BEFORE THE PUBLIC UTILITY COMMISSION

OF OREGON

UM 1505

In the Matter of	**)**	
	)	
Public Utility Commission of Oregon	**)**	**Dave Sullivan's request for**
	)	**an e-Docket discussion about**
Solar Photovoltaic Draft Report	**)**	**solar incentive rates**
Comments and Recommendations	**)**	
	)	

Executive Summary

This request begins by looking at three problems with the small-scale and medium-scale parts of Oregon's pilot solar incentive program:

- **Part 1: An unfair registration process.** Nearly all capacity reservations are grabbed by solar industry insiders, some of whom have developed sophisticated computer programs to enter applications faster than a human can type.
- **Part 2: Incentive rates have been set too high.** Incentive rates have been set at least 30 percent too high for small-scale and medium-scale systems.
- **Part 3: Perverse incentives to waste electricity.** The program discourages participants from adopting conservation measures, and in some cases it gives people a huge incentive to actively waste electricity.

Interestingly, all three problems can be solved with one relatively simple fix: use a market-based method to balance available capacity with customer demand. This leads to:

- **Part 4: A request for an e-Docket discussion about incentive rates**
- **Part 5: A formal challenge of the rebuttable assumption about incentive rates**

Fortunately the pilot program is both small and young, so making changes should be straightforward. No one expects additional capacity to be available until April, so a three-month window exists for discussion.

Sincerely,

Dave Sullivan, signed on December 13, 2010

Part 1: An unfair registration process

Any economist will tell you that if you put enough money on the table, you will see a feeding frenzy as soon as people are allowed to grab it. Since people haven't been allowed to compete based on price for capacity reservations, we've seen them compete with progressively faster methods of entering data into the web-based capacity reservation forms. If the PUC doesn't change its administrative rules, the April 1st registration window will remain open for only a few seconds and all available capacity will be grabbed by computer-savvy solar industry insiders.

> "… people should not have to develop custom software in order to participate in the solar power pilot program …"

When I learned about the existence of this pilot program in September, I talked with sales representatives from several solar installation firms. I soon learned the hardest part of getting into the new solar incentive program would be to enter a capacity reservation quickly enough. Everyone thought demand for the October 1st registration window would be far higher than available capacity.

A sales representative for National Solar told me many of their July 1st capacity applications weren't accepted because the registration process closed too quickly. They had made a strategic blunder and had expected each typist who started at 8:00 a.m. to be able to enter several applications. He explained they had learned from this painful lesson and had hired Microsoft engineers to develop custom software to enter their applications quickly. He promised me they could get my application approved on October 1st.

As another example, I had lunch in November with a local solar installation firm's sales representative. He explained everyone who worked for his firm came to the office to type in applications on October 1st. Their plan was to have each worker enter one application. All the workers knew exactly what to type. This was the same successful strategy that this firm had used on July 1st, but it backfired on October 1st. Most workers were not able to enter their application before the registration window closed – no human can type as fast as a custom software program designed to fill out forms quickly. When this sales representative learned about my skill at writing software, he offered to pay me a fee to develop software to enter applications on April 1st.

This page has been filled with anecdotal evidence about the registration process because I cannot get detailed facts. Because the PUC decided to keep application information private, I cannot directly find out who has applied to the program or when their applications arrived. This privacy policy seems to run counter to the pilot program's goal of allowing people to

learn from the pilot program. How can we learn if critical information about the pilot program is locked away from public view?

Obviously, this process is not fair to the ordinary residential customer – people should not have to develop custom software in order to participate in the solar power pilot program.

Would a lottery be fairer?

The easiest Band-Aid to apply would be to require the registration window to stay open 24 hours. If more applications are received during the 24-hour window than the pilot program has capacity, then a lottery could select which applications to approve.

On November 23, 2010, Mark Pengilly filed a request with the PUC to change the application process to a lottery-based system. The request included:

> … under the current application process, some applicants are employing sophisticated computer programs to prepare applications ahead of time and to auto-fill the application instantaneously when it becomes available online. This amounts to "gaming the system." Application procedures must be put in place to give all applicants a fair chance of "winning" at [sic] capacity allocation.

Vermont used a lottery-based system to accept applications to their feed-in tariff program. They kept the registration window open all day on October 19, 2009. The Vermont solar feed-in tariff program was limited to 14.25 megawatts of solar capacity, but they received 185 applications for a total of 147 megawatts of capacity. Using a lottery, the top 16 applications were accepted, and the rest were deferred.

