

SOLAR ENERGY CONCEPTUAL STUDY FOR:



LAKE HAVASU UNIFIED SCHOOL DISTRICT

April 21, 2009

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Executive Summary



The State of Arizona budget crisis has led to the drastic reduction in funds available for school districts. This includes the funds that districts use to operate the basic utility systems in their facilities. The Lake Havasu Unified School District currently pays the majority of their energy bills to their electricity provider. The District has expressed an interest in reducing these utility burdens so that more money could be directed towards basic education and operations in the coming years.

In order to address electric power usage and costs, Kennedy Partners, has conducted a solar feasibility study for the district under the guidelines of the Arizona Revised Statutes, specifically the Qualified Provider section 15-213.01. This statute allows districts to procure alternative energy savings measures through a variety of financing options. The District and Kennedy Partners selected the District's High School campus as being the best candidate for a solar energy project. In the process of generating the following report our team reviewed historical energy data, met with the local electric power provider (UniSource Electric Service), and made preliminary calculations to ascertain a probable system size and cost. On behalf of the District, Kennedy Partners has researched available tax credits and incentives as well as energy related rebates from various resources.

Typically, when it is determined that a solar power project is feasible, Kennedy Partners will recommend a combination of solar power arrays and ground mounted structural supports that become power producing shading devices on the District site.

As a result of the findings delineated in this document, Kennedy Partners has determined that as much as 100% of the electric power being used at the High School is recoverable with the development of a solar power project. We recommend that the District issue a Request for Proposal (under the above referenced Qualified Provider Statute) for a lease to own, Solar Photovoltaic (PV) shade system for the High School. The scenario described in this report will not require any capital outlay by the District and will result in significant electric energy savings which would be equal to a lease payment. The recommended solar shade systems should be placed on the District site in the configurations that are conceptually illustrated in this study.

Implementation of this project will promote the Lake Havasu District and its Board as being both fiscally conservative and good stewards of their environment. A solar project will also serve the most important aspect of your District, the children, by the potential instructional opportunities of a cutting edge solar project on campus; it will position the District as "Leaders in the Community" with renewable energy.

Utility Company Data

The electric utility provider for the Lake Havasu Unified School District is **UniSource Electric Services (UES)**. The blended rates (standard rate and demand rate) the district receives from UES are significantly lower than the rates that we have seen around the state from the other utility companies. The High School budget for power is still significant with the district spending over \$320,000 last year to power the 272,000 square foot facility.

Effective October 2008, all electric utility companies in Arizona are required by the Arizona Corporation Commission to allow and/or permit the use of a system called "net metering". Net metering is defined in depth in the appendixes of this report but can be briefly explained as follows: instead of a normal one-way meter installed on your building that indicates you electric usage, your solar power system will have an additional meter that indicates you electric production. Both your energy consumption and production are connected directly to the main electric grid. The utility provider will monitor both meters and provide a statement of your "net" energy use annually. In this case, the "grid" acts as a no cost energy bank for the net metering customer.

Most utility companies in Arizona provide Rebates or Performance Based Incentives for solar power projects. These funding resources, along with the Federal Investment Tax Credit, generally make the difference between projects that are financially feasible and those that are not. School Districts and other Public Entities are not eligible for tax based credits or rebates and are therefore, not a likely candidate for an affordable project.

Funding Resources

The relatively new Qualified Provider statute in Arizona with its Lease-to-own provision remedies this by allowing a School District such as yours to enter into an agreement with a "Qualified Provider." This Provider is a private entity and who can capture the value of the Rebates and Tax Credits and pass that value along to the School District in the way of a credit to the cost of the system. The Qualified Provider also provides the balance of the financing for the project and becomes the Lessor in a Lease-to-own agreement with the District.

The Qualified Provider will capture the maximum benefit to the District from the following funding resources:

- Federal Investment Tax Credit (ITC)
- Public Utility Rebate
- Renewable Energy Credits (REC)
- Performance Based Incentives (PBI)
- State Tax Credit
- Accelerated Depreciation (MACRS)
- Commercial Financing

We have included the definitions and explanations for these credits in the appendix of this document.

Site Analysis and Approach

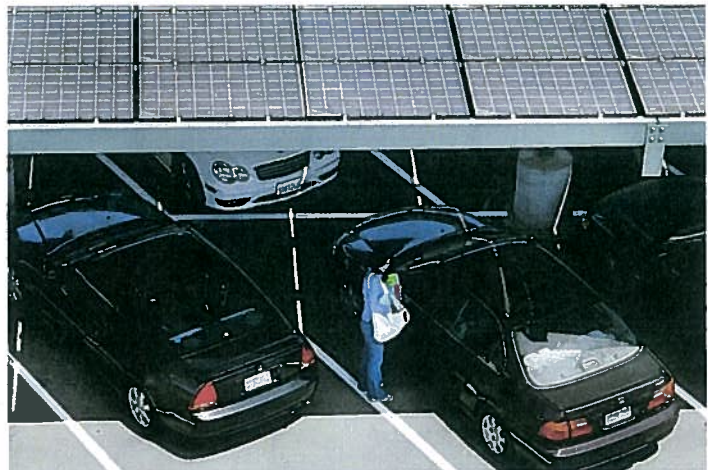
As was indicated in the Executive Summary, when it is determined that a solar power project is feasible, Kennedy Partners will recommend a combination of solar power arrays and ground mounted structural supports that become power producing shading devices on the District site. When we review a site for feasibility, we look for optimum orientation, square footage of potential shade area, accessibility, and the type and location of the electrical Service Entrance.



As Owner Representatives and Planning Consultants to schools, Kennedy Partners is foremost an advocate for facilities Owners and operators. Our basic recommendation to make shade with solar energy systems comes from our understanding that shade is a valuable commodity on almost every occupied site in Arizona – especially schools, as well as our strong belief that building roofs should not be used as a location for apparatus unless all other options have been exhausted. The Lake Havasu High School campus provides several excellent opportunities to provide both solar/shade structures for parking areas and solar/shade structures for outdoor gathering areas. Our recommendation is to study the parking areas first in order to maximize the potential size of the solar power system.

In order to achieve optimal performance from the solar power array systems, the panels should be placed on a tilted structure facing south. South orientation produces maximum hours of sunlight on the panel surface. Many sites have parking or outdoor gathering areas that are oriented east to west which easily allows for south-facing orientation. Shifting the orientation to the east or west will lower the insolation hours and the system performance. For example, if a system is shifted 90 degrees to face due west the performance will be approximately 85% of optimal.

The Lake Havasu High School northeast, northwest, and central parking lots are currently configured at a diagonal to the direct north/south orientation. It is likely that these lots will require reconfiguration/restriping as a result of optimizing the location of solar/shade structures. This can be achieved without sacrificing the utility of the parking lots. Additionally, the football field parking lot provides a wide-open opportunity if additional area is needed. Combined, the three parking areas mentioned above along with a number of outdoor solar/shading devices on campus for student use provide enough surface area for the development of a solar PV system capable of producing 100% of the power needed for the operation of this campus annually.



Summary

LAKE HAVASU HIGH SCHOOL

Findings:

The High School budget for power is significant with the district spending over \$320,000 last year to power the 272,000 square foot facility with an estimated energy use of 3,120,000 KWh.

A survey of the buildings and site reveals favorable conditions for photovoltaic renewable energy systems development. Various configurations of PV systems arrays are possible including shaded parking area, student areas and roof area. The Lake Havasu School District has expressed concern relative to the placement of equipment on the roofs of District buildings. The electrical Service Entrance Sections are fairly complex and located at a number of locations on the site as the campus has been increased in size a number of times.

The local electric utility, which is Unisource Electric Services (UES), indicates that it is their policy to enter into a Net-metering agreement with the owner for a grid-tied PV system. Additionally, UES will provide Rebates or Performance Based Incentives for solar power projects. These funding resources, along with the federal Investment Tax Credit, are generally necessary in order to make projects financially feasible.

The relatively new Qualified Provider statute in Arizona with its term financing provisions allows a School District to enter into an agreement with a "Qualified Provider." This Provider is a private entity and who can capture the value of the Rebates and Tax Credits and pass that value along to the School District in the way of a credit to the cost of the system. The Qualified Provider also provides the balance of the financing for the project.

Recommendations:

In order to capture valuable incentives, provide short term stabilization and long term energy cost savings, it is recommended that the School District initiate a procurement process based on the current Arizona school procurement rules and the Qualified Provider statute.

It is recommended that the District consider proposals for photovoltaic systems that:

1. are consistent in its construction, placement and operation with an educational environment and the Mission of the District
2. maximize the statutory and funding opportunities available
 - Federal Investment Tax Credit (ITC)
 - Public Utility Rebate
 - Renewable Energy Credits (REC)
 - Performance Based Incentives (PBI)
 - State Tax Credit
3. minimize costs to the district for the entire life of the system
4. provide for system Design, Construction, Financing, Commissioning, Operation, Administration and Maintenance of the proposed system

KENNEDY PARTNERS

Procurement Recommendations:

In the event of a statutory procurement, it is recommended that respondents to an RFP provide the following minimum information in their response:

- Size of the proposed solar PV system in DC watts
- Size of the proposed solar PV system in footprint area
- Expected annual output in KWh/Y
- Configuration of the solar PV system: location on the site and/or buildings; description of the support structures; recommended metering systems.
- A description of the financial structure of the proposed agreements and how that structure is to be administered.
- Term/length of the proposed Lease, Installment Agreement and/or Power Purchase Agreement
- Outline any and all costs, that the proposer expects will result from the design, construction, financing, commissioning, operation, administration and maintenance of the proposed system including costs related to impacts to existing site and/or buildings, other than those covered under a Lease, Installment Agreement and/or Power Purchase Agreement, for which the District will be responsible.

KENNEDY PARTNERS



Lake Havasu High School – Northeast Parking Lot



Havasus High School – Site Plan of Upper Campus

System Configuration Recommendations

This section includes basic data for the recommended shade support structures and configuration, photovoltaic system description, other design or technical recommendations or observations. The design of the on-site solar PV system will be the responsibility of the Qualified Provider Team; however, the system must be compliant with applicable utility company design guidelines. This section delineates the minimum technical and installation specifications required by the District for this Project. It is the intent of these specifications to insure that the PV systems installed are consistent with and adhere to any and all Building Codes and standards, applicable utility rules and tariffs, and any and all technical and installation specifications and guidelines as may developed and established.

