**To:** Clare Cordero, SJSU

**From:**  Bloom Energy Consulting Firm

**Subject:** Proposal for R&D project to integrate Bloom Energy SOFC

**Date:**  October 27, 2015

**Introduction and Purpose**

The purpose of this memo is to introduce our company Bloom Energy. We are a part of the consulting division at Bloom Energy. Our goal is to provide research and development plans in transitioning or integrating alternative energy on existing energy sources. We will evaluate ground breaking technologies that can substantially make a difference in our changing environment and implement these technologies to customers that share the same interest. Our client is San Jose Municipal District and the California Energy Commission. We propose that the city of San Jose integrate alternative energy sources using SOFC (Solid Oxide Fuel Cells) blocks to the residential sector as a pilot run. Using SOFC as a source of energy can provide more energy, with less harm to the environment. Bloom Energy is a manufacturer of SOFC blocks and there is measurable success in integrating these blocks to each household. The key to the success of our proposal is to make the SOFC blocks the primary source of energy in the city of San Jose and make the grid the secondary source.

**Summary**

The proposal will be based on Bloom Energy’s strong breakthrough in the energy industry with our use of SOFC. Our product currently serves medium to large size companies such as Ebay and Walmart, however, it would be advantageous for both us and the consumer, such as homeowners, to implement our SOFCs. In order to form an adequate proposal, we must try to find an answer to a few questions: How can fuel cells be used in the City of San Jose ? How much will it cost to implement a fuel cell energy system? How will the San Jose Municipal and the California Energy Commission benefit from SOFC? How will SOFC compare with other alternative energies? In order to answer these questions, we will use various methodologies to gain a better understanding and in turn construct an effective proposal. To do this we will need to use various sources, namely journal articles that are recent, relevant, and peer reviewed as well as information from reputable websites. Once we have compiled this information, we will need apply this knowledge to formulate a strong and cohesive argument for the implementation of our SOFCs. For our final proposal, we would like to present the SOFCs in a manner in which it is determined to be the undisputed, most effective and efficient form of energy than any other alternatives. We would like to present data that backs up this claim, however, we would also acknowledge the shortcomings that come with this technology. Despite the contentions made from other forms of energy, we would like to be the obvious choice for not only the City of San Jose, but the State of California.

To answer these questions the proposal will cover the following topics:

1) The details of the proposal.

2) Background and history of energy generation. This will also cover the evolution and the

motivation to alternative energy.

3) Advantage and disadvantages of different type of energy generation.

4) Advantage and disadvantages of SOFC

5) Cost of integrating SOFC

The design method to implement the integration of SOFC to the residential sector is as follows:

1) Evaluation of individual household - Power and cost analysis.

2) Evaluation of safety, gas storage, and reusability.

3) Installation of SOFC. Known methods suggested by Bloom Energy.

4) Data Analysis and recommendation to homeowners.

**Description of Gantt Chart**

1. The first step we need to take it to Write the memo and presentation for our proposal and we would work on it over the weekend, through google docs.
2. 10/27/201-10/30/2015 - Research About Bloom Energy and Fuel Cells.
3. 10/31/201-10/31/2015 - Meet to Split up roles, including the different writing each person has to do.
4. 10/31/2015-11/8/2015 - Finish Title Page/ Letter of Transmittal/ Executive Summary/ Table of Contents.
5. 11/8/2015-11/15/2015 - Finish Scope of Work/ Environmental Aspects/ Technical Aspects.
6. 11/15/2015-11/19/2015 - Proofread and Edit Report to make sure nothing is missing.
7. 11/19/2015-11/22/2015 - Create a Formal Presentation and Practice Presentation.
8. 11/22/2015-11/23/2015 - Go through final checklist and make sure paper meets all apa criteria.
9. 11/23/2015-11/24/2015 - Evaluate other group members and make sure paper is ready for final submission.

**Conclusion**

SOFC can be used to provide clean and inexpensive energy. Fuel cells have a higher efficiency than gas or diesel engines, which make them the better source of reliable energy. Our consulting group is trying to implement SOFC that Bloom Energy makes to utilize in San Jose’s Energy System. We will show why SOFC are a better means of energy than nuclear power. Our goals are in line with the Green Vision Goals of San Jose by creating clean tech jobs and receiving electric power from clean, renewable sources. Our team will create a proposal that we will give to the City of San Jose to persuade them into using SOFC to improve their energy system.

