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 2004 the percentage is 0. 8% of which at least 60% 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 EPS Rules (A.A.C. R14-2-1618). The four issues identified by the Commissioners were:

1. A discussion of increasing EPS funding levels.
2. Elimination of the EPS expiration date.
3. Restoration of DSM funding.
4. Allocation of funding among various technologies.

Staff commenced the workshop series on March 5, 2004. The last and fifth Workshop was June 25, 2004.

Renewable Generating Capacity

This report covers TEP's progress for January 1, 2004 through June 30, 2004, and includes cumulative reporting from January 1, 1997. As of June 30, 2004, TEP had installed or supported installation of a total of 10,365 kW of renewable generating capacity, which has generated 193,154,830 kWh of renewable energy and generated 313,314,718 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 $29,548,961 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 $17,220,253 for these programs. Thus, TEP has spent $12,328,708 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 carried a surplus of 138,225,031kWh 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 carried 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 photovoltaic ("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 and Net Metering

TEP offers the SunShare hardware buy-down program, with ACC approval, to its customers. Since the program was offered in 2001, 40 customers have purchased our Option 2 package, which is a solar kit offered by TEP at a pass through cost. This accounted for 53 kits delivered for installation. Fifty-seven customers qualified for, and joined, the SunShare Option 1 or Option 3 program through June 30, 2004, with a total installed DC capacity of 122 kWp. The net program total is 97 SunShare participants through June 30, 2004. There is currently 262 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 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 June 30, 2004, thirty-nine 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 2003 Mid-Year DSM Report. Eight customers with net metering are not SunShare customers.

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 June 2004, TEP has commitments from 1,866 residential customers, amounting to adoption of 4,135 blocks and 41 commercial customers who have adopted 658 total blocks of green energy.

Total revenues produced to date are $39,741 from commercial customers and $155,789 from residential customers for total revenue of $194,789. 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, 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 for the Solar Electric Power Association, at the national Utility Photovoltaic Experience ("UPEx") conference in October 2003 in Scottsdale, where TEP Vice President and Technical Advisor Thomas Hansen presented papers. TEP also was 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 Mr. 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 32 kilowatts to eight 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"]) 4 kW for a shaded overhang; Civano Community School (Vail Unified School District) -- 1 kW on roof; Mountain View High School (Marana Unified School District) -- 5 kW, Hohokum Middle School (TUSD) - 4kW, Project MORE (TUSD) – possible 10kW, Botanical Gardens – 2kW, Tucson Audubon Society – 2kW, 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 eight, 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 Solar System ("SGSSS"), 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 the Springerville Generating Station ("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 2005. During the first half of 2004, 540 kWp DC has been installed and commissioned at SGS, 10.5kWp DC installed at Operating Headquarters and 64.3kWp DC of SunShare systems installed. TEP is well on its way to meeting and exceeding these goals.

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	178,733,183	278,823,766
Solar PV	4,865	14,421,647	34,493,104
Solar Trough	0	0	0
Small Hydro-Electric	0	0	0
Wind Generation	0	0	0
Total Renewable	10,365	193,154,830	313,316,870
Total Other Renewable	5,500	178,733,183	278,823,766
Total Solar Electric	4,865	14,421,647	34,493,104

SUMMARY OF EPS REQUIREMENTS

Description	Reporting Period 12/31/03 - 6/30/04	Y-T-D 6/30/04	Cumulative 6/30/04
Retail Sales for 2004, kWh	3,968,261,000	3,968,261,000	3,968,261,000
Retail Sales for 2003, kWh			8,229,552,740
Retail Sales for 2002, kWh			8,012,417,966
Retail Sales for 10 months of 2001, kWh			6,884,068,333
Cumulative Retail Sales for EPS Program, kWh			27,094,300,039
TEP EPS Requirement For 2004 (0.8% of Retail Sales), kWh	31,746,088	31,746,088	31,746,088
			49,377,316
TEP EPS Requirements through 12/31/200 kWh			45,817,809
			126,941,213
TEP EPS Requirements through 12/31/200 kWh			
Landfill Gas Project "Other" Credits Applied to EPS % goals	12,698,435	12,698,435	60,295,997
"Solar Electric" Resource Credits Applied EPS % goals	8,897,150	8,897,150	34,493,104
Wind Credits Purchased	1,922	1,922	13,073
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	-(9,888,538)	-(9,888,538)	-31,450,687
Excess "Other" Credits Above Meeting EPS Requirements, kWh	2,953,173	2,953,173	149,090,412

SUMMARY OF PROGRAM EXPENDITURES

Program	Program Costs		
	Period	Y-T-D	Life of Program
Solar Electric	$3,261,471	$3,261,471	$29,311,442
Solar Thermal	$0	$0	$0
Geothermal	$0	$0	$0
Landfill Gas	$0	$0	$85,000
Wind	$3,200	$3,200	$152,519
Hydro	$0	$0	$0
Other Technologies	$0	$0	$0
Marketing **	$23,576	$23,576	$145,117
Hardware Buydown Program - Option 1 **	$58,330	$58,330	$145,430
Solar Buyback Program - Option 2 **	$44,000	$44,000	$118,000
Total TEP Renewables Program	$2,773,311	$2,773,311	$29,548,961

****** Cost included in solar electric costs

SUMMARY OF PROGRAM REVENUES

Description	Period	Y-T-D	Y-T-D Retail Energy Sales MWh	Life of Project
GreenWatts Total	$37,161	$37,161	-	$194,789
Allocation of SBC Total	$1,105,000	$1,105,000	-	$8,845,000
Residential Surcharge Total	$623,176.74	$623,176.74	1,537,270	$4,052,940
Small Commercial Surcharge Total	$587,495.67	$587,495.67	987,460	$4,027,619
Large Commercial Surcharge Total	$11,453.76	$11,453.76	1,483,311	$100,226
Renewables Surcharge Total*	$1,222,126	$1,222,126	3,692,897	$8,180,464

***** Renewables Surcharge Total includes the Residential, Small Commercial and Large Commercial Surcharge Totals.

INSTALLATION PROGRESS

Project	Install Date	kWp DC Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
Residential						
3131 S. Naco Vista	Apr-99	0.75	5,508	$6,944	$6,494	$0.2504
Small Commercial						
Reid Park Zoo ASE/TR 840w Xtal	Mar-00	0.84	3,713	$7,400	$6,469	N/A
Pima Air Museum ASE/TR 1200w Xtal	Jun-00	0.9	5,095	$7,099	$0	$0.1267
UofA Agriculture Station	Jan-02	5.62	24,135	$0	$0	$0.0000
Hayden/Udall # 1 ASE/TR 21.6 KW Xtal ***	2002	21.6	66,847	$142,975	$341	$0.1299
Hayden/Udall # 2 ASE/TR 21.6 KW Xtal ***	2002	21.6	64,276	$142,050	$191	$0.1274
Military						
Ft Huachucha Solar ASE/OMN 30 KW Xtal	1997	30	182,807	$180,000	$2,300	$0.1225
Utility (TEP)						
SGS-125C-1 ASE/XN 135 KW Xtal	Jul-01	135	627,668	$1,125,637	$3,389	$0.1601
SGS-125C-2 ASE/XN 135 KW Xtal	Jul-01	135	660,153	$848,927	$3,389	$0.1180
SGS-125C-3 ASE/XN 135 KW Xtal	Aug-01	135	616,630	$779,470	$3,632	$0.1094
SGS-125C-4 ASE/XN 135 KW Xtal	Aug-01	135	607,409	$885,503	$3,389	$0.1246
SGS-125C-5 ASE/XN 135 KW Xtal	Nov-01	135	581,001	$891,576	$3,389	$0.1264
SGS-125C-6 ASE/XN 135 KW Xtal	Nov-01	135	588,902	$830,314	$3,389	$0.1150
SGS-125C-7 ASE/XN 135 KW Xtal	Oct-02	135	435,916	$896,984	$3,001	$0.1245

