Bloom Box

Mohammed Ajmal. A ,Nisanth. N ,Yogeshwari.R
Department of Computer Science,Sri Krishna Adithya College Of Arts And Science

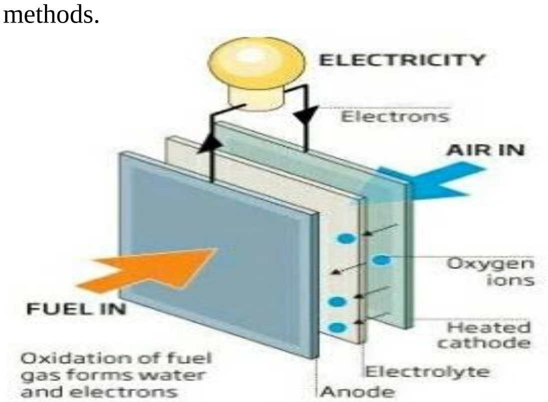
Abstract
We have many problems due to produce electricity for during generation and future generation. So we need to produce electric energy in the form of reliable, flexible, less polluting and continuous supply of electric energy from a cheap material. The Bloom Energy is the manufacturer of solid oxide fuel cells. It is the 'heart of every energy server'. Solid oxide fuel cell is defined as the 'distributed generation solution that is clean and reliable and affordable all at the same time'. "A solid oxide fuel cell is an electrochemical cell that converts a source fuel into an electrical current. .The reactants flow into the cell and reaction products flow out of it while the electrolyte remains within it. Each fuel cell, which consists of a metal alloy plate sandwiched between two ceramic layers, generates 25 watts of power. A single fuel cell can power a light bulb, but a one solid oxide fuel cell is producing 2KW electricity. Bloom refers to as "legacy fuel cells". Our paper shows how to produce this kind of electric energy, that Energy is called as 'Bloom energy'. the solid oxide fuel cells are as efficient as much as doubly efficient as a conventional power plant. Solid oxide fuel cell made by methane and oxygen.

Keywords - *Oxide fuel cell, bloom box, bloom energy server, solid oxide fuel cell, Bloom box fuel cell, SOFC.*

I. INTRODUCTION

The most prominent modern application of the solid oxide fuel cells is the "Bloom Box" whose history stems from Dr. K. R. Sridhar's research group for the NASA Mars exploration program. The latest Bloom Box model, the Bloom Energy ES-5000 which can intake natural gas, hydrogen, or even garbage dump gas costs $700,000-800,000 (Bloomberg, 2010).Its proven reliability and economic efficiency has been shown in eBay's decision to use this SOFC fuel source in generating 15% of the electricity consumed in its main San Jose, California headquarters. It is capable of generating 100kW, enough electricity for approximately 100 homes. This seemingly miraculous technology does come with a few disadvantages and hurdles however. As a result, Bloom Boxes may be vulnerable to breaking down if not managed and serviced properly. Most of the dangers of such a high operating temperature are harnessed, but it still causes some hindrances when it comes to efficient operation. .

This conversion technique gives much higher conversion efficiencies than conventional thermo-mechanical methods. A fuel cell operates as long as both fuel and oxidant are supplied to the electrodes, and the influence it exerts on the surrounding environment is negligible.The use of this product is no mistake as it is highly economical, generating electricity at 8 to 10 cents a kilowatt hour, albeit with subsidies from the state of California, much lower than the usual commercial cost of electricity at 14 cents/kilowatt hour. A fuel cell operates as long as both fuel and oxidant are supplied to the electrodes, and the influence it exerts on the surrounding environment is negligible. Fuel cells are devices that convert fuel into electricity through a clean electro-chemical process without any combustion. Besides the high upfront capital costs, solid oxide fuel cells also relies on extremely high operating temperatures, around 800-1000 degrees Celsius. This conversion technique gives much higher conversion efficiencies than conventional thermo-mechanical methods.



