October 27, 2011

Subject: Transmittal to ISEA Council of the Solar Task Force Report

Dear Council Members:

The purpose of this letter is to transmit to you a report summarizing issues, opportunities, and suggested actions to address the State of Idaho energy objectives outlined in the Legislature's 2007 Idaho Energy Plan. This report is focused on solar resources.

The Board of Directors (Board) of the Idaho Strategic Energy Alliance (ISEA) recognizes and thanks the Solar Task Force, one of more than a dozen expert groups working as part of the Alliance, for their development of this report. The ISEA Task Forces are comprised of volunteer experts, including energy engineers, developers, private and academic researchers, regulators, and policy experts who have come together in the interest of Idaho citizens to develop and analyze options, provide information, and build partnerships necessary to address Idaho's energy challenges and capitalize on Idaho's energy opportunities. The reports produced by these Task Forces present an understanding of the current status and potential path forward for each resource, and as such, provide a first step in executing the Legislature's 2007 Energy Plan.

The core of this report is the identification of barriers and challenges to, and the development of options for expanding development of solar resources in Idaho. The conclusions and recommended options are not intended to be exhaustive, but rather, form a starting point for informed discussions.

As you know, it is the Board's responsibility to evaluate the potential benefits and costs of the recommended options developed by ISEA Task Forces. Our initial review comments on the Solar Task Force report are summarized in this transmittal. The Board believes that an adequate policy assessment of individual reports cannot be made, however, until all of the Task Force reports and options have been evaluated together, including considerations of Economic Development & Finance, Energy Transmission, and Communications. In this respect, both this report and the Board's comments should be viewed as "living documents" that will be updated as significant new information and/or perspectives emerge.

Summary of Task Force Recommendations

The Task Force recommendations, which are listed below, are described in detail in the body of the report. In some instances, the ISEA Board concurred completely with the Task Force recommendations. In other instances, there was conditional or no consensus. In all cases, we as a Board feel that it is valuable for you to have an understanding of the recommendation, its potential benefits and downsides.

The Solar Task Force identified thirty-one recommended options as having potential to enhance development of solar resources in Idaho. These options are grouped in three categories:

A. Removing Barriers

1. Develop training programs for installers, designers and developers
2. The utilities should fund public education programs on solar

3. A specialty solar contractor licensing program should be established
4. Idaho should have a standardized net metering law and require all utilities (including consumer-owned) to provide net metering
5. Idaho utilities should have standardized interconnection agreements
6. Idaho should streamline permitting for PV and solar thermal systems
7. Additional assurances from the IPUC that solar investments will receive rate recovery
8. Change the regulatory environment to include resource diversification, transmission and distribution savings, peak demand reductions, energy independence, and reduced price volatility as well as other societal and environmental externalities
9. Encourage utilities to provide voluntary ratepayer funded programs for PV development
10. Create local markets for solar to encourage manufacturing to locate in Idaho
11. Transmission expansion plans should include solar

B. Financial Drivers: Tax Code Changes

1. Sales and use tax rebates
2. Make tax credits transferrable
3. Expand gross energy earnings options to include solar
4. Provide tax credits and loan options to finance solar systems

C. Financial Drivers: Ratepayer Funded Programs

1. Idaho should develop pilot programs for production based incentives
2. Develop a system of rebates to pay for systems above-market costs
3. Develop a Renewable Energy Standard (RES) with a solar carve-out

The Board was unanimous in support of a couple of recommended options, including streamlining permitting and expanding the current gross energy earnings options in lieu of property taxes to include solar.

The Board was unanimously opposed to some of the recommended options, including having the state fund outreach and education programs, requiring net metering and increasing the size of net metering limits for all utilities to 2 MW (though the Board agrees that the IPUC could examine how net metering could be made more consistent and beneficial to customers), and providing incentives and loans for solar (due to economic concerns.)

The Board's support was mixed for several recommended options, and these may be candidates for further evaluation and discussion. These options included: incorporating additional factors into valuing renewable resources, requiring utilities to incorporate solar into their transmission planning (some commented that this is already being done), requesting incentives from the city or county level to help customers pay for solar systems (there were several requests for more information on this recommendation), allowing tax credits to be transferrable, allowing property tax exemptions for small-scale distributed generation, and establishing an income tax credit for utility-scale solar facilities. There was also a lack of support for encouraging Idaho to consider any kind of renewable energy standard and there was a lack of unanimous support for establishing an energy siting council or a working group to develop siting best practices.

In overview, there is no question that the slate of recommended options could help facilitate development of solar (and other resources) in Idaho. In rejecting a large number of the options, however, the Board recognized that many of the recommendations either posed inappropriate risks or costs for electric consumers (e.g. utilities and ratepayers funding incentives), or were very difficult to implement due to current market conditions.

Proposed Action Items

In addition to commenting on recommended options, the Board believes it has the responsibility to suggest the State agencies to which the Council and Governor might consider assigning the responsibility for evaluating, and possibly implementing recommended options. This evaluation would include, as appropriate, development of an implementation plan and timeline for Board review. The Board's recommendations are presented below.

- **Department of Commerce**
  1. Evaluate the transferrable business tax credit
  2. Attract solar manufacturing industries

- **Office of Energy Resources**
  1. State lead in environmental permitting
  2. Lead the effort to streamlined energy related permitting, siting and right of way
  3. Lead public education efforts around renewable energy

- **Public Utilities Commission**
  1. Require all regulated utilities to provide consistent net metering
  2. Develop standardized interconnection agreements
  3. Potentially evaluate externalities in utility IRP's
  4. Examine increasing the size limit for net metering

- **Idaho Legislature with Assistance and Information from the Tax Commission**
  1. Remove the size limit of 25kW for the sales-and-use tax rebate
  2. Reinstate the sales and use tax rebate
  3. Change the tax code to allow transferring tax credits
  4. Allow property tax exemption for small-scale distributed power systems

Again, the Board is pleased to commend the work of the Solar Task Force and is pleased to submit their report to Council members for your review.