Project	Install Date	kWp DC Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
SGS-125C-8 ASE/XN 135 KW Xtal	Oct-02	135	445,722	$896,332	$3,001	$0.1238
SGS-125C-9 ASE/XN 135 KW Xtal	Oct-02	135	442,085	$900,199	$4,032	$0.1262
SGS-125C-10 ASE/XN 135 KW Xtal	Oct-02	135	432,903	$910,976	$4,032	$0.1239
SGS-125C-11 ASE/XN 135 KW Xtal	Jun-02	135	486,294	$899,885	$4,032	$0.1242
SGS-125C-12 ASE/XN 135 KW Xtal	Jun-02	135	436,028	$901,081	$4,032	$0.1280
SGS-125C-13 ASE/XN 135 KW Xtal	Jun-03	135	238,701	$866,453	$2,434	$0.1197
SGS-125C-14 ASE/XN 135 KW Xtal	Jun-03	135	236,770	$866,190	$2,434	$0.1206
SGS-125C-15 ASE/XN 135 KW Xtal	Aug-03	135	221,861	$867,159	$2,434	$0.1209
SGS-125C-16 ASE/XN 135 KW Xtal	Aug-03	135	224,944	$860,732	$2,434	$0.1184
SGS-125C-25 ASE/XN 135 KW Xtal	Jun-04	135	570	$825,208	$158	N/A
SGS-125C-26 ASE/XN 135 KW Xtal	Jun-04	135	12,761	$789,255	$158	N/A
SGS-125C-27 ASE/XN 135 KW Xtal	Jun-04	135	12,893	$710,986	$158	N/A
SGS-125C-28 ASE/XN 135 KW Xtal	Jun-04	135	13,225	$781,116	$158	N/A
SGS-125C-29 ASE/XN 135 KW Xtal	Nov-03	135	162,489	$849,606	$158	$0.1186
SGS-125C-30 ASE/XN 135 KW Xtal	Nov-03	135	159,355	$724,018	$158	$0.0994
SGS-125C-31 ASE/XN 135 KW Xtal	Aug-03	135	211,699	$856,574	$2,434	$0.1187
SGS-125C-32 ASE/XN 135 KW Xtal	Aug-03	135	205,554	$856,552	$2,434	$0.1191
SGS-125TF-1 FS/XN 134.4 KW Cd-Tl	Sep-01	129	606,460	$737,815	$16,262	$0.1047
SGS-125TF-2 FS/XN 134.4 KW Cd-Tl	Sep-01	129	530,011	$620,396	$15,016	$0.0881
SGS-125TF-3 FS/XN 134.4 KW Cd-Tl	Jun-03	129	253,094	$759,114	$929	$0.1098
SGS-125TF-4 FS/XN 134.4 KW Cd-Tl	Jun-03	129	254,060	$759,122	$929	$0.1036
SGS-125TF-5 BP/XN 129 KW a-si	Oct-01	129	570,736	$760,802	$1,678	$0.1285
SGS-125TF-6 BP/XN 129 KW a-si	Oct-01	129	605,960	$760,717	$1,678	$0.1206
SGS-125TF-7 BP/XN 129 KW a-si	Oct-01	129	575,872	$736,514	$1,678	$0.1193
SGS-125TF-8 BP/XN 129 KW a-si	Oct-01	129	576,277	$741,162	$1,678	$0.1196

Project	Install Date	kWp DC Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
OH ASE/SB - 1200w Xtal	Jul-01	1.2	3,855	$8,563	$0	$0.1531
OH ASE/TR - 1200w Xtal	Aug-01	1.2	5,330	$8,369	$0	$0.1105
OH BPMST-50/TR - 1500w a-si	Sep-01	1.5	5,119	$6,666	$840	$0.1208
Solar Trailers BP Solar/TR 5000w Xtal	Jun-05	5	29,297	$70,000	$490	$0.4644
OH Gate 2A Solarex/TR - 2500w Xtal	Mar-00	2.5	17,293	$10,250	$358	$0.0888
OH3 20KW ASE/TR 21.6 KW Xtal	Sep-00	20	129,685	$146,342	$652	$0.1346
OH4 20KW ASE/TR 21.6 KW Xtal	Oct-00	20	134,507	$110,534	$126	$0.0991
OH 5KW BP/MST50/Beacon a-si	Feb-04	7.5	3,404	$29,574		
St Johns Test	Sep-00	2.5	3,512	$11,517	$0	No kWh Data
SGS 20 KW ASE/TR 21.6 KW Xtal	Oct-00	25	122,633	$135,060	$526	$0.1926
DMP 1 ASE/OMN 108 KW Xtal	Dec-00	108	603,305	$589,020	$1,202	$0.1100
DMP 2 ASE/OMN 108 KW Xtal	Dec-00	108	593,270	$527,199	$820	$0.1006
Test Trees	Jun-01	5	8,214	$1,500	$0	N/A
OH Global Solar Test/TR - 1440w CIGS	2002	1.4	3,070	$13,447	$431	$0.2412
Tohono Chul BPSX140U/SB - 2800w Xtal	Dec-02	2.8	7,469	$23,286	$0	$0.1597
Sun Share Reported 1999 **	1999	6.2	40,811	$50,000	$0	$0.2020
Sun Share Reported 2000 **	2000	4.8	9,298	$25,000	$0	$0.1690
Sun Share Reported 2001 **	2001	13.64	37,719	$79,110	$0	$0.2638
Sun Share Reported 2002 **	2002	44.1	114,141	$266,532	$0	$0.1090
Sun Share Reported 2003 **	2003	48	79,302	$295,820	$25,057	$0.1169
Sun Share Reported 2004 **	2004	64.3	57,330	$410,449	$0	$0.1193
OH BP SX140U/TR-1400w Xtal	2002	1.4	3,333	$8,237	$0	$0.1223
OH Sharp 165/SB – 1320w Xtal	Mar-03	1.32	1,809	$7,476	$0	$0.1511
OH Sharp 165/TR – 1320w Xtal	Mar-03	1.32	2,436	$8,223	$358	$0.1357
OH Kyocera 158/TR - 1422w Xtal	Apr-03	1.422	2,476	$8,236	$0	$0.1287
OH Sanyo 167HIT/SB - 1336w Xtal/a-si	May-03	1.336	2,505	$8,962	$0	$0.1362
OH Unisolar 64/Trace - 1536w Xtal/a-si	Jun-03	1.536	2,848	$10,228	$0	$0.1295
OH BP SX150U/TR-1500w Xtal	May-03	1.5	2,305	$8,714	$0	$0.1254
OH Sanyo 180HIT/SB -	Jul-03	1.44	2,445	$8,955	$0	$0.1169