Support Structures:

The support structures for solar/shade photovoltaic panel arrays are structural steel framing systems with steel columns that are extended into concrete foundations – much like typical shade canopies that are used in parking areas in the southwest. These structures are able to be configured in a fairly wide range of sizes, shapes and lengths in order to conform to the task that they are performing. For example, solar arrays are tilted at about 20 degrees from level in order to capture the greatest amount of sunlight. The steel support structures easily conform to that requirement. All structures possess night or security lighting on the bottom side and will require painting every 8 – 10 years. All structures must comply with local zoning and building codes as well as the International Building Code.

Solar Panels:

There are several varieties of panels available for this application. We recommend that the minimum specification be based on a higher quality 20 - 25 year product such as a Siliken 225, SLF 60P67 or a Sunpower SPR 230 watt panel. Thin film panels that are directly applied to a substrate are more vandal resistant but are less efficient and are not warranted for as long. We do not recommend this type of panel for your District. Modules should be certified to the standard provided in UL 1703 – “Flat-Plate Photovoltaic Modules and Panels”.

Power Sources:

Power provided must be compatible with the onsite distribution system. The distribution systems at the High School campus are of a variety of ages and conditions, but should generally be considered to meet current codes and standards and should be compatible with any/all specified systems. The Qualified Provider team should include a registered electrical engineer who would be responsible for verifying power requirements and adaptability on the “school side” of the system. All systems must be installed in accordance with all applicable requirements of local electrical codes and the National Electrical Code (NEC), including but not limited to Article 690, “Solar Photovoltaic Systems” and Article 705 – “Interconnected Electrical Power Production Sources”.

Other Components:

All Balance of Systems (wiring, component, wiring, conduits, and connections) must be suited for conditions for which they are to be installed. It is the preference of the District that when possible, inverters are located inside, out of the weather in a minimum NEMA 12 enclosure. If inverters are in exterior locations, they shall be installed in all-weather NEMA 4X enclosures. An interval data meter must be installed to measure the AC output of the inverter. This meter should be located in a location accessible to facilities personnel.

Procurement Process

We recommend that the District utilize the Qualified Provider Energy Savings Statute (ARS 15-213.01) and initiate procurement by developing and issuing a Request for Proposal in a two step format. The District will then form a committee to review and score qualifications of a design-build and finance team then open pricing proposal of qualified firms. The District will then select a team based on best value for the District based on State of Arizona school procurement rules.

A step by step description and timeline of how this would work is described herein. District issues the RFP as described above and select a Qualified Provider team. The Qualified Provider team will consist of the financing entity (who will "own" the system and credits), the general contractor (who will be contracted by the financing entity), the solar provider (who will be a sub-contractor to the general contractor), the umbrella management entity ("qualified provider" whose fees will be paid by the financing entity). The District's contact throughout the term of the lease will be the Qualified Provider.

The District will continue to pay their current utility bills through the financing entity and the system will be paid for via the various credits, and the difference between the current utility bills and the savings generated by the system. The system will be maintained by the owner entity until such time as the lease obligation has been paid for. At the time that the system has been completely paid for, all of the savings generated by the system will be realized by the District.

Recommended Timeline:

Governing Board Approves Statutory Procurement Process:	April 21 th , 2009
Advertisements in Daily Publication:	May 1 st & 8 th
Mandatory Pre-proposal Meeting	May 13 th
Proposals Due at District Office	May 26 th
Selection Committee Reviews and Ranks Proposals	May 28 th
Selection Committee Interviews Respondents (If Deemed Necessary)	June 4 th
Governing Board Approves Entering into Contract Negotiations	June 9 th
Governing Board Approves Contracts	July 14 th
Design Phase	July 15 th - Oct 9 th
Governing Board Approves Design:	October 13 th
Construction Phase(s)	Oct 14 th – March 12 th
Commissioning/Utility Company Approval – System on Line	March 31 st , 2010
First Net Meter Reading	April 30 th , 2010
Lease to Own Term	10-12 years*

* Lease term is established at completion of Contract Negotiations and full execution of a net metering agreement with your utility provider. The district OWNS the photovoltaic system at completion of the lease term. The Recommended Timelines may change based on final design, permitting, solar panel availability, Governing Board/District Administration availability for meetings and approvals.

Appendices

- Definitions
- Net Metering Diagram
- DSIRE Library Pages
 - Arizona Net Metering
 - Business Energy Tax Credit
 - Corporate Solar & Wind Tax Credit
 - UES Renewable Energy Credit (REC) Purchase Program
- Electric Utility Providers – Arizona
- Solar Radiation – Arizona

Definitions

Qualified Provider means a person or a business experienced in designing, implementing or installing energy cost savings measures – a training program or facility alteration designed to reduce energy consumption or operating costs. A school district may contract for the procurement of a guaranteed energy cost savings contract with a qualified provider through a competitive sealed proposal process as provided by the procurement practices adopted by the state board of education. A school district may enter into a guaranteed energy cost savings contract with a qualified provider if it determines that the amount it would spend on the energy cost savings measures recommended in the proposal would not exceed the amount to be saved in energy and operational costs over the expected life of the energy cost savings measures implemented or within twenty-five years, whichever is shorter, after the date installation or implementation is complete, if the recommendations in the proposal are followed.

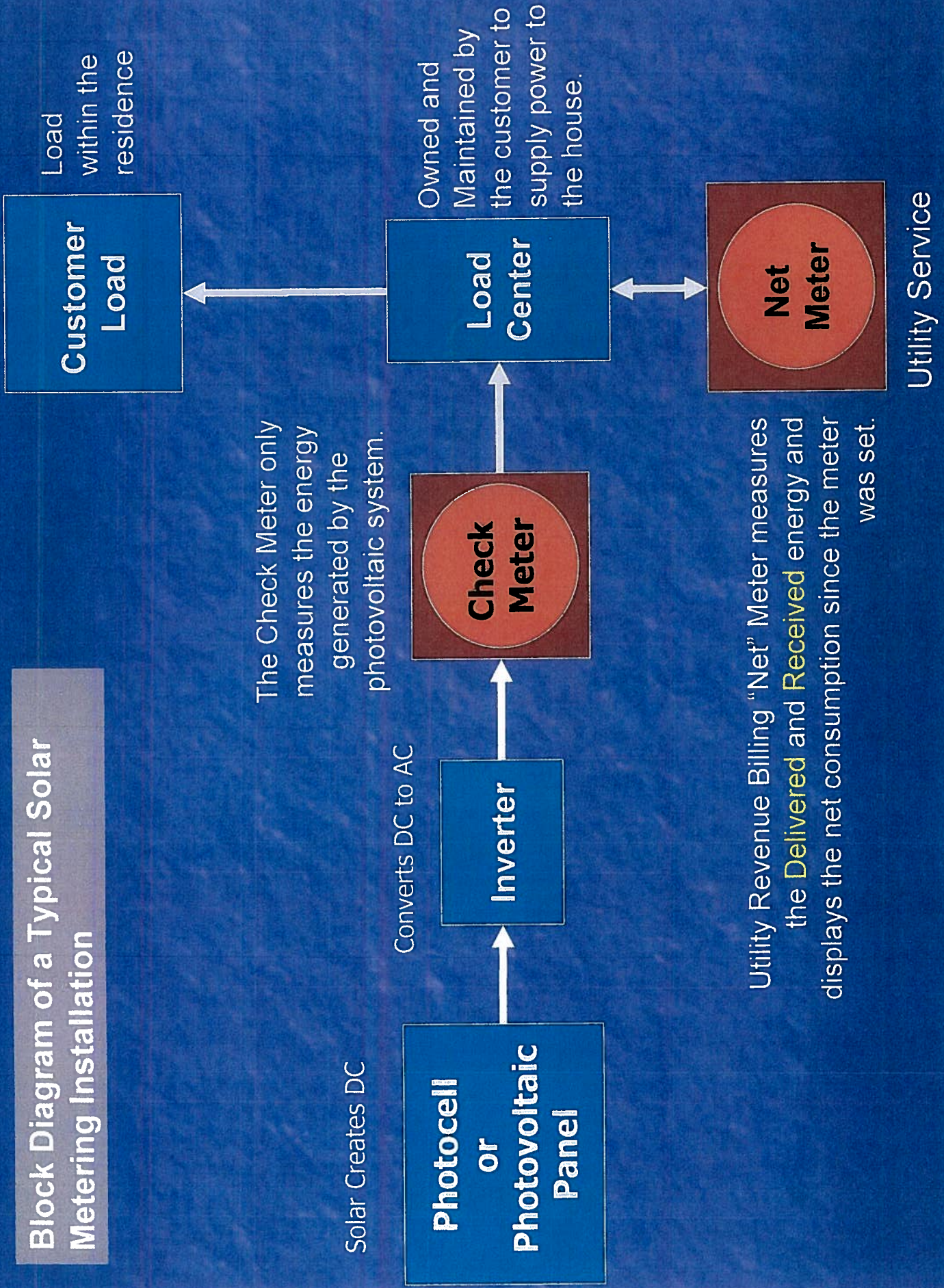
Net Metering is an electricity policy for consumers who own renewable energy facilities, such as wind, solar power or home fuel cells. "Net", in this context, is used in the sense of meaning "what remains after deductions" -- in this case, the deduction of any energy outflows from metered energy inflows. Under net metering, a system owner receives retail credit for at least a portion of the electricity they generate. The ideal has your existing electricity meter spinning backwards, effectively banking excess electricity production for future credit. In reality, the rules vary significantly by country and possibly state/province; if net metering is available, if and how long you can keep your banked credits, how much the credits are worth (retail/wholesale), etc.

