

2009 Governor's Regional & Rural Development Conference

August 26-28, 2009



Litchfield Park, Arizona

A partnership between the Arizona Association for Economic Development and the Arizona Department of Commerce



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Tucson Solar Innovations



Doug Crockett, Energy Manager

Bruce Plenk, Solar Energy Coordinator

Tony Larrivee, Facilities Management Administrator



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Introductions



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Innovations Agenda

- Leadership Doug
 - Tucson solar support
 - Solar America Cities grant Bruce
- Financing Tony
 - Power Purchase Agreements (PPAs)
 - Clean Renewable Energy Bonds (CREBs)
- Technology Bruce
 - Inverters
 - Panels
 - Monitoring Tony
- Conclusions All



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Solar Leadership



Dignitaries at Thornydale Phase III Dedication (2007)

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Tucson Solar Support

- Hired a full-time Energy Manager (1994).
- Adopted the Civano Sustainable Energy Standard (1995)
- Joined the Greater Tucson Coalition for Solar Energy (1997).
- Adopted the City Sustainable Energy Standard (1998).
- Approved a Tucson Solar Investment Fund (1999).
- Contributed to the Greater Tucson Strategic Energy Plan (2006).
- Adopted the LEED Silver plus 5% solar requirement (2006).



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Sun Tran Bus Shelters



Older flat plate solar panels

Newer thin-film solar roof



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Remote Applications



Wash crossing warning flasher



Dog park lighting



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Roof-Mount Applications



Ward IV

El Rio Education Center



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Ground & Reservoir Applications



Hayden-Udall Phase I

Thornydale Reservoir Phase I & II



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Pennington Street Garage - 64 kW



Tucson skyline above

Shaded parking below



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Leadership in Energy & Environmental Design (LEED)



Fire Station #22 - LEED Gold
(Solar hot water & day-lighting systems)

The Zoo School - LEED Platinum
(14 kW PV, solar hot water,
day-lighting & systems)



Solar Investment (1999-2008)

- \$960,000 cumulative solar investment with City funds.
- Over \$200,000 leveraged from solar grants & utility rebates.
- Bus shelter solar funded through advertising.
- System size range: 3 kW- 64 kW.
- 220 kW installed on 8 City sites.



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TUCSON

SOLAR AMERICA

CITY ™



U.S. DEPARTMENT OF
ENERGY

**COMMITTED TO A
SUSTAINABLE SOLAR FUTURE**



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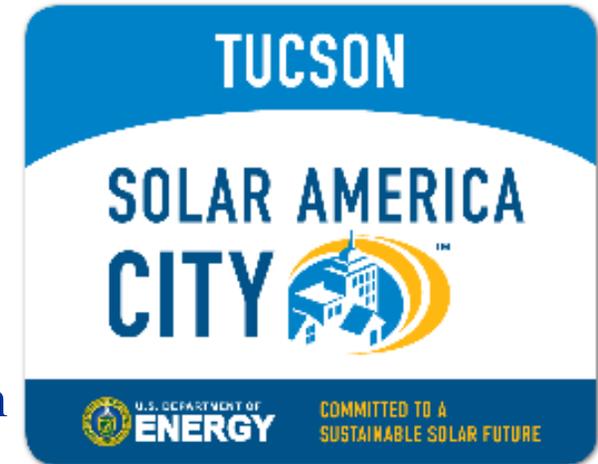
USDOE's Solar America Cities



