

Alternative Energy for Economic Development: Implementation of Biomass, Hydro and Solar Power

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Table of Contents

Introduction.....	1
Biomass Facilities	2
Middlebury College - Vermont.....	2
Sierra Pacific Industries - Washington.....	4
Hydropower Facilities	5
Ohio River - Ohio, Kentucky, Michigan, Virginia, West Virginia	6
Solar Power Facilities	9
Ivanpah Solar Energy Generating System - California	10
Tori Richard – Hawaii	12

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Introduction

Places both urban and rural are working to implement green energy technologies to stimulate economic development. The construction of alternative energy facilities are on the rise, and as more of these green power generators are built and operated, planners and economic development professionals have the opportunity to learn from those existing facilities. This paper will investigate six case studies wherein green energy facilities have stimulated local and regional economic growth. Here we will investigate specific cases where communities have invested in biomass, hydroelectric, and solar inputs to lower energy costs and provide residents with renewable energy, and where businesses have converted to alternative energies to lower production costs and lower market clearing price. The focus of this paper will be to glean best practices from successful cases so that communities across the nation can gain a deeper understanding of the key considerations and steps necessary in selecting the appropriate green energy facilities. This paper will look to these case studies to investigate how communities can capitalize on locational advantages and specific strategies to foster economic development through the use of green energy.

Economic developers can use these case studies to understand the level of public and private cooperation that is possible to address alternative energy concerns. Of course, unless the economic development community can put environmental goals into economic terms that can be monetized and analyzed in cost savings for companies and communities, many environmental sustainability projects will not be carried to fruition. It is the responsibility of economic developers to be able to communicate to public and private sector clients how undertaking specific alternative energy initiatives will result in tangible and long term economic benefits. The case studies included here are intended to illustrate how economic developers can assess and communicate the cost savings and economic benefits to businesses seeking to increase their profit margins, and places interested in utilizing their locational assets, marketing their place as amiable to alternative energy, and attract firms.

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Biomass Facilities

Biomass facilities use “materials--such as wood, lawn and garden clippings, agricultural waste, leaves, tree pruning as well as non-recyclable paper--to produce heat or electricity”¹. The raw organic materials that are the inputs for biomass typically come from the waste of other processes such as the output from wood and lumber processing, or from naturally overabundant materials such as leaves and corn stalks. “Biomass is currently the largest domestic source of renewable energy providing 2.8% of total U.S. energy consumption. Wood is the largest feedstock accounting for 70% of U.S. biomass consumption for energy”². This percentage of U.S. energy share is projected to grow, and the U.S Energy Information Administration estimates that biomass will comprise 54% of all renewable energy usage by 2030³. The opportunities for communities to use biomass energy are high, provided those communities are within close proximity to dense organic inputs with the capacity to diversify their inputs, have access to transportation networks to bring the requisite tonnage daily, have sufficient storage capacity, and benefit from supporting policies such as producer credits and receptive host communities.

Middlebury College – Vermont

In 2009, the private institution of Middlebury College in Vermont installed a biomass gasification facility on campus⁴. The \$12 million dollar biomass plant is a signature part of the college’s commitment to becoming carbon neutral by 2016. “As of December, 2009, the plant has successfully and reliably provided the College with heat from woodchips through a broker,

¹ Cal Recycle. Biomass Diversion Credit. <http://www.calrecycle.ca.gov/lgcentral/basics/Biomass.htm>. Last accessed 10/25/2010.

² Government Economic Development Initiatives for BioMass Power Projects. 2007 Fredrikson and Byron, P.A. <http://www.fredlaw.com/bios/attorneys/taylor todd/BioMass.pdf>. Last accessed 10/26/2010.

³ Government Economic Development Initiatives for BioMass Power Projects. 2007 Fredrikson and Byron, P.A. <http://www.fredlaw.com/bios/attorneys/taylor todd/BioMass.pdf>. Last accessed 10/26/2010.

