COMPANY
Gridtential Energy

CITY
Santa Clara, CA

SOFTWARE
Autodesk CFD®
Simulation Mechanical®
Autodesk Inventor®

Designing The Next Generation of Lead Batteries Efficiently

Thanks to Autodesk® CFD and Autodesk Inventor®, battery prototyping through thermal and mechanical simulation is now more accurate, efficient and cost-effective than ever before

> We have seen a significant cost savings through the use of Autodesk Simulation and CFD, but the time savings has been even more remarkable. We estimate that we've saved as much as a year of our time, over the last five years, because we've been able to circumvent ordering the wrong parts and figure out exactly what parts work.
>
> **—Christiaan Beekhuis**
> CEO, Gridtential Energy

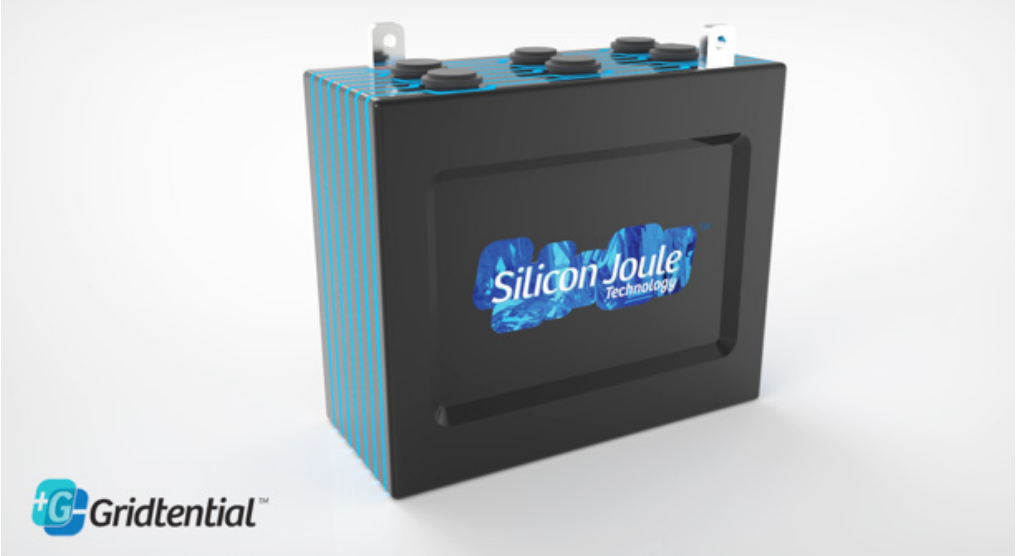

Image courtesy of Gridtential Energy

Gridtential Energy, an innovator in low-cost, high-performance energy storage technologies has developed batteries that combine the traditional benefits of lead with next-gen, lithium-like performance characteristics. The breakthrough stack cell architecture provides the battery with the power density associated with lithium technology while retaining the low cost, recyclability, long cycle life, wide temperature range and safety of lead.

All of this innovation started with Autodesk's green technology program, which presented Gridtential with software tools to help them get started on their goals. From the beginning, Gridtential has saved thousands of man-hours through the use of complex simulations within Autodesk CFD. Batteries are expensive to produce, but with these tools from Autodesk the company can now circumvent the traditional prototyping phases and start off right with a design that they know will work.

The Challenge: Cost Effective Prototyping

Gridtential's greatest challenge has been integrating its proprietary silicon wafers into lead batteries expeditiously and cost-effectively. As the company sought to streamline its design process, Autodesk was with the team from the start. Autodesk's Green Technology Program provided Gridtential with three years of free software, and has been foundational to the company's initial success, according to CEO, Christiaan Beekhuis. Since Gridtential's licensing model requires the company to improve existing lead battery designs and leverage established infrastructure, Gridtential could have made tens of physical prototype iterations before designing its battery architecture. However, Gridtential has been able to overcome time intensive prototype iterations and design its proprietary Silicon Joule architecture much faster.

The Solution: Silicon Joule's Premium Performance

The Autodesk stress analysis portfolio and CFD, along with Inventor, have allowed Gridtential to meet its need for rapid battery design and to avoid expen-sive physical prototyping.

"Technology from Autodesk has allowed us to simulate our new silicon wafer-based battery design with a unique architecture and platform," according to Gridtential's CEO.

Silicon Joule replaces the lead grids in conventional batteries with coated silicon solar wafers. The simplified, stacked architecture doubles the available energy density and discharge rate, eliminates 40% of the lead traditionally used, and still achieves high efficiency and an increased cycle life. Per kilogram of material, silicon and lead are in the same category for conductivity, but the silicon wafers allow more energy to be extracted from the same lead content.

This solution has been made possible by Autodesk's simulation and design technologies, which have allowed Gridtential to reduce the lifecycle cost of renewable energy, and ultimately license its technology to global lead battery manufacturers, enabling the $40B industry to compete against new and emerging technology threats without gigascale capital investments.

Performance improvement over traditional lead batteries is achieved by an architectural modification rather than by electrochemical changes, which allows battery manufacturers to maintain proprietary advantages in paste formulation, market positions, and distribution channels. Patented silicon wafer plates provide premium performance advantages, including:

- **2x depth and rate of discharge**
- **90% efficiency**
- **2-5x cycle life**

> We now have a low cost, sustainable, recyclable battery that allows energy to be extracted at a higher rate.
>
> **—Christiaan Beekhuis**
> CEO, Gridtential Energy

The Result: Battery pioneers embrace new innovation in lead

Autodesk tools helped Gridtential design its patented Silicon Joule technology and has given the company thousands of hours back along the way. To date, Gridtential has secured seven major manufacturing partners, built and tested more than 250 batteries, and issued 10 patents and provisional patents, covering use of silicon as a substrate. Two of Gridtential's U.S. licensing partners' represent over 30% of the US market.

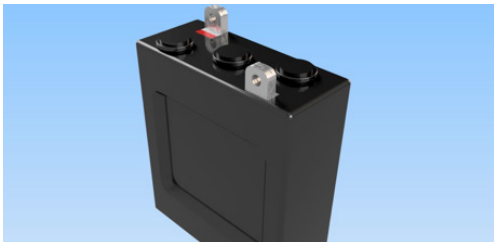

Image courtesy of Gridtential Energy

Each new battery application relies on Autodesk design capabilities, which can be realized in Inventor, CFD, and Simulation Mechanical. By frontloading the design process and iterating through the Autodesk platform, Gridtential has saved significant time and money while developing an innovative, custom battery solution for an established industry.

> Technology from Autodesk has allowed us to simulate our new silicon wafer based battery design with a unique architecture and platform.
>
> **—Christiaan Beekhuis**
> CEO, Gridtential Energy

AUTODESK.