UCSD Jacobs | Mechanical and Aerospace Engineering

Clean Renewable Energy Bond Applications

A funding case study in San Diego, CA

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Outline

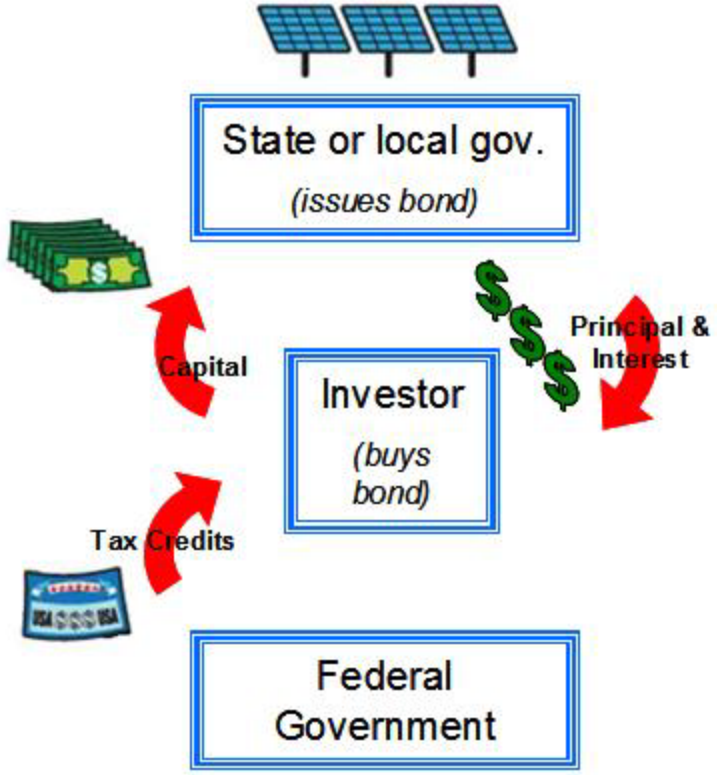
- Introduction to CREBs
- Involvement
- Application Requirements
- Our Approach
- Analysis Tools
- Results

Introduction

- A number of incentive programs are currently available to balance costs of PV installations:
  - California Solar Initiative (CSI) Incentive
  - Clean Renewable Energy Bond (CREBs) (tax credit bonds)
- CleanTECH San Diego was interested in boosting renewable energy funding in San Diego using these funding sources

Clean Renewable Energy Bonds (CREBs)

- Alternative to other municipal financing
- Tax-credit bonds (interest free)
- In 2009, $2.4 billion was made available
- Municipalities must apply first, including analysis of potential systems and then seek investors



http://financere.nrel.gov/finance/content/financing-renewable-energy-government-facilities

Involvement

- Proposed by Byron Washom, UCSD with guidance from CleanTECH San Diego
- Graduate Course Project, Prof. Jan Kleissel
- Goal to create simple analysis tool for CREB applications
- January - August 2009




CREB Application Requirements

- Information needed for application
  - Identify the Issuer and Borrower
  - Certification by an independent, licensed engineer that the project is eligible and technically viable
  - Location, dollar amount, and plan to obtain necessary regulatory approvals
  - Projected place in service date
  - Detailed description of the plan financing
    - Sources of Security and repayment of CREBs (general obligation or revenue pledge), and face amount of all bonds used
  - **Expected spending schedule and requested dollar amount of the CREBs**

Project Goals

- Obtain maximum amount of funding for San Diego County Solar Projects
- Marin County (2008) obtained the most funding in the nation by the “divide and conquer” approach
  - Separate applications for each building
  - CREB bonds awarded from smallest to largest project
- Application could not exceed site load

Our Approach

- “Divide and Conquer”
- Needed to process a large volume of applications per applicant (school district, municipality, etc)
  - Applications were applied on a per-building basis
- Tool needed to be designed that was easy to use
  - Minimal training required

Design Considerations & Assumptions

- 3 Installation Types (Assumptions)
  - Rooftop (70% useable area)
  - Parking Structure (50% useable area)
  - Ground based (70% useable area)
- Cost per square foot
  - Based on UCSD Kyocera installations
  - Assumed $100 per square foot
- Fixed, South-facing panels

