

## Quantifying the Effect of Natural Gas Price Elasticity on the Cost of a Feed-In Tariff

December 10, 2008

California Energy Commission  
1516 9<sup>th</sup> Street, MS-29  
Sacramento, CA 95814-5512

Commissioners:  
Karen Douglas  
Jackalyne Pfannensteil  
Jeffrey D. Byron

Dear Commissioners,

We are writing in support of a California Renewable Energy Feed-In Tariff (FIT) currently being considered by the California Energy Commission and which, we believe, will boost the goals of the Renewable Portfolio Standard (RPS) as required by SB 1969.

The CEC has put a great deal of time and effort into investigating all aspects of a potential statewide FIT, and deserves praise for putting California, once again, in a defining position with regards to energy policy in the United States. Now it is time to make the final step in instituting a program that will make a success of the RPS: A well-crafted FIT including a must-take contract available to projects of an installed capacity of 20 MW and under.

The current California FIT is being discussed, in part, as a means to provide the time-sensitive RPS with the support needed to make up the 8% difference by the now-adjusted 2013 date and can assist with Governor Schwarzenegger's newest goal of 33% renewables by 2020. Much of the opposition to bringing a FIT online is the cost premium for renewable energy that is levied onto ratepayers. We have studied one way in which this effect is mitigated – the depression of natural gas prices due to reduced natural gas demand from renewable deployment.

In this analysis, we explore the effect of bringing the necessary 8% of California renewable electricity online through photovoltaic (PV) generation increasing over four years (2% per year) starting in 2009. We assume a FIT contract length of 20 years and a price of 22¢/kWh, decreasing by 1¢/kWh per year over the four years. For example, in 2011 a 20¢/kWh, 20 year contract would be offered to PV electricity producers.

Installing this large volume of PV generation will displace electricity currently produced using natural gas during peak load and therefore reduce demand for natural gas. Due to the inverse price elasticity of supply, natural gas prices will be depressed nationally and regionally, resulting in significant ratepayer savings. National Energy Modeling System (NEMS) calculations show the national inverse price elasticity factor ( % change in price / % change in demand) for natural gas to be approximately 1.2. Due to local supply constraints that cause a tight regional market in California, the impact of this national inverse elasticity factor is amplified to an average inverse elasticity factor of 2.8 over a 20 year period. This means that in California, a reduction in natural gas demand will more strongly affect the local natural gas price, especially in the short term. Ratepayer savings were derived using the methodology of Ryan Wiser and Mark Bollinger from Lawrence Berkeley National Laboratory and based on natural gas projections from the California

Energy Commission and the US Energy Information Agency.

It should be noted that our analysis of natural gas price depression will hold for any renewable or mix of renewables that displace large fractions of electricity produced by natural gas – photovoltaics are used here simply as an important example. We assume that 85% of the PV electricity generated translates into natural gas displacement.

Our results show that a FIT replacing 8% of California electricity consumption with photovoltaic electricity over four years would have a present-value impact (7% real discount rate) of at least \$2.7 bn cumulative savings to utility ratepayers on natural gas costs over the course the FIT program (based on 20 year fixed rate FIT contracts). This mitigates the cost of photovoltaic electricity brought on by the FIT in California by approximately 1.11¢/kWh. Figure 1 shows this effect graphically for the first year of electricity production.

