College of Engineering, Forestry, and Natural Sciences Dept. of Mechanical Engineering

Solar Irradiance Measuring Device

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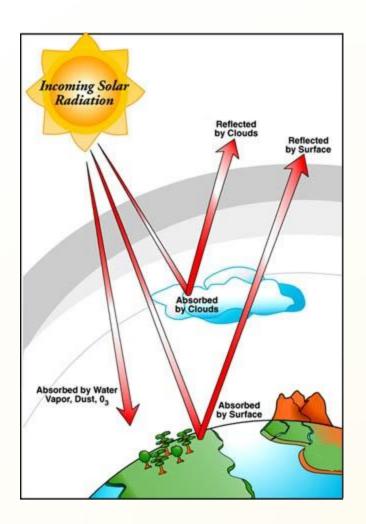
10/12/2012

Overview

- Introduction
- Need identification
- Needs and goals
- Objectives
- Constraints
- Quality Function Deployment
- Project timeline

Irradiance Definition

- Energy flux $\left[\frac{W}{m^2}\right]$
- Changes with weather
 Inconsistent output
- Variance data used to determine viability of solar site

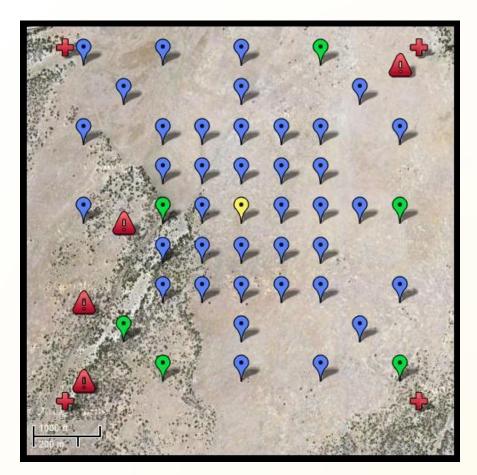


Clients

- NextEra Energy
 - Construction and operation of energy production sites
- WindLogics
 - Analysis of viable energy sites
- Institute for Sustainable Energy Solutions
 - Dr. Tom Acker

Current Site

- Located at COBar Ranch
 - 35 miles north of the San Francisco Peaks
- 1 square mile
- 50 sensors



Needs Identification

- Current problems:
 - Large number of devices in use
 - Long set-up time / permanent
 - Data collection errors
 - Large area usage
 - Access issues
 - High cost

Needs and Goals

Need Statement:

The current system is inefficient with its use of land, man hours, and produces poor data.

Goal:

Design a relatively small, portable solar irradiance measuring system that can accurately quantify variance in solar irradiance over a larger area.

Objectives

Objectives	Basis for Measurement	Units
Scales Down	Fit into Current Site	Square Feet
GPS Location	Data Collection	Feet
Easy Set-up/Operation	Data Collection	Time
Longevity	Durability	Months
Size	Transportable	Cubic Feet
Weight	Manageable	Lbs
Cost	Inexpensive	\$\$

Constraints

- Data Correlation
- A_{surface} ≤ 7800 ft² (100 ft diameter circle)
- Safe data storage
- Setup Time ≤ 16 Man Hours
- Stand Alone Functioning
- Accurate sensor location
- Synchronous data collection
- Cost
- Longevity