Vermont told everyone their applications would become part of the public record, and they published an Excel list showing who had applied along with contact information and a date/time stamp showing when they applied. Here is an abbreviated list showing the lucky top 7 winners in Vermont's feed-in tariff program along with a couple of the folks who were not so lucky:

Submitted On	Lottery Order	Contact Person	Solar Project Capacity (KW)
10/19/2009 11:54	1	Frank Ammirato	2
10/19/2009 9:19	2	Trevor Parsons	100
10/19/2009 9:05	3	Andy Broderick	450
10/19/2009 9:02	4	John Guerin	2,200
10/19/2009 9:25	5	Van Chesnut	32
10/19/2009 9:04	6	Russ Broderick	1,005
10/19/2009 9:16	7	Robert Fuller	26

To save space, I've deleted applications 8 through 183

10/19/2009 9:07	184	Chad Farrell	1,000
10/19/2009 9:03	185	David McManus	1,360
Application total:	**185**		**146,955**

I used the phone numbers that Vermont published to call several applicants. The people I talked with seemed eager to share their thoughts about Vermont's feed-in tariff program. For example, I talked with Naoto Inoue, President, Talmage Solar Engineering. His firm's 2,200 kilowatt application was one of the lucky 16 applications to be drawn in the statewide lottery. Talmage Solar Engineering plans on installing the solar panels on a 22-acre industrial site. Installation hasn't begun yet because of environmental permitting delays, but he expects the system to be operational next year. I asked him about the economics of this project, and he said the 30 cent/kilowatt incentive rate over 25 years will make the project profitable.

I'd like the PUC to change its administrative rules so applications to the pilot program become public information. Anyone who wants to be paid through this pilot program should be willing to make their application information public.

Using a lottery trades one set of fairness problems for other set of problems: people would game the lottery process by entering slightly different applications for essentially the same project. For example, in the list above Andy Broderick entered an application at 9:05 a.m. and Russ Broderick entered an application at 9:04 a.m. Since this might have been a coincidence, I decided to look at the list carefully. Although there were 185 applications, there were only 68 unique phone numbers for the applicants. Richard Silkman submitted 16 applications, and all of them had project names like Hannaford – 8397 or Hannaford – 8353.

No one should be surprised to learn people in Vermont were able game the feed-in tariff lottery. Like Oregon, Vermont put a lot of money on the table. Unlike Oregon, access to the money was based on filling out multiple applications instead of filling out a form quickly. But in both cases, the fundamental problem came from having a government-mandated incentive rate.

Consider my four-plex rental building in Albany. Each apartment has its own meter and has a unique mailing address. If the PUC had used a lottery-based process earlier this year, I would have submitted four different applications for this building. Each application would have used a different Pacific Power electric account and different physical address – and each would have listed enough capacity to cover the entire roof. That way, I would have had a four-fold increase in the likelihood of winning the lottery.

Part 4 discusses a fundamentally better way to determine who gets into the pilot program: Use an auction. But first, Part 2 examines how the incentive rates were set too high.

Part 2: Incentive rates have been set too high

Incentive rates were set at least 30 percent too high for the July 1st and October 1st registration dates. This error was made possible when the PUC decided to create a government-mandated price-fixing system to set incentive rates. With this system, the PUC Staff built financial models from historical costs, and then the models were used to set future incentive rates. If people in the private sector collaborated to set prices for an entire industry in this way, they would be thrown in prison.

> "We should be seeking to have the maximum kW solar installed for the minimum subsidy."
> --John Gear, Salem attorney

Setting future incentive rates by looking at historical costs makes as much sense as driving while looking only in the rearview mirror. The future throws unexpected curves at us, so all well-designed administrative systems need to react quickly as events unfold. But instead of reacting quickly, the PUC decided to review incentive rates only once every six months and to change rates by only 5 or 10 percent at a time. Collectively, these decisions added at least 30 percent to the program's cost without resulting in a single additional watt of solar energy.

The PUC Commissioners said it would be an irreversible mistake to set the incentive rates too high:

> A critical element of the success of the pilot program is setting the initial rates for energy produced by small-scale and medium-scale systems under the net metering arrangements. … The consequences of setting rates too high cannot be undone. Eligible capacity will be reserved without recourse for ratepayers. In contrast, rates set at levels too low to promote participation can be raised during later stages of the pilot program.

John Gear, a Salem attorney, supports the general idea of using a feed-in tariff to promote the use of solar power. After reading my guest opinion article in the Statesman Journal, he wrote:

> We should be seeking to have the maximum kW solar installed for the minimum subsidy. The decision to select a fixed price based on estimates was terrible, the kind of central planning that gives renewable incentives a bad name.

The rest of Part 2 examines how this incentive rate-pricing blunder was made:

- Sections 2.1 through 2.3 look at cost trends and projections to understand how PUC financial models overstated actual costs so much.
- Section 2.4 examines the costs and oversized profits of a 9.4 kilowatt system.
- Section 2.5 compares Oregon's incentive rates with other feed-in tariff systems.

