City of Austin
Austin Energy
Tool for Analysis of Economic Development Benefits
For
Solar Manufacturing & Installation

Final Report
May 11, 2006
(This final report has revisions relative to the final report dated April 20, 2006)

PO Ref. No. 11001001066
Principal Investigator
Christy Herig
Segue Energy Consulting, LLC
cherig@tampabay.rr.com

Executive Summary

The City of Austin and Austin Energy (AE) has one of the most aggressive local programs for solar energy. In its desire to include all value propositions in its solar energy business and the resulting relations with AE customers, AE contracted for a solar economic development calculator. As a result, Segue Energy Consulting, LLC has developed the Austin Energy Solar Economic Trade-off Tool (Tool).

At the time the tool was completed, Austin Energy's program design was to meet its aggressive solar deployment goals, by soliciting, purchasing, owning and maintaining the solar installations. Therefore, though the Tool calculates many economic development values, the two values realized directly by the City of Austin are the sales tax revenue gains and the property tax revenue gains. The resulting values expressed in units similar to rate tariffs are:

Property Tax Gains – 0.38 ¢/kWh
Sales Tax Gains – 0.02 ¢/kWh

Summed together under the present program scenario, the value for a solar system generated kilowatt-hour is -

0.4 ¢/kWh

The tool also calculates two manufacturing plant construction sets of benefits (see tables 3 and 4). The global solar market is in such a state of high demand that market limits strongly diminish the probability for a municipality to attract manufacturing[1]. However, under the current program scenario of AE ownership, if the City was successful in attracting manufacturing, the benefits of manufacturing plant construction would also be realized. These economic benefits are a one time community investment and do not easily convert to a ¢/kWh result. However, if one assumed that 5 MW per year of a 100 MW flat plate plant were then installed in Travis County, the construction investment tax venue benefits would be equal to 0.1 ¢/kWh.

The main result requested by Austin Energy was for per unit (MW and kWh) values for their investment in solar, related to tax revenues and economic development. The table below presents the results from the calculator using the default values of 1,507 kWh/kW-yr solar system production, a 5% discount factor, $8/W system cost, and 80% factor of new jobs will be filled by new residents to the city of Austin.

5. Per Unit Benefits of PV Installed

	per MW	$/kWh
Total Increase In-state Jobs	2.9	
Total Cumulative GRP Increases ($M/MW) & ($/kWh)	$9.5	$0.4110
Increase in Earnings ($M/MW) & ($/kWh)	$2.8	$0.1221
Sales Tax Gains ($M/MW) & ($/kWh)	$0.09	$0.0038
Property Tax Gains ($M/MW) & ($/kWh)	$0.01	$0.0002

The gross regional product, defined as the market value of goods and services produced by labor and property in Travis County as a result in the gain in solar investment or the loss in the electricity production and distribution, is not directly attributable to the value relation between AE and its customers. However, it is a value felt throughout the community through increased economic health and should be a factor in the decision for the overall investment. The jobs and earnings values are realized directly by the City through the property and sales tax revenues. Obviously AE is aware of this since it has economic development rates with a more than 25% discount from general service, or about equal to the per units value of the tax revenues for solar installations.

[1] Appendix B provides data on the global market

The overall program economic development impacts are impressive. As per the proposal, timeline scenarios for 2007, 2010, 214, and 2020 were developed. If Austin Energy meets its 100 MW goal in 2020, the benefits with the same inputs as noted above are:

$952 Million Net Increase in Gross Regional Product
293 Net New Jobs
$283 Million Increased Earnings
$8.8 Million in Net Sales Tax Revenue
$0.6 Million in Net Property Tax Revenue

Austin Energy, as a leader in utility solar deployment programs, can now calculate and include the economic development values for its solar programs.

Background

The City of Austin and Austin Energy (AE), in order to have its strategic decisions fully informed, needs applied analysis and a method of quantifying the expected economic development benefits of solar electric energy system installation and (separately) manufacturing in the City of Austin. The analysis results and tool discussed below provides quantifiable benefits for the investment Austin Energy is making to achieve their solar goals within their renewable portfolio standard. Outputs are expressed as revenue impacts and benefits (changes in local employment, salaries, and changes in Gross Regional Product) for the current AE program goal scenarios as well as per unit values on both a per Megawatt (MW) and dollar per kilowatt-hour of solar electric generation capacity.

The analysis presented uses methodology and multipliers from RIMS II (Regional Input-Output Modeling System) developed by the U.S. Department of Commerce, Bureau of Economic Analysis. RIMS II is based on an accounting framework called an I-O table. The multipliers used for the initial benefits analysis were aggregate level multipliers based on the 2002 national annual input-output table and 2002 regional economic accounts data[2].