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Solar America Cities Grant

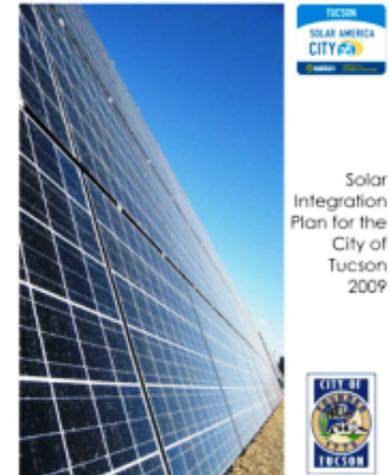
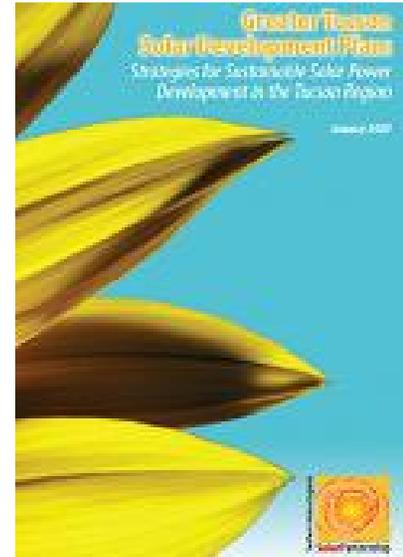
- Tucson Solar Initiative (2007-2009)
- Purpose:
 - Expand the Tucson solar market
 - Remove financial and educational barriers
- Deliverables:
 - Greater Tucson Solar Energy Development Plan
 - City Solar Integration Plan
- Partners - AZ Energy Office, MEC, TEP, PAG, AzRISE & CEC
- Funding:
 - \$200,000 US Department of Energy
 - \$353,000 City of Tucson & Partners match
 - Total \$535,000 project budget over a 2-year term
 - Additional \$250,000 of technical assistance provided



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Grant Accomplishments

- Hired full-time Solar Energy Coordinator.
- Created City of Tucson Energy Office website with solar links.
- Hosted the first national Solar America Cities Conference in Tucson.
- Completed Regional Solar Development Plan.
- Completed City Solar Integration Plan.
- Adopted Solar Ready Homes Ordinance.
- Solar Access to be considered as part of new Flexible Lot Design Ordinance
- 2 MW regional goal for installed solar already achieved.



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Solar Financing



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Power Purchase Agreements (PPAs)

- Most common funding mechanism for many businesses, governments, schools and non-profits.
- 3rd party (solar provider + financier) bears all the costs - financing, construction, maintenance, repairs, etc.
- Customer agrees to buy power at an agreed-upon rate for a fixed contract term (typically 20 years).
- Customer leases land or roofs to the solar provider.
- Contract may provide for yearly escalation factor
- Solar provider+financier gets all tax credits and utility rebates.



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PPA Challenges

- Negotiate power costs no greater than current power cost and less than anticipated future power costs
- Costly to draft and execute.
- Requires legal oversight and close review to assure no hidden costs to the customer.
- The Arizona Corporation Commission (ACC) is currently considering whether PPA providers are “public service companies” and thus subject to regulation.



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PPAs - a useful way to fund large-scale solar projects

- City water project: 1 MW PV project scheduled for completion in 2010
 - Similar to Nellis AFB project (shown at the right)
- Lease of city land being considered for 20-100 MW solar farm projects
 - Possible concentrating solar power (CSP) installations (example shown at the right).



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Clean Renewable Energy Bonds (CREBs)