⁴ “Biomass gasification is the process by which low-value biomaterial, such as corn stalks or cotton gin trash, is partially combusted in the absence of air to produce carbon monoxide (CO) and hydrogen (H). The gases extracted from the biomaterial are often called producer gas, low BTU gas, or syngas. This gas can, in turn, be fed into a gas turbine to produce electricity” *Utilizing Agricultural BioMass in Energy: Production and Economic Development*. Clifford, Fedle B.; Hanson, Jeffrey L.; Bervides, Mario; Simonton, James; Lyford, Conrad. Texas Tech University. December 2008. P. 29.

Cousineau Forest Products”⁵. The College’s intention is for the plant is to become the primary heating and cooling source. The plant runs on wood pellets that are harvested within 75 miles of the college. The addition of the biomass plant is expected to cut the school’s carbon dioxide emissions by 40% (12,500 metric tons). In order to achieve this reduction, the plant requires 20-35 tons of wood chips to be shipped into campus each day. The existing contract with Cousineau Forest Products specifies that the campus will be supplied with 20,000 tons of wood inputs per year. As of now however, there are no procurement standards outlined in this agreement, and the school is working to devise standards that are socially, environmentally and economically sustainable. The inclusion of such procurement standards will likely increase the cost of inputs, however this increase will be however, this increase will be mitigated by the cost savings from reduced oil consumption⁶. The majority of these wood chips are waste produced as a byproduct of nearby logging and milling operations.

The facility is the largest investment to date made by the university to reduce emissions. The concept was supported by an independent feasibility study which showed the long term savings that would be generated by the plant. “At \$1.50 a gallon for #6 oil and \$37/ton for woodchips the internal rate of return is 8.75% and the payback period is approximately 12 years”⁷. As the price of oil increases, the cost savings of biomass increases. Switching to biomass from oil is expected to save the College approximately \$840,000 each year in heating and cooling costs. Each year, this savings figure is projected to increase by 3%. Additional regional economic benefits include the infusion of capital into the local economy through the purchase of waste wood chips, and the job creation associated with collecting, processing, and transporting those chips to the campus. The effects together are expected to inject \$800,000 into the local economy each year⁸.

Middlebury is able to undertake such a project with the support of private university funds and because of the school’s proximity to lumber and wood processing facilities. Indeed

⁵ Biomass Procurement at Middlebury College: Assessments and Recommendations. Environmental Studies Senior Seminar. Fall 2009. P. 1.

⁶ A report by the college’s environmental science department states that since “the switch from oil to biomass has generated significant savings for the College, we propose that the College could afford a more expensive, but more sustainable biomass chip.” Biomass Procurement at Middlebury College: Assessments and Recommendations. Environmental Studies Senior Seminar. Fall 2009. P. 2.

⁷ Middlebury.com Sustainability. <http://www.middlebury.edu/sustainability/energy-climate/biomass/faq>. Last accessed 10/26/2010.

⁸ Middlebury.com Sustainability. <http://www.middlebury.edu/sustainability/energy-climate/biomass/faq>. Last accessed 10/26/2010.

The locational assets of dense forests are central to the success of the biomass facility⁹. While this example is of a college that took the initiative to build such a facility, municipalities and corporate entities can also utilize waste from nearby wood processing operations to create and sustain biomass facilities. These facilities are well suited for areas such as the northeast, the Midwest, and the Pacific Northwest. The Middlebury project helped pave the way for other projects. Colby College in Waterville Maine is currently in the construction phase of a similar biomass facility¹⁰. The creation of energy from biomass is a ‘weight-losing’ process; where the cost of transporting the raw materials to process into energy is greater than the cost of distributing the final product. Moving tons of wood and wood products to become energy necessitates a close, dense supply of organic materials. Transporting raw materials from far outside an area will decrease the potential to reach market clearing price, and so this energy source is best suited to locations that can capitalize on either naturally occurring raw materials, or a consistent output of organic waste materials.