Section 2.1 – Hardware prices are falling dramatically

Solar panel prices have dropped rapidly since 2008 and are projected to continue dropping through 2011. Inverters are dropping in price but not as rapidly. Historically, solar panels have accounted for 40 to 60 percent of an installed system's total cost; inverters usually account for more than 10 percent. Worldwide, most solar panels are produced by Asian companies, and the market-leading inverter firm is a German company, so money spent on solar systems goes primarily overseas.

"the pending glut will see … [solar panel] prices drop as low as $1.10 per watt in 2011" …

"Meanwhile market leader SMA Solar Technology sees average inverter prices dropping 15% to 20% next year …"

According to "Slowdown Dims Solar Panel Prices 40-50%" published by Business Line on September 5, 2009:

> Solar panels cost around $3.75 - $4.00 a Watt till the third quarter of 2008, after which they started falling. The prices are about $1.90 - $2.00 a Watt now, according to Mr. Yogesh Mathur, Chief Financial Officer, Moser Baer India Ltd.

According to "Solar Panel Glut Projected in 2011" published in The Portland Business Journal on November 17, 2010:

> [Axiom Capital Management's solar analyst] Gordon Johnson predicts that the pending glut will see … [solar panel] prices drop as low as $1.10 per watt in 2011 from $1.80 in 2010.

According to "Solar Market is Risking Sunstroke" published in The Wall Street Journal on December 11, 2010, a worldwide manufacturing glut is causing rapidly falling prices:

> Joel Silverman of Arete Research Services reckons industrywide capacity has more than doubled this year to over 34 gigawatts and should hit roughly 48.5 GW by the end of 2011. He pegs demand for those two years at just 16.3 GW and 19 GW, respectively. …
>
> Meanwhile market leader SMA Solar Technology sees average inverter prices dropping 15% to 20% next year …

This section shows industry analysts predict hardware costs for solar panels and inverters will continue to plummet. But because financing costs and other incidental costs are as important as the hardware cost when building an overall economic model of solar power, the next section looks at the Total Cost of Ownership for solar systems.

Section 2.2 – The Total Cost of Ownership for small-scale versus large-scale systems

The TCO or Total Cost of Ownership concept was created to understand the cost of

installing computer systems in large organizations, but the concept makes sense for solar electric systems. The TCO philosophy suggests a cost-benefit analysis should look beyond a system's initial purchase price and should include other factors like maintenance, upgrades, replacement, training, security, and so on.

Most homeowners take pride in having solar panels on their roof, and they handle routine maintenance, security and paperwork without hiring professionals. This can result in significant savings in relation to the costs required to operate a commercial solar installation.

> … small-scale systems can sidestep or reduce many costs required by large-scale commercial solar installations …

Financing (interest rate) costs

Solar panels work for decades, so interest rates and financing plays a central role in the overall economics of solar systems. The PUC set incentive rates by using a 6 percent interest rate, but many homeowners can get financing for less than 6 percent.

Residential solar systems cost less than $50,000, so homeowners can tap into entirely different sources of financing than large-scale systems which can cost millions of dollars. Rates will vary by individual circumstances, but these rates were available to Oregon homeowners on December 3, 2010 from Bank of America:

- 12-month CD with $10,000 minimum balance: 0.50 % APR
- 15-year fixed mortgage: 3.93 % APR
- Home equity line of credit: 4.37 % APR
- Cash-out refinance ARM: 3.30 % APR

For example, consider the retired couple who has invested their savings in a bank CD earning 0.5 percent annually. Or consider the middle-aged professional who can get a cash-out refinance ARM loan for 3.3 percent. These people don't need a 6 percent return on investment to make a healthy profit on a solar electric system.

I've written a series of successful textbooks about computing. I've found one of the best ways to understand complex topics is to discuss a case study that presents someone faced with an ethical question, so I've put a case study on the next page. I hope it prompts people to discuss how incentive rates should be set. – Dave Sullivan

A Case Study in Ethics:
Cunning Advertising Ploy – or –Legalized Theft from Ratepayers?

Mark Pengilly is a Portland attorney on the staff for Oregonians for Renewable Energy Policy. That organization's website says, "In 2009, his primary focus has been his work with Oregonians for Renewable Energy Policy, working to pass Feed-In Tariff legislation in Oregon."

Pengilly initially became interested in solar power during a 2006 visit to Germany. He describes seeing solar arrays everywhere, even on churches. Returning to Oregon, he wanted Americans to capture the same enthusiasm for solar power that he had seen in Germany – so he helped usher a Feed-In Tariff system through the Oregon Legislature.

Figure 1: Mark Pengilly as he appeared in the July 1, 2010 Oregonian article.

