



Date: August 7, 2012
To: Erik Anderson, Rocky Mountain Power
From: Heidi Ochsner, Aaron Jenniges, and Mihir Desu, Cadmus
Re: Cost-effectiveness Results for the Proposed Utah Solar Incentive Program

Introduction

PacifiCorp has administered the Utah Solar PV Incentive Pilot Program since 2007, and has been overwhelmed with the level of interest in the program. The Pilot Program's funding level was unable to meet customer demand, and had to turn away many applications. PacifiCorp is therefore exploring implementing a full-scale five-year incentive program which will have a larger budget, enabling PacifiCorp to provide incentives to more customers.

As such, PacifiCorp asked Cadmus to conduct a cost-effectiveness analysis for the proposed program design. This memo outlines the methodology and results of the analysis.

Methodology

Cadmus analyzed program costs and benefits from the following perspectives:

- **Total Resource Cost Test (TRC):** This test examines program benefits and costs from the perspective of PacifiCorp and its customers. Benefits include fuel cost reductions; costs include those incurred by PacifiCorp and program participants.
- **Utility Cost Test (UCT):** This test examines program benefits and costs from PacifiCorp's perspective. Benefits include the avoided generation costs for electricity that is instead generated by the PV systems, while costs include administrative and incentives costs.
- **Ratepayer Impact Test (RIM):** This test is from the perspective of utility customers and measures whether rates will increase as a result of the program. This test includes program costs (administrative and incentives) as well as lost revenues. Benefits include avoided energy costs.
- **Participant Cost Test (PCT):** This test examines benefits from a program participant perspective. Costs include any measure costs incurred by participants. Benefits are bill reductions due to installing the PV system, and any incentives paid to participants.

The levelized cost of energy (LCOE) and the standard economic tests were calculated using the same methodology as previous program years, which is consistent with California's Standard Practice Manual. The UCT is the standard test in Utah, therefore an overview of the methodology for that test is provided below.

The UCT is a ratio of the benefits to the costs, from the utility's perspective. The utility benefits include the following variables:

- **Energy Savings.** The analysis includes an 8760-hour load profile representing the energy savings from the PV systems installed through the Utah Solar PV Incentive Pilot Program administered by PacifiCorp in 2011. The load profile is based on metered data. The energy savings are adjusted to include line losses, which were provided by PacifiCorp.
- **Avoided Costs.** The energy savings are then multiplied by PacifiCorp's avoided costs to provide thirty years (the assumed measure life) of annual benefits. PacifiCorp provided decrement values specific to PV. These avoided costs account for capacity as well as energy.
- **Net Present Value.** The net present value of these benefits is determined by discounting annual benefits using PacifiCorp's weighted average cost of capital.

The formula for utility benefits is:

$$Utility\ Benefits = \sum_{y=1}^{30} \frac{\sum_{h=1}^{8760} (kWh\ Savings_h \times Line\ Loss \times Avoided\ Cost_h)_y}{(1 + Discount\ Rate)^{y-1}}$$

The utility costs include the following variables:

- **Incentives.** PacifiCorp provided their proposed program design, which has incentive step levels for each sector when defined capacity goals are reached. The incentives range from \$1.25/W to \$1.05/W for residential installations, and \$1.00/W to \$0.60/W for small and large commercial installations.
- **Program administration costs.** The administration costs include the costs associated with operating and marketing the program.

The formula for utility costs is:

$$Utility\ Costs = Incentives + Admin\ Costs$$

The UCT is then calculated by taking the ratio of the utility benefits to the costs.

The inputs and assumptions underlying this analysis are summarized in **Error! Reference source not found.**

Table 1. Summary of Inputs

| Input | Value | Source |
|--|----------|--|
| Measure Life | 30 years | Typical warranty length for modules |
| Residential System Cost in Year 1 | \$7.45/W | Average cost from a review of 1) the Utah Solar PV Incentive Pilot Program, 2) the Utah State Energy Program, 3) the California Solar Initiative (CSI), and 4) the Energy Trust of Oregon Program. |
| Commercial System Cost in Year 1 | \$6.67 | Average cost from a review of 1) the Utah Solar PV Incentive Pilot Program, 2) the Utah State Energy Program, 3) the California Solar Initiative (CSI), and 4) the Energy Trust of Oregon Program. |
| Annual Change in System Cost | -4.6% | Lawrence Berkeley National Laboratory. Tracking the Sun IV: The Installed Cost of Photovoltaics in the U.S. from 1998-2010. September 2011. |
| BC Test Discount Rate | 6.88% | Per PacifiCorp |
| Environmental Adder | 10% | Standard assumption |
| Large C&I Payment Period | 5 years | Per PacifiCorp |
| Large C&I Payment Discount Rate | 6% | Per PacifiCorp |
| Program Administration Cost Percentage | 10% | Per PacifiCorp |
| Residential Line Loss | 9.3% | Per PacifiCorp |
| Commercial Line Loss | 8.7% | Per PacifiCorp |
| Free-Ridership | 7% | Based on programs in WI and NY |
| Inflation | 1.9% | Per PacifiCorp |

