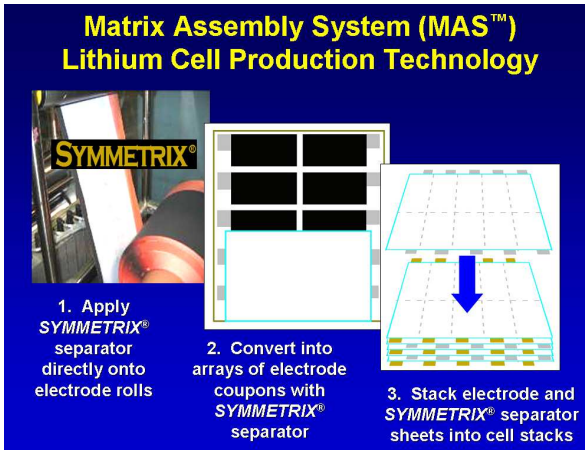
NAATBatt
Advanced Battery Weekly

Interview with Tim Feaver, CEO of Porous Power Technologies (PPT):

Please describe Porous Power Technologies (PPT).
Porous Power's patent-pending SYMMETRIX® separator membranes and MAS™ production system will allow lithium-ion cell manufacturers to improve nearly all aspects of performance, eliminate a very expensive purchased component and use high-volume roll-to-roll production to gain dramatic productivity improvements over one-at-a-time processes now used universally.

While SYMMETRIX can benefit any lithium-ion battery, PPT is focused on flat cells for hybrid- and electric-drive vehicles and similar large-cell applications, particularly those using stacked electrodes that enable efficient use of space and better performance, safety and cycle life.



Customers can either buy SYMMETRIX separators in finished rolls from licensed PPT distributors or license the SYMMETRIX production process and produce separators in-house at a cost less than half that of other separators. SYMMETRIX separators can be thermally laminated or solution-coated directly onto electrodes, greatly simplifying the assembly of stacked cells, as well as improving the safety and reliability of completed cells, particularly in high-vibration environments. Many large non-battery markets exist for PPT membranes, including waterproof breathable fabrics, filtration products, and other energy storage devices.

Discuss the functionality and importance of the separator in determining battery performance. How much of the BOM does the membrane account for?
SYMMETRIX® separators are up to twice as porous as separators now used in all lithium-ion cells and can improve performance across the board for nearly any cell. Improved ionic conductivity means less resistance and less heat generation, particularly during high-rate charge and discharge. Argonne National Lab tests (5C HPPC, 10 seconds) have shown that the area-specific impedance of common polyolefin separators is around 25% higher than that of SYMMETRIX. At discharge rates above 2C, 3-4X improvements in cell capacity are common; both in high-energy and high-power cells, as the voltage of cells with traditional polyolefin separators drop with the increased current drain. Third-party tests in which 10 Ah pouch cells using SYMMETRIX were discharged at 2C rates at low temperatures showed average capacity doubled vs. identical cells with polyolefin separators at -20°C, and *increased by nearly eight times* at -30°C.

Higher porosity and excellent pore uniformity across the surface of the electrode also increases cycle life, which can reduce the total cost of electric drive vehicles by thousands of dollars. Cycle life increases of 20-25% or longer are very typical in most charge/discharge scenarios.
Shrink-resistance and exceptional thermal stability (the separator's PET backbone is stable to 250°C) improve safety. Testing performed by PPT and customers have demonstrated that the highly efficient SYMMETRIX separators promote very stable voltage and temperature profiles under hot box and overcharge conditions, leading to graceful degradation without thermal runaway under extreme conditions

where traditional shutdown separators catch fire. Similarly, cells with SYMMETRIX may be charged and discharged at significantly higher rates without generating excessive heat that can affect performance and cycle life.

SYMMETRIX' unique open pore structure allows it to wick electrolyte 2-3 times faster than any of the leading polyolefin separators, making it practical to produce larger cells more rapidly and efficiently and reducing the likelihood of dry spots that can create performance, safety and cycle life issues. This is because traditional separators are made with a stretching process in which the open pore structure tends to run through the thickness of the separator. SYMMETRIX is made with a solution casting process that results in a very open, omnidirectional pore structure that soaks up electrolyte very uniformly and efficiently.