In a February 2010 filing submitted to Oregon's Public Utility Commission in support of the July 1st capacity reservation window, Pengilly submitted an Excel-based financial model for determining the incentive rates to use in the new pilot solar program. The Excel model was carefully constructed to arrive at high incentive rates. For example, for a small residential solar electric system, it recommended using a $7.50 installed cost-per-watt, and it included lots of other costs like spending $100 per year on tax preparation.

On July 1, 2010, the Oregonian published an article titled, "Oregon solar program fills in 15 minutes leaving some customers excited and others frustrated." It begins by saying,

> Mark Pengilly sat at a computer in his Northwest Portland home at 8 a.m. Thursday, poised to apply for Oregon's new solar pilot program the moment it opened. By 8:04, Pengilly had completed an application to reserve 6.5 kilowatts of capacity for solar panels.

On December 7, 2010, I had lunch with Mr. Pengilly. He said his solar system won't be installed until 2011. According to the best industry estimates (discussed in Section 2.1), when his system is finally installed, the wholesale cost of solar panels is likely to be close to $1.10 per watt. His payment rate, however, will be locked in for the next 15 years based on much higher historical costs. When I asked Pengilly about his motivation on July 1st, he said, "I spent 18 months working on this program – I wanted to get mine."

When Pengilly was asked about the huge imbalance between available capacity and demand for the pilot program, he was unapologetic. He said he wanted to prompt enthusiasm for the program … he wanted the decision about whether to buy solar systems through the program "to be a no-brainer." Like a proud father, he pointed to all the people who had learned about the program who would not have learned about it except for the oversized financial benefits it offers.

Discussion questions:

1. Assume Pengilly knows Oregon's solar incentive rates are 30 percent higher than necessary to balance supply with demand. Does he have an ethical responsibility to Oregon's ratepayers to ask for the rates to be decreased – or is this premium price justifiable because it provokes interest in solar power?
2. If Pengilly deliberately helped set rates higher than necessary as a sort of ratepayer-funded advertising for solar electric power, does he have an ethical responsibility to refrain from signing up in the program himself?
3. Oregon's pilot solar electricity program picks one renewable energy approach and funds it – while leaving other approaches like bio-mass conversion, geothermal energy, or improving the efficiency of hydro turbines "out in the cold." What are the benefits and costs of having government fund one technical approach while shunning others?

A specific example: my solar system

Once again, a specific example will help clarify issues. Last week, Sunwize Technologies in Philomath completed installing a 9.4 kilowatt solar system on my four-plex in Albany.

Figure 1: Solar panels on the roof of Dave Sullivan's four-plex in Albany.

- **Financing:** I paid for the system from my retirement savings. Unfortunately, I've lost money on these savings since the 2008 financial crisis, so my personal cost of financing is quite low – and for the last three years, it has been unintentionally negative!
- **Tax Preparation:** I buy a copy of TaxCut each year, and I use it to prepare my tax returns. Because I own rental property, I already file all tax schedules the new solar system will require. I expect the solar system will add two hours to my tax preparation time this year. The effort in later years will be minimal because TaxCut will automatically pick up capital costs and depreciation from the prior years.
- **Insurance:** My properties are insured for fire and a $1,000,000 liability umbrella. The cost of this insurance is based on the square footage of my properties, so adding a solar system won't change my annual insurance premiums.
- **Maintenance:** I understand it will be important to clean the solar panels annually with a bucket of Windex-laced water and a long-handled squeegee. The solar panels have a 25-year warranty; the inverter has a 10-year warranty.

According to estimates filed with the Public Utility Commission by Mark Pengilly with Oregonians for Renewable Energy Policy, my expenses should include:

$546	Loan origination fee at 1 percent of loan
$36,881	Total interest payments @ 7.5%
$5,730	Risk premium @ 1.0 %
$1,500	Tax preparation @ $100/year

$2,580	Insurance @ $172/year
$4,950	Cleaning and inspection @ $330/year
$52,187	**Total**

These expenses might make sense for a large commercial solar system, but they don't apply to my residential system, and they add up to more than my system's $46,622 purchase price.

So far, Sections 2.1 and 2.2 explain how the PUC's historical cost models predicted much higher costs than a typical system will actually have. Section 2.3 looks at how economies of scale have allowed solar installation firms to drop prices further than Sections 2.1 and 2.2 would predict.

Section 2.3 – Economies of scale

Nearly every production process benefits from economies of scale. This basic understanding lies behind why feed-in tariffs exist: people want to jump-start the use of solar electric systems in order to drive costs down rapidly.

Somehow this cost-reduction logic was lost when the PUC decided to set incentive rates based on historical costs. This meant if the program was successful and costs fell, then participants would be paid an excessive incentive rate.

> … economies of scale have forced solar installation firms to shrink the installed cost-per-watt gap that historically has existed between small-scale and large-scale solar systems.

