

Fall 2011



EARTHRISE OBSERVATORY

Commentary on energy & environmental technology industry developments

ENERGY & ENVIRONMENT NEWS

Start-Stop Starts Up

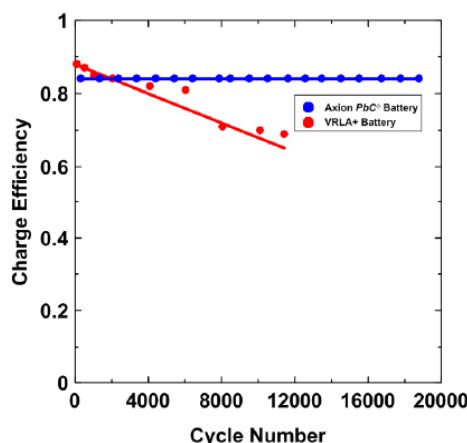
Johnson Controls to Build \$100 Million Start-Stop Battery Plant in China

Frankfurt, 14 Sept. 2011. Due to increasing global demand for high-quality automotive batteries for environmentally friendly Start-Stop technology, Johnson Controls is investing \$100 million to build a Start-Stop vehicle battery plant in China.

"Interest in the environment and more energy efficient vehicles is driving many of our OE customers to add Start-Stop vehicles to their fleets," said Kim Metcalf-Kupres, vice president strategy, sales and marketing at Johnson Controls Power Solutions.

Johnson Controls anticipates the market for Start-Stop vehicles will grow to 35 million globally by 2015. To support this rapid growth, the company is investing \$520 million worldwide over the next four years in additional production capacity for Start-Stop batteries: \$280 million in Germany, an additional \$140 million in the United States, and \$100 million dollars in China.

Source: Johnson Controls press release.



Graph comparing Axion Power's charging efficiency versus traditional VRLA lead-acid batteries. Note how quickly lead-acid performance declines.

Source: Axion Power

EARTHRISE OBSERVATION

With this latest announcement, Johnson Controls has now committed to invest \$520 million in new production capacity for automotive start-stop and other demanding battery applications. We view Johnson Controls' capacity additions as an indication that auto companies are serious about introducing start-stop technology into their fleets. Our investment in Axion Power in December 2009 was based largely on our expectation that just such a development would occur.

Start-stop systems for gasoline-powered vehicles shut off the engine during idle, and restart it when the driver engages the clutch or releases the brake pedal. Johnson Controls (JCI) estimates that start-stop can reduce fuel use and emissions by 5% - 12%.

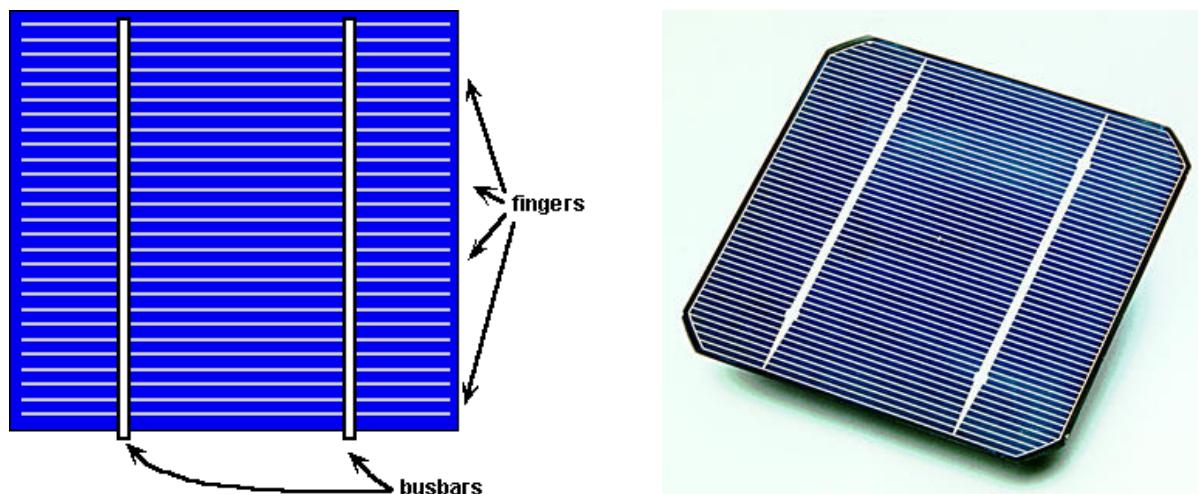
Start-stop technology requires a robust battery that can accept thousands of charge and discharge cycles over its lifetime. Conventional lead acid batteries degrade too quickly, while lithium ion batteries and ultracapacitors are too expensive. JCI is proposing to use absorbed glass mat (AGM) batteries, a form of lead acid battery. Although AGM lasts longer in start-stop than traditional lead acid batteries, its durability still appears insufficient. As mileage and emission standards tighten further, we expect the auto industry to move away from AGM batteries to more appropriate solutions.