Results

The cost-effectiveness results are presented in multiple ways, including:

- **Levelized Cost of Energy (LCOE):** The ratio of the costs to the electricity generated. The LCOE is a useful comparison to other sources of electricity generation.
- **Benefit to Cost (B/C) Ratio:** The ratio of program benefits to program costs. Benefits and costs are calculated over the life of the program, and discounted to reflect the time value of money. A B/C ratio greater than 1.0 indicates program benefits exceeded costs.
- **Net Benefits:** The difference between discounted program benefits and costs. Net benefits greater than zero indicates program benefits exceed costs.

Table 1 through Table 3 summarize the costs and benefits, the LCOE results, and the results from the cost-effectiveness tests with and without free-ridership, respectively. The proposed program design is cost-effective from the UCT perspective, with a B/C ratio of 1.75 excluding free-ridership, and a B/C ratio of 1.63 when including free-ridership. Note that free-ridership was not measured in the Utah Pilot program, and the free-ridership rate is an average from PV incentive programs in other states. The incentive program is not cost-effective from any of the other perspectives.

Table 1. Levelized Cost of Energy Inputs and Results

| Cost and Benefit Inputs | |
|--|---------------|
| Customer Cost (for capacity receiving incentives) | \$310,321,820 |
| Incentives | \$40,693,758 |
| Administration | \$3,974,388 |
| Total Annual Generation (MWh/year) – Five-Year Total | 105,023,054 |
| Results | |
| Levelized Total Cost (\$/MWh) | \$238 |
| Levelized Utility Cost (\$/MWh) | \$34 |

Table 2. Results for Standard Economic Tests (without free-ridership)

| | Levelized \$/kWh | Costs | Benefits | Net Benefits | Benefit/Cost Ratio |
|--|---------------------|---------------------|---------------------|---------------------|-----------------------|
| Total Resource Cost Test (PTRC) + Conservation Adder | \$0.24 | \$314,296,208 | \$85,924,652 | -\$228,371,556 | 0.27 |
| Total Resource Cost Test (TRC) No Adder | \$0.24 | \$314,296,208 | \$78,113,320 | -\$236,182,888 | 0.25 |
| Utility Cost Test (UCT) | \$0.03 | \$44,668,146 | \$78,113,320 | \$33,445,174 | 1.75 |
| Rate Impact Test (RIM) | | \$151,384,357 | \$78,113,320 | -\$73,271,037 | 0.52 |
| Participant Cost Test (PCT) | | \$310,321,820 | \$147,409,969 | -\$162,911,851 | 0.48 |
| Lifecycle Revenue Impacts (\$/kWh) | | | | \$0.00005405 | |

Table 3. Results for Standard Economic Tests (with 7% free-ridership)

| | Levelized \$/kWh | Costs | Benefits | Net Benefits | Benefit/Cost Ratio |
|--|---------------------|---------------------|---------------------|---------------------|-----------------------|
| Total Resource Cost Test (PTRC) + Conservation Adder | \$0.22 | \$292,573,681 | \$79,909,926 | -\$212,663,754 | 0.27 |
| Total Resource Cost Test (TRC) No Adder | \$0.22 | \$292,573,681 | \$72,645,387 | -\$219,928,293 | 0.25 |
| Utility Cost Test (UCT) | \$0.03 | \$44,668,146 | \$72,645,387 | \$27,977,241 | 1.63 |
| Rate Impact Test (RIM) | | \$143,914,222 | \$72,645,387 | -\$71,268,835 | 0.50 |
| Participant Cost Test (PCT) | | \$310,321,820 | \$147,409,969 | -\$162,911,851 | 0.48 |
| Lifecycle Revenue Impacts (\$/kWh) | | | | \$0.00005257 | |