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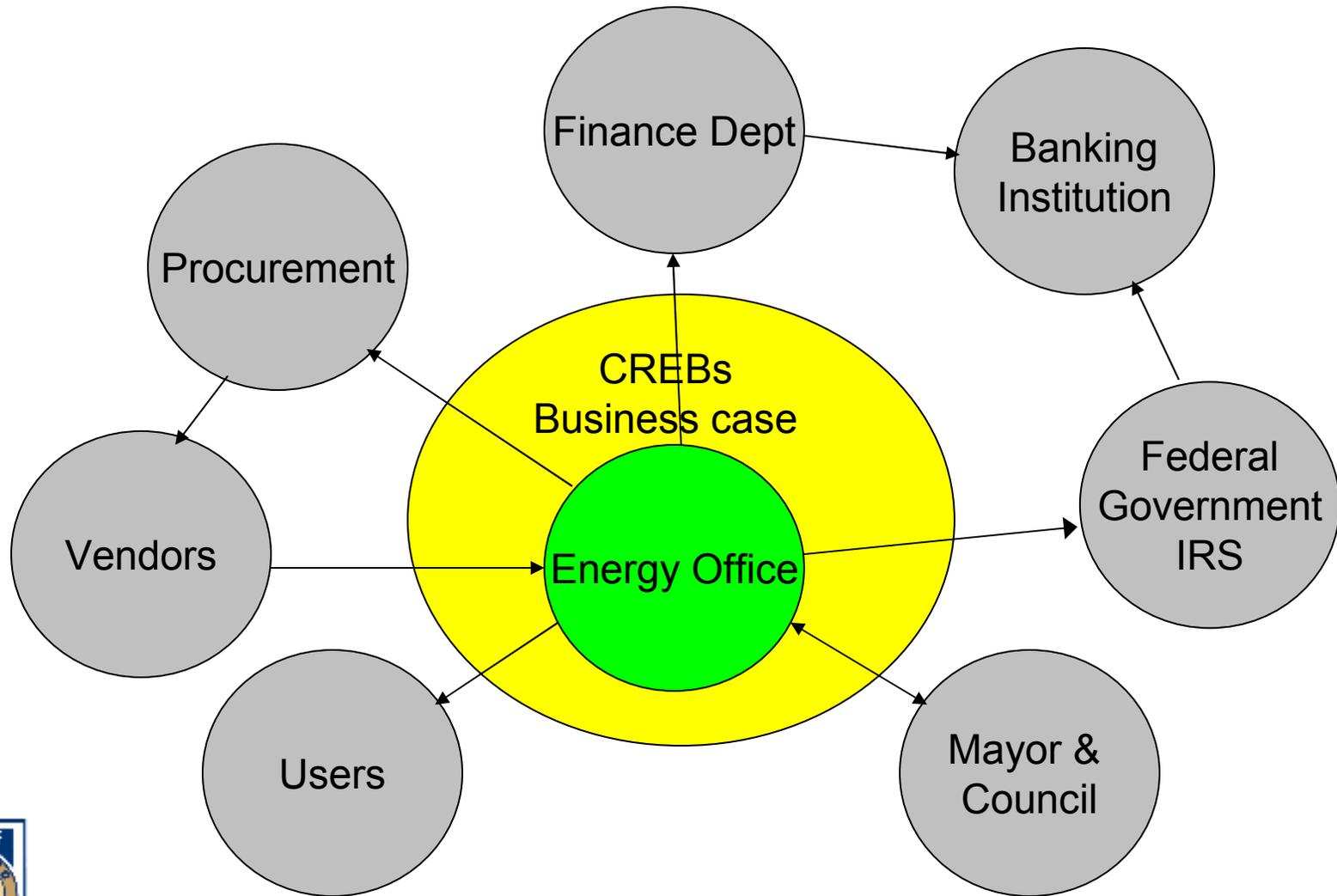
CREBs Funding

- \$7.6 million financed through interest-free Clean Renewable Energy Bonds (CREBs).
- Solar photovoltaic (PV) installations on 7 City sites.
- City owned and maintained with a 10-year service contract.
- Approximately 1 MW capacity - 1,572 metric tons of CO₂/year reduced.
- Bonds issued late Feb. 2009, construction to be complete by Jan. 2010.