Net Metering is generally a consumer-based renewable energy incentive. While it is important to have Net Metering available for any consumer that interconnects their renewable generator to the grid, this form of renewable incentive places the burdens of pioneering renewable energy primarily upon fragmented consumers. Often over-burdened energy agencies are not providing incentives on a consistent basis and it is difficult for individuals to negotiate with large institutions to recover their Net Metering credits and/or rebates for using renewable energy. In the U.S.A., as part of the Energy Policy Act of 2005, under Sec. 1251, all public electric utilities are now required to make available upon request net metering to their customers.

Renewal Energy Credits (REC's) also known as Green tags, Renewable Energy Credits, or Tradable Renewable Certificates (TRCs), are tradable environmental commodities in the United States which represent proof that 1 megawatt-hour (MWh) of electricity was renewable (generated from an eligible renewable energy resource). These certificates can be sold and traded and the owner of the REC can claim to have purchased renewable energy. While traditional carbon emissions trading programs promote low-carbon technologies by increasing the cost of emitting carbon, RECs can incentivize carbon-neutral renewable energy by providing a production subsidy to electricity generated from renewable sources. It is important to understand that the energy associated with a REC is sold separately and is used by another party. The consumer of a REC receives only a certificate.

In states which have a REC program, a green energy provider (such as a solar PV energy array) is credited with one REC for every 1,000 kWh or 1 MWh of electricity it produces (for reference, an average residential customer consumes about 800 kWh in a month). A certifying agency gives each REC a unique identification number to make sure it doesn't get double-counted. The green energy is then fed into the electrical grid (by mandate), and the accompanying REC can then be sold on the open market.

Block Diagram of a Typical Solar Metering Installation



Solar Creates DC

Converts DC to AC

The Check Meter only measures the energy generated by the photovoltaic system.

Owned and Maintained by the customer to supply power to the house.

Utility Revenue Billing "Net" Meter measures the **Delivered** and **Received** energy and displays the net consumption since the meter was set.

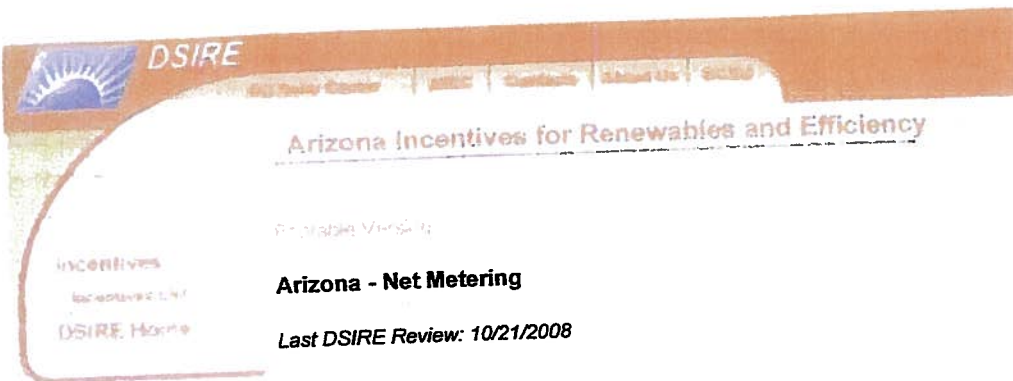
Load within the residence

Customer Load

Load Center

Net Meter

Utility Service



Arizona - Net Metering

Last DSIRE Review: 10/21/2008

- Incentive Type: Net Metering
- Eligible Renewable/Other Technologies: Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Geothermal Electric, Municipal Solid Waste, CHP/Cogeneration, Hydrogen, Biogas, Anaerobic Digestion, Small Hydroelectric, Fuel Cells using Renewable Fuels
- Applicable Sectors: Commercial, Industrial, Residential, Nonprofit, Schools, Local Government, State Government, Institutional
- Limit on System Size: 125% of customer's total connected electric load; or, in the absence of customer load data, a capacity that is less than or equal to the customer's electric service drop capacity
- Limit on Overall Enrollment: None stated
- Treatment of Net Excess: Credited to customer's next bill at utility's retail rate with accounts generally reconciled annually at the avoided-cost rate
- Utilities Involved: All investor-owned and cooperative utilities
- Interconnection Standards for Net Metering? No
- Authority 1: ACC R 14-0-2.101 A1 5001
- Date Enacted: 10/16/08
- Effective Date: 10/16/08 (utility tariffs will take effect in early 2009)

Summary:

Note: In October 2008, the Arizona Corporation Commission (ACC) adopted net metering rules that apply to all investor-owned electric utilities and cooperative utilities in the state. Utilities must file compliance tariffs by mid-January 2009, and the ACC must approve these tariffs before they take effect. Under the new state rules, net metering will be available to customers who generate electricity using solar, wind, hydroelectric, geothermal, biomass, biogas, combined heat and power (CHP), or fuel cell technologies. Separate net metering programs previously developed by two utilities – APS and TEP – will remain in effect until the new tariffs are approved.*

Under Arizona's rules, net metering is available to customers who generate electricity using solar, wind, hydroelectric, geothermal, biomass, biogas, combined heat and power (CHP) or fuel cell technologies. The ACC did not set a firm kilowatt limit on system size capacity, as is found in most other states' net metering policies. Instead, systems must be sized to meet all or part of a customer's electric load in that the system may not exceed 125% of the customer's total connected load. If there is no available load data for the customer, the generating system may not exceed the customer's electric service drop capacity. Additionally, the ACC did not set an aggregate capacity limit for all net metered systems in a utility's territory. The utility must instead demonstrate to the ACC why such a cap should be allowed.

The ACC requires that net metering charges be assessed on a non-discriminatory basis. Any new or additional charges that would increase an eligible customer-generator's costs beyond those of other customers in the rate class to which the eligible customer-generator would otherwise be assigned must be proposed to the ACC for consideration and approval.

Net metering is accomplished using a single bi-directional meter. Any customer net excess generation (NEG) will be carried over to the customer's next bill at the utility's retail rate, as a kilowatt-hour (kWh) credit. Any NEG remaining at the customer's last monthly bill in a calendar year will be paid to the customer, via check or billing credit, at the utility's avoided cost payment.

For customers taking service under a time-of-use rate, off-peak generation will be credited against off-peak consumption, and on-peak generation will be credited against on-peak consumption. The customer's monthly bill is based on the net on-peak kWh and net off-peak kWh amounts. Any monthly customer NEG will be carried over to the customer's next bill as an off-peak or on-peak kWh credit.

Under the ACC rules, each utility must file an annual report listing the net metered facilities and their installed capacity for the previous calendar year.

** SRP and municipal utilities do not fall under the jurisdiction of the ACC, and therefore are not subject to the state rules.*

Contact:

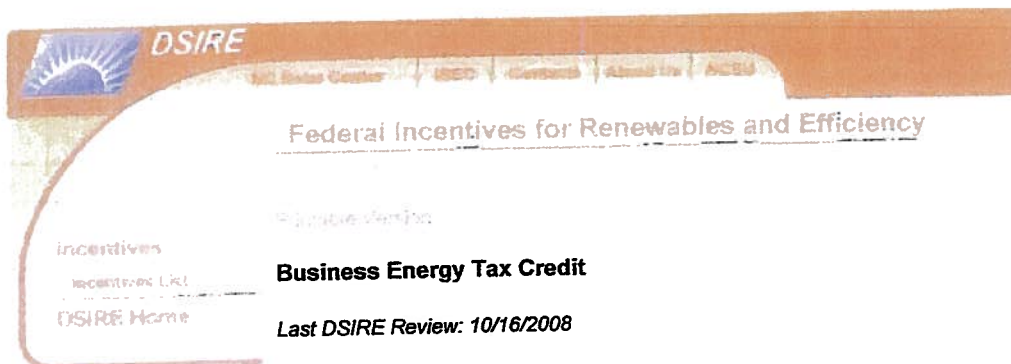
Barbara Keene
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Phoenix, AZ 85007
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Federal Incentives for Renewables and Efficiency

Business Energy Tax Credit

Last DSIRE Review: 10/16/2008

Incentive Type: Corporate Tax Credit

Eligible Renewable/Other Technologies: Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Wind, Biomass, Geothermal Electric, Fuel Cells, Geothermal Heat Pumps, CHP/Cogeneration, Solar Hybrid Lighting, Direct Use Geothermal, Microturbines

Applicable Sectors: Commercial, Industrial, Utility

Amount: 30% for solar, fuel cells and small wind;
10% for geothermal, microturbines and CHP

Maximum Incentive: \$1,500 per 0.5 kW for fuel cells; \$200 per kW for microturbines; \$4,000 maximum credit for small wind. No maximum specified for other technologies.

Eligible System Size: Small wind turbines: 100 kW or less
Fuel cells: 0.5 kW or greater
Microturbines: 2 MW or less
CHP: 50 MW or less

Equipment/Installation Requirements: Fuel cells, microturbines and CHP systems must meet specific energy-efficiency criteria

Authority 1: 26 USC § 48

Authority 2: H.R. 1424; Div. B of the Energy Improvement and Extension Act of 2008

Date Enacted: 10/3/2008

Effective Date: 10/3/2008

Summary:

The federal business energy tax credits available under 26 USC § 48 were expanded significantly by the Energy Improvement and Extension Act of 2008 (H.R. 1424), enacted in October 2008. The new law extended the duration – by eight years – of the existing credits for solar energy, fuel cells and microturbines; increased the credit amount for fuel cells; established new credits for small wind-energy systems, geothermal heat pumps, and combined heat and power (CHP) systems; extended eligibility for the credits to utilities; and allowed taxpayers to take the credit against the alternative minimum tax (AMT), subject to certain limitations.

Credits are available for eligible systems placed into service on or before December 31, 2016.*

- **Solar.** The credit is equal to 30% of expenditures, with no maximum credit limit stated. Eligible solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat. (Passive solar systems and solar pool-heating systems are *not* eligible.) Hybrid solar lighting systems are those that use solar energy to illuminate the inside of a structure using fiber-optic distributed sunlight.

Click [here](#) for a four-page Q&A on the revised federal solar tax incentives, prepared by the Solar Energy Industries Association.

