Simple Photovoltaic Economic Calculations
Mar 31, 2010 – Donna Heimiller, National Renewable Energy Laboratory
Task 3 deliverable, NARUC

The maps generated by this task implement a simplistic cost algorithm, developed by NREL for use with solar feasibility studies.. The maps are derived by manipulating this single algorithm to solve for different components.

1) Payback Period = System Cost / (Annual Energy Delivered * Cost of Electricity) [Note; this is "simple" payback and doesn't include the time value of money]
2) Savings-to-Investment Ratio = (Annual Energy Delivered * Cost of Electricity * Present Worth Factor) / System Cost
3) Electricity Rate to achieve Savings-to-Investment Ratio of 1 = System Cost / (Annual Energy Delivered * Present Worth Factor)

System cost is assumed to be $8,500/kW, with O&M costs of $0.006/kWh generated.

Payback period or present worth factor is set at 17.41 years, representing a 25 year lifetime and discount rate of 3% as specified by the Federal Energy Management Program (http://www1.eere.energy.gov/femp/information/download_blcc.html, http://www.bfrl.nist.gov/oae/publications/handbooks/135.pdf).

Electricity rate data is 2006 blended annual commercial electricity rates by utility (except Kentucky, which provided 2008 commercial electricity rates), derived from database and GIS files purchased from a commercial vendor (Platts).

Annual Energy Delivered is calculated using hourly modeled solar resource data with a 10 km spatial resolution from the National Solar Radiation Database, averaged over the model period of record from 1998 to 2005. The conversion from resource to energy delivered uses the PVWatts algorithm assuming tilt of the array = latitude of the resource site. More information on PVWatts can be found at: http://www.nrel.gov/rredc/pvwatts/version1.html.

The calculations were performed with and without the impact of photovoltaic incentives. The version of the incentive data used is current as of May 2009, but we are now processing an updated version of this database into a geographic framework and will be producing a revised analysis based on this update within the next few months (and would be great tie this in with any customized economic analysis for the task 4 deliverable). For each state, we have provided a list of the incentives currently included and a list of the incentives that would be included in the update. Please note that the incentives are processed in a generalized fashion (% of total costs covered, total $ limit, minimum and maximum system sizes, etc.). Individual incentives do not always lend themselves to the general categorization and would need individual review to identify the applicability to each potential user's project. For this analysis, incentives for a commercial project 1 MW in size were calculated.