Sierra Pacific Industries - Washington

Biomass facilities are also a useful tool for local manufacturers to cooperate with other area businesses and local energy authorities to share and recycle waste for fuel. This symbiosis decreases energy costs for manufacturers, provides sustainable energy to local residents, creates eco-industrial linkages, while also reducing land fill waste. One such example is the Sierra Pacific Industries facility in Aberdeen, Washington. Sierra Pacific is a functioning sawmill that now has an 18-megawatt power plant on site and transmission lines that pump energy to local consumers through the use of wood byproducts. The mill has been operational since 2003 and is now one of the primary suppliers to the Grays Harbor Utility District. The plant has long been using sawdust and left over wood to power its own operations, but now the plant has enough of this energy to sell back to the regional power authority.

The current agreement with the Grays Harbor Public Utility District (PUD) mandates that the mill supply the area with a minimum of 5 MWh of power each year for the next 12 years¹¹.

⁹ 9. More than 78% of Vermont is forested. Biomass Procurement at Middlebury College: Assessments and Recommendations. Environmental Studies Senior Seminar. Fall 2009. P. 5.

¹⁰ http://www.colby.edu/news_events/press_release/biomassconstruct.cfm

¹¹ Aberdeen Lumber Mill Supplies Biomass Electricity: From a Distance, the Sierra Pacific Industries Sawmill Looks Like Any Other Large Forest Manufacturing Operation. Bruscas, Angelo. August 4, 2010. The Seattle

This steady supply of alternative energy allows the PUD to fulfill its state legislative requirement of procuring a percentage of renewable energy each year. “While the deal calls for 5 megawatts initially, at a cost of \$56.33 a megawatt, the PUD eventually plans to purchase up to 15 megawatts of generating capacity in the future, or enough power to supply more than 15,000 homes”¹². The plant consumes roughly 80,000 pounds of waste wood remnants each hour. All of this electricity is being produced from materials that previously were collected and sent to landfills. The recycling of this waste into energy also satisfies local green energy procurement standards which mandate that a percentage of energy be provided by alternative sources. Using such a local source reduces the PUD’s cost of acquiring alternative energy from farther away locations, which would increase transport and transmission costs and thereby reduce market clearing price. The partnership between Sierra Pacific and the Grays Harbor PUDS “cuts the PUD's capital costs to acquire green power elsewhere, such as what Lovely said is the estimated \$77 million it ultimately would have cost the district for the proposed Radar Ridge wind energy project currently under environmental review in Pacific County”¹³.

Sierra Pacific Industries is an example of a functioning eco-industrial facility that utilizes green energy practices within their day to day operations, and also engages in practices that provide renewable energy to the local population. The amount of savings depends upon the energy that can be generated on site and sold to the surrounding area, as well as depends upon global oil prices. This symbiosis decreases energy costs for manufacturers, provides sustainable energy to local residents and creates eco-industrial linkages.

Hydropower Facilities

Hydropower facilities are a sustainable and cost effective way to provide electric power to local populations. Capturing energy from falling water produces virtually no carbon

Times. http://seattletimes.nwsourc.com/html/localnews/2012530987_apwabiomasslumbermill1stldwritethru.html. Last accessed 10/25/2010.

¹² Aberdeen Lumber Mill Supplies Biomass Electricity: From a Distance, the Sierra Pacific Industries Sawmill Looks Like Any Other Large Forest Manufacturing Operation. Bruscas, Angelo. August 4, 2010. The Seattle Times. http://seattletimes.nwsourc.com/html/localnews/2012530987_apwabiomasslumbermill1stldwritethru.html. Last accessed 10/25/2010.

¹³ Aberdeen Lumber Mill Supplies Biomass Electricity: From a Distance, the Sierra Pacific Industries Sawmill Looks Like Any Other Large Forest Manufacturing Operation. Bruscas, Angelo. August 4, 2010. The Seattle Times. http://seattletimes.nwsourc.com/html/localnews/2012530987_apwabiomasslumbermill1stldwritethru.html. Last accessed 10/25/2010.

emissions.¹⁴ No solid waste is generated, and there is no risk of toxic spillage or contamination. The cost of maintaining these facilities is generally low after the initial cost of construction and, as the following examples will show, there is a great opportunity to convert the nation's 80,000 existing dams into hydroelectric generation sites. The establishment or conversion of a hydroelectric dam is in itself an economic development investment because "hydropower is one of the least expensive sources of electricity and areas with good sources of hydropower tend to attract industries with large needs for electricity"¹⁵. The spin-off effects of establishing hydroelectric facilities suggest that this alternative energy source has the capacity to attract large scale manufacturing establishments into close proximity of the facility and has the potential for substantial job creation at hydroelectric generator sites.