Quality Function Deployment

	Engineering Requirements								
	Surface area	Set-Up Time	GPS Location	Data Storage	ΔTime	Longevity	Packed Sized	Weight	Cost
Scales Down Current Site	Х						Х		
Useable Data Collection			Х	X	X				
Store Data Safely				X		X			X
Easy to Set Up		X						Х	X
GPS Location for Each Sensor			Х	X					
Stand Alone Functioning				X		X			X
Time Stamped Data				X	Х				
Inexpensive	Х								X
Units	ft ²	hours	ft	days eq.	S	months	ft ³	Lbs	\$
	~7800	16	±1	30	1	14	30	50	5000
	Engineering Targets								
	Useable Data Collection Store Data Safely Easy to Set Up GPS Location for Each Sensor Stand Alone Functioning Time Stamped Data Inexpensive	Scales Down Current SiteXUseable Data CollectionStore Data SafelyEasy to Set UpGPS Location for Each SensorStand Alone FunctioningTime Stamped DataInexpensiveXUnitsft²	Scales Down Current SiteXUseable Data CollectionIStore Data SafelyIEasy to Set UpXGPS Location for Each SensorIStand Alone FunctioningITime Stamped DataIInexpensiveXUnitsft²hours	Scales Down Current SiteXScales Down Current SiteScales Down Current SiteXScales Down Current SiteXScales Down Current SiteXScales Down Current SiteScales Down Current SiteXScales Down Current SiteXScales Down Current SiteXScales Down Current SiteScales Down Current SiteScales Down Current SiteXScales Down Current SiteScales Down Current SiteScales Down Current SiteScales Down Current SiteScales Down Current SiteXScales Down Current SiteXScales Down Current SiteScales Down Current Site <td>Scales Down Current SiteXImage: Scales Down Current SiteImage: Scales Down Current SiteImage:</td> <td>Scales Down Current SiteXSSS<</td> <td>Scales Down Current SiteXUseable Data CollectionXXXXStore Data SafelyXXXXGPS Location for Each SensorXXXXStand Alone FunctioningXXXXTime Stamped DataXXXXInexpensiveXXXXYYIYY</td> <td>Scales Down Current SiteXScales Down Current SiteXXXUseable Data Collection-XXXXStore Data SafelyXXXEasy to Set Up-XXX-GPS Location for Each SensorXXXX-Stand Alone Functioning-XXX-Time Stamped Data-XXX-InexpensiveXWith StateTime Stamped DataInexpensiveXWith StateWith StateStand Alone FunctioningTime Stamped DataTime Stamped DataWith StateWith StateWith StateWith StateWith StateWith StateWith StateWith StateWith State</td> <td>Scales Down Current SiteXImage: Scales Down Current SiteImage: Scales Down Current SiteImage: Scales Down Current SiteImage: Scales Down Current SiteImage: Scales Down Current</td>	Scales Down Current SiteXImage: Scales Down Current SiteImage:	Scales Down Current SiteXSSS<	Scales Down Current SiteXUseable Data CollectionXXXXStore Data SafelyXXXXGPS Location for Each SensorXXXXStand Alone FunctioningXXXXTime Stamped DataXXXXInexpensiveXXXXYYIYY	Scales Down Current SiteXScales Down Current SiteXXXUseable Data Collection-XXXXStore Data SafelyXXXEasy to Set Up-XXX-GPS Location for Each SensorXXXX-Stand Alone Functioning-XXX-Time Stamped Data-XXX-InexpensiveXWith StateTime Stamped DataInexpensiveXWith StateWith StateStand Alone FunctioningTime Stamped DataTime Stamped DataWith StateWith StateWith StateWith StateWith StateWith StateWith StateWith StateWith State	Scales Down Current SiteXImage: Scales Down Current SiteImage: Scales Down Current SiteImage: Scales Down Current SiteImage: Scales Down Current SiteImage: Scales Down Current

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Recapitulation

Goal:

Design a relatively small, portable solar irradiance measuring system that can accurately quantify variance in solar irradiance over a larger area.

Why:

To determine viability of a solar energy site at COBar Ranch.

How:

Project Timeline

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	27 28 29 30 1 2 3 4 5	6 7 8 9 10 11 12 13 14	15 16 17 18 19 20 21 22 23 24	25 26 27 28 29 30 31 1	2 3 4 5 6 7 8 9 10	11 12 13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28 29 30) 1 7
Needs Identification		247 (55) 552 (52)247 (55) 552 (52)247 (55)		0 MR 00 90 MR 00 90	- 19 - 196 - 185 - 189 - 199 - 197 - 183 - 189 - 199 - 1	K 193, 10° 100 147, 283, 10° 102 147, 183, 1	0° 10° 14° 653 10° 10° 14° 553 10° 10	- 14C - 143
Meet with client								
Needs Statement	¥ {Tim Tormey}							
Gantt Chart	{Wes Hills}							
Problem Statement								
Goals and Objectives	{Allie Venezia}							
Flowchart	{Joey Cavaretta,Nick J	lurik}						
Constraints	{Peter Journell, Joey Cav	varetta}						
QFD	{Peter Journell, Joey Cav	varetta}						
Concept Generation & Selection				1				
Initial Website Setup		{Wes Hills}						
Engineering Analysis								
Final Design and Proposal					+			
Report 1	•							
Presentation 1		*						
Presentation 2				•				
Report 2				•				
Presentation 3					*			
Report 3					•			
Presentaion 4							*	
Report 4							•	
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Resources

- Dr. Thomas Acker
- Dr. David Wiley
- Twidell, John, and Weir, Tony. *Renewable Energy Resources*. New York: Taylor and Francis Group, 2006.

Questions