ORIGINAL

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Tucson Electric Power Company

4350 E. Irvington Road, Post Office Box 711
Tucson, Arizona 85702

February 9, 2006

Docket Control
Arizona Corporation Commission
1200 West Washington Street
Phoenix, AZ 85007

Re: Compliance Filing due pursuant to A.A.C. R14-2-1618, paragraph D
Docket No. **RE-00000C-00-0377**, Decision No. 63486

Docket Control:

Tucson Electric Power Company is required by A.A.C. R14-2-1618, paragraph D to file reports on sales and portfolio power demonstrating the output of portfolio resources, the installation date of portfolio resources, and the transmission of energy from those portfolio resources to Arizona consumers. Please find enclosed an original and thirteen copies of the required reports for the year ended 2003. Also enclosed is an additional copy of the filing that the Company requests you date-stamp and return in the self-addressed, stamped envelope for our files.

If you have any questions, please do not hesitate to contact me at 520-884-3680.

Sincerely,

Jessica Bryne

Jessica Bryne
Regulatory Services

Cc: Brian Bozzo, ACC
Carmela Leon, ACC
Dave Couture, UNS

TUCSON ELECTRIC POWER
ENVIRONMENTAL PORTFOLIO STANDARD PROGRAMS

EXECUTIVE SUMMARY

The ACC has mandated under the Environmental Portfolio Standard ("EPS"), R14-2-1618, that any Load Serving Entity shall derive a percentage of its total retail energy sold from new solar resources or environmentally-friendly renewable electricity technologies whether that energy is purchased or generated by the seller. The percentage changes each year, increasing to a maximum of 1.1% in 2007 and remaining the same through the life of the standard. In 2003 the percentage was 0.6% of which at least 50% must be derived from solar electric generation.

At the Arizona Corporation Commission Staff ("Staff") meeting on January 6, 2004, the Commissioners directed Staff to hold a series of workshops to consider four issues related to the Environmental Portfolio Standard Rules (A.A.C. R14-2-1618). The four issues identified by the Commissioners were:

1. A discussion of increasing Environmental Portfolio Standard ("EPS") funding levels.
2. Elimination of the EPS expiration Date.
3. Restoration of Demand Side Management ("DSM") funding.
4. Allocation of funding among various technologies.

Staff commenced the workshop series on March 5, 2004. The tentative date for the second Workshop is April 5, 2004.

Renewable Generating Capacity
This report covers TEP's progress for January 1, 2003 through December 31, 2003, and includes cumulative reporting from January 1, 1997. As of December 31, 2003, TEP had installed or supported installation of a total of 9,806 kW of renewable generating capacity, which has generated 174,145,626 kWh of renewable energy and generated 280,845,417 kWh of renewable credits using the appropriate multiplying factors in the EPS since January 1, 1997. The following tables will summarize capacity, program costs and requirements of the EPS.

EPS Program Results Summary
Since 1999, TEP has spent $26,538,131 on renewable energy development programs in support of developing renewable generation resources to meet the annual energy percentage goals of the EPS. In return, TEP has received revenues of $14,856,288 for these programs. Thus, TEP has spent $11,681,843 more than revenues received in our best effort to meet the annual solar energy percentage goals of the EPS. EPS surcharge collections effectively began in March 2001, and the annual retail energy reported for EPS purposes has been prorated to a 10-month year in 2001 for the purpose of this report.

TEP has successfully met the EPS requirement for "Other" credits every year of the EPS and carries a surplus of 138,225,031 kWh of "Other" credits into 2004. However, TEP was only able to meet **55.25%** of its "Solar Electric" credit goals for the 34-month period ending December 31, 2003, and carries a deficit of 21,299,519 kWh of Solar credits into 2004. Overall, TEP met **78.06%** of its EPS renewable energy goals for 2003, and has met **77.63%** of its total 34-month EPS renewable energy goals.

The implementation of a multi-year, pay as you build funded EPS allows for development of cookie cutter PV system designs in a size optimized to take advantage of partnering opportunities with the manufacturers of the major components of PV systems to optimize Balance of System ("BOS") costs through both material and installation labor cost reductions. TEP has taken advantage of this intended feature of the EPS by using refined design techniques to effect cost reductions in electrical systems, support structures, inverters, site preparation, grid connection and data acquisition systems. The EPS, as adopted by the ACC, allowed TEP to be assured of multi-year funding and has provided TEP with certainty of financing essential to enter into long-term relations with specific makers of the primary components of PV systems – PV modules and inverters – to allow for partnering to optimize the BOS design and installation, resulting in BOS costs of less than $1 per DC watt of installed PV capacity in 2003, only the third year of the EPS. This BOS cost level meets a long-term goal of federal renewable energy programs. This benefit would not have been possible with year-to-year EPS funding.

Technical Requirements

In addition to the relatively high initial cost of solar electric generation, there continue to be some technical issues related to the reliability and annual energy production of smaller solar electric generation systems that are a deterrent to widespread commercialization of customer-based solar electric generation products. These issues of high initial cost, reduced reliability, and reduced annual energy performance are addressed in the Solar PV Resource Development section of this report.

SunShare & Net Metering

TEP offers the SunShare hardware buy-down program, with ACC approval, to its customers. Since the program was offered in 2001, there have been more than 1,107 expressions of interest and more than 173 customers have applied to participate in the program. Of those, 98 customers have sites that meet the SunShare requirements. Overall, 23 customers have purchased our Option 2 package, which is a solar kit offered by TEP at a pass through cost. This accounted for 28 kits delivered for installation. Thirty-three customers qualified for, and joined, the SunShare Option 1 program through December 31, 2003 with a total installed DC capacity of 116 kWp. The net program total is 56 SunShare participants through December 31, 2003. There is currently 170 kW DC of customer sited, installed PV capacity as part of the SunShare or customer partnering programs. TEP requested, and received on February 10, 2004, ACC approval for changes in the SunShare program for 2004 to allow more customers to qualify for the program while retaining high standards for safety, reliability and performance of systems in the SunShare program. The high standards are necessary to rebuild consumer confidence in solar energy systems after the problems created in Arizona in the 1980s from installation of poor quality, customer sited solar domestic hot water systems.

In 2001, TEP offered, with Commission approval, a net metering option for owners of photovoltaic ("PV") systems of less than 5 kW AC in size. TEP requested, and the Commission approved in March 2003, an increase in the maximum size of a PV generation system qualifying for net metering to 10 kW AC and expanded the eligible technologies to include wind generation up to that size. As of December 31, 2003, thirty-one PV customers have qualified and enrolled in the net metering program. No wind customers have yet enrolled in net metering. These PV customers have a combined installed solar generation capacity of about 76 kW AC, a significant increase from the 33 kW of the first half 2003 report. Eight customers with net metering are not SunShare customers.

One large manufacturer of thin film PV modules, BP Solarex ("BP"), made a decision to leave that market late in 2002, with what was initially believed to be a significantly adverse effect on the SunShare program. The SunShare Option 2 offering was based on the BP MST type a-si modules. However, BP made a large amount of unsold MST-50 modules available for TEP to purchase at attractive rates, allowing the Option 2 program to continue. However, TEP has expanded the effort of developing a new small, low cost, reliable PV SunShare Option 2 system that meets annual energy output performance expectations in the Tucson climate. We are currently testing more than a dozen different PV modules of four different technology types and five different small PV inverters of up to 5 kW in size.

GreenWatts

GreenWatts is an ACC approved TEP green power purchase program that enables interested supporters to pool funds and invest directly in the creation of green power. Each GreenWatt is sold in "blocks" of 20 kWh per month. Revenues from GreenWatts are used for installing more community based solar generation. At the end of December 2003, TEP has commitments from 1,711 residential customers, amounting to adoption of 3,830 blocks and 38 commercial customers who have adopted 653 total blocks of green energy.

Total revenues produced to date are $33,842 from commercial customers and $123,786 from residential customers for total revenue of $157,628. All of these funds have been or soon will be applied to installation costs of additional community based PV systems installed in the Tucson area, such as at the Tohono Chul Museum, the City of Tucson's Hayden Udall Water Treatment Facility, Reid Park Zoo, Pima Air Museum, Safford Middle School and Palo Verde High School, among others.

The number of GreenWatts adopters more than tripled after a membership campaign featuring "Sunny" the GreenWatt was rolled out in spring of 2002, combined with bulk mailing to all TEP customers. Another membership campaign in November of 2003 increased membership by more than 32%. However, total membership after four years of program offering is just over 0.52% of all TEP customers, as compared to a national average of about 0.8% where green power purchase options have been offered for eight years or more.

Solar Generation Educational Outreach Efforts

TEP participates in a range of public events, publicizing GreenWatts and SunShare and providing general outreach about solar and renewable energy. In 2003, TEP personnel provided technical information, education and reminder-trinkets to the public at the Solar Safari at the Tucson Zoo, the Earth Day Celebration at the Tucson Children's Museum and the Ironwood Festival sponsored by the Audubon Society. In addition, Sunny, TEP's GreenWatts' mascot, attended events at Tucson Electric Park, and appeared at various school fairs/celebrations geared to children and families, providing visibility and community presence and encouraging kids to think and ask questions about energy.

In an effort to provide in-depth, technical education to highly motivated consumers about solar energy, TEP has co-sponsored and participated in the following events (multiple years when appropriate): The Solar and Sustainable Building Home Tour (including demonstrations); a week-long Solar Electric Institute installation training; and a two-day DOE-sponsored solar and renewable energy workshop in 2003. TEP was also a co-sponsor, along with other industry leaders and the primary sponsor Solar Electric Power Association, at the national Utility Photovoltaic Experience ("UPEx") conference in October in Scottsdale, where TEP Vice President and Technical Advisor Tom Hansen presented papers. TEP also is represented on the planning committee for DOE's Sustainable Building Industry Council – sponsored Design Strategies for Low-Energy, Sustainable Buildings program (February 24 – 25, 2004).

In 2003, members of the TEP solar group made numerous presentations to civic, educational and neighborhood groups ranging from 15 to 200 people on topics that focused on TEP's solar and renewable programs. These appearances included high-level presentations by TEP Vice President and Technical Advisor Tom Hansen to groups ranging from the Tucson/Pima Metropolitan Energy Commission and the Raytheon Management Club to classroom lecture/demonstrations at the University of Arizona and Northern Arizona University, as well as a presentation to the Northern Arizona Council of Governments and at UPEx. Also in 2003, Mr. Hansen made renewable energy presentations at the Southwest Renewable Energy Conference in Flagstaff, the Apache County Renewable Energy Fair in St. Johns, the ECO Workshop Conference in Phoenix, Sandia National Laboratories in Albuquerque, Department of Energy Inverter Technology Workshop in Baltimore, Power Gen International Conference in Las Vegas and the Arizona State Legislature as well as the Arizona Corporation Commission. Others on the TEP team spoke at community gatherings, providing more general presentations about solar and renewable energy.

Much of TEP's community outreach focuses on partnerships with an educational component. TEP has committed SunShare kits to total 11 kilowatts to five projects that will be completed in 2004, and is actively involved with the design of those projects. They are Hohokam Middle School (Tucson Unified School District ["TUSD"]) -- 1 kW for a shaded overhang; Civano Community School (Vail Unified School District) -- 1 kW on roof; Mountain View High School (Marana Unified School District) -- 1 kW and Davidson Elementary School (TUSD) – 4 kW integrated into a walkway canopy. The latter project may not be completed until 2005, but the collaboration is ongoing. TEP began working in 2003 on a 2004 project in partnership with the City of Tucson, Pima County and Pima Community College, the Clements (Recreation) Center. Work progresses with the architect on an expansion of the current multi-purpose center that will feature 4 kW on the roof of the Gymnasium. Work also continues on completion of the City of Tucson's El Rio Service Center and Midtown Service Center PV projects totaling more than 14 kW.

TEP is also supplying a PV system to enable four University of Arizona seniors to develop a solar test program. While we supplied the hardware to the group, they are designing the system, picking the components, installing it and developing the test program around design boundaries we prescribed. Although it is physically in the solar test yard at TEP's Operating Headquarters location, it is a partnership that not only assists industry developments, but also yields valuable knowledge for our future projects.

TEP is a financial supporter of the Arizona Solar Center, a renewable energy Web site dedicated to providing renewable energy information specific to Arizona.

The GreenWatts.com Web site sponsored by TEP provides educational information about solar generation and the TEP renewables programs. This includes the "SunSite-FunSite," a color splashed interactive Web zone with easy to learn lessons about the technology and terminology of solar energy for both the young and the not so young explorers.

Renewable Energy Resources and Renewable Resource Survey Systems

TEP continues to operate a system of 13 renewable resource survey systems. This includes six 40-meter high fixed wind survey towers at locations in Arizona. TEP continues to evaluate a wide range of renewable energy options for the future, including landfill gas, biomass, wind, digester gas, geothermal and solar thermal electric conversion.

TEP installed 1,450 kWp DC of solar PV electric generation in 2003, including additions of 1,359 kWp DC at the Springerville Generating Station ("SGS") Solar System, 15 kW DC of solar electric generation at Operating Headquarters in Tucson and 76 kWp DC rating of SunShare systems.

The 2004 renewable program includes planned installation of 810 kWp DC of PV at SGS, 5 kWp DC at Operating Headquarters in Tucson and an expected minimum of 85 kWp DC in SunShare systems and customer partnering opportunities. The Los Reales landfill gas collection system will be upgraded to improve collection capacity in 2004.

Past Environmental Resource Development Goals

TEP reached its goal of having 5 MW of renewable generating capacity by the end of the year 2000, which was derived from the ACC's 1992 Integrated Resource Planning Procedures.