In the last couple of years, the installation of solar electric generation systems has exploded in Oregon. The Energy Trust of Oregon 2009 Annual Report says "more than twice as many residential solar electric projects were completed in 2009 than in 2008."

Here are more current figures (Energy Trust of Oregon figures are from Kacia Brockman, Senior Solar Program Manager; Pilot Program figures are from Kelcey Brown at the PUC):

	Energy Trust	Pilot Program	Total
2009	5,401,549	-	5,401,549
2010*	7,258,690	8,589,467	15,848,157

* Energy Trust figures for 2010 cover only January through November. Pilot Program figures represent capacity reservations – some of these systems will not be installed in 2010.

These data suggest the installation of solar electric systems will double yet again in 2010. With a lot more work to do, solar installation firms have bought components in large enough volumes to skip distributors and deal directly with manufacturers. Lower component prices

have lead to lower cost-per-watt prices on installed solar systems, and the effect has been most pronounced for small-scale and medium-scale systems.

A dramatic example of how the increase in solar installations has reduced costs comes from cooperative neighborhood projects such as Solarize Portland. A "Solarize" cooperative allows multiple homeowners to band together, hire the same contractor, and receive a discounted price. This method of price negotiation is so effective it has spread to other Portland neighborhoods, Salem, Beaverton, and Pendleton.

> **Ironic humor break:** Two views on how to deal with economies of scale.
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> **View 1:** On April 12, 2010, Mark Pengilly wrote in a PUC filing:
>
> > Solarize [Portland's] cost figures are strikingly lower than those reported by RNP or the ETO's most recent historical data. … While the Solarize projects are useful for putting larger numbers of solar panels on roofs, for creating demand and for helping drive down the cost of solar projects, OREP's judgment is that the Solarize data should not be used as the basis for calculating VIRs [volumetric incentive rates] for individual solar PV projects. … VIRs based on Solarize data would be dramatically lower.
>
> **View 2:** At 8:00 a.m. on July 1, 2010, Pengilly was typing furiously in his Portland home in order to get his 6.5 kilowatt capacity reservation into a PGE web-based form.

Summary of Sections 2.1 through 2.3

Section 2.1 shows prices have plummeted for the major hardware components of a solar system. Section 2.2 shows the non-hardware costs in a Total Cost of Ownership economic model are lower for small-scale solar systems than large-scale systems. Section 2.3 shows economies of scale have forced solar installation firms to shrink the installed cost-per-watt gap that historically has existed between small-scale and large-scale solar systems. Collectively, these sections explain how the PUC's historical cost models produced incentive rates at least 30 percent too high. Next, Section 2.4 looks at how all these factors come together on an example small-scale system.

Section 2.4 – The costs, incentives, and outrageous profit of my solar system

Earlier sections in Part 2 have looked at broad economic trends that caused the PUC's historic cost models to predict much higher costs than actual solar systems would incur. This section provides a concrete example: it examines the costs, incentives, and profit from a small-scale solar system that was installed on my property in early December 2010. Table 1 lists facts about my solar system, and Table 2 shows a simple cash flow model.

I received a 9.4 kilowatt capacity reservation on October 1, 2010. This locked in a 58.5 cent per kilowatt hour rate with Pacific Power for the next 15 years. Once I had this capacity reservation, I shopped around for a solar installer and signed a contract with SunWize Technologies of Philomath to provide and install the system for $46,622. Thus, the cost per watt for this example is $4.96 – much lower than the historical costs used by the PUC when setting the 58.5 per kilowatt hour incentive rate. I negotiated this $46,622 cost directly with SunWize – I was not part of a "Solarize" project that might have lowered my cost further.

> "I will earn an outrageously high IRR (internal rate of return) on this project."
> -- Dave Sullivan

The panels were installed on a south-facing roof that is not shaded by trees or other obstructions in Albany, Oregon (see Figure 1 on page 9). According to the Energy Trust of Oregon estimation methods, it will produce 11,008 kilowatts each year. Because the system will qualify for a 30 percent federal tax credit, the net cost will be $32,635.

Table 1: Facts about the cost and productivity of my 9.4 kilowatt solar electric system

Cost of system	$46,622
Kilowatts of DC capacity	9.4
Kilowatt hours produced/year	11,008
Federal credit	30%
Feed-in tariff rate/kilowatt hour	$0.585

Table 2: A simplified cash flow and internal rate of return for my 9.4 kilowatt system

Year	**Cash Flow**
0	($32,635)
1	$6,439
2	$6,439
3	$6,439
4	$6,439
5	$6,439
6	$6,439
7	$6,439
8	$6,439
9	$6,439
10	$6,439
11	$6,439
12	$6,439
13	$6,439
14	$6,439
15	$6,439
Total	$63,955
IRR	**18.1%**

I worked as a Division Finance Manager at Tektronix, so I know some people will criticize Tables 1 and 2 as being too simplistic. Items left out of the analysis include:

- The $10/month meter fee required by the feed-in tariff approach.
- Financing costs, tax preparation, insurance, and professional maintenance. These costs were discussed in Section 2.3 and don't apply in my case.
- Depreciation, state and federal taxes.
- The small annual degradation of output from the solar panels.
- The residual value of the system at the end of year 15.