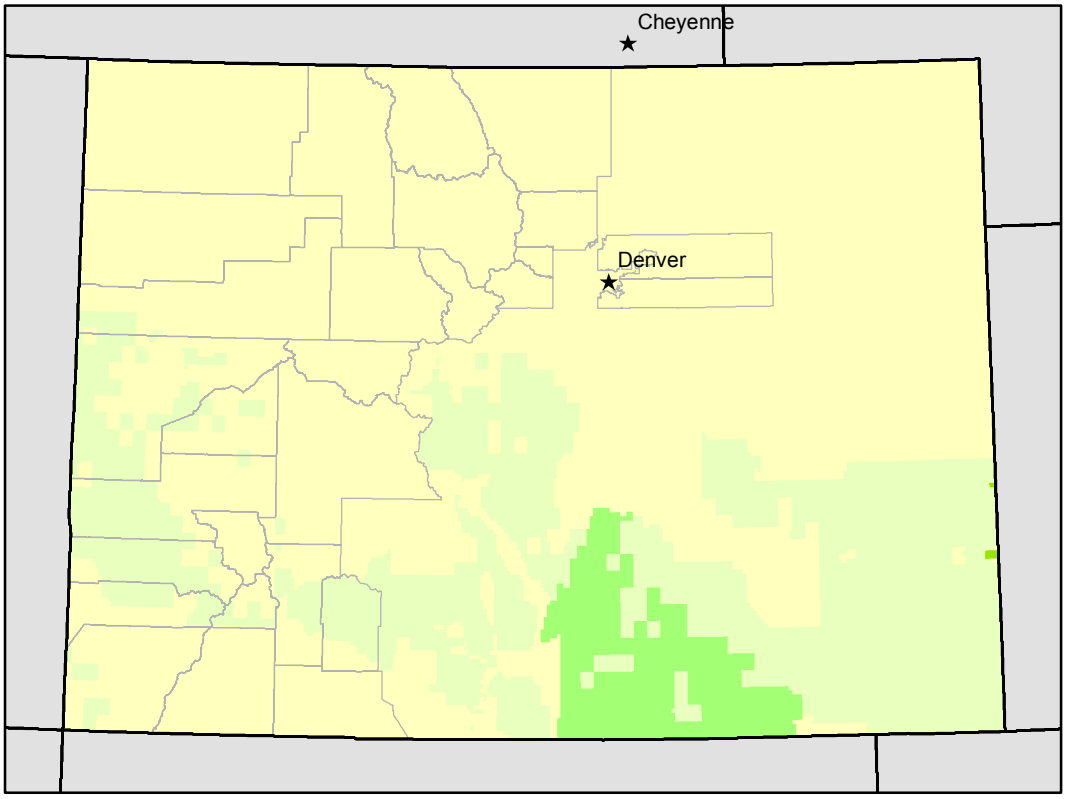
How to interpret the results

Payback period – this is the time it would take to recover/break even on the initial investment cost and ongoing O&M costs, in years. Shorter payback periods are more desirable.

Savings-to-investment ratio (SIR) – this is the percent of money recovered from the system generation compared to the initial investment cost and ongoing O&M costs, with reference to a specific desired payback period (17.41 years in this case). Within the specified time frame: values of 1 indicate that the investment cost was completely recouped; values greater than 1 indicate savings greater than the investment, values less than 1 indicate the investment cost is more than the potential savings from the system. A value of 0.2 indicates that within the desired payback period, only 20% of the investment cost was recovered; a value of 1.4 indicates that the savings exceeded the investment cost by 40%.

Electricity rate to achieve a SIR value of 1 – the annual average electricity rate required to recover the initial investment cost and ongoing O&M costs within the desired payback period (17.41 years in this case). This rate can be compared to current or projected electricity rates. A site that has a current or projected electricity rate higher than that shown on the map would be an economically attractive candidate.

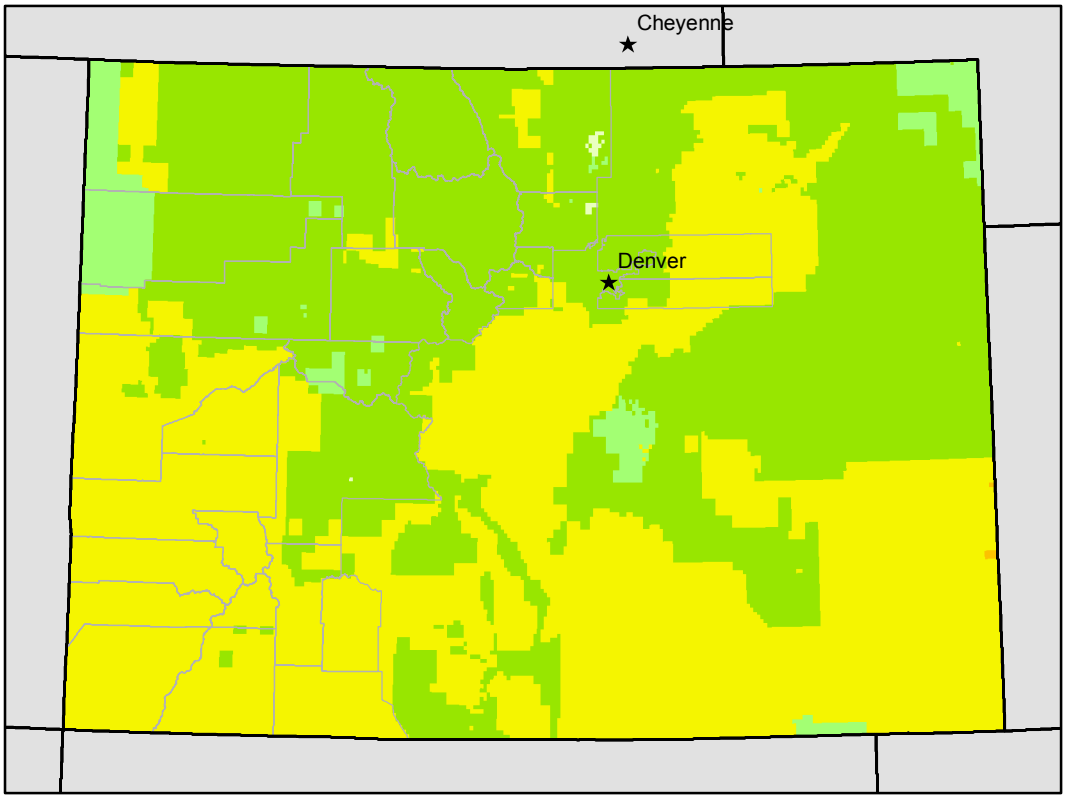
Colorado - Simple Payback for Photovoltaic Systems (Commercial - 1 MW size)



