# Sustainable Energy Trust Financial Analysis

Washington State Housing
Finance Commission

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# Section 1.0 Executive Summary

The Washington State Housing Finance Commission (Commission) commissioned David Paul Rosen & Associates (DRA) to conduct a financial analysis of alternative solar photovoltaic (PV) energy generation systems that can be financed by the Commission's Sustainable Energy Trust (SET). DRA, with Commission staff, identified the following three solar PV system prototypes to analyze in this study:

- Prototype #1: Single Family Residential Use
- Prototype #2: Non-profit or Government-Owned School Use
- Prototype #3: Agricultural Use

DRA modeled the development costs for each solar PV system as well as the available financing through federal, State and local funding programs. For each prototype, we examined the available funding sources under two ownership scenarios:

- The system owned by the ratepayer.
- The system is owned by a third-party who sells the electricity produced at a reduced rate to the user, under the terms of a Power Purchase Agreement (PPA).

This report summarizes DRA's analysis of the alternative financing and ownership structures for each solar system prototype. Our analysis assumes that the funding gap between the cost of installing the solar PV system and the financing available to the system's owner is filled by a loan provided by the SET. We then model the system owner's repayment of the SET loan and project the amount of time required to pay the loan back in full. For the scenarios in which the system is owned by the ratepayer, we assume that the source for paying back the SET loan is the owner's savings in electricity costs as a result of the solar PV system, as well as the Washington Solar Energy Incentive payments received. For the PPA scenarios, the source for repayment of the SET loan is the revenue generated through selling the electricity produced by the system to the user and the Washington Solar Energy Incentive payments.

## Key Findings

DRA's analysis, based on conservative assumptions regarding solar system financing and costs, finds that none of the prototypes studied are financially feasible and none of the prototypes or ownerships structures analyzed result in paying back the SET loan in full by the end of the loan's 25 year term. This result is based on several factors specific to Washington. The primary reason for the long payback period for these solar systems is the relatively low electricity cost in Washington. Washington's average electricity rate is approximately $0.068 per kWh compared to California's average cost of approximately $0.14 per kWh and a national average cost of $0.10 per kWh[1]. Because the cost of a solar PV system is recovered through electricity savings realized, the payback period of such a system is highly dependent on the cost of the electricity it is replacing.

In other states with higher electricity costs, a solar system's annual savings in electricity payments is higher than in Washington, resulting in shorter payback periods. This is a primary reason cited by many interviewed in preparing this study for the relatively low level of solar PV systems installed in Washington compared with other states.

Washington's low average electricity rate is due in large part to the State's supply of hydroelectric power, which, at a cost as low as $0.02 per kWh, is a very low-cost source of electricity compared to electricity generated with fossil fuels. About three quarters of the State's electricity is produced by hydroelectric power.[2] While there are environmental impacts from this source of electricity, including modification or loss of fish habitats, it produces zero greenhouse gas (GHG) emissions and is considered a renewable energy source. Therefore, replacing low-cost hydroelectric power with renewable energy produced, at a high capital cost, through solar panels may not be the most efficient and effective use of public resources. In addition, it may not be the optimal strategy for Washington to increase its supply of renewable energy and reduce its GHG emissions.

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[1] *Electric Power Monthly with data for June 2009*, Energy Information Administration.

[2] *Washington State Hazard Mitigation Plan, January 28, 2008,* Washington Military Department Emergency Management Division.

Another reason for the long payback period of solar PV systems in Washington is the structure of the State's Solar Energy Incentive. This incentive, paid to owners of solar systems, is low in relation to other states with more active solar markets. The $5,000 per year cap on the incentive means that all solar systems larger than approximately 33 kilowatts receive the maximum incentive. Medium and large systems, then, do not receive incentive payments proportional to their size or electricity produced, thus limiting the effect of the incentive on the system's cost and payback period. Therefore, the relatively modest nature of the State's incentive system fails to make larger systems financially feasible, thus limiting the number of such systems installed in Washington. Larger systems, then, are not good candidates for SET financing, due to their inability to repay debt over the long term.

On the other hand, the payback period for smaller systems, such as the system modeled in Prototype #1 for single family residential use, is more sensitive to the incentive payments projected. This is because small systems do not reach the incentive cap, allowing the incentive payments to remain proportional to the system's size and cost. Payback projections for small systems that use equipment manufactured outside of Washington, and are therefore eligible for the lowest incentive rate, do not show the SET loan being paid off within 25 years. However, these projections improve if the systems include equipment manufactured in Washington. Such equipment is projected to come on the market this year.

## Recommendations

Given the findings of this financial analysis, we recommend that the Commission undertake further research to confirm that the future electricity market and solar PV financing opportunities available in the State do not materially change the financial picture presented here for the solar PV prototypes modeled. We also recommend exploring alternative opportunities for using the Commission's SET authority to support renewable energy and energy efficiency in the State. We therefore make the following five recommendations for next steps:

1. Explore the potential future markets for carbon credits under a federal cap and trade system and Renewable Energy Credits (RECs), as well as their impact on the financial feasibility of solar PV systems in the State. As utility companies are required, per Washington's Initiative 937, to obtain 15 percent of their electricity from renewable sources (*not* including hydroelectric) by 2020, a market may develop for utility companies to purchase RECs from solar PV system owners. In addition, climate change legislation in California, which will require the State to obtain 33 percent of its electricity from renewable sources

by 2020, may create a market in Washington for selling RECs or renewable energy to California utilities. Furthermore, federal climate change legislation may create a market for solar PV system owners to sell carbon credits under a cap and trade system. Explore the role the Commission can play to facilitate the buying and selling of these credits and the value it can add to the transactions.

