

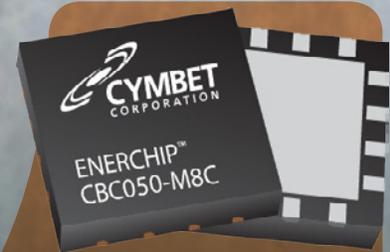
**Bill Priesmeyer**  
CEO of Cymbet

## CLEAN, EMBEDDED POWER

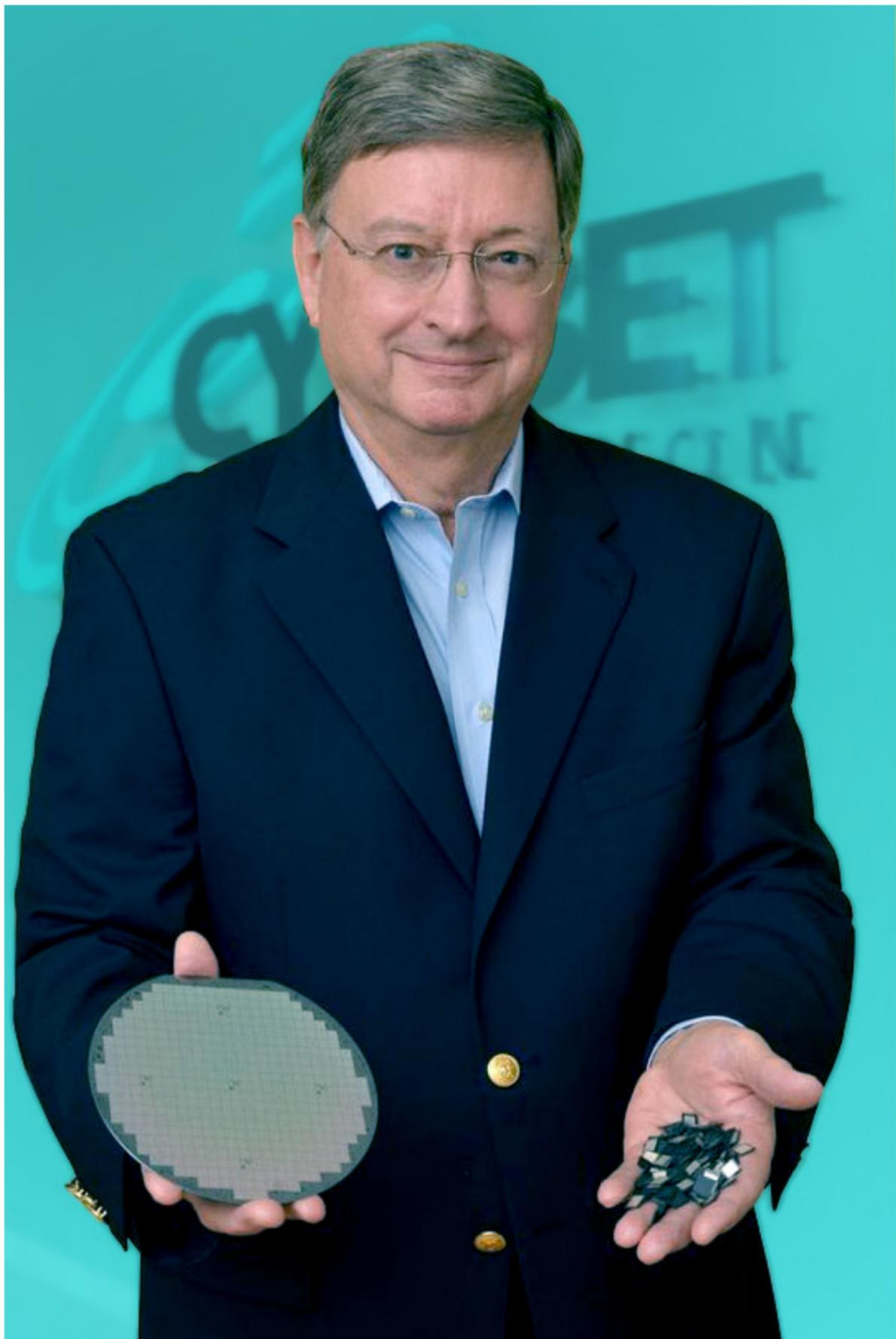
Cymbet's solid-state batteries offer system designers the embedded advantage.