Summary Of Renewable Generation And Capacity

Type of Generation	Capacity kW	Cumulative Generation, kWh	Cumulative Renewable Credits, kWh
Landfill Gas	5,500	163,531,921	255,248,799
Solar Photovoltaic	4,306	10,613,705	25,596,618
Solar Trough	0	0	0
Small Hydro-Electric	0	0	0
Wind Generation	0	0	0
Total Renewable	9,806	174,145,626	280,845,417
Total Other Renewable	5,500	163,531,921	255,248,799
Total Solar Electric	4,306	10,613,705	25,596,618

Summary of EPS Requirements

Description	Reporting Period 6/30/03-12/31/03	Y-T-D 12/31/03	Cumulative 12/31/03
Retail Sales for 2003, kWh Retail Sales for 2002, kWh Retail Sales for 10 months of 2001, kWh Cumulative Retail Sales for EPS Program, kWh	4,513,585,591	8,229,552,740	8,229,552,740 8,012,417,966 6,884,068,333 **23,126,039,039**
TEP EPS Requirement For 2003 (0.6% of Retail Sales), kWh TEP EPS Requirements through 12/31/2002, kWh TEP EPS Requirements through 12/31/2003, kWh	27,081,514	49,377,316	49,377,316 45,817,809 **95,195,125**
Landfill Gas Project "Other" Credits Applied to EPS % goals	13,540,757	24,688,659	47,597,562
"Solar Electric" Resource Credits Applied to EPS % goals	7,871,061	13,854,056	26,298,043
Wind Credits Purchased	5,587	5,587	11,151
Other Credits Purchased	0	0	0
"Solar Electric Manufacturing" Credits Obtained from Global Solar, kWh	240,900	240,900	680,360
Sales of "Other" Credits, kWh	8,000,000	9,014,893	69,437,357
Purchases of "Solar Electric" Credits	21,065	21,065	21,065
Excess "Solar Electric" Credits Above Meeting EPS Requirements, kWh	-(5,669,696)	-(10,834,603)	-21,299,519
Excess "Other" Credits Above Meeting EPS Requirements, kWh	12,317,290	18,543,834	138,225,031

SUMMARY OF PROGRAM EXPENDITURES

Program	Program Costs		
	Period	Y-T-D	Life of Program
Solar Electric	$2,632,200	$8,649,531	$26,049,971
Solar Thermal	$0	$0	$0
Geothermal	$0	$0	$0
Landfill Gas	$0	$0	$85,000
Wind	$0	$3200	$120,519
Hydro	$0	$0	$0
Other Technologies	$0	$0	$0
Marketing	$24,247	$36,167	$121,541
Hardware Buydown Program - Option 1 **	$24,270	$15,980	$87,100
Solar Buyback Program - Option 2 **	$32,000	$42,000	$74,000
Total TEP Renewables Program	$2,712,717	$8,746,878	$26,538,131

** Cost included in solar electric costs

SUMMARY OF PROGRAM REVENUES

Description	Period	Y-T-D	YTD Retail Energy Sales MWh	Life of Project
GreenWatts Total	$30,940	$62,839	-	$157,628
Allocation of SBC Total	$1,105,000	$2,210,000	-	$7,740,000
Residential Surcharge Total	$634,995	$1,234,900	3,370,540	$3,429,763
Small Commercial Surcharge Total	$660,723	$1,227,803	3,247,009	$3,440,123
Large Commercial Surcharge Total	$14,534	$30,368	1,612,004	$88,774
Renewables Surcharge Total*	$1,310,252	$2,493,071	8,229,553	$6,958,660

INSTALLATION PROGRESS

Project	Install Date	kWp DC Peak Capacity	kWh, AC Output - Thru 12/31/03	Initial Costs	Total Operating Cost 12/31/03	$/kWh for Project
Residential						
3131 S. Naco Vista	Apr-99	0.75	4,613	$6,944	$6,494	$0.2684
Small Commercial						
Reid Park Zoo ASE/TR 840w Xtal	Mar-00	0	3,713	$7,400	$6,469	$3.7353 Removed in 1/2003
Pima Air Museum ASE/TR 1200w Xtal	Jun-00	1.2	4,161	$7,099	$2,400	$0.2166
UofA Agriculture Station	Jan-02	5.62	19,086	$120,000***	$0	$0.4415
Hayden/Udall # 1 ASE/TR 21.6 KW Xtal	2002	21.6	48,462	$174,150***	$341	$0.1706
Hayden/Udall # 2 ASE/TR 21.6 KW Xtal	2002	21.6	45,668	$174,150***	$191	$0.1576
Military						
Ft Huachucha Solar ASE/OMN 30 KW Xtal	1997	30	158,001	$300,000***	$2,300	$0.2249
Utility (TEP)						
SGS-125C-1 ASE/XN 135 KW Xtal	Jul-01	135	510,115	$1,125,637	$3,231	$0.1914
SGS-125C-2 ASE/XN 135 KW Xtal	Jul-01	135	539,785	$848,927	$3,231	$0.1245
SGS-125C-3 ASE/XN 135 KW Xtal	Aug-01	135	497,342	$779,470	$3,474	$0.1168
SGS-125C-4 ASE/XN 135 KW Xtal	Aug-01	135	488,481	$885,503	$3,231	$0.1321
SGS-125C-5 ASE/XN 135 KW Xtal	Nov-01	135	463,013	$891,576	$3,231	$0.1510
SGS-125C-6 ASE/XN 135 KW Xtal	Nov-01	135	468,094	$830,314	$3,231	$0.1322
SGS-125C-7 ASE/XN 135 KW Xtal	Oct-02	135	315,396	$896,984	$2,843	$0.1479
SGS-125C-8 ASE/XN 135 KW Xtal	Oct-02	135	324,659	$896,332	$2,843	$0.1496
SGS-125C-9 ASE/XN 135 KW Xtal	Oct-02	135	322,704	$900,199	$2,843	$0.1503
SGS-125C-10 ASE/XN 135 KW Xtal	Oct-02	135	309,859	$910,976	$2,843	$0.1298
SGS-125C-11 ASE/XN 135 KW Xtal	Jun-02	135	364,990	$899,885	$2,843	$0.1314
SGS-125C-12 ASE/XN 135 KW Xtal	Jun-02	135	318,184	$901,081	$2,843	$0.1588
SGS-125C-13 ASE/XN 135 KW Xtal	Jun-03	135	117,744	$864,022	$2,276	$0.1279
SGS-125C-14 ASE/XN 135 KW Xtal	Jun-03	135	116,690	$863,759	$2,276	$0.1292
SGS-125C-15 ASE/XN 135 KW Xtal	Aug-03	135	101,968	$864,728	$2,276	$0.1421
SGS-125C-16 ASE/XN 135 KW Xtal	Aug-03	135	103,429	$858,301	$2,276	$0.1391
SGS-125C-29 ASE/XN 135 KW Xtal	Nov-03	135	43,107	$847,175	$2,276	$0.3294
SGS-125C-30 ASE/XN 135 KW Xtal	Nov-03	135	37,963	$721,587	$2,276	$0.3189
SGS-125C-31 ASE/XN 135 KW Xtal	Aug-03	135	91,112	$854,143	$2,276	$0.1571
SGS-125C-32 ASE/XN 135 KW Xtal	Aug-03	135	85,392	$854,121	$2,276	$0.1676
SGS-125TF-1 FS/XN 134.4 KW Cd-Tl	Sep-01	150	486,375	$699,951	$16,965	$0.1121
SGS-125TF-2 FS/XN 134.4 KW Cd-Tl	Sep-01	144	409,869	$581,286	$15,719	$0.0918
SGS-125TF-3 FS/XN 134.4 KW Cd-Tl	Jun-03	135	137,706	$759,114	$771	$0.1139
SGS-125TF-4 FS/XN 134.4 KW Cd-Tl	Jun-03	135	131,754	$759,122	$771	$0.1078
SGS-125TF-5 BP/XN 129 KW a-si	Oct-01	129	471,822	$760,802	$2,381	$0.1277
SGS-125TF-6 BP/XN 129 KW a-si	Oct-01	129	500,556	$760,717	$2,381	$0.1218
SGS-125TF-7 BP/XN 129 KW a-si	Oct-01	129	472,707	$736,514	$2,381	$0.1208
SGS-125TF-8 BP/XN 129 KW a-si	Oct-01	129	472,768	$741,162	$2,381	$0.1206
OH ASE/SB - 1500w Xtal	Jul-01	1.5	2,923	$8,563	$0	$0.1591
OH ASE/TR - 1200w Xtal	Aug-01	1.2	4,067	$8,369	$0	$0.1347
OH BPMST-50/TR - 1500w a-si	Sep-01	1.5	4,083	$6,666	$840	$0.1117
Solar Trailers/TR 5000w Xtal	Jun-05	5	26,767	$70,000	$490	$0.3945

Project	Install Date	kWp DC Peak Capacity	kWh, AC Output - Thru 12/31/03	Initial Costs	Total Operating Cost 12/31/03	$/kWh for Project
OH Gate 2A Solarex/TR - 2500w Xtal	Mar-00	2.5	15,303	$10,250	$358	$0.0916
OH3 20KW ASE/TR 21.6 KW Xtal	Sep-00	21.6	111,489	$146,342	$652	$0.1372
OH4 20KW ASE/TR 21.6 KW Xtal	Oct-00	21.6	115,887	$110,534	$126	$0.1027
St Johns Test	Sep-00	0	3,512	$11,517	$0	$3.2793 Removed 4/2002
SGS 20 KW ASE/TR 21.6 KW Xtal	Oct-00	21.6	110,899	$135,060	$526	$0.1371
DMP 1 ASE/OMN 108 KW Xtal	Dec-00	108	513,852	$589,020	$1,202	$0.1147
DMP 2 ASE/OMN 108 KW Xtal	Dec-00	108	505,808	$527,199	$820	$0.1035
Test Trees	Jun-01	0	8,214	$1,500	$0	$0.0086
Tohono Chul BPSX140U/SB - 2800w Xtal	Dec-02	2.8	5,039	$23,286	$0	$0.1637
OH Global Solar Test/TR - 1440w CIGS	2002	1.44	2,111	$13,447	$431	$0.2367
Sun Share Reported 1999	1999	6.2	36,685	$54,000	$0	$0.2020
Sun Share Reported 2000	2000	4.8	6,832	$50,000	$0	$0.1690
Sun Share Reported 2001	2001	13.44	32,720	$106,410	$0	$0.1075
Sun Share Reported 2002	2002	47.58	73,387	$297,852	$0	$0.1291
Sun Share Reported 2003	2003	55.26	33,535	$368,227	$7,532	$0.1629
OH BP SX140U/TR-1400w Xtal	2002	1.4	2,211	$8,237	$0	$0.1275
OH Sharp 165/SB - 1320w Xtal	Mar-03	1.32	985	$7,476	$0	$0.1838
OH Sharp 165/TR - 1320w Xtal	Mar-03	1.32	1,382	$8,223	$358	$0.1430
OH Kyocera 158/TR - 1422w Xtal	Apr-03	1.422	1,410	$8,236	$0	$0.1332
OH Sanyo 167HIT/SB - 1336w Xtal/a-si	May-03	1.336	1,408	$8,962	$0	$0.1388
OH UnSolar 64/Trace - 1536w Xtal/a-si	Jun-03	1.536	1,532	$10,228	$0	$0.1237
OH BP SX150U/TR-1500w Xtal	May-03	1.5	1,147	$8,714	$0	$0.1266
OH Sanyo 180HIT/SB - 1440w Xtal/a-si	Jul-03	1.44	1,168	$8,955	$0	$0.1278
OH Shell 40/Tr-1440w a-si	Sep-03	1.44	791	$9,244	$0	$0.1947
OH Shell 150/Sharp-3000w Xtal	Sep-03	3	1,271	$16,991	$0	$0.2229
		4,306	10,475,870	$26,653,035	$130,177	$0.1387

* Portion installed after January 1, 1997.
** Includes customer expenses for these systems.
*** Estimated after grant removal.

Renewable Generation Option Analysis

TEP has analyzed a number of possible options of renewable generation resources available to meet the implementation of a 10% renewable energy portfolio standard. The scenarios assume that all new renewable generation would be pure, that is not a mix of different resources. The scenarios are based on the actual 2003 hourly retail loads in the TEP service territory, modeled 2003 hourly wholesale electric prices at Palo Verde based on actual daily peak and off-peak prices, actual hourly solar electric generation at Springerville and Tucson sites and hourly wind resources at a northern Arizona monitoring site applied to a Vestas wind turbine. For comparison, the average wholesale electric price at Palo Verde in 2002 was $41.97 per MWh. The results of the pure Wind and pure Solar PV cases are summarized in the following table:

	All Fueled Generation	Apache County Wind Generation with Fueled Generation	Springerville Solar Generation with Fueled Generation	Tucson Solar Generation with Fueled Generation
Installed Renewable Energy Capacity - MW	0	509	495	495
Installed Renewable Cost at 2003 Prices - $M	$0	$611	$2,574	$2,574
Maximum Hourly Renewable Generation Capacity during 2003 - AC MW	0	509	465	429
Annual Renewable Energy Production - MWh	0	922,918	850,964	834,976
Renewable Energy Production Wholesale Energy Value - $	$0	$40,702,261	$40,586,320	$40,378,910
Average Renewable Energy Value - $/MWh	$0	$44.10	$47.69	$48.36
Annual TEP System Load Required Fueled Generation Minimum Demand - MW	556	119	332	359
Annual TEP System Load Required Maximum Fueled Generation Demand - MW	2,032	2,001	2,025	1,865
Effective System Capacity Support from Renewables - MW	0	31	7	167
Percent of Annual System Energy from Renewable Energy Resources	0%	10.42%	9.60%	9.42%

Note: Additional information about these scenarios is available in graphical format in the Wind and Solar PV sections of this report.

SOLAR THERMAL ELECTRIC GENERATION

PROGRAM DESCRIPTION

The purpose of the Solar Thermal Electric Generation Development Program is for technology review and economic assessment of the use of large scale solar thermal electric generators both in combination with existing thermal generating stations and in stand alone generating station applications. This includes solar resource assessment at a couple of possible solar trough sites in Arizona.

TEP reviewed the addition of Thermal Solar Trough produced heat to the condensate cycle of Springerville Generating Station Unit #1 ("SGS #1") and Unit #2 ("SGS #2").

In addition, during 2002, TEP received and evaluated a proposal for installation of a solar dish generation system and an opportunity to install a stand alone solar trough generation system.

There has been no significant activity in this area in 2003.

PROGRESS AND PARTICIPATION

Testing has been performed on the extraction heaters of SGS to determine the steady state response to additional heat input in the condensate cycle. The test results were successful and subsequent review indicates that the installation of a solar trough system for SGS #1 and SGS #2 should be technically feasible. Detailed economic and constructability reviews are now on hold because the EPS does not provide sufficient funding to support a single year $16,000,000, single technology solar electric generation project. Nor is it clear any longer that solar trough integration into SGS has a clear-cut life cycle cost advantage over large-scale PV installations. Such a project would not have provided high value data beneficial to the 2003 review of solar electric generation, nor would it help reduce the initial cost of PV systems, those more likely to be used in customer sited distributed renewable generation systems. The solar trough system will be reviewed again as an option for the sixth year of the EPS. That will provide time to build a solid base of experience with multiple photovoltaic technology-based solar electric generators.

Detailed evaluation of the solar dish system indicated the life cycle cost economics of the system being proposed was not yet competitive with the life cycle cost economics of large scale photovoltaics. To a large degree, long-term operating costs were the driving force on the economics, but installed cost of a small solar dish system is also not competitive with PV installations of a similar size. Performance history considerations also were part of the evaluation. Additional solar dish installations are proposed by APS and SRP. This data will be essential for evaluations of future solar dish proposals. This system opportunity was declined for installation in 2003 and sufficient operating reliability and energy production data was not provided to make an informed decision for the 2004 installation phase. The full detailed evaluation material was provided to the vendor proposing this project for its use in reducing the costs that have a strong influence on life cycle economics.

High level evaluation of the installation of a stand alone solar trough proposal indicated that while the initial cost was competitive with large scale PV installations, long-term operating costs adversely influenced the life cycle cost economics of stand alone solar trough systems resulting in a higher life cycle cost than for large scale PV systems. Consequently, this system opportunity was also not chosen for installation in 2003 or 2004. The high level economic evaluation of this system was not provided to the vendor.

Solar resource assessment at the SGS indicates that while the cool, windy site is ideal for solar generation from photovoltaics, the same factors are not beneficial to production of solar thermal electricity. The gathering of solar thermal support data will continue for at least two additional years. Site data is also being gathered from a site in Tucson as a possible future site of a thermal trough electric generation system.

CHALLENGES/BARRIERS

Preliminary review of coordination with existing SGS boiler/turbine controls was completed. However, as SGS anticipates the installation of a new Digital Control System ("DCS") to include condensate, feedwater, boiler and turbine controls and associated modeling and tuning, further efforts towards modeling the transient reaction of the power generation cycle with condensate cycle solar heat input will be deferred until the new DCS is installed and in the testing phase.