2. Apply this financial analysis to an affordable and market rate. multifamily residential solar PV system prototype. The installation of the solar system will be modeled in conjunction with energy efficiency measures and improvements, in order to capture the savings in electricity costs these measures allow. This analysis will also model the costs, benefits and payback projections for such a system in the context of a low income housing tax credit property, both new construction and rehabilitation, under both non-profit and for-profit General Partner ownership. Solar PV systems have several financial impacts on the financing and cash flow of tax credit properties and thus the system's financial feasibility may be improved in this context. The SET's financing of the solar system may be combined with the Commission's financing of the project as a whole.

3. Expand the SET Analysis to include a solar PV system that is considered a Community Solar Project under the State's Energy Incentive legislation. Such systems are eligible for a higher incentive rate than those modeled in this study. In addition, Community Solar Projects are owned by several individuals, households or organizations, each of whom can earn up to the maximum $5,000 annual incentives. This may provide a scenario in which larger solar PV projects are rendered financially feasible and could repay an SET loan.

4. Perform a cost benefit analysis of conducting energy efficiency and water conservation retrofits of existing buildings, including quantifying the energy saved and water conserved in relation to the cost of the improvements. This analysis will include examining the SET's potential role in financing and/or incentivizing such retrofits. Include analysis of retrofits of residential (multifamily and single family), commercial, industrial and government buildings. Highlight potential policies the Commission can adopt to require energy audits for projects financed by the Commission, including new construction projects, rehabilitation projects, and projects currently in the Commission's portfolio.

5. Analyze the costs and benefits of alternative renewable energy technologies, such as wind power and co-generation or biodigester systems. The results of this analysis will inform the Commission regarding the financial feasibility of

renewable energy systems beyond solar and the potential opportunities for offering financing for such systems through the SET.

6. Research and analyze projections for the future demand for electricity in Washington relative to the future supply of hydroelectric power. Specifically, examine whether the State's hydroelectric capacity will be sufficient to meet its future electricity needs. If this is not projected to be the case, the financial feasibility of solar PV systems may be altered, as electricity prices may rise materially. In addition, if the State's ability to rely on hydroelectric power in the future is limited, it may be a more logical policy goal to increase the supply of alternative renewable energy sources, like solar power.

7. Develop legislative recommendations for improving the State's policies and incentives for renewable energy in order to more effectively focus policy on those cost efficient strategies that achieve real net reductions in GHG emissions.


# Section 2.0 Solar PV System Prototypes

DRA and Commission staff identified the following three prototypes for the SET analysis. All three prototypes are assumed to use commercially available PV technology and equipment and are not demonstration projects or advanced renewable energy technologies. The prototypes are detailed in Table 1 below.

- Prototype 1: Single family residential use, privately-owned
- Prototype 2: School use, non-profit or government-owned
- Prototype 3: Agricultural use, privately-owned

## 2.1 System Capacity

### Prototype 1: Single Family Residential Use

According to interviews conducted with solar system installers and staff of the Washington State University Energy Program (WSU Energy), the residential solar systems being installed in Washington currently range from about 2 kilowatts DC (kW DC) to about 4 kW DC, with the average residential solar system sized at 3kW DC. The single family prototype used in this analysis is modeled on the average installed system in Washington and is therefore sized at 3kW DC. As a rough estimate, a 3 kW DC system generates enough electricity to cover about 15 percent of the electricity needs of the average home with electric heating.

DRA's analysis also quantifies the costs and projects the payback period for a homeowner who conducts an energy efficiency retrofit of their home when installing a solar PV system. From an energy conservation and policy perspective, it is logical to make relatively inexpensive improvements to reduce a home's energy needs before taking more costly measures, such as installing a PV system, to generate renewable energy to cover its energy consumption. Energy efficiency improvements can vary from simple weatherstripping to more extensive whole-home retrofits involving replacing windows, upgrading appliances, adding insulation, addressing air leaks and improving heating and cooling systems. The extent of the energy efficiency improvements made will determine the retrofit's effect on the home's electricity consumption.

Because this analysis is assuming the single family home's solar system is sized to generate only a fraction of the home's electricity needs, we assume that the single family PV system prototype that is installed along with conducting an energy efficiency retrofit is the same size as the system installed without conducting energy efficiency improvements. In this scenario, the savings that accrue to the homeowner from conducting the retrofit are not realized by purchasing a smaller PV system, but instead by reducing the cost of electricity that is needed beyond the PV system's generation and that is therefore purchased from the local utility provider.

#### PROTOTYPE 2: SCHOOL USE

In determining the system size for this prototype, we relied on requirements of the San Juan Islands school districts' potential solar systems, for which they applyied to the Washington Department of Commerce for State Energy Program grant funds. The San Juan Islands are served by OPALCO, the Orcas Power and Light Cooperative, which allows a maximum solar system size of 200 kW DC per meter. We therefore assume that this prototype is a 200 kW DC system.

