

Overview

- Introduction
- Solar PV System Basics
- Quick Facts
- Myths of Solar
- Financial Considerations
- Benefits
- Array Designs
- Solar Power Systems
- Summary



Chris Brooks



- Director of Renewable Energy, Bombard Electric
- Native Las Vegas
- Fourth generation electrician
- Seven years renewable energy experience
- Vice Pres Solar NV
- PV instructor JATC
- NABCEP Certified
- Member of Nevada Renewable Energy Task Force

Chris Brooks 4.5 KW Solar Powered Home



Bombard Electric



- **Bombard Electric**
 - Largest electrical contractor in NV
 - One of the largest installers of PV Solar in North America
 - 20 State Certified Installers Devoted to Solar PV
 - 20 Megawatts Installed
 - Installed 11% of all grid tied PV in the nation for 2007

Bombard 27 KW Solar Powered Office



Bombard Electric



- Installed 85% of the PV in Nevada
- Have completed over 200 solar jobs
- Renewable energy Division is 4 years old
- 150% annual growth

Sunpower T-20 Tracking Arrays, Nellis AFB



Bombard Electric



- Customers Include:
- United States Air Force
 - Nevada Power
 - Sierra Pacific Power
 - APS Energy Services
 - University of Nevada Las Vegas
 - University of Nevada Reno
 - Desert Research Institute
 - City of Las Vegas
 - Clark County
 - Clark County School District
 - Molasky Corporate Center
 - Las Vegas Valley Water District
 - Southern Nevada Water Authority

Springs Preserve Solar Parking Structure



Bombard Electric



- Projected growth of 150% annually for the next three years
- Currently budgeting, bidding or have contracted over \$50M for 2008
- The sky is the limit

Nellis AFB 140 Acre Solar Site



Bombard Electric



- Intend on capturing the emerging Small Wind Market (2-150 KW)
- Increase our presence in the rest of the state
- Improve design and sales capabilities

Bergey Wind Unit at Sierra Plaza, Reno NV



Solar Power System Basics

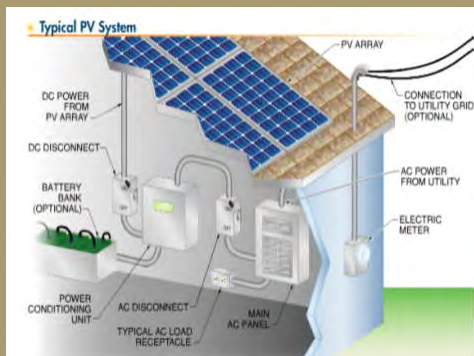
- All life on earth is supported by the sun.
- **Photovoltaic** – convert light energy to electricity.
- **Photoelectric Effect** – the ejection of electrons from the surface of a metal in response to light.
- Typical PV cell is a Semiconductor made of Silicon.



PV Cell



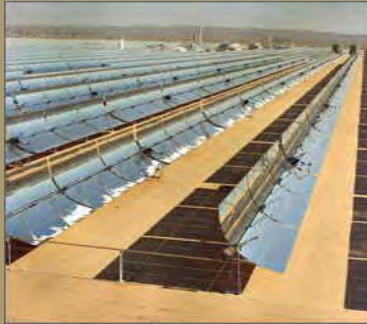
Solar Power System Basics



- **Grid-tied System.**
- **Most Common type of Installation.**
- **Net-Metering.**
- **Excess power stored on grid, credit for later use.**
- **Decreased Installation Cost.**
- **Batteries Optional.**
- **Residential and Commercial.**



Solar Energy Technologies



Concentrating Solar Power

- Photovoltaic (PV system)
- Concentrating Solar Power (CSP) systems
- Solar water heating systems



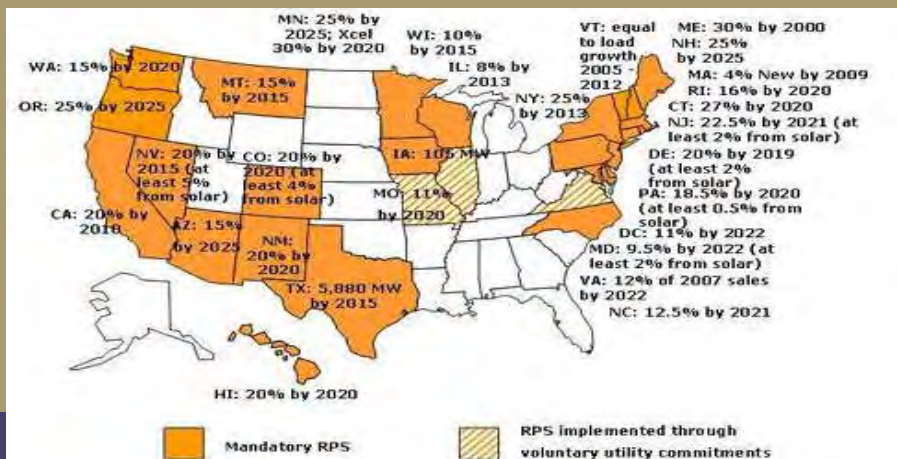
PV Quick Facts



- **Currently, 48 states have some type of Solar or Renewable incentive.**
- **Electric Rates and Incentives Vary from State to State.**
- **Federal Tax Credit of 30%**
 - Capped at \$2,000 for residential.
 - HR2776 passed house Aug. '07