Ohio River - Ohio, Kentucky, Michigan, Virginia, West Virginia

American Municipal Power¹⁶ (AMP) is constructing one of the nation's largest hydropower generating facilities with five stations along the Ohio River. These sites will convert existing dams into alternative energy facilities that will provide the local region with an abundant supply of affordable energy. The facilities are slated to go online in 2013 and will cost a total of \$416 million dollars¹⁷. The benefits of the hydro dams will be far reaching and power from "the [project] will eventually be sold to municipal electric systems in 79 communities in Kentucky, Ohio, Michigan, Virginia and West Virginia"¹⁸. When all five dams along the Ohio have been converted to functioning hydroelectric generators, the facilities will reduce carbon emissions by

¹⁴ Water Energy FAQ. LennTech: Water Treatment Solutions. <http://lenntech.com/water-energy-FAQ.html>. Last accessed November 4, 2010.

¹⁵ Renewable Energy Sources in the United States. NationalAtlas.gov. http://www.nationalatlas.gov/articles/people/a_energy.html#one. Last accessed November 4, 2010.

¹⁶ "AMP is the nonprofit wholesale power supplier and services provider to 129 member municipal electric systems in Kentucky, Michigan, Ohio, Pennsylvania, Virginia, and West Virginia". Project Development: From Concept to Construction: Steps to Developing a Hydro Project. Meier, Phil; Blaszczyk, Paul; Harris, Craig; and Gilbert, Kirby. Hydroworld.com. <http://www.hydroworld.com/index/display/article-display/1449359119/articles/hydro-review/volume-29/issue-3/articles/project-development.html>. Last accessed November 3, 2010.

¹⁷ Cannelton Locks and Dam: Power of Ohio River to be harnessed to create green energy. Newton, Katie. U.S. Army Corp. of Engineers: Louisville District. <http://www.lrl.usace.army.mil/diwms/news.asp?id=127>. Last accessed November 3, 2010.

¹⁸ Powerhouse Construction to Begin on Hydroelectric Plant. IstockAnalyst. August 29, 2010. <http://www.istockanalyst.com/article/viewiStockNews/articleid/4449437>. Last accessed 11/1/2010.

2 million metric tons and “will supply more than 350-megawatts of renewable energy into the region”¹⁹ each year.

Job creation resulting from this large scale project will occur in three areas; 1) temporary construction jobs, 2) permanent facility operating jobs, and 3) regional manufacturing jobs. Each of the project sites will create between 200 and 400 temporary construction jobs and there will be approximately 10-12 permanent employees operating each of the plants²⁰. Voith Siemens Hydro is now under contract with AMP to manufacture turbine components locally in York, Pennsylvania and is exploring the feasibility of opening additional manufacturing operations in Ohio. The order intake for Voith Siemens Hydro resulting from this project is expected to be \$300 million dollars²¹, and is expected to have additional indirect job creation impacts on the regional economy by creating new demand for suppliers and tertiary industries.

The AMP dams are an example of a large scale hydro project that is possible due to cooperation between federal, state, and municipal entities, and due to the abundance of water and the ability to capitalize on an existing lock system. Capturing energy from water that is already falling at height differentials along the Ohio River significantly lowers the upfront costs and makes hydropower economically feasible. The potential for other communities to similarly tap into existing dams, whether they are on large rivers or on small tributaries, is substantial. Currently, “just 3 percent of the nation’s more than 82,000 dams generate electricity”²². One barrier to implementing hydro power from existing dams is the cost of conversion. Secured Clean Renewable Energy Bonds (CREBs) are one way to reduce the upfront costs of implementation. The Ohio River project has received a total of \$22.6 million in CREBs to date²³.