CREB Analysis Tool

- Creation of Excel Spreadsheet
- Used Google Earth for area calculations
- Used PV Watts for solar potential calculations
- Generates report directly useable in CREB application
- Used by UCSD Students, San Diego Unified School District Students and others

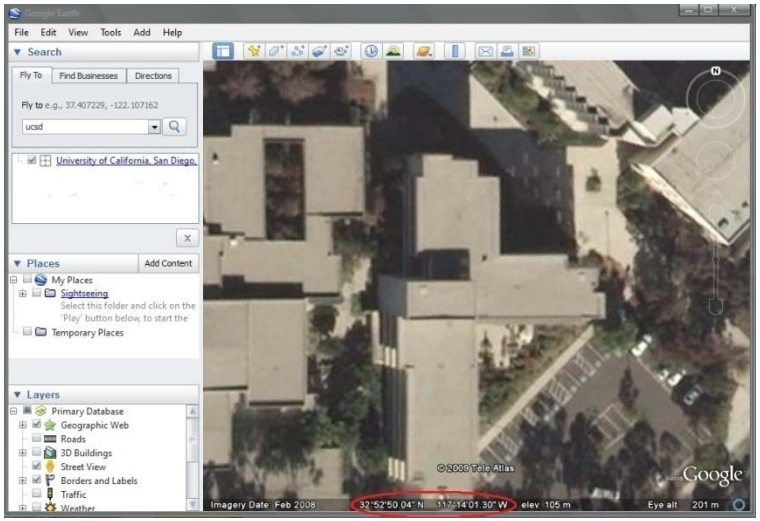
An Applied Example

- Download/load the file **solarassessment.xls**
- On “Front” Sheet; enter the “Name” of the location and “Address Line 1” and “Address Line 2” into the provided cells
- Run Google Earth (http://earth.google.com/) and find rooftop
  - Enter latitude/longitude from Google Earth, (Bottom of Screen) into the spreadsheet

Required Input

Location Name:	Name of Location	***Optional Pa***
Address	Address Line 1	
	Address Line 2	

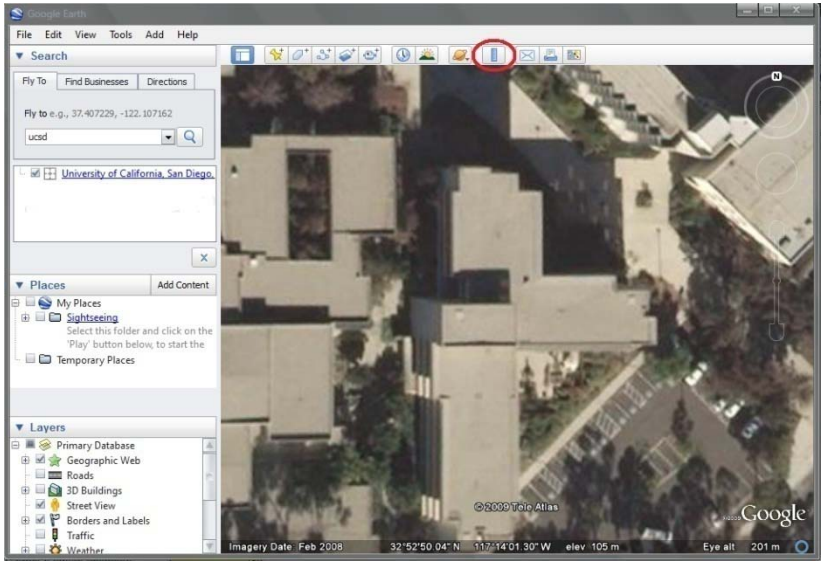
From Google earth				
	Degrees	*minutes*	*seconds*	
Lat				N
Long				W
Type of location	Roof (20 degree)			
Area of roof(ft^2)				