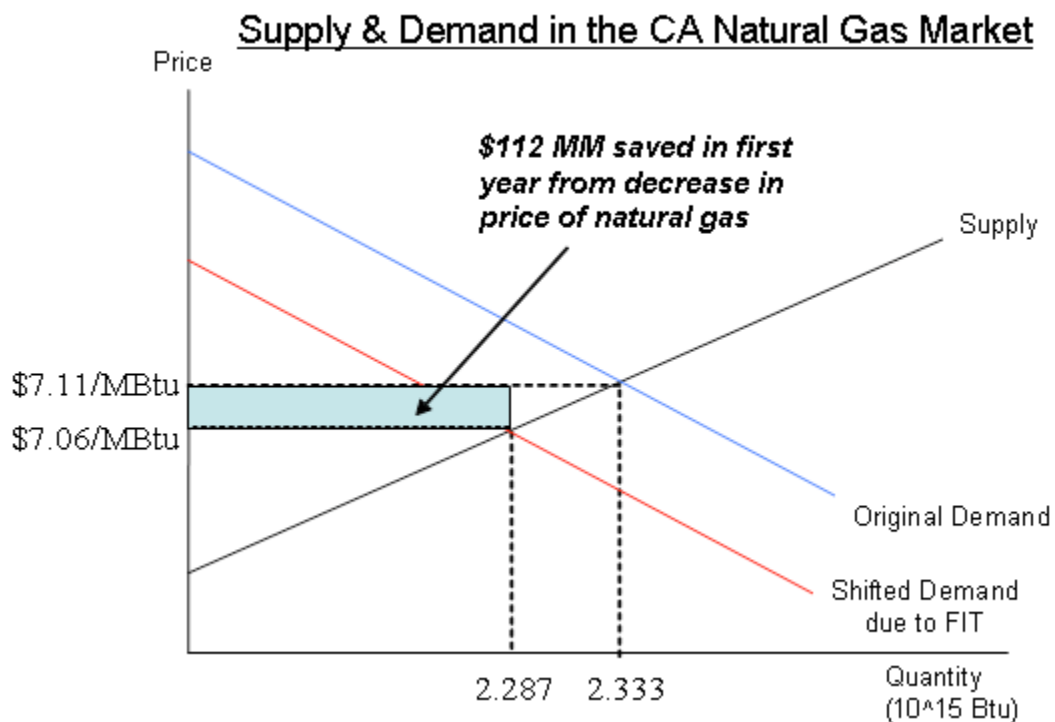


Figure 1: The effect on electricity prices of decreasing natural gas demand, depicted for the first year of FIT electricity production.

This mitigation of ratepayer cost due to natural gas price elasticity should be considered alongside other value adders for photovoltaics such as time of delivery (TOD) and locational benefits (LB), as shown in Figure 2.

**Time of Delivery:** As solar energy generally offsets peak or near-peak loads, electricity produced by photovoltaics is on average more valuable than that of their baseload counterparts. This is quantified in a TOD multiplier to the base Market Price Referent (MPR), as suggested in the California Public Utilities Committee (CPUC) resolution E-4214 to the MPR. For solar we standardized this number from several service areas and varying times of delivery multipliers to approximately 1.3.

**Locational Benefits:** For photovoltaic installations of 20 MW and under, renewable electricity can be produced on the distribution side of the grid, thereby alleviating distribution

and transmission losses, as well as reducing the necessity to build new transmission. As shown by the CPUC-commissioned E3 Cost-Effectiveness Model and subsequent analysis by GreenVolts, this effect adds 35% value to the base MPR for photovoltaics.

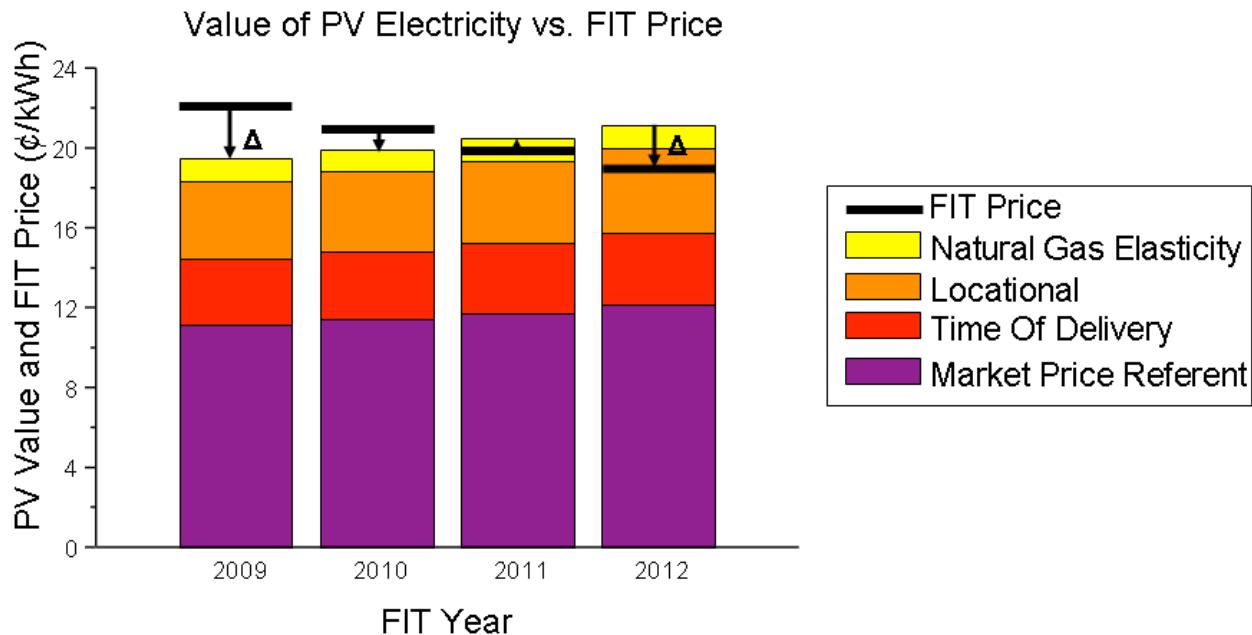


Figure 2: Cost breakdown over the four years of FIT introduction. Note: values are not discounted. Natural gas elasticity, locational, and time of delivery benefits all add to the base MPR value for the value of new generation capacity. The difference between the price of the FIT and the MPR plus these three benefits is the premium ( $\Delta$ ) paid by ratepayers to install photovoltaics. A negative value of  $\Delta$ , as is shown in 2011 and 2012, indicates that photovoltaic electricity can pay for itself – it can have a net zero or slightly positive *benefit* to ratepayers!