Project	Install Date	kWp DC Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
1440w Xtal/a-si						
OH Shell 40/Tr-1440w a-si	Sep-03	1.44	2,024	$9,244	$0	$0.1250
OH Shell 150/Sharp-3000w Xtal	Sep-03	3	3,231	$16,991	$0	$0.1445
OH Shell 150/TR - 1500w Xtal	Feb-04	1.5	849	$8,414	$0	$0.1652
OH AstroPower/TR - 1500w Xtal	May-04	1.485	440	$8,532	$0	$0.3232
TOTALS		4,864.625	14,421,647	29,913,295	144,755	$0.1314

* Portion installed after January 1, 1997.

** Includes customer expenses for these systems.

*** Estimated after grant removal.

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 2004.

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. It is no longer clear 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 PVs. 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 Arizona Public Service ("APS"). 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 SGS indicates that while the cool, windy site is ideal for solar generation from PVs, 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 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 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 Sundt 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 June 30, 2004) the project has displaced the use or production of the following:

Tons of Coal Not Burned	80,883
Tons of CO2 Not Produced	118,629
Tons of SO2 Not Produced	712

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, 2003 or 2004. 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.

2004 LANDFILL GAS GENERATION SUMMARY

	January	February	March	April	May	June	Year to Date
Landfill Gas Burned-Mscf from Operating Summary	59	46	57	52	50	57	321
Landfill Gas Ave Btu/scf From Operating Summary	489	495	494	488	478	469	243
Landfill Gas Heat Input-MMBtu Calculated From Op Summary	28,266	23,211	28,158	25,376	23,900	26,733	155,644
Unit 4 Net Heat Rate From Operating Summary	10,149	10,169	10,038	10,378	10,920	10,155	5,151
MMBtu of Landfill Gas From Invoice	28,873	22,792	28,152	25,394	23,914	26,745	155,870.00
Landfill Gas Generation in kWhCalculated From Data Above	2,844,911	2,241,322	2,804,543	2,446,907	2,189,927	2,633,678	15,161,287

	January	February	March	April	May	June	Year to Date
Monthly U4 Service Hours From Operating Summary	744.00	606.87	735.77	702.27	640.85	720.00	4,150
Average Landfill Generation Capacity in kW - Calculated	3,824	3,693	3,812	3,484	3,417	3,658	3,654
Cumulative 2004 Landfill Gas Generation in kWh - Calculated	2,844,911	5,086,232	7,890,775	10,337,682	12,527,609	15,161,287	15,161,287
Unit #4 Coal Heat Value HHV in Btu/lb - Operating Summary	11,566	11,587	11,495	10,600	11,355	10,179	5,565
Coal Displaced by Landfill Gas, in Tons, Calculated	1,248.2	983.5	1,224.5	1,197.8	1,053.0	1,313.7	585
2004 Cumulative Coal Displaced By Landfill Gas in Tons	1,248.2	2,231.7	3,456.2	4,654.1	5,707.1	7,020.8	24,318
CO2 Emissions Deferred by Burning Coal in Tons - 40% Fixed	1,831	1,442	1,796	1,757	1,544	1,927	858
2004 Cumulative CO2 Emissions Deferred by Burning Coal - Tons	1,831	3,273	5,069	6,826	8,370	10,297	0
SO2 Emissions Deferred by Burning Coal in Tons - 0.44% Sulfur	11	9	11	11	9	12	5
2004 Cumulative SO2 Emissions Deferred by Burning Coal - Tons	11	20	30	41	50	62	0
Hours Available	744	696	744	720	744	720	4,368
On Line Availability Hours	744	606.87	735.77	702.27	640.85	720	4,150
Percentage on Line	100.00%	87.19%	98.89%	97.54%	86.14%	100.00%	95.00%

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 or 2005 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, 2003 and 2004 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 June 2004, TEP was receiving data from eight, 40 meter survey towers and wind data at an additional five fixed and two mobile monitor installations. Sites for an additional six 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 Salt River Project ("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. However, preliminary monitoring activities begun recently in one of the areas predicted by the model to be a Class 5 wind regime have indicated the wind resource to be considerably less in power production than predicted. 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. The first step in this review is to gather additional information from the installation of a planned grid of wind monitor towers. Development of additional transmission resources to move the wind energy to the population centers is a high priority once the wind resources are accurately determined.

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 evaluating the results of the existing wind survey towers before continuing negotiations for use of up to an additional 12 wind survey sites in Arizona for installation of monitor towers in the first half of 2005. We are still waiting for permits to be issued as these sites are on state land. To date, TEP has spent $130,337 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. TEP now installs two anemometers at the 40 meter level to allow for failure of 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. There is some good work being performed in this area at the national laboratory level. These should result in commercial wind turbines appropriate for use in Arizona in the 2007 to 2010 timeframe.

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 with needed transmission 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, and at the end of June 2004 had received general proposals from two parties.

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. The relatively disappointing wind speed data from the first three months of the wind survey west of Springerville have caused a reconsideration of planning for future commercial wind development by TEP.

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, 2003, or to date in 2004. 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. A promising opportunity exists near Clifton near the site of a known hot spring.

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 from Clifton and Flagstaff 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 4,507 kW DC were completed by the end of June 2004 in Tucson and at Springerville. These systems use PV array building blocks of 21.6 kW DC to 135 kW DC in size, and represented 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. In addition, four events were recorded in 2004 where a grid disturbance in one area triggered a trip of an inverter in a remote area. For example, the loss of all three Palo Verde generators on June 14, 2004 resulted in nearly all Tucson based PV inverters, and one Springerville inverter tripping off line for the required five minutes before automatically reconnecting. Further review will be given to this effect in the future.

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 include 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 have been successful in providing energy in support of EPS solar credit goals and in developing public interest in solar energy. To date 593 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, Civano Community 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, 40 customers have purchased our Option 2 package, which is a solar kit offered by TEP at a pass through cost. This accounted for 53 kits delivered for installation. Fifty-seven customers qualified for, and joined, the SunShare Option 1 or Option 3 program through June 30, 2004 with a total installed DC capacity of 122 kWp. The net program total is 97 SunShare participants through June 30, 2004. There is currently 202 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 minimum clearance behind the modules 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 1,200 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.

