



GRAND VALLEY SOLAR CENTER AND THE NATURAL RESOURCES AND LAND
POLICY INSTITUTE AT COLORADO MESA UNIVERSITY



SOLAR POWER IN MESA COUNTY, COLORADO

The Growth of “Grid-Tie” Solar

Dr. Lou Villaire

10/15/2012

ABSTRACT

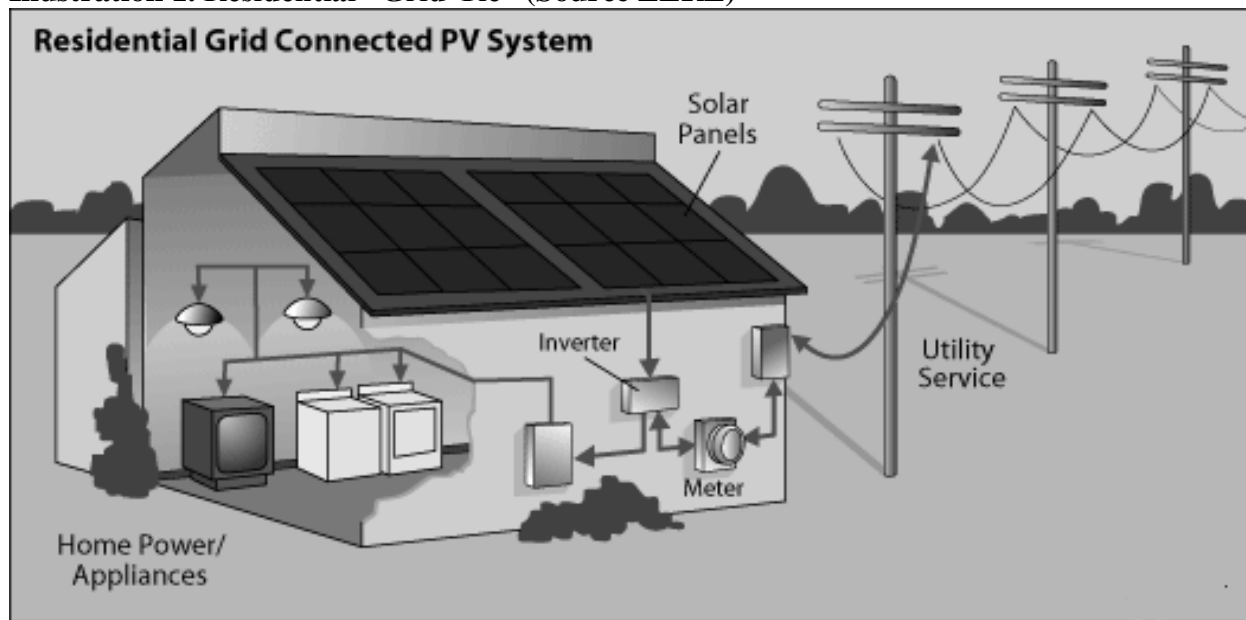
In the last 6 years approximately 10 megawatts of solar electric power capacity has been installed in the Grand Valley of western Colorado. This solar power provides enough generation capacity to power about 1500 homes and businesses in the Grand Valley. Before the Spring of 2006, there were no “grid-tie” solar electric systems in the Grand Valley of Colorado. Since the Spring of 2006, there have been over 1200 “grid-tie” solar electric systems installed in the Grand Valley. And by the end of 2012, there will be approximately 1500 “grid-tie” systems in the Grand Valley. The “grid-tie” solar industry has grown 100% per year in Colorado and the Grand Valley since 2006. In the Grand Valley alone, this now represents an approximately 12-15 million dollar annual industry. The Grand Valley Solar Center estimates that solar power generators in the Grand Valley net residential and commercial customers over 2 million dollars annually in energy savings, while offsetting 600 tons of carbon dioxide/month. This report gives some details on this remarkable growth in solar in the Grand Valley of western Colorado.

RESIDENTIAL AND COMMERCIAL CUSTOMER SITED SOLAR POWER IN MESA COUNTY, CO

Introduction

Solar cells that produce electricity are known as “photovoltaics” or “PV”. PV uses semiconductor materials to convert sunlight into electric current (photons to electrons). Customer sited “grid-tie” solar power means that the solar power is produced on site, and the customer receives the solar power directly from the PV system for the customer’s consumption. The customer remains connected to the “grid” and has no need for energy storage such as lead acid batteries. See illustration 1 to see how a “grid-tie” PV system works.