Both solar dish and solar trough generation technologies find it difficult to compete with the more "mature" technology of PV in small-scale installations. Small scale is likely being defined as less than roughly 20 MW. However, it is also difficult to raise the capital needed to install a large scale solar generation system given the somewhat poor reliability and performance history of that technology in Arizona. Also, these technologies have less opportunity to be transferred to customer sited distributed generation applications than the development of large scale PV. The renewable energy development programs of APS and SRP are planning to help overcome this barrier by assuming the technical and financial risk of installing additional solar dish systems. TEP's renewable energy development program is directed at understanding the role and economics of PV deployment in Arizona, and will include thermal solar electric generation when those technologies are economically competitive with PV in the appropriate size increments.

No problems were encountered during this period.

PROGRAM CHANGES FOR 2004

There are no changes planned for 2004.

LANDFILL GAS AND BIOMASS PROJECT

PROGRAM DESCRIPTION

The purpose of the Landfill Gas and Biomass Project program is to develop existing landfill gas and biomass resources into reliable, cost effective environmentally sensitive electric generation fuel sources. The program's purpose is also to find and economically use existing biomass resources to produce electric energy.

PROGRESS AND PARTICIPATION

In August 1999, TEP and the City of Tucson started electric production from the installation of a nominal 5 MW Landfill Gas System at the Los Reales Landfill in Tucson, Arizona. The landfill gas is piped from the landfill to the Irvington Unit 4 Generating Station where it is co-burned with coal and/or natural gas. During the very dry year of 2003, the average energy produced from landfill gas was 3,741 kW; however, based on previous generating performance exceeding a monthly average of 6,000 kW during periods of normal atmospheric moisture, TEP is claiming 5,500 kW of landfill gas capacity in the Executive Summary.

To date (1999 through December 31, 2003) the project has displaced the use or production of the following:

Tons of Coal Not Burned	73,862
Tons of CO2 Not Produced	108,332
Tons of SO2 Not Produced	650

There were no costs beyond those expected of normal fueled generation from the operation of the landfill gas to energy system in 1999, 2000, 2001, 2002 or 2003. Thus, there are no expenses against the EPS surcharge or other sources of renewable generation revenue. EPS credits produced have been reported by TEP to meet EPS annual credit requirements, sold to other utilities providing additional revenue for solar generation development or banked for the future. The current status of EPS landfill gas generation production credits are reported in the EPS Programs Executive Summary.

2003 LANDFILL GAS GENERATION SUMMARY

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year Dat
Landfill Gas Burned-Mscf	3	2	33	60	62	53	60	61	48	61	60	57	
Landfill Gas Ave Btu/scf	627	856	522	516	529	501	500	489	484	480	472	489	
Landfill Gas Heat Input-MMBtu	1,881	1,712	17,226	30,960	32,798	26,553	30,000	29,829	23,232	29,280	28,320	27,873	279,
Unit 4 Net Heat Rate	11,132	13,365	9,659	10,253	10,237	9,958	9,906	10,010	10,115	9,978	10,717	10,365	10,
MMBtu of Landfill Gas	1,881	1,711	17,216	30,956	32,787	28,534	30,023	29,853	23,248	29,272	28,313	27868	281,
Landfill Gas Generation in MWh	169	128	1,782	3,019	3,203	2,865	3,031	2,982	2,298	2,934	2,642	2,689	27,
Monthly U4 Service Hours	56.45	44.50	744.00	720.00	744.00	720.00	744.00	744.00	720.00	744.00	720.00	715.02	7,
Average Landfill Generation Capacity in kW	2,993	2,877	2,396	4,193	4,305	3,980	4,074	4,008	3,192	3,943	3,669	3,760	3,
Cumulative 2003 Landfill Gas Generation in MWh	169	297	2,079	5,099	8,301	11,167	14,198	17,180	19,478	22,412	25,054	27,742	27,
Unit #4 Coal Heat Value HHV in Btu/lb	11,372	11,513	11,578	11,428	11,554	11,547	11,078	11,198	11,385	11,385	11,515	11,373	11,
Coal Displaced by Landfill Gas, in Tons	82.7	74.3	743.5	1,354.4	1,418.9	1,235.6	1,355.1	1,333.0	1,021.0	1,285.6	1,229.4	1,225.2	1,
Cumulative Coal Displaced By Landfill Gas in Tons	82.7	157.0	900.5	2,254.9	3,673.7	4,909.3	6,264.4	7,597.3	8,618.3	9,903.9	11,133.3	12,358.5	12,
CO_2 Emissions Deferred by Burning Coal in Tons - 40% Fixed Carbon	121	109	1,090	1,986	2,081	1,812	1,987	1,955	1,497	1,885	1,803	1,797	1,
Cumulative CO_2 Emissions Deferred by Burning Coal - Tons	121	230	1,321	3,307	5,388	7,200	9,188	11,143	12,640	14,526	16,329	18,126	18,
SO_2 Emissions Deferred by Burning Coal in Tons - 0.44% Sulfur	1	1	7	12	12	11	12	12	9	11	11	11	
Cumulative SO_2 Emissions Deferred by Burning Coal - Tons	1	1	8	20	32	43	55	67	76	87	98	109	
Hours Available	744	744	744	720	744	720	744	744	720	744	720	744	8,
On Line Availability Hours	56.45	44.5	744	720	741.9	666.15	744	742.33	720	744	720	715.02	7,
Percentage on Line	7.59	5.98	100.00	100.00	99.72	92.52	100.00	99.78	100.00	100.00	100.00	96.10	8[illegible]

CHALLENGES/BARRIERS

The output of the Landfill Gas declined from 46,445,118 kWh in 2001 to 31,661,430 kWh in 2002 and to 27,742,486 kWh in 2003. Although the average energy production from landfill gas was slightly higher in 2003 as compared with 2002, Sundt Unit 4 had an overhaul in January and February 2003, reducing the amount of time available for burning landfill gas. Consequently, annual energy production declined in 2003.

1. The gas production rate is strongly related to the moisture in the landfill as well as the moisture introduced through atmospheric purge air - the wetter the season, the greater the gas production. The years 2002 and 2003 have been two of the driest years in recent history. Because of the drought, the gas output of the system was reduced.
2. Some of the gas capture wells have been damaged due to bulldozers and other large vehicles running over the wells and collection piping resulting in no gas output from those wells. Repairs to some damaged items were made during the summer of 2002, and eight new wells are to be placed in the existing landfill cells in 2004 to replace production lost from damaged collector pipes.

Generation of electricity from forest waste and other biomass sources is being investigated with a number of interested parties. Samples of various biomass sources have been collected and sent to selected companies for experimental gasification. Results of these tests indicate that while the materials tested are capable of being gasified by a number of different processes, some materials are more prone to plug the new technologies than other materials. While these technical issues are a concern, economic considerations are currently the primary impediment to effective use of this resource. Harvesting costs alone for forest waste, if unsubsidized, are about four cents per kWh. Biomass transportation costs can add another two to three cents per kWh, depending on the material and distance of transport.

ANALYSIS AND EVALUATION

Optimization of landfill methane production is ongoing. During one month in 2001, the system produced an average of more than 6.5 MW. However, lower atmospheric moisture and rainfall levels in 2002 and 2003 have reduced the moisture introduced to the landfill from inlet purge air. Consequently, trash decay rates have reduced along with output of landfill gas and methane. As moisture introduced to the landfill through purge air is varied by atmospheric conditions, adjustments in purge air rates and landfill gas removal rates will be made to maintain a constant methane content percentage of about 50%. This adjustment will continue for the life of the landfill gas extraction.

A beneficial meeting to discuss landfill gas production issues, both short and long term, was held in December 2002 with the landfill gas vendor US Energy, the City of Tucson and TEP. Information on long-term needs and opportunities was presented, landfill operational constraints noted and general plans for future development of additional landfill gas resources introduced. Dialog between the three parties continued on a more frequent basis in 2003 resulting in landfill gas capacity enhancement projects to be implemented in 2004 and 2005.

PROGRAM CHANGES FOR 2004

TEP continues to review additional landfill gas to energy projects as well as a number of biomass waste-to-energy projects. An ongoing technology search is in progress to find efficient technologies to convert a number of biomass products into electricity in a safe, reliable, cost-effective manner. The search will continue to locate technically feasible, economically advantageous and environmentally appropriate methods for converting forest waste and agricultural by-products into electricity. Landfill gas production enhancements will be installed in 2004 at the Los Reales Landfill in Tucson.

WIND RESOURCE DEVELOPMENT

PROGRAM DESCRIPTION

The purpose of the Wind Resource Development Program is for wind resource information gathering, technology review and economic assessment of the use of wind energy for electric generation both in combination with existing generating stations and in stand alone generating station applications.

Wind monitor stations have been installed by TEP throughout Arizona. At the end of 2003, TEP was receiving data from six, 40 meter survey towers and wind data at an additional five fixed and two mobile monitor installations. Sites for an additional eight monitor stations are being developed. The bulk of the monitoring is being performed in eastern Arizona around SGS. However, as customers have indicated an interest in development of wind resources in their area, TEP has monitored those showing signs of promise.

TEP participated with APS and SRP in funding, through Northern Arizona University in collaboration with National Renewables Energy Laboratories ("NREL"), the development of a new high-resolution wind model for Arizona. The final wind model was issued for public use in August 2003. The new model indicates that wind capacity in the state of Arizona is likely to be viable in a few selected areas in the eastern and northern part of the state and on ridges and mountaintops, generally a great distance from Arizona's primary population centers. TEP provided NREL with wind data from all but one of its monitoring stations to use in verifying the wind model prior to public issue. In general, Arizona's potential wind resource is not as plentiful or as geographically widespread as the Arizona solar resource. However, the resource is significant and harvest of the wind resource must be given serious technical, economic and policy review.

PROGRESS AND PARTICIPATION

TEP completed a two-year monitoring period for wind and solar resources at seven locations in Arizona. Sites chosen for monitoring have not yet included sites such as high ridges and mountain tops upon which the installation of wind turbines could have a scenic impact from the construction of roads to allow access to the ridges and mountaintops, the transmission lines that will need to be added to move the electricity to market and the operation of the wind turbines themselves.

One site west of Springerville, Arizona, has wind of very marginal economics, about 11% annual capacity factor. One site located northeast of Springerville had wind of even less economic value, as did a site in southern Arizona near Rain Valley. All three monitoring sites located on the property of SGS completed three years of data monitoring at the end of 2003, and monitor of the fourth site was discontinued as it did not show promise as a successful wind farm location. Of these sites, the best location exhibited a 20% annual capacity factor, when corrected for elevation and temperature, not normally considered sufficient for development of a wind farm. However, the site does have wind with very little turbulence and a 25% capacity factor when coincident with TEP summer peak load periods.

Three other sites completed a two-year monitor period at the end of July 2003, at which time the data was reduced to determine the economic viability of wind generation at those sites. Data indicates one of those sites with a marginally economic level of wind resource at roughly 20% annual capacity factor, when corrected for elevation and temperature, given the newer models of wind turbines capable of operation at lower wind speeds. Two valley type sites that have been monitored for a year or more do *not* have an economically viable wind resource as compared to other sites. The monitor towers at both of these sites were relocated to new sites. The monitor site in southern Arizona has exhibited a poor wind resource and its proximity to a canyon yielded a very shallow wind with little overall energy content during most hours of the year. This tower was relocated in late 2003 to another southern Arizona location, which the new wind model indicates may have promise.

TEP plans to continue monitoring wind data and is currently negotiating for use of up to an additional 12 wind survey sites in Arizona for installation of monitor towers in the first half of 2004. We are still waiting for permits to be issued as these sites are on state land. To date, TEP has spent $120,519 on wind survey tower installation and data analysis.

CHALLENGES/BARRIERS

It is at times difficult to obtain permits for wind monitor tower erection in a timely manner. We have been waiting for more than a year for permits for survey tower installations on state land.

Reliability of wind direction instrumentation continues to be a problem on towers of heights greater than 20 meters. In addition to more than a dozen wind direction sensor failures in the past, TEP monitor towers have also experienced failure of seven anemometers. The manufacturer addressed these concerns with new sensor models, but two of the failures were with the new model anemometers.

Just as there is a need to develop photovoltaic equipment that is well suited for operation in the Arizona climate, there is a need to develop wind generation machines that will operate reliably and efficiently in the Arizona climate. The low air density that results from high ambient air temperatures and/or high elevations must be considered in the selection of appropriate wind generators for use in Arizona.

The new Arizona wind resource map shows the best wind resources located on mountain ridges and tops. The citizens of Arizona have been protective of the scenic vistas of their mountain ranges. The proposed installation of wind turbines on Arizona mountain ranges may bring conflict with residents during the permitting phase, which TEP experienced in Huachuca City, Arizona. Preliminary data taken from survey sites on the gently sloping plains of eastern Arizona indicate that while wind generation is technically viable in those plain locations, due to lower average wind speed regimes in these locations the cost of electricity will be higher than if the wind generators were located on mountain ridges. The cost of developing these wind resources is still likely to be less than 10 cents per kWh, but more than 7 cents per kWh. Preliminary evaluation of the scope of resources required for development of this large wind resource indicates the need for additional transmission capacity between northern Arizona and the population centers of Arizona. At this time, the necessary transmission capacity upgrades have not been quantified.

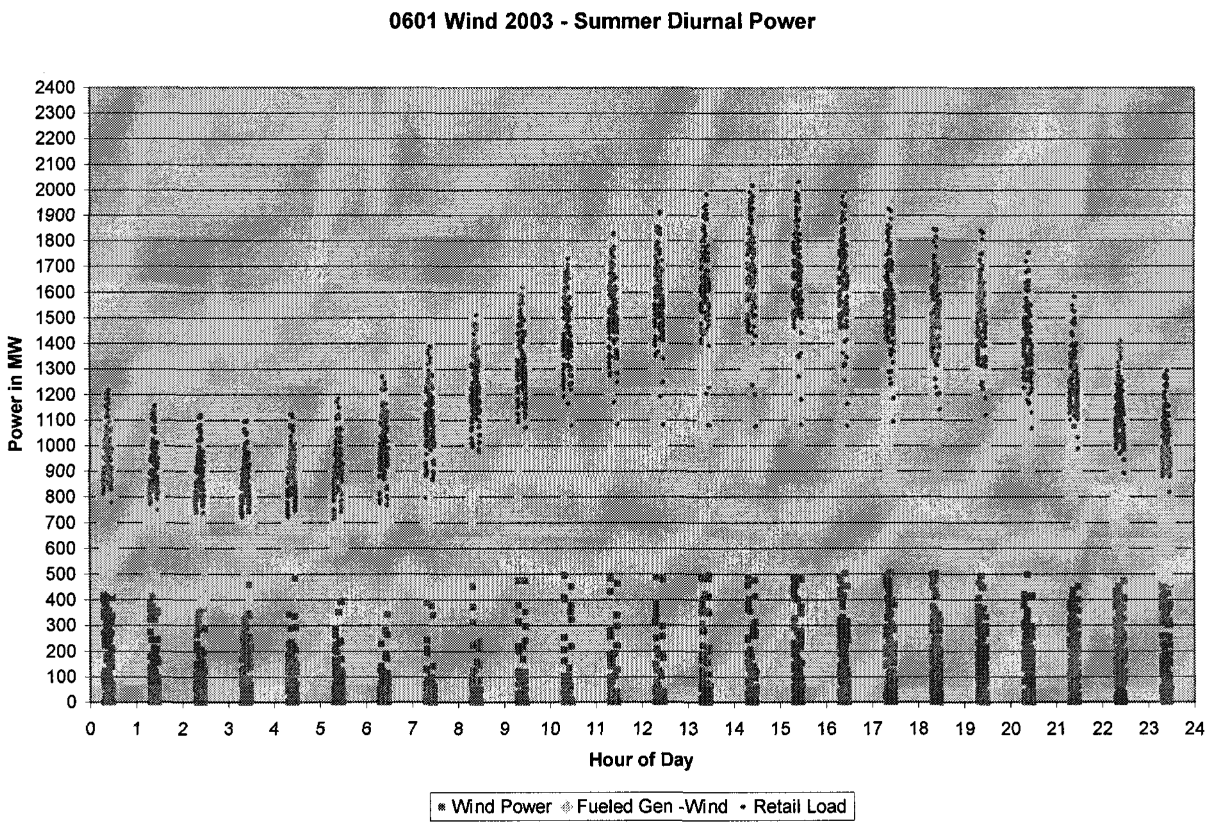
An informal request for wind turbine pricing in 2003 resulted in budgetary quotes that were 40% higher for the wind turbine machines alone than are reported by wind developers at public hearings. Follow up will be done in 2004 on pricing issues. TEP has requested proposals for wind power from three wind developers, but at the end of 2003 had not received any proposals.