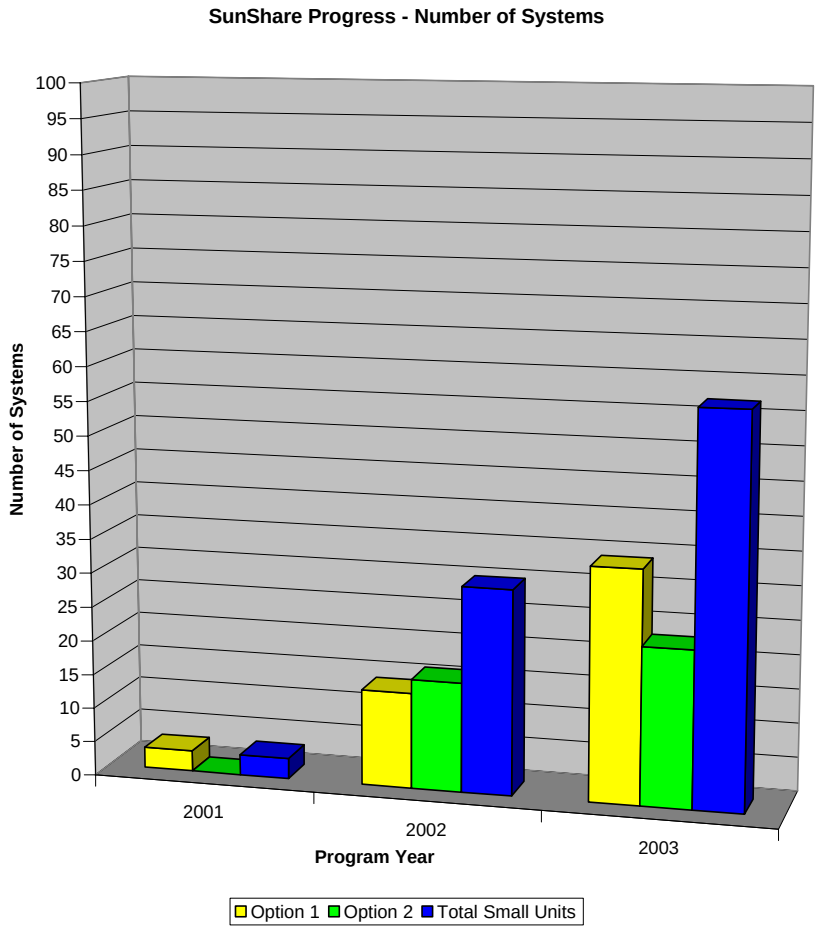
7. The Option 1 rating can now be determined either by test or by comparison to historical data of another "equal" system.

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

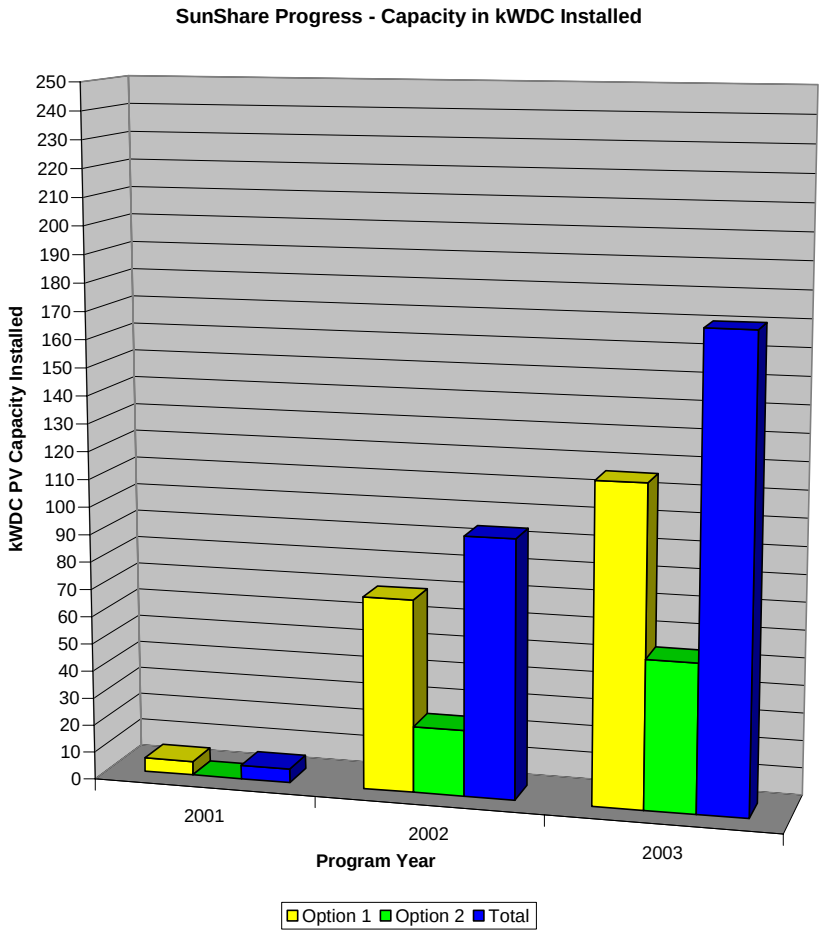
TEP provides extensive outreach and education about the benefits of solar energy, as described in the Executive Summary of this report, for promotion of the SunShare program. The SunShare Program has shown steady participation gains in its three years of existence. The first three years of the SunShare program has been more successful than the first three years of the California Emerging Technologies program on a per capita basis.

The graphs on the following pages 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 June 30, 2004, thirty-nine 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 4,865 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 Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
Residential						
3131 S. Naco Vista	Apr-99	0.75	5,508	$6,944	$6,494	$0.2504
Small Commercial						
Reid Park Zoo ASE/TR 840w Xtal	Mar-00	0.84	3,713	$7,400	$6,469	N/A
Pima Air Museum ASE/TR 1200w Xtal	Jun-00	0.9	5,095	$7,099	$0	$0.1267
UofA Agriculture Station	Jan-02	5.62	24,135		$0	$0.0000
Hayden/Udall # 1 ASE/TR 21.6 KW Xtal ***	2002	21.6	66,847	$142,975	$341	$0.1299
Hayden/Udall # 2 ASE/TR 21.6 KW Xtal ***	2002	21.6	64,276	$142,050	$191	$0.1274
Military						
Ft Huachucha Solar ASE/OMN 30 KW Xtal	1997	30	182,807	$180,000	$2,300	$0.1225
Utility (TEP)						
SGS-125C-1 ASE/XN 135 KW Xtal	Jul-01	135	627,668	$1,125,637	$3,389	$0.1601
SGS-125C-2 ASE/XN 135 KW Xtal	Jul-01	135	660,153	$848,927	$3,389	$0.1180
SGS-125C-3 ASE/XN 135 KW Xtal	Aug-01	135	616,630	$779,470	$3,632	$0.1094
SGS-125C-4 ASE/XN 135 KW Xtal	Aug-01	135	607,409	$885,503	$3,389	$0.1246
SGS-125C-5 ASE/XN 135 KW Xtal	Nov-01	135	581,001	$891,576	$3,389	$0.1264
SGS-125C-6 ASE/XN 135 KW Xtal	Nov-01	135	588,902	$830,314	$3,389	$0.1150
SGS-125C-7 ASE/XN 135 KW Xtal	Oct-02	135	435,916	$896,984	$3,001	$0.1245
SGS-125C-8 ASE/XN 135 KW Xtal	Oct-02	135	445,722	$896,332	$3,001	$0.1238
SGS-125C-9 ASE/XN 135 KW Xtal	Oct-02	135	442,085	$900,199	$4,032	$0.1262
SGS-125C-10 ASE/XN 135 KW Xtal	Oct-02	135	432,903	$910,976	$4,032	$0.1239
SGS-125C-11 ASE/XN 135 KW Xtal	Jun-02	135	486,294	$899,885	$4,032	$0.1242