Payback Period

Years

- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- > 60

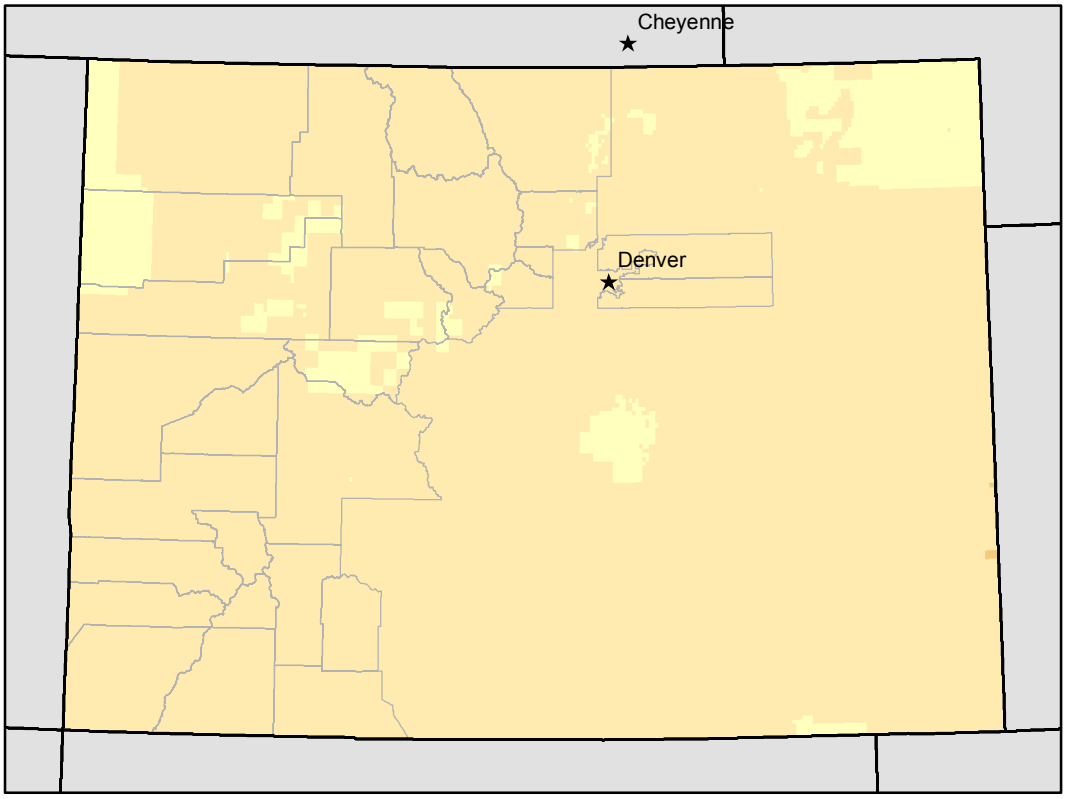


Incentives examined:
Business Energy Tax Credit (Federal)
Renewable Energy Production Incentive (Federal)
Residential Solar and Fuel Cell Tax Credit (Federal)
USDA Rural Energy for America Program (Federal)
Aquila - On-Site Solar PV Rebate Program (Utility)
Aspen - Solar Pioneer Rebate Program (Utility)
Colorado Springs Utilities - Renewable Energy Rebate Program (Utility)
Holy Cross Energy - WE CARE Rebates (Utility)
La Plata Electric Association - Renewable Generation Rebate Program (Utility)
Local PV Rebate Programs (Utility)
Xcel Energy - Solar*Rewards Program (Utility)

Incentives used reflect entries from May 2009 in the dsireusa.org database, categorized to apply them within a national framework. This map is intended to indicate potential savings from incentives; to identify whether a specific application would qualify, please visit http://www.dsireusa.org to see details for each incentive.

