Providing for PV

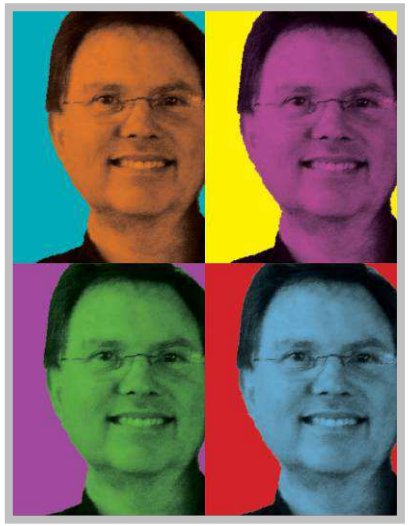
John Ewan, CEA

Considerations
for
Photovoltaic Systems
On Non-Residential Buildings

www.flickr.com/photos/bullitt_center

John Ewan

- Cal Poly Graduate
- Licensed General Contractor
- Designer/Builder Passive Solar
- Pacific Energy Company, 1980
- First PV System – Off Grid, 1980
- CABEC Certified Energy Analyst
- Photovoltaic Basis of Design – SME
- Net Zero Team Member



CABEC
California Association of Building Energy Consultants
CERTIFIED ENERGY ANALYST
John R. Ewan
R08-07-285

PACIFIC ENERGY COMPANY

Net Zero?

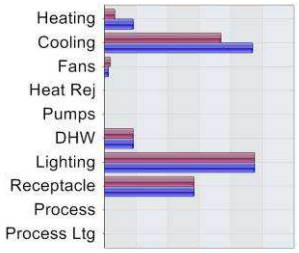
- CEC Net Zero is offsetting on site TDV energy use as referred to in T-24. (Envelope)
- Energy Cost Net Zero is offsetting all Electric Utility Cost.
- Full Net Zero is offsetting all on site energy use.

PERFORMANCE CERTIFICATE OF COMPLIANCE (Part 2 of 3) **PERF-1C**

Project Name: *Epoch Estate Wines Tasting Room* | Date: *11/12/2013*

ANNUAL TDV ENERGY USE SUMMARY (kBtu/sqft-yr)

Energy Component	Standard Design	Proposed Design	Compliance Margin
Space Heating	18.51	6.69	11.82
Space Cooling	93.90	74.03	19.87
Indoor Fans	2.41	3.91	-1.49
Heat Rejection	0.00	0.00	0.00
Pumps & Misc.	0.00	0.22	-0.22
Domestic Hot Water	18.30	18.30	0.00
Lighting	95.23	95.23	0.00
Receptacle	56.82	56.82	0.00
Process	0.00	0.00	0.00
Process Lighting	0.00	0.00	0.00
TOTALS	285.18	255.19	29.98
Percent better than Standard		10.5 %	(10.5 % excluding process)



TDV

- TDV = Time Dependent Valuation, with higher value energy occurring during peak times of usage
- Currently High Value Electricity is during the summer weekday, noon to 6pm.
- Net Metering allows for the annual accumulation of energy production.

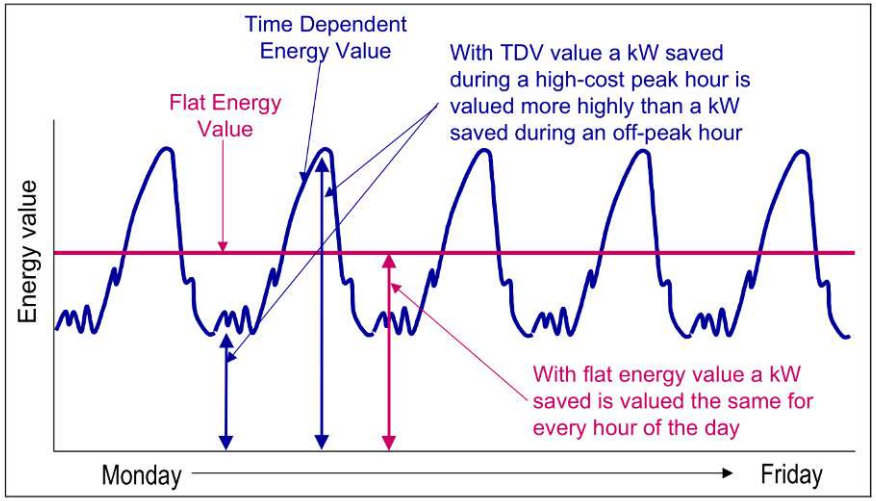


Figure 3 - TDV Costing Compared to Flat Costing – summer weekday

Basis Loads

- Base on Building Occupancy
  - Envelope Heating & Cooling
  - Lighting Loads
  - Plug Loads
  - Process Loads
- Specialty Software for:
  - Pool Heating
  - Personnel Loads
  - Electric Car Charging