The separator is traditionally considered to be one of the most expensive components of a lithium-ion battery, ranging from 5% of the COGS of a typical high-energy cell to as high as 25% in a high-power cell. Various industry analysts have indicated that current separators share the dubious honor of being the most expensive component of a lithium-ion HEV cell, along with the cathode active materials.

The U.S. Advanced Battery Consortium (USABC), made up of the DOE and the Big Three automakers, have set a separator cost target of $1.00/m^2. Most separators now sell for $2.00/m^2 or more and show little sign that their price can be reduced to hit the USABC target. However, cell manufacturers that license the SYMMETRIX process from PPT should easily be able to reduce their separator costs to less than half of what they are currently paying. The in-house coating process also enables high-volume roll-to-roll assembly of cell stacks, creating an entirely new cell assembly paradigm (PPT's patent-pending *Matrix Assembly System*™, or MAS™ production processes) enabling much higher productivity and lower production costs.

Is the material that Porous Power is developing better suited for specific applications (i.e. energy vs. power or stationary vs. consumer)?
The improved cycle life, low-temperature performance and safety benefits associated with SYMMETRIX are applicable to all types of cells. While improved high-rate capacity is most frequently of interest to those producing high-power cells, SYMMETRIX can also enable high-energy cells to operate at significantly higher rates and is a good tool to optimize power and energy for many applications. A large part of PPT's experience and expertise has been focused on the construction of laminated cells, in which the separator is thermally laminated across the entire surface of the electrodes, rather than only at the edges, as is done in most pouch cells. This can enable a fully integrated cell stack with better safety, performance, and cycle life characteristics that is also easier to manufacture. Much of this work has been focused on cells with flat stacked electrodes, a design that appears to be becoming the standard for next-generation automotive cells.

Three major players dominate the lithium-ion separator market, what is the Porous Power value proposition?
All of the mainstream suppliers of separator membranes provide polyolefin separators that are extruded and stretched using one of two similar processes. These products are generally limited to less than 50% porosity (SYMMETRIX separators are typically 65-80% porous) and are not amenable to thermal lamination, nor to coating in-situ directly on electrodes, as is SYMMETRIX. None are practical for application in wide-format roll-to-roll cell assembly techniques. PPT roll goods offer across-the-board performance improvements at similar prices to polyolefin separators. Licensees of PPT's SYMMETRIX production process and MAS production systems can produce cells with higher electrochemical performance, at separator prices less than half those of existing suppliers, and achieve additional productivity gains and cost reductions in their entire cell assembly process. PPT's principals have many

years experience in the lithium-ion and lithium-ion separator industry and a wealth of practical knowledge that gives us a significant competitive advantage vs. other would-be competitors.

What is the go-to-market strategy?
PPT's U.S.-based production line can now produce six million m^2 of SYMMETRIX per year, and capacity is readily expandable. PPT has begun production and distribution of SYMMETRIX roll goods by selected licensees in China and Japan (production in the U.S.), and expects to establish similar agreements with commercial partners in the U.S. and Europe. PPT recently executed a large non-equity based product development agreement with a commercial partner to develop an advanced automotive-grade separator. PPT is also engaged with various equipment suppliers to develop and sell production equipment that is compatible with PPT's MAS production system. While PPT is developing close working relationships with preferred equipment suppliers, we are following an open development approach in which we encourage other manufacturers to develop equipment that may be used with the SYMMETRIX and MAS production processes. PPT will license cell manufacturers directly, regardless of equipment supplier, and sell materials optimized for the application.

PPT's 12,000SF Technical and Engineering Center in Plymouth Meeting, PA allows us to build and test large, high performance lithium-ion cells. It includes coaters for electrode and separator production, laminators and cell assembly equipment, a large dry room, electrolyte fill and packaging, and computerized cell cyclers. Our first MAS™ production system is being constructed there. PPT is working with various battery manufacturers in the facility to develop high-performance cell designs melding PPT technology with customer electrodes and other components.

The STOBA material (developed in Taiwan) was recently unveiled. What kind of impact has it had (if any at all) on the company's long-term target market objectives?
At this point, STOBA has had no impact on PPT's long-term market objectives. It appears to be an interesting product with good potential for improving the safety of lithium-ion cells if it can be implemented at an acceptable cost. One appealing aspect of PPT's unique production process is that it uses a relatively low-temperature, low-pressure casting process that is very amenable to the use of various additives. These can include ceramic materials (which are very difficult to securely apply to most polyolefin products), different polymer formulations and various other passive and active materials that can be readily added to SYMMETRIX formulations to enable novel performance enhancements in the finished product. We expect to evaluate STOBA along with other materials to determine their benefit and compatibility with PPT's unique processes. Along these lines, PPT recently began a $1.5M joint project with Oak Ridge National Laboratory to develop enhanced safety separators optimized for our new in-plant coating process.