### MCU WARS:

32-bit Microcontrollers



Cymbet's  
**ENERCHIP**  
Battery



Bill Priesmeyer, CEO of Cymbet

# CYMBET

## THE EMBEDDED ADVANTAGE

**Cymbet** is a clean technology company based in Elk River, Minnesota. Their eco-friendly, rechargeable solid-state batteries provide engineers with an array of new embedded power capabilities. With 33 employees, and about 90 patents granted and applied, Cymbet remains the only company in the solid-state battery space because of the business strategy they pursued.

We spoke with Bill Priesmeyer, CEO of Cymbet, about the unique technology the company is developing, the new markets the company is pursuing, and how these solid-state batteries offer engineers the embedded advantage.



**Could you give us an overview of Cymbet?**

The R&D facility was established in Minneapolis in 2001. The Company was started with the goal to commercialize solid state battery technology recently licensed from Oak Ridge National Laboratories, where it was developed. The technology received wide industry attention in the early days as a potential large battery replacement, but semiconductor technology did not really lend itself to these large format devices.

Strategically, Cymbet took a different direction by targeting low power devices for embedded IC applications – a market that did not really exist at the time, but one that was clearly emerging. As a technology company, we built the business to address what we saw as fundamental trends that would not be met by current technology: 1) a trend towards ultra-low power processors and clocks, 2) wireless smart devices and sensors, 3) component integration and miniaturization, 4) the preference for eco-friendly and renewable battery technology. While all this certainly has taken longer than we expected to develop, these trends are now firmly in place and accelerating. Currently, Cymbet has 36 employees, about 90 patents granted/applied, two manufacturing facilities and are the leaders in the supplying solid state batteries for electronic systems applications. We are the only solid state battery company in commercial, high volume production that addresses many markets.

Our product, the EnerChip™ rechargeable battery, is a new and unique silicon-based solid state device that works like a battery, lasts the life of the product, is small, thin, reflow tolerant for automated assembly and completely eco-friendly. We offer the EnerChip in bare die form for co-packaging with other ICs or packaged in plastic QFN/DFN style packages on tape and reel for SMT. The EnerChip CC is co-packaged with a Cymbet custom power management IC making it a “smart battery.” The EnerChip is available in range of capacities from 1uAh to 50uAh, with higher capacity devices coming soon. Just 10 years ago batteries of these capacities would not do much, but today they are a great fit with the “ultra-low power” revolution.

Our target markets are generally anyplace you would find a processor, a clock, or applications where the unique characteristics of small, permanently rechargeable battery are needed. The key segments are back-up power for processors and clocks, embedded energy that integrates power with other ICs, and energy harvesting or scavenging. Let me give a few examples.

The EnerChip can be used to back-up microcontrollers and real time clocks replacing coin cells or super capacitors in many applications. We find the greatest utility in this application is where space is limited or life-time reliability is of particular concern. We like to think of this application as a “UPS in a Chip.”

We have found that embedding or co-packaging an EnerChip bare die has a particularly strong appeal in the implantable medical field where low profile and high reliability facilitates miniaturization. A big advantage also is that the EnerChip is completely non-cytotoxic, so for medical devices – it’s safe.