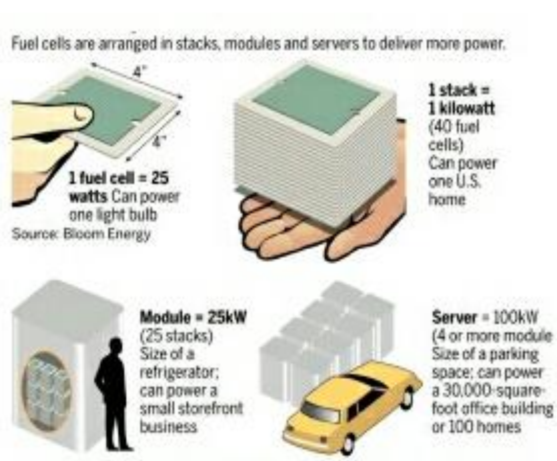
II. HISTORY OF BLOOM BOX

In October 2001, K.R Sridhar C.E.O had a meeting with John Doerr from the large venture capital firm Kleiner Perkins. Bloom Energy has received $400 million of start-up funding from venture capitalists, including Kleiner Perkins and Vinod Khosla. The company, originally called Ion America, was renamed to Bloom Energy in 2006. Sridhar credited his nine-year-old son for the name, saying that his son believed jobs, lives, environment and children would bloom. Sridhar was asking for more than $100 million to start the company. The CEO gave a media interview to the Fortune Magazine for the first time in 2010, eight years after establishing the company, because of pressure from his customers. On February 24, 2010, the company held its first press conference. The company, originally called Ion America, was renamed to Bloom Energy in 2006.

III. SOLID OXIDE FUEL CELL

A SOFC is like a rechargeable battery that always runs. It Consists of three parts: an electrolyte, an anode, and a cathode. In Bloom's SOFC, the electrolyte is a solid ceramic square made from a common sand-like powder. The Bloom server does not require chemicals, such as the corrosive acids used in conventional fuel cells. A SOFC is a type of fuel cell valued for its potential market competitiveness, with high efficiency in fuel input and electricity output. One side of the ceramic electrolyte plate is coated with a green nickel oxide-based ink that works as an anode; the other side, which works as a cathode, is coated with black ink. it uses inexpensive metal alloy plates for electric conductance between the two ceramic fastion conductor plates, as opposed to the use of costly precious metals like Gold or Platinum that are used for high conductance in other fuel cells.

Each Bloom Energy fuel cell is capable of producing about 25W of energy, which is enough to power a light bulb. A few stacks together (about the size of a loaf of bread) are enough to power an average U.S. home. In an Energy Server multiple stacks are aggregated into a "power module"; and multiple power modules, along with a common fuel input and electrical output, are assembled as a complete system. The current Energy Server in the market has the capacity to generate 100kW of electricity. For more power, multiple cells are mounted together, along with metal interconnect plates, to form a fuel cell stack. When more power is required—for example, for commercial or industrial sites—multiple Energy Serve systems can be deployed side by side.



The electro-chemical process within SOFC requires a high operating temperature for its reactions to take place. Oxygen ions combine with the reformed fuel to produce electricity, water, and a small amount of carbon dioxide gas. The continuous supply of fuel, air, and heat constantly generates the electricity from the cell. At a high temperature, warm air enters the cathode side of the fuel cell. The resulting steam mixes with the fuel to produce reformed fuel; this reformed fuel enters the anode side, and a chemical reaction takes place. The continuous supply of fuel, air, and heat constantly generates the electricity from the cell.

IV. APPLICATION OF BLOOM

Businesses have been required to install many different energy technologies to address all their energy needs. If they simply wanted clean power, they installed solar panels or purchased Renewable Energy Credits. . To ensure power reliability, they purchased costly backup solutions. In addition to clean, reliable, affordable electricity, Bloom customers can realize a multitude of other advantages:

A. *Carbon sequestration*

The electrochemical reaction occurring within Bloom Energy systems generates electricity, heat, some H2O, and pure CO2. The pure CO2 emission allows for easy and Costeffective carbon sequestration from the Bloom systems.

B. *Time To Power*

The ease of placing Bloom Energy Servers across a broad variety of geographies and customer segments allows systems to be installed quickly, on demand, without the added complexity of cumbersome combined heat and power applications or large space requirements of solar. Fast installation simply requires a concrete pad, a fuel source, and an internet connection.

C. *Hydrogen production*

Bloom's technology, with its NASA roots, can be used to generate electricity and hydrogen.

D. *Reverse Backup*

Businesses often purchase generators, uninterruptible power supplies and other expensive backup applications that sit idle 99% of the time, while they purchase their electricity from the grid as their primary source.

E. *DC power*

Bloom systems natively produce DC power, which provides an elegant solution to efficiently power DC data centers and/or be the plug-and-play provider for DC charging stations for electric vehicles.

V. INSTALLATION COST OF BLOOMENERGY

The current cost of each hand-made 100 kW Bloom Energy Server is $700,000–800,000. Bloom estimates the size of a home sized server as 1 kilowatt, although cNet News reports critical estimates recommend 5 kW capacities for a residence. The capital costs according to Newsweek magazine is $7–8 per watt.

On 24 February 2010, Sridhar told Todd Woody of The New York Times that his devices are making electricity for 8–10 cents/kWh using natural gas, which is cheaper than today's electricity prices in some parts of the United States, such as California.

On 24 February 2010, Sridhar told Todd Woody of The New York Times that his devices are making electricity for 8–10 cents/kWh using natural gas, which is cheaper than today's electricity prices in some parts of the United States, such as California.