Project	Install Date	kWp DC Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
SGS-125C-12 ASE/XN 135 KW Xtal	Jun-02	135	436,028	$901,081	$4,032	$0.1280
SGS-125C-13 ASE/XN 135 KW Xtal	Jun-03	135	238,701	$866,453	$2,434	$0.1197
SGS-125C-14 ASE/XN 135 KW Xtal	Jun-03	135	236,770	$866,190	$2,434	$0.1206
SGS-125C-15 ASE/XN 135 KW Xtal	Aug-03	135	221,861	$867,159	$2,434	$0.1209
SGS-125C-16 ASE/XN 135 KW Xtal	Aug-03	135	224,944	$860,732	$2,434	$0.1184
SGS-125C-25 ASE/XN 135 KW Xtal	Jun-04	135	570	$825,208	$158	N/A
SGS-125C-26 ASE/XN 135 KW Xtal	Jun-04	135	12,761	$789,255	$158	N/A
SGS-125C-27 ASE/XN 135 KW Xtal	Jun-04	135	12,893	$710,986	$158	N/A
SGS-125C-28 ASE/XN 135 KW Xtal	Jun-04	135	13,225	$781,116	$158	N/A
SGS-125C-29 ASE/XN 135 KW Xtal	Nov-03	135	162,489	$849,606	$158	$0.1186
SGS-125C-30 ASE/XN 135 KW Xtal	Nov-03	135	159,355	$724,018	$158	$0.0994
SGS-125C-31 ASE/XN 135 KW Xtal	Aug-03	135	211,699	$856,574	$2,434	$0.1187
SGS-125C-32 ASE/XN 135 KW Xtal	Aug-03	135	205,554	$856,552	$2,434	$0.1191
SGS-125TF-1 FS/XN 134.4 KW Cd-Tl	Sep-01	129	606,460	$737,815	$16,262	$0.1047
SGS-125TF-2 FS/XN 134.4 KW Cd-Tl	Sep-01	129	530,011	$620,396	$15,016	$0.0881
SGS-125TF-3 FS/XN 134.4 KW Cd-Tl	Jun-03	129	253,094	$759,114	$929	$0.1098
SGS-125TF-4 FS/XN 134.4 KW Cd-Tl	Jun-03	129	254,060	$759,122	$929	$0.1036
SGS-125TF-5 BP/XN 129 KW a-si	Oct-01	129	570,736	$760,802	$1,678	$0.1285
SGS-125TF-6 BP/XN 129 KW a-si	Oct-01	129	605,960	$760,717	$1,678	$0.1206
SGS-125TF-7 BP/XN 129 KW a-si	Oct-01	129	575,872	$736,514	$1,678	$0.1193
SGS-125TF-8 BP/XN 129 KW a-si	Oct-01	129	576,277	$741,162	$1,678	$0.1196
OH ASE/SB - 1200w Xtal	Jul-01	1.2	3,855	$8,563	$0	$0.1531
OH ASE/TR - 1200w Xtal	Aug-01	1.2	5,330	$8,369	$0	$0.1105
OH BPMST-50/TR - 1500w a-si	Sep-01	1.5	5,119	$6,666	$840	$0.1208
Solar Trailers BP Solar/TR 5000w Xtal	Jun-05	5	29,297	$70,000	$490	$0.4644
OH Gate 2A Solarex/TR - 2500w Xtal	Mar-00	2.5	17,293	$10,250	$358	$0.0888
OH3 20KW ASE/TR 21.6 KW	Sep-00	20	129,685	$146,342	$652	$0.1346

Project	Install Date	kWp DC Capacity	kWh, AC Output - Thru 6/4/04	Initial Costs	Total Operating Cost 6/30/04	$/kWh for Project
OH4 20KW ASE/TR 21.6 KW Xtal	Oct-00	20	134,507	$110,534	$126	$0.0991
OH 5KW BP/MST50/Beacon a-si	Feb-04	7.5	3,404	$29,574		
St Johns Test	Sep-00	2.5	3,512	$11,517	$0	No kWh Data
SGS 20 KW ASE/TR 21.6 KW Xtal	Oct-00	25	122,633	$135,060	$526	$0.1926
DMP 1 ASE/OMN 108 KW Xtal	Dec-00	108	603,305	$589,020	$1,202	$0.1100
DMP 2 ASE/OMN 108 KW Xtal	Dec-00	108	593,270	$527,199	$820	$0.1006
Test Trees	Jun-01	5	8,214	$1,500	$0	N/A
OH Global Solar Test/TR - 1440w CIGS	2002	1.4	3,070	$13,447	$431	$0.2412
Tohono Chul BPSX140U/SB - 2800w Xtal	Dec-02	2.8	7,469	$23,286	$0	$0.1597
Sun Share Reported 1999 **	1999	6.2	40,811	$50,000	$0	$0.2020
Sun Share Reported 2000 **	2000	4.8	9,298	$25,000	$0	$0.1690
Sun Share Reported 2001 **	2001	13.64	37,719	$79,110	$0	$0.2638
Sun Share Reported 2002 **	2002	44.1	114,141	$266,532	$0	$0.1090
Sun Share Reported 2003 **	2003	48	79,302	$295,820	$25,057	$0.1169
Sun Share Reported 2004 **	2004	64.3	57,330	$410,449	$0	$0.1193
OH BP SX140U/TR-1400w Xtal	2002	1.4	3,333	$8,237	$0	$0.1223
OH Sharp 165/SB – 1320w Xtal	Mar-03	1.32	1,809	$7,476	$0	$0.1511
OH Sharp 165/TR – 1320w Xtal	Mar-03	1.32	2,436	$8,223	$358	$0.1357
OH Kyocera 158/TR - 1422w Xtal	Apr-03	1.422	2,476	$8,236	$0	$0.1287
OH Sanyo 167HIT/SB - 1336w Xtal/a-si	May-03	1.336	2,505	$8,962	$0	$0.1362
OH Unisolar 64/Trace - 1536w Xtal/a-si	Jun-03	1.536	2,848	$10,228	$0	$0.1295
OH BP SX150U/TR-1500w Xtal	May-03	1.5	2,305	$8,714	$0	$0.1254
OH Sanyo 180HIT/SB - 1440w Xtal/a-si	Jul-03	1.44	2,445	$8,955	$0	$0.1169
OH Shell 40/Tr-1440w a-si	Sep-03	1.44	2,024	$9,244	$0	$0.1250
OH Shell 150/Sharp-3000w Xtal	Sep-03	3	3,231	$16,991	$0	$0.1445
OH Shell 150/TR – 1500w Xtal	Feb-04	1.5	849	$8,414	$0	$0.1652
OH AstroPower/TR - 1500w Xtal	May-04	1.485	440	$8,532	$0	$0.3232
TOTALS		4,864.625	14,421,647	29,913,295	144,755	$0.1314

* Portion installed after January 1, 1997.