Axion Power's lead-carbon battery appears to have the durability and charge acceptance needed for start-stop. Axion has tested its battery for vehicular use to 100,000 cycles before degradation, sufficient for 7 to 8 years of normal driving usage. The company is optimizing its first production line in Pennsylvania to prepare for commercial sales in the near future for automotive, rail and stationery power uses.

EARTHRISE CAPITAL PORTFOLIO OBSERVER

In our “Earthrise Capital Portfolio Observer,” we hope to provide a deeper understanding of our portfolio companies through management interviews, technology summaries and real-world examples of products at work.

This installment of the Portfolio Observer features an emerging application of the nanomaterials technology developed by NanoMas Technologies, Inc., Earthrise Capital Fund’s first investment. NanoMas has a patented process technology for making extremely small, highly stable nanoparticles from silver, gold and other metals. One of NanoMas’s first products is expected to be a nanosilver-based conductive ink for printing the “fingers” that collect the electric current generated by crystalline silicon solar cells.



Images courtesy of PVeducation.org and DOE/NREL

The standard method for “metallizing” (attaching metal features to) a silicon solar cell is screen printing – pressing a thick paste through a fine-mesh screen. For the purposes of the solar industry, screen printing is workable but not optimal. Issues with screen printing include line resolution, print speed, wafer breakage, and the need for manual screen replacement every few hours. Replacing screen printing with higher-speed, higher-resolution, non-contact processes like plating and inkjetting requires new materials and formulations. For example, the silver particles used in screen print pastes are much too large for inkjet print heads.

NanoMas is one of the few companies in the world able to make silver particles small and stable enough for inkjetting solar cell current collectors. The company is working with an industry partner and the National Renewable Energy Laboratory to develop silver ink formulations tailored for inkjet-based metallization processes. Based on initial tests, inkjetted current collectors can improve crystalline silicon cell efficiency from about 16%-17% to 17%-18%, which could raise manufacturer gross margins by 10%-20+, depending on various factors, and/or reduce the price of solar cells. Even small increases in solar cell efficiency have an outsized impact on solar cell costs.

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EARTHRISE ACTIVITIES

- Ann Partlow and Jim LoGerfo were active participants in this year's **New Energy New York** (NENY) venture forum. In addition to screening and selecting companies to present at NENY, the Earthrise team mentored the CEO of one of the presenting companies, and served as members of the judges panel at the forum.
- Similarly, Ann and Jim also took part in the company selection process for the **24th Annual National Renewable Energy Laboratory Industry Growth Forum**, a premiere event for emerging energy technology companies and investors. The Earthrise team will attend the NREL Growth Forum in Denver in November, and will participate on the judges panels there.
- Ann Partlow has joined **Energy InfoTech** as a founding member. Energy InfoTech is an alliance of entrepreneurs, investors, utility representatives, policymakers and other stakeholders supporting the growth of new businesses improving the energy efficiency of New York City's built environment. Energy InfoTech is supported by NYSERDA, the New York State Energy Research & Development Agency.



The comments expressed in this report reflect the opinion of Earthrise Capital as of the date of publication. The information, including historical data series, estimates and projections, contained herein is believed to be reliable and has been obtained from sources believed to be reliable, but Earthrise Capital makes no representation or warranty, either express or implied, as to the accuracy, completeness or reliability of such information.

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Earthrise Capital Fund is a venture capital fund which invests in resource efficient technologies, including energy efficiency, clean energy, power conversion, energy storage, alternative fuels, and green chemistry.

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