Bloom Energy is developing Power Purchase Agreements to sell the electricity produced by the boxes, rather than sell the boxes themselves, in order to address customers' fears about box maintenance, reliability and servicing costs.

A. Efficiency

Each Bloom Energy Server provides 100kW of power, enough to meet the base load needs of 100 average homes or a small office building. Current gas fired power stations convert chemical energy to thermal energy to mechanical energy to electrical energy. The CEO of eBay says Bloom Energy Servers have saved the company $100,000 in electricity bills since they were installed in mid-2009, yet Paul Keegan of Fortune calls that figure "meaningless without the details to see how he got there. Sridhar says Bloom Boxes convert chemical energy to electrical energy in one step, and are more fuel efficient than current gas fired power stations and also reduce transmission/distribution losses by producing power where it is used.

B. Portable Units

Sridhar plans to install Bloom Energy Servers in third world nations. Bloom Energy board member, said the Bloom Energy generators could be useful to the military because they are lighter, more efficient, and generate less heat than what the military uses now.

C. Feasibility

Bloom Energy Server technology is based upon stacking small fuel cells which operate in concert. USA Today claims that Bloom Energy has made a technological advance by developing stacked fuel cells where individual plates expand and contract at the same rate at high temperatures, however many other solid oxide fuel cell producers have solved that problem in the past. Scott Samuelsen of the University of California, Irvine National Fuel Cell Research Center questions how long the reliable operational life of Bloom Servers will be. According to BBC tech blogger Maggie Shields, Bloom Energy is "being very coy and playful about what it will reveal to the press". . If Bloom Energy can develop such a technology, Kanellos predicts that established energy firms such as General Electric would derive most of the profits due to greater ability to manufacture and market a product. Jacob Grose, senior analyst at Lux Research told Fortune Magazine that he doubts Dr. Sridhar has come up with a way of making these ceramic fuel cells cheaply enough to be truly revolutionary. Energy Server is cheaper and cleaner than the grid. An expert at Gerson Lehrman Group, wrote that, given today's electricity transmission losses of about 7% and utility size gas fired power stations efficiency of 33-48%, the Bloom Energy Server is up to twice as efficient as a gas fired power station. Bloom Energy Server technology is based upon stacking small fuel cells which operate in concert. Fortune noted on 24 February 2010 that "Bloom has still not released numbers about how much the Bloom Box costs to operate per kilowatt hour" and estimates that natural gas rather than bio-gas will be the primary source of fuel for Bloom Energy Servers.

VI. ADVANTAGES OF BLOOM BOX

1.The obtained anode showed good electrical conductivity and polarization resistance.

2.We synthesized a core-shell Ni–YSZ composite powder by a high speed mixing technique.

3.A Nano Ni–YSZ powder can be obtained by heat-treating the Ni–YSZ in air atmosphere.

4.Low cost raw materials.

5.The Perovskite anode can be used in any Solid Oxide Fuel Cell.

6.The single phase $LaMnO_3$ fine powder was obtained after milling only for 30 min.

7.Simplicity of the Process and the ability to obtain fine powder.

8.The world fuel sell Market is predicted to more than triple by 2005 to US$8.5 billion, and exceed US$23 billion by 2010.

9.Nano-sized grains smaller than 30 nm.

10. Good adhesion.

11. The coating processes were completed at the room temperature.

VII. DISADVANTAGES OF HIGH TEMPRATURE SOFC

1.Operation at less than 700°C means that low cost metallic materials.

2.Reducing the operation temperature significantly reduces corrosion rates.

3.Material costs are high, particularly for interconnect and construction materials.

4.In high temperature SOFC the interconnect may be a ceramic such as lanthanum chromite, or, if the temperature is limited to <1000°C, a sophisticated refractory alloy .

5.Operation of the SOFC at a reduced temperature can overcome some of these problems and bring additional benefits.

6.Reducing operating temperature simplifies the design and materials requirements of the balance of plant.

7.Stack construction materials and balance of plant also need to be refractory enough to contain and manipulate the high temperature gas streams.

8.Lower temperature operation offers the potential for more rapid start up and shut down procedures.

VIII. SAVE MONEY AND ENVIRONMENT

The efficiency built into Bloom's fuel cell systems allows a typical customer to achieve a 3-5 year financial payback making it an easy and economically sound choice. Customers can also reduce their co2 emissions by 40%-100% compared to the U.S. grid.

Bloom allows you to save money first.

IX. USEAGE

The bloom energy offers increased electrical reliability and improved energy security. providing a clear path to energy independence. The bloom energy provides following benefits:

A. Lower Cost Energy Source

The bloom energy enables the user to produce their own energy at much lower cost which there are paying today. To achieve this bloom energy is using widely available, inexpensive materials, leveraging proven manufacturing techniques, and delivering an extremely efficient system which is twice as efficient as conventional technologies.