** Includes customer expenses for these systems.

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. However, the high demand for PV in Germany during 2004 has resulted in price increases and long delivery times for PV modules.

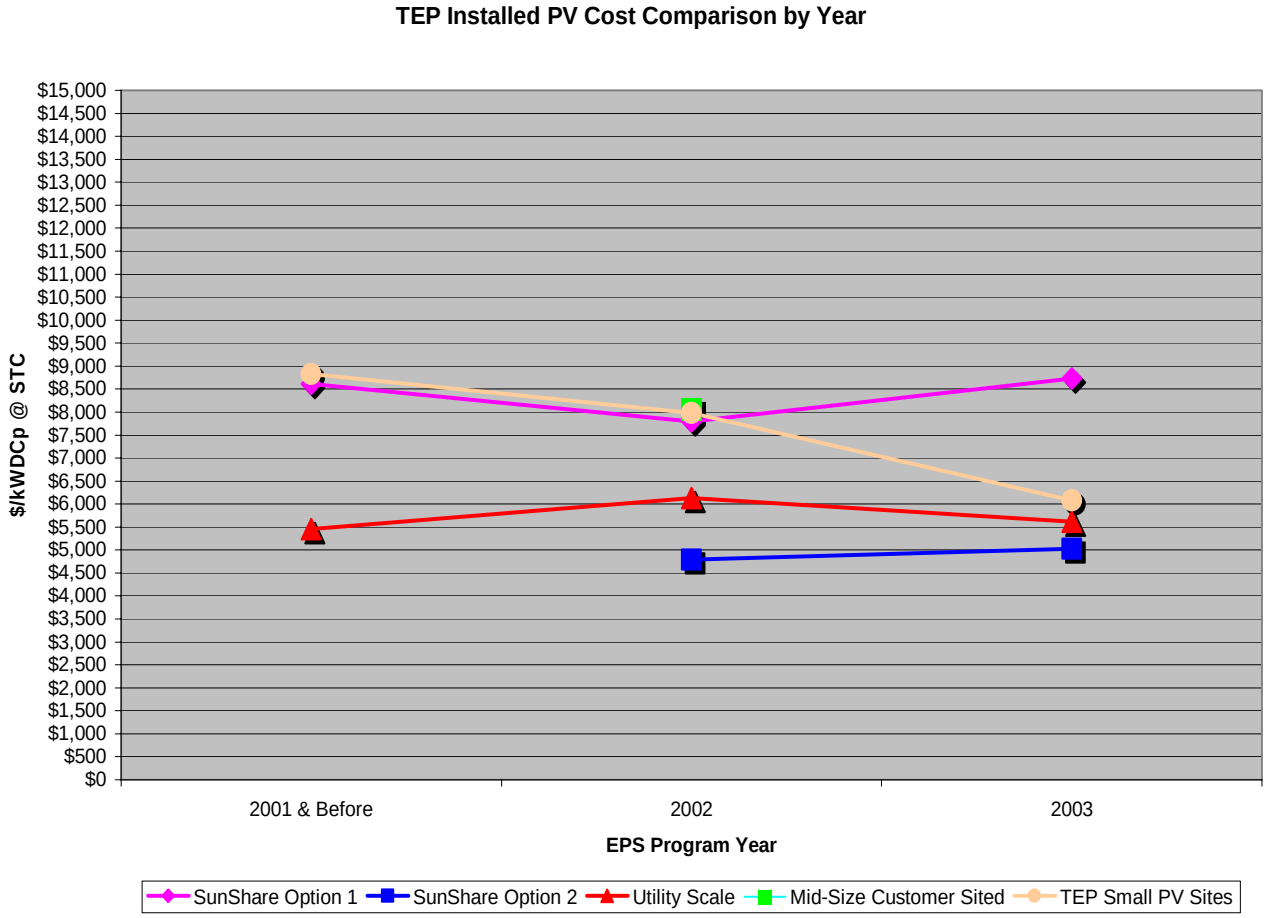
Competition in the inverter market is driving improvements in quality, reliability and price, which are reducing the life cycle cost of PV ownership through reduced initial and maintenance costs as well as increased energy output. However, much work remains to produce residential size PV inverters with 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 are 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 2004. The unit was off-line from February 16, 2004 until February 19, 2004, due to High DC Voltage indication. Both units were off line for that period as the units do not reset automatically.

On June 20, 2004 the output on H/U 2 showed cutting out for no apparent reason. Observed to see if the problem would appear and nothing showed up while present on site.

On July 1, 2004 unit 1 and 2 tripped off due to a frequency dip and unit 1 did not return. The unit was off line when service personnel arrived at the site.

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. During the first six months of 2004, ninety customer sites were visited. Of those, seven failures were found and repaired. 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.

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. Through June 2004, eighteen 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. Two additional test systems and three new Inverters will be installed during the remainder of 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 June 30, 2004, TEP acquired 97 SunShare customers. Of those, 40 customers purchased a total of 53 TEP systems under Option 2, and 57 installed third party systems under the Option 1 or Option 2 programs. Of the 40 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, seven wiring problems and 16 inverter problems found by TEP during acceptance testing.

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 18 systems, using a combination of 13 different manufacturers' inverters and modules. We are in the process of installing two additional systems of different manufacturers' products.

Below is a table of the systems presently in test.