¹⁹ Cannelton Locks and Dam: Power of Ohio River to be harnessed to create green energy. Newton, Katie. U.S. Army Corp. of Engineers: Louisville District. <http://www.lrl.usace.army.mil/diwms/news.asp?id=127>. Last accessed November 3, 2010.

²⁰ Powerhouse Construction to Begin on Hydroelectric Plant. IstockAnalyst. August 29, 2010. <http://www.istockanalyst.com/article/viewiStockNews/articleid/4449437>. Last accessed 11/1/2010.

²¹ Voith Siemens Hydro Receives \$300M Order for Ohio River Projects. June 24, 2010. SustainableBusiness.com. <http://www.sustainablebusiness.com/index.cfm/go/news.display/id/16264>. Last accessed November 3, 2010.

²² AMP breaks ground on Ohio River hydro plant. August 7, 2010. Hydroworld.com. http://www.hydroworld.com/index/display/article-display/6453074438/articles/hrhrw/hydroindustrynews/newdevelopment/amp-breaks_ground.html. Last accessed November 3, 2010.

²³ Project Development: Hydro Development: A New Day. Hydroworld.com. <http://www.hydroworld.com/index/display/article-display/361642/articles/hydro-review/volume-27/issue-2/feature-articles/project-development-hydro-development-a-new-day.html>. Last accessed November 3, 2010.

Federal, state, and municipal cooperation is imperative in the establishment of large scale hydroelectric facilities because these projects often directly impact many states simultaneously. As is the case with the Ohio River, the river itself is the border between the five states benefitting from the generated power. Cooperative policies and inter-governmental support to revitalize these existing dams is central to the success of such a large scale alternative energy project.

Boulder Micro-Hydro - Colorado

Creating large dams can negatively affect the local ecosystem and thus oftentimes big dams are met with significant public opposition. However, hydropower generation does not need to exist solely on the scale of the Ohio River project. ‘Micro-hydro’ facilities can be important to smaller rural communities and can be used to promote economic development. Beginning in 1985, Boulder Colorado installed eight hydroelectric generators in the city’s municipal water system. The power capacity of all eight generators combined is roughly 20.1 MWh²⁴, enough to power 7,500 homes²⁵ or roughly 11 percent of the electricity needed by the city’s 96,000 residents²⁶. The installation and up-front investment costs totaled approximately \$12 million and, as of 2009, the City is deriving revenue of \$20.2 million dollars²⁷ from the generators. Once generated, the hydropower is sold to the private Xcel Company. The City is benefiting from this alternative energy investment both financially and environmentally. “Boulder’s hydropower project is estimated to have displaced the need to burn 170,000 tons of coal since the first generator went online”²⁸.

Recently the City of Boulder received \$1.18 million dollars in Federal Recovery and Reinvestment Funds. These funds were added to \$4 million of the City’s money to renovate one

²⁴ Hydroelectricity. City of Boulder Colorado.

http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=4994&Itemid=1189. Last accessed November 2, 2010.

²⁵ Hydroelectricity. City of Boulder Colorado.

http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=4994&Itemid=1189. Last accessed November 2, 2010.

²⁶ Case Study: The Benefits of Small Hydro in Boulder, Colorado. April 12th, 2009. ChelseGreen: The Politics and Practice of Sustainable Living. <http://www.chelseagreen.com/content/case-study-the-benefits-of-small-hydro-in-boulder-colorado/>. Last accessed November 2, 2010.

²⁷ Hydroelectricity. City of Boulder Colorado.

http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=4994&Itemid=1189. Last accessed November 2, 2010.

²⁸ Case Study: The Benefits of Small Hydro in Boulder, Colorado. April 12th, 2009. ChelseGreen: The Politics and Practice of Sustainable Living. <http://www.chelseagreen.com/content/case-study-the-benefits-of-small-hydro-in-boulder-colorado/>. Last accessed November 2, 2010.

of the generators; an investment anticipated to generate \$8 million dollars of electricity over its lifespan²⁹. In addition to the profits derived from electricity generation, the Boulder facilities also create project development, deployment, operations and maintenance jobs.