Steven E. Aumeier,

Chair, ISEA Board of Directors

Idaho Strategic Energy Alliance Board Members:

Tim Clark, Intermountain Gas
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Russ Hendricks, Idaho Farm Bureau
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Don Sturtevant, J. R. Simplot Company
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David Solan, Center for Advanced Energy Studies
Karl Bokenkamp, Idaho Power Company

Solar Task Force Options: Pros and Cons

Recommendation	Pro/Con	Comment from Board	Comments from Team
Provide Additional Tax Incentives and Loans incentives (for PV and solar hot water)	Con	Tough to do this when state is moving the opposite direction in funding	Still worth recommending
All utilities (not just IOUs) should be required to provide net metering	Con	The IPUC does not have the authority to require non-IOUs to provide net metering. This is a legislative task	The report does not suggest that the IPUC should do this. The report suggests legislative action.
	Con	The IPUC could allow, but not require, all regulated utilities to provide net metering programs IF it is beneficial to the ratepayers and the utility.	
	Con	Best to have standard net-metering across IOUs - if IPUC does not have regulatory authority over a utility than it can't make requirements	Same as above
The IPUC should increase the current system size limits for net metering to 2 MW	Pro	The task force report did not suggest that the limit be raised to 2 MW, they simply stated that it could be raised and observed that Oregon allows net metering up to 2 MW.	Note that utility scale PV is usually over 5 MW. Large businesses such as Wal-Mart or Micron may install systems as large as a megawatt.
	Con	Net metering was proposed as an alternative to PURPA for small systems that are sized to meet a single user's typical load, as a means of mitigating the mismatch between load and resource timing. 2 MW greatly exceeds the typical single user's load. Systems over 100kW will most likely find PURPA treats them much better economically.	Net metering is for customers that use the resource they are producing. It is not about electricity generation for other users. PURPA is in place for that purpose.
The IPUC should better structure net excess requirements to be more consistent and beneficial to the customer	Pro	Generally, solar is generating during peak hours and not generating during off-peak hours so it should better coincide with rates than wind, for instance.	True.
	Neutral	Net excess requirements should not encourage sizing systems to exceed the users load.	Agreed
	Pro	Agree but IPUC doesn't have to listen	The report does not task the IPUC with this.
The Legislature should remove the system size requirement of at least 25 kW for the sales-and-use tax rebate or enact legislation exempting sales-and-use tax for solar systems	Pro	Would allow far more systems to qualify.	
	Con	Would be an administrative nightmare. Would be better administered as simply a sales tax exemption. Then the question becomes "Why should solar receive an exemption when other energy sources do not?"	Sales Tax exemption would be welcome and is done by neighboring states including Wyoming.

Solar Task Force Options: Pros and Cons

Recommendation	Pro/Con	Comment from Board	Comments from Team
The Legislature should extend the existing sales-and-use tax rebate expiration date of July 1, 2011 at least 5 years	Pro	Would have assisted with increasing development.	
	Con	Legislature already rejected extending sales tax rebate	Reword the recommendation to suggest reinstatement and amendment of the rebate. Done
The Legislature should change the tax code to allow the transfer of tax credits.	Pro	Would allow more entities to utilize the credits.	Exactly
	Con	Much more complicated and less transparent when transferability is allowed. More costly to administer.	True, but ideally outweighed by benefits
The Legislature should allow property tax exemption for small-scale distributed generation	Pro	Would definitely provide an incentive to install solar systems.	
	Con	Should not shift taxes to other taxpayers. Only the solar system itself should be considered for a property tax reduction.	Yes only the solar considered for the tax reduction.
Idaho cities or counties should establish incentives via a Property Assessed Clean Energy (PACE), in which the city or county offers a customer a loan to finance a solar system and the loan is paid back through reductions in property tax payments (often funded via bonds)	Con	PACE programs should not be expanded until the foreclosure crisis clears up - governments do not want to be real estate agents or residential homeowners	
	Con	Need more info to comment.	
	Support with Conditions	The current controversy regarding the impact of PACE financing on federal mortgage financing needs to be cleared up first.	
Idaho should consider a variety of rate-payer funded programs or funds such as rebates that pay for the systems' above-market costs	Con	Rate Payer funded incentives need to be cost effective, below marginal costs, after considering externalities such as risk, fuel costs, environmental effects, etc.	First adopters and high income customers are the ones using this technology now. Incentives would help move it into the mainstream.
	Con	Ratepayers should not have to pay higher rates simply to have solar included in the portfolio. It needs to be cost effective to be included.	"Cost effective" should include the features and benefits of renewable sources. Cost alone is not the only basis to make a choice and therefore idaho should consider some ratepyer funded programs.

Solar Task Force Options: Pros and Cons

Recommendation	Pro/Con	Comment from Board	Comments from Team
Idaho should consider a production-based incentive, which pays the system owner a specific incentive based on every kWh or BTU produced	Con	Net-metering is more effective	not by a long shot if the purpose is incentivising solar development.
	Con	PURPA already does this. Higher than PURPA rates requires legislative action.	PURPA is not good for smaller systems and distributed installations like an individual home
	Con	This is not transparent. The rate negotiated between the utility and the producer needs to be transparent enough to give consumers information about the cost of their power.	Yes, true. All three of these comments indicate the BPI may not be clearly understood.
The IPUC should consider resource diversification, transmission and distribution savings, peak demand savings, reduced price risk, societal & environmental benefits in valuing renewables	Pro	All cost factors, both direct and indirect, should be considered when making resource decisions.	Locking in a price reduces risk.
	Pro	The Commission already allows utilities to consider these impacts, but does not require it. The IPUC has not established values for the specific factors or procedures for determining the values. Utilities have considered some of these factors in some of their IRPs, but not consistently.	
	Con	It is difficult to place a dollar value on some factors mentioned such as social and environmental externalities.	True. Though we need to figure out how to do this.
The Legislature should fund the OER to provide outreach & public education on renewable energy	Con	Legislature moving the opposite direction and OER is resource challenged	That is not really a con - just a statement of fact/opinion. We still recommend this.
	Con	The best education comes from demonstrating reliable, cost effective projects.	And we can highlight some of those in the education piece.
Idaho Utilities should fund outreach & public education on renewable energy	Con	Utilities already provide such outreach and education. I would not support increasing current efforts.	
	Con	We should not require the utilities to perform education and outreach. If it is in the interest of their business, they will do it.	As a business utilities should be interested in selling more electricity and charging as high a rate as possible for it.
Idaho should streamline permitting for both photovoltaic and solar thermal systems	Pro	Reducing time and effort in permitting would be a benefit for all concerned.	Please see reference: http://irecusa.org/fileadmin/user_upload/ConnectDocs/IREC_IC_Model_October_2009.pdf

