

Greening Your World...

**Commercial Solar Savers,  
Oct. 7, 2010**



Center for  
**Sustainable Energy**  
CALIFORNIA

## Vision: Creating a Sustainable Energy Future

- Areas of Focus
  - Energy Efficiency
  - Renewable Energy
  - Green Buildings
  - Climate Change
  - Transportation

## CCSE Services

- Cash Incentives
- Educational Workshops
- Resource & Tool Lending Libraries
- Technical Assistance
- Technology Display Center
- Distributed Generation Assessment Services
- Carbon Impact Assessment and Management
- Technical and Policy support for Local Governments

# Trash Disposal

## Recycle



## Compostables



# Housekeeping

- Online Registration is the best way to guarantee a spot
- Restrooms
- Phones Off
- Shhhh. . . Quiet in Hallway
- Sign-in Sheets & Evaluations

## CCSE Disclaimer

Workshops are provided as a public service with the understanding that the California Center for Sustainable Energy makes no warranties, either expressed or implied, concerning the accuracy, completeness, reliability, or suitability of the information.

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# Big Savings for Clean Generation

- Energy Efficiency
  - Lower first costs
  - Quick payback
  - High Net Present Value
- Distributed Generation
  - Producing energy onsite
  - Positive Net Present Value

## The Power and Payback of EE

- Retrofitting old lights & ballasts can save 32W per fixture.
- At \$0.10/kWh, that's \$14 per fixture per year.
- Installation was estimated at \$43/fixture (parts and labor)
- Could receive a \$9.80 rebate through Energy Savings Bid.
- Simple ROI (without federal tax credit): **42%**
  - F40-T12CW with standard magnetic ballast (92W)
  - Conversion to F32-T8 RE70 Electric I.S. ballast (59W)

# Evaluating Savings

- Simple Payback
  - Initial cost  $\div$  yearly savings
  - Poorly captures value of complex cash flows
  - Ignores time value of money
- Internal Rate of Return (IRR)
  - Used to compare profitability of different investments
  - Best used for similar projects

## Net Present Value

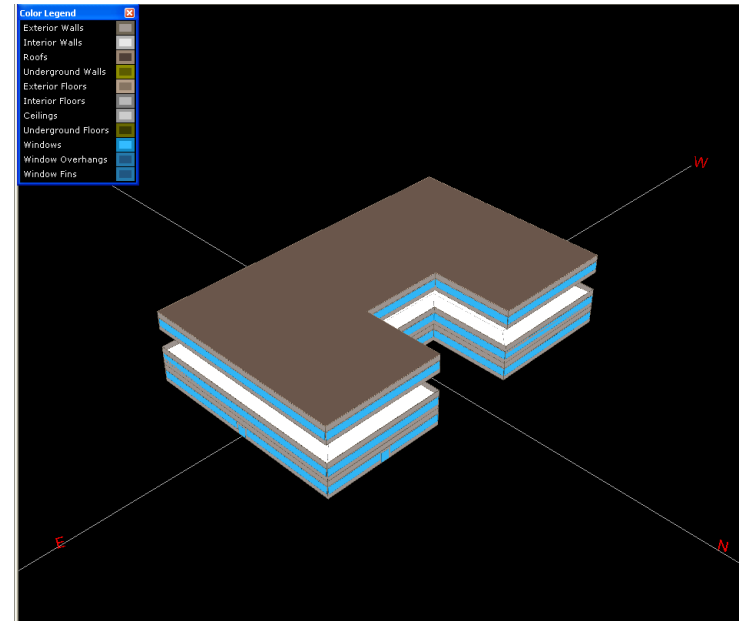
- Discounts future benefits in today's dollars
- Powerful enough to account for full product life cycle
- Captures positive and negative cash flows
- Demonstrates relative profitability
- Assumes known discount rate (opportunity costs)