Location

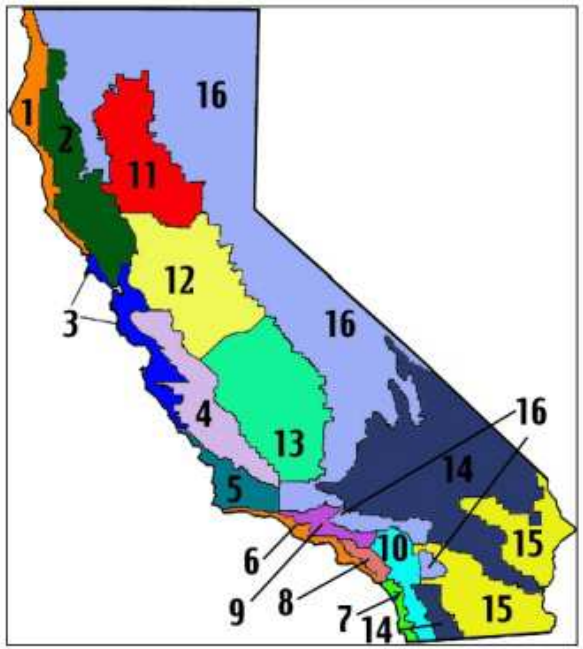
- Climate Zone Effects Energy Design Choices.

Table 4: Annual Energy Use—2013 Building Energy Efficiency Standards and the 2012 IECC

2100 1-story	Total kTDV/sf-yr				
Climate Zone	2013 T24 Standard Design Energy Use	2012 IECC Proposed Design Energy Use	Energy Diff.	Weighted Energy Diff.	Construction
1	36.04	38.71	-2.67	-0.01	65
2	25.18	23.20	1.98	0.05	579
3	14.37	24.04	-9.67	-0.69	1,636
4	14.37	24.04	-9.67	-0.65	1,541
5	11.83	24.70	-12.87	-0.17	299
6	7.93	8.74	-0.82	-0.07	2,034
7	2.08	3.02	-0.94	-0.09	2,062
8	15.38	12.36	3.02	0.37	2,765
9	29.43	25.42	4.01	0.58	3,280
10	30.44	28.50	1.94	0.21	2,484
11	61.58	66.91	-5.34	-0.15	621
12	38.78	40.33	-1.55	-0.18	2,665
13	65.38	64.32	1.05	0.06	1,380
14	56.77	55.27	1.50	0.03	493
15	101.34	102.03	-0.69	-0.01	494
16	53.57	49.63	3.93	0.07	398
	564.47	591.22			22,796
Statewide Savings	564.47	591.22	26.75	4.5%	

Source: California Energy Commission

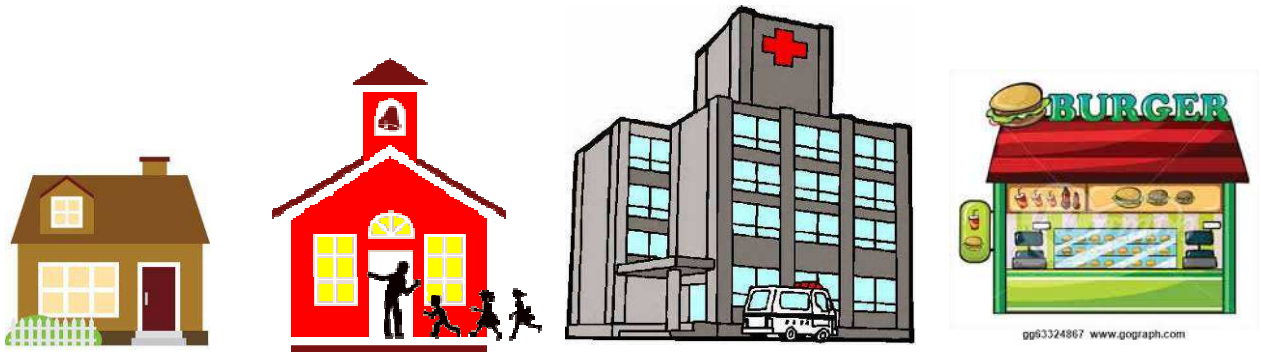
Figure 1: California Climate Zones—*Building Energy Efficiency Standards*