Recommendation	Pro/Con	Comment from Board	Comments from Team
Idaho should Idaho should extend the sales-and-use tax rebate, which currently expires July 1, 2011 for at least five years	Pro	Would stimulate development.	
	Con	The Legislature has already rejected extending the rebate.	Change to recommend reinstatement and revision of the incentive. Done
Idaho should expand the 3% tax on gross energy earnings in lieu of property taxes to include solar energy (it currently only applies to wind & geothermal)	Pro	This is a good solution to "levelize" local property taxes for the lifetime of the project to avoid windfalls at the beginning of the project, and then declining revenues as the project is depreciated out.	
Idaho should establish an income tax credit for utility-scale solar	Con	Solar needs to compete on a level playing field with other renewables.	If Idaho wants to encourage Renewable Energy development, It should consider an income tax credit for renewable energy development.
Idaho should consider an appropriate Renewable Energy Standard with a solar carve out	Con	Without federal mandate RES not viable in Idaho - carveouts would also be sought for by geothermal and other renewable sources - Peer-reviewed research shows that carveouts take longer to roll out than more general RES or RPS	Longer rollout is fine.
	Con	While it may help the solar industry, it would most likely lead to electric rates that were higher than they would be without an RES. Idaho's utilities are investing in renewables at levels comparable to the utilities in States with an RES already.	Electric rates would go up. True. Are the renewable resources that utilities are investing in, for electricity for idaho?
	Con	Solar should not receive a carve-out, it should compete with any other renewable. Idaho already has far and away more renewables than most states, an RES is unnecessary.	If the case is made that Solar as an industry is worth supporting and developing in Idaho, then a carve out would be appropriate
Idaho should establish a working group to identify best practices for siting and permitting and to develop approaches to streamline the process	Pro	Would help provide guidance to local governments who may not have expertise on staff.	
	Con	May not fully consider all relevant local issues.	Depends on the team and is a true pitfall of any process like this.
	Pro	Would provide expertise that is not available at the local level.	

Solar Task Force Options: Pros and Cons

Recommendation	**Pro/Con**	***Comment from Board***	***Comments from Team***
Idaho should consider establishment of an Idaho energy facility siting council	Con	Should only be used when requested by local governments, should not override local control.	Rather than "requested by" the information would be "available to" local goverments. But they can use it or not as they see fit.
Utilities should consider solar in their transmission expansion planning	Con	I believe utilities are currently considering solar in their transmission planning.	Why is this a con? It is a recommendation that is happening.
	Con	Until utility scale solar becomes cost effective, utilities should not include possible future solar development into their decisionmaking process for siting transmission, unless it does not add to the cost of the project.	The nature of planning for the future should include technologies that are on track to be important in the future.
The state should implement a renewable energy manufacturing incentive	Con	Rather than a special incentive for renewable manufacturing, it would be preferrable to reduce rates for all business across the board, this would benefit not only renewables, but all other businesses as well.	True enough, but it depends on what the goal is. The state needs revenue to function, and most incentives are financial. Reducing rates for all businesses reduces revenue. Reducing rates for certain types of business courts that type of business.

Idaho Strategic Energy Alliance
Solar Task Force Report

2011

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Table of Contents

Executive Summary

Solar energy has many direct uses, including passive architectural applications such as lighting and thermal comfort provided by the use of proper building materials and orientation, as well as active water and space heating. This report primarily focuses on solar power, which is the conversion of sunlight to electricity.

1/100 of 1 percent of America's electricity is derived from solar power
- Energy Information Administration (EIA)

Sunlight can be converted directly into electricity using photovoltaics (PV), or indirectly with concentrating solar power (CSP), which focuses the sun's energy to either directly or indirectly boil water that is then used to generate electricity. Solar can also be used to directly heat water for domestic use. Solar energy is an inexhaustible renewable resource. The sun constantly produces vast amounts of energy that can be collected and converted into usable heat and electricity.

Almost every day Idaho has access to more energy than it can consume via the sun. This energy is delivered free and the technologies to capture it are proven, reliable and available. Solar energy has been used for centuries. We have developed ways to capture it directly and convert it into usable forms of heat or electricity including passive solar, solar electric and solar thermal.

Solar energy has many distinct advantages:

- Renewable
- Non-polluting
- No fuel cost
- Readily available
- An inexhaustible resource

Every day the sun shines down 6,000 times the amount of energy needed by the entire planet.
- Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany

Energy from solar is versatile; it can be used to power everything from buildings and cars to satellites and water fountains. It can also be an excellent supplement to other renewable sources. In remote locations, solar PV power can be a more economic energy option than establishing a long connection to the utility grid.

As the technology to harness solar energy becomes more affordable, solar has the potential to make an important contribution to Idaho's energy needs, as well as to Idaho's economy.

Idaho has little fossil fuel energy resources. But Idaho does have solar, hydro, wind, biomass, and geothermal energy resources. Of these, solar is the most readily available, yet the least used energy source in the state. Using the power of the sun can help Idahoans down the path of energy independence and diversify the state's energy generation resources.

During the summer months when the state's power requirements are highest, southwest Idaho's solar generation potential is very similar to the desert southwest, which has the highest solar potential in the United States. According to the National Renewable Energy, the southwest corner of Idaho is one of the highest rated solar spots in the nation with a solar electricity generation potential of 60 million MWh/yr.[1] The Northwest Energy Project[2] indicates that the Northwest receives more than enough sunlight to meet much of our energy needs. So what are the barriers to using solar and what can be done to develop this resource?

Utilize Idaho's Strengths: In addition to Idaho's excellent solar resource potential, Idaho offers low-interest loans and tax credits for solar systems installed in the state. Many parts of Idaho are attractive locations for utility-scale solar plants. In addition to the solar resource and suitable lands, the state has a rational permitting environment, a summer daytime load electrical peak that closely matches solar availability, and supportive utilities.

Address Idaho's Weaknesses: A number of opportunities exist to enhance the development of solar energy in the state. This includes educating Idahoans on the costs and benefits of solar power. It is also important to consider the significant environmental and societal benefits of energy derived from solar resources in electric energy rate making and pricing. A streamlined permitting process, installation guidelines and implementing a program to certify qualified installers will further assist in the development of solar resources in the state. Legislative and regulatory options also exist, including additional incentives that may be considered to further develop the use of solar resources.

However, there are some barriers. Currently, the initial capital costs of solar installations are high relative to other alternatives, and utility-scale plants require a significant land footprint. However, the payoffs related to solar energy are numerous and include: decreasing our dependence upon fossil fuels, diversifying the state's energy portfolio, reducing the state's reliance on outside sources, hedging against possible green house gas tax impacts and improving our stewardship of the earth's resources. It is compatible with Idaho's existing generation systems and would fit well into the state's energy mix. Solar has a definite place in Idaho's energy future.