- **Fuel Cells.** The credit is equal to 30% of expenditures, with no maximum credit limit stated. The credit for fuel cells is capped at \$1,500 per 0.5 kilowatt (kW) of capacity. Eligible property includes fuel cells with a minimum capacity of 0.5 kW that have an electricity-only generation efficiency of 30% or higher. (Note that the credit for property placed into service on or before October 3, 2008, is capped at \$500 per 0.5 kW.)
- **Small Wind Turbines.** The credit is equal to 30% of expenditures, with a maximum credit of \$4,000. Eligible small wind property includes wind turbines up to 100 kW in capacity. This credit applies to eligible property placed into service after October 3, 2008.
- **Geothermal Systems.** The credit is equal to 10% of expenditures, with no maximum credit limit stated. Eligible geothermal energy property includes geothermal heat pumps and equipment used to produce, distribute or use energy derived from a geothermal deposit. For electricity produced by geothermal power, equipment qualifies only up to, but not including, the electric transmission stage. For geothermal heat pumps, this credit applies to eligible property placed into service after

October 3, 2008.

- **Microturbines.** The credit is equal to 10% of expenditures, with no maximum credit limit stated (explicitly). The credit for microturbines is capped at \$200 per kW of capacity. Eligible property includes microturbines up to two megawatts (MW) in capacity that have an electricity-only generation efficiency of 26% or higher.
- **Combined Heat and Power (CHP).** The credit is equal to 10% of expenditures, with no maximum limit stated. Eligible CHP property generally includes systems up to 50 MW in capacity that exceed 60% energy efficiency, subject to certain limitations and reductions for large systems. The efficiency requirement does not apply to CHP systems that use biomass for at least 90% of the system's energy source, but the credit may be reduced for less-efficient systems. This credit applies to eligible property placed into service after October 3, 2008.

In general, the original use of the equipment must begin with the taxpayer, or the system must be constructed by the taxpayer. The equipment must also meet any performance and quality standards in effect at the time the equipment is acquired. The energy property must be operational in the year in which the credit is first taken.

If the project is financed in whole or in part by subsidized energy financing or by tax-exempt private activity bonds, the basis on which the credit is calculated must be reduced. (The formula is described in the tax credit instructions.) Subsidized energy financing means "financing provided under a federal, state, or local program, a principal purpose of which is to provide subsidized financing for projects designed to conserve or produce energy." Therefore, a business must reduce the basis for calculating the credit by the amount of any such incentives received. Businesses who receive other incentives are advised to consult with a tax professional regarding how to calculate this federal tax credit.

History

The federal Energy Policy Act of 2005 (EPAAct 2005) expanded the existing federal business energy tax credit for solar and geothermal energy property to include fuel cells, microturbines and hybrid solar lighting systems installed on or after January 1, 2006, and raised the credit for solar to 30%. Prior to the provisions of EPAAct 2005, a 10% credit was available to businesses that invested in or purchased solar or geothermal energy property.

** Note that the credit for geothermal property, with the exception of geothermal heat pumps, has no stated expiration date. The credit for solar energy property reverts to 10% after December 31, 2016.*

Contact:


Public Information - IRS
Internal Revenue Service
1111 Constitution Avenue, N.W.
Washington, DC 20224
Phone: (800) 829-1040
Web site: <http://www.irs.gov>



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DSIRE

Arizona Incentives for Renewables and Efficiency

Replaces Version:

Incentives

Incentives List

DSIRE Home

Non-Residential Solar & Wind Tax Credit (Corporate)

Last DSIRE Review: 05/20/2008

Incentive Type: Corporate Tax Credit

Eligible Renewable/Other Technologies: Passive Solar Space Heat, Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Wind, Solar Cooling, Solar Pool Heating, Daylighting

Applicable Sectors: Commercial, Industrial, Nonprofit, Schools, Local Government, State Government, Tribal Government, Fed. Government, Agricultural, Institutional

Amount: 10% of installed cost

Maximum Incentive: \$25,000 for any one building in the same year and \$50,000 in total credits in any year

Carryover Provisions: Unused credit may be carried forward for not more than five consecutive taxable years

Eligible System Size: No system size restrictions specified

Project Review/Certification: Project Businesses/Non-residential entities must apply to the Arizona Department of Commerce and receive certification to be eligible for the credit

Website: <http://www.azdo.commerce.com/BizAsset/Incentives/Solar+Energy+1+admin/incentives+Program.htm>

Authority 1: A.R.S. §43-1055

Effective Date: 1/1/2006

Expiration Date: 12/31/2012

Authority 2: A.R.S. §43-1184

Effective Date: 1/1/2006

Expiration Date: 12/31/2012

Authority 3: A.R.S. §41-1013.01

Summary:

Arizona's tax credit for solar and wind installations in commercial and industrial applications was established in June 2006 (HB 2429). In May 2007, the credit was revised by HB 2491 to extend the credit to all non-residential entities, including those that are tax-exempt. Third parties who install or manufacture the system are now eligible as well – not only those that finance a system as allowed in the original legislation. These provisions are retroactive to January 1, 2006.

The tax credit, which may be applied against corporate or personal taxes, is equal to 10% of the installed cost of qualified "solar energy devices" and applies to taxable years beginning January 1, 2006 and extending through December 31, 2012.

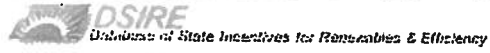
A solar energy device is defined as "a system or series of mechanisms designed primarily to provide heating, to provide cooling, to produce electrical power, to produce mechanical power, to provide solar daylighting or to provide any combination of the foregoing by means of collecting and transferring solar generated energy into such uses either by active or passive means, including wind generator systems that produce electricity. Solar energy systems may also have the capability of storing solar energy for future use. Passive systems shall clearly be designed as a solar energy device, such as a trombe wall, and not merely as a part of a normal structure, such as a window."

The maximum credit per taxpayer is \$25,000 for any one building in the same year and \$50,000 in total credits in any year. If the allowable credit exceeds the taxpayer's income tax liability, the amount of the claim not used to offset taxes may be carried forward for not more than five consecutive taxable years as a credit against subsequent years' income tax liability.

To qualify for the tax credits, a business must submit an application to the Arizona Department of Commerce (DOC). The DOC will review applications, provide an initial certification to qualifying installations, and issue a credit certificate to the business once the installation is complete and approved. The Arizona Department of Revenue will also receive a copy of the credit certificate. The DOC may certify tax credits up to a total of \$1 million each calendar year. The DOC and the Department of Revenue will collaborate in adopting rules to implement the tax credit program.

Contact:


Program Manager
Arizona Department of Commerce
Energy Office
1700 West Washington Ave.
Suite 220
Phoenix, AZ 85007
Phone: (602) 771-1100
E-Mail: energy@azcommerce.com
Web site: <http://www.azcommerce.com/energyinfo/az.asp>



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Arizona Incentives for Renewables and Efficiency

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UES - Renewable Energy Credit Purchase Program

Last DSIRE Review: 07/18/2008

Incentive Type: Utility Rebate Program

Eligible Renewable/Other Technologies: Solar Water Heat, Solar Space Heat, Solar Thermal Process Heat, Photovoltaics, Landfill Gas, Wind, Biomass, Geothermal Electric, Geothermal Heat Pumps, Solar HVAC, Solar Pool Heating, Daylighting, Anaerobic Digestion, Small Hydroelectric, Other Distributed Generation Technologies

Applicable Sectors: Commercial, Residential

Incentive Amount: PV incentives may be de-rated based on expected performance
 Grid-tied residential PV: \$3/watt DC
 Off-grid Residential (less than 5 kW): \$2/watt DC;
 Grid-tied non-residential PV: \$2.50/watt DC or production-based incentive (PBI)
 Off-grid non-residential PV: \$1.50/W DC or PBI
 Residential/small solar water heating: \$0.75/kWh of estimated first-year savings
 Commercial/large solar water heating and solar HVAC systems: production based incentive
 Solar Daylighting: \$0.20/kWh estimated first year savings
 Other renewables: performance-based incentive

Maximum Incentive: Up-front incentives can pay for no more than 60% of the cost

Installation

Requirements: Solar system must meet orientation, tilt, and shading guidelines.

Ownership of Renewable

Energy Credits: UES

Website: <http://uesaz.com/Community/Environment/GreenWatts/Sunshare.asp>

Effective Date: 2004

Summary:

Through the Renewable Incentive Program, UniSource Energy Services (UES) offers customers who install various renewable energy sources the opportunity to sell the credits associated with the energy generated to UES. Previously, UES only provided incentives for solar technologies, but they expanded the list of qualified renewables in 2008 to include all technologies eligible for Arizona's [Renewable Energy Standard \(RES\)](#). The solar technologies eligible for a rebate include photovoltaic (PV), solar hot water, solar HVAC and solar daylighting systems. Up-front incentives for PV may be de-rated based on expected performance. Renewable energy systems are eligible for the following credit amounts:

- **Grid-tied residential PV:** \$3/watt DC, adjusted based on expected performance; No system size limit.
- **Grid-tied non-residential PV:** \$2.50/watt DC; or commercial customers may opt for a production-based incentive (PBI) on a 10, 15 or 20 year contract.
- **Off-grid residential PV:** \$2/watt DC; System must be less than 5 kW.
- **Off-grid non-residential PV:** \$1.50/W or PBI
- **Solar hot water systems (residential and non-residential):** Rebate amounts for small systems are based upon an estimate of first-year energy savings at \$0.75/kWh based on OG-300 ratings, up to 50% of the system's cost. The incentive structure for large SWH systems is based on actual performance, and can range between \$0.051/kWh-equivalent and \$0.07/kWh-equivalent depending on the length of the contract. Incentives are limited to 50% of total system cost.
- **Solar HVAC systems (non-residential only):** The incentive for the thermal energy delivered for cooling by a solar HVAC system is based on actual performance and ranges between \$0.12/kWh-equivalent and \$0.16.kWh equivalent. In addition, systems that incorporate solar thermal heating and/or solar thermal water heating are eligible for the large solar water heating PBI.
- **Solar Daylighting (non-residential only):** \$0.20/kWh anticipated first year savings.
- **Other solar technologies (non-residential only):** PBI amount varies by contract length and technology.
- **Grid-tied wind systems (residential and non-residential):** \$2.50/W up to 50% of the system cost; non-residential systems may opt for the PBI
- **Off-grid wind systems (residential and non-residential):** \$2.00/W up to 50% of the system

- cost; non-residential systems may opt for the PBI
- **Other renewables** installed by non-residential customers can apply to receive a PBI.