PROGRAM CHANGES FOR 2004

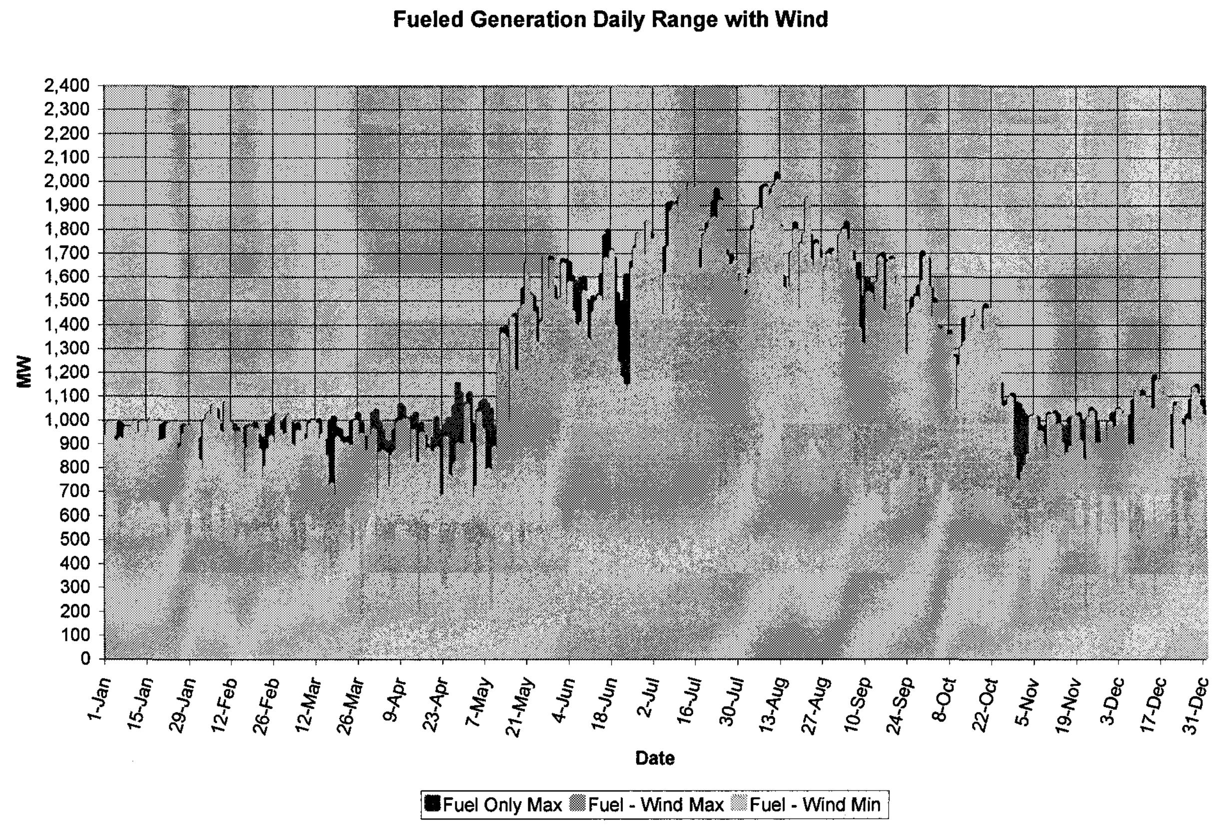
TEP plans to continue evaluating the data from existing wind survey sites, reviewing geographic information to predict new potential wind resource sites and licensing sites for installation of wind and solar resource monitor instrumentation. This data will be shared with entities like NREL and other wind energy development entities under terms of non-disclosure agreements. However, data from sites that have demonstrated poor wind economics will be shared with all others to reduce duplicate expenditures in low yield areas. We expect to more aggressively pursue wind farm conceptual development in 2004.

RESULTS AND FORECASTS

Below is a graph of the TEP 2003 hourly native retail load, overlaid by the hourly energy produced by 509 MW of hypothetical wind generation located at the area of one of the TEP monitor stations and the effect on fueled generation demand reduction – 31 MW – from the application of 509 MW of wind capacity. The 509 MW of wind capacity was chosen as the level needed to produce 10.41% of the TEP annual retail energy sold from new renewable generation sources in 2003, which is about the proposed national renewable portfolio standard of 10%. The reduction of the need for fueled generation is shown by the displacement between the red points and the yellow points. Where they are coincident, there is no displacement of fueled generation from wind.



Below is a graph of the TEP 2003 hourly daily maximum and minimum native load generation demand as if provided by: 1) maximum daily demand met by fueled generation only, in red; 2) maximum daily demand met by fueled generation as reduced by 509 MW of wind generation, in pink; and 3) minimum daily demand met by fueled generation as reduced by 509 MW of wind generation, in blue. Minimum daily loads are much more difficult to predict with a significant amount of wind generation as part of the generation resource base. Displacement of peak fueled capacity needs by wind energy is indicated where the red shows through the pink areas. Displacement of fueled generation by wind energy at minimum loads is indicated where the pink show through the blue areas.



GEOTHERMAL ELECTRIC DEVELOPMENT

PROGRAM DESCRIPTION

The purpose of the Geothermal Electric Development Program is for exploration and basic research into the location and extent of high thermal level geothermal resources in Arizona. If the results of the research indicates a high probability that such resources exist, the second phase of the program will be development of the most appropriate generation technologies given the need for appropriate economic viability and minimal, if not zero, environmental impact.

PROGRESS AND PARTICIPATION

Several meetings were held in Arizona in 2002 and 2003 to determine locations of possible geothermal resources, potential output power, interconnection points to the electric grid and associated development costs. To date, there have not been any geothermal generators installed in Arizona. Review of the NREL geothermal maps indicates that Arizona does not have significant amounts of high thermal level geothermal resources like our neighbors Nevada, Utah and California. Last decade there was an exploratory geothermal resource well bored near Nutrioso, Arizona, using Department of Energy funding. The results of this exploratory well were made available for review by TEP. The review indicated a lack of sufficient thermal gradient to justify any further review of that site or the surrounding related geology for geothermal development.

No funds were expended by TEP on geothermal generation projects in 2002 or 2003. However, some time was spent attending meetings regarding potential geothermal opportunities in Arizona and reviewing significant amounts of background information on geothermal resources, such as volcanic intrusions, in Arizona and evaluating the technologies used for geothermal generation in other states. Review of project economics indicates that capital costs of high thermal level wet geothermal generation projects of a size below 20 MW are prohibitive to the development of the project, and development of dry hot rock resources is prohibitive in Arizona at any size, given current geothermal generation, drilling and reservoir encapsulation technologies and environmental issues specific to Arizona. It has been the general belief at some meetings attended by TEP that commercial development of a geothermal resource will require sufficient energy resource to sustain at least 50 MW of generation for 24 by 7 operations for a period of at least 50 years.

GeoPowering America has taken a lead in the identification of Arizona geothermal resources along with significant involvement of many professors at Northern Arizona University.

Two major volcanic intrusions have been identified in Arizona. The one with greater promise is located north of Flagstaff, Arizona, but is primarily located under National Forest land much of which has been declared as protected habitat. The second volcanic intrusion is located north of Springerville, Arizona, but is an older intrusion which may not have as much high level thermal energy remaining to be tapped. In both cases, it is expected that the resource will be found at a depth of at least 5,000 feet below ground surface and could be as much as 10,000 feet below. Consequently, the cost of resource exploration could be significant.

Other work in geothermal exploration for thermal heating applications is being performed in southeastern Arizona.

CHALLENGES/BARRIERS

There are high capital costs and low success risk factors associated with past exploration efforts for geothermal resources in Arizona and currently there are no federal or state grant funding sources available for these projects. In the past a number of geothermal resources were identified in the southwestern U.S. and were developed with generation systems, only to find the resource was not sustainable. In the 1990s the largest known U.S. resource of geothermal energy at The Geysers in California was oversubscribed and energy output declined. Since that time better methods for determining the long term sustainable energy production of a geothermal resource have been developed. Technologies have been developed for handling significant amounts of somewhat mineral laden water with full respect for environmental compatibility, but permitting challenges remain once a geothermal resource is identified in or near inhabited areas or those with protected habitat.

PROGRAM CHANGES FOR 2004

Participation in GeoPowering America meetings and evaluation of geothermal resource data will continue in 2004.

SOLAR PV RESOURCE DEVELOPMENT

The TEP Solar PV program is designed to develop large utility scale distributed PV generation systems as well as provide incentives and support for TEP customers to install PV on their premises in a safe, economical manner, which maximizes electrical production from the sun. The large utility scale installations provide the opportunity to provide cost savings through long-term purchases from specific manufacturers and to reduce the cost of solar components through bulk purchasing for the customer based systems.

The goal of the program is to best meet the annual solar electric generation energy requirements of the EPS within the limited funding provided by the EPS while providing sufficient long-term PV demand to drive down PV component costs during the term of the EPS, and to provide feedback to PV component makers to help them improve the safety, reliability and performance of their products to help move the PV industry to product maturity.

PROGRESS AND PARTICIPATION

Large Utility Size Distributed Generation

Installation of large utility scale distributed generation PV systems totaling 4,102 kW DC were completed by year end 2003 in Tucson and at Springerville. These systems use PV array building blocks of 21.6 kW DC to 135 kW DC in size, and represent 95.40% of the TEP solar generation base at the end of 2003, while producing 95.52% of the solar electricity in 2003. Different PV module technologies have been used, including crystalline silicon, Cad-Tel and amorphous silicon. Testing of new module technologies is supported by TEP at the utility scale PV system sites. The results of daily energy production performance are shared with interested manufacturers, and used to identify and correct performance related problems. These systems are heavily instrumented and results are reviewed daily to ensure proper operation of the systems. Effective availability of these systems in 2002 was 99.43% and 99.78% in 2003, a very high online operational record for any generating system. These have proven to be very cost effective installations using the opportunity provided by the EPS program to eliminate financing charges. Finance charges are a considerable portion of total costs in high capital, low operational cost projects such as PV. Elimination of finance charges to reduce life cycle ownership costs using the "pay as you go" up front funding concept inherent in the EPS mechanism adopted by the ACC has made a significant reduction in life cycle cost of energy generated with PV. Evaluation of life cycle costs given limited experience with long-term operating costs of large scale PV indicate that large utility scale distributed PV generation systems should produce EPS Solar credits at a cost less than produced by small solar generating systems.

One partnering manufacturer retested PV modules that had been in service in Tucson for 28 months to test for dirt and time related output degradation. Modules were tested first without cleaning and then after cleaning. Results indicated less than 1% output degradation from dirt on modules that had not been cleaned in two years and overall time related degradation of clean modules much less than that expected.

The units at Springerville experienced numerous failures of the distribution grid during 2003. Some planned, some not planned. In all cases all inverters met their IEEE-929 island detection requirements, even with 28 inverters in parallel on the line and some inductive pump motor load, and disconnected nearly instantaneously. As additional inverters are added and the installed capacity of PV approaches the installed load of the pumps and other loads on the radial line, it will be instructive to monitor the transient response of line faults as verification of correct IEEE-929 compliance. There were some events recorded where inverters detected a line disturbance and disconnected even though the distribution line relays did not detect the event. In these cases the reasons recorded for disconnect by the inverters were not always consistent. Further review will be given to this effect in the future.

SGSSS Lightning Event of July 21, 2003

The Springerville Generating Station Solar System ("SGSSS") received a number of direct lightning strikes from a single severe lightning storm on the afternoon of July 21, 2003, starting at 16:53. Witnesses who were working in the area described the lightning storm as the most intense they had witnessed. Many reported seeing four lightning strikes in a one minute period on the solar field prior to evacuating the area before the storm reached them. This was consistent with the inverter data recorded in the first 11 minutes of the storm, indicating all damage occurred in the first 11 minutes. TEP purchased the recorded data of the lightning storm stroke intensity and location from Vaisala and determined the storm had produced 1.7 average years of lightning ground strokes for this area in the first 11 minutes of the storm – 54 lightning strikes. Due to minimal sunlight just prior to the storm, all inverters had shut off two minutes prior to the beginning of lightning strikes, likely reducing the damage from the lightning. The lightning damaged, to varying degrees, 11 of the 24 systems installed at the time. The damage was limited to electronic components inside the inverters, some external components of the data collection systems and some 480 volt revenue meters. Physical inspection of the externals of the systems with the most damaged inverter components did not reveal much, if any, physical damage. Only a couple of small scorch marks on the vegetation could be found. It did appear that the PV module array grid had functioned as intended – a large metal surface to dissipate the lightning energy over a large area, rather than allow the lightning bolts to concentrate current in any particular point.

The damage included:

- One Cat5 network cable needed to be replaced, C-9.
- Three inverter PCU boards required replacement.
- Seven PCU boards were damaged and repaired.
- All seven network switches were damaged and replaced.
- Ten communications computers were damaged and replaced.
- Five communications converters were damaged and replaced.
- Five 480 volt revenue meters were damaged and replaced.

- One main contactor coil was damaged and replaced, C-16.
- One inverter matrix was replaced, C-12.
- One Met station power supply was weak and was replaced, M-1.

Seven inverter PCU boards required repair for varying degrees of problems. Some would not function but did communicate to the RS-232 port, others would function but not communicate. Some would not function or communicate, and others were just dead. One inverter matrix had to be replaced in C-12, but it had shown signs of failure prior to the lightning strike. No PV modules were damaged by the lightning storm. One inverter main contactor coil was short circuited in the only case of what could be called typical lightning damage. This inverter, C-16, was the most southeastern inverter in the field and the storm approached from the southeast, so this inverter was most exposed to the initial lightning front. The total cost of repairing the lightning damage was $26,405. Repair work spanned exactly 28 days before all inverters and data systems were functioning correctly again. During that time as replacement parts were received, inverters were repaired and placed back in service, minimizing the loss of solar energy production. Many lessons were learned by TEP and the inverter vendor in terms of the number of spare parts to keep in the field and the turnaround time for PCU repairs. The inverter vendor, Xantrex, did an excellent job of supporting the repair and replacement of TEP components during what is typically a high volume repair period during the summer lightning season.