- **Grid connected solar installations doubled from 2009 to 2010 for a total of 890 MW installed in 2010**
- **Q1 2011 total grid connected solar in the U.S. is 2.5 GW**
- **U.S. global market share of installations is 5%**
- **U.S. module production in Q1 2011 increased by 17% over Q4 2010 (297 MW to 348 MW)**
- **1,100 MW of CSP and CPV are under construction in the U.S.**

www.seia.org/cs/research/solarinsight

Policy Recommendations

To grow Idaho's PV and solar thermal market, even modest changes in public policy have the potential to significantly increase the number and size of system installations in the state. The major barrier to Idaho's distributed PV and solar hot water market is cost, followed by the lack of trade development and limited public awareness about the benefits of these resources. The three primary barriers to the growth of the utility-scale PV and CSP development are cost, utility rate-recovery and

[1] http://www.energyatlas.org/PDFs/LowRes/atlas_state_ID.pdf or http://www.energyatlas.org/downloads/ID_booklet.pdf
[2] http://www.nwenergy.org/

permitting challenges. Public policy changes in Idaho can make a major impact in addressing these barriers.

To expand the number of PV and solar thermal installations in the state, Idaho should consider ways to reduce barriers to solar development. In addition, changes to state policies and incentive structures should be considered that would increase solar development.

Removing Barriers

Education

Idaho's universities, community colleges and trade unions should be encouraged to continue developing training programs for solar installers, system designers and project developers.

Robust public education is essential. A third-party program manager could be established to implement such a program. Funding for this program could be obtained as part of a utility's general marketing budget, as a small part of the utility Demand Side Management budget, or as a separate renewable energy fund budget.

Specialty Contractor Licensing

A specialty solar contractor licensing program should be created and adopted by the Department of Building Safety. Solar contractors should be appropriately licensed to design and install PV systems. This program would involve a process for state inspections and certification; revenue from the licensing program would fund the inspection process. A number of states across the nation have adopted a licensing program for solar installation contractors. Division of Building Safety is interested in and actively working on this licensing.

Net-Metering

Idaho does not have a net-metering law. Forty-three states, including all of the western states, have net-metering laws. A law standardizing net-metering requirements and size limits for all utilities (including non-IOUs) in the state would better drive market demand for distributed PV. All of the investor owned utilities (IOUs) operating in Idaho are required by neighboring states to have programs, which they currently have voluntarily extended to Idaho customers. Net-metering allows customer generation to offset use on a monthly (or yearly) basis. Currently all three IOU's carry monthly excess production forward as a credit, and "zero out" a customer once a year.

Idaho should require all utilities (not just IOUs) to provide net-metering as an option for their customers, and standardize the requirements.

Each net-metering utility in Idaho has different size caps for customer systems. In some cases, these caps are too low and are a barrier to PV development. A consistent and appropriate size cap that would apply to all utilities is recommended. A cap of two megawatts is suggested as a reasonable and appropriate cap for this purpose.

It is also recommended that Idaho's utilities should, to the extent practicable, use standardized interconnection agreements and requirements for net-metered systems. Standardizing the agreements and technical requirements will streamline the interconnection process for utilities and provide certainty for potential system owners.

Rate Recovery Assurance/Regulatory Environment

For a utility to make an investment in any new generation resource, particularly a generation resource that is at a cost disadvantage while providing significant benefit to objectives as stated in the 2007 energy plan (e.g. sustainability, etc.), utilities need some assurances that they will receive rate-recovery from the Idaho Public Utilities Commission (IPUC) for their investment. Changes to the regulatory environment from simply a least-cost, least-risk decision-making to a decision-making process in which the IPUC also considers resource diversification, transmission and distribution savings, peak demand savings, energy independence and reduced price volatility could more appropriately value the benefits of distributed PV. This vision will play an important role in all energy development in the state. Some concepts for enhanced rate structure / rate design / rate recovery / regulatory environment include:

- Recognize the peak demand value of the resource in any energy payments. (Value can be incorporated into the price of power as well as in developing levelized costs)
- Consideration of social and environmental externalities

Voluntary Renewable Programs

Encourage and allow utilities to provide voluntary programs that can include a ratepayer funded pilot program or voluntary funding by ratepayers for PV development. In any ratepayer-funded incentive structure, it is important to recognize that the utility will need approval from the IPUC for rate-recovery. See previous suggestion.

Solar Manufacturing

Idaho is actively recruiting manufacturing to the state. Solar manufacturing businesses are more attracted to a location that uses and needs their products. Low cost electricity, available trained labor, and a desirable living area are all important attractors for manufacturing. But a local market for products is also important. Creative local markets and culture will help attract solar manufacturing to Idaho.

Transmission Expansion Should Consider Solar

In order to facilitate the development of utility scale solar resources, it will be essential to have a cohesive siting process for transmission lines in order to connect the solar resource to the grid.

Financial Drivers, Tax Code Changes

Sales Use and Tax Rebate

The sales use and tax rebate for PV systems 25 kilowatts or larger expired July 1, 2011. This rebate should be reinstated with modifications. The minimum size criteria should be removed so that the sales use tax rebate is available to residential customers; most residential systems are in the 2-10 kW range. It is recommended that the rebate period be for a minimum of five to ten years.

Transferability of Tax Credits

The transferability of the tax credit has proven to be an essential tool in expanding solar markets. System owners without sufficient tax liability are able to transfer the tax credit to another taxpayer in return for a cash payment. Transferability allows utilities, non-profit entities, public entities and others to take advantage of solar power. Modifications to state law are often required to allow legal transferability. To maximize the efficient transfer of tax credits, the state should consider a similar transfer program set up by the Oregon Department of Revenue to transfer its Business Energy Tax Credits to those with tax liability.

Gross Energy Earnings Option Expanded to Include Solar

Idaho should consider expanding the 3% tax on gross energy earnings in lieu of property taxes to solar energy. This incentive currently only applies to wind and geothermal resources.

Additional Tax Incentive and Loan Options

For the residential market, a tax credit rather than the current tax deduction would make the incentive available to a much wider scope of customers. An additional tax incentive worthy of consideration for distributed systems is a property tax exemption. For the commercial market, an income tax credit in addition to the sales-and-use tax rebate could significantly drive development.

Loan option incentives could take the form of Property Assessed Clean Energy (PACE). In this instance, the city or county offers the property owner a loan to finance a solar system; the loan is paid back through property tax payments over a set period of time. These programs are typically funded through municipal or county-issued bonds.

Financial Drivers, Ratepayer Funded Programs

Production Based Incentives

Idaho should consider pilot programs for production based incentive (PBI) renewable payment programs. A PBI pays the system owner a specific incentive based on every kWh or BTU produced. A more specific form of production-based incentive is a feed-in tariff or standard offer contract, where the utility enters into a contract to purchase the energy at a specified rate from the system owner over a set period of time.