Illustration 1. Residential “Grid-Tie” (Source EERE)



Right now PV only provides a small portion of the world’s electricity - a generation capacity of some 70,000 megawatts (MW). But do to technological improvements; cost decreases and policies that promote PV in many states and countries, annual PV production has increased dramatically. Photovoltaic production has been doubling every two years, increasing by an average of 50 percent each year since 2002, making it the world’s fastest-growing energy technology. The largest world markets for PV are in Italy, Germany, China, France, and the US. U.S. PV installations have grown by 500% percent in since 2009. U.S. Big-box retail stores led the PV installation boom including Wal-Mart, Best Buy, Home Depot and others, along with municipal and utility large scale PV installations of 1-300 megawatts. In total, the U.S. now has 5.7 gigawatts of installed solar capacity, enough now to power 1 million homes in the US.

Colorado is now the 6th largest PV market in the US. In order, to place the Colorado PV market in context, what follows is a short description of the two largest state PV markets in the US, California and New Jersey, and then details on the Colorado solar market.

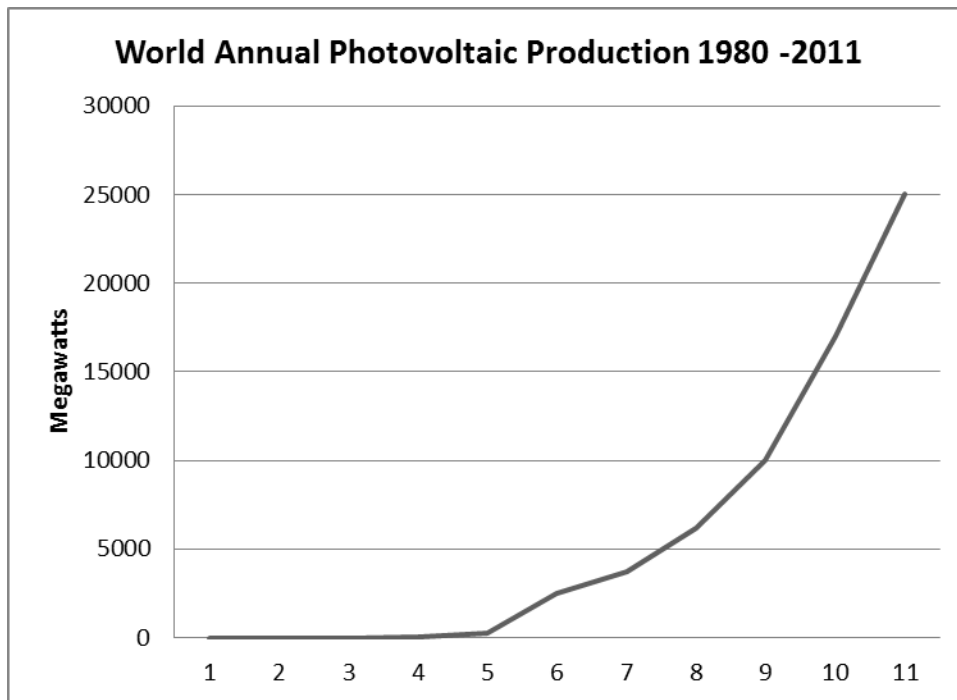


Chart 1. World Annual PV Production Source: SEIA

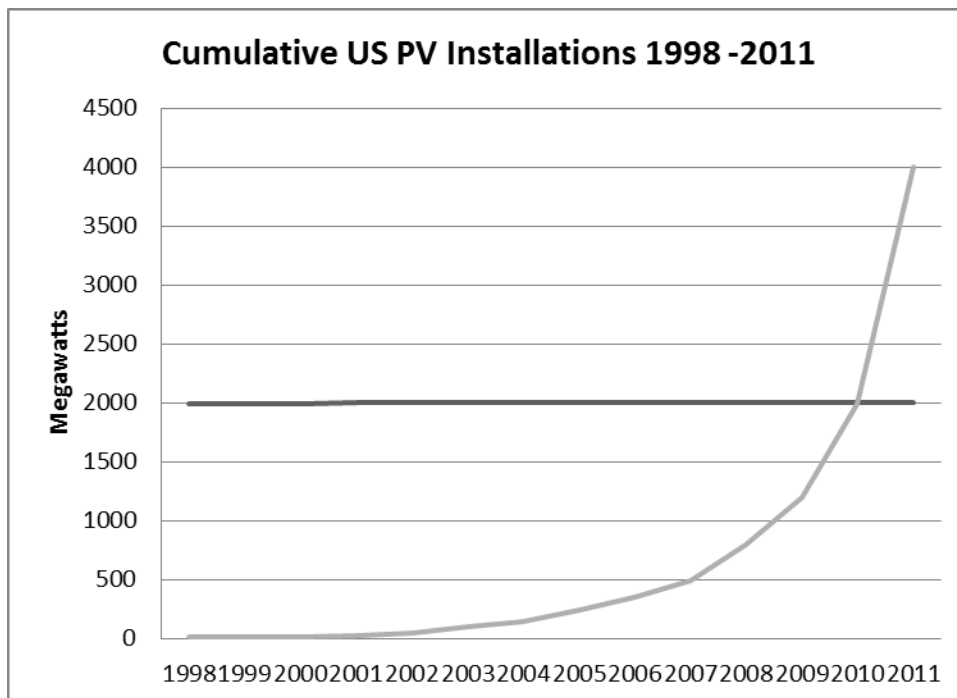


Chart 2. Cumulative PV Installations in the US Source: IREC

US Markets

The state of California enacted the largest solar program outside of Germany through the passage of the California Solar Initiative (CSI) and Million Solar Roofs program. Numerous other states improved solar programs in 2007 that expand incentives or require the use of solar as part of their state Renewables Portfolio Standards (RPS). Thirty seven states and the District of Columbia now have mandatory or voluntary Renewables Portfolio Standards. The RPS is a policy that requires retail sellers of electricity to include in their resource or generation portfolio a certain amount of electricity generated from “new” renewable energy resources (usually solar, wind, and biomass).

California is still the dominant U.S. market for PV, but shrank from a U.S. market share of 73 percent of the grid-tied installations in 2006 to (see Table 1) 30% in 2011. New Jersey remains the second largest solar market. CO is the sixth largest US state market for solar energy after California, New Jersey, Arizona, New Mexico, and Pennsylvania. Colorado continues to have PV rebates that are relatively good. What are solar PV rebates?

Table 1. Installed PV by State, 2011 Source: IREC

State	Installed MW Solar PV 2011
California	537
New Jersey	306
Arizona	287
New Mexico	132
Pennsylvania	78
Colorado	75
New York	68
Texas	51
North Carolina	45
Hawaii	40
All Other States	232

Solar Rebates