Results

The tool uses a 2004 economic baseline, with no financing, or time value of money (except for the levelized cost calculations) included. The results from the tool are a single page with 1 input table and 5 output tables. Changing the inputs will change drastically the results. The following page shows the layout of the results page. The second or back of this page is the definitions and assumptions for explanation and clarification (see Appendix C).

Table 1, Input Variables, has four values for input. If no inputs are supplied the calculator uses the default values.

The first output, Table 2 is the Austin Energy program scenario analysis for the 2007, 2010, 2014 and 2020 goals. This table provides a comparison with business as usual scenarios, which is typical decision criteria for economic development value decisions. Additionally, the local tax revenue benefits are calculated, with consideration of an Austin Energy ownership scenario.

Table 3 provides the same set of benefits for the construction of a 20 MW/yr module assembly manufacturing plant. This type of plant does not include cell production, only the assembly of purchased cells into a module. Industry sources have indicated that 20 MW is the smallest plant that would be considered under this manufacturing scenario. Additionally, the local market has to be substantial enough to attract the manufacturing.

Table 4 provides the same set of benefits for construction of a 100 MW/yr full flat plate module manufacturing plant. This type of plant does include cell production and could possibly include silicon feedstock manufacturing. Industry sources have indicated that 100 MW is the smallest plant that would be considered under this manufacturing scenario. As seen by the market numbers in Appendix B, manufacturing does build capacity near the market. Full module assembly plants of this size have in recent years been based near the Japanese and German markets.

In addition to the one time construction benefits, Table 5 provides potential electric sales in megawatt-hours for different types of plants. If a plant were built in Travis County, the AE program as designed would at most consume 5 MW per year of this plant and Austin Energy would collect plant operation electric revenue at the applied rate tariff – another revenue benefit stream.

The per units benefits are provided in Table 6, these are based on the deployment plan only and does not include the benefits attributable to the construction of the manufacturing plants. The dollars per MW benefits are based on a single MW of Solar electric at the default assumed values, operating for 30 years.

[2] Documents explaining methodology and the multipliers are available at http://www.bea.doc.gov

Austin Energy Analysis of Solar Economic Tradeoffs

1. Input Variables

	Input	Default
Solar Output kWh/kW-yr	0	1507
Discount Factor		5%
PV System Installed Cost $/W		$8.00
Percent New Residents for New Jobs		80%

2. Economic Development Analysis for PV Policy and Market Scenarios

Economic Development	**Base Case 2004**	**Business as Usual 2007**	**Alt. 15 MW 2007**	**Net Benefits 2007**	**Business as Usual 2010**	**Alt. 30 MW 2010**	**Net Benefits 2010**	**Business as Usual 2014**	**Alt. 50 MW 2014**	**Net Benefits 2014**	**Business as Usual 2020**	**Alt. 100 MW 2020**	**Net Benefits 2020**
Gross Regional Product ($M)	$48,003	$54,442	$54,585	$143	$61,638	$61,924	$286	$72,175	$72,651	$476	$89,909	$90,861	$952
Total In Region Jobs	673095	719999	720043	44	763859	763947	88	823404	823550	146	914949	915242	293
Regional Earnings ($M)	$27,299	$30,486	$30,528	$42	$33,889	$33,974	$85	$38,716	$38,857	$141	$46,523	$46,806	$283
Tax - Revenues													
Sales Tax Gains @1% ($M)				$1.32			$2.65		$4.41				$8.83
Property Tax Gains ($M)				$0.09			$0.17		$0.28				$0.57

3. Module Assembly Manufacturing Plant Construction Gains 20 MW/Yr Capacity*

Gross Regional Product ($M)	$27.13
Jobs	6.40
Earnings ($M)	$6.65
Sales Tax Gains ($M)	$0.21
Property Tax Gains ($M)	$0.01

4. Full Flat Plate Manufacturing Plant Construction Gains 100 MW/Yr Capacity*

Gross Regional Product ($M)	$361.70
Jobs	85.33
Earnings ($M)	$88.62
Sales Tax Gains ($M)	$2.76
Property Tax Gains ($M)	$0.01

* The plant construction values are a one time benefit during the construction of the plant. Operation of the plant at full capacity results in electric sales at the applied electric rate tariff as presented in Table 5

5.Annual Plant Operation Electric Sales

	W/O SI Feedstock		With SI Feedstock	
20 MW Module Assembly	6,260	MWh		MWh
100 MW Flat Plate multicrystal	154,800	MWh	230,000	MWh
100 MW Flat Plate monocrystal	225,600	MWh	307,000	MWh