Test Station	Panel Manufacturer/ Model No.	Install Date	Cell Type	Inverter Manufacture	Total Installed Cost per Watt	System KWdc Rating
Inverter/Module						
OH SB/Sanyo 167	Sanyo 167 HIT	05/17/03	Amor/Cryst	Sunny Boy 1800 SBD	$6.71	1336
OH Tr/Shell 40/1440	Shell ST40	08/07/03	CIS Thin Film	Trace 2500	$6.01	1440
OH TR/Unisolar	Unisolar 64	06/14/03	Triple Junct. Sil	Trace 1500	$6.66	1536
OH Tr/BP150	BP SX 150U	05/13/03	Multi-Crystal	Trace 1500	$5.81	1500
OH SB/Sharp	Sharp 165	05/01/03	Multi-Crystal	SunnyBoy 1100	$5.66	1320
OH Tr/Sharp	Sharp 165	05/01/03	Multi-Crystal	Trace 1500	$6.23	1320
OH Tr/Kyocera	Kyacera 158	04/23/03	Multi-Crystal	Trace 1500	$5.79	1422
OH Tr/BP 140	Bp SX140U	10/15/02	Multi-Crystal	Trace 1500	$5.88	1400
OH SB/Shell 150	SP 150-PC	07/15/03	Multi-Crystal	SB/2500	$5.06	3000

Test Station	Panel Manufacturer/ Model No.	Install Date	Cell Type	Inverter Manufacture	Total Installed Cost per Watt	System KWdc Rating
OH Sharp/ Shell150/MST50	MST50	03/08/04	Asi	Sharp 3500	$6.88	1500
Global Solar Test	GS-45	12/15/02	CGIS	Trace 1500	$7.99	1440
OH SB/Sanyo 180	Sanyo 180 HIT	07/01/03	Amor/Cryst	Sunny Boy 1800	$6.22	1440
OH Fronius/Sanyo 180	Sanyo 180 HIT	04/13/04	Amor/Cryst	Fronius IG 2000	$6.53	1440
OH Tr/MST 50	BP MST 50	08/20/03	Asi	Trace 1500	$4.44	1500
OH Tr/MST 50	BP MST 50	08/20/03	Asi	Trace 2500	$4.44	1500
OH Tr/Shell 150	SP 150-PC	02/24/04	Multi-Crystal	Trace 2500	$5.61	1500
OH Beacon/MST50 (5kW)	BP MST 50	02/24/04	Asi	Beacon M5	$3.94	7500
OH Trace/Astr Power 165	Asto Power 165	05/01/04	Single Cystal	Trace 2500	$5.75	1485

Presently we are collecting data manually but as the number of test systems has grown we 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

Task Number	Panel Manufacturer	Install Date	Inverter Manufacture	Panel KWdc Rating	System KWdc Rating	Average Monthly KwH/Kw Rated	DC Watts Actual/ Rated	Volts(mpp) Actual/ Rated
EC 92240	Sanyo 167 HIT	05/17/03	Sunny Boy 1800 SBD	167	1336	133.06	0.87	0.86
EC 92239	Shell ST40	08/07/03	Trace 2500	40	1600	139.74	0.87	0.96
EC 92229	Unisolar 64	06/14/03	Trace 1500	64	1536	141.00	0.90	0.93
EC 92228	BP SX 150U	05/13/03	Trace 1500	150	1500	124.56	0.77	0.83
EC 92227	Sharp 165	05/01/03	SunnyBoy 1100	165	1320	93.78	0.81	0.88
EC 92226	Sharp 165	05/01/03	Trace 1500	165	1320	131.06	0.80	0.87
EC 92225	Kyocera 158 G	04/23/03	Trace 1500	158	1422	115.08	0.74	0.83
GO06465	Bp SX140U	10/15/02	Trace 1500	140	1400	129.58	0.79	0.88
EC 92241	SP 150-PC	09/19/03	Sharp 3500	150	1500	104.07	0.87	0.91
EC 92242	BP MST 50	03/08/04	Sharp 3500	50	1500	123.33	0.71	N/D
GO06465	GS-45	12/15/02	Trace 1500	45	1440	116.83	0.74	0.80
EC 92244	Sanyo 180 HIT	07/01/03	Sunny Boy 1800 SBD	180	1440	139.90	0.89	0.88
GO06465	BP MST 50	08/20/03	Trace 1500	50	1500	116.44	0.75	0.84
GO06465	SP 150-PC	02/24/04	Trace 2500	150	1500	138.44	0.79	0.90
GO06465	BP MST 50	02/24/04	Beacon M5	50	7500	113	0.77	0.79
GO06465	Asto Power	05/01/04	Trace 2500	165	1485	148.15	0.81	0.86

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

SUNSHARE INSTALLATIONS

DC KW	Cost	Initial Insp	Maint Date	Maint Date	Condition	Cost Maint	Inverter	Panels	Wiring	Meter
1.44	$10,200		03/08/04	03/11/04	Good	$100				
3.20C										
1.50A	$4,500		03/01/04		Good	$100				
1.536	$10,000	04/30/04			Good	$100				
1.50A	$6,000		04/14/04		Good	$50				
3.00C	$9,500	04/14/04			Good	$150				
3.00A	$8,500		05/11/04		Good	$150				
3.30	$18,000		01/19/04		Good	$100				
1.44	$10,705	05/24/04			Good	$100				
1.44	$10,705	05/24/04			Good	$100				
1.50A	$6,000		03/31/04		Good	$100				
1.44	$10,500	02/05/04			Good	$150				
7.00	$75,000	03/15/04			Good	$400				
3.00C	$11,700	06/26/04			Good	$100				
1.50A	$4,750		04/09/04		Good	$100				
1.50A	$6,000		01/25/04		Good	$100				
1.44	$10,820	06/02/04			Good	$100				
1.44	$10,200		01/12/04	03/11/04	Good	$100				
1.20	$10,200		02/25/04		Good	$100				
1.44	$10,200		05/24/04		Good	$100				
1.44	$11,090	05/07/04			Good	$100				
3.00A	$8,500		06/02/04		Good	$150				
1.50A	$4,500	06/02/04			Good	$100				
1.50	$5,800		03/18/04		Good	$100				
2.40	$17,000		02/25/04		Good	$150		$150		
1.50	$10,835	05/07/04			Good	$200			$100	
1.50	$10,835	05/07/04			Good	$200			$100	
1.44	$8,500	04/12/04			Good	$100				
1.50A	$6,000		05/05/04	05/6/04	Good	$300		$200		
1.44	$10,200		03/11/04		Good	$100				
1.44	$14,187									
1.50		06/03/04			Good	$100				
1.40	$10,200		03/16/04		Good	$100				
3.00C	$10,700	06/28/04			Good	$100				
1.50C										
1.44	$10,700	03/10/04			Good	$100				
1.50C	$6,600		01/20/04		Good	$100				
1.40	$10,200		01/12/04	03/11/04	Good	$100				
1.50A	$6,000	01/31/04			Good	$100				
2.40	$21,000		04/08/04		Good	$100				
1.44	$11,200		04/09/04		Good	$100				