Funds are assigned through a reservation process. All necessary forms can be downloaded from the program website.

UES is purchasing solar credits and renewable energy certificates to help the company meet the state's Renewable Energy Standard (RES). Participating customers receive a one-time rebate or receive an incentive based on system output or kWh savings. UES will have access to the credits for the life of the RES program.

Contact:

Renewable Energy Credit Purchase Program - UES
UniSource Energy Services
PO Box 3099
Kingman, AZ 86402-3099
Phone: (866) 467-1229
E-Mail: renewables@uesaz.com
Web site: <http://uesaz.com/>

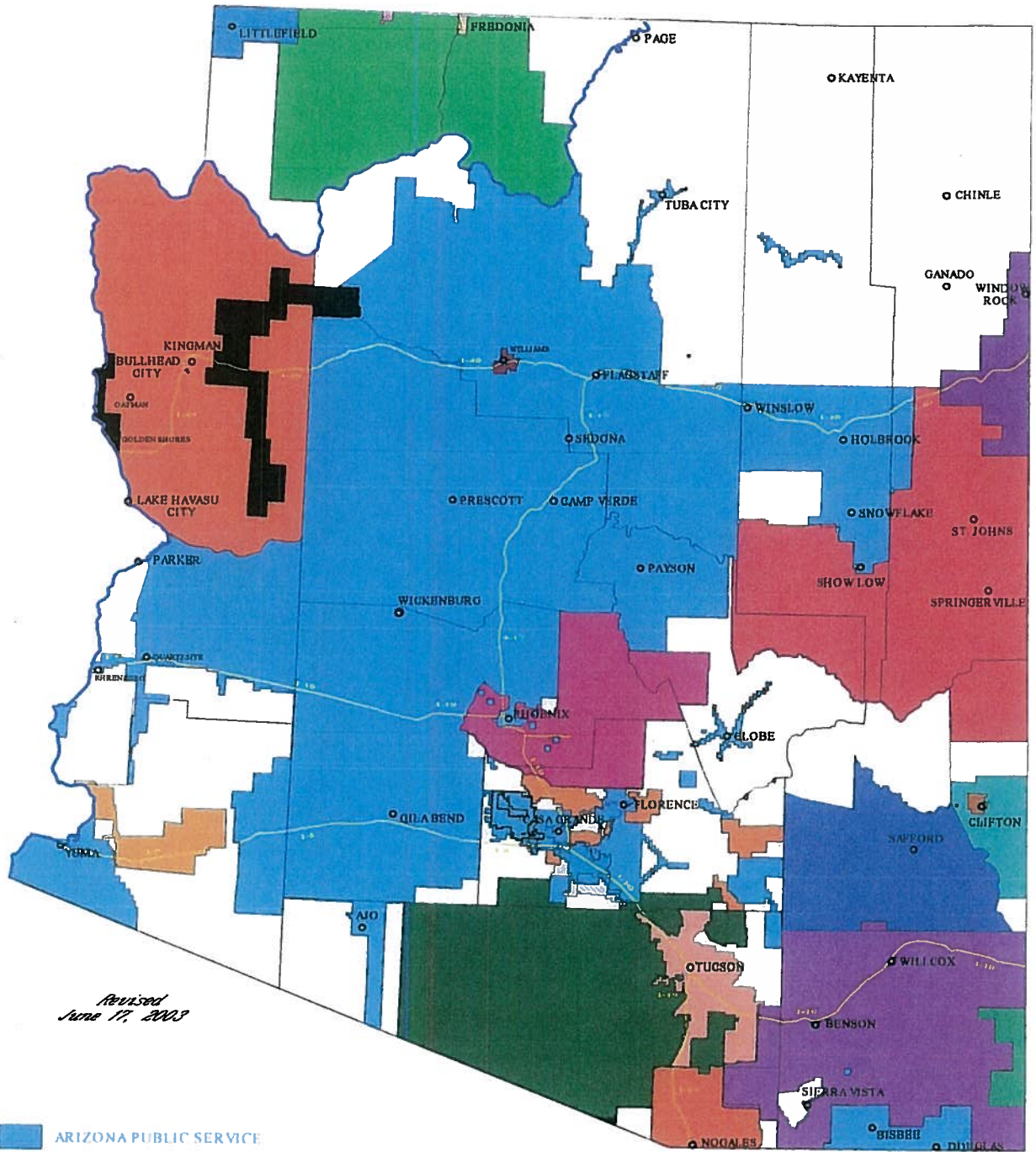


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












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*Revised
June 17, 2003*

- | | | |
|---|--|---|
|  ARIZONA PUBLIC SERVICE |  ELECTRIC DISTRICT NO. 1 |  MORENCI WATER & ELECTRIC |
|  UNISOURCE ENERGY SERVICES |  ELECTRIC DISTRICT NO. 2 |  NAVOPACHE ELECTRIC CO-OP |
|  |  ELECTRIC DISTRICT NO. 3 |  SALT RIVER PROJECT |
|  CITY OF WILLIAMS |  ELECTRIC DISTRICT NO. 4 |  SAN CARLOS IRRIGATION |
|  COLORADO CITY |  ELECTRIC DISTRICT NO. 5 |  SULPHUR SPRINGS VALLEY ELECTRIC COOPERATIVE, INC. |
|  COLUMBUS ELECTRIC CO-OP |  GARKANE POWER ASSOCIATION |  TRICO ELECTRIC COOPERATIVE |
|  CONTINENTAL DIVIDE ELECTRIC COOPERATIVE, INC. |  GRAHAM COUNTY ELECTRIC COOPERATIVE, INC. |  TUCSON ELECTRIC POWER |
|  DIXIE ESCALANTE RURAL ELECTRIC ASSOCIATION |  MOHAVE ELECTRIC COOPERATIVE |  WILTON MOHAWK |
|  DUNCAN VALLEY ELECTRIC COOPERATIVE, INC. | | |

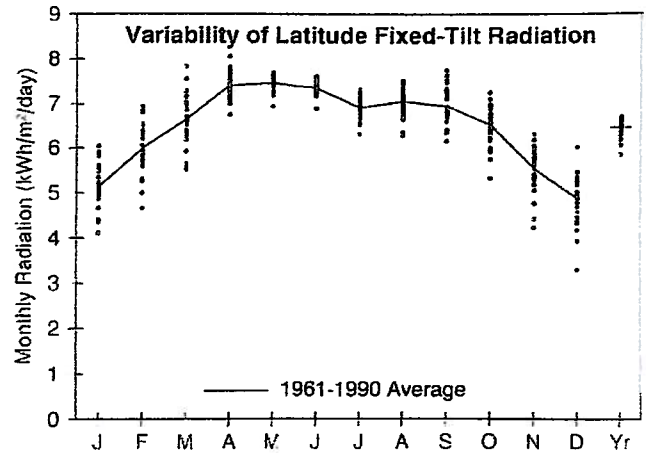
STATE OF ARIZONA - ELECTRIC

Phoenix, AZ

WBAN NO. 23183

LATITUDE: 33.43° N
 LONGITUDE: 112.02° W
 ELEVATION: 339 meters
 MEAN PRESSURE: 974 millibars

STATION TYPE: Primary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.2	4.3	5.5	7.1	8.0	8.4	7.6	7.1	6.1	4.9	3.6	3.0	5.7
	Min/Max	2.8/3.7	3.5/4.8	4.7/6.4	6.4/7.8	7.5/8.3	7.8/8.7	6.9/8.1	6.3/7.5	5.4/6.7	4.2/5.3	3.0/4.0	2.2/3.5	5.3/5.9
Latitude -15	Average	4.4	5.4	6.4	7.5	8.0	8.1	7.5	7.3	6.8	6.0	4.9	4.2	6.4
	Min/Max	3.6/5.1	4.3/6.2	5.3/7.4	6.8/8.2	7.4/8.2	7.6/8.4	6.8/8.0	6.5/7.8	6.1/7.6	5.0/6.6	3.8/5.5	2.9/5.1	5.8/6.6
Latitude	Average	5.1	6.0	6.7	7.4	7.5	7.3	6.9	7.1	7.0	6.5	5.6	4.9	6.5
	Min/Max	4.1/6.0	4.7/6.9	5.5/7.8	6.8/8.1	6.9/7.7	6.9/7.6	6.3/7.3	6.3/7.5	6.2/7.8	5.3/7.3	4.3/6.3	3.3/6.0	5.9/6.7
Latitude +15	Average	5.5	6.2	6.6	6.9	6.6	6.3	6.0	6.4	6.7	6.7	5.9	5.3	6.3
	Min/Max	4.4/6.6	4.8/7.3	5.4/7.8	6.2/7.5	6.1/6.8	5.9/6.5	5.5/6.3	5.7/6.8	5.9/7.5	5.4/7.4	4.4/6.8	3.5/6.7	5.6/6.5
90	Average	4.9	5.0	4.5	3.7	2.7	2.3	2.4	3.1	4.2	5.1	5.1	4.8	4.0
	Min/Max	3.8/5.9	3.8/5.9	3.7/5.3	3.3/3.9	2.6/2.8	2.1/2.4	2.2/2.5	2.8/3.3	3.7/4.6	4.1/5.7	3.7/6.0	3.1/6.2	3.5/4.2