States, local governments and utilities offer rebates and incentives to promote the installation and use of renewable energy and energy efficiency measures. The majority of rebate programs that support renewable energy are administered by state agencies, municipal, and investor owned utilities and electric cooperatives; these programs commonly provide funding for solar water heating and/or photovoltaic (PV) systems. Rebate amounts vary widely based on technology and program administrator. PV rebates usually come based on per-watt installed or they are performance based incentives (PBI) – tied to electric output of the system (kWh). In general, PV rebate programs are moving in the direction of PBI, and are designed to be phased-out over time, as has taken place in Japan, and is now taking place in Germany, Spain, Italy, and France.

California Solar

California's Renewables Portfolio Standard (RPS) program requires retail sellers of electricity to increase their sales of eligible renewable-energy resources by at least 1 percent of retail sales per year, so that 20% of their retail sales are now served with eligible renewable energy resources. The state of California has set a longer-term state goal of 33% by 2020, and currently the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) are considering ways to achieve that goal. California's Pacific Gas & Electric recently contracted for almost 1 Gigawatt (GW) of PV (1000 kW).

The California Solar Initiative (CSI) provides more than \$3 billion in incentives for solar-energy projects with the objective of providing 3,000 megawatts (MW) of solar capacity by 2016. The CA CSI targets commercial and residential projects. The CSI rebates were originally limited to customers of the state's investor-owned utilities. However, the CSI was expanded in 2006 to include municipal utility territories. Municipal utilities were required to offer incentives beginning in 2008. The CSI transitions to performance-based incentives (as opposed to rebates based on per-watt installed), with the purpose of promoting quality design and long-term electricity output. CSI incentive levels will be reduced over the length of the program. The CA rebate program is managed by the Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), and the California Center for Sustainable Energy. Average CA PV costs per-watt installed have decreased 60-70% from \$12 to ~\$6/watt installed PV system cost.

New Jersey Solar

New Jersey's Renewable Portfolio Standard (RPS) is one of the most aggressive in the US. It requires NJ utilities to reach 22.5% renewable power production by 2021. The New Jersey Board of Public Utilities (BPU) made revisions to the RPS in 2006, which significantly increased the required percentages of solar energy. By the year 2021, 2.12% solar electricity is required. New Jersey's 1999 electric restructuring legislation provides for investments in energy efficiency and renewable energy through a "Societal Benefits Charge" (SBC) collected from all customers of electric public utilities. In 2001, the BPU approved funding for renewable-energy programs, including a customer-sited renewables rebate program for homes, businesses, institutions and non-profits. The NJ solar rebate program is also being transitioned from a capacity based incentive to a PBI. In July 2012 New Jersey enacted S.B. 1925, which revises in solar set aside.