Adjustments of the sort discussed in the bullets above would not affect the basic analysis significantly, and they would cloud the analysis and discussion unnecessarily. The bottom line of this example is: I will earn an outrageously high IRR (internal rate of return) on this project.

One really nice feature of a spreadsheet model is its ability to perform "what-if" analysis. I wanted to know what incentive rate would make the IRR equal 6 percent. After a bit of trial-and-error, the answer came back at 30.5 cents/hour – far lower than the 58.5 cents/hour I will actually be paid.

This section shows Oregon's incentive rates for small-scale systems are so high they resulted in outrageously high profits for my solar system. This result confirms the broad trends discussed in Sections 2.1 through 2.3. Section 2.5 looks at another way to check the reasonableness of Oregon's incentive rates by comparing them with incentive rates in other feed-in tariff programs.

Section 2.5 –A comparison of Oregon's incentive rates with other feed-in tariff systems

This section compares Oregon's incentive rates to other solar feed-in tariff rates used within the United States. I decided to limit this analysis to the United States because it sidesteps currency exchange and cultural issues, but foreign countries have much larger and older feed-in tariff programs. Anyone interested in learning more about feed-in tariff systems should begin by reading the 143-page booklet titled, "A Policymaker's Guide to Feed-in Tariff Policy Design", published by the National Renewable Energy Laboratory in July 2010 (available at: http://www.nrel.gov/docs/fy10osti/44849.pdf).

Outside Oregon, only Vermont and Hawaii have state-wide solar feed-in tariffs that are based on the cost of generation plus a profit. In addition, the City of Gainesville, Florida, has a feed-in tariff program worth comparing.

Feed-in tariff rates are not directly comparable. An honest comparison needs to blend and adjust these four factors:

1. The feed-in tariff rate per kilowatt hour and when the rate was set
2. The size of solar system allowed.
3. Amount of sun, rain, and fog.
4. Length of contract

Table 3 summarizes basic facts about each system for Vermont, Gainesville, Hawaii, and Oregon.

Table 3: Basic facts about four feed-in tariff systems

Line	Description	Vermont	Gainesville	Hawaii	Oregon
1	**Incentive rate/kilowatt hour**	$0.30	$0.24 - $0.32	$0.238 - $0.274	$0.50 - $0.65
2	**kWh/year for 4 kW-DC system**	4,550	5,276	5,675	4,494
3	**Retail electric rate per kWh**	$0.14	$0.09	$0.14	$0.08
4	**Capacity limits in MKH**	14.25	4	80	25
5	**Length of contract in years**	25	20	20	15

Incentive rate/kilowatt hour and size of system allowed

None of the rates listed below allow the use of state tax credits.

- **Vermont:** A flat 30 cent/hour rate was set in 2009. All systems received the same rate regardless of size, and the maximum system size was 2.2 megawatts. Vermont's rate prompted a stampede of applicants on October 19, 2009 as described on pages 3 and 4.
- **Gainesville:** The rates for roof-mounted systems less than 10 kilowatts of capacity have stayed unchanged since 2009 at 32 cent/hour. The rate for ground-mounted systems greater than 25 kilowatts will be lowered in 2011 to 24 cent/hour. Like Vermont, Gainesville has had many more applicants than capacity.
- **Hawaii:** Rates were set in October 2010. Systems with less than 20 kilowatts AC receive 27.4 cents/hour; while 20 to 500 kilowatt AC systems receive 23.8 cents/hour. Hawaii's program is too young to know how supply and demand will balance.
- **Oregon:** The rates for 2010 varied based on system size, location, and date. The overall average rate for systems less than 100 kilowatts was 55.9 cents/hour.

Amount of sun, rain, and fog

A solar panel's output depends on where it is placed. Hawaii gets more sun than Oregon, and Pendleton gets more sun than Portland. To adjust for these differences, I used the

National Resources Energy Laboratory's PVWatts Viewer program (available at http://mapserve3.nrel.gov/PVWatts_Viewer/index.html). I asked it to assume a 4,000 kilowattDC system would be optimally oriented at various locations. For Hawaii and Vermont, I chose their state capitals: Honolulu and Montpelier. Gainesville, Florida was a self-defined choice. For Oregon, I chose Albany because that is where I live.

