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

Solar Irradiance Measuring Device

Joey Cavaretta

John Hills

Peter Journal

Nick Jurik

Tim Tormey

Allie Venezia

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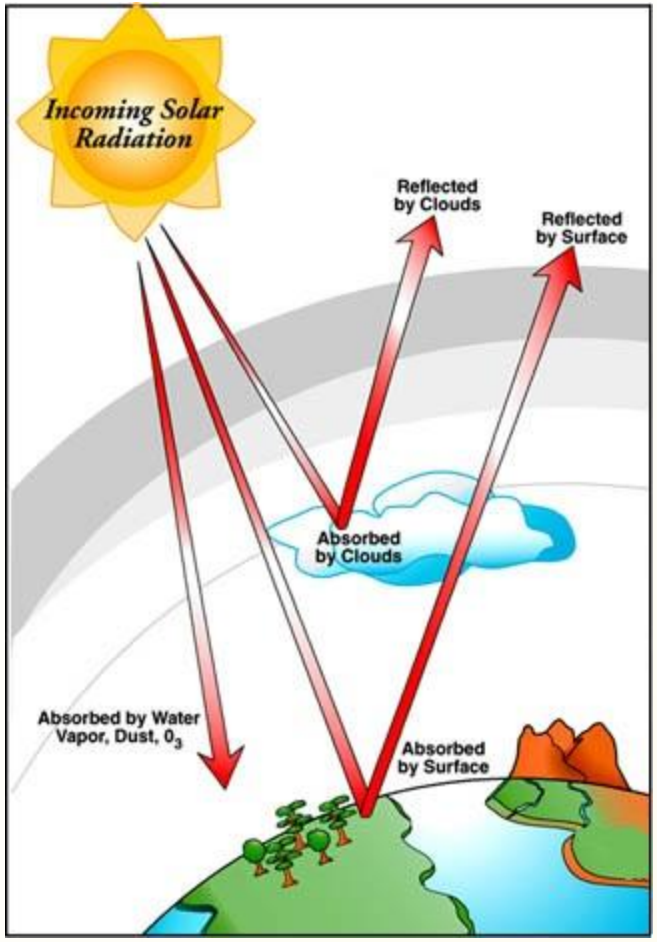
Overview

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

Irradiance Definition

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

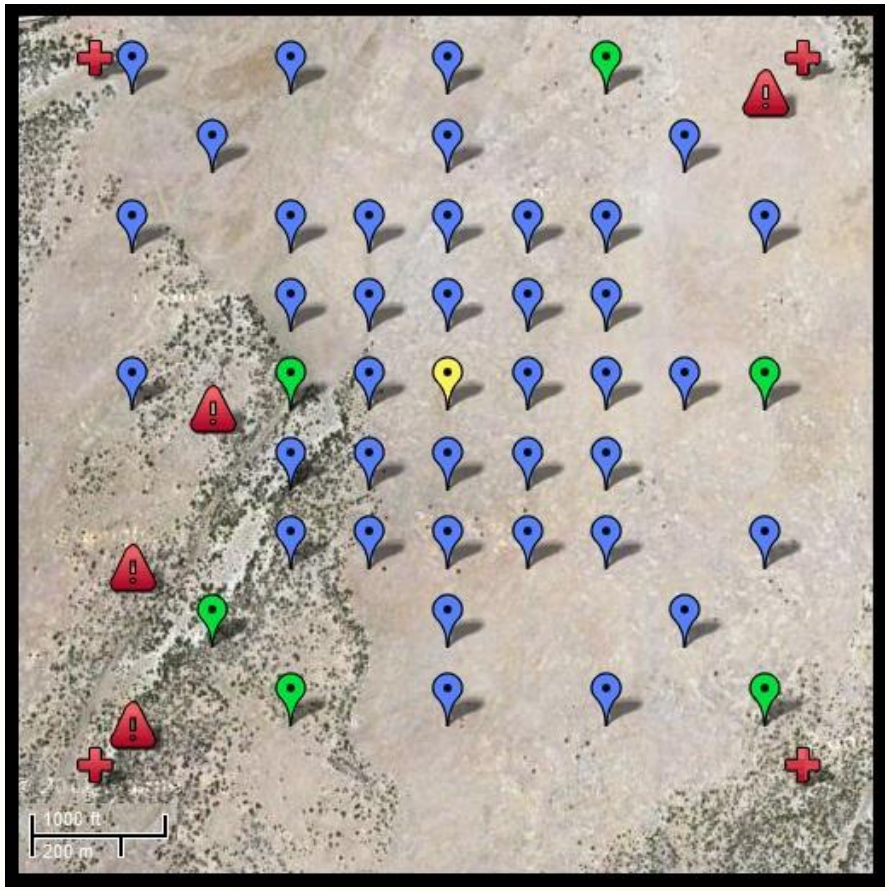


Clients

- **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.