Colorado Solar Amendment 37

Colorado became the first U.S. state to create a renewable portfolio standard (RPS) by ballot initiative when voters approved Amendment 37 in November 2004. The original version of Colorado's RPS required utilities serving 40,000 or more customers to generate or purchase enough renewable energy to supply 10% of their retail electric sales. The original RPS also implemented a rebate program for customers of the state's two investor-owned utilities, Xcel Energy and Aquila. Xcel Energy is a public utility company based in Minneapolis, Minnesota, serving customers in Colorado, Michigan, Minnesota, New Mexico, North Dakota, South

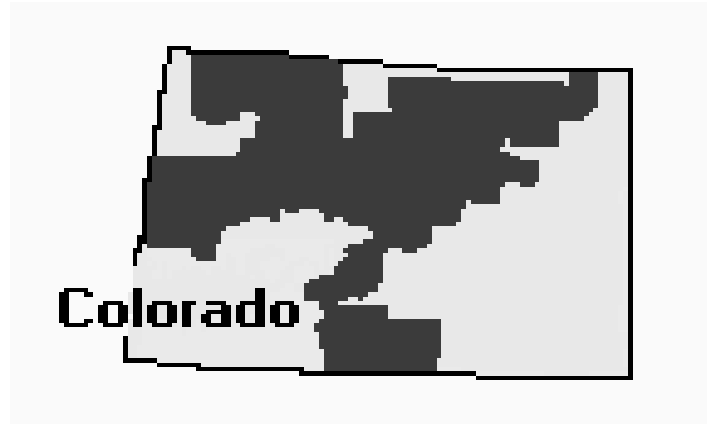
Dakota, Texas, and Wisconsin. Xcel Energy provides electricity services to approximately 3.4 million customers, and natural gas services to approximately 1.8 million customers.

In 2007, Colorado House Bill 1281 increased the RPS and extended the renewable-energy requirement to state electric cooperatives, among other changes. HB 1001 of 2010 further expanded the RPS to be 30% by 2020. Eligible renewable-energy resources include solar-electric, wind, geothermal-electric, biomass facilities that burn nontoxic plants, landfill gas, animal waste, hydropower, recycled energy, and fuel cells using hydrogen sourced from eligible renewables. The RPS rules were changed as required by HB 1001 in August 2010. The RPS rules generally apply to investor-owned utilities. Electric cooperatives and municipal utilities serving more than 40,000 customers are still bound to the separate requirement approved by the state legislature in 2006. Colorado's RPS requires each investor-owned utility to provide specific percentages of renewable energy and/or recycled energy according to this timetable: 3% of its retail electricity sales in Colorado for the year 2007; 5% of its retail electricity sales in Colorado for the years 2008-2010; 12% of its retail electricity sales in Colorado for the years 2011-2014; 20% of its retail electricity sales in Colorado for the years 2015-2019; and 30% of its retail electricity sales in Colorado for the year 2020 and for each following year.

For investor-owned utilities, at least 4% of the RPS must be generated by solar-electric technologies. And, at least one-half of the solar requirements must be generated by solar-electric systems located on-site at customer facilities. The 2006 update of the Colorado's RPS now requires all electric cooperatives to provide specific percentages of renewable energy and/or recycled energy according to the following timetable: 1% of its retail electricity sales in Colorado for the years 2008-2010; 3% of its retail electricity sales in Colorado for the years 2011-2014; 6% of its retail electricity sales in Colorado for the years 2015-2019; and 10% of its retail electricity sales in Colorado for the year 2020 and each following year.

There is no solar specific RE requirement for electric cooperatives and eligible municipal utilities, but solar electricity generated by a facility receives 300% credit for CO RPS-compliance. About a dozen of CO electric co-ops are now offering limited solar rebates with matching funding from the Governor's Energy Office. This number is sure to rise next year as the funding for this rebate program doubles.