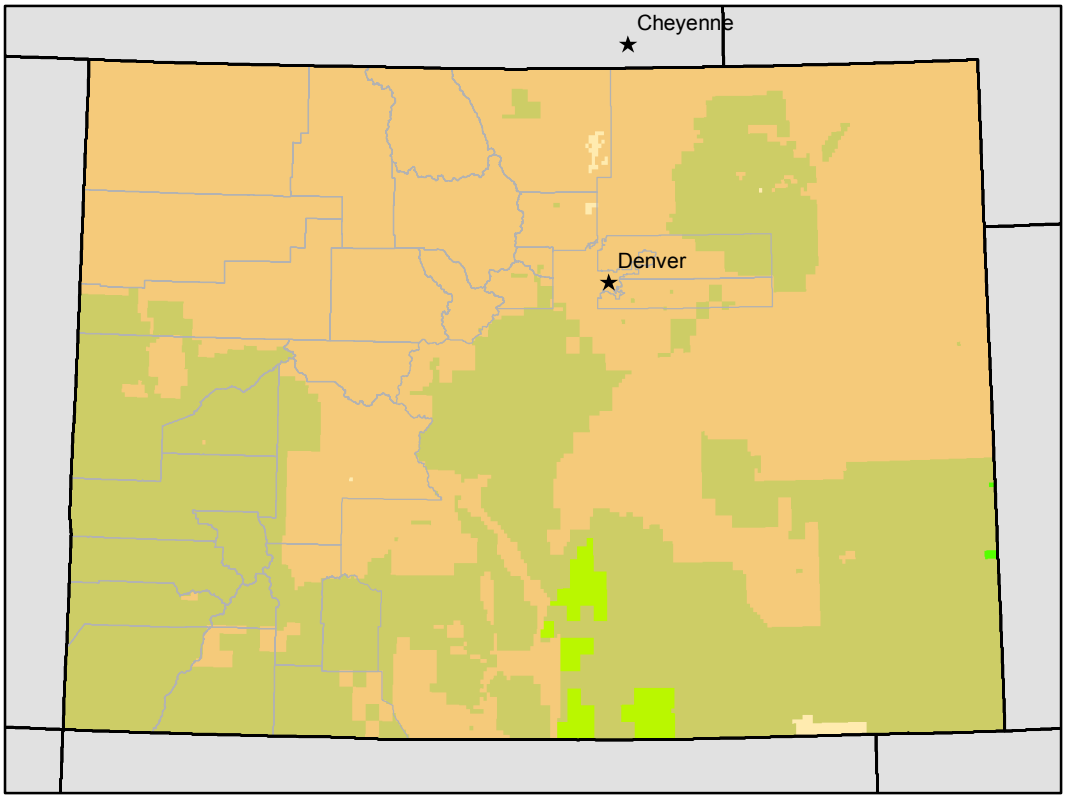
This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.
2010-Mar-30

Colorado - Simple Savings-to-Investment Ratio for Photovoltaic Systems (Commercial - 1 MW size)



Savings-to-Investment Ratio

- > 2
- 1.5 - 2
- 1 - 1.5
- 0.8 - 1
- 0.6 - 0.8
- 0.4 - 0.6
- 0.2 - 0.4
- 0 - 0.2