Please highlight some of the obstacles that the company has overcome and challenges ahead.
PPT is a startup company, albeit a mature startup company, competing against some of the largest corporations in the world. However, we have been extremely resourceful by leveraging our capabilities with those of various customers and other strategic partners to accomplish far more than we could have on our own. Our recently commissioned high-volume production capabilities with coating partner NEPTCO is testament to that, as are large product development contracts, of which a number have either been secured or are pending. New and ongoing cooperative relationships will help us keep up with the demands of providing a ground-breaking technology to a rapidly growing large international market.

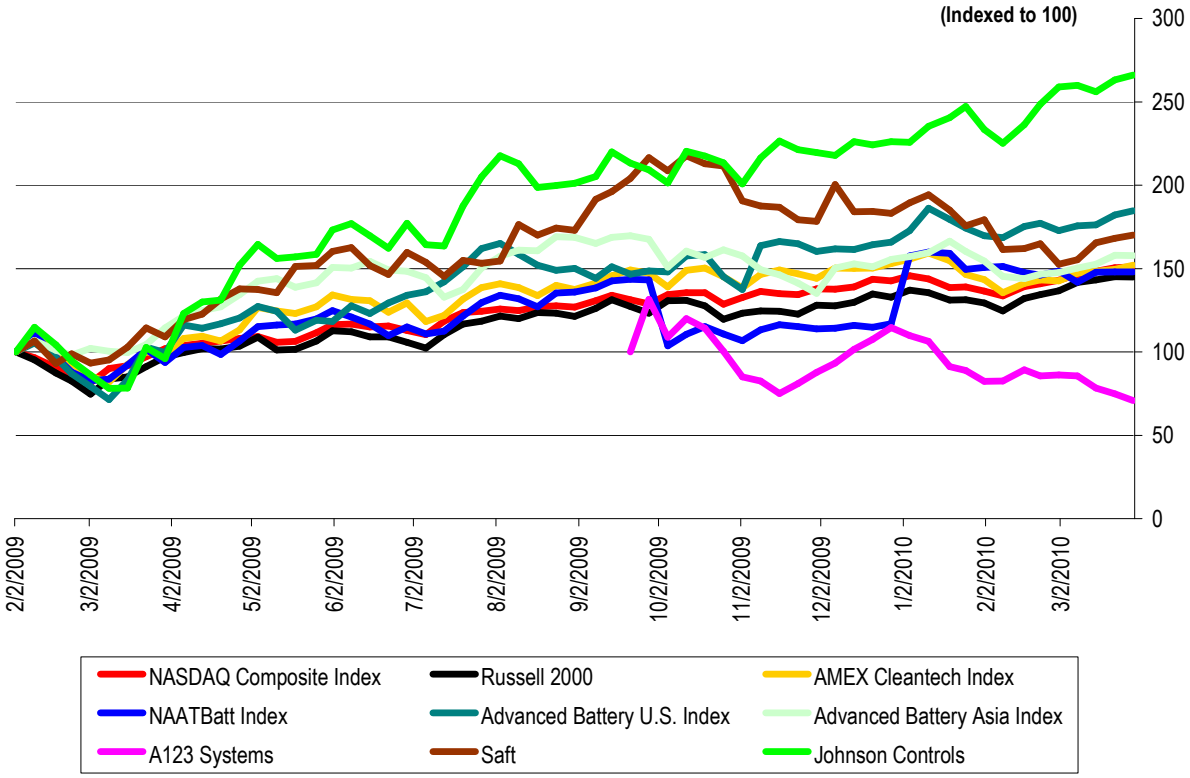
How large is the addressable market opportunity?
We anticipate that the total separator demand will exceed one billion square meters by 2014, with between half and two-thirds of that coming from large-cell automotive applications. We believe that we can supply a substantial portion of that market, particularly through licensing of the SYMMETRIX and MAS production processes directly to cell builders.