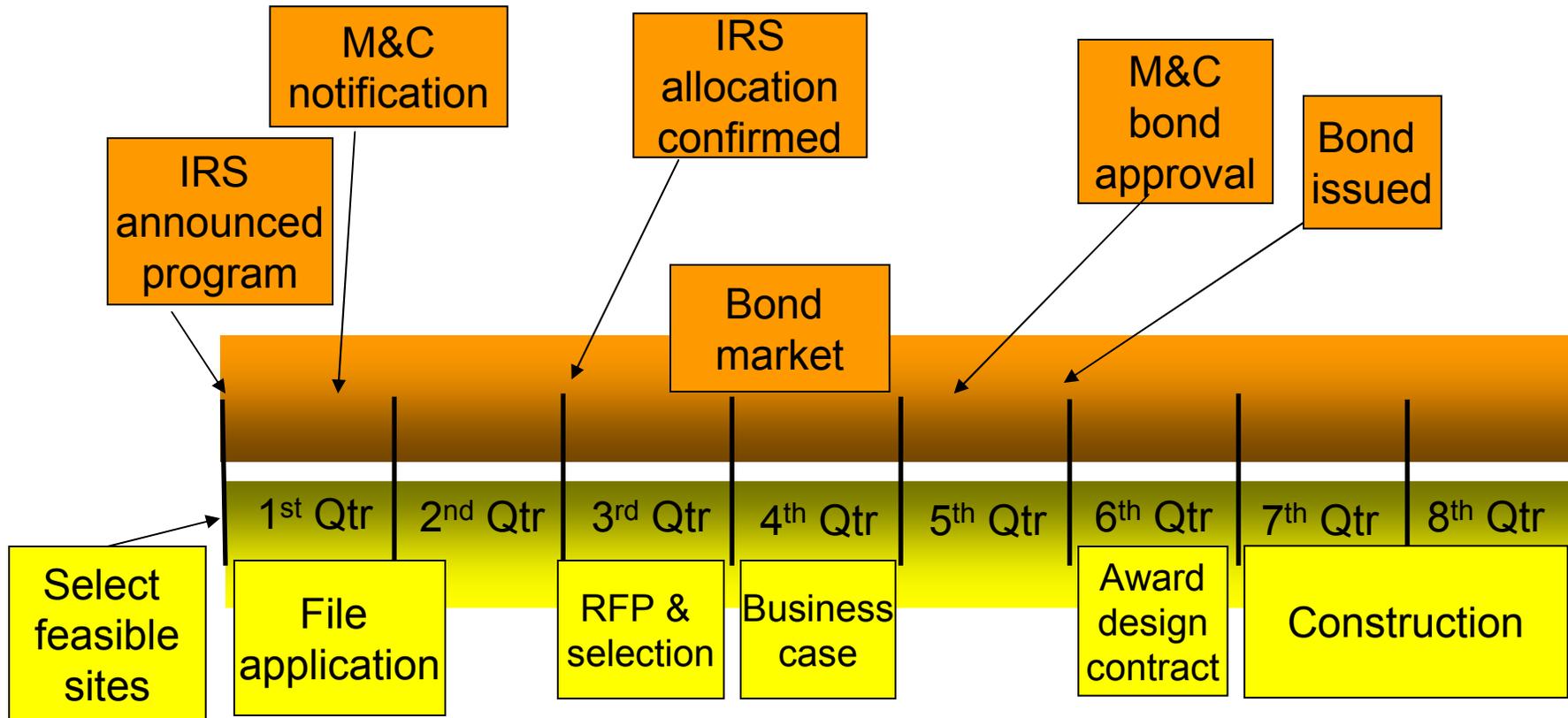
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Facilitating CREBs



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CREBs Timeline



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Choosing Your Sites



Hayden-Udall CAP
Water Plant ground-
mounted system

El Pueblo Activity Center
roof-mounted system



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Analyzing Site Requirements

- Electric load
- Structural analysis
- Roof age, condition & coating
- Access to roof
- Vandalism
- Pigeon abatement
- Electric power company requirements
- Upgrade of electrical service
- Road access/dust control
- Permitting (regulated washes & native plant requirements)

**TOTAL COST
Plus
Contingencies**



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How To Pay The Bond?

- Created an Internal Service Fund (ISF)
 - Revenue from electric cost off set from users
 - Revenue from REST or Green Credits
- Critical Issues
 - To be cash positive the first year
 - Realistic hours of production (PV Watts 1 & 2)
 - Monitoring of the system



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Business Case

- Actual cost per kW installed
- Anticipated kWh savings
 - Peak reduction?
 - Experience from similar tariffs.
- Historical performance of system for your area including panel de-rating
- 25-year cash flow table with inflation assumption
- Guaranteed production or “up time”



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Bond Issuance

- Clean Renewable Energy Bonds (CREBs) as General Obligation Bond or **Revenue Bond**
- Business Case – How will we pay back the bond?
- Lease purchase agreement as collateral
- Issues
 - Disbursement of funds – when single project completed – CASH issued



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Solar Technology



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Inverters

- Inverter life shorter than panel life-need to budget for replacement
- Warranties (5 year min., 10-15 year available now)
- Uptime warranty an option (but expensive)
- Single inverter vs. multiples



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Panels

- Panels: Traditional silicon panels vs. exotics (Solyndra; combined PV/solar thermal, etc)
- Traditional panels look like this:



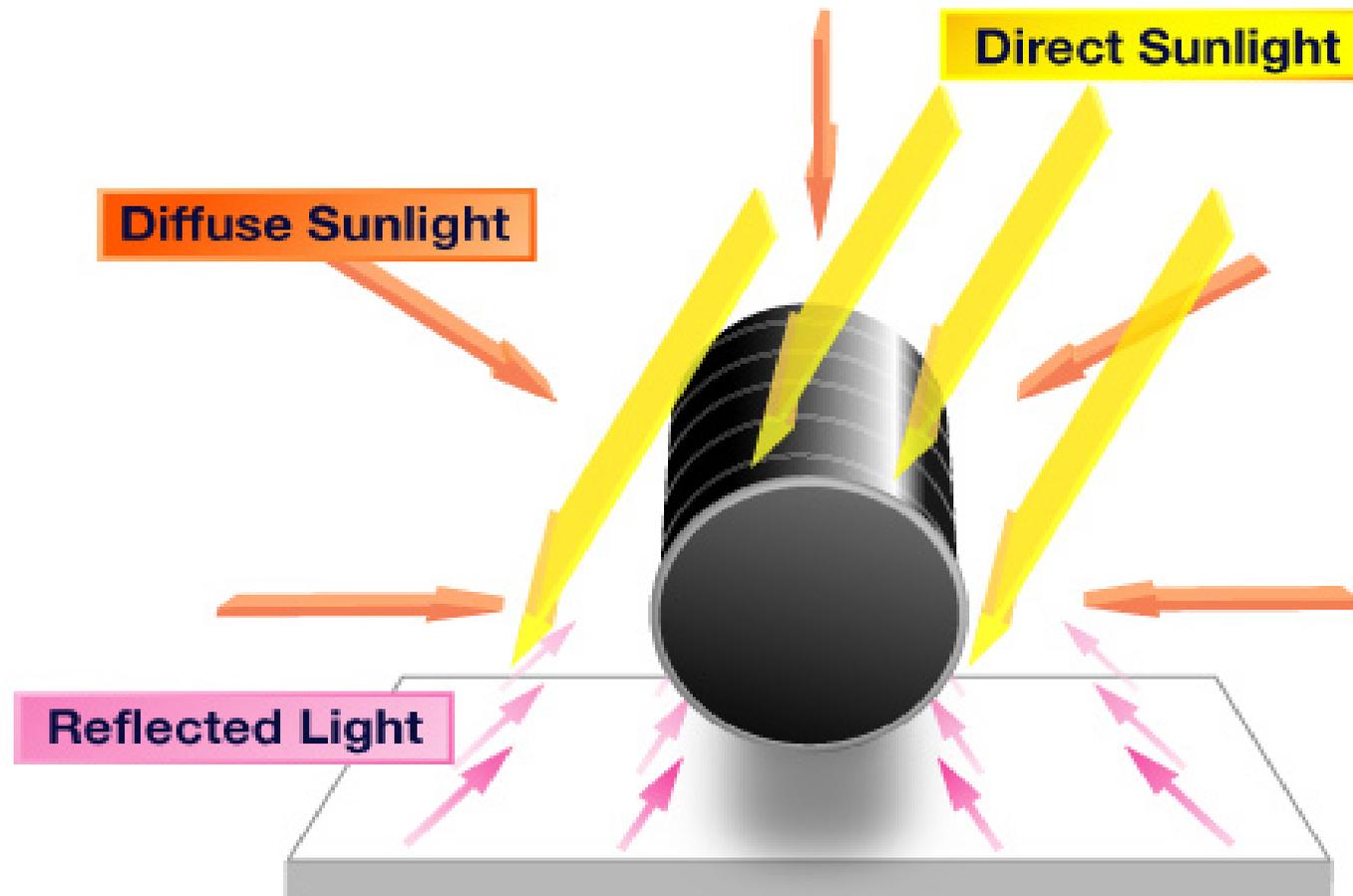
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Solyndra - a new type
of solar panel looks like this:



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Solyndra produces electricity at low angle sun in morning and afternoon



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Roof Attachment

- Standard racks
 - Roof penetration issues
 - Leaks, roof warranties, etc.
- Ballasted systems
 - Heavy weight
 - Sand, pavers, etc



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Ground Mounted vs. Tracker



Hayden-Udall Phase II



Public Safety Training Academy



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Tracker System at Hayden Udall CAP Plant - 229 kW