6. Per Unit Benefits of PV Installed

	per MW	$/kWh
Total Increase In-state Jobs	2.9	
Total Cumulative GRP Increases ($M/MW) & ($/kWh)	$9.5	$0.4110
Increase in Earnings ($M/MW) & ($/kWh)	$2.8	$0.1221
Sales Tax Gains ($M/MW) & ($/kWh)	$0.09	$0.0038
Property Tax Gains ($M/MW) & ($/kWh)	$0.01	$0.0002

Austin Energy Analysis of Solar Tradeoffs (ASET) Tool

The AE ASET tool (Tool) consists of 11 Excel worksheets. The first worksheet has no calculations and is strictly input and output. The next two worksheets are the calculators, and the final worksheets are input data. Throughout the worksheet, comments have been inserted on both methodology and data sources for ease of updating and editing. The following list identifies the Tool's worksheets by name and function.

1. Input-Output – function as titled
2. Baseline and Scenario – calculations
3. Levelised and per MW – calculations
4. Travis County Economic Data – data
5. Travis County Growth Factors – data
6. Austin Energy Forecast – data
7. RIMS II – Travis – data
8. Census Demographic 2004 – data
9. Census Economic 2004 – data
10. Taxes Travis County – data
11. Taxes - data

The Tool is set to automatically calculate, and there is no password or hidden cell protection. The following describes in detail, the function of each worksheet, including data sources, term definitions and methods of calculation.

Input-Output

This worksheet simply pulls data and calculations forward and presents results in a printable format. It also includes an area for user input variables, which is printed out with the results. Where possible, assumptions have been included in titles and data labels.

The input table is shown above as Table 1 and includes default values. The inputs must be at either zero or left blank for the logic functions in the calculations to work.

The Solar output is calculated with PVWatts calculator and a 15% deration factor. This is the AC PV system output per year in kWh for every DC watt of module rating. See Appendix A.

The results or output tables have been described. Term definitions will be included in the other worksheet descriptions.

Baseline and Scenario

This worksheet calculates the business as usual and alternative scenario analysis, revenue impacts and benefits and manufacturing benefits.

Baseline Electric Sector Statistics – This data is used both in calculations and validity checks.

Total Sale MWhrs	Taken directly from the Austin Energy Forecast supplied by AE for 2004, 2007, and 2010. The 2020 data is calculated using the growth factor from 2014, since in 2015 the growth escalated to 2.7%, which was more than 20% higher than any other year's growth during forecast time period.
Total Revenue ($1000)	Taken from the AE 2002-2003 budget at http://www.austinenergy.com/ with 2% growth as per Austin Energy Forecast for the 2004 figure and then calculated according to forecasted MWh sales provide by AE and a constant kWh price which was calculated from the 2004 sales and revenue figures.
Electric Sector Salaries ($1000s)	Calculated from ratio of jobs (382) to salaries (27713) from Bureaus of Labor Statistics and AE budget on jobs
Electric Sector Jobs	Austin energy 2002-2003 budget at http://www.austin energy.com….Total FTE's, with

	no growth factors
Electric Sector Jobs per $M of Revenue	Calculated from Total Revenue ($1000) and Electric Sector Jobs
Gross Regional Product (Million$)	Directly from Travis County Economic data supplied by Mark Kapner Definition provided in next section.
Electric Cost as % of GRP	Revenue divided by GRP
Population	Taken from Travis County Economic data supplied by Mark Kapner (note this figure is 4% higher than the census figure)
Average Cost of Electricity	Revenues divided by sales for 2004, 2007 was 2006 with fuel adjustment included and remaining years based on the growth.
Percent of Revenue that goes to salaries	Salaries divided by Revenue

Travis County Baseline and Scenario (PV Installations Only)

This section calculates the benefits and loses for the investment in PV installations based on an installed price. The calculation differences in the alternate scenarios are the number of MW installed. All gains are calculated in the Construction[3] sector (230000) and all losses are calculated in the Power Generation and Supply (221A00) sector using RIMS II – Travis County final demand multiplier values. These assume gains for every million dollars spent on solar, based on full installed cost. Losses are for every million dollars not spent on utilities (at full retail value – average cost of electricity) over the assumed 30 years of the PV system life.