Conclusions of root cause analysis of the lightning induced failures resulted in addition of lightning arrestors and associated surge resistant components in many areas of the data collection system and on the 480 volt meter of every inverter. Cost of the lightning protection enhancements was $6,381. Lightning protection enhancement work was complete by the first week of November 2003. The investigation also uncovered a problem with the DC surge protection in all inverters that was subsequently corrected by the inverter vendor. The problem was not responsible for any of the damage from the lightning storm, but could have contributed if the lightning failure modes of the other components had been different. Interestingly, not a single surge arrestor on the 208 volt AC side of the inverters showed a target from suppressing a lightning induced voltage surge.

Despite lightning damage and both planned and unplanned wellfield distribution line outages, the utility scale PV systems in Tucson and at Springerville made a significant contribution to TEP's annual solar energy production:

2003 ANNUAL SOLAR ENERGY PRODUCTION

Category	Installed Capacity	Annual Energy	Energy %
SunShare Systems	127 kWDCp	128 MWh	2.25
TEP Solar Partnering	43 kWDCp	70 MWh	1.23
TEP Customer Sited	34 kWDCp	57 MWh	1.00
TEP Utility Scale	4,102 kWDCp	5,440 MWh	95.53
TEP Solar Energy	4,306 kWDCp	5,695 MWh	100.00

TEP has sufficient numbers of PV systems of various sizes, locations and technology types to begin making comparisons of these factors on the annual energy production performance of PV systems. These comparisons are made by normalizing the annual energy output by the manufacturers rated power of the total power rating of the PV array modules as measured at the Standard Test Conditions ("STC") by a factory test. Some general trends observed based on 2003 specific annual energy production of systems that had a full year of operation:

- Utility scale PV systems have proven to be more productive than smaller PV systems.
- The cool, windy location of the SGSSS has proven more energy productive than Tucson.
- Crystalline Silicon modules are more productive than thin film modules at Springerville, but the gap is closing.

Results of the specific performance of the different categories of PV systems in 2003 that had a full year of operation:

2003 ANNUAL SPECIFIC ENERGY OUTPUT IN KWH AC PER KWDCP @ STC

SunShare Option 2 Average:	1,347
SunShare All Options Average:	1,375
TEP Tucson Sited Small Systems Average:	1,429
TEP "Tucson" Sited Large Systems Average:	1,596
SGSSS Sited a-si Module Type Average:	1,602
SGSSS Sited CdTe Module Type Average:	1,664
SGSSS Sited C-si Module Type Average:	1,743

- SunShare Option 2 systems are all less than 10 kWDCp in size, amorphous silicon module technology systems, located on customer sites in Tucson.
- SunShare All Options systems are all less than 10 kWDCp in size of various module technologies – primarily crystalline silicon - located on customer sites in Tucson and include all of the amorphous silicon Option 2 systems.
- TEP Tucson Sited Small Systems are all less than 10 kWDCp in size of various module technologies – primarily crystalline silicon - located either on customer sites or TEP's Operating Headquarters solar test facility in southeastern Tucson.
- TEP Tucson Sited Large Systems are all larger than 10 kWDCp in size, all of crystalline silicon module technology, located either on customer sites or TEP's property in Tucson and includes the single 22 kWDCp system at the Auto Shop at SGS and the single 30 kWDCp system at Fort Huachuca.
- SGSSS Sited Systems are the systems at the West Well field area of the SGS. These systems are distinguished by differences in the module technology used in the various systems. Note that there were array enhancements made to the CdTe systems during late 2003, so the results are not fully comparable to the results of the other SGSSS technologies.

Small Utility Supported Distributed Generation
Installation of small TEP supported distributed generation systems throughout Tucson has been successful in providing energy in support of EPS solar credit goals and in developing public interest in solar energy. To date 210 kW DC of small TEP supported and maintained PV systems have been installed on customer premises or TEP property. These systems represent 0.79% of the TEP solar generation base at the end of 2003, while producing 1.00% of the solar electricity in 2003. These systems do not provide the same economics for production of EPS solar credits as the large scale PV systems, but provide better solar program visibility. Some GreenWatts revenues are used for support of solar installations in the Tucson area, such as at the Tohono Chul Museum, Pima Air Museum, Safford Middle School and Palo Verde High School, among others.

Customer Partnering Distributed Generation
TEP has partnered with customers, notably the City of Tucson, to install medium sized customer owned and sited PV systems totaling 43 kW DC. These systems represent 1.00% of the TEP solar generation base at the end of 2003, while producing 1.23% of the solar electricity in 2003. These systems provide the opportunity for significant leverage of EPS funding and provide EPS Solar credits at the lowest life cycle costs. However, there are a limited number of customers with available funding to support these types of projects. Some GreenWatts revenues are used for support of these installations.

SunShare
TEP offers the SunShare hardware buy-down program, with ACC approval, to its customers. Since the program was offered in 2001, there have been more than 1,107 expressions of interest and more than 173 customers have applied to participate in the program. Of those, 98 customers have sites that meet the SunShare requirements. Overall, 28 customers have purchased our Option 2 package, which is a solar kit offered by TEP at a pass through cost. This accounted for 40 kits delivered for installation. Twenty-eight customers qualified for, and joined, the SunShare Option 1 program through December 31, 2003 with a total installed DC capacity of 73 kWp. The net program total is 56 SunShare participants through December 31, 2003. There is currently 142 kW DC of customer sited, installed PV capacity as part of the SunShare program. These systems represent 2.95% of the TEP solar generation base at the end of 2003, while producing 2.25% of the solar electricity in 2003.

The SunShare program was developed to support EPS program goals with small customer based distributed generation PV systems through hardware buy down payments to customers installing any qualifying PV system of their choice (Option 1), and offer of a pre-qualified PV system at a significantly discounted price as compared to market rates (Option 2).

TEP requested in 2003, and received on February 10, 2004, ACC approval for changes in the SunShare program offerings for 2004, 2005 and 2006 to allow more customers to qualify for the program while retaining high standards for safety, reliability and performance of systems in the SunShare program.

The SunShare program changes include:

1. Adds Option 3, which provides for a $2.00 per DC watts subsidy payment instead of the $2.00 per AC watt (roughly $1.33 per DC watt) payment of Option 1 or Option 2. Maintenance is not included in this Option, but does include an annual visit to ensure the equipment still exists and is functional. This Option offers more customer choice.

2. Adds a factor for off angle or shaded installations, reducing the subsidy payment by the percentage of the amount of expected annual energy output reduction from the off angle or shading condition. A table defining the percent reduction is included in program documents for easy prediction of the reduction percentage. The percentage reduction affects all three options. The system must face from 90 degrees east of north through south to 90 degrees west of north and have an angle of 10 degrees to 60 degrees from horizontal and be fully unshaded from three hours after sunrise to three hours before sunset to qualify. This should allow more installations to qualify, while retaining an annual energy based subsidy criteria.

3. A rear of module clearance distance qualification has been added to ensure output is not reduced from overheating due to lack of natural convective cooling.

4. Increases the maximum qualifying PV system size from 5 kW AC to 10 kW AC, or what is typically about 15 kWDC. The minimum size remains at 800 watts AC or about 1200 watts DC. All systems will still be metered, and TEP still supplies the meter and meter socket. This change should allow more systems to qualify and matches the maximum size of a net metered system.

5. Removes the 5 kW system from Option 2, as that system could never be offered due to lack of a qualifying inverter. Limits Option 2 kits to 10 maximum per customer.

6. The program still has an annual cap of 200 kW of qualifying PV installations. The program will be offered in 2004, 2005 and 2006.

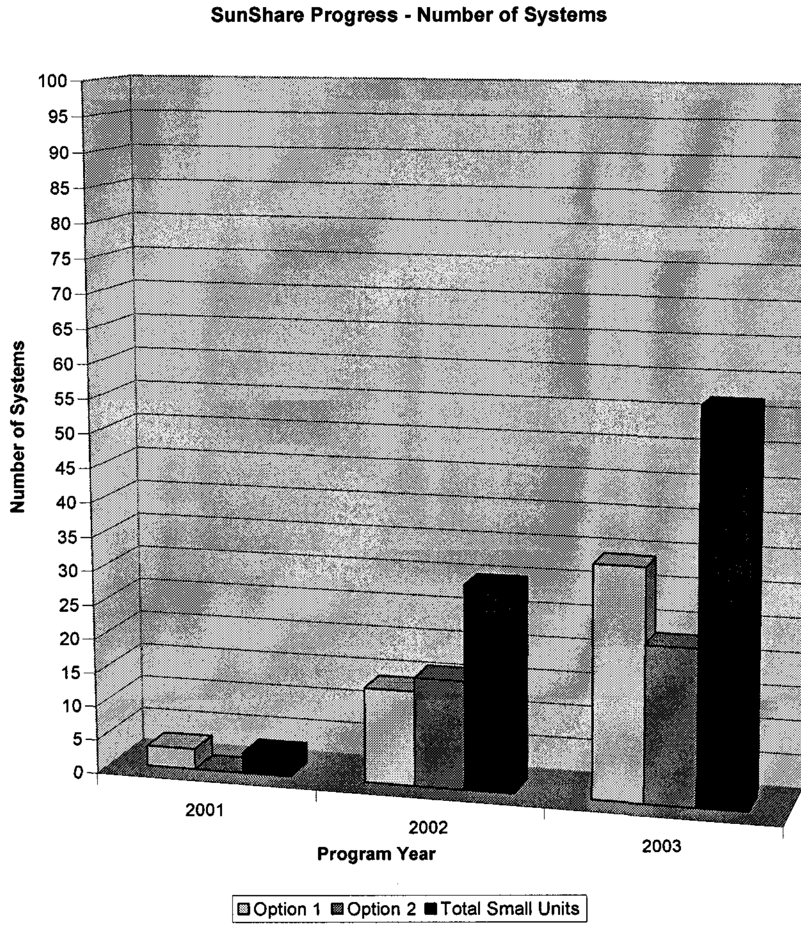
7. The Option 1 rating can now be determined either by test or by comparison to historical data of another "equal" system.

8. Revised the SunShare Annual Report filing date to April 15 to coincide with the DSM/Renewable Report filing date to simplify reporting requirements.

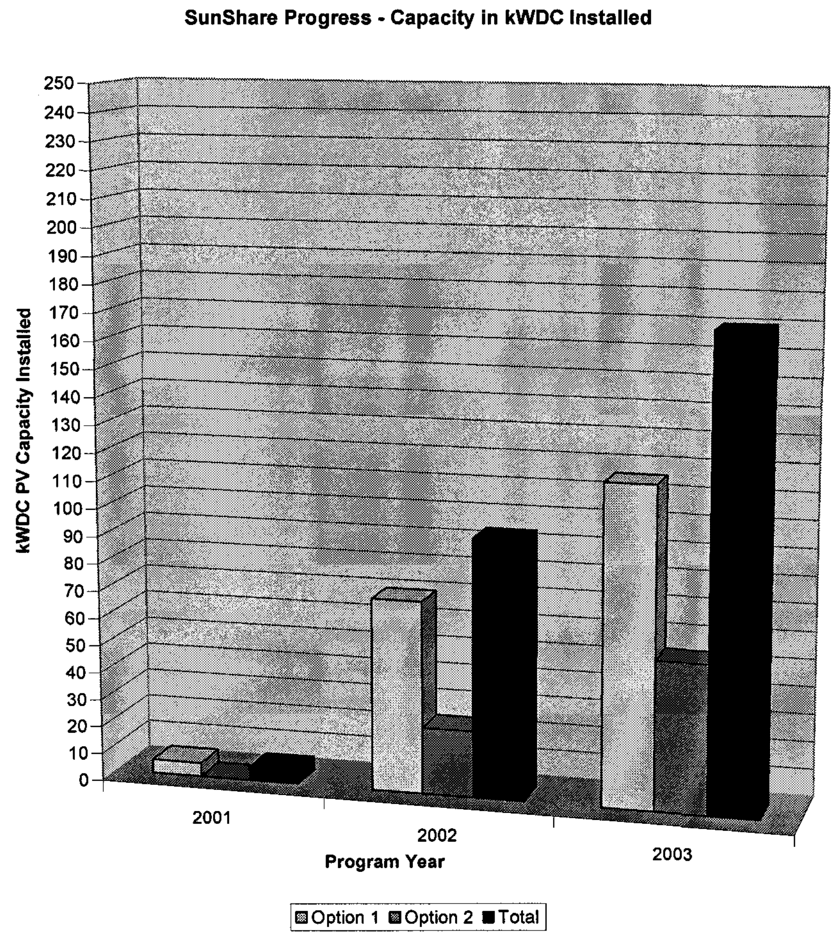
TEP provides extensive outreach and education about the benefits of solar energy, as described in the Executive Summary of this report, for promotion of the SunShare program. The SunShare Program has shown steady participation gains in its three years of existence.

The graphs below demonstrate that progress. These include the capacity of the City of Tucson's Hayden/Udall Water Treatment Solar Generation system installed in 2002, since TEP does provide maintenance support of the system under a separate agreement similar to the SunShare program maintenance:

PROGRESS BY YEAR FOR THE SUNSHARE PROGRAM – NUMBER OF PARTICIPATING CUSTOMERS



PROGRESS BY YEAR FOR THE SUNSHARE PROGRAM – INSTALLED PV CAPACITY



Net Metering

In 2001, TEP offered, with Commission approval, a net metering option for owners of PV systems of less than 5 kW AC in size. TEP requested, and the Commission approved in March 2003, an increase in the maximum size of a PV generation system qualifying for net metering to 10 kW AC and expanded the eligible technologies to include wind generation up to that size. As of December 31, 2003, thirty-one PV customers have qualified and enrolled in the net metering program. No wind customers have yet enrolled in net metering. These PV customers have a combined installed solar generation capacity of about 76 kW AC, a significant increase from the 33 kW of the first half 2003 report. Eight net meter customers are not SunShare customers. To further simplify customer sited PV and wind installations, in addition to net metering, TEP also offers simple interconnection requirements for small customer located PV and wind systems.

Summary of PV Programs

In summary, the TEP Solar PV program, in response to ACC's EPS annual renewable energy production requirements, has effected the installation or assisted in the development of 4,306 kW DC of solar PV generating resources in Arizona.

