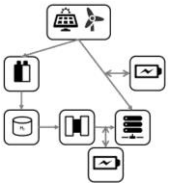
DEFN-14-230

PROJECT DEFINITION

APPROVALS			
ROLE	**NAME**	**SIGNATURE**	**DATE**
Team Leader	Blake Lane		2/18/15
Advisor	Jack Brouwer		2/20/15
Experimental Leader	Sam Heller		2/18/15
Budget Leader	Lizette Chavez		2/18/15
Theoretical Leader	David Kim		2/18/15
Member	Calvin Nguy		2/18/15
Member	Ben Ordanza		2/18/15
Member	Brian Fritchman		2/18/15



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Document Number:	DEFN-14-230
Document Name:	Project Definition
Release Date:	2/10/15
Author:	Blake Lane
Version:	-

Fuel Cell

Revision History

REV	DESCRIPTION	DATE	APPROVED BY
-	Initial Release	2/10/15	Blake Lane

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1 PROJECT OVERVIEW

1.1 Executive Summary

This project aims to design a 100 MW data center that runs entirely on clean, renewable energy. We will determine which renewable energies to use; possibilities include solar, wind, hydro, and other energy sources. The data center will ideally be powered by these energy sources when possible, to decrease potential areas for power loss. Due to the varying nature of most renewable energy sources, we will design an energy storage system that will take electricity from times of excess and store it as hydrogen using an electrolyzer. The hydrogen will then be used in a fuel cell at times when the data center is not receiving enough power from the other sources. Because fuel cells do not respond quick enough to the demands of servers, batteries will also store energy to be used on transient responses of the servers.

After research, we have found that solar and wind power will be the best renewable sources of energy for this project. Therefore, we will direct our study on a system with solar panels, wind turbines, an electrolyzer, fuel cells, and batteries.

To determine the specifications for the data center, we will be conducting small scale experiments on the individual sections. We will measure the wind speed using an anemometer. Through the use of a computer model, we will determine an appropriate power output from the wind speed. We will use the solar panels to determine how much power we can generate from the sun. We will also connect a server to the solar panels to see how directly using solar power will affect the server. We will take data from an electrolyzer to determine how quickly we can make hydrogen and other relevant specifications. We will use the hydrogen to fuel the fuel cell which will power the servers. Batteries will provide power at times when the fuel cell cannot meet the demand fast enough.

When we have gathered the relevant data, we will extrapolate to design a full scale 100 MW data center.

See project specification sheet for further details.

2 PROJECT DETAIL

2.1 Project Objectives

Objective 1 – Determine required specifications for each component of the 0.5 kW model

1. Calculate requirements for solar panels, wind turbines, fuel cells, and energy in order to meet the 0.5 kW requirements
2. Requirements include power output, size, and connectivity specifications

Objective 2 – Gather data from the model

1. Measure voltage and current generated from the solar, wind, and fuel cells
2. Measure load demand of the server rack in different load situations
3. Measure required time for the fuel cell to ramp up to the load variation of servers

Objective 3 – Analyze data from the model

1. Determine what mix of solar and wind energy provides the most power per dollar
2. Determine cheapest adequate mix of battery and hydrogen energy storage
3. Determine whether direct renewable or power through electrolyzer is desired

Objective 4 – Design a 100 MW data center that runs on hydrogen and renewable energy

1. Scale model results to meet a power output of 100 MW
2. Consider cooling needs and different methods

2.2 Scope Details

We will be analyzing individual, small scale models of each part of our full scale data center design. We will then extract our model findings to make a full scale design. We will not be making a small scale model of the entire system.

2.3 Project Milestones

Milestone Name	Target Date	Comments
Finish Preliminary Research	12/8/15	Finish research fall quarter
Submit Order Forms	1/27/15	Must finish to start building
Build Testing Rigs	3/13/15	Get preliminary data for review

2.4 Project Team

#	Name	Project Role	Email	Phone	Standing	Units
1	Blake Lane	Team Leader	balane@uci.edu	(714)-925-5025	Senior	4
2	Sam Heller	Exper. Leader	hellers@uci.edu	(650)-339-1396	Senior	2
3	Lizette Chavez	Budg. Leader	lchavezf@uci.edu	(949)-836-4234	Senior	4
4	David Kim	Theor. Leader	DavidKim327@gmail.com	(818)-350-3055	Senior	3

5	Calvin Nguy	Member	cnguy93@yahoo.com	(707)-771-0988	Senior	4
6	Ben Ordanza	Member	ordanzab@uci.edu	(714)-858-0753	Senior	3
7	Brian Fritchman	Member	brian.fritchman@sbcglobal.net	(949)-380-9871	Senior	3

2.5 Steering Team

#	Name	Title	Steering Role	Email	Phone
1	Jack Brouwer	Professor	Advisor	jbrouwer@uci.edu	(949)-824-1999x221

2.6 Project Costs Estimation

Project Expense	Comments	Est. Amount ($)
Solar panel (x2)	Generate solar power for server	600
Solar cable, 100 ft (x2)	Connect panels to server	100
Solar cable, 6 ft (x2)	Connect panels together	15
Clamps for panels	Secure solar panels to frame	40
Roof mounts for panels	Rails to hold solar panels	120
Y Branch adaptor cable	Connect panels in parallel	15
Solar power meter	Collect for solar power data	100
Wind anemometer	Collect wind speed data	350
Shipping	Shipping cost	300
	Total	*1,640*

2.7 Resource Estimation

Name	Est. Hours	Rate ($/hr)	Est. Total ($)
Blake Lane	480	45	21,600
Sam Heller	240	45	10,800
Lizette Chavez	480	45	21,600
David Kim	360	45	16,200
Calvin Nguy	480	45	21,600
Ben Ordanza	360	45	16,200
Brian Fritchman	360	45	16,200
Jack Brouwer	30	100	3,000
Total	*2,790*		*127,200*

3 Project Risks and Communication

3.1 Risk Mitigation Plan

Risk	Severity	Probability	Mitigation
Losing members	High	High	Decrease scope of project
Lower funding	High	Medium	Decrease scope of project

3.2 Communication Plan

Communication Type	Audience	Frequency	Responsibility
Weekly Meeting	Everyone	Weekly, Monday	Blake Lane
Email	Everyone	Twice weekly	Blake Lane
Group texting	Students	Daily	N/A

4 Additional Project Details

N/A