Gains – ($M/MW-PV)*MW*(RIMS II multiplier/$M)[see note on multipliers]

Losses - ($/kWh)*(yrs - PV system life)*(MWh/MW-yr)*(kWh/MWh)*MW*(RIMS II multiplier/$M)[see note on multipliers]

Note RIMS II Multipliers
GRP – output/$million
Jobs – job-years/$million (then divided by assumption of 30 job-years/job)
Earnings – earnings/$million

Gross Regional Product ($M)	Defined as the market value of goods and services produced by labor and property in Travis County as a result in the gain in solar investment or the loss in the electricity production and distribution.
Jobs	RIMS II calculates job-years. A conversion factor of 30 job-years per job was assumed.
Earnings	Defined as the sum of personal income-wage and salary disbursements, supplements to wages and salaries, and proprietors' income

Revenue Gains

This area calculates direct revenue costs and gains to the City of Austin for all scenarios.

Sales Tax Gains	This calculation includes both the increase in earnings and jobs. The jobs are converted to dollars using the median income for Travis County ($49,181) and is reduced by the input factor for the percent of new residents. These earnings and net new incomes are then multiplied by the 3% local tax burden on personal income reported by the Bureau of Economic Analysis
Property Tax Gains	Net new jobs are multiplied by the net new residents input factor and then the median housing figure is $165K and the Austin property tax rate of $0.48 / $1000 of value

[3] Given that there are no multipliers specific to the solar industry or any other building-related technologies, the multipliers for construction were used. In addition, no solar-specific assumptions were made with respect to equipment manufacturing location; it is assumed that the portion of overall construction materials and equipment that are manufactured in the state vs. out-of-state is the same for solar projects. More information on RIMS II can be found at: www.bea.doc.gov/rims.htm.

Manufacturing Plant Construction Benefits

The manufacturing benefits are strictly for the plant construction and not the plant operation. The figures are based on input from Paul Maycock of PV Energy Systems who provided the following input.

> Flat plate with ingot casting, slicing, cell production, testing, cell tabbing and stringing, testing, lamination and module framing and junction boxes is about $2.00 per watt for 100 MW plants. Starting with purchased cells the module fabrication, (stringing, tabbing, and laminating for 20 MW is about $.75 per watt. For a complete line contact GE Solar, for module line contact Spire.

Plant operation benefits are typically based on a bill-of-goods analysis, which is difficult for a small region like Travis County, because not all goods are produced locally and the industry data is less valid, the smaller the region. The operation benefits for the five MW per year of installations for the AE program are captured in the net PV installed benefits. If Austin were successful in attracting a manufacturing plant they would also benefit from annual electric revenue sales as calculated in MWh. The dollar revenue figure would depend on the rate tariff.

Levelised and Per MW

This worksheet calculates the per unit values of PV installations in Austin. The per MW calculations for all values are the same as above, but for only 1 MW rather than the program installation goal. The $/kWh levelised cost are calculated as:

(cost recovery factor[a])*($M/MW)*(solar output MWh/MW-yr)*($M/$)/(1000kWh/Mwh)

a – the cost recovery factor assumes the input discount rate and 30 yrs life

Travis County Economic Data

Supplied by Mark Kapner AE, with the 2004 real GRP deflated by the inflation rate in the table

Travis County Growth Factors

Supplied by Mark Kapner AE

Austin Energy Forecast

Supplied by Mark Kapner AE, with a 2020 growth calculation based on 2014 growth rate

Rims II-Travis

Purchased from Bureau of Economic Analysis as per subcontract. All industry multipliers are available for bill-of-goods analysis.

Census Demographic 2004

Source in Census Bureau Home Page at http://www2.census.gov/www/index.html. Specifically the American Community Survey.

Census Economic 2004

Source in Census Bureau Home Page at http://www2.census.gov/www/index.html. Specifically the American Community Survey.

Taxes Travis County

Source: http://ecpa.cpa.state.tx.us/taxrates/RateCalc.jsp

Taxes

http://www.bea.doc.gov/bea/regional/spi/

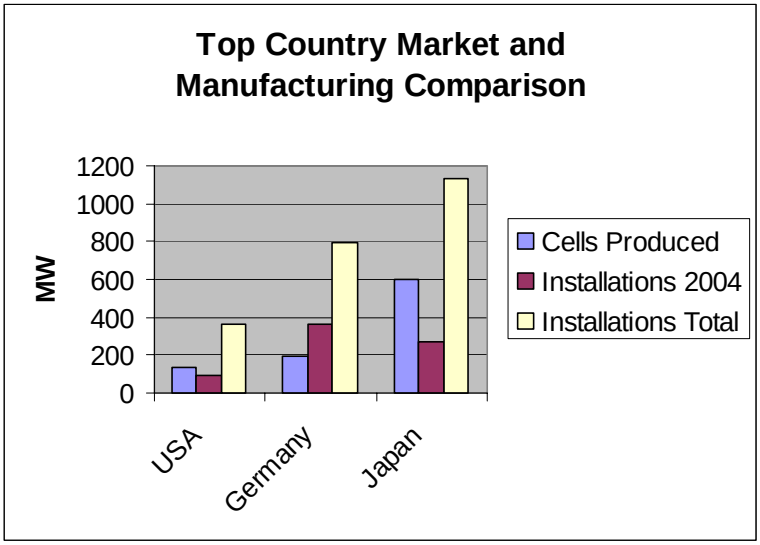
Appendix A
PV Watts Calculation http://www.nrel.gov/ncpv/