Installations, capacity, energy production and costs of these systems are summarized below:

INSTALLATION PROGRESS

Project	Install Date	kWp DC Peak Capacity	kWh, AC Output - Thru 12/31/03	Initial Costs	Total Operating Cost 12/31/03	$/kWh for Project
Residential						
3131 S. Naco Vista	Apr-99	0.75	4,613	$6,944	$6,494	$0.2684
Small Commercial						
Reid Park Zoo ASE/TR 840w Xtal	Mar-00	0	3,713	$7,400	$6,469	$3.74 Removed in 1/2003
Pima Air Museum ASE/TR 1200w Xtal	Jun-00	1.2	4,161	$7,099	$2,400	$0.2166
UofA Agriculture Station	Jan-02	5.62	19,086	$120,000***	$0	$0.4415
Hayden/Udall # 1 ASE/TR 21.6 KW Xtal	2002	21.6	48,462	$174,150***	$341	$0.1706
Hayden/Udall # 2 ASE/TR 21.6 KW Xtal	2002	21.6	45,668	$174,150***	$191	$0.1576
Military						
Ft Huachuca Solar ASE/OMN 30 KW Xtal	1997	30	158,001	$300,000***	$2,300	$0.2249
Utility (TEP)						
SGS-125C-1 ASE/XN 135 KW Xtal	Jul-01	135	510,115	$1,125,637	$3,231	$0.1914
SGS-125C-2 ASE/XN 135 KW Xtal	Jul-01	135	539,785	$848,927	$3,231	$0.1245
SGS-125C-3 ASE/XN 135 KW Xtal	Aug-01	135	497,342	$779,470	$3,474	$0.1168
SGS-125C-4 ASE/XN 135 KW Xtal	Aug-01	135	488,481	$885,503	$3,231	$0.1321
SGS-125C-5 ASE/XN 135 KW Xtal	Nov-01	135	463,013	$891,576	$3,231	$0.1510
SGS-125C-6 ASE/XN 135 KW Xtal	Nov-01	135	468,094	$830,314	$3,231	$0.1322
SGS-125C-7 ASE/XN 135 KW Xtal	Oct-02	135	315,396	$896,984	$2,843	$0.1479
SGS-125C-8 ASE/XN 135 KW Xtal	Oct-02	135	324,659	$896,332	$2,843	$0.1496
SGS-125C-9 ASE/XN 135 KW Xtal	Oct-02	135	322,704	$900,199	$2,843	$0.1503
SGS-125C-10 ASE/XN 135 KW Xtal	Oct-02	135	309,859	$910,976	$2,843	$0.1298
SGS-125C-11 ASE/XN 135 KW Xtal	Jun-02	135	364,990	$899,885	$2,843	$0.1314
SGS-125C-12 ASE/XN 135 KW Xtal	Jun-02	135	318,184	$901,081	$2,843	$0.1588
SGS-125C-13 ASE/XN 135 KW Xtal	Jun-03	135	117,744	$864,022	$2,276	$0.1279
SGS-125C-14 ASE/XN 135 KW Xtal	Jun-03	135	116,690	$863,759	$2,276	$0.1292
SGS-125C-15 ASE/XN 135 KW Xtal	Aug-03	135	101,968	$864,728	$2,276	$0.1421
SGS-125C-16 ASE/XN 135 KW Xtal	Aug-03	135	103,429	$858,301	$2,276	$0.1391
SGS-125C-29 ASE/XN 135 KW Xtal	Nov-03	135	43,107	$847,175	$2,276	$0.3294
SGS-125C-30 ASE/XN 135 KW Xtal	Nov-03	135	37,963	$721,587	$2,276	$0.3189
SGS-125C-31 ASE/XN 135 KW Xtal	Aug-03	135	91,112	$854,143	$2,276	$0.1571
SGS-125C-32 ASE/XN 135 KW Xtal	Aug-03	135	85,392	$854,121	$2,276	$0.1676
SGS-125TF-1 FS/XN 134.4 KW Cd-Tl	Sep-01	150	486,375	$699,951	$16,965	$0.1121
SGS-125TF-2 FS/XN 134.4 KW Cd-Tl	Sep-01	144	409,869	$581,286	$15,719	$0.0918
SGS-125TF-3 FS/XN 134.4 KW Cd-Tl	Jun-03	135	137,706	$759,114	$771	$0.1139

Project	Install Date	kWp DC Peak Capacity	kWh, AC Output - Thru 12/31/03	Initial Costs	Total Operating Cost 12/31/03	$/kWh for Project
SGS-125TF-4 FS/XN 134.4 KW Cd-Tl	Jun-03	135	131,754	$759,122	$771	$0.1078
SGS-125TF-5 BP/XN 129 KW a-si	Oct-01	129	471,822	$760,802	$2,381	$0.1277
SGS-125TF-6 BP/XN 129 KW a-si	Oct-01	129	500,556	$760,717	$2,381	$0.1218
SGS-125TF-7 BP/XN 129 KW a-si	Oct-01	129	472,707	$736,514	$2,381	$0.1208
SGS-125TF-8 BP/XN 129 KW a-si	Oct-01	129	472,768	$741,162	$2,381	$0.1206
OH ASE/SB - 1500w Xtal	Jul-01	1.5	2,923	$8,563	$0	$0.1591
OH ASE/TR - 1200w Xtal	Aug-01	1.2	4,067	$8,369	$0	$0.1347
OH BPMST-50/TR - 1500w a-si	Sep-01	1.5	4,083	$6,666	$840	$0.1117
Solar Trailers/TR 5000w Xtal	Jun-05	5	26,767	$70,000	$490	$0.3945
OH Gate 2A Solarex/TR - 2500w Xtal	Mar-00	2.5	15,303	$10,250	$358	$0.0916
OH3 20KW ASE/TR 21.6 KW Xtal	Sep-00	21.6	111,489	$146,342	$652	$0.1372
OH4 20KW ASE/TR 21.6 KW Xtal	Oct-00	21.6	115,887	$110,534	$126	$0.1027
St Johns Test	Sep-00	0	3,512	$11,517	$0	$3.2793 Removed 4/2002
SGS 20 KW ASE/TR 21.6 KW Xtal	Oct-00	21.6	110,899	$135,060	$526	$0.1371
DMP 1 ASE/OMN 108 KW Xtal	Dec-00	108	513,852	$589,020	$1,202	$0.1147
DMP 2 ASE/OMN 108 KW Xtal	Dec-00	108	505,808	$527,199	$820	$0.1035
Test Trees	Jun-01	0	8,214	$1,500	$0	$0.0086
Tohono Chul BPSX140U/SB - 2800w Xtal	Dec-02	2.8	5,039	$23,286	$0	$0.1637
OH Global Solar Test/TR - 1440w CIGS	2002	1.44	2,111	$13,447	$431	$0.2367
Sun Share Reported 1999	1999	6.2	36,685	$54,000	$0	$0.2020
Sun Share Reported 2000	2000	4.8	6,832	$50,000	$0	$0.1690
Sun Share Reported 2001	2001	13.44	32,720	$106,410	$0	$0.1075
Sun Share Reported 2002	2002	47.58	73,387	$297,852	$0	$0.1291
Sun Share Reported 2003	2003	55.26	33,535	$368,227	$7,532	$0.1629
OH BP SX140U/TR-1400w Xtal	2002	1.4	2,211	$8,237	$0	$0.1275
OH Sharp 165/SB - 1320w Xtal	Mar-03	1.32	985	$7,476	$0	$0.1838
OH Sharp 165/TR - 1320w Xtal	Mar-03	1.32	1,382	$8,223	$358	$0.1430
OH Kyocera 158/TR - 1422w Xtal	Apr-03	1.422	1,410	$8,236	$0	$0.1332
OH Sanyo 167HIT/SB - 1336w Xtal/a-si	May-03	1.336	1,408	$8,962	$0	$0.1388
OH UnSolar 64/Trace - 1536w Xtal/a-si	Jun-03	1.536	1,532	$10,228	$0	$0.1237
OH BP SX150U/TR-1500w Xtal	May-03	1.5	1,147	$8,714	$0	$0.1266
OH Sanyo 180HIT/SB - 1440w Xtal/a-si	Jul-03	1.44	1,168	$8,955	$0	$0.1278
OH Shell 40/Tr-1440w a-si	Sep-03	1.44	791	$9,244	$0	$0.1947
OH Shell 150/Sharp-3000w Xtal	Sep-03	3	1,271	$16,991	$0	$0.2229
		4,306	10,475,870	$26,653,035	$130,177	$0.1387

* Portion installed after January 1, 1997.

** Includes customer expenses for these systems.

*** Estimated after grant removal.

CHALLENGES/BARRIERS

Initial Cost

The current high cost of PV modules and inverters is the primary barrier to use PV as a widespread generating technology. This high initial cost also raises those operating costs associated with value, such as property taxes and insurance. While PV module costs were very high in 2001 and 2002, due in some part to excessively high subsidies for PV in neighboring states, the costs have been decreasing in late 2002 and continuing into 2003.

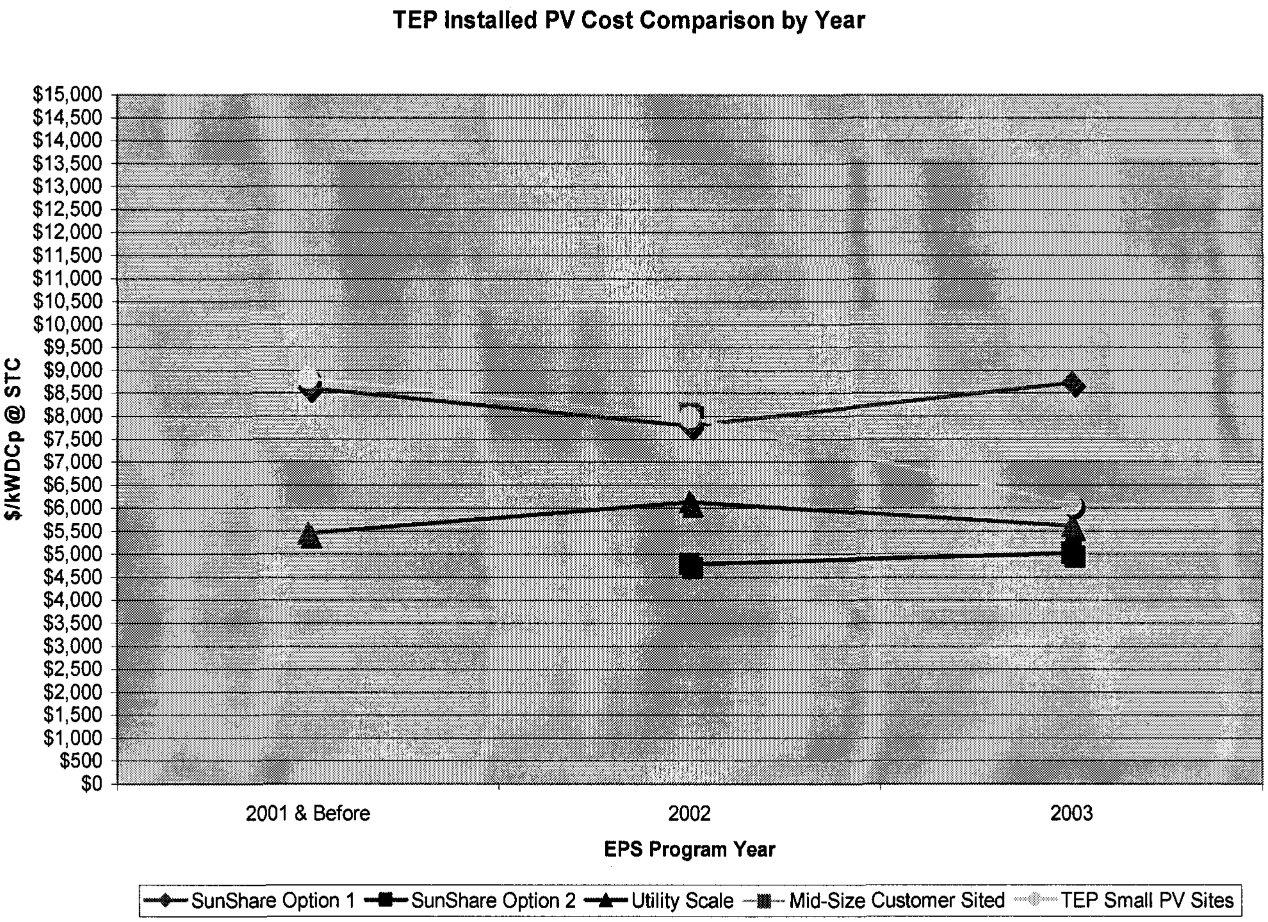
Competition in the inverter market is driving improvements in quality, reliability and price, which are reducing the life cycle cost of PV ownership through reduced initial and maintenance costs as well as increased energy output. However, much work remains to produce residential size PV inverters with the same reliability, performance and cost per watt factors as utility scale PV inverters.

The implementation of a multi-year, pay as you build funded EPS allows for development of cookie cutter PV system designs in a size optimized to take advantage of partnering opportunities with the manufacturers of the major components of PV systems to optimize BOS costs through both material and installation labor cost reductions. TEP has taken advantage of this intended feature of the EPS by using refined design techniques to effect cost reductions in electrical systems, support structures, inverters, site preparation, grid connection and data acquisition systems. The EPS, as adopted by the ACC, allowed TEP to be assured of multi-year funding and has provided TEP with certainty of financing essential to enter into long- term relationships with specific makers of the primary components of PV systems – PV modules and inverters – to allow for partnering to optimize the BOS design and installation, resulting in BOS costs of less than $1 per DC watt of installed PV capacity in 2003, only the third year of the EPS. This BOS cost level meets a long-term goal of the federal government renewables programs. This benefit would not have been possible with a "year-to-year" type of EPS.

TEP PV program cost and customer PV cost trend data is shown below. These costs assume that no subsidies or grant funds were used to reduce the cost to the customer. In reality, customers did effectively pay less than this as a result of TEP subsidies, federal tax credits, state tax credits and grants from a number of sources.

SMALL PV CUSTOMER INSTALLED COST BEFORE SUBSIDY IN $/KWDCP @ STC

Average SunShare Option 1 Cost 2001 through 2003:	$8,340
Average SunShare Option 2 Cost 2001 through 2003:	$4,921
Average TEP Small PV System Cost 1999 through 2003:	$7,535



Performance & Reliability

While the TEP fleet of large scale PV systems had a very high percentage of effective availability in both 2002 and 2003 – more than 99.4% when only PV related factors are included, there are challenges remaining in maintenance of PV systems, both large and small. There were more than 40 separate incidents in 2003 requiring some level of human response to restore the large PV systems to full operation. This does not include the lightning damage related items at SGSSS. Less than half of these incidents were the result of a PV related item. Most were data collection failure, human error or distribution system outage related items. These incidents were only identified because of the instrumentation and communications that is economically viable on large scale systems. The software of the data collection system was updated near the end of 2003 to allow a grid power failure to be reset automatically instead of requiring human intervention. These upgrades included changes to allow the data collection system to resolve its own problems, in most cases, without on site human intervention. The system now also allows remote reset of an inverter to resolve a transitory nuisance problem. These improvements are expected to reduce the number of unscheduled site visits by more than 75% in 2004.

The Hayden/Udall Water Treatment Solar Generation system required a number of visits by TEP personnel in the early part of 2003, ultimately resulting in a factory warranty repair of one inverter. After that repair, the systems performed well for the rest of 2003.

During 2003, TEP personnel made 65 visits to 48 different customer sited PV systems. Thirty-one of the visits found the PV system to be operating properly and no corrective action was required. The other thirty-four visits resulted in some level of corrective action required to allow the PV system to operate properly. In most cases the repair work could be completed on the spot during the inspection visit. However, a significant number of the repairs required subsequent visits for replacement of inverters or PV modules. In some cases the inspection was a performance check prior to SunShare program acceptance and the repair work was completed by the PV system installer. The 2003 annual specific energy production of the small PV systems in the SunShare program was 25% less than the large SGS crystalline systems, to a certain degree because a SunShare system failure was generally not found until TEP made an inspection. Small systems need to have the capability to notify the customer when attention is needed, without adding any significant cost to the price of the system.

