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From: Stanton, John W
Sent: Friday, June 06, 2014 7:59 AM
To: Yvonne Hinson-Rawls
Cc: Viehe, Kathy E; Beaulieu, David E; Chase, Todd N.
Subject: Fuel Cells

Yvonne,

You have asked a couple times about fuel cells. Mark Vesky (spelling?) keeps mentioning the Bloom Box. We will get you info to RUC but here is info on the Bloom Box fuel cell. The comments in red are mine.

The Bloom Energy Server (the Bloom Box) is a solid oxide fuel cell (SOFC) made by Bloom Energy, of Sunnyvale, California, that can use a wide variety of inputs meaning it still requires fuel (including liquid or gaseous hydrocarbons[1] produced from biological sources) to generate electricity on the site where it will be used.[2][3] It can withstand temperatures of up to 1,800 °F (980 °C), that would cause many other fuel cells to break down or require maintenance.[4] According to the company, a single cell (one 100 mm × 100 mm metal alloy plate between two ceramic layers) generates 25 watts size of refrigerator light bulb.[5]

Bloom stated that two hundred servers have been deployed not sold in California for corporations including eBay, Google, and Wal-Mart.[6]

The Bloom Energy Server uses thin white ceramic plates (100 × 100 mm)[7] that are made from "beach sand". Each plate is coated with a green nickel oxide-based ink on one side, forming the anode, and another black (probably Lanthanum strontium manganite) ink on the cathode side.[8][9] According to the *San Jose Mercury News*, "Bloom's secret technology apparently lies in the proprietary green ink that acts as the anode and the black ink that acts as the cathode..." but in fact these materials are widely known in the field of SOFCs. *Wired* reported that the secret ingredient may be yttria-stabilized zirconia based upon US patent that was granted to Bloom in 2009; but this material is also one of the most common electrolyte materials in the field.[10] US patent 20080261099 , assigned to Bloom Energy Corporation, says that the "electrolyte includes yttria stabilized zirconia and a scandia-stabilized zirconia, such as a scandia ceria stabilized zirconia". ScSZ has a higher conductivity than YSZ at lower temperatures, which provides greater efficiency and higher reliability when used as an electrolyte. Scandia is scandium oxide (Sc_3O_2) which is a transition metal oxide that costs between US$1400 to US$2000 per kilogram in 99.9% pure form. Current annual world wide production of scandium is less than 2,000 kilograms. Most of the 5,000 kilograms used annually is sourced from Soviet era stockpiles.

To save money, the Bloom Energy Server uses inexpensive metal alloy plates for electric conductance between the two ceramic fast ion conductor plates. In competing lower temperature fuel cells, platinum is required at the cathode.[8]

History

In October 2001, CEO K.R Sridhar met with John Doerr from the venture capital firm Kleiner Perkins.[13] Sridhar asked for more than $100 million to start the company. Bloom Energy eventually received $400 million of start-up funding from venture capitalists, including Kleiner Perkins[8] and Vinod Khosla.[14]

The company, originally called Ion America, was renamed Bloom Energy in 2006.[15]

Sridhar credited his nine-year-old son for the name, saying that his son believed jobs, lives, environment, and children would bloom.[16] Michael R. Bloomberg appeared at the launch by video link.[17] Bloomberg's business news network covered the event, but attributed every statement to "Bloom Energy".[18]

The CEO gave a media interview (to *Fortune Magazine*) for the first time in 2010, eight years after founding the company, because of pressure from his customers.[11] A few days later he allowed Lesley Stahl of the CBS News program *60 Minutes* to see the factory.[19] On February 24, 2010, the company held its first press conference.[15]

Bloom Energy's well-known customers include Walmart, Staples, AT&T, Adobe, CocaCola, Ebay, Google, Bank of America, FedEx, Life Technologies,[20] and Safeway.

Costs

Installation

The current cost of each hand-made 100 kW one tenth of one MW Bloom Energy Server is $700,000–$800,000. In 2010, the company announced plans plans not products for a smaller, home sized Bloom server priced under $3,000.[8] Bloom estimated the size of a home-sized server at 1 kilowatt, although others recommended 5 kW. A typical central air conditioning system is 2kW to 5kW by itself.

The capital cost is $7–8 per watt. Very expensive. US Energy Information Administration 2010 update on cost of generation has pulverized coal at $3.17, advanced gas combined cycle at $1, biomass (with BFB boiler like GREC) at $3.80 and fuel cell at $6.84

According to the New York Times (Green Blog), in early 2011 "... Bloom Energy ... unveiled a service to allow customers to buy the electricity generated by its fuel cells without incurring the capital costs of purchasing the six-figure devices.... Under the Bloom Electrons service, customers sign 10-year contracts to purchase the electricity generated by Bloom Energy Servers while the company retains ownership of the fuel cells and responsibility for their maintenance.... 'We're able to tell customers, 'You don't have to put any money up front, you pay only for the electrons you use and it's good for your pocketbook and good for planet,' ' [CEO K.R. Sridhar] said."[23]

Usage

On 24 February 2010, Sridhar claimed that his devices were making electricity for 8–10 cents/kWh using natural gas, cheaper than today's electricity prices in some parts of the United States not cheaper than in Florida, such as California.[24][25] Twenty percent of the cost savings depend upon avoiding transfer losses that result from energy grid use. These devices are not "utility scale" for central station generation. They are distributed generation and I absolutely expect them to be competition for GRU in the future, possibly by 2020. Savings to a home owner come from not being connected to the grid and paying for the distribution system. They are powered by gas, which a home owner can't buy cheaper than a utility. They are less efficient in turning a BTU of gas into a kW-h of electricity than an advanced combined cycle unit. BUT …if you don't pay the utility for use of its grid (i.e., go it alone with no backup) your bill can be less. One more thing; the cost to maintain the grid is relatively independent from how many people are using it. Therefore, the fewer users the higher cost to those still using.

Bloom Energy claimed to be developing power purchase agreements to sell electricity produced by the boxes, rather than selling the boxes themselves, in order to address customers' fears about box maintenance, reliability, and servicing costs.[19]

As of 2010, fifteen percent of the power at eBay was created with Bloom technology; after tax incentives subsidized! that covered half the capital costs. eBay expects "a three-year payback period" for the remaining half, based on California's $0.14/kWh cost higher than ours of commercial electricity.

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