#### PROTOTYPE 3: AGRICULTURAL USE

This prototype is assumed to be a 1 megawatt (MW) system. It is our understanding that there are no commercial, user-owned solar systems of this size currently in the State. This is due in large part to the $5,000 per year cap on the State Energy Incentive. This cap makes the return on large systems insufficient for businesses to consider investing in large PV systems. However, modeling this prototype will illustrate the financing gap such a system has and how the SET may fill this gap and make larger commercial systems possible in Washington.

## 2.2 Annual Energy Generation

Solar PV systems' annual energy generation varies, depending on the systems' size, shading, orientation, tilt, location and panels and modules used. According to our interviews, solar systems in Seattle average about 900 kilowatt hours (kWh) annually per installed kilowatt DC. In Puget Sound, an optimally-oriented system can generate about 1,000 kWh per installed kilowatt DC and in eastern Washington, one kilowatt DC can generate about 1,200 kWh per year.

Our analysis assumes annual energy generated by the prototype systems to be 1,000 kWh per installed kW DC, or 3,000 kWh for Prototype #1, 200,000 kWh for Prototype #2 and 1,000,000 kWh for Prototype #3. We note that, while it can vary from house to house, the average single family home with electric heating uses approximately 20,000 kWh per year. The residential solar system we model therefore only generates approximately 15 percent of the average home's electricity needs.

Per interviews with solar installers and experts, we assume that the solar PV systems degrade slightly each year. Most solar panel producers claim that their panels will produce at least 80 percent of their rated output after 20 to 25 years of use. We therefore assume an annual degradation rate of 0.75 percent for all of the prototypes.

## 2.3 Space Needed

The number of square feet of roof or ground space required by a solar system depends on the system's size and the efficiency of the panels used, which varies greatly depending on the panels' manufacturer and technology. Per interviews with installers and a review of panels for sale, we assume that a system requires 100 square feet (SF) per kW DC. Therefore, Prototype 1 requires 300 SF of roof space, Prototype 2 requires 20,000 SF and Prototype 3 requires 100,000 SF.

## 2.4 Development Costs

### 2.4.1 PV System Cost Per Watt

The all-in cost of a solar PV system includes the system equipment (panels and inverters), mounting equipment, interconnection equipment and labor costs. Due to recent changes in the economy as well as increases in the market's supply of panels and solar installers, solar system costs are decreasing. According to installers, other Washington solar experts and DRA's experience, the current all-in system cost ranges from $6.75 to $7.50 per watt for residential systems, down from about $8 per watt one year ago. This analysis assumes the residential system's cost is $7 per watt, or $21,000 for the entire system.

Larger systems can achieve some economies of scale in purchasing the solar panels as well as in installation costs. Some installers state that these economies of scale apply equally to all large systems, whether they are 200 kW DC or 1 MW DC. Therefore, we assume a cost of $6 per watt for the 200 kW DC system and the 1 MW system. The 200 kW DC system therefore costs a total of $1.2 million and the 1 MW DC system costs $6 million.

The above assumptions assume the prototypes use the lowest cost systems and installers available. While there are Washington-made inverters currently available on the market, and one Washington-based manufacturer that will soon start selling solar panels, these panels will likely be at a higher cost than those quoted above. We therefore do not assume the systems use solar panels or inverters manufactured in Washington. This assumption will cause the systems to be eligible for the lowest Washington Solar Energy Incentive rate, as the rate is increased when the installed system includes Washington-made inverters and panels. DRA's analysis therefore illustrates the worst-case incentive rate scenario for the prototypes modeled.

### 2.4.2 Energy Efficiency Retrofit Costs

As discussed above, an energy efficiency retrofit of a single family home can vary greatly in its comprehensiveness and resulting cost. The home's location and size will also affect the retrofit's cost. According to interviewees experienced in the energy efficiency retrofit field, it is generally understood that a whole house energy efficiency retrofit can range from $3,000 to $15,000. Because of the incentives available, most home energy efficiency retrofits currently being performed in Washington are of low income homes. These average $5,000 per home.

A 2001 evaluation of the Washington State Weatherization Assistance Program found that the average low income home retrofit resulted in mean normalized annual savings of close to 3,000 kWh, or 12 percent of the home's pre-weatherization electricity use. This estimate was confirmed by interviewees' more recent experience with home energy retrofits. We therefore assume that the energy efficiency improvements, totaling $5,000 in cost, reduce the home's annual energy needs by 2,500 kWh or 13 percent of the home's pre-retrofit annual electricity use of 20,000 kWh.