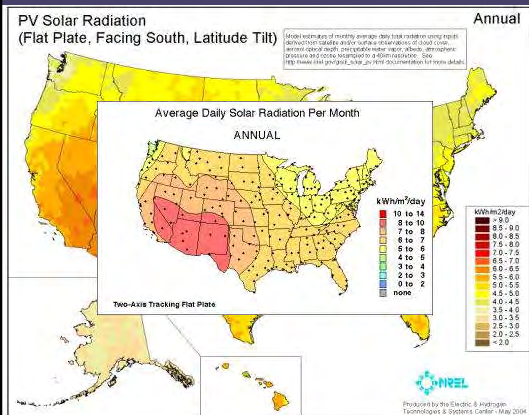


Renewable Portfolio Standard State by State



http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm

Utilizing Renewable Energy



• Potential

- RPS law of 20% by 2015
- 25% from efficiency??
- Only 1% of Utility Retail Sales must be from Solar.
- Net metering law (1MW) capped of 1% of utility peak.
- Lots of sun in Southwest
- Many well producing regions.

Lots of Sun!



PV Quick Facts

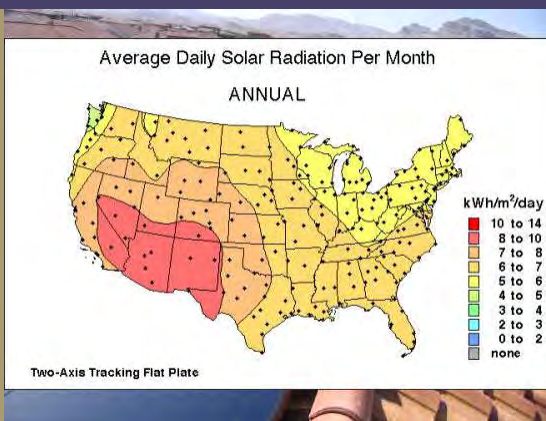


- PV is silent and highly reliable.
- Current high quality Silicon Modules as high as 19.3% efficient (Sunpower).
- PV-generated power correlates well with utilities Peak Demand.
- The largest PV installation in the U.S. as of 2008 is 14.6 MW in Las Vegas, NV.



PV Quick Facts

- A 110 square mile area in Las Vegas could produce enough power to meet the nations energy demands.
- The average Southern Nevada home could be powered with approximately 700 square feet of PV on the roof (16,000 kW/hr annually).



Myths of Solar

- **Solar Electricity cannot serve any significant fraction of U.S. or world electricity needs.**
- **Solar electricity can do everything – right now!**
- **PV is too expensive and will never compete with traditional power generation.**



Myths of Solar

- **Photovoltaic's only appeals to small niche markets.**
- **Nothing remains to be done. There will be no further advances with PV.**
- **Photovoltaic's is a polluting industry.**
 - Semiconductor processing
 - Industry Improvements in; etching, lead-free solders, training, automated handling and robotics



Myths of Solar

- **PV cannot significantly offset environmental emissions.**
 - One KW will offset
 - 16 Kilograms of nitrogen oxides
 - 9 Kilograms of sulfur oxides
 - 2,300 Kilograms of Carbon Dioxide.

 - In 30 year lifetime is Equal to:
 - 117,167 car miles driven
 - 224 mature trees planted
 - 134 Barrels of Oil Offset
 - 64,829 Gallons of Water



Myths of Solar

- **Takes more energy to produce a PV system then you will get out of it.**
 - Dutch Researcher Erik Alsema estimates 4 year energy payback for multicrystalline silicon PV systems.
 - Japanese researchers Kato et al figured 2 years.
 - Palz and Zibetta calculated 2 years.
 - Knapp and Jester found it be 3.3 years.