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	4.7	6.2	7.8	9.9	11.0	11.4	10.0	9.6	8.6	7.1	5.3	4.4	8.0
	Min/Max	3.8/5.6	4.6/7.3	6.2/9.5	8.9/11.4	9.9/11.8	10.3/12.2	8.8/11.1	8.0/10.5	7.4/9.9	5.6/8.1	4.0/6.2	2.9/5.5	7.1/8.4
Latitude -15	Average	5.6	7.1	8.5	10.3	11.1	11.3	10.0	9.8	9.2	8.0	6.3	5.3	8.5
	Min/Max	4.4/6.7	5.2/8.3	6.7/10.3	9.2/11.9	9.9/11.8	10.2/12.1	8.8/11.1	8.2/10.8	7.9/10.5	6.2/9.1	4.6/7.3	3.4/6.7	7.6/8.9
Latitude	Average	6.2	7.5	8.7	10.3	10.7	10.8	9.6	9.6	9.3	8.4	6.8	5.8	8.6
	Min/Max	4.8/7.4	5.5/8.9	6.8/10.6	9.1/11.8	9.6/11.5	9.8/11.6	8.4/10.7	8.1/10.6	8.0/10.7	6.5/9.5	4.9/8.0	3.8/7.4	7.6/9.0
Latitude +15	Average	6.5	7.7	8.6	9.9	10.1	10.1	9.0	9.2	9.1	8.5	7.1	6.2	8.5
	Min/Max	5.0/7.8	5.6/9.1	6.8/10.5	8.8/11.4	9.1/10.8	9.1/10.8	7.9/10.0	7.7/10.1	7.8/10.5	6.6/9.7	5.1/8.3	4.0/7.9	7.5/8.9

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	6.6	7.7	8.7	10.4	11.2	11.6	10.1	9.8	9.3	8.5	7.1	6.3	8.9
	Min/Max	5.1/7.9	5.6/9.1	6.9/10.6	9.2/11.9	10.1/12.0	10.5/12.4	8.9/11.3	8.3/10.9	8.0/10.7	6.6/9.7	5.1/8.4	4.0/8.1	7.9/9.4

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	4.2	4.6	4.8	5.7	6.4	6.8	5.6	5.3	5.2	5.0	4.5	4.1	5.2
	Min/Max	3.0/5.4	3.0/5.9	3.4/6.3	4.8/7.1	5.2/7.1	6.0/7.5	4.5/6.7	4.4/6.3	4.1/6.3	3.5/6.0	2.6/5.8	2.5/5.8	4.5/5.6
1-Axis, N-S Horiz Axis	Average	3.4	4.6	5.8	7.6	8.5	8.9	7.2	7.0	6.5	5.4	4.0	3.2	6.0
	Min/Max	2.4/4.5	2.8/5.9	4.0/7.7	6.5/9.8	7.0/9.7	7.9/10.0	5.7/8.8	5.6/8.4	5.1/8.1	3.6/6.6	2.2/5.1	1.8/4.5	5.2/6.5
1-Axis, N-S Tilt=Latitude	Average	4.7	5.7	6.5	7.8	8.2	8.3	6.8	7.0	7.1	6.5	5.2	4.5	6.5
	Min/Max	3.3/6.1	3.6/7.3	4.5/8.6	6.6/10.1	6.7/9.4	7.3/9.3	5.4/8.3	5.6/8.4	5.5/8.7	4.4/7.8	3.0/6.7	2.6/6.3	5.6/7.1
2-Axis	Average	5.0	5.8	6.5	8.0	8.7	9.1	7.3	7.2	7.1	6.5	5.5	4.8	6.8
	Min/Max	3.5/6.5	3.7/7.5	4.5/8.6	6.7/10.3	7.1/9.9	8.0/10.1	5.8/9.0	5.7/8.6	5.5/8.7	4.4/7.9	3.1/7.1	2.8/6.8	5.8/7.4

Average Climatic Conditions

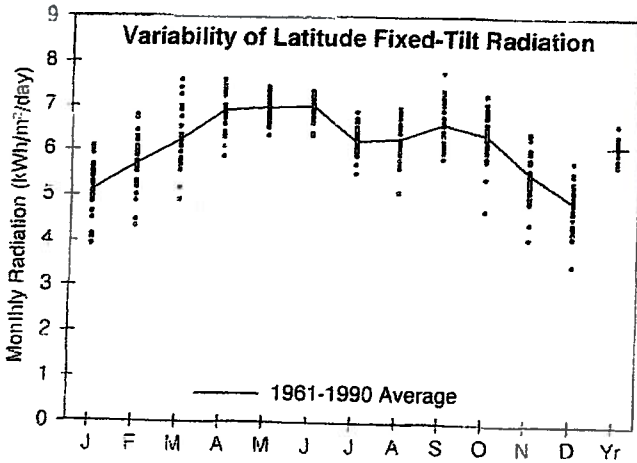
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	12.0	14.3	16.8	21.1	26.0	31.2	34.2	33.1	29.8	23.6	16.6	12.3	22.6
Daily Minimum Temp	5.1	7.1	9.3	12.9	17.7	22.7	27.2	26.2	22.7	16.0	9.4	5.4	15.2
Daily Maximum Temp	18.8	21.5	24.2	29.2	34.2	39.7	41.1	39.8	36.8	31.2	23.8	19.0	29.9
Record Minimum Temp	-8.3	-5.6	-3.9	0.0	4.4	10.0	16.1	15.6	8.3	1.1	-3.9	-5.6	-8.3
Record Maximum Temp	31.1	33.3	37.8	40.6	45.0	50.0	47.8	46.7	47.8	41.7	33.9	31.1	50.0
HDD, Base 18.3°C	201	126	101	42	4	0	0	0	0	9	74	192	750
CDD, Base 18.3°C	4	12	53	123	242	387	491	457	343	173	23	4	2312
Relative Humidity (%)	51	44	39	28	22	19	32	36	36	37	44	52	37
Wind Speed (m/s)	2.5	2.8	3.2	3.4	3.4	3.2	3.4	3.2	3.0	2.8	2.6	2.5	3.0

Prescott, AZ

WBAN NO. 23184

LATITUDE: 34.65° N
 LONGITUDE: 112.43° W
 ELEVATION: 1531 meters
 MEAN PRESSURE: 847 millibars

STATION TYPE: Secondary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.1	3.9	5.1	6.6	7.5	8.0	6.9	6.3	5.7	4.6	3.4	2.8	5.3
	Min/Max	2.6/3.5	3.2/4.5	4.2/6.1	5.7/7.1	6.8/8.0	7.2/8.5	6.1/7.7	5.1/7.0	5.1/6.7	3.6/5.2	2.8/3.9	2.2/3.2	5.1/5.7
Latitude -15	Average	4.4	5.1	5.9	7.0	7.5	7.7	6.7	6.5	6.5	5.8	4.8	4.1	6.0
	Min/Max	3.5/5.1	4.0/6.0	4.7/7.2	6.0/7.7	6.8/8.0	6.9/8.1	5.9/7.5	5.3/7.2	5.7/7.6	4.4/6.6	3.7/5.5	3.0/4.8	5.6/6.5
Latitude	Average	5.1	5.7	6.2	6.9	7.0	7.0	6.2	6.3	6.6	6.4	5.5	4.9	6.1
	Min/Max	3.9/6.1	4.3/6.8	4.9/7.6	5.8/7.6	6.3/7.4	6.3/7.3	5.5/6.9	5.1/7.0	5.8/7.8	4.7/7.3	4.1/6.4	3.5/5.8	5.7/6.6
Latitude +15	Average	5.5	5.9	6.1	6.4	6.1	6.0	5.4	5.7	6.4	6.5	5.9	5.4	5.9
	Min/Max	4.2/6.6	4.4/7.1	4.8/7.5	5.4/7.1	5.6/6.5	5.4/6.3	4.8/5.9	4.6/6.3	5.6/7.5	4.7/7.5	4.3/6.9	3.7/6.4	5.5/6.4
90	Average	5.0	4.9	4.3	3.5	2.6	2.3	2.3	2.9	4.0	5.0	5.2	5.0	3.9
	Min/Max	3.8/6.1	3.6/5.9	3.4/5.2	3.0/3.8	2.5/2.8	2.2/2.3	2.1/2.4	2.4/3.1	3.6/4.7	3.6/5.8	3.6/6.2	3.4/6.0	3.5/4.2

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day), Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	4.8	5.9	7.4	9.4	10.6	11.3	9.3	8.8	8.4	7.1	5.4	4.4	7.7
	Min/Max	3.7/5.7	4.4/7.2	5.7/9.5	7.9/10.6	9.4/11.5	9.9/12.0	7.9/10.8	7.0/10.1	7.1/10.2	5.0/8.2	4.0/6.3	3.2/5.2	7.1/8.4
Latitude -15	Average	5.7	6.8	8.1	9.8	10.6	11.2	9.3	9.0	9.0	8.0	6.3	5.4	8.3
	Min/Max	4.3/6.9	5.0/8.3	6.2/10.3	8.2/11.0	9.4/11.6	9.8/11.9	7.8/10.7	7.1/10.4	7.6/10.9	5.6/9.3	4.6/7.5	3.8/6.4	7.5/9.0
Latitude	Average	6.3	7.2	8.3	9.8	10.3	10.7	8.9	8.8	9.1	8.4	6.9	6.0	8.4
	Min/Max	4.7/7.6	5.3/8.8	6.3/10.6	8.1/11.0	9.2/11.3	9.4/11.4	7.6/10.4	7.0/10.2	7.7/11.1	5.8/9.8	4.9/8.2	4.1/7.2	7.6/9.2
Latitude +15	Average	6.6	7.4	8.2	9.4	9.7	10.1	8.4	8.4	8.9	8.5	7.2	6.3	8.3
	Min/Max	4.9/8.1	5.3/9.1	6.2/10.6	7.7/10.6	8.6/10.6	8.8/10.7	7.1/9.7	6.7/9.8	7.5/10.9	5.8/9.9	5.1/8.6	4.3/7.6	7.5/9.0

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day), Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	6.7	7.4	8.3	9.9	10.8	11.5	9.4	9.0	9.1	8.5	7.2	6.5	8.7
	Min/Max	4.9/8.2	5.3/9.1	6.3/10.6	8.2/11.1	9.6/11.8	10.0/12.2	8.0/11.0	7.2/10.4	7.7/11.1	5.8/9.9	5.1/8.7	4.4/7.8	7.9/9.5