The last area is energy harvesting or using available ambient energy to charge an EnerChip. Combining EH-powered EnerChips with a microcontroller, sensor and radio will function as a “self-powered” system. While still early, the advancements in component

power consumption and standards – Bluetooth Smart and IPV6 over 802.15.4 - are making these devices possible. We see a lot of interest in Internet of Things (IoT), wearables and other needs for a power source for these types of products in all market segments

**Could you tell me a little bit about your strategy and some of the companies you've partnered with, in terms of providing Cymbet as part of a solution?**

Our three target applications—back-up power, embedded energy, and self-powered devices—are all applicable in the key vertical market segments we serve: industrial, consumer, wireless, agriculture, handheld, security & safety, building controls, medical, transportation, military and aerospace. You will find EnerChip batteries in products being introduced in all of these segments. For example, handheld devices, white goods, medical sensors and therapies, industrial locks, communications equipment, security sensors, airborne electronics, pretty much anyplace where you need to design a low profile, low cost integrated battery to protect against a power interruption, droop or even a main battery swap-out for a microcontroller or a clock. Aerospace applications are also an example where the EnerChip battery can be used since it is completely air-transport safe and legacy batteries and super capacitors cannot be used for safety reasons.

As a company, Cymbet partners in several ways. First off we partner with companies that make devices we support – the industry leaders in the IC space – like Texas Instruments, NXP, Microchip, Freescale, etc. Secondly, for a relatively new company, our distribution and sales partners around the world are extraordinarily important to us, such as Digi-Key and Mouser in the U.S., Avnet Abacus in EMEA, GEC in Japan, Opto-sensor in China, and Seamax in Asia Pacific among them.

Thirdly, we have longer term partnerships with customers that are innovating disruptive new products enabled by a unique application of EnerChip solid state battery technology, especially in the medical and military fields.

Lastly, we are investing heavily to be the preferred power supply for energy harvesting to support the coming revolution in IoT,

wearables, self-powered sensors and devices, etc. Our ecosystems partners include the IC companies, providers of the various transducer technologies that turn light, heat, motion, vibration, or RF into energy that charge EnerChips, and of course our customers that want the competitive advantage of our technology.

**On the operations side, where are your devices manufactured?**

We currently have two manufacturing sites for EnerChips – Minneapolis, MN and Lubbock TX. The Minneapolis facility is our headquarters, R&D center and the smaller of Cymbet's two manufacturing facilities.

At the Lubbock, TX facility we have manufacturing and technical partnership with X-FAB Texas, a division of the German-based foundry company. Together we built a high-volume wafer manufacturing facility that utilizes a fab in a foundry concept. We do post-processing of the wafers in Asia, which is, as you might expect, is where most of the product actually is eventually destined.

**"The EnerChip can be used to back-up microcontrollers and real time clocks replacing coin cells or super capacitors in many applications."**



**Cymbet's EnerChip**

**"As a company, we are focused on ramping the acceptance of this disruptive technology where Cymbet has a solid value proposition and the markets are—or will be—underserved by current solutions."**

**You have a few different solutions and products that you sell. Which product is your most recently released?**

Our standard product family today ranges from 5uAhr to 50uAhr in capacity - rechargeable >5000 times - with sizes from 1.7x2.25mm to 5.7x6.1mm (essentially the same product in different die sizes). We have also supplied 1uAhr bare die devices that are 1x1mm. Those products are available as 1) a bare die, for high volume embedded applications 2) packaged with just the battery in QFM/DFM type plastic package or 3) co-packaged in a QFN/DFN with our custom power management ASIC that has the supply supervision, battery management and regulated output functions. That's what we'd refer to as the "smart, rechargeable battery." So we offer different battery capacities with the option of integrated power management.

As for new product offerings, we've recently announced a family of next generation systems level products we call the EnerChip RTC. The first product to the market is a 5x5 mm packaged device that integrates: a real-time clock chip, Cymbet solid state battery and a Cymbet custom power management ASIC. These EnerChip RTC devices are capable of supplying up to 100 hours of backup for a microcontroller or clock chip. What we've introduced is a tiny, low cost, all-in-one device that is reflow-tolerant, surface mountable chip package that's suitable for most any back-

up application and particularly for very tight spaces and very high-reliability applications. Today, you might see a coin cell or a super-capacitor as one component, and a real-time clock chip as another component on a board. The Cymbet CBC34123 simplifies and combines all that.