| Table 1 | | | |
|---|---|---|---|
| **PV Prototypes and Assumptions** | | | |
| **System Use:** | **Prototype #1: Single Family Residential Use** | **Prototype #2: Non-Profit School Use** | **Prototype #3: Agricultural Use** |
| **System Specifications without Energy Efficiency (EE) Improvements** | | | |
| System capacity (kW DC) | 3 kW DC | 200 kW DC | 1,000 kW DC |
| Annual electrical production (kWh) | 3,000 kWh | 200,000 kWh | 1,000,000 kWh |
| System efficiency (SF/kW) | 100 SF/kW | 100 SF/kW | 100 SF/kW |
| Space needed (SF) | 300 SF | 20,000 SF | 100,000 SF |
| Annual system degredation[1] | 0.75% | 0.75% | 0.75% |
| Annual replacement reserve funding[2] | 1.00% | 1.00% | 1.00% |
| | | | |
| **System Specifications with EE Improvements** | | | |
| Annual electricity consumption, before EE improvements | 20,000 kWh | N/A | N/A |
| Annual electricity saved by EE | 2,600 kWh | N/A | N/A |
| EE improvements' cost | $5,000 | N/A | N/A |
| Reduction in electricity consumption | 13% | N/A | N/A |
| PV system capacity (kW DC) | 3 kW DC | N/A | N/A |
| Annual electrical production (kWh) | 3,000 kWh | N/A | N/A |
| | | | |
| **Development Costs** | | | |
| System cost (per watt) | $7.00 | $6.00 | $6.00 |
| Total cost w/o EE improvements | $21,000 | $1,200,000 | $6,000,000 |
| Total cost w/ EE improvements | $26,000 | N/A | N/A |
| **Other Assumptions** | | | |
| Offset electricity cost per kWh – low[3] | $0.068 | $0.068 | $0.068 |
| Offset electricity cost per kWh – high[4] | $0.080 | $0.080 | $0.080 |
| Annual electricity cost escalation rate | 5.30% | 5.30% | 5.30% |
| PPA rate, as % of market rate | N/A | 90% | 90% |
| PPA annual electricity cost escalation | N/A | 4.50% | 4.50% |
| WA Solar Energy Incentive Rate[5] | $0.15 | $0.15 | $0.15 |
| Maximum Energy Incentive per year | $5,000 | $5,000 | $5,000 |
| Annual interest rate on SET loan | 6.75% | 6.75% | 6.75% |

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Notes to Table 1:

[1] Percent by which the PV system's electricity output is diminished annually, on average, due to degradation of equipment and components.

[2] As a percentage of the system's total cost.

[3] Statewide average electricity cost, per kWh in June 2009, per *Electric Power Monthly with data for June 2009*, Energy Information Administration.

[4] Average electricity cost of the three highest-cost utilities in the State: Puget Sound Energy, Seattle City Light and Snohomish County PUD, per Mike Nelson, WSU Energy.

[5] Base Solar Energy Incentive rate, per kWh produced, to be paid annually until 2020, per RCW 82.16.120.


# Section 3.0 Development Sources and Uses

DRA modeled the sources and uses for each prototype's solar PV system, under two ownership structures: one in which the system is privately-owned by the system's user and one in which it is owned by a third party who sells the energy produced by the system at a reduced rate to the user, under a Power Purchase Agreement (PPA). Depending on the nature of the system's owner and/or user, different financing sources may be available for the same system.

The financing required by the Sustainable Energy Trust to render the system feasible is equal to the gap between the total funding available from all applicable financing sources and the cost of the system. The three prototypes' sources and uses are shown in Tables 2 through 4 below.

## 3.1 Development Financing Sources

DRA produced, under separate cover, a summary of federal, State and local funding sources available to leverage SET funds in financing solar PV systems. These profiles include the major sources of financing available for solar PV systems in Washington. DRA's SET Financial Analysis includes the following financing sources, as appropriate for the prototypes and the ownership structures analyzed:

- Federal Business Energy Investment Tax Credit and Residential Renewable Energy Tax Credit
- Federal Residential Energy Efficiency Tax Credit
- Washington Solar Energy Incentive
- Bonneville Environmental Foundation's Solar 4R Schools Program
- The USDA Rural Energy for America Program

| Table 2 | | |
|---|---|---|
| **Development Sources and Uses<br>Prototype #1: Single Family Residential Use<br>System Privately-Owned by User** | | |
| | **With Energy Efficiency (EE) Improvements** | **Without Energy Efficiency Improvements** |
| **Uses:** | | |
| System Cost | $21,000 | $21,000 |
| EE Improvements | $5,000 | $0 |
| **Total Uses:** | $26,000 | $21,000 |
| | | |
| **Sources:** | | |
| Federal Residential Renewable Energy Tax Credit[1] | $6,300 | $6,300 |
| Federal Residential Energy Efficiency Tax Credit[2] | $1,125 | $0 |
| SET Loan Financing | $18,575 | $14,700 |
| **Total Sources:** | $26,000 | $21,000 |
| | | |
| Total SET Financing per watt produced/saved | $3.32 | $4.90 |
| SET Financing as % of total cost | 71.4% | 70.0% |

[1] Federal Residential Renewable Energy Tax Credit is equal to 30 percent of the system's cost.

[2] Federal Residential Energy Efficiency Tax Credit is equal to 30 percent of eligible energy efficiency costs, for improvements made in 2009 or 2010. The credit shown here assumes that 75 percent of the energy efficiency improvements' cost is eligible for the credit.

| Table 3 | | |
|---|---|---|
| **Development Sources and Uses** | | |
| **Prototype #2: Non-Profit School Use** | | |
| | **System Owned by Non-Profit User** | **Power Purchase Agreement Ownership** |
| **Uses:** | | |
| System Cost | $1,200,000 | $1,200,000 |
| **Total Uses:** | $1,200,000 | $1,200,000 |
| | | |
| **Sources:** | | |
| Federal Investment Tax Credit[1] | $0 | $360,000 |
| Solar 4R Schools Program[2] | $396,000 | $0 |
| SET Loan Financing | $804,000 | $840,000 |
| **Total Sources:** | $1,200,000 | $1,200,000 |
| | | |
| Total SET Financing per watt produced | $4.02 | $4.20 |
| SET Financing as % of total cost | 67.0% | 70.0% |

[1] Federal Investment Energy Tax Credit is equal to 30 percent of the system's cost.