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day), Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	4.4	4.5	4.5	5.4	6.1	6.8	5.0	4.7	5.0	5.2	4.8	4.4	5.1
	Min/Max	2.8/5.8	2.8/6.0	2.8/6.4	4.0/6.4	5.0/6.9	5.3/7.4	3.8/6.3	3.1/5.9	3.9/6.7	3.0/6.4	2.8/6.2	2.5/5.7	4.3/5.8
1-Axis, N-S Horiz Axis	Average	3.7	4.5	5.6	7.3	8.3	9.1	6.7	6.4	6.5	5.7	4.2	3.4	6.0
	Min/Max	2.3/4.8	2.8/6.1	3.5/8.1	5.5/8.9	6.9/9.5	7.2/10.1	5.1/8.6	4.4/8.1	4.9/8.9	3.2/7.1	2.5/5.5	2.0/4.4	5.1/6.8
1-Axis, N-S Tilt=Latitude	Average	5.0	5.6	6.3	7.6	8.0	8.5	6.3	6.4	7.1	6.8	5.6	4.8	6.5
	Min/Max	3.1/6.6	3.5/7.6	3.9/9.1	5.6/9.1	6.7/9.1	6.7/9.4	4.8/8.1	4.4/8.1	5.4/9.6	3.8/8.4	3.3/7.3	2.8/6.2	5.5/7.4
2-Axis	Average	5.4	5.8	6.3	7.7	8.5	9.3	6.8	6.6	7.1	6.9	5.9	5.2	6.8
	Min/Max	3.4/7.1	3.6/7.8	3.9/9.1	5.7/9.3	7.0/9.7	7.3/10.2	5.2/8.7	4.5/8.4	5.4/9.6	3.9/8.5	3.5/7.7	3.0/6.7	5.8/7.8

Average Climatic Conditions

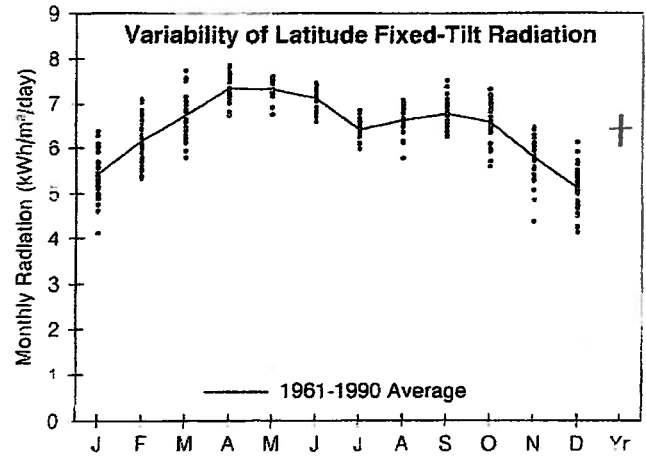
Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	2.3	3.9	5.9	9.6	14.2	19.6	22.8	21.3	18.1	12.6	6.7	2.6	11.7
Daily Minimum Temp	-5.6	-4.4	-2.2	0.8	5.1	9.9	14.4	13.2	9.3	3.4	-1.9	-5.4	3.1
Daily Maximum Temp	10.2	12.2	14.1	18.3	23.3	29.2	31.2	29.4	26.7	21.8	15.3	10.6	20.2
Record Minimum Temp	-18.3	-18.3	-13.9	-6.1	-3.3	2.2	8.3	4.4	1.1	-7.2	-13.3	-22.8	-22.8
Record Maximum Temp	23.3	25.0	27.2	30.6	35.0	39.4	38.9	37.2	35.0	32.2	26.1	21.1	39.4
HDD, Base 18.3°C	496	403	384	262	138	32	0	0	41	182	350	489	2775
CDD, Base 18.3°C	0	0	0	0	11	68	139	96	32	4	0	0	351
Relative Humidity (%)	59	53	49	38	33	27	44	51	47	46	51	59	47
Wind Speed (m/s)	3.1	3.5	4.1	4.2	4.3	4.1	3.5	3.1	3.4	3.3	3.3	3.0	3.6

Tucson, AZ

WBAN NO. 23160

LATITUDE: 32.12° N
 LONGITUDE: 110.93° W
 ELEVATION: 779 meters
 MEAN PRESSURE: 925 millibars

STATION TYPE: Primary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day). Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.4	4.4	5.6	7.1	7.9	8.1	7.1	6.7	6.0	5.0	3.8	3.2	5.7
	Min/Max	2.8/3.9	3.9/4.9	5.0/6.3	6.5/7.6	7.3/8.2	7.4/8.6	6.5/7.6	5.8/7.2	5.5/6.6	4.4/5.4	3.1/4.2	2.7/3.6	5.5/5.9
Latitude -15	Average	4.6	5.5	6.4	7.5	7.8	7.8	6.9	6.9	6.6	6.1	5.0	4.3	6.3
	Min/Max	3.6/5.4	4.8/6.3	5.6/7.3	6.8/8.0	7.2/8.1	7.2/8.3	6.4/7.4	6.0/7.4	6.1/7.3	5.2/6.7	3.9/5.6	3.6/5.1	6.0/6.5
Latitude	Average	5.4	6.2	6.7	7.3	7.3	7.1	6.4	6.6	6.8	6.6	5.8	5.1	6.5
	Min/Max	4.1/6.4	5.3/7.1	5.8/7.7	6.7/7.8	6.8/7.6	6.6/7.5	6.0/6.9	5.8/7.1	6.3/7.5	5.6/7.3	4.4/6.5	4.1/6.1	6.1/6.7
Latitude +15	Average	5.9	6.4	6.6	6.8	6.4	6.1	5.6	6.0	6.6	6.8	6.2	5.6	6.3
	Min/Max	4.4/7.0	5.5/7.5	5.7/7.7	6.3/7.3	6.0/6.7	5.7/6.3	5.3/6.0	5.3/6.4	6.0/7.3	5.7/7.5	4.6/7.0	4.5/6.8	5.8/6.5
90	Average	5.2	5.1	4.4	3.5	2.5	2.1	2.2	2.8	4.0	5.1	5.3	5.1	3.9
	Min/Max	3.8/6.3	4.3/6.0	3.7/5.1	3.3/3.6	2.4/2.6	2.0/2.1	2.1/2.2	2.6/3.0	3.6/4.3	4.2/5.7	3.8/6.1	4.0/6.2	3.6/4.1

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day). Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	5.2	6.6	8.1	10.1	11.0	11.2	9.2	9.0	8.5	7.4	5.8	4.8	8.1
	Min/Max	3.9/6.2	5.5/7.7	6.7/9.6	9.1/11.2	9.9/11.6	9.7/12.2	8.4/10.1	7.6/10.0	7.6/9.8	6.2/8.4	4.2/6.6	3.8/5.8	7.5/8.5
Latitude -15	Average	6.1	7.4	8.7	10.4	11.1	11.1	9.1	9.2	9.0	8.2	6.7	5.6	8.6
	Min/Max	4.5/7.3	6.2/8.7	7.2/10.3	9.4/11.6	9.9/11.6	9.6/12.0	8.4/10.1	7.7/10.2	8.1/10.4	6.8/9.3	4.8/7.6	4.5/6.9	7.9/9.0
Latitude	Average	6.7	7.8	9.0	10.4	10.7	10.6	8.8	9.1	9.1	8.6	7.3	6.2	8.7
	Min/Max	4.9/8.1	6.6/9.3	7.3/10.6	9.3/11.5	9.6/11.3	9.1/11.5	8.1/9.7	7.6/10.0	8.1/10.5	7.1/9.8	5.2/8.3	4.9/7.7	8.0/9.2
Latitude +15	Average	7.0	8.0	8.9	10.0	10.1	9.9	8.2	8.6	9.0	8.7	7.6	6.6	8.6
	Min/Max	5.1/8.5	6.7/9.6	7.3/10.6	9.0/11.1	9.1/10.6	8.5/10.8	7.5/9.1	7.2/9.5	7.9/10.3	7.2/10.0	5.3/8.7	5.2/8.1	7.9/9.0

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day). Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	7.1	8.1	9.0	10.5	11.2	11.3	9.3	9.2	9.2	8.7	7.6	6.7	9.0
	Min/Max	5.2/8.6	6.7/9.6	7.3/10.7	9.4/11.6	10.1/11.8	9.8/12.3	8.5/10.2	7.8/10.2	8.1/10.5	7.2/10.0	5.4/8.7	5.3/8.3	8.3/9.5

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day). Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	4.7	5.0	5.1	5.9	6.5	6.7	5.0	5.0	5.1	5.3	5.0	4.5	5.3
	Min/Max	3.1/6.0	3.8/6.3	3.6/6.5	4.8/6.9	5.4/7.1	5.3/7.7	4.2/6.0	3.8/5.9	4.3/6.3	4.0/6.4	3.0/6.0	3.1/5.9	4.7/5.7
1-Axis, N-S Horiz Axis	Average	4.0	5.1	6.2	8.0	8.8	8.9	6.5	6.6	6.6	5.9	4.5	3.6	6.2
	Min/Max	2.6/5.2	3.8/6.6	4.4/8.1	6.5/9.5	7.4/9.6	6.9/10.4	5.4/7.8	5.0/7.9	5.4/8.2	4.4/7.2	2.6/5.5	2.5/4.8	5.4/6.8
1-Axis, N-S Tilt=Latitude	Average	5.3	6.2	6.9	8.2	8.5	8.3	6.2	6.6	7.0	6.9	5.8	4.9	6.7
	Min/Max	3.5/6.8	4.6/8.0	4.9/9.0	6.7/9.7	7.1/9.3	6.4/9.6	5.2/7.3	5.0/7.9	5.8/8.8	5.2/8.4	3.4/7.0	3.4/6.5	5.9/7.3
2-Axis	Average	5.7	6.3	6.9	8.3	9.0	9.0	6.6	6.8	7.1	7.0	6.1	5.4	7.0
	Min/Max	3.7/7.3	4.7/8.2	4.9/9.0	6.8/9.9	7.5/9.8	7.0/10.5	5.5/7.9	5.1/8.1	5.8/8.9	5.2/8.5	3.5/7.4	3.7/7.1	6.1/7.6