## Case Study Outline

- Energy Efficiency vs. Solar savings
  - Generate same offset of kWh
- Energy Efficiency/Solar PV Synergy
  - Place PV on upgraded building

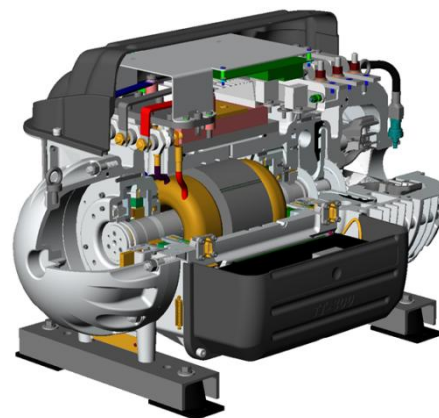
## Example Building

- 130,000 sq ft office building
- 4 floors
- Has had multiple tenants
- Modeled in EQuest



## Strategies for Savings: Retrofits

- Replace old systems with new
- Enhance controls
- Increased efficiency generates savings



# Energy Efficiency

- More energy to core services
- Reliable and stable energy supply
- Onsite generation takes higher load
- Most cost effective way to meet green goals & mandates

## Retrofits: Upgrade example

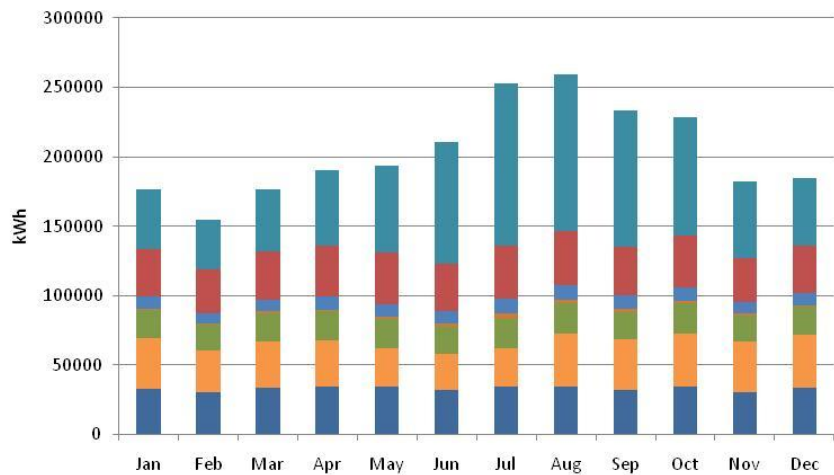
- Add Variable Frequency Drives to fans
- Upgrade 2 chillers from 6 EER to 18 EER
- Make lighting 10% more efficient:
  - T8 32W to T8 28W conversion.
- 25 year equipment life

## Retrofit Upgrade Costs

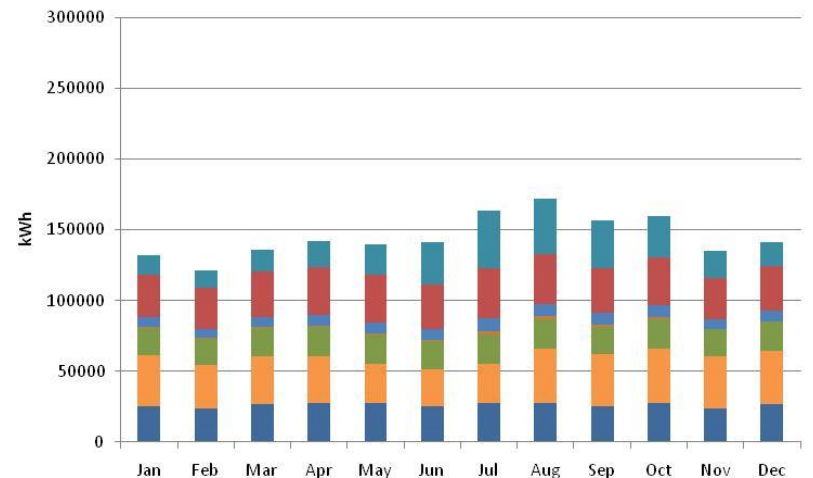
- 2 new chillers: \$1,000,000  
(design, parts, labor)
- Variable Frequency Drives for fans \$5,000
- New Lights \$279,500