For the Cymbet CBC34123 EnerChip RTC product we've partnered with NXP for the RTC chip. We have also introduced the CBC34803 and CBC34813 products where we partnered with Ambiq Micro for their ultra-low power real-time clock chips that provide unique features our customers are requiring. We have had great customer feedback on these new EnerChip RTC solutions.

**Is the battery included in the NXP package for instance?**

It's actually the other way around. The NXP RTC is in the Cymbet package and is co-packaged with the Cymbet EnerChip and the Cymbet power management IC - it's actually an all-in-one Cymbet system level product with integrated power backup. It's a good example of how the EnerChip can improve a solution using our embedded energy approach.

To that end, Cymbet is implementing embedded energy with our IC and module partners to include EnerChip bare die into their packages. We share the view that there is significant value by providing an all-in-one package that is reliable, small-space, and which provides extraordinary backup times for the size of the package. In 2014, our Partners will be releasing new products that integrate EnerChips with sensors, MCUs, timers, A/Ds, energy storage, and power management in a single package.

**What future markets could you see Cymbet getting in to?**

I can give you a general idea of our thinking and what we are actually working on. We've tended to be realistic about large scale solid state batteries and the associated capital/technology investment required to be successful. As a company, we are focused on ramping the acceptance of this disruptive technology where Cymbet has a solid value proposition and the markets are - or will be - underserved by current solutions. That's why

our investors took the long view and bet on a silicon-based IC compatible format before the markets identified that a new power source would be needed to fulfill the requirements of the ultra-low power revolution. We still think those trends are right on, but we also recognize that we're really at the beginning of where this technology can go.

Our product roadmap is based on our robust existing technology platform that we will continue to build on from the standpoint of solid-state battery technology, silicon processing and intellectual property. This will allow us to move the technology forward to increase battery capacity, improve battery performance, continue to lower costs and further integrate devices in new and more sophisticated ways with both partner products and a new generation of devices.

We believe the Internet of Things (IoT) will be a significant application for ultra-low-power, self-powered devices, particularly sensors that are highly-integrated, very low cost, and that serve functions from wearable medical monitoring to security to environmental building controls to asset tracking. The environmental disaster of routinely replacing batteries in billions of sensor nodes must be avoided. We are spending a fair amount of our effort helping our partners and customers accelerate their IoT projects. Continued improvement of all the components must happen to realize the full potential of self-powered devices. We actually have about a quarter of our opportunities that want devices like these in the marketplace

**"The environmental disaster of routinely replacing batteries in billions of sensor nodes must be avoided."**

**What is a realistic storage capacity on the high-end of solid-state batteries?**

The 50 micro amp hours is currently our highest capacity standard device although the design engineer can scale these by using multiple devices. We do expect to continue to add battery capacity as the market indicates the need. Since we know there is no Moore's law for batteries, but there is tremendous need for improved technology, we have protected a few ideas along the way for making large format solid state batteries.

Given the focus of our business and the economics of the marketplace, the intersection of single device capacity for us is about 500uAh and perhaps to as much as 1 milliamp hour. At the low end of this range we believe 80 percent of our target markets can be addressed from a performance and economic standpoint.

We actually think the volume opportunity is great for Cymbet. By our analysis, when you think about the number of portable batteries sold in smart phones for example, those are in the low billions per year. When you think about the number of backup devices and primary power devices that serve a variety of existing markets today and what we see evolving, it's really in the hundreds of billions. That is why we believe we are very well positioned in a large and growing market with the growing need for a new power source.

We find there are many applications where legacy coin cell batteries and supercapacitors do not meet the design requirements of new innovative devices such as: small footprint, easy and cheap to assemble, superior electrical characteristics, safe to transport, safe disposal, and life of product energy storage. We created EnerChip rechargeable solid state batteries to meet exactly those types of design requirements and our customers are thrilled that we did. ■