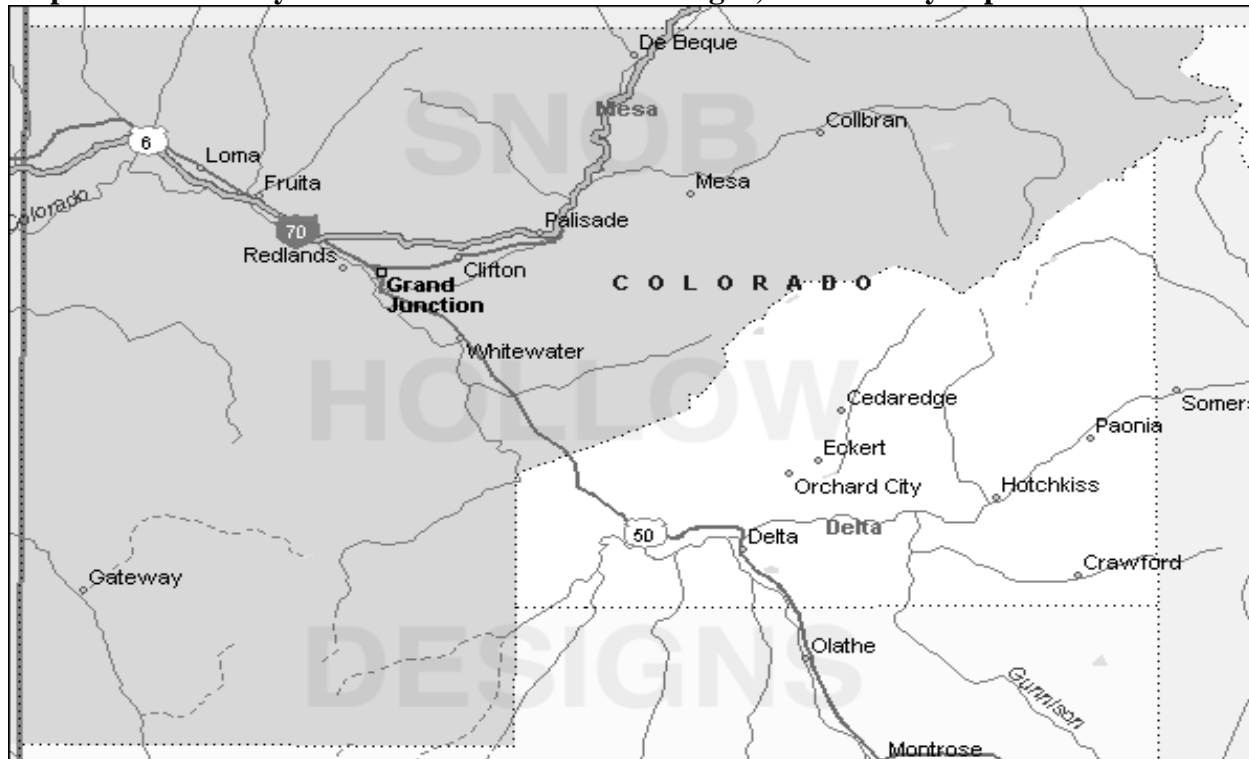
Map 1. Xcel Energy Service Territory in Colorado (Natural Gas and Electric, xcelenergy.com)



About 10% of Xcel Energy's Colorado electricity customers (3% of total electricity customers) are in Mesa County.