Third Party Administered Above Market Fund

One incentive option is the establishment of a system of rebates that pay for the systems' above-market costs. Utility ratepayers typically fund these rebates. The rebate program is administered by the utility, a third-party non-profit such as a solar trade ally network or a state agency. Potential sources of funding could be established via a surcharge as part of the utilities' demand side management program. Alternatively, funding would come from a separate surcharge for the development of renewable energy. This option would require approval by the IPUC and may require changes in state law.

Implement a Renewable Energy Standard

As utility-scale solar becomes more cost-competitive, a Renewable Energy Standard (RES) in Idaho would help ensure that Idaho's utilities are able to recover in rates costs associated with the RES. Some states have also established solar carve-outs or solar procurement standards as part of the state's RES policy. A solar procurement standard should also include competitive forces legislation to ensure that it is competitively procured.

Recently completed 86 kW grid connected solar electric system on Madison High School Vocational building, Rexburg, Idaho – Photo by Andy Tyson

Types of Solar Power

Solar power is the generation of electricity from sunlight. It would be great if 100% of the sun's energy could be converted into electricity, but unfortunately we are not there yet. Various technologies are available to convert solar energy into electricity. Although there are a number of different technologies available to convert solar energy into electricity, the two primary technologies are photovoltaic (PV) and concentrating solar power (CSP).

PV

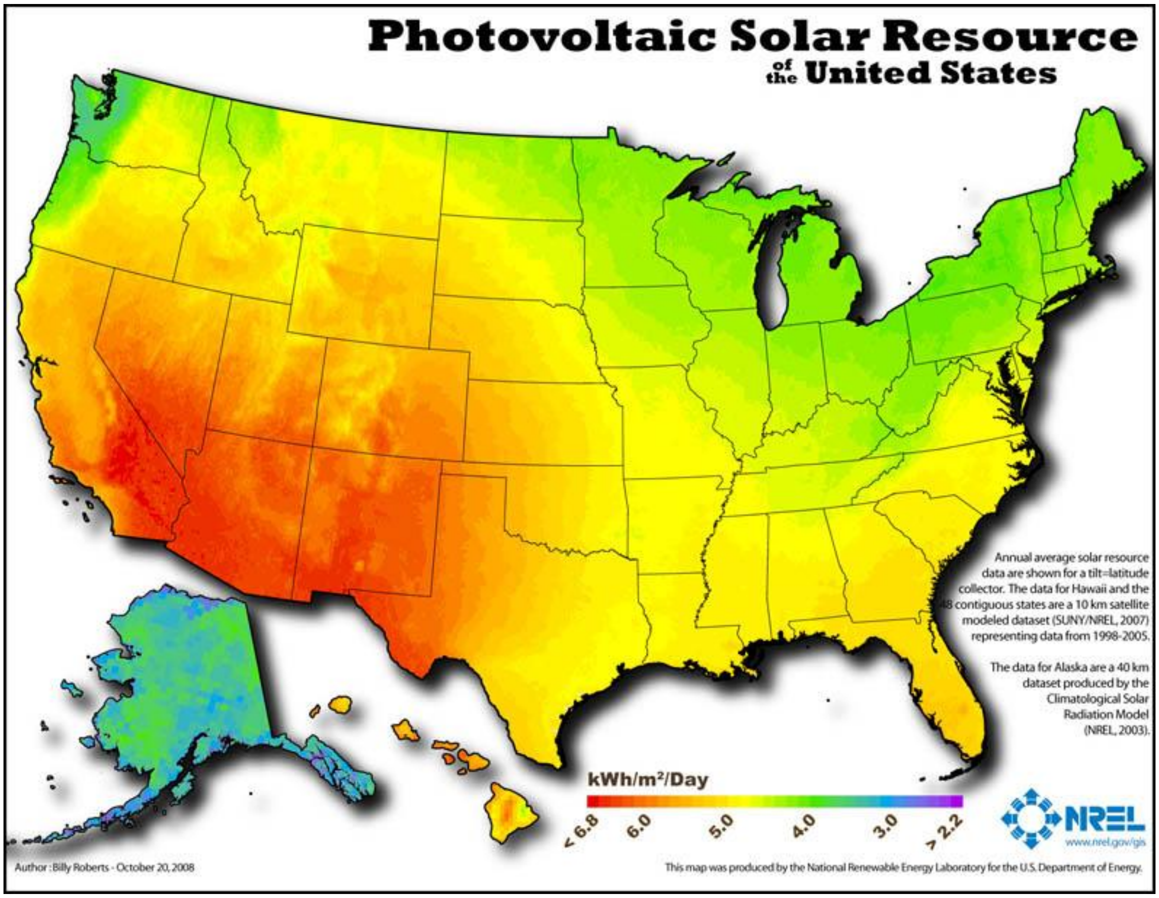
A solar cell, or photovoltaic cell (PV), is a device that converts light into electric current. Photovoltaic is the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the "photoelectric effect" that causes them to absorb photons of light and release electrons. When these free electrons are captured, an electric current is created. PV panels absorb solar energy collected from sunlight shining on solar cells (panels). A percentage of the solar energy is absorbed into the semiconductor material. The energy accumulated inside the semiconductor material jars the electrons loose and allows them to flow freely. The solar cells also have one or more electric fields that force electrons to flow in one direction as a direct current (DC). The DC energy is passed through an inverter, converting it to alternating current (AC), which can then be used on site, stored in a battery, or delivered to the grid.[3] Though a sunny day is best, a cloudy or overcast day still provides sufficient diffused light to produce electricity. Under light overcast conditions a PV system might produce about half as much as it can under full sun, ranging down to as little as five to ten percent on a dark overcast day.[4]

The largest solar power plants at present are concentrating solar thermal plants, but recently multi-megawatt photovoltaic plants have been built, including a 46 MW photovoltaic power station in Portugal and a 40 MW PV solar park in Germany. These appear to be characteristic of the trend toward larger photovoltaic power stations; even larger ones are proposed in the United States.

The following photovoltaic chart, developed by NREL, indicates the PV potential across the United States:

[3] http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells

[4] http://www.solarhome.org/solarpanelsfaqs.html



Source: National Renewable Energy Laboratory

If an area equal to the size of American Falls Reservoir, which is approximately 87 square miles (or four percent of the land in Owyhee County), were covered in PV panels, it would provide enough energy to serve Idaho's entire average daytime load with zero emissions, according to calculations by the Idaho Strategic Energy Alliance Solar Task Force. (Side note: In 2008, American Falls dam provided about 1% of Idaho's average daytime load [92 MW nameplate, 2008 capacity factor of 33%, (92*33%)/2,760)].)