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	10.7	12.4	14.8	18.8	23.3	28.8	30.3	29.2	26.9	21.3	15.1	11.1	20.2
Daily Minimum Temp	3.7	5.0	7.0	10.2	14.4	19.9	23.1	22.3	19.7	13.7	7.6	4.3	12.6
Daily Maximum Temp	17.7	19.9	22.7	27.3	32.2	37.6	37.4	36.0	34.1	29.1	22.6	17.9	27.9
Record Minimum Temp	-8.9	-6.7	-6.7	-2.8	3.3	8.3	16.7	16.1	6.7	-3.3	-4.4	-8.9	-8.9
Record Maximum Temp	30.6	33.3	37.2	40.0	41.7	47.2	45.6	42.8	41.7	38.3	32.2	28.9	47.2
HDD, Base 18.3°C	236	168	127	54	4	0	0	0	0	15	104	224	932
CDD, Base 18.3°C	0	3	18	67	159	313	372	336	257	108	8	0	1641
Relative Humidity (%)	48	43	37	27	22	21	42	47	42	38	43	50	38
Wind Speed (m/s)	3.8	3.8	4.0	4.3	4.1	4.1	4.0	3.7	3.9	3.8	3.7	3.6	3.9

Flagstaff, AZ

WBAN NO. 03103

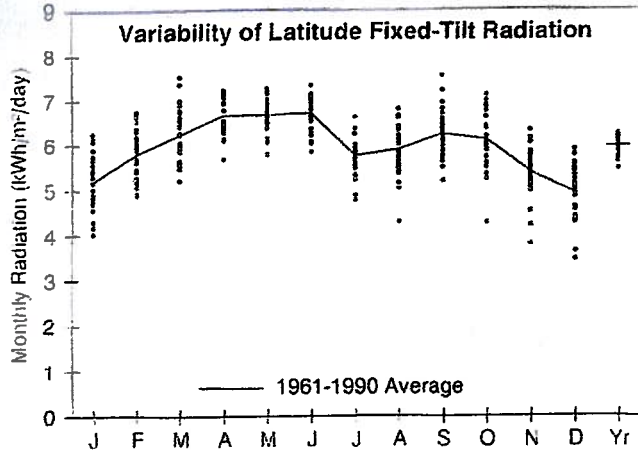
LATITUDE: 35.13° N

LONGITUDE: 111.67° W

ELEVATION: 2135 meters

MEAN PRESSURE: 788 millibars

STATION TYPE: Secondary



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day). Uncertainty ±9%

Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	3.1	4.0	5.1	6.3	7.2	7.7	6.4	5.9	5.4	4.4	3.3	2.8	5.1
	Min/Max	2.7/3.5	3.5/4.5	4.3/6.0	5.4/6.8	6.2/7.8	6.6/8.4	5.2/7.4	4.4/6.8	4.6/6.4	3.4/5.0	2.6/3.7	2.2/3.2	4.8/5.4
Latitude -15	Average	4.4	5.2	5.9	6.8	7.2	7.4	6.2	6.1	6.1	5.6	4.7	4.2	5.8
	Min/Max	3.5/5.3	4.4/6.0	5.0/7.1	5.8/7.3	6.2/7.8	6.4/8.1	5.2/7.2	4.5/7.1	5.1/7.4	4.0/6.5	3.4/5.4	3.0/4.9	5.4/6.1
Latitude	Average	5.2	5.8	6.2	6.7	6.7	6.7	5.8	5.9	6.3	6.1	5.4	4.9	6.0
	Min/Max	4.0/6.3	4.9/6.8	5.2/7.5	5.7/7.2	5.8/7.3	5.8/7.3	4.8/6.6	4.3/6.8	5.2/7.6	4.3/7.1	3.8/6.3	3.5/5.9	5.5/6.2
Latitude +15	Average	5.6	6.1	6.2	6.2	5.9	5.7	5.0	5.4	6.0	6.3	5.8	5.4	5.8
	Min/Max	4.3/6.9	5.1/7.1	5.2/7.5	5.3/6.8	5.1/6.4	5.0/6.2	4.2/5.8	3.9/6.2	5.0/7.3	4.3/7.3	4.0/6.8	3.7/6.5	5.3/6.1
90	Average	5.3	5.3	4.6	3.6	2.6	2.2	2.2	2.8	3.9	4.9	5.1	5.1	4.0
	Min/Max	4.1/6.5	4.3/6.2	3.8/5.4	3.0/4.6	2.4/2.8	2.1/2.3	2.0/2.4	2.1/3.1	3.2/4.6	3.3/5.8	3.4/6.1	3.5/6.4	3.6/4.3

Solar Radiation for 1-Axis Tracking Flat-Plate Collectors with a North-South Axis (kWh/m²/day). Uncertainty ±9%

Axis Tilt (°)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
0	Average	4.8	6.0	7.4	9.1	10.1	10.8	8.6	8.2	7.9	6.8	5.2	4.4	7.5
	Min/Max	3.8/5.8	4.9/7.1	5.8/9.2	7.4/10.2	8.4/11.3	8.9/12.1	6.7/10.3	5.7/9.8	6.4/9.8	4.6/8.0	3.5/6.2	3.1/5.3	6.7/7.9
Latitude -15	Average	5.8	6.9	8.0	9.5	10.2	10.7	8.6	8.4	8.5	7.6	6.2	5.4	8.0
	Min/Max	4.4/7.1	5.6/8.2	6.3/10.1	7.7/10.6	8.5/11.4	8.9/12.0	6.7/10.3	5.8/10.0	6.9/10.6	5.1/9.1	4.2/7.4	3.7/6.4	7.1/8.4
Latitude	Average	6.4	7.4	8.3	9.4	9.9	10.3	8.3	8.3	8.6	8.0	6.7	6.0	8.1
	Min/Max	4.8/7.9	5.9/8.8	6.5/10.4	7.7/10.6	8.3/11.1	8.5/11.5	6.4/9.9	5.7/9.9	6.9/10.7	5.3/9.6	4.5/8.1	4.1/7.2	7.2/8.6
Latitude +15	Average	6.8	7.6	8.2	9.1	9.4	9.6	7.8	7.9	8.4	8.1	7.0	6.4	8.0
	Min/Max	5.1/8.4	6.1/9.0	6.4/10.3	7.4/10.2	7.8/10.5	7.9/10.8	6.0/9.3	5.5/9.4	6.8/10.5	5.3/9.7	4.6/8.5	4.3/7.7	7.1/8.5

Solar Radiation for 2-Axis Tracking Flat-Plate Collectors (kWh/m²/day). Uncertainty ±9%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
2-Axis	Average	6.8	7.6	8.3	9.5	10.3	11.0	8.7	8.5	8.6	8.1	7.1	6.5	8.4
	Min/Max	5.1/8.5	6.1/9.0	6.5/10.4	7.8/10.7	8.6/11.6	9.1/12.3	6.8/10.5	5.9/10.1	6.9/10.7	5.3/9.7	4.6/8.5	4.3/7.9	7.5/8.9

Direct Beam Solar Radiation for Concentrating Collectors (kWh/m²/day). Uncertainty ±8%

Tracker		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1-Axis, E-W Horiz Axis	Average	4.4	4.4	4.4	5.1	5.7	6.3	4.4	4.3	4.6	4.9	4.6	4.3	4.8
	Min/Max	2.5/6.0	2.9/6.0	2.7/6.4	3.8/6.1	4.2/6.8	4.7/7.7	2.8/6.0	2.3/5.6	3.4/6.4	2.5/6.3	2.6/6.1	2.3/5.7	3.9/5.3
1 Axis, N-S Horiz Axis	Average	3.6	4.4	5.4	6.9	7.9	8.6	6.0	5.9	6.0	5.4	4.1	3.4	5.6
	Min/Max	2.1/5.0	2.8/5.9	3.3/7.8	5.1/8.4	5.8/9.4	6.3/10.3	3.7/8.1	3.3/7.7	4.4/8.4	2.7/6.9	2.2/5.4	1.8/4.5	4.6/6.2
1-Axis, N-S Tilt=Latitude	Average	4.9	5.5	6.1	7.2	7.6	8.0	5.7	5.9	6.5	6.4	5.4	4.7	6.2
	Min/Max	2.9/6.8	3.5/7.4	3.7/8.9	5.2/8.7	5.7/9.1	5.9/9.7	3.5/7.7	3.3/7.8	4.8/9.1	3.3/8.3	2.9/7.2	2.5/6.3	5.0/6.8
2-Axis	Average	5.3	5.7	6.1	7.3	8.1	8.7	6.1	6.1	6.6	6.5	5.7	5.1	6.4
	Min/Max	3.0/7.3	3.6/7.6	3.7/8.9	5.3/8.8	6.0/9.6	6.4/10.5	3.7/8.2	3.4/8.0	4.8/9.2	3.3/8.4	3.1/7.6	2.8/6.8	5.2/7.1

Average Climatic Conditions

Element	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Temperature (°C)	-1.8	-0.3	1.8	5.7	10.2	15.4	19.1	17.8	14.1	8.4	2.7	-1.3	7.7
Daily Minimum Temp	-9.3	-7.9	-5.9	-2.9	0.7	5.2	10.3	9.4	5.1	-0.6	-5.3	-9.0	-0.8
Daily Maximum Temp	5.7	7.4	9.6	14.3	19.7	25.7	27.7	26.3	22.9	17.4	10.6	6.3	16.1
Record Minimum Temp	-30.0	-30.6	-26.7	-18.9	-10.0	-5.6	0.0	-4.4	-5.0	-18.9	-25.0	-30.6	-30.6
Record Maximum Temp	18.9	21.7	22.8	26.7	30.6	35.6	36.1	33.3	32.2	29.4	23.3	20.0	36.1
HDD, Base 18.3°C	625	521	512	378	252	104	16	36	132	307	470	609	3962
CDD, Base 18.3°C	0	0	0	0	0	17	39	21	3	0	0	0	81
Relative Humidity (%)	62	60	56	47	40	33	51	58	55	53	57	61	53
Wind Speed (m/s)	2.9	2.8	3.1	3.3	3.2	3.0	2.3	2.0	2.3	2.4	2.8	2.6	2.7