Realities of Solar

- **Nellis AFB, 15MW, will offset:**
 - 76,270 barrels of oil / yr
 - 127,405 mature trees planted / yr
 - 135,205 lbs Smog Emissions reduction / yr
 - 281,245 lbs Acid Rain Emissions reduction / yr
 - 36,834,808 gallons of water / yr
 - 53,250,132 lbs GreenHouse Gas Reduction / yr
 - 66,571,987 car miles / yr



Realities of Solar

- **Some of the largest companies in the world are involved in solar.**
- **When designed and installed by properly trained professionals, modern solar systems are safe, efficient and reliable.**
- **Solar can make 100% of your homes electricity.**
- **Solar power can make a significant portion of the States electricity!**
- **Solar can be very attractive.**
- **Nevada has the potential to export billions of dollars in Renewable Energy!**



Financial Considerations

- State Incentives (RPS, Solar Generations)
- Federal Tax Credit (ITC)
- Increased Value in Home.
- 5 KW system about \$8-10 / watt (AC)
- 5 KW = 11,000 KW/hrs a year in Las Vegas
- Expected increase of utility power in future (??).
- Cost of PV power is about 11 ¢ a KW/hr for 30 years after State and Federal Incentives.
- Retail Power is currently about 12 ¢.



Financial Considerations

• Commercial

- State and Federal Incentives
- Increased Property Value.
- 100 KW system about \$9 / watt (AC)
- 220,000 KWhrs / year in Las Vegas
- Use Green Power has Marketing Tool
- Expected increase of utility power in future.
- Cost of Solar Power is about 14 ¢ / KWhr for 30 years before Incentives



Utilizing Renewable Energy



- **Customers**

- Property owners
 - Residential
 - Commercial
- Electrical utilities
- On Grid (have utility power)
- Off Grid (have no utility power)

Mitchell Residence 5 KW Grid Tied System



Benefits of Renewable Energy



- **Cost Savings \$\$\$**
- **Environmental solution**
- **Political awareness**
- **Media recognition**

Clark Station 75 KWAC Concentrating PV System



LEED Certification Credits



- **Renewable Energy**
 - 5% = 1 point
 - 7.5% = 1 point
 - 12.5% = 1 point
- **Solar Power Provides an Opportunity for a total of 3 LEED points.**

400 KW Parking Structure at Springs Preserve



Western Renewable Energy Generation Information System

W.R.E.G.I.S.

- An Accounting System
 - Issue, Register and Track Renewable Energy Certificates (RECs)
 - Regulatory Market
 - Voluntary Market
- 1 REC = 1KWhr of Produced Renewable Energy.**
- Solar
 - Wind
 - Geothermal
 - Hydroelectric



Western Renewable Energy Generation Information System

Regulatory Market

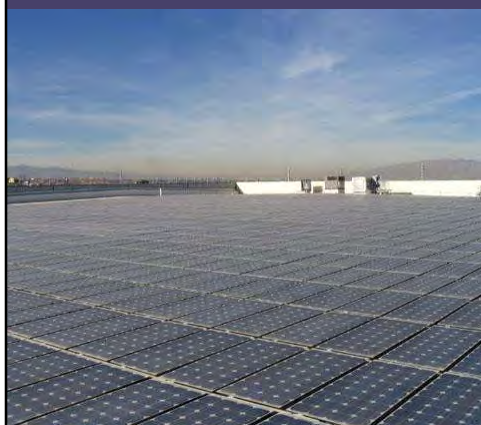
- **Utilities**
 - Renewable Energy Portfolios

Voluntary Market

- ✓ **Johnson & Johnson**
- ✓ **Lowe's Home Improvement**
- ✓ **Nike**
- ✓ **The Coca Cola Company**
- ✓ **DuPont**
- ✓ **BP (USA)**



Commercial Non-Penetrating Roof Top Systems



- **Lowest installed cost- \$8.00- \$10.00 a watt**
- **Flexible installation on existing buildings**
- **Quick to build**
- **Reduced risk of roof repair and leak issues**

Powerlight 215 KWDC PowerGuard System



Commercial Non-Penetrating Roof Top Systems



- **Weigh 3-5 lbs / ft²**
- **Many different manufacturers**
 - SunPower
 - Powerlight
 - RWE Schott
 - Kyocera
 - Direct Power and Water
 - Sun Link

115 Kilowatt Sun Link System on Ryan Center, N. Las Vegas.



Commercial Racked Roof Top Systems



- **High power output due to steeper angles**
- **Flexible design**
- **Light weight, 2.5-5 lbs.**
- **Less soiling**
- **Many quality manufacturers**

Unirac with Unistrut



Commercial Racked Roof Top Systems



- Many roof penetrations
- Requires more available roof area to avoid shading between rows
- Longer installation period
- Labor intensive \$\$\$

Sun Frame with Unistrut



Commercial Structure Mounted Systems



- Perform very well due to good sun angles and better air flow
- Can serve dual purposes
- High public awareness
- Aesthetically pleasing