To determine PV generation potential, annual Global Horizontal Solar Radiation measurements are used. Global Horizontal Solar Radiation is ***total*** solar radiation: the sum of direct (sunbeams), diffuse (includes sunlight bouncing off clouds and other atmospheric surfaces), and ground-reflected radiation (sunlight reflected back into the atmosphere after striking the Earth.)[5]

Solar Water Heating

Residential solar thermal systems are plumbing systems that absorb heat from the sun to create hot water that can be used for showers and baths, dish washing, clothes washing, space heating and other uses. A basic system has a solar collector on the roof plumbed to a hot water storage tank in the building and some form of backup energy source. Equipment required for solar hot water systems is generally less expensive than PV panels for the same amount of BTU's produced.

[5] http://rredc.nrel.gov/solar/glossary: Glossary of Solar Radiation Resource Terms

CSP

Utility-scale solar thermal systems, also called Concentrating Solar Power (CSP), use heat from the sun to produce electricity. CSP technology has more than one form. Troughs, dishes and towers are the different forms available today. Concentrating Solar Thermal (CST) technologies use reflective materials such as mirrors to reflect and focus a large area of sunlight into a small beam and onto receivers that collect the solar energy and convert it to high temperature heat. The concentrated heat is then used as a heat source for a conventional power plant via a steam turbine, or the heat can be transferred to oil or other medium such as molten salt where it is moved to a collection point and be used to generate steam to drive a turbine.


Parabolic-trough CST in the Mojave

A wide range of concentrating technologies exist, including the parabolic trough, Dish Sterling, Concentrating Linear Fresnel Reflector, and solar power tower. Each concentration method is capable of producing high temperatures and correspondingly high thermodynamic efficiencies, but vary in the way that they collect and use the sun's energy. Some even have storage capabilities. It is also possible to hybridize these plants, using traditional fossil fuels to provide back up or supplemental power as needed.

To provide an idea of the potential size of these installations, nine parabolic-trough generating facilities were built in the Mojave Desert in California between 1985 and 1991 with a collective capacity of 354 MW.

Solar Benefits/Advantages

Solar energy is not a finite resource as fossil fuels are. Solar fuel is abundant and free.

Photovoltaic systems convert sunlight to electricity directly, so that bulky mechanical generator systems are unnecessary. They can be installed quickly and can be almost any size (up to utility-scale systems). Their environmental impact is minimal, requiring no cooling water and generating no emissions. They can also be utilized in areas where connecting to the electric distribution system is cost prohibitive. Large concentrated solar systems have minimal environmental impact – they create little noise, no emissions, and do not require fossil fuel unless some form of backup is required. Large concentrated solar systems can be designed to include energy storage capability that allows the stored energy to be dispatched to meet peak load requirements including after sunset or during overcast conditions. However, the vast land area requirements of these systems can be a barrier.

Generation of electricity from solar sources use has surged at about 20 percent a year over the past 15 years, thanks to rapidly falling prices, gains in efficiency, renewable energy portfolio standards and mandated regulatory feed-in tariffs. China, Japan, Germany and the United States are major markets for solar PV cells. Depending on the level of tax and other financial incentives and prevailing retail rates for electricity, solar electric systems can have a significant return on investment.

Some of the many advantages of solar energy:

- Solar energy is a renewable resource.
- Solar energy PV cells are silent.
- Significant environmental benefits: no greenhouse gas emissions, or pollution.
- Solar PV panels require very little maintenance, they have few if any moving parts that need to be serviced so operations and maintenance costs are low.
- Solar panels have long economic lives.
- Solar energy produced from PV systems, if connected to the utility, reduces the amount of energy the utility requires to meet its peak period energy requirements.
- Zero long-term fuel costs (the energy and heat from the sun is free.)
- Multiple applications include buildings, water heaters, pumps, cars and satellites.
- It is often an excellent supplement to other renewable sources.
- In remote locations, solar power may be a more economic alternative compared to connecting to the grid.
- Zero long-term fuel costs.
- Proven technology with multi-megawatt plants operating successfully in the USA and around the world.
- Job creation, especially in rural areas.
- Rapidly deployable.
- Scalable from bus stop lighting to multi-megawatt central power plants.
- In CSP applications, potential for dispatchable power for peaking and intermediate loads through hybridization and/or thermal storage.

Every hour, the sun radiates more energy onto the earth than the entire human population uses in one year.

- American Energy Independence

Barriers to Solar Development[6]

The technology required to harness the power of the sun is available now. So what are the major barriers for solar generation to meet more of our energy needs?

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[6] Sources: : http://www.nrel.gov/docs/fy07osti/40116.pdf
http://news.cnet.com/8301-11128_3-9939715-54.html
"Renewable Energy Policies and Barriers" by Fred Beck, Renewable Energy Policy Project, fbeck@repp.org and Eric Martinot, Global Environment Facility, emartinot@theGEF.org
http://www.martinot.info/Beck_Martinot_AP.pdf

Cost is the primary reason solar energy generation is not more prevalent, but there are several factors that impact the ability of solar to become a more widely used energy generation resource:

1. ***Cost***: Solar power is recognized as one of the most expensive forms of renewable energy, in the range of 12 to 30 cents per kilowatt-hour depending on technology, system size, and incentives. By comparison, (depending on technology and system size) energy produced from coal-fired generating resources costs about 5 to 7 cents and energy from natural gas fired generating resources costs 6 to 9 cents per kilowatt-hour. The development of solar based electricity has lagged the development of fossil-based and other sources of energy for several reasons:
    - High initial up-front cost: Even though lower fuel and operating costs may make solar renewable energy cost-competitive on a life-cycle basis, the higher initial capital cost for renewable resources means that the installed cost per kilowatt is usually higher than conventional energy sources. Renewable energy investments require higher amounts of financing for the same capacity.
    - Valuation methodologies: In traditional regulatory pricing models, the price of renewable energy does not include the full impact of the social and environmental benefits attributable to renewable energy sources compared to conventional sources.
    - Intermittency: One of the major issues is the intermittency of the delivered energy since its output depends on the sun and prevailing weather conditions which cannot be entirely controlled. As a result, the amount paid (or credited) for the energy produced may not recognize the capacity of the resource.
    - Scale: The smaller scale of most solar energy projects results in disproportionately high transaction costs for risk management tools as well as complex (and expensive) financing arrangements. It can be cost prohibitive to install infrastructure solely for a small renewable energy project. The implementation and transaction costs are greater on smaller projects as a percentage of the overall cost.
    - Footprint: Utility scale solar arrays occupy significant land area for energy production. This has various cost implications including land and permitting costs.