The FIT structure in this paper has been suggested by concentrated solar power company GreenVolts as a fair structure to encourage photovoltaic deployment while not overburdening ratepayers with undue producer profits. It has been shown here that this FIT structure can reduce the premium paid for photovoltaic electricity to values less than zero, thereby making photovoltaics cost effective and grid competitive.

Thank you for your consideration,

Angela Eaton, James Nelson  
University of California, Berkeley

Corresponding author:  
[jimmynelson@berkeley.edu](mailto:jimmynelson@berkeley.edu)

Acknowledgement:

We would like to give special thanks to Craig Lewis from GreenVolts for much help and advice throughout the process of this analysis.

## References

### Papers

California Energy Commission 2007, *Integrated Energy Policy Report*, California Energy Commission, Sacramento.

Earnest Orlando Lawrence Berkeley National Laboratory 2005, *Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Efficiency*, R Wisser & M Bolinger, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, Berkeley.

Energy Economics Group & Fraunhofer Institute Systems and Innovation Research 2008, *Evaluation of different feed-in tariff design options - Best practice paper for the International Feed-In Cooperation*, 2nd edition, update by October 2008, Klein A, Pfluger B, Held A, Ragwitz, M (Fraunhofer Institute Systems and Innovation Research), & G Resch, & T Faber (Energy Economics Group Institute Systems), report to the Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Berlin.

Fraunhofer Institute Systems and Innovation 2007, *The Merit-order effect: A detailed analysis of the price effect of renewable electricity generation on spot market prices in Germany*, Sensfuss F, M Ragwitz, & M Genoese, Fraunhofer Institute Systems and Innovation, Freiburg.

KEMA, Inc. 2008, *September 2008 California Feed-In Tariff Design and Policy Options*, Draft report to the California Energy Council, Sacramento.

Resolution Adopting the 2008 Market Price Referent, Resolution E-4214, December 2008, California Public Utilities Commission.

### Websites

Annual Energy Outlook 2008, Report #: DOE/EIA-0383(2008) June 2008, Energy Information Administration, Washington, DC, viewed November 26, 2008, <<http://www.eia.doe.gov/oiaf/aeo/>>

Natural Gas Consumption by End Use (Million Cubic Feet), 2008, Energy Information Administration, Washington, DC, viewed November 26, 2008, <[http://tonto.eia.doe.gov/dnav/ng/ng\\_cons\\_sum\\_dcu\\_SCA\\_a.htm](http://tonto.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm)>

California Energy Demand 2008-2018, November 2007, California Energy Commission, viewed November 26, 2008, <<http://www.energy.ca.gov/2007publications/CEC-200-2007-015/CEC-200-2007-015-SF2.PDF>>

2007 Final Natural Gas Market Assessment, December 2007, California Energy Commission, viewed November 26, 2008, <<http://www.energy.ca.gov/2007publications/CEC-200-2007-009/CEC-200-2007-009-SF.PDF>>

California Electricity Profile, 2006, Energy Information Administration, Washington, DC, viewed November 26, 2008, <[http://www.eia.doe.gov/cneaf/electricity/st\\_profiles/california.html](http://www.eia.doe.gov/cneaf/electricity/st_profiles/california.html)>

E3 Cost-Effectiveness Model, prepared for the California Public Utilities Commission.  
<[http://www.ethree.com/dg\\_ce\\_tools.html](http://www.ethree.com/dg_ce_tools.html)>

GreenVolts Locational Benefits (LBs) analysis, March 2008, CPUC filing to the 2008 MPR proceeding.  
<<http://docs.cpuc.ca.gov/efile/CM/80092.pdf>>

### Presentations

Lawrence Berkeley National Laboratory, 2008, *Suppressing Natural Gas Prices: An Ancillary Benefit of Renewable Generation*, Bolinger, M & R Wisser, report to KEMA on behalf of the Energy Commission Renewable Energy Support, Lawrence Berkeley National Laboratory, Berkeley.

### Interviews

Craig Lewis, VP Government Relations, GreenVolts. Multiple interviews, October - December 2008

Paul Gipe, advocate for the responsible development of renewable energy, interviewed November 15, 2008

Rich Furgeson, Research Director CEERT. Interviewed November 18, 2008

Mark Bolinger, Research Scientist in the Electricity Markets and Policy Group at Lawrence Berkeley National Laboratory. Interviewed December 4, 2008