# Electricity Savings Retrofit

Post Commissioning Electricity



Post Retrofit Electricity



■ Cooling end-use energy

■ Heat rejection end-use energy

■ Exterior to the building end-use energy

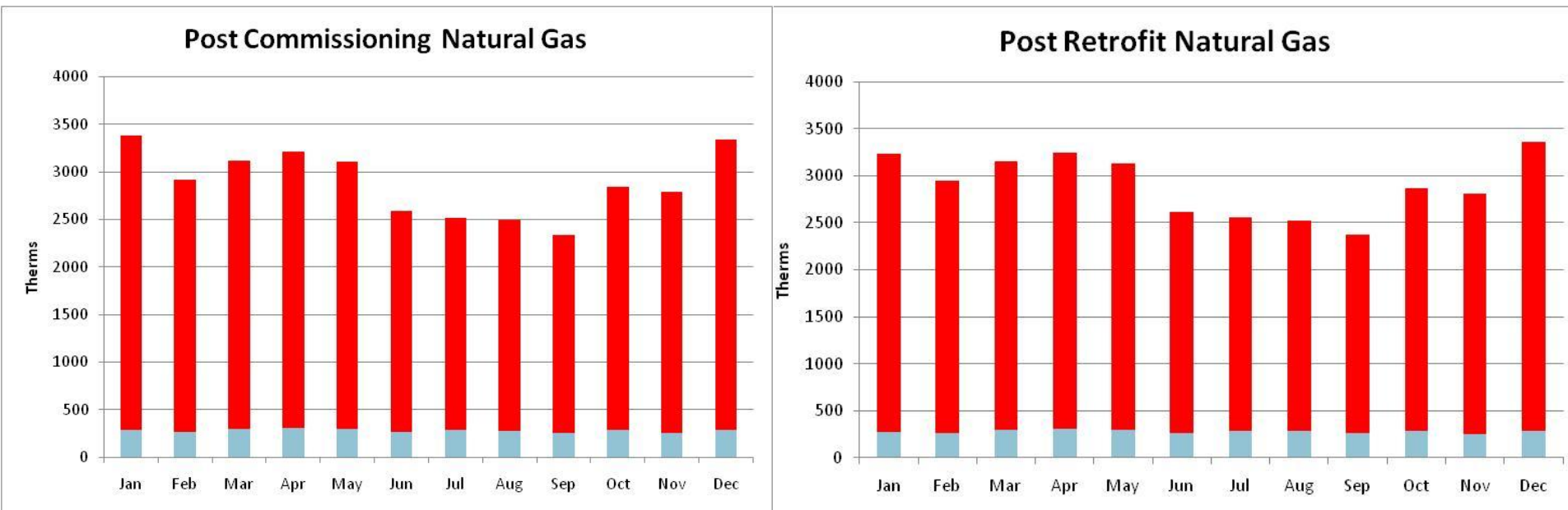
■ Vent fan end-use energy

■ Miscellaneous equipment end-use energy

■ Lighting end-use energy

■ Auxiliary end-use energy (pumps)

# Gas Savings Retrofit



- Heating end-use energy
- Domestic hot water end-use energy

## Retrofit Upgrade Savings

- 690,000 kWh (28%)
- -364 Therms (-1%)
  - More efficient lighting produces less heat
- \$317,900 rebate from Utility programs
- 6 year simple payback
- \$149,500/year savings
- 11% MIRR
- \$1,172,000 Net Present Value

# Distributed Generation

- Onsite Energy Production
- Supplements' Energy Efficiency
- Energy Costs Reduction