**References**

Cunningham, W, & Cunningham, M (2006). *Principles of environmental science: Inquiry and applications*. New York: Mcgraw Hill.

Mohit

Singhal, S. C. (2014). Solid oxide fuel cells for power generation. *WIREs Energy and Environment, 3*(2), 179-94. doi:10.1002/wene.96

This article discusses how fuel cells can generate power and how people can use this power. Since our proposal is to convince Bloom Energy to make fuel cells in the

residential area for the average citizen to use. We can talk about how fuels can make clean energy for people living in the city of San Jose.

Wen, H., Ordonez, J. C., & Vargas, J. V. C. (2013). Composite electrode modelling and optimization for solid oxide fuel cells. *International Journal of Energy Research, 37*(2), 95-104. doi:10.1002/er.2941

This article is important because it discusses how solid oxide fuel cells can be made more efficient to supply more power. This can be useful in our report because then we can explain how fuel cells can become more efficient to benefit its users.

Smithsonian Institution. (2008). Fuel Cell Basics. Retrived from : <http://americanhistory.si.edu/fuelcells/basics.htm>

This reference gives a basic idea to how fuel cells work and their benefits. It goes into a detailed explanation of fuels cells and the internal reaction it uses to create energy.

Max

Triphob, N., Wongsakulphasatch, S., Kiatkittipong, W., Charinpanitkul, T., Praserthdam, P., & Assabumrungrat, S. (2012). Integrated methane decomposition and solid oxide fuel cell for efficient electrical power generation and carbon capture. *Chemical Engineering Research & Design, 90*(12), 2223-2234. doi:10.1016/j.cherd.2012.05.014

This article compares the effectiveness of methane decomposition (MD) as a fuel processor to as opposed to methane steam reforming (MSR) for a methane-fuelled solid oxide fuel cell (SOFC) system. This would allow for us to determine the most effective form of a solid oxide fuel cell.

Yang, W., Zhao, Y., Liso, V., & Brandon, N. (2014). Optimal design and operation of a syngas-fuelled SOFC micro-CHP system for residential applications in different climate zones in china. *Energy and Buildings, 80*, 613-622. doi:10.1016/j.enbuild.2014.05.015

This article provides insight into the optimal design for solid oxide fuel cells in smaller residences throughout China in various climates. This study will provide tremendous insight due to its relevance of residential use of SOFCs.

Noel

Herron, S., & Williams, E. (2013). Modeling Cascading Diffusion of New Energy Technologies: Case Study of Residential Solid Oxide Fuel Cells in the U.S. and Internationally. Environmental Science & Technology, 47(15), 8097-8104. doi:10.1021/es400063a

This article illustrates models of new energy technology, SOFC, to be adopted to reduce the cost of energy. This is an important part of our group pitch because it will help plan how the government subsidy can help reduce the cost and project policies. This journal also takes into account combined heating and power delivery. It talks about market curves and how to develop experience curves.

Ellamla, H. R., Staffell, I., Bujlo, P., Pollet, B. G., & Pasupathi, S. (2015). Current status of fuel cell based combined heat and power systems for residential sector. Journal Of Power Sources, 293312-328. doi:10.1016/j.jpowsour.2015.05.050

This article highlights the residential cogeneration system using SOFC. The models demonstrate the methodology needed to generate power and heat, system description, and the performance analysis. It also highlights the energy consumption compared to conventional system.

Anahit

Betts, D. A., & Graham, M. (2015). Development of a Fuel Cell Integrated Combined Power and Air Conditioning System. *ASHRAE Transactions*, *121*(2), 1-8.

This article provides information on how fuel cells can be incorporated within household appliances such as air conditioners. It outlines the difference between gas powered air conditioners and a new type of air conditioner which is a hybrid known as combined air conditioning and power system (CACP). The article provides design methods and many testing results to show how less energy is consumed.

Kerman, K., & Ramanathan, S. (2014). Performance of solid oxide fuel cells approaching the two-dimensional limit. *Journal Of Applied Physics*, *115*(17), 174307-1-174307-7. doi:10.1063/1.4874738

This article shows how efficient solid oxide fuel cells are when in use. It also provides detail on how fuel cells perform near the second dimensional limit of usage. This is helpful in determining how efficiently solid oxide fuel cells can be used to provide power to residential levels infrastructure.