The Boulder micro-hydro case study highlights two issues facing all communities that utilize alternative energy through cooperation with private companies to deliver the generated electricity. Firstly, the issue of who should receive the Renewable Energy Credits from the federal government must be mutually agreed upon. In this instance, the City of Boulder received 50% of the credits, and the Xcel Company receives 50%. This arrangement was agreed upon after a lengthy debate and costly litigation and negotiations are underway for a new contract between the City and Xcel. “Xcel has indicated they are unwilling to continue the current contract status of 50% city/ 50% Xcel ownership of the RECs”³⁰ Secondly, the project was not successful at creating local manufacturing jobs. Currently, most of the infrastructure comes from China, Spain and England, and while Boulder sought to purchase domestic equipment, the supply of such was insufficient. Without capitalizing on the manufacturing job potential, these facilities are not creating as many permanent jobs as they could. This current reality must be included in a community’s decision to either build or renovate small scale hydro facilities.

Solar Power Facilities

Harnessing energy from sunlight comes in two main forms: direct and indirect. Direct solar energy conversion uses panels, or PhotoVoltaic Arrays (PV’s), which are then mounted on the ground, or to building based supports. Indirect solar energy conversion uses Concentrated Solar Power (CSP) lenses or mirrors to track the sun’s energy and to concentrate rays into a high intensity beam. CSP functions in a way similar to using a magnifying glass to concentrate solar energy. The concentrated energy is then used as a heat source in a conventional power facility. CSP must capture large quantities of the sun’s energy, and are thus limited to warmer climates such as the southwestern U.S. Primary barriers to solar energy implementation are generation and transmission costs, and innate regional differences that preclude solar from being a viable

²⁹ Hydroelectricity. City of Boulder Colorado.
http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=4994&Itemid=1189. Last accessed November 2, 2010.

³⁰ Boulder’s Long-Term Energy Strategy, Renewable Energy Credits and the Xcel Franchise. Boulder City Council Study Session. April 13, 2010. http://www.bouldercolorado.gov/files/City%20Manager/other_cm-cc_communications/Energy_Future/Renewable_Energy_Credits.pdf. P.34. Last accessed November 9, 2010.

option in areas of the country. Solar power, in theory, has the capacity to provide a significant share of the U.S energy demand. “Although solar intensity varies across the nation, the land-based solar resource provides a yearly average of more than 5×10^{22} J (13.9 million TWh) and thus exceeds, by several thousand-fold, present annual U.S. electrical energy demand, which totals 1.4×10^{19} J (~4,000 TWh). Hence, at even modest conversion efficiency, solar energy is capable, in principle, of providing enormous amounts of electricity without stress to the resource base”³¹. There is great potential to attach PV panels directly to residential and commercial rooftops to generate energy. “Estimates of the rooftop area suitable for installation of PV systems have been performed state-by-state for the whole United States”³². The results show that 22% of all residential rooftops, and 65% of all commercial rooftops could support PV panels³³.

Ivanpah Solar Energy Generating System - California

Plans are underway between Brightsource Energy Inc, a California based solar thermal power plant developer, and the California Energy Commission to site the world’s largest CSP facility in the Mojave Desert. The Ivanpah Solar Energy Generating System (ISEGS) will consist of three separate plants generating a combined 392 MW of electricity. The U.S Department of Energy has conditionally committed \$1.37 billion to the project in the form of a conditional loan. The existence of ISEGS alone will double the solar electricity output of the United States³⁴.

This large scale project will have profound economic development impacts upon the local area. Short-term construction labor jobs are estimated to surpass 1,000 workers. In the long-term, employment at the massive plant will generate over \$650 million dollars in earnings over the next thirty years of operation³⁵, and the project is estimated to generate \$8.2 million dollars in tax

³¹ Electricity from Renewable Sources: Status, Prospects, and Impediments. National Academy of Sciences, National Academy of Engineering, National Research Council. National Academies Press, Washington D.C. P. 4

³² Electricity from Renewable Sources: Status, Prospects, and Impediments. National Academy of Sciences, National Academy of Engineering, National Research Council. National Academies Press, Washington D.C P. 49

³³ Electricity from Renewable Sources: Status, Prospects, and Impediments. National Academy of Sciences, National Academy of Engineering, National Research Council. National Academies Press, Washington D.C P. 49

³⁴ Climate Progress. Brightsource To Build Largest Concentrating Solar Power Plant. August 8, 2010. <http://climateprogress.org/2010/08/08/brightsource-to-build-largest-concentrating-solar-power-plant/>. Last accessed December 12, 2010.