Step By Step

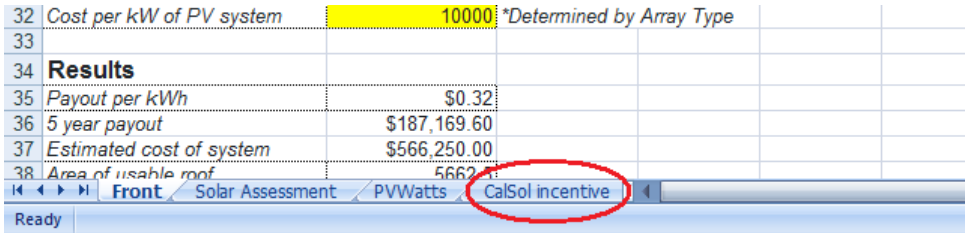
- Select the type of system in the Excel file: Roof (*with 20 degree tilt*), Parking Structure (*with 10 degree tilt*), or Ground (*tilt based on latitude*).
- Use the ruler tool to measure the area of the rooftop from the displayed screen.
- Enter the “Estimated Electricity Cost” in cents/kWhr.
  - 24 cents/kWh is default

System qualities	
Array Type	Fixed Tilt
Electricity cost (cents/kWh)	17.288



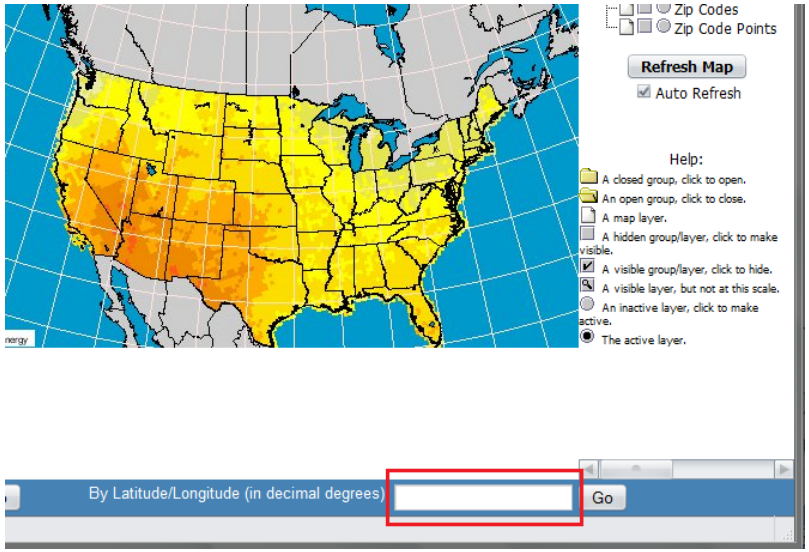
Step By Step

- Enter the “Estimated Electricity Cost” in cents/kWhr.
  - 24 cents/kWh is default
- Pick Cal Sol Step level.
  - More information on “CalSol incentive” Sheet