# Distributed Generation

- California Solar Initiative (CSI)
  - Solar PV
- CSI Solar Thermal
  - Solar Water Heating
- Self Generation Incentive Program (SGIP)
  - Wind
  - Fuel Cell

## Distributed Generation Benefits

- Energy Costs Reduction
- Allows access to different tariffs
- USGBC LEED Points
- Reduces peak demand and energy use
- Increases energy security
- Very public statement to going green

## Solar Photovoltaics

- Produces energy from sun light
  - Best on south facing rooftops.
- Eligible for Federal Tax Credit
- May receive CA state rebate
- May qualify for DG-R tariff

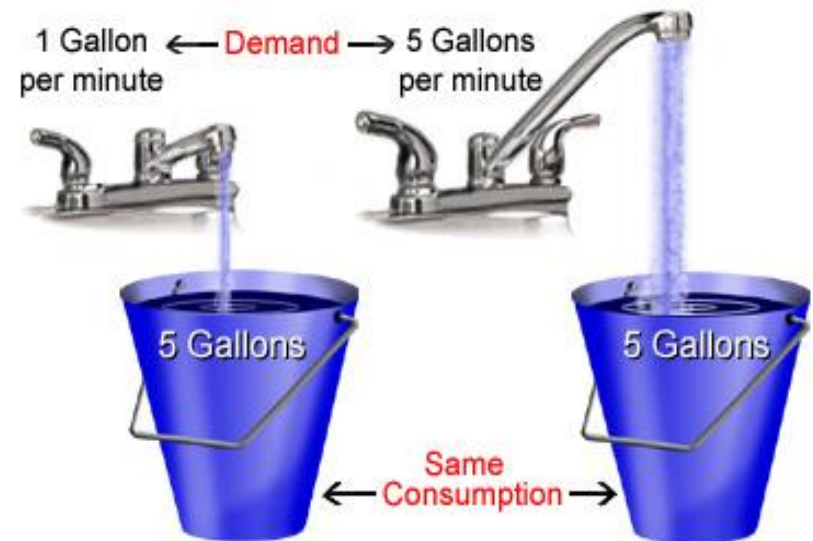


# Tariffs

- Commercial customers pay for:
  - Energy (kWh)
  - Demand (kW)
- Prices can vary
  - Time of day
  - Amount of use
- Tariffs govern how we pay the bill
  - AL-TOU
  - DG-R

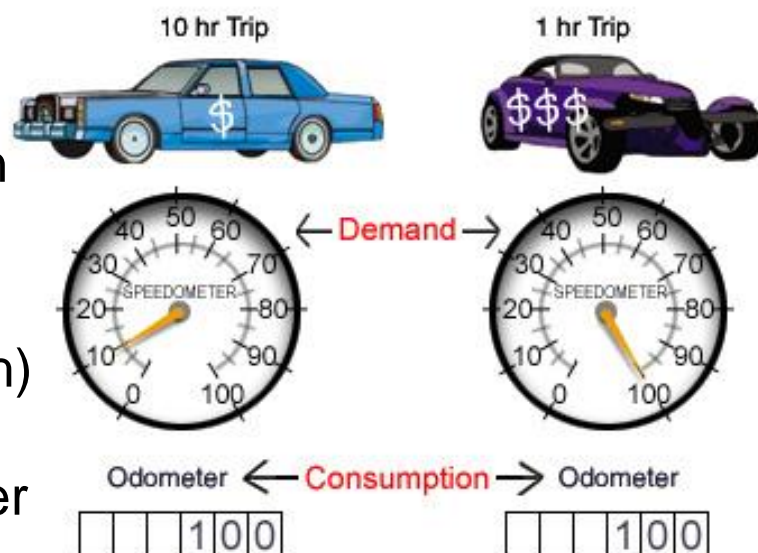
# Energy (kWh) vs Demand (kW)

- What is “demand”?
  - Measuring demand means monitoring and recording the maximum average instantaneous energy need for every 15 minute interval within each billing period (kW).
  - The maximum rate of energy use a consumer needs available at all times.