2. ***Risk***: Regulatory constraints on long-term electricity contracts create a risk premium that affects capital-intensive technologies, such as renewables and nuclear, more than technologies with high fuel costs, such as fossil fuel plants. It is difficult especially for small renewable energy developers to acquire affordable financing. This is especially true if the payment structure does not recognize the firm peak contribution the resource provides. Consumers or project developers may lack access to credit to purchase or invest in renewable energy because of lack of collateral, poor creditworthiness, or distorted capital markets. Without large-scale deployment, cost of innovative technologies remains high and investors continue to underwrite established technologies. Risk factors from the utility perspective include:
    - Technology risk: concern that a technology will underperform or become obsolete prematurely; due to the relative newness of some solar technologies, utilities,

which are typically risk adverse, are reluctant to embrace technologies that do not have a long-term or demonstrated operating history.

- Credit risk: concern by lenders about project's ability to service debt from project cash flow; lack of maturity of the company and technology and lack of proven acceptance in the marketplace
- Revenue security risk: need for revenue security during the capital investment payback period.
- Market competition risk: concern by financiers about high capital cost of renewable energy projects and lower cash flows compared with traditional energy sources

3. ***Technical Issues***:
    - The electricity grid was designed for conventional, centralized power plants and not for the intermittent nature of renewable energy; however, this issue is changing as utilities and grid operators learn to use new forecasting tools, modify the operational characteristics of their existing fleet and implement new flexible technologies to provide the necessary resources to complement the intermittent nature of some forms of renewable resources (typically wind).
    - Interconnection issues can be a major factor, especially for small commercial and residential systems. Connecting to utility grids may involve burdensome, inconsistent, expensive, or unclear utility interconnection requirements. Transmission access is necessary because some renewable energy resources may be located far from load centers. Transmission or distribution access is also necessary for direct third-party sales between the renewable energy producer and the purchasing entity. Lack of uniform requirements can increase transaction costs.
    - Another issue is a lack of trained, qualified installers and inspectors; this is especially relevant for small PV systems.
    - Permitting processes are not necessarily tailored to renewable energy. Lack of adequate codes, standards, interconnection rules and net-metering guidelines add additional complexity and cost.
    - Large solar generating systems, especially CSP, require water to condense steam or other working fluid, mirror cleaning and other process water needs; typically the water requirements for these systems can be large and sourcing the water as well as the treatment of the waste streams needs to be properly managed.

4. ***Policy***: Public policy can have a major impact on the development of renewable resources. State and local government policy should also compare the attributes of renewable resources with fossil fuel resources.

5. ***Awareness***: Electric energy customers need to become more knowledgeable about how their energy is produced and the options available. There is a tendency for consumers to see choices about environmental impacts of electricity as the responsibility of utilities and regulators. Making customers aware of available alternatives will enhance the development of solar resources. Ancillary benefits associated with developing solar resources include

added resale value for homes with PV, pride of ownership, personal values, and recognition of environmental impacts. And finally there is still a lingering effect of poor experience with first generation solar thermal systems in the 1970s and 1980s.

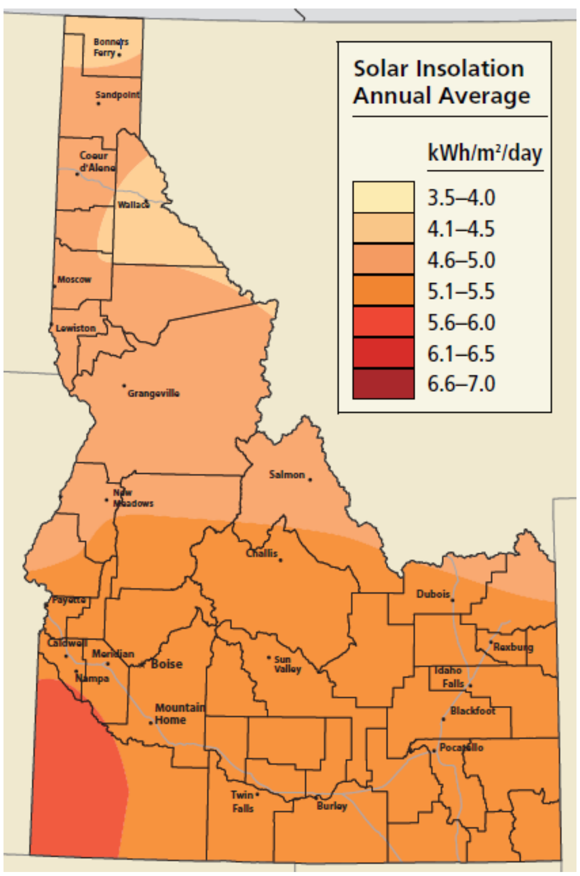
Solar Potential for Idaho

Researchers at Fraunhofer Institute in Germany have calculated that the sun sends enough energy to Earth in one hour to cover the entire human population's energy needs for a full year.[7] Yet, in the United States, only 1/100 of 1 percent of America's electricity is derived from solar power, according to the Energy Information Administration (EIA). In Idaho, a mere 2/1000 of 1 percent of the state's electricity is generated from solar power, according to a survey conducted by the Idaho Strategic Energy Alliance Solar Task Force.

"If photovoltaic (PV) solar plants were built on 4% of the land in Owyhee County (an area about the size of American Falls Reservoir, approximately 2,000 square miles), they would provide enough energy to serve all of Idaho's average daytime load with zero emissions."

- *Idaho Strategic Alliance Solar Task Force, March 2010*

So just what is the solar potential for Idaho?

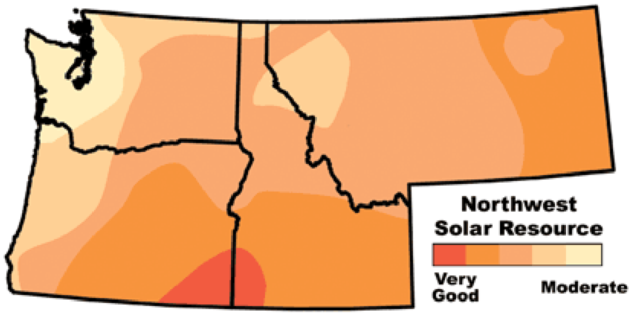


In 2008, Idaho Power Company hired Black & Veatch[8] to perform an independent Solar Feasibility Study for Southwest Idaho. This study determined that during the summer, southwest Idaho's insolation is very similar to the desert southwest, which has the highest solar potential in the United States. Insolation is the measure of solar radiation reaching the earth's surface (the higher the solar radiation, the greater the solar potential for an area). During winter, it is approximately 50 percent less.