How large do you envision the market for electric vehicles (include bikes and heavy-duties) will be by 2015?
Based on stated customer RFQs and various other industry estimates, we anticipate the market for electric vehicle batteries to grow to nearly $40 billion annually by that time. The market for lithium-ion cells (as opposed to full packs) will be slightly less than half of that number.

How large do you envision the stationary market will become for lithium-ion applications in the long-term?
We don't have nearly as good a read on that market as we do the automotive space and have treated it very conservatively in our own financial projections at 10% of the balance of market. Lithium-ion seems to be a less likely solution for stationary applications where pack weight and volume is not nearly as critical.

Any closing thoughts.
Porous Power Technologies is developing and selling next-generation high-performance materials, equipment and processes that will dramatically improve the performance, and reduce the cost, of lithium-ion batteries, and could fundamentally change the way that large cells for automotive and similar applications are produced in the future. We are always seeking strategic corporate partners and investors with compatible objectives that can help us help us take advantage of the large opportunities that are before us.

Exhibit 3: Indices Performance
(From February 2, 2009)

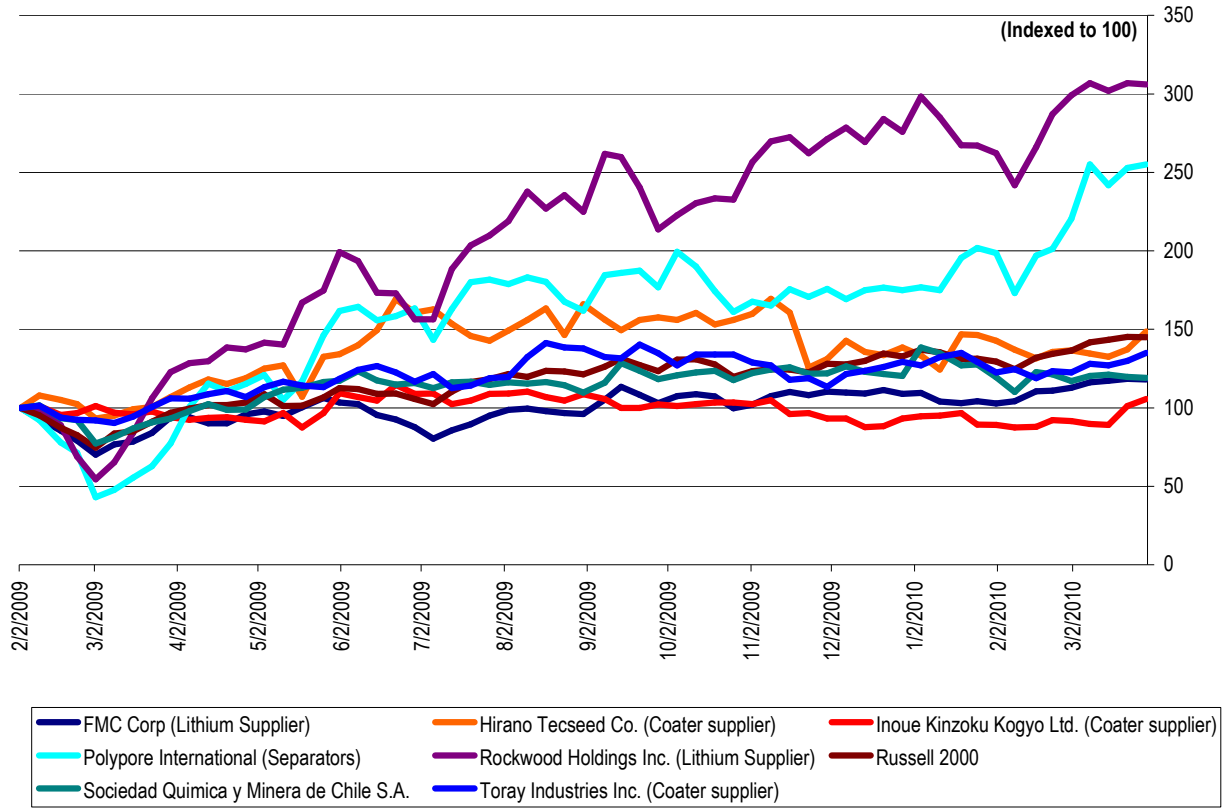


Index	Close on 3/29/2010	52-Wk High	% of 52-Wk High	Performance LTM	YTD	Week
Dow	10,895.9	10,985.3	99.2%	40.2%	4.5%	1.0%
S&P 500	1,173.3	1,180.7	99.4%	45.0%	5.1%	0.6%
NASDAQ	2,404.4	2,432.3	98.9%	58.5%	4.8%	0.4%
Russell 2000	682.3	693.3	98.4%	61.0%	8.6%	(0.1%)
AMEX Cleantech Index	1,056.1	1,112.5	94.9%	50.0%	(1.0%)	1.8%