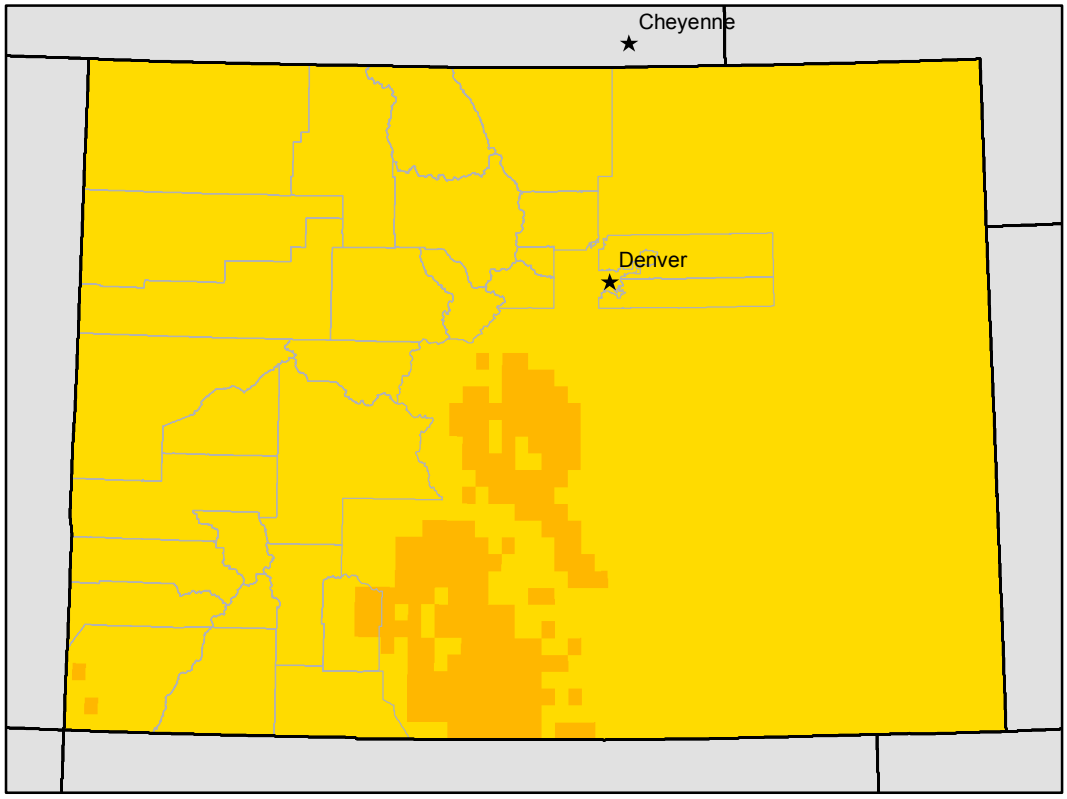


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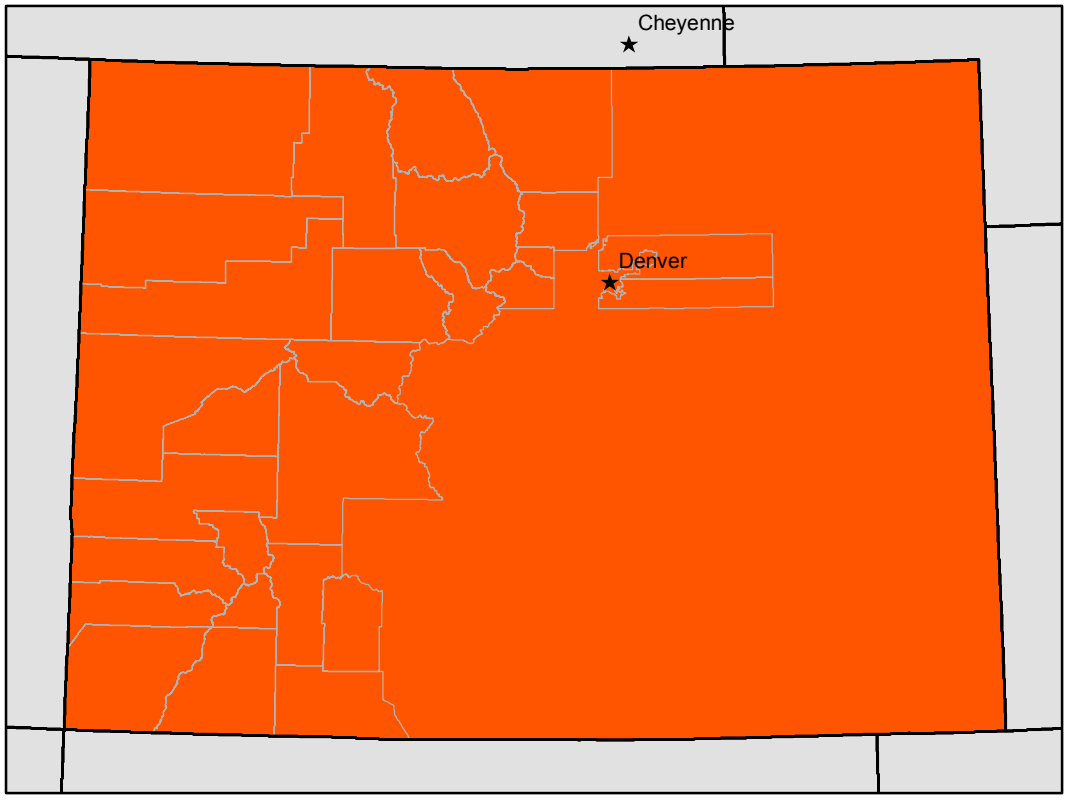
Colorado - Electricity Rate for Savings-to-Investment Ratio = 1 for Photovoltaic Systems (Commercial - 1 MW size)



Electricity Rate for SIR = 1

$/kWh

- > 0.50
- 0.40 - 0.50
- 0.30 - 0.40
- 0.20 - 0.30
- 0.10 - 0.20
- 0.08 - 0.10
- 0.06 - 0.08
- 0.04 - 0.06
- 0.02 - 0.04
- <= 0.02



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