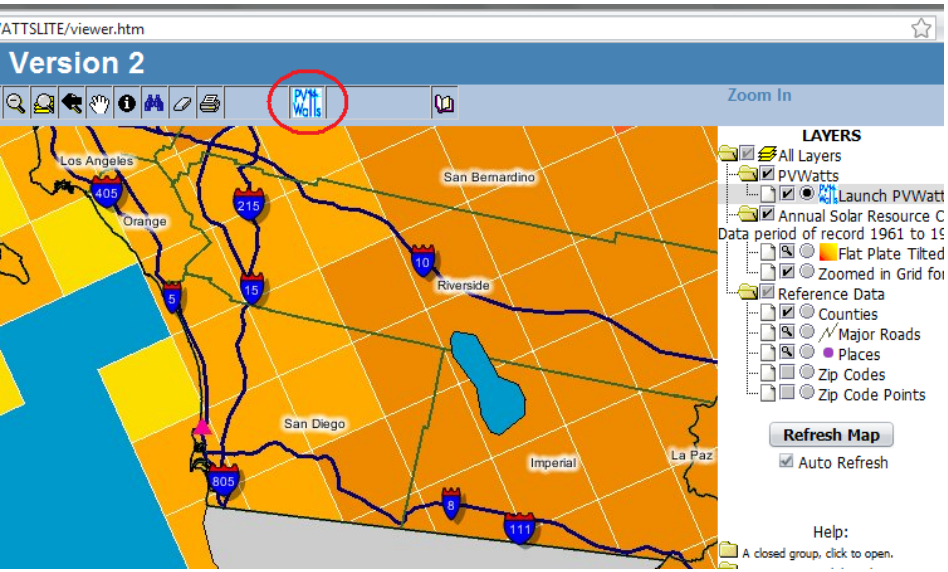
Step by Step

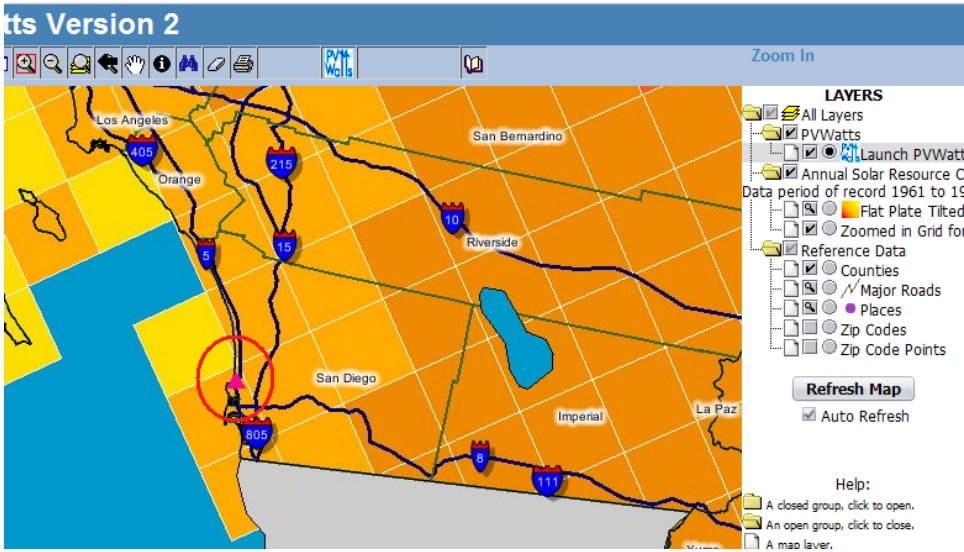
- Open your browser and load PV Watts version 2.0 (http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version2/)
- Read instructions and select "I have read this document." If you have disabled pop-ups, PV Watts 2 will pop up
- Enter you Latitude/longitude into PV Watts from your spreadsheet and press "GO"



Step by Step

- Press the PV Watts button then click the location on the map





Step by Step

- Input “DC Rating”, “Array Type”, “Array Tilt”, “Array Azimuth”, and “Electricity Cost” from your spreadsheet and press “Calculate”

9	**From Google earth**				
10		Degrees	minutes	seconds	
11	Lat	32	52	50.04	N
12	Long	117	14	1.3	W
13	Type of location	Parking Structure (10 degree)			
14	Area of roof(ft^2)	11325			
15					
16	**System qualities**				
17	Array Type	1-axis Tracking			
18	Electricity cost (cents/kWh)	24			
19					
20	**Cost estimation**				
21	Cal Sol step level	5			
22					
23	**Optional Input**				
24	Latitude	32.88056667	Converted to		
25	Longitude	-117.2336944	degrees		
26	DC rating (kW)	56.625			
27					
28	ArrayTilt (degrees)	10			
29	Array Azimuth (degrees)	180			
30					
31	**Cost estimation**				
32	Cost per kW of PV system	10000	*Determined by Array Type		
33					
34	**Results**				
35	Payout per kWh	$0.32			
36	5 year payout	$187,169.60			
37	Estimated cost of system	$566,250.00			
38	Area of usable roof	5662.5			

Front | Solar Assessment | PVWatts | CalSol incentive

Ready

Cell ID: 0174365

State*: California

Latitude*: 32.73

Longitude*: -117.248

PV System Specifications:

DC Rating (kW): 4.0

DC to AC Derate Factor: 0.77 DERATE FACTOR HELP

Array Type: Fixed Tilt

Fixed Tilt or 1-Axis Tracking System:

Array Tilt (degrees): 32.73 (Default = Latitude)

Array Azimuth (degrees): 180.0 (Default = South)