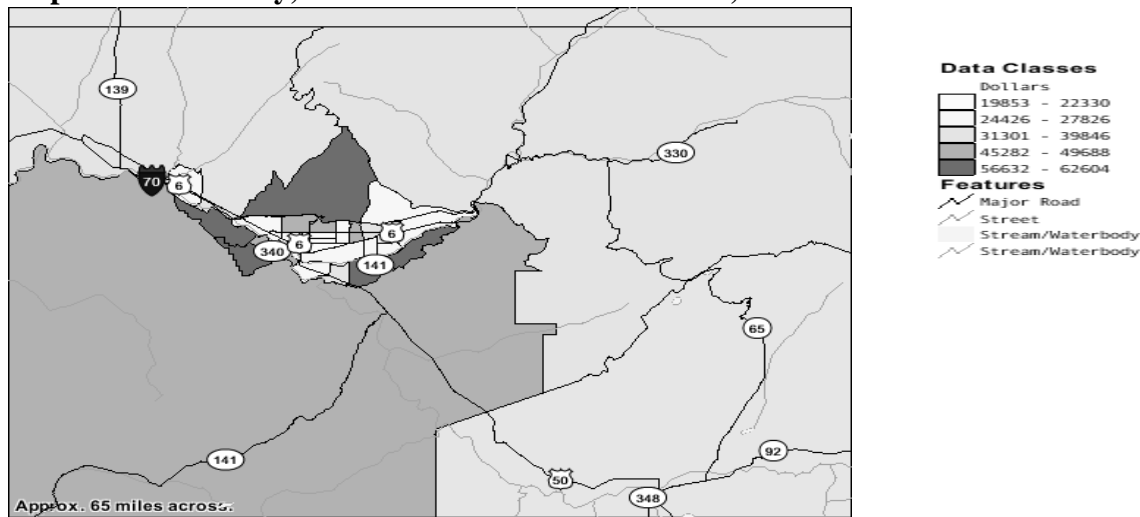
Brief Description of Mesa County

Map 2. Mesa County CO Source: Snob Hollow Designs, www.countymapscolorado.com

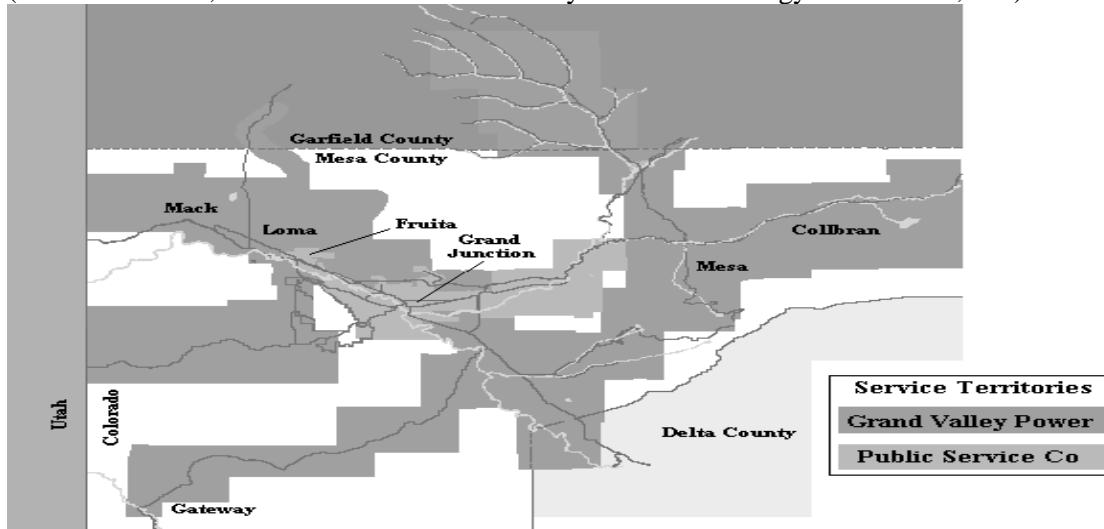


Mesa County is located on the western border of Colorado, 250 miles west of Denver. The County encompasses about 3,309 square miles. Approximately 72% of the land in Mesa County is public owned and is controlled primarily by the U.S. Forest Service and the Bureau of Land Management. Grand Junction is the Mesa County Seat, and is the largest city in Western Colorado. The Grand Junction area serves as the banking center, health care service provider and retail trade center for a large geographical area in western Colorado and eastern Utah. Today Mesa County is home to more than 146,000 people in 15 communities. The largest of these is Grand Junction, followed by Fruita and Palisade. Other towns and unincorporated areas of the County include Clifton, Fruitvale, De Beque, Collbran, Mesa, Mack, Loma, Gateway, Glade Park and Whitewater. From 1990 to 2000 Mesa County's population grew by 24.8%, putting it in the top 10% of counties nationwide in terms of population growth. The Colorado Department of Local Affairs projected that Mesa County's population would grow to about 144,000 by 2010, which is 22.8% growth from 2000, and to about 225,000 by 2025, which is 92.3% growth from 2000. Most of the household wealth in Mesa County is concentrated in outlying areas of Grand Junction – Redlands, North of GJ, and Orchard Mesa. See Map 3. Map 4 shows the service territories of Grand Valley Power and Xcel Energy in Mesa County.

Map 3. Mesa County, CO Median Household Income, 2000 Census Source: Census.gov



Map 4. Xcel Energy and GVP Service Territory in Mesa County (gvp.org)
(GVP serves ~16,000 customers in Mesa County while Xcel Energy serves ~120,000.)



Greater Grand Junction PV Market *Local Economic Impact*

Before 2006, there were no “grid-tie” solar electric systems in the Grand Valley of Colorado. In the Spring of 2006, the first “grid-tie” was installed in a residence in GJ. Since then there have been over 1200 “grid-tie” solar electric systems installed in the Grand Valley. And by the end of

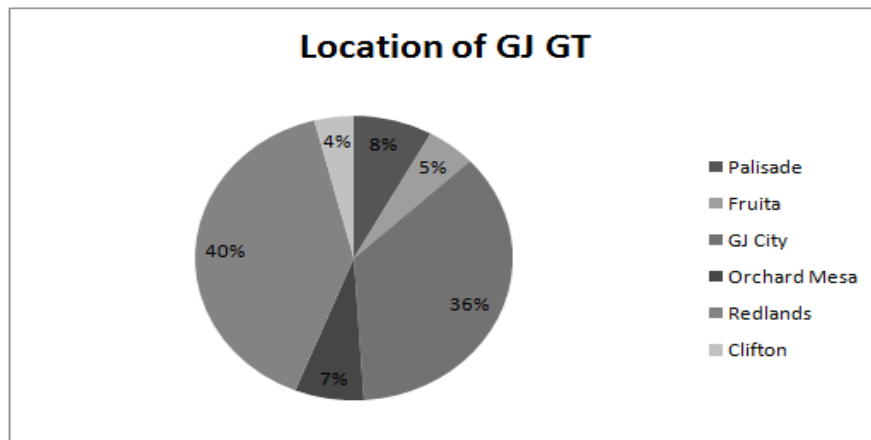
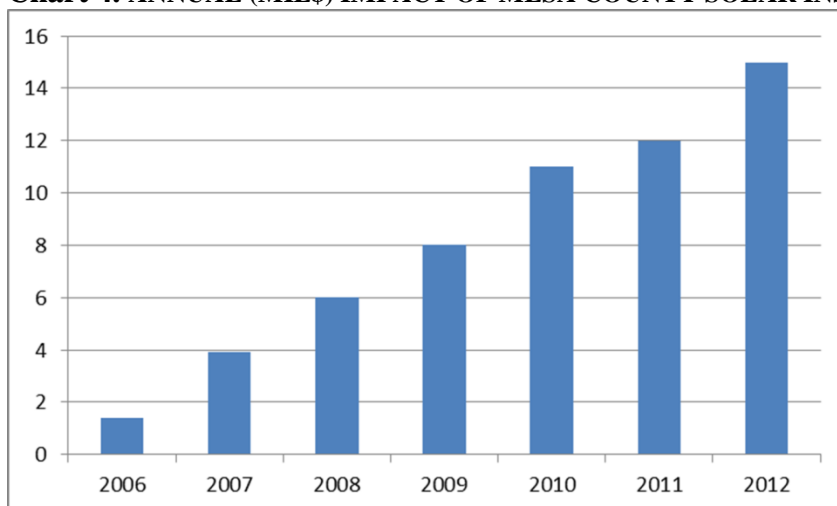