Source: Bloomberg and ThomsonOne

Note: The select NAATBatt Index is a market-value-weighted average and includes ALTI, BASF, COP, ENS and XIDE. The Advanced Battery U.S. Index is a market-value-weighted average and includes HEV, MGA, MXWL, UQM and VLNC. The Advanced Battery China Index is a market-value-weighted average and includes BYD, CBAK, GS Yuasa, LG Chem and Panasonic.

Exhibit 4: Supplier Performance
(From February 2, 2009)



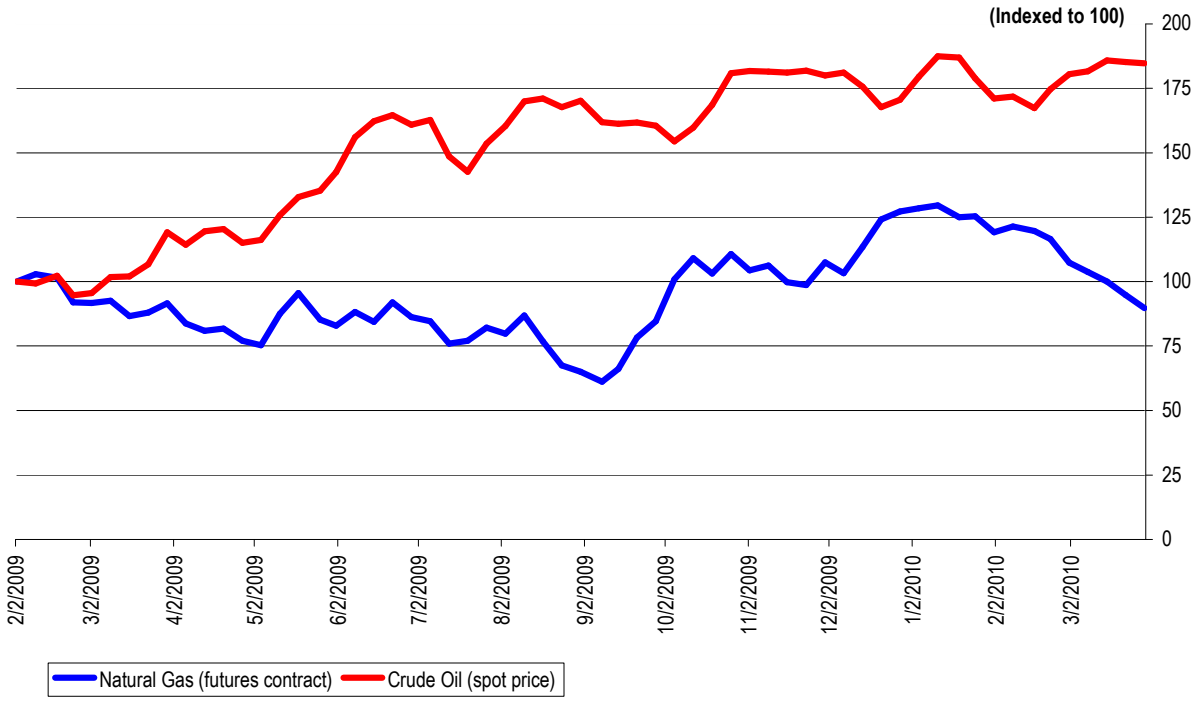
Source: Bloomberg

Exhibit 5: Commodity Prices

Commodity	Price on 3/29/2010	Price on 3/22/2010	Price on 3/1/2010	1 Week Change	1 Month Change
LME Nickel (Cash, $ per tonne)	23,925	21,290	21,365	12.4%	12.0%
LME Lead (cash, $ per tonne)	2,153	2,185	2,151	(1.5%)	0.1%

Source: LME

Exhibit 6: Natural Gas and Crude Oil
(From February 2, 2009)



Source: EIA