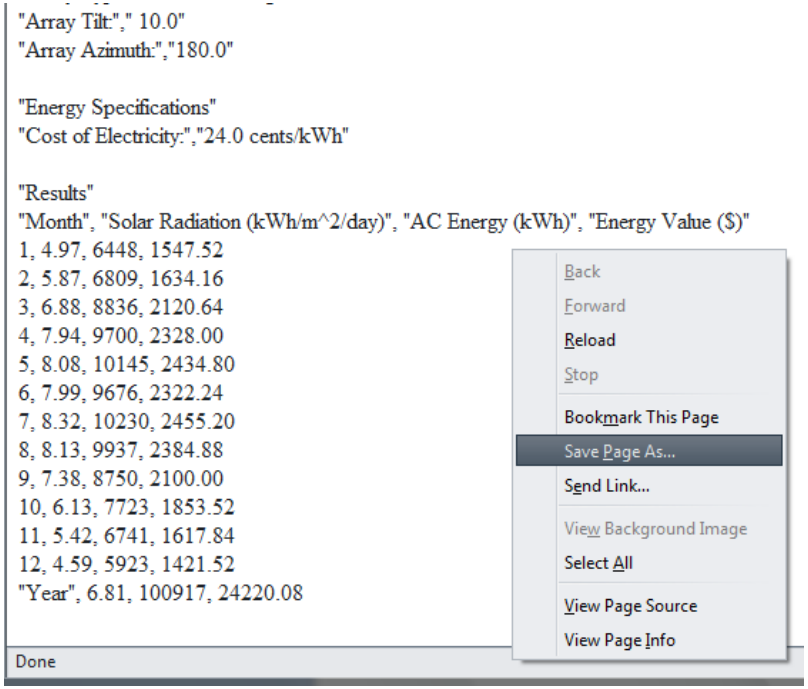
Energy Data:

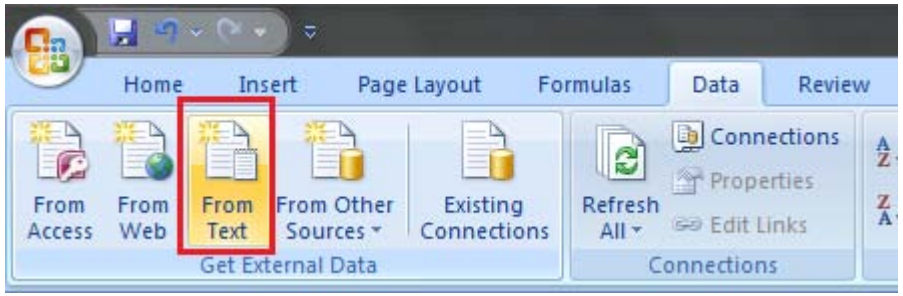
Cost of Electricity (cents/kWh): 17.288

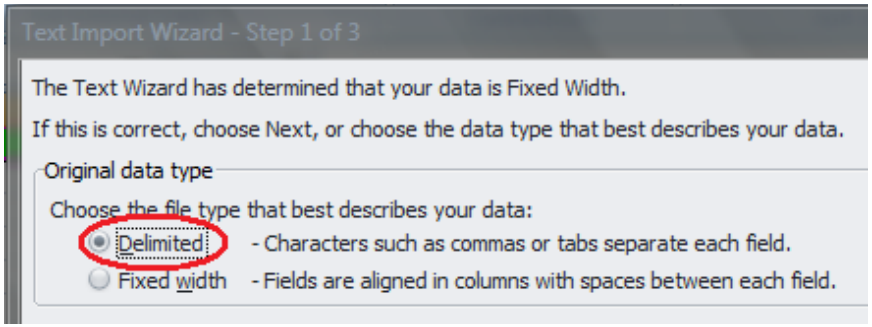
Calculate HELP Reset Form

Step by Step

- Save PV Watts output as a text file
- Import the text file you saved by opening it as a comma separated format (CSV) file







Step by Step

- The information is now loaded into your excel spreadsheet. Go back to Google Earth to you location and go to file>save>save image and save the image
- Open the tab “Solar Assessment” in your excel document and right click the “Insert Google Earth Image Here”
- Check to make sure all values appear on the spreadsheet, and then select file>print. Print your report and your initial assessment is complete