³⁵ Climate Progress. Brightsource To Build Largest Concentrating Solar Power Plant. August 8, 2010. <http://climateprogress.org/2010/08/08/brightsource-to-build-largest-concentrating-solar-power-plant/>. Last accessed December 12, 2010.

revenue for the County each year³⁶. In an effort to reduce land consumption, ISEGS will use a unique design wherein solar panels are mounted to poles that extend vertically rather than rest the panels horizontally on concrete slabs on the ground. The completed project will cover approximately 5.3 miles of desert land³⁷. Using desert land is economically advantageous in the sense that opportunity costs for these areas are generally low. Additionally, solar facilities typically require less land to generate electricity than do hydroelectric facilities or coal plants. Lower land use conflicts adds to the viability of solar energy as an economic alternative. However, it is important to note that desert lands are often times protected from development, as is much of the eastern Mojave, and so conservation policy conflicts may arise in the siting of CSP stations³⁸. Additionally, transmission stations must be sited to distribute the captured energy effectively.

Once captured, the energy would be converted into electricity that would be transmitted through the Southern California Grid through a series of grid upgrades. The electricity would then be sold to area residents through both Pacific Gas and Electric Co. and Southern California Edison Co. Current estimates approximate that the generated electricity would power 140,000 area homes³⁹. Another interesting feature of ISEGS is that the plant will operate a closed loop water recycling system to reduce water consumption by 95% that of other solar thermal facilities⁴⁰. This technology is incredibly important to the viability of CSP solar facilities as places with high concentrations of solar energy area likely to be those without access to high quantities of water. Recycling water throughout the operations of the plant will greatly reduce input costs and reduce the market clearing price.

ISEGS is possible primarily due to the area's natural assets of direct sunlight, ample space, and also due to substantial federal support. Without the \$1.37 billion dollars from the U.S Department of Energy, this project would not likely be seen through to fruition. As mentioned

³⁶ BrightSource Energy Ivanpah Solar Electric Generating System. Bureau of Land Management. http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS_REALTY_AND_RESOURCE_PROTECTION_/energy/solar_and_wind.Par.78074.File.dat/factIvanpahSEGS.pdf. Last accessed 12/10/10

³⁷ Ivanpah Solar Electric Generating System. The California Energy Commission. <http://www.energy.ca.gov/sitingcases/ivanpah/index.html>. Last accessed 12/09/10.

³⁸ The Ivanpah Solar Facility is sited in the Western Mojave.

³⁹ Climate Progress. Brightsource To Build Largest Concentrating Solar Power Plant. August 8, 2010. <http://climateprogress.org/2010/08/08/brightsource-to-build-largest-concentrating-solar-power-plant/>. Last accessed December 12, 2010.

⁴⁰ Ivanpah Solar Electric Generating System. Brightsource Energy Co. <http://ivanpahsolar.com/>. Last accessed 12/9/10.

above, the areas of the country that are suited for CSP solar energy are limited. To implement this technology, an area must have abundant direct sunlight in an area large enough to place large panels. If this is a remote area, transmission infrastructure is necessary, and upgrades to the existing power grid would be mandated to process the new energy input. Not every place in the country interested in CSP needs to create a structure on the scale of Ivanpah, however, there are lessons that areas need to glean from the practices of this facility. Access to potable water is important, but Ivanpah shows there are technologies available to reduce water consumption, which has the long term economic benefit of lowering input costs. For the areas of the country for which this is a good fit, CSP can provide substantial economic benefits in terms of lower energy costs, tax revenue, and job creation to the community receiving the generated energy.