Chart 3. Distribution of Grand Junction Grid Tie Solar

2012, there will be approximately 1500 “grid-tie” systems in the Grand Valley (see Charts 3 and 5), which will likely exceed 12MW of installed capacity (see Chart 6).

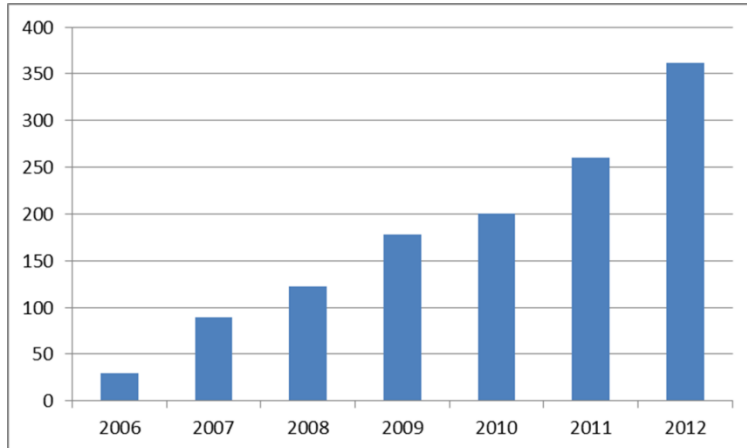
The “grid-tie” solar industry has grown 100% per year in Colorado and the Grand Valley since 2006. In the Grand Valley alone, this now represents an approximately \$15,000,000.00 annual industry in 2012 (see Chart 4). According to the Colorado Solar Industries Association (COSEIA), there are now over 400 solar related companies in Colorado. Colorado officials state that CO is now the number one state for renewable energy research, development, and deployment. In the Grand Valley there are 10-15 companies directly engaged in the solar industry. This includes a half dozen installation companies, electrical contractors, and electrical suppliers. Estimates indicate that the PV industry in the Grand Valley directly employs 40-50 people, and indirectly employs another 25-30.

Chart 4. ANNUAL (MIL\$) IMPACT OF MESA COUNTY SOLAR INSTALLATIONS 2006 – 2012



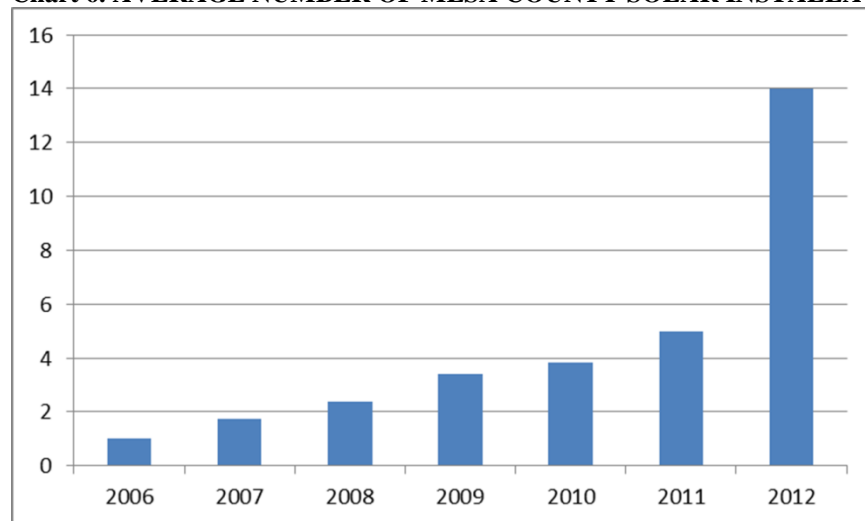
Surveys of solar customers reveal that there are three main reasons why they chose solar. First, they enjoy the energy independence. Second, they are concerned with the “straight payback” of the solar. And third, customers are concerned with the ecological impacts of fossil fuels.