[2] The Bonneville Environmental Foundation's Solar 4R Schools Program provides up to 33 percent of a school's renewable energy system for systems larger than 1.1 kW DC. The school must own the system.

| Table 4 | | |
|---|---|---|
| **Development Sources and Uses** | | |
| **Prototype #3: Agricultural Use** | | |
| | **System Owned by Non-Profit User** | **Power Purchase Agreement Ownership** |
| **Uses:** | | |
| System Cost | $6,000,000 | $6,000,000 |
| **Total Uses:** | $6,000,000 | $6,000,000 |
| | | |
| **Sources:** | | |
| Federal Investment Tax Credit[1] | $1,800,000 | $1,800,000 |
| USDA Rural Energy for America Program[2] | $500,000 | $0 |
| SET Loan Financing | $3,700,000 | $4,200,000 |
| **Total Sources:** | $6,000,000 | $6,000,000 |
| | | |
| Total SET Financing per watt produced | $3.70 | $4.20 |
| SET Financing as % of total cost | 61.67% | 70.0% |

[1] Federal Investment Energy Tax Credit is equal to 30 percent of the system's cost.

[2]USDA Rural Energy for America Program (REAP) provides grants to agricultural producers for renewable energy projects in amounts up to 25 percent of the project's cost, up to a maximum grant amount of $500,000.

### 3.1.1 Federal Energy Tax Credits

The primary source of financing for privately-owned solar PV systems is the Federal Business Energy Investment Tax Credit (ITC) for commercial and industrial users and the Federal Residential Renewable Energy Tax Credit for homeowners. Both tax credits are equal to 30 percent of the system's equipment and installation costs, with no maximum credit. The credit is taken in the year the system is placed in service and systems must be placed in service before December 31, 2016.

To claim the ITC, the original use of the system must begin with the taxpayer, or the system must be constructed by the taxpayer. Businesses claiming the ITC may opt for a US Treasury Department grant in the same amount of the ITC. Homeowners may not opt for the grant, but may carry the tax credit forward to the succeeding year, until 2016, if the credit exceeds that year's tax liability.

DRA's financial analysis shows the Residential Renewable Energy Tax Credit as equal to 30 percent of the system's cost for Prototype #1. We also show the ITC equal to 30 percent of the system's cost for the agricultural scenario in Prototype #3. Prototype #2 is not eligible for the ITC if the system is owned by a non-profit or governmental entity, as they are not taxpayers. However, under the PPA ownership structure, the ITC is claimed by the owner of the system who then sells the electricity produced at a reduced rate to the non-profit or governmental entity.

Because the credit is claimed in the year in which the system is placed in service, in all scenarios in which the federal tax credit applies, the credit is shown as a development source for the PV system. The credit, then, reduces the gap financing required on a dollar-for-dollar basis.

### 3.1.2 Federal Residential Energy Efficiency Tax Credit

Taxpayers making energy efficiency improvements to existing homes and purchasing eligible energy efficiency equipment before December 31, 2010 can claim the Residential Energy Efficiency Tax Credit. The credit is worth 30 percent of eligible costs and is capped at $1,500.

As a conservative assumption, we assume that 75 percent of the costs of the energy efficiency retrofit modeled in Prototype #1 represents eligible expenses. Therefore, the Prototype #1 scenario including energy efficiency improvements assumes a tax credit of $1,125. This assumes the retrofit is completed in 2010.

Similar to the ITC and Residential Renewable Energy Tax Credit, this credit is shown as a development source to finance the energy efficiency improvements on the home. It therefore reduces the gap financing required on a dollar-for-dollar basis.

### 3.1.3 Washington Solar Energy Incentive

The Revised Code of Washington Section 82.16.120 establishes an investment cost recovery incentive for the installation of renewable energy generation systems. This incentive is provided to individuals, businesses, government entities and participants in community solar projects who own a solar system in the State. The incentive is calculated based on the energy produced by the system and is provided as an annual payment by the recipient's utility provider. The incentive cannot exceed $5,000 per year and will be paid for the system's annual energy production through June 30, 2020.

The Solar Energy Incentive base rate is $0.15 per kilowatt hour produced. This rate can increase up to $0.54 per kWh if the system's inverters and/or modules are manufactured in Washington. For the purposes of this analysis, we assume that the systems' inverters and modules are manufactured outside of Washington and that the systems' owners are therefore eligible for the base incentive rate of $0.15 per kWh. This will illustrate the worst-case scenario in terms of the Solar Energy Incentive provided, and the resulting larger financing gap required to be filled by the SET financing.