DC KW	Cost	Initial Insp	Maint Date	Maint Date	Condition	Cost Maint	Inverter	Panels	Wiring	Meter
1.50A	$5,000		07/12/04		Good	$100				
1.50A	$4,500	04/14/04			Good	$150				
1.44	$10,820	06/02/04			Good	$100				
1.50A	$6,000		03/18/04		Good	$150				
1.50A	$6,000		05/10/04		Good	$150				
7.20	$77,426		02/19/04		Good	$100				
7.50A	$34,800		06/03/04		Good	$200				
1.44	$10,705	05/24/04			Good	$100				
1.44		06/03/04			Good	$100				
1.44	$10,705	05/24/04			Good	$100				
1.68	$12,000		03/31/04		Good	$100				
1.2	$12,000		05/11/04		Good	$100				
3.00A	$12,800		05/26/04		Good	$150				
3.00A	$12,800		05/26/04		Good	$150				
1.50A	$5,000		07/13/04		Good	$100				
1.44	$10,820		03/11/04		Good	$100				
2.40	$19,000									
1.44	$10,705	06/02/04			Good	$100				
1.50A	$5,100		01/12/04	03/12/04	Good	$200				
4.00	$45,000		07/06/04			$1,500	$1,250			
1.38	$5,000		07/13/04		Good	$100				
1.50A	$6,600		02/11/04	05/25/04	Good	$1,900	$1,250	$200	$100	
1.20	$10,000	04/08/04			Good	$150				
1.44	$10,705	05/24/04			Good	$100				
1.44	$10,820		04/12/04		Good	$100				
1.44	$10,705	06/03/04			Good	$100				
1.44	$10,200		01/12/04	03/11/04	Good	$100				
1.50A	$5,000		030/1/04		Good	$100				
1.20	$10,000	04/08/04			Good	$150				
3.00C	$12,500	01/06/04			Good	$100				
4.80	$52,244									
3.00	$9,500	04/08/04			Good	$150				
1.50A	$6,000		02/02/04		Good	$100				
1.44	$10,200		03/11/04		Good	$100				
1.44	$10,200	04/09/04	04/09/04		Good	$100				
1.44	$10,700	04/09/04			Good	$100				
3.20C	$8,625	07/09/04			Good	$100				
1.44	$10,700	06/03/04			Good	$100				
2.58	$19,000									
1.50A	$4,500		01/12/04		Good	$50				
2.80	$16,000									
1.50A	$6,500	03/09/04			Good	$100				
2.80	$23,286									
2.88	$22,000		02/12/04		Good	$175				
1.50	$5,500		02/17/04		Good	$50				
3.00	$10,200	05/04/04			Good	$100				

DC KW	Cost	Initial Insp	Maint Date	Maint Date	Condition	Cost Maint	Inverter	Panels	Wiring	Meter
3.00C	$7,200	05/20/04			Good	$100				
1.29	$9,500		05/26/04		Good	$100				
5.00	$52,000		04/12/04		Good	$350	$250			
2.58	$25,000		04/08/04		Good	$100				
1.44	$15,000	04/08/04			Good	$100				
1.44	$10,805	06/03/04			Good	$100				
1.50A	$5,050		02/02/04		Good	$100				
1.44	$15,000	04/08/04			Good	$100				
6.00A	$17,000									
1.29	$6,500		05/26/04		Good	$100				
3.20C										
1.50A	$6,500	03/09/04			Good	$100				
3.00C	$7,000	05/20/04			Good	$100				

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.

GLOBAL SOLAR JOINT VENTURE

PROJECT DESCRIPTION

Advanced Energy Technologies, Inc. ("AET") is an Arizona corporation that is a wholly-owned subsidiary of Millennium Energy Holdings, Inc. ("Millennium"). Millennium is a wholly-owned subsidiary of UniSource Energy Corporation ("UniSource Energy"), the parent company of TEP. AET is a developer of distributed power systems and a producer of flexible thin-film PV ("PV") modules through its 98%-owned affiliate, Global Solar Energy, Inc. ("Global Solar"). Global Solar has built an advanced manufacturing facility in Tucson, Arizona to produce copper indium Gallium diselenide ("CIGS"), thin-film PV modules on flexible substrates. The many potential applications for this unique technology include use in advanced military, aerospace and commercial applications. Global Solar's principal office and place of business is 5575 S. Houghton Road, Tucson, Arizona 85747, and AET's principal office and place of business is One South Church Avenue, Tucson, Arizona 85701.

THE PRODUCTION FACILITY

Global Solar's production facility in Tucson, Arizona is ramping up its production of CIGS PV products, with a view towards rapidly expanding the annual production capacity to meet the growing commercial demand.

IMPORTANCE OF THIN-FILM PV TECHNOLOGIES

Crystalline technology currently dominates the PV industry because it is a proven product with a mature manufacturing process. The cost reductions needed to make this technology more commercially viable are difficult to achieve because the principle raw material utilized (silicon) is increasingly expensive and the manufacturing process is both labor and capital intensive.

The most credible means of reducing PV manufacturing costs is through the development of thin-film PV. Thin-film PV modules are commonly comprised of a very thin layer of PV material affixed to a supporting structure -- usually rigid and, most commonly, glass. Thin-film modules are less expensive to manufacture due to their reduced labor, lower material, energy, handling and capital costs. In contrast, Global Solar is commercializing continuous roll-to-roll deposition of thin-film PV on a flexible substrate.

COPPER INDIUM GALLIUM DISELENIDE

Global Solar's PV material utilizes an absorber layer primarily composed of CIGS.

The distinct advantage of CIGS is that the light-absorbing band gap of this thin-film most closely matches that of natural ambient light. As a result, CIGS has achieved much higher conversion efficiencies than all other thin-film PV technologies to date. Unlike other low-cost thin-film

options, CIGS also possesses higher device efficiency and longer-term stability comparable to

silicon. This is an important point because efficiency and long-term stability drive the sizing of a given PV system and, hence, its attendant cost.

Unlike silicon devices where size is severely restricted by the availability of large silicon wafers, CIGS device size is only limited by the size of the vacuum chamber and deposition system used in the manufacturing process. Global Solar's production cost is minimized by utilizing low-cost, industrially-proven, thin-film deposition technologies similar to those used to apply reflective coatings on eyeglasses, food packages and plate glass in commercial buildings. Moreover, Global Solar will employ a high degree of automation and intelligent processing control to improve product yield. Furthermore, GIGS has a demonstrated ability to pass appropriate environmental certification and regulated waste-handling issues.

UNIQUENESS OF GLOBAL SOLAR'S PV PRODUCTS

The literal flexibility of Global Solar's thin-film PV coupled with certain proprietary design characteristics ensures an extremely durable product. In addition, this PV product is highly portable and can be rolled or folded into compact packages for shipping. This ability to provide compact storage and damage tolerance is a significant advantage for numerous military, space, consumer and commercial applications and makes it ideal for, among other things, satellites, portable or remote stationary communication equipment, low-cost housing and remote agricultural irrigation.

Global Solar is currently delivering products to domestic and international markets. Such products include Portable Power Packs™, small solar power systems that fold into small, lightweight packages. These small Power Packs™ can be used to power radios, computers, and other compact power needs and can replace or complement traditional batteries.

COST RECOVERY AND RENEWABLE RESOURCE COMMITMENT

Since UniSource Energy is investing in Global Solar as a "for profit" subsidiary, expenses associated with Global Solar are not included as part of TEP's recoverable $2,100,000 per year expenditure commitment to renewables. However, Global Solar's production capacity will be applied towards TEP's 5 MW commitment to implement renewable resources.