Chart 5. ANNUAL NUMBER OF MESA COUNTY SOLAR INSTALLATIONS 2006 – JUNE 2012



Approximate calculations indicate that about 15% of Xcel Energy Solar Rewards Rebates have been paid out to residents in Mesa County. Rough calculations indicate that each Colorado Xcel Energy customer has paid about \$45 toward the Xcel Solar Rewards customers solar systems, or approximately \$6.00 - \$12.00/year/customer. GJGT customers are now receiving over 2 million dollars annually in energy savings, while offsetting 600 tons of carbon dioxide/month. The average price per watt installed GJGT has decreased 50-60% from 2006 to 2012. The average size of a residential GJGT is 4-5kW. Xcel Energy now has over 10,000 solar electric systems installed in its service territory in Colorado.

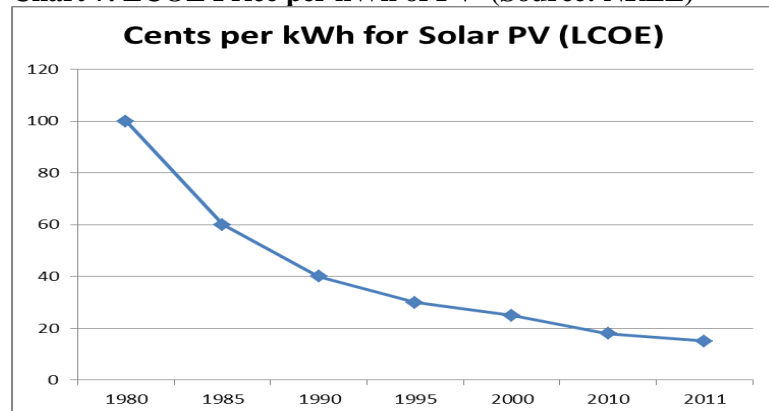
Chart 6. AVERAGE NUMBER OF MESA COUNTY SOLAR INSTALLATIONS PER WEEK 2006 – 2012



Conclusions

The extraordinary growth of grid tie solar in the Grand Valley is a microcosm of the tremendous growth in solar power in the US and worldwide (see Charts 1 and 2). Solar power is now the fastest growing energy source in the world. The levelized cost of producing power from solar PV has steadily decreased in the last 25-30 years. (see Chart 7) Advocates of solar PV claim that PV can reach “grid-parity,” where the cost of producing power from PV is comparable with the cost of producing power from conventional fuels (coal, natural gas, and uranium) sources by 2015.

Chart 7. LCOE Price per kWh of PV (Source: NREL)



Projections indicate that the Grand Junction grid-tie market will continue to grow, although maybe not at the extraordinary rate of the last two to three years, depending on how quickly PV prices continue to decline.

Additional Sources:

“Developing State Solar Photovoltaic Markets: Riding the Wave to Clean Energy Independence,” JP Ross, The Vote Solar Initiative and Bracken Hendricks, Project Manager, Center for American Progress, January 2008.

“U.S. Solar Market Trends 2011, Larry Sherwood, Interstate Renewable Energy Council (IREC), August 2012.

“The Rise of Renewable Energy,” Daniel Kammen, *Scientific American*, pgs. 82-91, Sept 2006.

“Solar Electric Power Association’s First Annual Top Ten Utility Solar Integration Rankings,” Results of the 2007 U.S. Utility Solar Electricity Market Survey, August 4, 2008 Updated Version, authors Mike Taylor, SEPA Director of Research and Yasmeeen Hossain, SEPA Research and Project Analyst.

“Utility Solar Assessment: (USA) Study, Reaching Ten Percent Solar by 2025,” Clean Edge, Inc. And C o-op America Foundation, Ron Pernick Clean Edge and Clint Wilder, June 2008.

(One kW of PV offsets 300lbs of CO₂/month. GJGT customers are now offsetting 1000kW x 300lbs/month = 300,000lbs of CO₂/month, or 150tons of CO₂/month.)

Building Department, Mesa County Colorado, 2006-2012.

Xcel Energy Solar Rewards and Colorado Solar Energy Industries Association (COSEIA).

US Department of Energy, National Renewable Energy Laboratory (NREL), Golden, CO

Report Author:

The author of the Report is Dr. Louis A. Villaire. Mr. Villaire is a former energy analyst at the Gas Technology Institute (oil and gas industry research and development), a researcher at the US Environmental Protection Agency, and now a solar industry market analyst and project developer. Mr. Villaire has an undergraduate degree in renewable energy engineering and environmental science and policy, a master’s degree in energy and environmental policy, and has a PhD in Political Science from Northern Illinois University.

Research assistance for this report was provided by Eric Johnson, student CMU Business Dept. Thank you to the CMU Natural Resources and Land Policy Institute for support of this report.

Contact: Lou Villaire, Grand Valley Solar Center, 970.314.4413,
lvillaire@yahoo.com, <http://grandvalleysolarcenter.blogspot.com/>