TECHNICAL EVALUATION REVIEW RESULTS

This technical evaluation is based on 22 months of one minute interval data taken from operation of the SGSSS units. Units U-1 through U-12 are made of 450 ASE 300DG-50 modules, connected with 9 in series. Units U-33 through U-36 are made of at least 2,688 First Solar FS-50 modules, connected 6 in series. Units U-37 through U-40 are made of 3,000 BP MST-43 modules, connected 5 in series. All modules are facing due south at an angle of 34 degrees from horizontal, which is latitude angle. The ASE and BP modules, with the exception of those in C-12 and C-14 are commercial products, not test or preproduction modules. However, the First Solar modules in U-33 and U-34 are a preproduction module, purchased for testing purposes and were not expected to perform like production modules. Any interpretations of First Solar module data or comparisons with other systems at Springerville or elsewhere must reflect that these First Solar modules are a preproduction version.

All units use a Xantrex PV-150 150 KVA inverter proven in operation to be capable of intermittent operation at output levels as high as 161 KVA. The 208 volt three phase output of the inverter is stepped up to 480 volt three-phase at which point it is metered for reporting purposes. The site is at 6,600 foot elevation, in eastern Arizona. ASE modules were installed in 2001, 2002 and 2003. All BP modules, except replacements for failed modules, were installed in 2001, and First Solar modules were installed in 2001, 2002 and 2003.

Qualitative PV Technology Evaluation

The crystalline silicon modules from ASE are the best overall performers in terms of specific annual energy output, reliability and predictability of output. After the initial month of operation, during which all module types at SGS experienced some degree of infant mortality, as of December 31, 2003, we have experienced only two ASE module failures. DC bus voltage ranges from 450 volts in the winter to 380 volts in the summer, exhibiting a normal pattern of thermally induced voltage sag as the time approaches noon and the voltage rises again after noon. The modules exhibit expected voltage changes with temperature, lower in summer and higher in winter and power output follows the rule as well. The inverters follow maximum power point with great accuracy. The output of these modules with a given set of ambient conditions, including solar insolation, ambient temperature and wind speed is highly predictable and allows for detection of a single failure in an array of 9,000 or more ASE modules. The algorithm currently developed by TEP for use in monitoring these systems detected and alarmed the loss of energy from a small animal gaining entrance to the array field, by jumping the fence, on January 7, 2003, after it accidentally disconnected a row lead on the south most row of U-10. The specific annual energy performance of the ASE systems in 2003 was 1,743 AC kWh per kWDCp at STC. This performance was determined from those five units having a full year of operation in 2003 that were not severely impacted by the lightning events. This was a total of five systems. Of the lightning impacted units, 10 out of 11 were in the crystalline field. The storm came from the southeast, and the crystalline field is the eastern portion of the SGSSS. The storm's fury broke over the east side, according to witnesses and the evidence found from data system failures.

The second installation of The First Solar Cad-Tel systems installed in 2003 in U-35 and U-36 have met the minimum DC voltage required by the inverters in warm weather. The modules exhibit expected voltage changes with temperature, lower in summer and higher in winter and power output follows the rule as well. The First Solar units also exhibit much higher voltage earlier in the morning under partial light conditions and can start the inverter earlier than either the ASE or BP Solarex (BP) modules. Under partial light conditions, the First Solar modules have outperformed the ASE systems in terms of daily energy output. However, the variation of performance characteristics over the range of ambient conditions is not as predictable as that of the crystalline modules. Work continues to refine the variables in our performance prediction algorithms for the CdTe systems, and to determine if any long-term degradation is occurring. To date, with less than a year of operation with the production modules installed during the spring of 2003, it is too early to determine any rates of long term degradation. The specific annual energy performance of the First Solar systems in 2003 was 1,664 AC kWh per kWDCp at STC. This was only from the preproduction module systems, U-33 and U-34, since the production module systems did not have a full year of operation, so specific annual energy production could not be calculated for those units. Given the better performance of the production modules as compared to the preproduction modules in our daily energy production results to date, the First Solar modules will give the ASE modules a race in 2004 for the best specific annual energy production. Of the lightning impacted units, one1 out of 11 was in the CdTe field.

The BP a-si modules have been challenging. U-37 has been a poor performer from day one and continues to exhibit open circuit voltage about 20 volts below the other three BP units. After the initial degradation period expected of a-si, which took about one week in summer, the other three BP units have generally also not been able to reach the 300 volt voltage floor of the inverter, but in the latter part of both the summer of 2002 and 2003 the array max power point was about 280 to 290 volts, so power loss was minimal, given the flat IV curve of a-si. As winter approached and temperatures dropped in October of both 2002 and 2003, the units exhibited a slight rise in DC voltage and a rise in power output, just like the ASE and First Solar units, and U-38, U-39 and U-40 started to exhibit DC bus voltages slightly above 300 volts in the early morning and the afternoon. However, toward the end of October of both 2002 and 2003, the max power point DC bus voltage never climbed above 300 volts on any BP units, and a downward trend in daily energy output started, sometimes as much as 20 percent below the daily energy output of the ASE units. This trend did reverse when warm weather resumed. In 2002 the daily energy production returned to "normal" in early June with the return of normal summer temperatures. However, in 2003, the daily energy performance of the BP systems did not return to "normal" until mid-July with record daily high temperatures for the region. This characteristic is observed only in cold climate installations, not in our Tucson installations of the BP MST series modules. The BP modules have proven to be very reliable. In 2002, after 15 months of operation, less than 1% of modules had cracked or failed after one year of service and all failed modules were replaced under warranty by September of 2002. In 2003, after a second full year of operation, only 25 modules out of 12,000 had failed in the second year of operation. These were replaced by the end of September 2003. TEP has generally been satisfied with the performance of the BP systems, with the exception of U-37 and the concern over lost production in cold weather. The inverters are seldom able to follow maximum power point since the units generally have a max power point below the 300 volt floor of the inverter. Significant tuning of inverter constants to prevent inverter trip during cloud enhancement was needed. Consideration of revising the array configuration to connect 6 modules in series instead of 5 was dropped when open circuit voltage testing in early 2003 in ambient temperatures of 10 degrees F. demonstrated loop voltages with 5 modules in excess of 520 volts. Especially given the low DC voltage problem and the negative cold weather output characteristics of this material, the variation of performance characteristics over the range of ambient conditions is not as predictable as that of the crystalline modules. While the amorphous silicon modules have performed well all year in the warm climate of Tucson, proper design consideration of the low temperature characteristics of that material must be given for use in cold climates. Work continues to refine the variables in our performance prediction algorithms for the a-si systems. The specific annual energy performance of these systems in 2003 was 1,602 AC kWh per kWDCp at STC. Of the lightning impacted units, none were in the BP a-si field, which is on the extreme west end of the SGSSS field.

The Future

In 2003, TEP installed two additional systems of 2,688 First Solar modules. TEP has confidence that the issues found with the pre-production modules are being resolved. The 2003 systems are also test units, but have two additional years of development behind them and a much stronger performance standard to meet than the initial two units. There are no plans to install any more a-si units at SGS until a better understanding of the cold weather degradation issue is completed. TEP also installed another ten ASE systems in 2003, one of which is a test unit. TEP expects to install a Copper Indium Gallium Selenide (CIGS) system at SGS at some time in the not too distant future. There is a 1.2 kW CIGS system in test in Tucson, alongside similarly sized a-si and crystalline systems. In 2003, nine test installations, in the 1000+ AC watt size, have been installed in Tucson. These systems are made up of various combinations of manufacturer's components and are testing the equipment tolerances to the manufactures performance specifications. This side-by-side testing will provide accurate, comparable data, in Tucson's climate. Four additional test systems will be installed during 2004.

TEP will continue to evaluate the reams of solar production data taken during the three years of our solar development program. By this time next year TEP will have additional insight into some of the items raised on voltage response with respect to temperature for all thin-film and crystalline materials in test. This data will be shared with inverter and PV module manufacturers and other interested solar industry participants to provide needed feedback for use in developing mature, reliable, predictable and low cost solar consumer products in the future.

PROGRAM CHANGES FOR 2004

The 2004 renewable program includes planned installation of 810 kWp DC of PV at the SGSSS, 5 kWp DC at operating headquarters in Tucson and an expected minimum of 85 kWp DC in SunShare systems and customer partnering opportunities.

SUNSHARE PROGRAM DETAILS

Through December 31 2003, TEP acquired 56 SunShare customers. Of those, 23 customers purchased a total of 40 TEP systems under Option 2, and 33 installed third party systems under the Option 1 program. Of the 33 Option 1 systems, 14 did not initially qualify due to inverter, wiring or module problems. After repairs, the 14 were retested and qualified for the SunShare program. All together, there have been 10 PV module problems, 7 wiring problems and 16 inverter problems found by TEP during acceptance testing. Presently, there remain 28 – 1,000 watt AC rated systems in the warehouse inventory from the original 40 ordered.

SYSTEM PERFORMANCE TESTING

TEP has developed a test program for different manufacturers' small PV systems to gather performance data on their operation in the Tucson environment. This is a two-fold effort; 1) develop operating experience of the different systems to pass on to solar installers and our customers, and 2) offer the best performing most economical systems to our Option 2 SunShare customers. This testing provides invaluable information that is not normally available to the home owners and others interested in investing in solar energy. Presently, we are testing 13 systems, using a combination of 14 different manufacturers' inverters and modules. We are in the process of installing four additional systems of different manufacturers' products.

Below is a table of the systems presently in test.

PV Test Systems

Test Station	Panel Manufacturer	Cell Type	Inverter Manufacture	Total Installed Cost per Watt	System KWDC Rating
Inverter/Module					
OH SB/Sanyo 167	Sanyo 167 HIT	Amor/Cryst	Sunny Boy 1800 SBD	$6.71	1336
OH Tr/Shell 40/1600	Shell ST40	CIS Thin Film	Trace 1500	$5.78	1600
OH Tr/Shell 40/1440	Shell ST40	CIS Thin Film	Trace 1500	$6.01	1440
OH Tr/Shell 40/1440	Shell ST40	CIS Thin Film	Trace 2500	$6.01	1440
OH TR/Unisolar	Unisolar 64	Triple Junct. Sil	Trace 1500	$6.66	1536
Tohono Chul	Bp SX140U	Multi-Crystal	Sunny Boy 2500	$5.48	2800
OH Tr/BP150	BP SX 150U	Multi-Crystal	Trace 1500	$5.81	1500
OH SB/Sharp	Sharp 165	Multi-Crystal	SunnyBoy 1100	$5.66	1320
OH Tr/Sharp	Sharp 165	Multi-Crystal	Trace 1500	$6.23	1320
OH Tr/Kyocera	Kyocera 158	Multi-Crystal	Trace 1500	$5.79	1422
OH Tr/BP 140	Bp SX140U	Multi-Crystal	Trace 1500	$5.88	1400
OH SB/Shell 150	SP 150-PC	Multi-Crystal	SB/2500	$5.06	3000
OH Sharp/Shell 150	SP 150-PC	Multi-Crystal	Sharp 3500	$5.66	3000
Global Solar Test	GS-45	CGIS	Trace 1500	$7.99	1440
OH SB/Sanyo 180	Sanyo 180 HIT	Amor/Cryst	Sunny Boy 1800 SBD	$6.22	1440
OH Tr/MST 50/1500	BP MST 50	a-si	Trace 1500	$4.44	1500

Presently we are collecting data manually but as the number of test systems has grown will need to install an automated data logger system. We expect to have this in place by the end of 2004. Below is a table of performance results from our testing.

PV Test System Comparisons

Test Station	Panel Manufacturer	Inverter Manufacture	Panel KWDC Rating	Ave Monthly kWh/kWp Rated	Peak DC Watts Actual/Rated	Volts(mpp) Actual/Rated
OH SB/Sanyo 167	Sanyo 167 HIT	Sunny Boy 1800 SBD	167	(1) 133	0.86	0.87
OH Tr/Shell 40	Shell ST40	Trace 2500	40	137	0.87	0.95
OH TR/Unisolar	Unisolar 64	Trace 1500	64	144	0.90	0.93
OH Tr/BP150	BP SX 150U	Trace 1500	150	123	0.74	0.81
OH SB/Sharp	Sharp 165	SunnyBoy 1100	165	(1) 93	0.81	0.88
OH Tr/Sharp	Sharp 165	Trace 1500	165	134	0.78	0.87
OH Tr/Kyocera	Kyocera 158	Trace 1500	158	125	0.72	0.83
OH Tr/BP 140	Bp SX140U	Trace 1500	140	128	0.77	0.87
OH Sharp/Shell 150	SP 150-PC	Sharp 3500	150	146	0.87	0.90
Global Solar Test	GS-45	Trace 1500	45	121	0.73	0.87
OH SB/Sanyo 180	Sanyo 180 HIT	Sunny Boy 1800 SBD	180	(1) 135	0.89	0.88
OH Tr/MST 50	BP MST 50	Trace 1500	50	126	0.79	0.86

The following Table on SunShare installations provides specific data on the systems installed to date.

SunShare Installations

DC KW	Installation Cost	Material Cost	Total Cost	In Service Date	Tested	Inverter Problem	Wiring Problems	Panel Probler
1.44	$2,100.00	$8,720.00	$10,820.00	11/4/02	Retested			X
1.50	$500.00	$4,000.00	$4,500.00	5/2/03	TEP			
1.50	$2,000.00	$4,000.00	$6,000.00	5/29/03	TEP			
3	$500.00	$8,000.00	$8,500.00	7/5/02	TEP			
3.3	$4,200.00	$15,382.00	$19,582.00	12/7/02	Tested			
1.5	$2,100.00	$4,000.00	$6,100.00	12/27/02	TEP			
7.50			$71000.00	9/25/03	Retested	X	X	
1.5	$1,100.00	$4,000.00	$5,100.00	10/15/02	TEP			X
1.5	$2,000.00	$4,000.00	$6,000.00	7/25/02	TEP			
1.44	$2,100.00	$8,720.00	$10,820.00	2/11/03	Retested	X		
1.2	$2,100.00	$8,100.00	$10,200.00	6/1/01	Retested	X		
3	$500.00	$8,000.00	$8,500.00	11/5/02	TEP			
1.50	$2,100.00	$4,000.00	$6,100.00	2/19/03	TEP			
2.4	$4,000.00	$13,000.00	$17,000.00	5/4/01	Tested			
1.5	$2,000.00	$4,000.00	$6,000.00	6/27/02	TEP			
1.44	$2,100.00	$8,720.00	$10,820.00	2/5/01	Retested			X
1.44	$10,000.00	$8,000.00	$18,000.00	11/4/03	Tested			
1.44	$2,100.00	$8,720.00	$10,820.00	11/4/02	Retested			X
1.44	$2,100.00	$8,720.00	$10,820.00	10/5/02	Retested	X		X
2.4	$5,000.00	$11,890.00	$16,890.00	3/20/01	Tested			
1.44	$4,500.00	$8,000.00	$12,500.00	8/18/03	Tested			
2.2	$6,000.00	$17,500.00	$23,500.00	12/31/02	Retested	X		
1.5	$500.00	$4,000.00	$4,500.00	12/28/02	TEP		X	
1.50	$2,000.00	$4,000.00	$6,000.00	6/11/03	TEP			
1.5	$2,000.00	$4,000.00	$6,000.00	11/7/02	TEP			
9.00		$24,000.00		10/20/03	TEP		X	X
1.68	$2,000.00	$8,000.00	$10,000.00	4/10/02	Retested	X		
6.00	$8,000.00	$16,000.00	$24,000.00	10/27/03	TEP	X	X	
1.5	$1,000.00	$4,000.00	$5,000.00	2/7/03	TEP			
1.44	$4,500.00	$8,000.00	$12,500.00	8/12/03	Tested			
1.5	$2,000.00	$4,000.00	$6,000.00	7/12/02	TEP	X		
4.8		$16,000.00	$16,000.00	5/30/01	Tested	X		
1.40	$750.00	$5,750.00	$6,500.00	10/1/03	Tested			
1.5	$2,500.00	$4,000.00	$6,500.00	7/1/02	TEP		X	X
1.44	$4,500.00	$8,000.00	$12,500.00	8/12/03	Retested	X		
1.44	$2,100.00	$8,720.00	$10,820.00	11/4/02	Retested	X		X
1.5	$500.00	$4,000.00	$4,500.00	8/5/02	TEP			
4.8	$1,250.00	$23,750.00	$25,000.00	6/15/00	Tested	X	X	
1.44	$4,500.00	$8,000.00	$12,500.00	10/17/03	Tested	X		
1.5	$2,000.00	$4,000.00	$6,000.00	8/30/02	TEP		X	