> **Ironic humor break:** An incentive to put solar panels in rainy, foggy places!
>
> Incentives usually are used to encourage good behavior, but Oregon pays higher incentive rates to encourage people to put solar panels in rainy parts of Oregon. I suspect this decision was actually made because lots of voters live in dreary Portland while few voters live in sunny Lakeview or Twin Falls where the panels would be 30 percent more efficient. The official reason behind this decision is "fairness." Of course any attempt to use government incentives to make the world a fair place opens interesting possibilities. Here are other ways solar incentives help make life fair:
>
> - **Senior citizen incentive rates:** Actuaries could set higher rates for old people because they are likely to die before Oregon's 15-year incentive period ends. Also, for safety reasons we should not encourage old folks to clean roof-top panels, so special senior citizen rates could help pay for professional cleaning.
> - **Roof-orientation incentive rates:** In Oregon, south-facing roofs have an unfair advantage, so incentive rates should compensate for solar panels on east-, west-, or north-sloped roofs.
> - **Forestry incentive rates:** Trees are eco-friendly because they remove carbon from the atmosphere, but they cast shade on solar panels placed in a forest. Solar panels provide diversity on a mature forest's floor where only three percent of sunlight penetrates, so high incentive rates would encourage trees and solar panels to coexist peacefully.

Length of Contract

Vermont's incentive system guarantees payments for 25 years. Hawaii and Gainesville stop payments after 20 years. Oregon stops payments after only 15 years.

Table 4 compares the Net Present Value (NPV) of incentive rates paid for a 4,000 kilowattDC solar system installed under four different feed-in tariff approaches. Oregon's NPV of $25,319 is 35 percent higher than the average for Vermont, Gainesville, and Hawaii.

Table 4: A comparison of the Net Present Value of a 4,000 kilowattDC solar system for four feed-in tariff systems

Interest rate	6%	6%	6%	6%
Rate/kWh	$0.300	$0.320	$0.274	$0.559
kWh/year	4,550	5,276	5,675	4,494
Contract length	25	20	20	15

Year	Montpelier, Vermont	Gainsville, Florida	Honolulu, Hawaii	Albany, Oregon
1	$1,365	$1,688	$1,555	$2,512
2	$1,283	$1,587	$1,462	$2,361
3	$1,206	$1,492	$1,374	$2,220
4	$1,134	$1,402	$1,292	$2,087
5	$1,066	$1,318	$1,214	$1,961
6	$1,002	$1,239	$1,141	$1,844
7	$942	$1,165	$1,073	$1,733
8	$885	$1,095	$1,008	$1,629
9	$832	$1,029	$948	$1,531
10	$782	$967	$891	$1,439
11	$735	$909	$838	$1,353
12	$691	$855	$787	$1,272
13	$650	$804	$740	$1,196
14	$611	$755	$696	$1,124
15	$574	$710	$654	$1,056
16	$540	$667	$615	$0
17	$507	$627	$578	$0
18	$477	$590	$543	$0
19	$448	$554	$511	$0
20	$421	$521	$480	$0
21	$396	$0	$0	$0
22	$372	$0	$0	$0
23	$350	$0	$0	$0
24	$329	$0	$0	$0
25	$309	$0	$0	$0
Total NPV	**$17,906**	**$19,975**	**$18,397**	**$25,319**

Table 4 assumes all solar systems will have no residual value when the feed-in tariff payments end, so payments fall to zero for Oregon at year 16. The gap between Oregon's NPV and the other systems would be larger than 35 percent if reasonable estimates of residual values were added to the model.

Part 2 looked at Oregon's incentive rates from many viewpoints, and they all suggest incentive rates have been at least 30 percent too high.

This comparison shows that even after making careful adjustments to compensate for program differences, Oregon's incentive rates are much higher than anywhere else in the US. For example, Oregon's 2010 incentive rates are much higher than Vermont's 2009 rates which prompted a stampede of applications – but prices have fallen dramatically since 2009.

Part 2 looked at Oregon's incentive rates from many viewpoints, and they all suggest incentive rates have been at least 30 percent too high. Next, Part 3 looks at the perverse incentives Oregon's pilot program gives people to waste electricity.

Humor Break: A wise man knows what's watt.

Part 3: Perverse incentives to waste electricity

The pilot solar program's administrative rules discourage participants from adopting conservation measures, and in some cases, the rules give people a huge incentive to actively waste electricity.

As an example, consider my recently installed solar system. The roof of my four-plex townhouse-style rental building in Albany will support a 9.4 kilowatt solar system. Each of the four tenants has had a separate electrical meter (as shown in Figure 3). Because of the economics described in Section 2.4, I wanted to put as many solar panels as possible on this building.