Tori Richard – Hawaii

Clothing manufacturer Tori Richard is the first domestic manufacturing facility to use solar PV panels to generate nearly all of its electricity. The Honolulu-based clothing manufacturer installed 676 PV panels onto its roof in 2008⁴¹. The upfront investment for the installation was \$1.1 million dollars, and the panels now provide the facility with 94% of its requisite electricity⁴². The solar panels combined have a capacity of 154 kWh. When compared with the company's electricity needs, generating energy from solar panels will reduce overhead costs by \$84,000 per year⁴³. The monthly electric bill now goes mostly to Hawaiian Electric Co. who runs the PV driven generation. The company candidly shares that their motivation for seeking alternative energy was economically driven, and that the conversion process was meticulously designed to have a marked return on investment. "Each phase of the project had at least a three-year ROI"⁴⁴.

⁴¹ Sunetric Commercial Case Study: Tori Richard LTD. Sunetric. <http://www.sunetric.com/assets/Documents/ToriRichard.pdf>. P.1. Last accessed 12/8/2010.

⁴² Sunetric Commercial Case Study: Tori Richard LTD. Sunetric. <http://www.sunetric.com/assets/Documents/ToriRichard.pdf>. P.1. Last accessed 12/8/2010.

⁴³ Hawaii Business: SmallBiz Energy Makeover Going Green Results In Major Savings. Enay, Shara. <http://www.hawaiibusiness.com/SmallBiz/October-2010/SmallBiz-Energy-Makeover/index.php?cparticle=2&siarticle=1>. Last accessed 12/8/2010.

⁴⁴ Hawaii Business: SmallBiz Energy Makeover Going Green Results In Major Savings. Enay, Shara. <http://www.hawaiibusiness.com/SmallBiz/October-2010/SmallBiz-Energy-Makeover/index.php?cparticle=2&siarticle=1>. Last accessed 12/8/2010.

Tori Richard was able to make this conversion due to heavy state and federal tax incentives for solar installation. These subsidies allowed the company to undertake a three phased system of energy upgrades, the final stage being the installation of the solar panels. Before adding the panels, the company replaced all lighting, and did everything they could to reduce their overall electricity usage. This electricity reduction would allow solar to provide a larger share of the company's total usage. "PV should always be the last phase, because you want to minimize the size of the PV system and you do that by lowering your usage"⁴⁵. Additionally, the company was able to finance the project by leasing the system from the Bank of Hawaii, where the green energy incentive credits were included in the capitalized lease cost⁴⁶. This strategy allowed the company to avoid the up-front financial burden.

This conversion to solar energy created both temporary installation jobs and the opportunity for the company to create permanent jobs by utilizing capital formerly spent on energy. When commercial entities decrease their input costs, they free up dollars that can be used to hire new workers, and of course these new employees create lasting economic benefits to the area economy. Also, from a municipal, regional, or even state perspective, assisting a company in such a large scale upgrade that provides notable cost savings further 'roots' that company in the area, helping ensure that the company does not leave in search of cheaper land or alluring tax incentives. Since many companies are 'foot-loose,' that is, can viably exist almost anywhere, practices that make it more attractive to remain in place, and that promote business retention and expansion are vital to local economies. The upfront costs of providing solar installation incentives have a long term public financial benefit of incentivizing manufacturing facilities to remain in the building outfitted with solar panels. In the event that the company does relocate, filling the now vacant building will be easier due to the built in lower energy costs.

⁴⁵ Hawaii Business: SmallBiz Energy Makeover Going Green Results In Major Savings. Enay, Shara. <http://www.hawaiiibusiness.com/SmallBiz/October-2010/SmallBiz-EnergyMakeover/index.php?cparticle=2&siarticle=1>. Last accessed 12/8/2010.

⁴⁶ Hawaii Business: SmallBiz Energy Makeover Going Green Results In Major Savings. Enay, Shara. <http://www.hawaiiibusiness.com/SmallBiz/October-2010/SmallBiz-Energy-Makeover/index.php?cparticle=2&siarticle=1>. Last accessed 12/8/2010.