

Viscous—Having a thick, sticky consistency between solid and liquid; having a high viscosity.

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