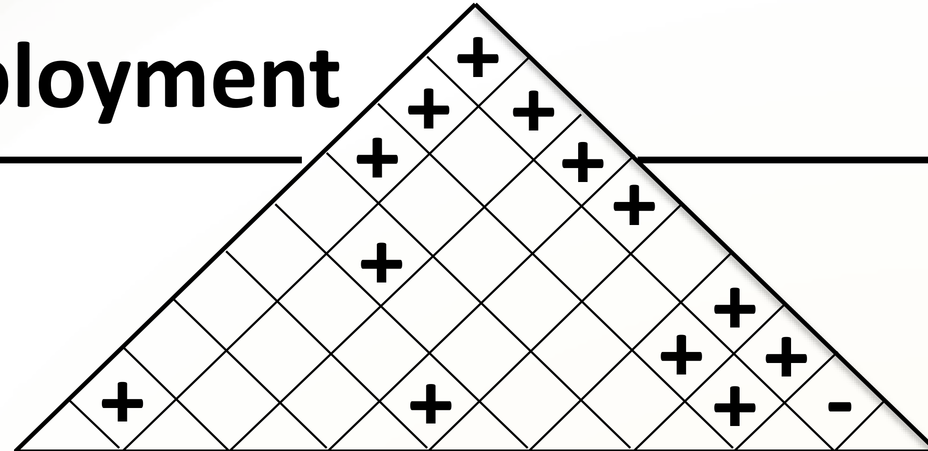
Objectives

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
- $A_{surface} \leq 7800\ ft^2$ (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



Customer Requirments	Surface area	Set-Up Time	GPS Location	Data Storage	ΔTime	Longevity	Packed Sized	Weight	Cost
	Engineering Requirements								
Scales Down Current Site	X						X		
Useable Data Collection			X	X	X				
Store Data Safely				X		X			X
Easy to Set Up		X						X	X
GPS Location for Each Sensor			X	X					
Stand Alone Functioning				X		X			X
Time Stamped Data				X	X				
Inexpensive	X								X
Units	ft^2	hours	ft	days eq.	s	months	ft^3	Lbs	$
Engineering Targets	~7800	16	±1	30	1	14	30	50	5000

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:

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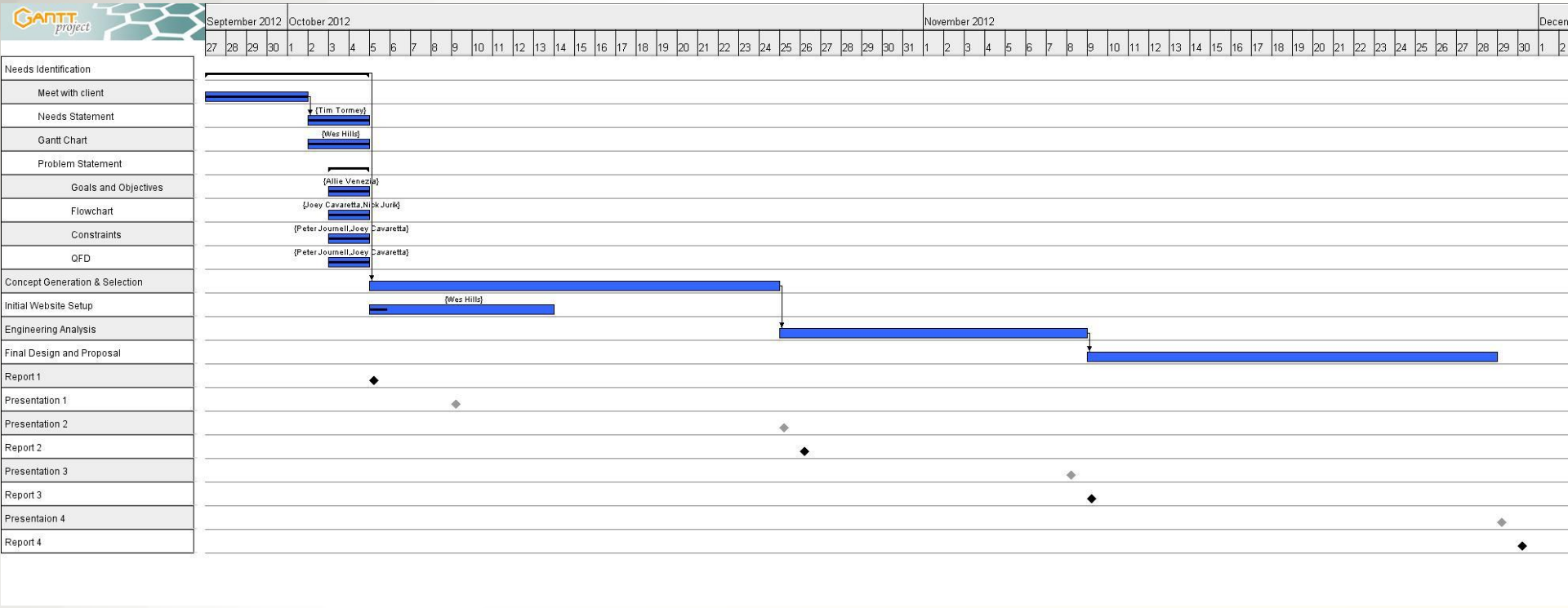
Project Timeline



Resources

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

Questions