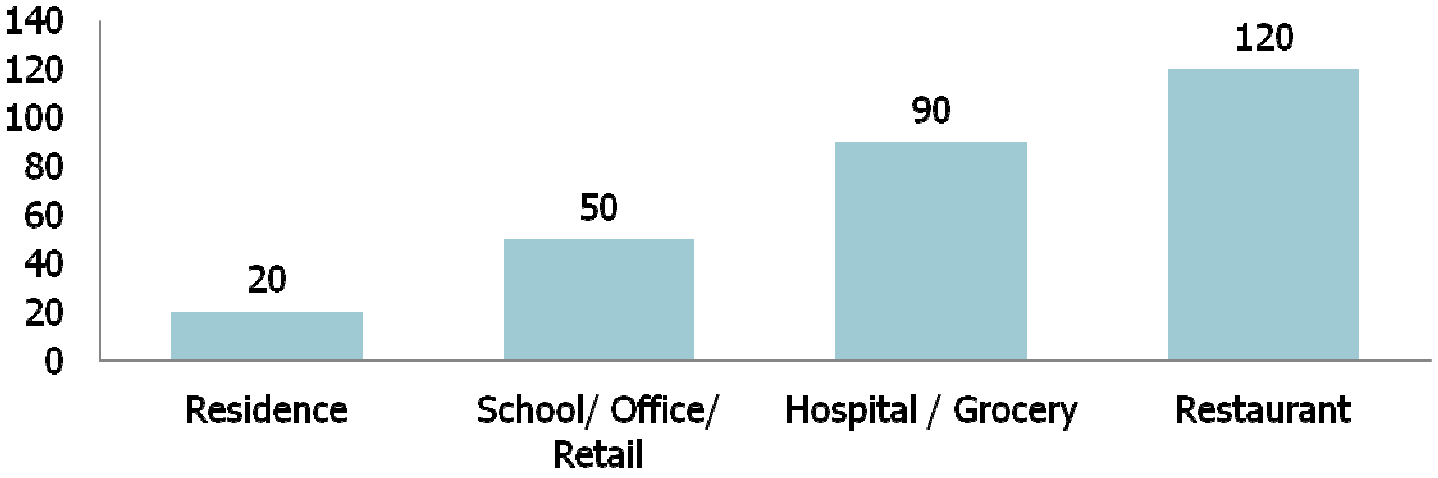


Source: California Energy Commission

Energy Use Based on Occupancy Type

- **Relative** energy use of building types





Area Considerations

- Impediments (vents, equipment)
  - 2.5 x Height clear from East, South & West
- Orientation & Slope
  - Southwesterly for TDV gain.
  - Minimum 10 degree slope.
  - 18 to 28 degree slope best.

Structural Considerations

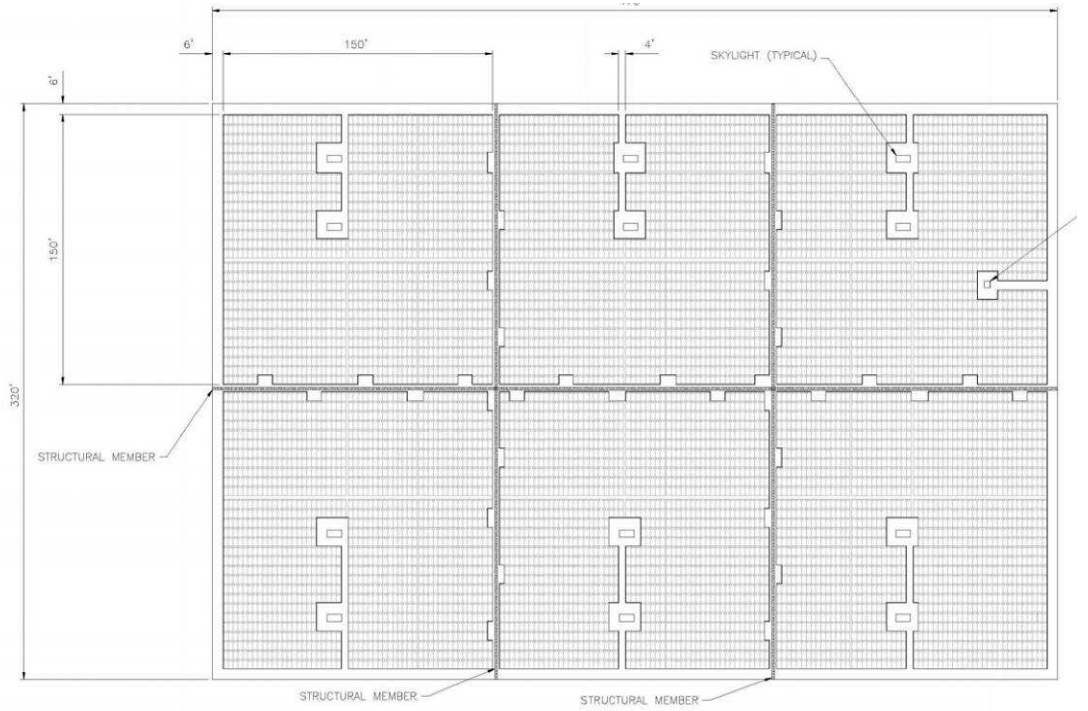
- BOS space requirements
  - Inverter(s)
    - Can be the size of a paperback book to larger than a refrigerator.
  - Conduit
    - Needs to be properly sized and terminated to meet code requirements.
  - Roof Loading
    - Bolt Down Mounting Systems ~ +3# sq. ft.
    - Ballasted Systems ~ + 9# sq. ft.