# Energy (kWh) vs Demand (kW)

- What is “energy”?
  - Cumulative electricity consumed over a period of time (kWh) known as “energy” charges.
  - For the electric industry, energy is the quantity of kilowatt-hours (kWh) supplied or consumed by a customer. It is the product of power in watts and the time during which the power was used.
  - 1 kW of demand for 1 hour = 1 kWh



## Solar Power: 380kW AC example

- Install a 380kW AC solar PV roof system.
- Switch to DG-R Tariff.
- Simulation makes assumptions about:
  - Weather
  - Efficiency
  - 25 year equipment life
- Cost: \$2,660,000
  - \$7/Watt AC

## Utility Rate Escalation

- Historically around 3.4%.
- May experience high price volatility.
- Impacts distributed generation cash flows

## 380kW AC Solar PV Impacts

- Upgrades offset 537,000 kWh of energy
- Allows access to advantageous DG-R tariff
- Reduces yearly electric bill by \$145,000
- Qualifies for MACRS and ITC tax benefits
- Simple Payback: 4 years
- \$145,000/year savings
- MIRR 10%
- NPV: \$1,153,000

## Equal Offset Comparison

| Financial Metrics                       | EE Upgrades | 380kW PV<br>(w/DGR) |
|---|-------------|---------------------|
| <b>Simple Payback</b>                   | 6           | 4                   |
| <b>Yearly Savings</b>                   | \$149,500   | \$145,000           |
| <b>Modified Internal Rate of Return</b> | 11%         | 10%                 |
| <b>Total Investment</b>                 | \$987,000   | \$1,667,000         |
| <b>Net Present Value (NPV)</b>          | \$1,172,000 | \$1,153,000         |

## Synergy: Energy Efficiency and Solar

- EE building “new” baseline
- Value adds for solar PV

## Solar Power: 58kW AC example

- All Energy Efficiency upgrades
- Install a 58kW AC solar PV roof system.
- Switch to DG-R Tariff.
- Cost \$1,606,000 total

## 58kW Solar PV and EE Impacts

- Allows access to advantageous DG-R tariff
- Reduces yearly electric bill by \$186,000
- Qualifies for MACRS and ITC tax benefits
- NPV: \$1,536,000

## Solar Power: 438kW AC example

- Install a 438kW AC solar PV roof system.
- Switch to DG-R Tariff
- Cost \$3,066,000 total

## 58kW Solar PV and EE Impacts

- Allows access to advantageous DG-R tariff
- Reduces yearly electric bill by \$159,000
- Qualifies for MACRS and ITC tax benefits
- NPV: \$1,232,000

# Final Comparison

| Financial Metrics                       | EE Upgrades | 380kW PV (w/DGR) | EE Upgrades and 58kW PV (w/DGR) | 438kW PV (w/DGR) |
|---|-------------|------------------|---------------------------------|------------------|
| <b>Simple Payback</b>                   | 6           | 4                | 5                               | 4                |
| <b>Yearly Savings</b>                   | \$149,500   | \$145,000        | \$186,000                       | \$159,000        |
| <b>Modified Internal Rate of Return</b> | 11%         | 10%              | 12%                             | 10%              |
| <b>Total Investment</b>                 | \$987,000   | \$1,667,000      | \$1,237,000                     | \$1,922,000      |
| <b>Net Present Value (NPV)</b>          | \$1,172,000 | \$1,153,000      | \$1,536,000                     | \$1,232,000      |

## The Complete Package

- Facility consumes minimum amount of energy for maximum comfort/efficiency.
- Distributed generation provides clean power and access to special tariffs.
- Benchmark your building
- IOU programs and tax credits increase ROI.

# California Solar Initiative

***Solar PV rebate information may be found at***

***[www.EnergyCenter.org](http://www.EnergyCenter.org)***

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**Thank you for coming!**