In some cases, the rules give gives people a huge incentive to actively waste electricity.

I phoned Pacific Power to find out how much power each tenant had been using because the pilot program limits the solar system's estimated production to 90-percent of the historical electrical usage. Pacific Power said most tenants hadn't been using enough electricity to allow the installation of the full 9.4 kilowatt system. But Suzie Clark lived in an end unit, and she used a lot more electricity than anyone else. Since she used enough to qualify for the full 9.4 kilowatt system, I had the electrical service for her apartment transferred into my name, and I applied for and received a 9.4 kilowatt capacity allocation.

Figure 3: Dave Sullivan stands next to the electrical equipment for his new solar system.

Suzie Clark moved out just after Thanksgiving, and new tenants named Paul and Travis moved in only days later. The odds are good Paul and Travis will want to use less electricity than Suzie did – but I can't afford to allow that to happen. If it does, then I won't get paid

58.5 cent/kilowatt hour for all electricity produced by my new solar system. My wife and I have discussed the situation with Paul and Travis. They understand that if they don't use as much electricity as the solar panels produce, then we will plug a heater into the outdoor receptacle to burn enough 8 cent/kilowatt electricity until we are allowed to sell all 58.5 cent/kilowatt solar-generated electricity. Obviously, we won't bill Paul and Travis for the electricity we waste this way.

Many other scenarios could force people into wasting electricity. Consider the situation of a building owner whose tenant moves out and the building sits vacant. The owner is already losing rent: Does anyone really expect the owner to also forgo selling the building's solar power at an incentive rate? Or consider the building which is put up for sale and sits vacant. Or consider whether an owner will want to make energy conserving improvements, such as adding insulation or better windows, if these improvements might possibly result in unsalable solar power sometime years later.

Several approaches could be taken to fix these problems. The easiest approach would be to put Band-Aids on the problem. For example, a simple administrative rule change would allow all electrical meters on a building to count toward the entire building's net meter requirement. This particular Band-Aid would remove the worst problems with my four-plex, but it wouldn't help with problems discussed in the last paragraph.

The best approach would be to eliminate net metering entirely by changing the pilot program into a true feed-in tariff system. Part 4 discusses how to do this by using auctions to set incentive rates.

Part 4: A request for an e-Docket discussion about incentive rates

All problems listed in Parts 1 through 3 would disappear if the PUC changes its administrative rules to allow a market-based process to determine incentive rates.

> … the first step should be to begin a public discussion about moving to market-based methods of determining incentive rates.

- Part 1's imbalance between supply and demand would disappear because incentive rates would naturally float down until a market clearing set of rates is found. Some solar industry firms would not like this because their sophisticated computer programs for quickly entering capacity reservations would instantly become obsolete. But the average residential customer would be happy because they could get into the program by offering to receive a market-based incentive rate.

- Part 2's cost analysis becomes unnecessary because the PUC would no longer need to set incentive rates.
- Part 3's perverse incentives to waste electricity would disappear because net metering would no longer be necessary to sidestep federal regulations. Thus, the pilot program would become a true feed-in tariff system.

This change should appeal to anyone who truly supports the idea of expanding the pilot program. Today the program is being attacked successfully as being unfair, inefficient, and prone to wasting electricity. Under a market-based incentive system, taxpayers and ratepayers would know the program's subsidy was as small as possible to fill the program to capacity.

Lots of market-based methods for setting incentive rates exist, and choosing a reasonable method is important. Competitive sealed-bid methods work best for sophisticated investors, so they would not be appropriate for the average residential customer. On the other hand, any eBay-like process would work, as would any silent auction method. These approaches are widely understood, would let people bid against each other and would set competitive, market-based incentive rates.

Another approach would be to adjust incentive rates on a daily or weekly basis in an automated fashion. For example, this might involve breaking up the annual capacity for PGE and Pacific Power into daily increments. If a given day's capacity is fully subscribed, then the next day's incentive rates would fall by 1 percent. If a given day's capacity is not claimed, then its capacity would be added to the next day's capacity, and the next day's incentive rates would rise by 1 percent. Rates would stay in balance because they could float up or down by 30 percent each month. This sort of system would allow anyone who wanted into the program a simple way to sign up at any time during the year, and it would provide daily market-based feedback about the current cost of balancing supply with demand.

If the PUC Commissioners think the ideas in this part of my comments make sense, then the first step should be to begin a public discussion about moving to market-based methods of determining incentive rates. If the Commissioners reject these ideas, then Part 5 becomes important.

Part 5: A formal challenge of the rebuttable assumption about incentive rates

As a duly certified intervener, I hereby formally challenge the rebuttable presumption that the incentive rates for April 1st should drop by 10 percent: The evidence in Part 2 shows incentive rates should drop by at least 30 percent.