Cal Fire

- Provide Access Around Perimeter, Equipment & Skylights, Then down the Middle

CALIFORNIA DEPARTMENT of FORESTRY
and FIRE PROTECTION
OFFICE OF THE STATE FIRE MARSHAL

SOLAR PHOTOVOLTAIC
INSTALLATION GUIDELINE
(In partnership with interested local fire officials, building officials, and industry representatives)



SOLAR ARRAY EXAMPLE – LARGE COMMERCIAL

4' WALKWAYS WITH 8' X 4' VENTING OPPORTUNITIES EVERY 20'

Examples

- Electric Vehicle Charging
  - Tesla Roadster ~ 50 kWH, Chevy Volt ~ 12 kWH
- 1 kW (CEC) Array = ~ 75 Sq. Ft.
  - ~14’ wide x 6’ tall sloped roof
  - Gap rows ~30” on a flat roof

Time To Charge Guide

TurboDock

The *Time to Charge Guide* provides you with an estimated time to fully charge your Battery Electric Vehicle or Plug-in Hybrid Vehicle. See which type of charger is right for you. Find out more on evsolutions.com and turbodock.com.

MAKE	MODEL	120V CORDSET HOURS TO FULLY CHARGE	240V HOURS TO FULLY CHARGE	240V EVSE-RS HOURS TO FULLY CHARGE
Nissan	LEAF	18 HRS	6.3 HRS	3.6 HRS
Ford	Focus Electric	18 HRS	7 HRS	3.6 HRS
Ford	Fusion Energi Plug-in	7 HRS	2.5 HRS	2.5 HRS
Ford	C-Max Energi Plug-in	7 HRS	2.5 HRS	2.5 HRS
FIAT	500e	23 HRS	6.3 HRS	3.6 HRS
KIA	Soul	19.3 HRS	7.1 HRS	4.1 HRS
Chevy	Volt	10-16 HRS	3.3 HRS	3.3 HRS
Chevy	Spark	20 HRS	7 HRS	7 HRS
BMW	i3	15.3 HRS	5.8 HRS	3.1 HRS
BMW	i8	6 HRS	1.8 HRS	1.8 HRS
Mercedes	B Class	20 HRS	7.4 HRS	3.9 HRS
Mitsubishi	i-MIEV	14 HRS	4.8 HRS	4.8 HRS
Honda	Fit EV	13.9 HRS	5.2 HRS	3 HRS
Smart	EV	12.2 HRS	5.3 HRS	5.3 HRS
Toyota	RAV 4	29 HRS	10.9 HRS	5.8 HRS
Toyota	Prius Plug-in	3.1 HRS	2.1 HRS	2.1 HRS
Tesla	Roadster (w/ J-1772 adapter)	38.9 HRS	14.7 HRS	7.8 HRS
Tesla	S (w/ J-1772 adapter)	59 HRS	22.4 HRS	11.8 HRS

LOW COST AND EASY-TO-USE COMMERCIAL AND WORKPLACE CHARGING SOLUTIONS WITH ACCESS CONTROL.

AV

PV Investment Value

- Build PV into the original Project Goals
  - A Measure of Security: Cashflow Payback: 4.8 years
  - Net Present Value (NPV): $347,497 on $221,000.00 Investment.
  - Internal Rate of Return (IRR): 19.6%
  - Stabilize Cost - Solar Electric (PV): $0.07 per kWh.

The Cost of Doing Nothing

Integrated Design Process

Pre-Design
- Set Project Energy Goals
- Define Net Zero Energy

Design
- Use Energy Analysis – Early
- Preliminary System Design – Early
- Team Meetings – design/eng./owner/Cx/builders

Final CD's
- Evaluate Systems Design with Cost Trade-offs
- Finalize loads and sizing

Constr.+ Post
- Approach Construction as Partnering Effort
- Commission, Monitor and Adjust

(adapted from Bill Reed, www.integrativedesign.net)

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Net Zero Team

- Create the Net Zero Energy Design Team:
  - Lead Designer
  - Certified Energy Analyst (CEA)
    - Performance Modeling
  - 3rd Party PV System Consultant
  - HERS II Rater
  - Commissioning Agent
  - MEP Consultants
  - Structural Engineer
  - Builder

Good Works

- Sample Systems

Contact

PACIFIC ENERGY COMPANY

Fireplaces | Solar Electric | Energy Analysis

- www.alteryourenergy.com
- 2121 Santa Barbara Avenue, San Luis Obispo, CA 93401 805-544-4700