In order to show the discounted present value of these incentive payments as a development source for financing the purchase and installation of the PV system, we would have to assume that the system's owner could provide the present value of the incentives in cash up front. This is not likely to be feasible for most system owners. Therefore, DRA's financial analysis assumes that the incentive payments received by the system owners are not used as an up-front source of financing for the system but instead are shown as an annual source of repayment for the SET loan.

### 3.1.4 The Bonneville Environmental Foundation's Solar 4R Schools Program

The Bonneville Environmental Foundation (BEF) Solar 4R Schools Program provides financing for solar PV systems installed on schools. The school must agree to own and maintain the system, provide access to a network to transfer solar data and implement an educational and/or outreach strategy regarding the use of photovoltaics. BEF generally completely funds or supplies systems sized at 1.1 kW and funds up to 33 percent of the cost of larger systems. While schools must apply for funding from BEF and the award is not guaranteed, DRA's analysis assumes that Prototype #2 receives a grant from BEF equal to 33 percent of the system's cost. This grant is only included in the scenario in which the school owns the system, as the system's owner in the PPA ownership structure scenario would not be eligible for this funding. However, unlike in the PPA scenario, in the scenario in which the school owns the solar system, the school is not eligible for federal tax credits. The BEF grant therefore supplants the tax credit as a source of financing.

### 3.1.5 USDA Rural Energy for America Program

The USDA Rural Energy for America Program (REAP) provides grants to agricultural producers and rural small businesses to purchase renewable energy systems, including solar PV systems that are used to make or sell electricity, and to make energy efficiency improvements. The grant is equal to 25 percent of the project's cost and is capped at $500,000.

DRA's analysis shows a REAP grant as a development source for Prototype #3. The grant shown is $500,000, the maximum grant amount allowed. Because systems that sell electricity are also eligible for this program, this grant is shown as a source for the scenario in which the agricultural producer owns the PV system as well as the PPA ownership structure scenario.

### 3.1.6 Local Utilities' Energy Efficiency Rebates and Incentives

Many utility companies in Washington offer rebates and incentives for energy efficiency improvements for residential and commercial buildings. The rebate amounts are often calculated as a fixed amount per technology used or energy efficient appliance installed. Some rebates are fixed amounts per building that meets specific energy efficiency standards.

The rebate amounts offered by the various utility providers in Washington vary greatly, making it difficult to model a prototypical rebate amount. In fact, the rebates offered by the three utilities that provide 75 percent of the State's electricity, Puget Sound Energy, Seattle City Light and Snohomish County PUD, vary to such an extent that using an average rebate amount would not be informative. While Snohomish County PUD offers rebates equal to 50 percent of qualified improvements and can add up to $9,700, Seattle City Light's maximum rebate amount is $220, or $20 for energy efficient lights and $100 each for qualified washer and dryers purchased. We therefore do not include energy efficiency rebates in our analysis but note that many single family homeowners undergoing energy efficiency retrofits on their homes would be eligible for such rebates.

### 3.1.7 Renewable Energy Certificates

Washington's Initiative 937, passed in 1996, requires all electric utilities that serve more than 25,000 customers to obtain 3 percent of their electricity from renewable sources by 2012, and thereafter gradually stepping up to a requirement that they obtain 15 percent of their electricity from renewable sources by 2020. Seventeen of Washington's 62 utilities, representing about 84 percent of the State's electricity load, must meet this standard. Utilities will meet this requirement by producing renewable electricity themselves or by buying Renewable Energy Credits or Certificates (RECs) from producers of renewable energy. RECs are typically purchased for renewable energy produced in increments of 1 megawatt.

There is not currently an active market for buying or selling RECs in Washington, although the Bonneville Environmental Foundation has purchased them from solar energy producers in the past. It is likely that as the requirements on the State's utilities step up, utility providers will enter the market for purchasing RECs from solar system owners. When this happens, they may attempt to aggregate the RECs from many small users to achieve the 1 MW threshold or may only purchase from large producers in the State, if such solar energy producers exist.

DRA's current analysis does not show RECs as a financing source for the PV prototypes since the market is currently nonexistent. However, we note that in the future the ability to sell one's RECs to a Washington utility may provide solar PV system owners with additional sources of financing.

## 3.2 SET Financing

In each prototype and ownership scenario, we model the SET providing gap financing to the system's owner in an amount equal to the difference between the solar PV system's total cost and the total financing available from other sources. We then model the repayment of this loan by the system's owner. In the scenarios in which the PV system is owned by the user of the electricity, the annual SET repayment amount is equal to the annual amount saved in electricity costs offset by the solar system, the annual cash benefits of depreciation and the annual Washington Solar Energy Incentive amount. In the PPA scenarios, the system's owner repays the SET loan annually in an amount equal to the revenue collected by selling the solar electricity to the user, the annual cash benefits of depreciation and the Washington Solar Energy Incentive amount.

We assume an interest rate on the SET loan of 6.75 percent and a term of 25 years, equal to the estimated useful life of the solar system.

# Section 4.0 Payback Projections

DRA projected the payback period for the SET loan for each of the prototypes studied, under the two ownership structures modeled. Given the assumptions described below, none of the scenarios modeled are able to pay back the SET loan within the 25 year term projected.