AC Energy & Cost Savings

Station Identification	
City:	Austin
State:	TX
Latitude:	30.30° N
Longitude:	97.70° W
Elevation:	189 m
PV System Specifications	
DC Rating:	1.0 kW
DC to AC Derate Factor:	0.850
AC Rating:	0.9 kW
Array Type:	Fixed Tilt
Array Tilt:	30.3°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	9.2 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	4.32	110	10.12
2	4.96	111	10.21
3	5.47	135	12.42
4	5.52	128	11.78
5	5.54	131	12.05
6	5.93	134	12.33
7	6.21	142	13.06
8	6.22	143	13.16
9	5.77	132	12.14
10	5.65	134	12.33
11	4.60	108	9.94
12	3.96	100	9.20
Year	5.35	1507	138.64

Appendix B
International Market Statistics
From www.IEA-PVPS.org



Module & Cell Production by World Region

		Japan	USA	Europe	Rest	TOTAL
Silicon feedstock	tonnes	1000	5100	2800	0	8900
Ingots	sc-Si, tonnes	1071	1000	275	0	2346
Ingots	mc-Si, tonnes	2400	500	3875	0	6775
Wafers	sc-Si, MW	150	181	352	0	860
Wafers	mc-Si, MW	177			0	
Cell Production	**All types, MW**	**604**	**138**	**329**	**38**	**1109**
Cell Production Capacity	MW / year	650	171	425	49	1295
Module Production						
	sc-Si, MW	109	86	126	1	322
	mc-Si , MW	396	30	86	1	513
	a-Si, MW	25	14	2	0	41
	Undefined , MW	60	0	198	9	267
	Other, MW	na	9	8	<1	17
	Total MW	**590**	**139**	**420**	**11**	**1160**
Module Production Capacity	MW / year	821	177	578	53	1629
(sc-Si & mc-Si)						

Appendix C
Results Second Page of Assumptions and Data Sources

Data Notes and Assumptions:

o Dollars are in constant 2004 dollars.

o Solar energy system life is assumed to be 30 years, Production is kW AC.

o Gross regional product (GRP) changes uses multiplier values and assumes gain of X for every $M on solar and loss of Y for every $M not spent on utilities (gains onetime and losses are over the system life.)

o Jobs uses multiplier values and assumes gain of X jobs for every $M on solar and loss of Y jobs for every $M not spent on utilities (gains one time and losses are over the system life.) Jobs = job-years/ 30 years

o Increase in Earnings uses multiplier values and assumes gain of X for every $M on solar and loss of Y for every $M not spent on utilities (gains one time and losses are over the system life.) Earnings is the net increase in income to all businesses due to the investment in solar.

o RIMS II multipliers were used to generate these figures. Given that there are no multipliers specific to the solar industry or any other building-related technologies, the multipliers for construction were used. In addition, no solar-specific assumptions were made with respect to equipment manufacturing location; it is assumed that the portion of overall construction materials and equipment that are manufactured in the region vs. out-of-region is the same for solar projects. More information on RIMS II can be found at: www.bea.doc.gov/rims.htm.

Baseline Data Sources include:

o U.S. Department of Commerce - Gross State Product http://www.bea.doc.gov/bea/regional/gsp/

o U.S. Energy Information Administration

o Average consumer cost per kWh http://www.eia.doe.gov/cneaf/electricity/esr/esr_tabs.html

o Electric generation statistics http://www.eia.doe.gov/cneaf/electricity/st_profiles/table_a3.pdf

o Future projections of electricity use are found at http://www.eia.doe.gov/oiaf/aeo/excel/aeotab_8.xls

o U.S. Census Bureau - 2002 Census Data from http://factfinder.census.gov/

o Plant Operation Energy is from - Alsema, E.A., de Wild-Scholten, M.J., The real environmental impacts of crystalline silicon PV modules : an analysis based on up-to-date manufacturers data, in : 20th European PV Solar Conference, Barcelona, 2005