26 Custom pole top Arrays at the Lied Animal Shelter



Dual Axis Tracking Ground Mounted Systems



- Most possible power production
- Can be small and scalable
- Very Visible
- Provide Shade
- Look COOL!!!
- \$10.00-\$13.00 an AC watt on systems 1.5 to 5 KW

2 KW Dual Axis Tracking Ground Mounted Systems



Covered Parking Systems



- Sleek, attractive design.
- Dual Purpose
- Protect cars from intense heat while generating electricity.
- Make use of existing space.
- Good use of available land

UNCE 32 KW- 22 Space Covered Parking array



Custom Covered Parking Systems



- Custom Design to meet customer goals.
- Fixed
- Tracking
- Dual Sided Modules

400 KW Parking Structure at Springs Preserve



Wall Mounted Fixed Installation



- More expensive, \$10-\$15 a watt
- Labor intensive
- Longer installation period
- More prone to vandalism

Desert Research Institute 3 KW Array



Ground Mounted Systems



- Great for remote locations
- Easy maintenance
- Range in price and difficulty for different applications
- Good power due to angles and airflow
- Fixed or tracking

3 KW Fixed ground mounted system in remote location



Ground Mounted Systems



- Highly visible
- Great for training and education
- Good production
- Can be vandalized

20 KW Fixed ground mounted system at UNLV (15 years old)



Ground Mounted Tracking Systems



- Increased power production
- Need to be large to make cost worthwhile
- More maintenance involved than fixed arrays
- Great for training and education
- Can be vandalized
- \$7.50-\$9.50 an AC watt on systems over 500 KW

800 KW Tracking ground mounted system at Ronzone Reservoir



Residential Roof Mounted Systems



- Excellent power production
- 2-15 Kilowatt Range
- Grid-tied
- Maintenance is minimal.
- Good use of available space
- Quick installation
- \$8-\$10 an AC watt

5 KW residential roof mounted system



Residential Custom Systems



- Roof or ground mounted
- Tile or shingle roofs available
- Quick returns on investment with available incentives
- Highly reliable
- Large choice of products
- Cool!!!

5 KW residential roof or ground mounted system



Thin Film



- Peal and Stick Laminate, no need for attachments to roof.
- Building Integrated Design
- Reduced Risk of Damage to Solar Array.
- Durability

Thin Film System Details



Thin Film Drawbacks

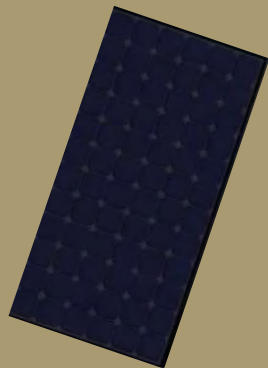


- **Thin Film Cells have Lowest Efficiency.**
- **Larger Footprint.**
- **Peel and Stick Laminate in Desert Heat.**
- **Limited type of Installation Options.**
- **Increased Soiling.**

Thin Film installed on Parking Structure



Crystalline Module Benefits



- **Highest Efficiency Cells.**
- **Smallest Foot Print.**
- **Flexible Installation Options.**
- **Lowest Maintenance.**
- **Reduced Soiling.**
- **Highest Level of Warranty.**

SunPower SPR-205-BLK Solar Module



Crystalline Module Drawbacks



- Labor Intensive.
- Possibility of Vandalism.
- Require Mounting Hardware.

Ryan Center 115KW



Summary



- **Covered Parking**
 - 1.5 KW / parking space
- **Tracking Systems**
 - 125 KWAC / Acre
- **Roof top**
 - 1 KW / 100 ft²



Summary

- Daily Solar Radiation for Southern Nevada (peak sun hours) = **6.4 hrs.**
- **AC kW = DC kW/ system efficiency.**
- Annual kilowatt/ hours = $(6.4 * 365 \text{ days} = 2,336) * \text{AC kW}$.
- Average house (1,800 ft. sq.) needs approximately **16,000 kilowatt hours a year.**
- $1,6000 / 2,336 = 6.9 \text{ kW AC}$
- **6.9 kW AC = 8.5 kW DC**
- **6.9 kW Ac (6,900 watts) * \$9 a watt = \$ 62,100 (with NO incentives)**
- Political Awareness
- Media Recognition
- Renewable Energy Credits or Utility Rebates
- Long term fixed Energy Price; **<\$.15 a kW/hr** over lifetime of system ($30 * 16,000 * 90\% = 432,000 \text{ kw/hrs}$; $\$62,100 / 432,000$).
- Greenhouse Gasses Avoided
 - $6.9 \text{ KW} = 21,530 \text{ lbs/year}$



Websites

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- www.wregis.org
- www.thegreenpowergroup.org
- www.solarnv.org
- www.bombardelectric.com



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