## 4.1 Payback Projection Assumptions

### 4.1.1 Electricity Cost

In order to quantify the financial benefit of the solar systems' offset electricity cost, we must determine the electricity rate paid by the system's owner. This rate varies greatly by the utility provider. The current statewide average electricity rate is $0.068 per kWh. The three utility providers with the highest electricity rates in the State cover three-quarters of the State's electricity use. Their average electricity rate is $0.08 per kWh. Our analysis therefore examines the solar systems' payback under a "low" electricity rate assumption of $0.068 per kWh and a "high" rate assumption of $0.08 per kWh.

For the PPA scenarios, we assume the systems' owners sell the electricity to the users at a rate that is 10 percent below the assumed market rate, or $0.059 for the "low" cost scenario and $0.072 for the "high" cost scenario. While the rates vary between PPAs and depend on the local cost of electricity and the terms negotiated with the PPA provider, a rate that is 10 percent below market is a common goal for PPAs. However, some PPA users pay only slightly below market electricity costs or even the same electricity rate as that offered by the local utility. Given Washington's relatively low cost of electricity, a PPA with an electricity rate 10 percent below market may be difficult to negotiate. In fact, there are few active PPAs in the State of Washington, primarily due to the low electricity rates and the resulting long payback period for solar PV systems. Our PPA scenario models, then, assume best case scenarios for the potential PPA terms.

#### ANNUAL ELECTRICITY INFLATION RATE

The Energy Information Administration compiles *Electric Power Monthly*, reporting the average electricity rate by state. According to this data from January 2005 through April 2009, the average electricity rate in Washington increased by an average of 5.3 percent per year. We therefore use this electricity rate inflator in the SET analysis.

In many PPAs, the user's savings in electricity cost is realized over time, as the electricity rate charged by the system's owner escalates at a lower rate than the market electricity rate. We therefore assume a 4.5 percent cost escalation rate for the PPA scenarios.

### 4.1.2 Modified Accelerated Cost Recovery System

The Federal Modified Accelerated Cost Recovery System (MACRS) allows the owner of eligible renewable energy systems, including solar PV systems, to take a depreciation deduction for the property and depreciate it over a six-year schedule. This accelerates the payback period for a solar PV system. The depreciation schedules, and the cash effect of each system's depreciation, are detailed in Tables 4 through 6 below.

DRA's payback projections calculate the tax benefits of MACRS for the owners of the solar systems, with the exception of Prototype #2 when the system is owned by a non-profit or government entity. In the PPA ownership structures for all prototypes, the MACRS benefits accrue to the PPA provider and system owner, not to the user of the electricity. These tax benefits allow the PPA provider to sell electricity to the user at a below-market rate.

#### INCOME TAX RATE

DRA assumes the following tax rates for the purposes of calculating the cash effects of MACRS for the systems' owners:

| | Federal Income Tax Rate | State Income Tax Rate |
|---|---|---|
| Corporate: | 34% | 0.484% |
| Individual: | 25% | 0% |

The federal corporate income tax rate above applies to corporations with taxable income between $335,000 and $10,000,000. The state corporate income tax rate shown above refers to Washington's 2009 Business and Occupation Tax for most non-retail and non-business services companies. The individual federal income tax rate shown above applies to the tax bracket of married couples filing jointly with an adjusted gross income of $67,900 to $137,050. Washington's 2009 median income for a family of four is $75,140. There is no Washington income tax for individuals.

### 4.1.3 Operations and Maintenance

Solar PV systems require minimal yearly maintenance. The only material maintenance cost for a PV system is replacing the inverters as they wear out. Many solar industry experts model replacing inverters after 10 years of use, although many are said to last up to 15 years and some manufacturers are starting to offer warranties on their inverters for up to 20 years. A safe assumption for accounting for the operations and maintenance cost of a system is to set aside 1 percent of the system's cost annually, per Mike Nelson of WSU Energy. This amount will be sufficient to replace inverters in 10 years, taking into account the fact that inverters will likely become less and less expensive and have longer useful lives as more are produced and technology improves.

**Table 5**

**Depreciation Calculations**

**Prototype #1: Single Family Residential**

| | |
|---|---|
| Total System Cost | $21,000 |
| (Less Federal Tax Credit – 30%) | ($6,300) |
| Total Depreciable Basis[1] | $17,850 |
| Federal Tax Rate[2] | 25.00% |

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 |
|---|---|---|---|---|---|---|
| MACRS Depreciation Schedule | 20.00% | 32.00% | 19.20% | 11.52% | 11.52% | 5.76% |
| MACRS Depreciation Amount | $3,750 | $5,712 | $3,427 | $2,056 | $2,056 | $1,028 |
| Cash Effect of Depreciation | $893 | $1,428 | $857 | $514 | $514 | $257 |
| Federal Tax Credit | $6,300 | | | | | |
| Total Annual Tax Savings | $7,193 | $1,428 | $857 | $514 | $514 | $257 |

[1] Depreciable Basis is calculated as the system's total cost, less 50 percent of the Federal Tax Credit Amount.