DC KW	Installation Cost	Material Cost	Total Cost	In Service Date	Tested	Inverter Problem	Wiring Problems	Panel Probler
1.44	$2,100.00	$9,720.00	$11,820.00	11/4/02	Retested			X
1.44	$2,100.00	$8,720.00	$10,820.00	11/8/02	Tested			
1.50	$1,000.00	$4,000.00	$5,000.00	6/3/03	TEP			
2.4	$4,500.00	$14,000.00	$18,500.00	10/3/02	Tested			
1.5	$0.00	$4,000.00	$4,000.00	9/16/02	TEP			
1.2	$2,200.00	$5,000.00	$7,200.00	10/12/01	Tested			
6.2	$2,500.00	$45,341.00	$47,841.00	12/1/99	Retested	X		
2.58	$6,000.00	$13,890.00	$19,890.00	9/17/03	Tested			
6.00	$1,000.00	$8,000.00	$9,000.00	8/18/03	TEP	X		X
1.5	$1,150.00	$4,000.00	$5,150.00	7/30/02	TEP			
1.376	$750.00	$5,750.00	$6,500.00	10/25/02	Retested	X		

RESULTS AND FORECASTS:

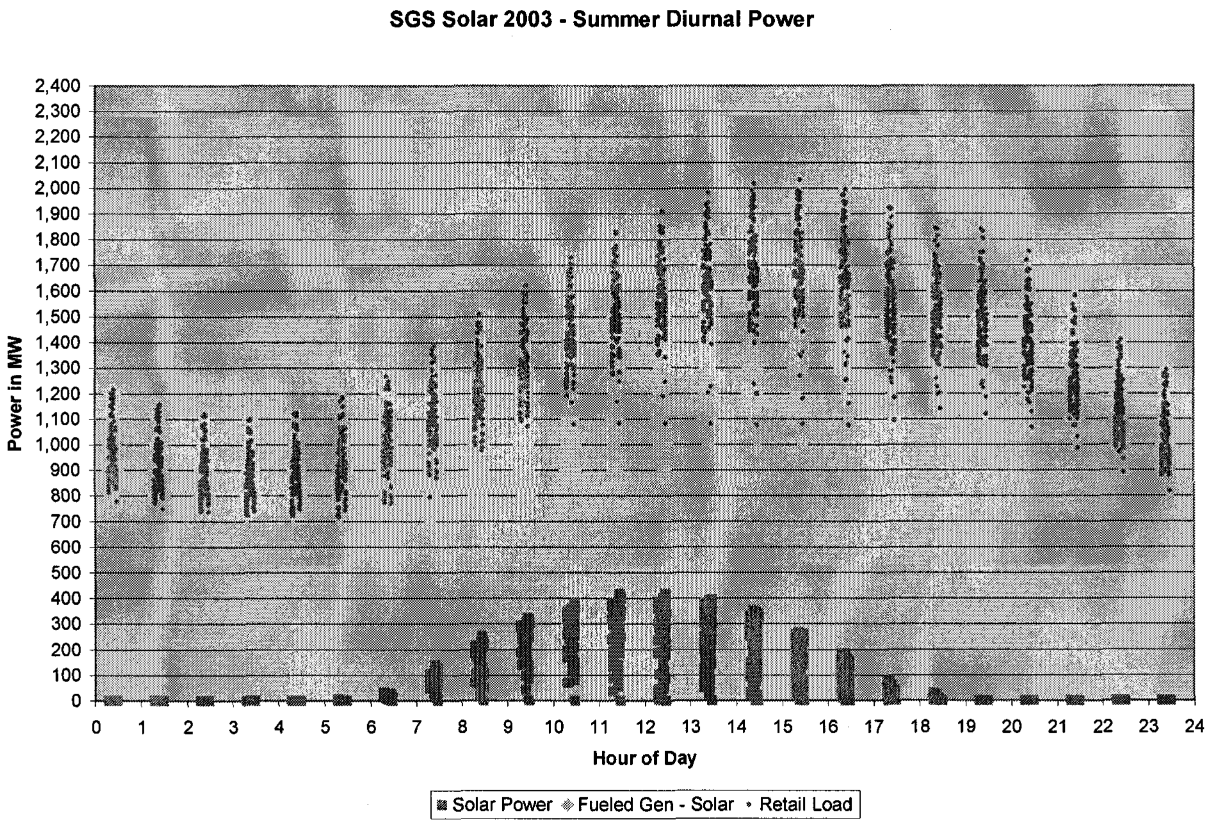
TEP has calculated the value of solar energy production by using an hourly wholesale spot market model based on real hourly on-peak and off-peak pricing at Palo Verde as multiplied by the actual hourly solar electricity production at both Springerville and Tucson locations. As expected, the closer coincidence of the Tucson loads with the solar input makes Tucson produced energy slightly more valuable than Springerville based solar energy on an annual $ per MWh basis. Again, due to coincidence between area electrical loads and solar influx, the average annual value for solar energy at both locations is higher than the Round the Clock average annual electricity value:

VALUE OF SOLAR ENERGY AT 2003 WHOLESALE SPOT MARKET RATES

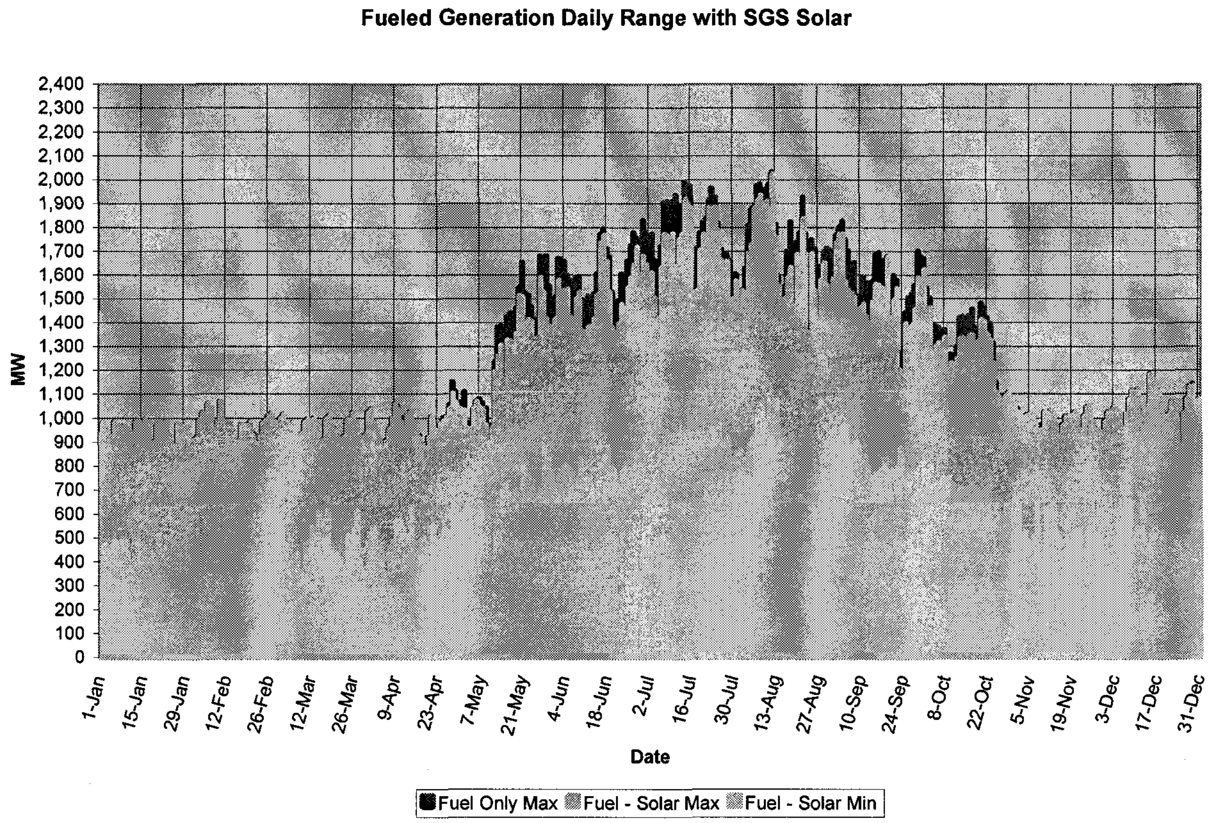
Around the Clock Market Value:	$41.97 per MWh
Solar Generation at SGSSS:	$47.69 per MWh
Solar Generation at Tucson Operating Headquarters:	$48.36 per MWh

TEP plans to continue the analysis of the effects of time variance of solar energy production on the effects of energy value and capacity value. The result of our capacity value review of the 2003 solar production is included in the next four pages.

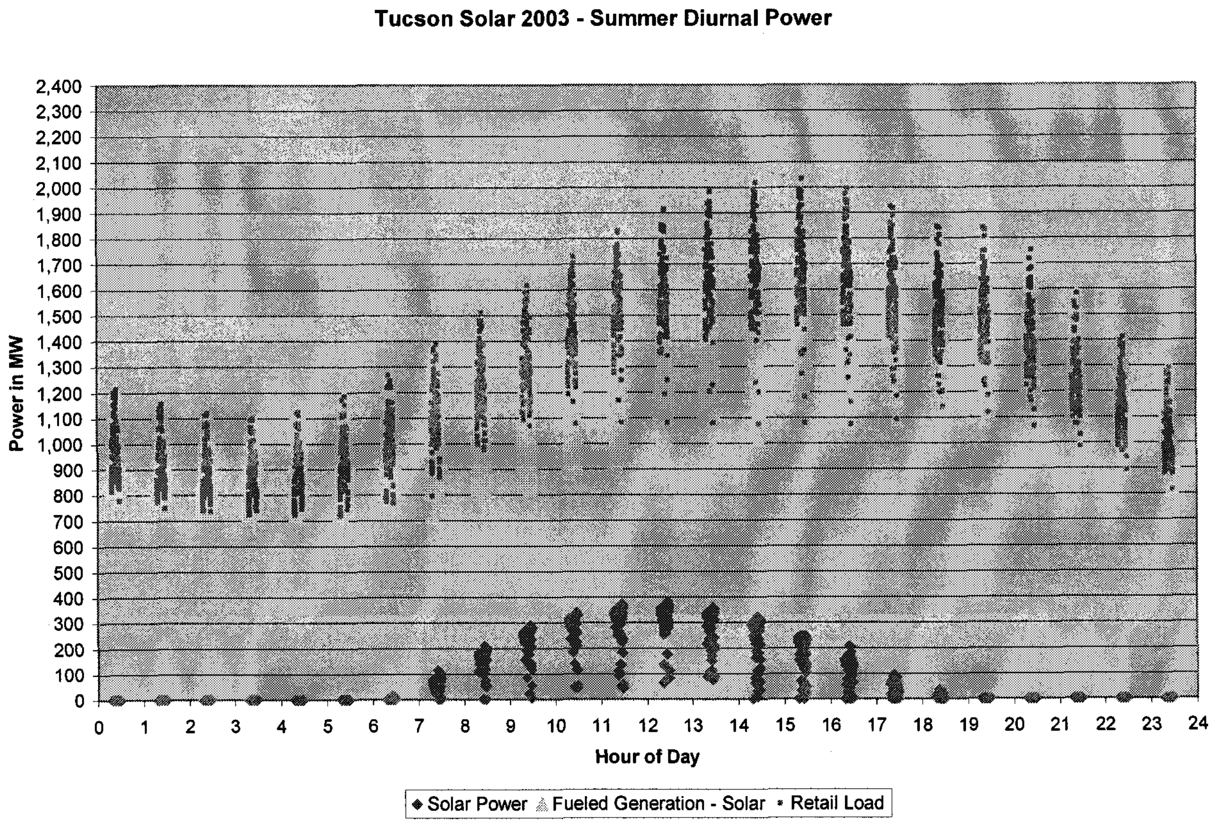
The graph below is the TEP 2003 hourly native retail load, overlaid by the hourly energy produced by 495 MW of hypothetical solar generation located at SGS and the effect on fueled generation demand reduction – 7 MW – from the application of 495 MW of solar capacity. The 495 MW of solar capacity was chosen as the level needed to produce 9.60% of the TEP annual retail energy sold from new renewable generation sources in 2003, which is about the proposed national renewable portfolio standard of 10%. The reduction of the need for fueled generation is shown by the displacement between the red points and the yellow points. Where they are coincident, there is no displacement of fueled generation from solar energy. More detail about this scenario is provided in the Executive Summary section of this report.



The graph below is the TEP 2003 hourly daily maximum and minimum native load generation demand as if provided by: 1) maximum daily demand met by fueled generation only, in red; 2) maximum daily demand met by fueled generation as reduced by 495 MW of SGS located solar generation, in pink; and 3) minimum daily demand met by fueled generation as reduced by 495 MW of SGS located solar generation, in blue. Displacement of peak fueled capacity needs by solar energy is indicated where the red shows through the pink areas. Displacement of fueled generation by solar energy at minimum loads is indicated where the pink show through the blue areas. More detail about this scenario is provided in the Executive Summary section of this report.



The graph below is TEP 2003 hourly native retail load, overlaid by the hourly energy produced by 495 MW of hypothetical solar generation located at TEP Operating Headquarters (OH) in Tucson and the effect on fueled generation demand reduction – 167 MW – from the application of 495 MW of solar capacity. The 495 MW of solar capacity was chosen as the level needed to produce 9.42% of the TEP annual retail energy sold from new renewable generation sources in 2003, which is about the proposed national renewable portfolio standard of 10%. The reduction of the need for fueled generation is shown by the displacement between the red points and the yellow points. Where they are coincident, there is no displacement of fueled generation from solar energy. More detail about this scenario is provided in the Executive Summary section of this report.



The graph below is TEP 2003 hourly daily maximum and minimum native load generation demand as if provided: 1) maximum daily demand met by fueled generation only, in red; 2) maximum daily demand met by fueled generation as reduced by 495 MW of TEP OH in Tucson located solar generation, in pink; and 3) minimum daily demand met by fueled generation as reduced by 495 MW of OH - Tucson located solar generation, in blue. Displacement of peak fueled capacity needs is indicated where the red shows through the pink areas. Displacement of fueled generation at minimum loads is indicated where the pink show through the blue areas. More detail about this scenario is provided in the Executive Summary section of this report.