B. Fuel Flexible

Bloom energy server is able to run of wide variety of renewableand fossil fuels. This enables the customer to choose between best suited fuel for their budget and availability.

C. Sustainability

This technology uses renewable and fossil fuels in such a way that it produces maximum energy with less emission which will ensure a sustainable future.

D. Increased Reliability and Scalability

Bloom energy is able to provide 24/7/365 power supply. It is very reliable, stable and easy to use. It is scalable and can be used as per the power requirement. To produce more power we can attach as many power units as we want.

E. Simple Installation and Maintenance

This system requires no maintenance from user end. The company handles all the management and maintenance. Its design results into easy installation and low space requirements.

Company claims that the bloom energy box can produce the electricity for 8-10 cents/kwh using natural gas which is cheaper than current electricity prices in some parts of United States such as California. Twenty percent of bloom energy server cost saving depend upon avoiding the transmission losses that results from energy grid. Bloom energy is looking forward for power purchase agreements to sell the electricity produced by the boxes, rather than selling the boxes themselves, in order to address the customers fear about box maintenance, reliability and serving costs. This approach will make the bloom energy technology certainly more competitive to most of other technologies.

Bloom energy can be primarily used for industrial purposes but as company predicts it will come up with small versions of bloom energy server "The Bloom Box" which will cost around $3000 can be used for domestic purposes. But it will take around three to five years to produce such a product on economy of scales.

Bloom energy is also finding its usage in military and space application. There is a huge market waiting for product like bloom box if bloom energy is able to provide such product then a new energy era will begin where world will enjoy clean and cheap energy.

X. CRITISIM

Over ten years the bloom will generate 8,760,000kWh. At 50% efficiency, it will consume 600,000 therms of natural gas. This makes a total cost of $1,220,000 and ten year electricity cost of $0.14/kWh. These numbers are highly optimistic and assume zero maintenance, zero downtime, minimal installation costs, and optimistic efficiency. The high capital costs of the Bloom $7–8/watt make the economic feasibility of the bloom questionable. With a natural gas price of $0.86 per therm, it would cost $520,000 in fuel with a capital cost of $700,000.

XI. CONCLUSION

One potentially disruptive feature of the technology is that it works both ways: fuel can produce electricity, but it can also go the other way so that electricity produces fuel. The electricity from the solar panels could produce fuel, which can be used to produce electricity to power the house or even to gas up your car. The costs should come down over time to the point where Bloom boxes really can be used in homes. Additionally it needs to be compared to other equivalent renewable technologies.

REFERENCE

[1] M. Tsuchiya, B. K. Lai, and S. Ramanathan, "Scalable nanostructured membranes for solidoxide fuel cells," Nature Nanotechnology, 6, 282-286 (2011).

[2] Energy and National Security Program Center for Strategic and International Studies.Www.bloomenergy.com

[3] http://www.bloomenergy.com

[4] A. C. Johnson, A. Baclig, D. Harburg, B.K. Lai and S. Ramanathan, Journal of Power Sources, 195, 1149 (2010) Fabrication and electrochemical performance of thin film solid oxide fuel cells with large area nanostructured membranes.

[5] www.linkedin.com/company/bloom-energy

[6] http://www.csmonitor.com/USA / Society /2010/0222/Bloo m-box-what-it-is-and-how-does-it-work.

[7] http://www.engadget.com / 2010 /02 /22 /the-bloom-box-apower-plant-for-the-home.

[8] B. K. Lai, H. Xiong, A. C. Johnson, M. Tsuchiya and S. Ramanathan, Fuel Cells, 9, 699 (2009) Microstructure and microfabrication considerations for self-supported on-chip ultrathin micro solid oxide fuel cell membranes

[9] A.C. Johnson, B.K. Lai, H. Xiong and S. Ramanathan, Journal of Power Sources, 186, 252 (2009) An experimental investigation into micro-fabricated fuel cells utilizing ultra-thin LaSrCoFeO3 cathodes and yttria-doped zirconia electrolyte films B.

[10] Lai, A. C. Johnson, H. Xiong and S. Ramanathan, Journal of Power Sources, 186, 115 (2009) Ultra-thin nanocrystalline Lanthanum Strontium Cobalt Ferrite thin films synthesis by RF-sputtering and temperaturedependent conductivity studies

[11] www.greentechmedia.com/articles/read/the-price-on-bloom-energy.

[12] www.linkedin.com/company/bloom-energy.

[13] Avadikyan, A., Cohendet, P., &Heraud, J. (Eds.). (2003). The Economic Dynamics of FuelcellTechnologies.Berlin,Newyork:Springer.