[2] Assumes a federal tax rate of 25 percent, which applies to the tax bracket of married couples filing jointly with an adjusted gross income of $67,900 to $137,050. Washington's 2009 median income for a family of four is $75,140.

| Table 6 | |
|---|---|
| **Depreciation Calculations** | |
| **Prototype #2: Non-Profit School Use** | |
| **Power Purchase Agreement Ownership** | |
| Total System Cost | $1,200,000 |
| (Less Federal Tax Credit – 30%) | ($360,000) |
| Total Depreciable Basis[1] | $1,020,000 |
| Federal Tax Rate[2] | 34.484% |

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 |
|---|---|---|---|---|---|---|
| MACRS Depreciation Schedule | 20.00% | 32.00% | 19.20% | 11.52% | 11.52% | 5.76% |
| MACRS Depreciation Amount | $204,000 | $326,400 | $195,840 | $117,504 | $117,504 | $58,752 |
| Cash Effect of Depreciation | $70,347 | $112,556 | $67,533 | $40,520 | $40,520 | $20,260 |
| Federal Tax Credit | $360,000 | | | | | |
| Total Annual Tax Savings | $430,347 | $112,556 | $67,533 | $40,520 | $40,520 | $20,260 |

[1] Depreciable Basis is calculated as the system's total cost, less 50 percent of the Federal Investment Tax Credit Amount.

[2] Assumes a federal tax rate of 34 percent and Washington's 2009 Business and Occupation Tax for manufacturing businesses of 0.484 percent.

| Table 7 |
|---|

**Depreciation Calculations**
**Prototype #3: Agricultural**
**System Owned by User**

| | |
|---|---|
| Total System Cost | $6,000,000 |
| (Less Federal Tax Credit – 30%) | ($1,800,000) |
| Total Depreciable Basis[1] | $5,100,000 |
| Federal Tax Rate[2] | 34.484% |

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 |
|---|---|---|---|---|---|---|
| MACRS Depreciation Schedule | 20.00% | 32.00% | 19.20% | 11.52% | 11.52% | 5.76% |
| MACRS Depreciation Amount | $1,020,000 | $1,632,000 | $979,200 | $587,520 | $587,520 | $293,760 |
| Cash Effect of Depreciation | $351,737 | $562,779 | $337,667 | $202,600 | $202,600 | $101,300 |
| Federal Tax Credit | $1,800,000 | | | | | |
| Total Annual Tax Savings | $2,151,737 | $562,779 | $337,667 | $202,600 | $202,600 | $101,300 |

[1] Depreciable Basis is calculated as the system's total cost, less 50 percent of the Federal Investment Tax Credit Amount.

[2] Assumes a federal tax rate of 34 percent and Washington's 2009 Business and Occupation Tax for manufacturing businesses of 0.484 percent.

## 4.2 Payback Projection Results

The results of the payback projections show none of the solar PV system owners being able to repay the SET loan in full by the end of its 25 year term. This is the result of the payback projections for every prototype studied and every ownership structure modeled. This finding means that the solar PV prototypes studied are not financially feasible in the current Washington market.

The PV prototypes studied have payback periods of longer than 25 years, compared to payback periods for solar PV systems in California of around 10 to 15 years. This is due to several factors specific to Washington. The primary reason for the long payback period for these solar systems is the relatively low electricity cost in Washington. Washington's average electricity rate is approximately $0.068 per kWh compared to California's average cost of approximately $0.14 per kWh and a national average cost of $0.10 per kWh[3].

Because the cost of a solar PV system is recovered through electricity savings realized, the payback period of such a system is highly dependent on the cost of the electricity it is replacing. This is a primary reason cited by many interviewed in preparing this study for the relatively low level of solar PV systems installed in Washington compared with other states.

Another reason for the long payback period of solar PV systems in Washington is the structure of the State's Solar Energy Incentive. This incentive, paid to owners of solar systems, is low in relation to other states with more active solar markets. The $5,000 per year cap on the incentive means that all solar systems larger than approximately 33 kilowatts receive the maximum incentive. Medium and large systems, then, do not receive incentive payments proportional to their size or electricity produced, thus limiting the effect of the incentive on the system's cost and payback period. Therefore, the relatively modest nature of the State's incentive system fails to make larger systems financially feasible, thus limiting the number of such systems installed in Washington. Larger systems, then, are not good candidates for SET financing, due to their inability to repay debt over the long term.

On the other hand, the payback period for smaller systems, such as the system modeled in Prototype #1 for single family residential use, is more sensitive to the incentive payments projected. This is because small systems do not reach the incentive cap, allowing the incentive payments to remain proportional to the

[3] *Electric Power Monthly with data for June 2009*, Energy Information Administration.

system's size and cost. Payback projections for small systems that use equipment manufactured outside of Washington, and are therefore eligible for the lowest incentive rate, do not show the SET loan being paid off within 25 years. However, these projections improve if the systems include equipment manufactured in Washington, thus earning the incentive at a rate of $0.54 per kWh. Such equipment is projected to come on the market this year.

The installation of solar systems on single family homes will likely increase as equipment manufactured in Washington becomes available and the systems' financial feasibility improves. The State will likely not see a rapid growth of larger systems, however, given the fact that they are financially infeasible in the context of Washington's current incentive structure and electricity costs. Therefore, as described in detail above, we recommend the Commission explore opportunities for using the SET's bond authority to finance smaller-scale solar projects and other renewable energy and energy efficiency projects beyond solar. Doing so may allow the SET to have a more meaningful impact on supporting and incenting these projects and ultimately reducing the State's GHG emissions.


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