Examples – Basic Science Building

Location Properties:

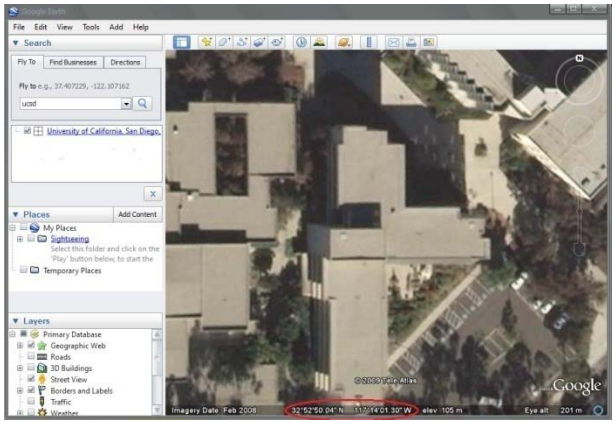
Roof Area:	22853 ft^2
Roof Area (Useable):	15997 ft^2
Facility Type (Panel Tilt):	Roof (20 degree)

Proposed System Properties:

DC Rating	159.971 kW
Array Type	Fixed Tilit
Electricity Cost	17.288cents/kWhr

Incentive Qualifications

Cal Sol Step Level	5
Payout Per kWh	$0.32
Cost per kW of PV System	$7,000



Projected System Cost:

Total System Cost	**$1,119,797**
Cost Per Year	$74,653

5 Year Payout	$372,890
Total Loan Payment	$865,827
Total Energy Savings	$1,007,268

Cost payback / valuation

Present value of total loan payments	$865,827
Energy value total	$1,007,268
Incentive payout	$372,890
Total payback	$514,330

15 Year Loan Payment Assessment (Including Inflation)

Year	Present value of payment (assuming inflation of 3.8%)	Energy savings (In present value)
1	$74,653	$40,291
2	$71,816	$40,291
3	$69,087	$40,291
4	$66,462	$40,291
5	$63,936	$40,291
6	$61,507	$40,291
7	$59,170	$40,291
8	$56,921	$40,291
9	$54,758	$40,291
10	$52,677	$40,291
11	$50,676	$40,291
12	$48,750	$40,291
13	$46,897	$40,291
14	$45,115	$40,291
15	$43,401	$40,291

Additional Steps

- To submit application, need stamp from licensed P.E. (Professional Engineer)
  - Not affiliated with your institution
- Once bond is approved
  - Set up financing
  - Contract company to design & install specific system

Results

- 192 applications submitted in San Diego County
  - Out of 996 total nationwide
- Mentored San Diego Unified School District High School student interns to submit 111 applications

Results

Public Agency	Number of Projects Receiving Allocations	Total Allocation for All Projects
City of Chula Vista	34 projects	$29,648,926
City of Lemon Grove	2 projects	$1,004,494
Fallbrook Public Utility District	1 project	$292,091
San Diego State University	1 project	$2,442,005
San Diego Unified School District	111 projects	$74,290,010
San Dieguito Union High School District	6 projects	$8,269,000
City of Santee	7 projects	$3,081,420
Santee School District	15 projects	$20,660,000
University of California, San Diego	15 projects	$14,961,540
Total for San Diego Region	192 projects	$154,649,486

Results

- The IRS allocated $800 million to 739 projects for public agencies throughout the nation. Overall, San Diego netted 19 percent of the total nationwide CREBs allocations.
- The San Diego Unified School District's total allocation amount is nearly twice that of the State of New Jersey, which is the second-largest *state winner* for total allocations going to public agencies in one state.
- Only three higher education institutions nationwide won allocations: University of California, San Diego ($15 million); University of California, Berkeley ($4.8 million); and San Diego State University ($2.4 million)

Installations so Far

- The San Diego Unified School District has already reached agreements to install a total of 9.6 MW of solar energy.
- The Santee School District has completed its first CREB-financed solar PV project with the 283 kW Hill Creek PV Shade Structure System

Santee School District Project

Thank you very much for your time

Special thanks to:
Ihab Kayhal, Kevin Peng, Byron Washom, Devin Uehling, & Jan Kleissel