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Evaluating Technologies



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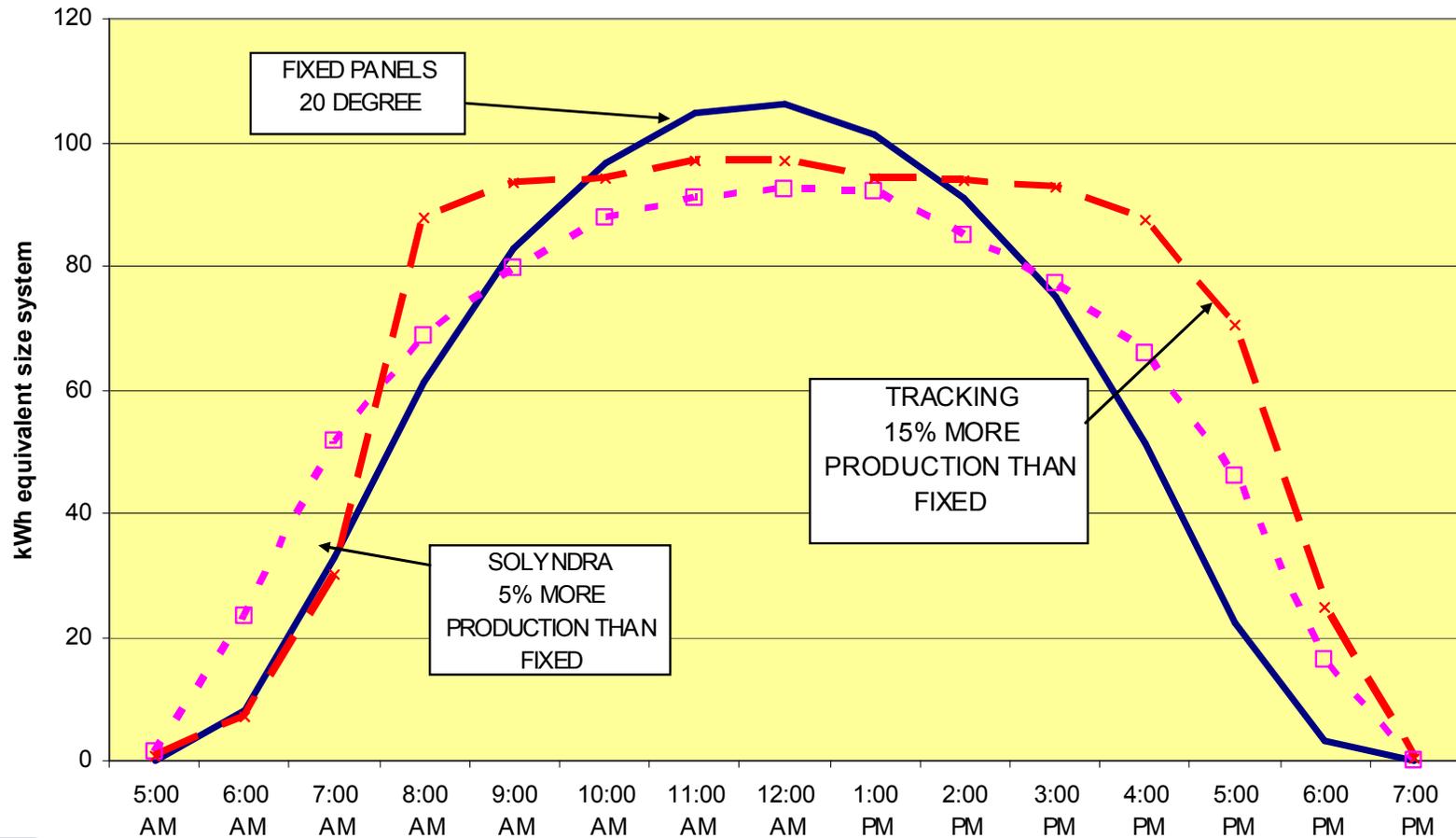
Performance Tracking

- Fat Spaniel and other companies offer 24/7 web-based monitoring.
- Alert features for malfunctions.
- Ability to compare production from different facilities.



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Technology Comparison



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Conclusions

- Financing (Tony)
- Technology (Bruce)
- Leadership (Doug)



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Solar Resource Links

- **Solar America Cities**

http://www1.eere.energy.gov/solar/solar_america_cities.html

- **Regional Solar Plan**

<http://www.pagnet.org/Programs/EnvironmentalPlanning/tabid/76/Default.aspx>

- **City of Tucson Energy Office**

<http://www.tucsonaz.gov/energy/solarintucson.htm>

- **Monitoring Tucson Solar Sites** (listed under SPG Solar)

<http://www.fatspaniel.com/fat-spaniel-in-action/live-sites/>



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**Questions &
Comments ?**