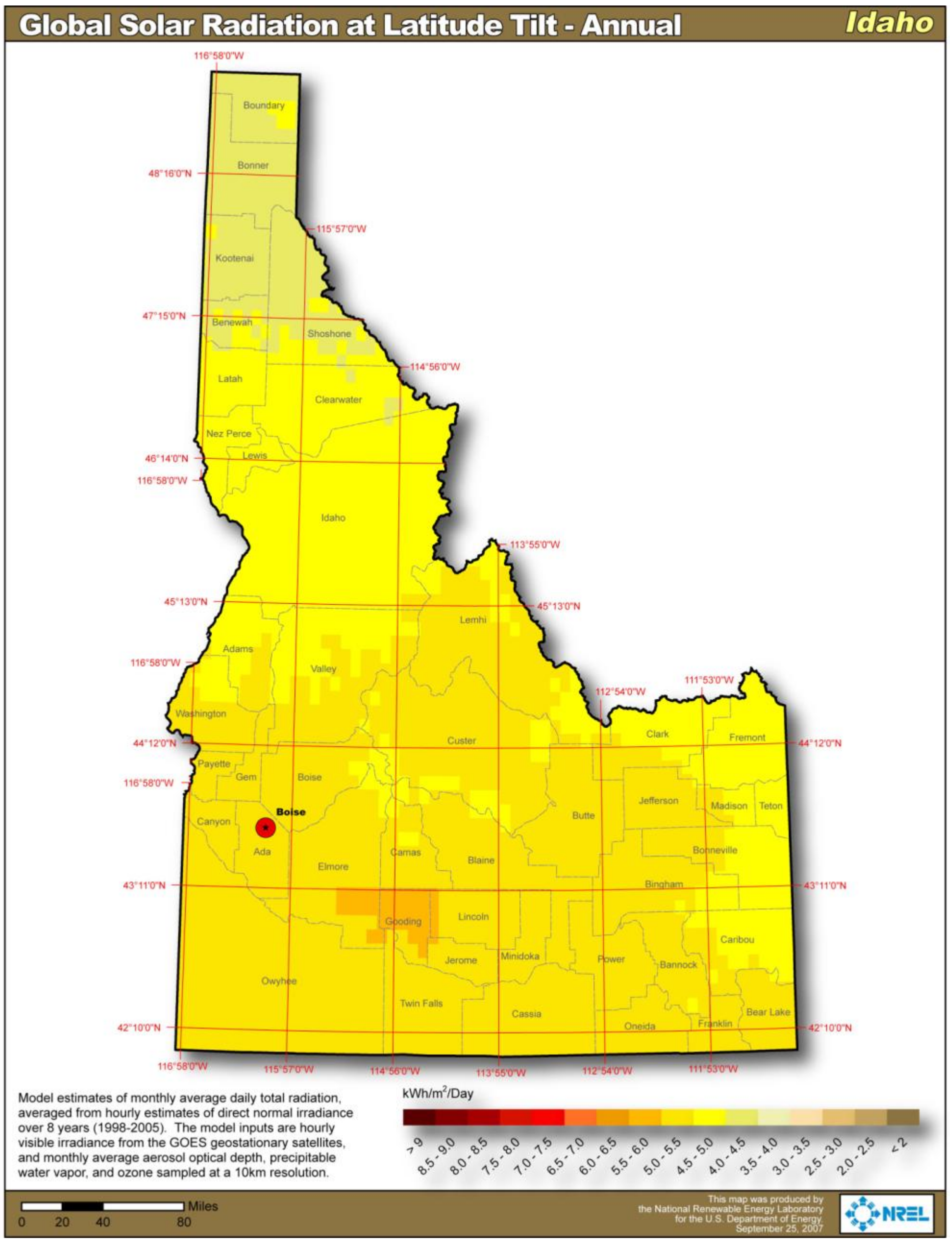
The National Renewable Energy Laboratory (NREL) map on the left shows that the southwest corner of Idaho has an annual direct insolation between 6.0 – 6.5 kilowatt-hours per square meter per day (kWh/m^2/day).[9]

During Idaho's peak energy month of July, NREL direct insolation data shows that this area is greater than 9.0 kWh/m^2/day (among the highest in the nation). *Idaho average is in the 4.0-6.0kWh/m^2/Day range.*

[7] http://www.photonics.com/Article.aspx?AID=37341
[8] Solar Generation Feasibility Study for Southwest Idaho, Black & Beach, August 2008; Idaho Power Company's Draft 2009 Integrated Resource Plan
[9] http://www.energyatlas.org/downloads/ID_booklet.pdf



According to the Northwest Energy Project, the Northwest receives more than enough sunlight to meet our entire energy needs for the foreseeable future. As this map illustrates, the Northwest's highest potential is in southeastern Oregon and southern Idaho; however, there are no "bad" solar sites—even the rainiest parts of the Northwest receive almost half as much solar energy as the deserts of California and Arizona, and they receive more than Germany, which has made itself a solar energy leader.[10]



[10] http://www.rnp.org/renewtech/tech_solar.html

All of the studies related to solar potential in Idaho seem to come to the same conclusion. Idaho has rich potential for solar development. The Renewable Energy Atlas of the West estimates the electricity generation potential for Idaho to be 60 million MWh/year.[11]

Idaho's Solar Power Potential

For Daylight Hours from 8:00 am to 5:00 pm

"If photovoltaic (PV) solar plants were built on 4% of the land in Owyhee County (an area about the size of American Falls Reservoir), they would provide enough energy during the daylight hours to serve the entire load for all of Idaho with zero emissions. Currently, 2/1000 of 1% of IdahoÕs electricity is derived from solar power."

Idaho Strategic Energy Alliance Solar Task Force, December 2009

	Molten Salt Power Tower with Energy Storage	Flat Plate Photovoltaic (PV)
2008 Idaho Average Load, 8:00 am to 5:00 pm	2,760	2,760
Nameplate Capacity Needed, MW	6,572	6,733
Land Area Needed, acres	85,440	47,128
Land Area Needed, square miles [1]	133	74
Land Area Needed, percent of Owhyee County [1]	7%	4%
8:00 am to 5:00 pm Annual Capacity Factor, percent[2]	42%	41%
Solar Technology, Type	Solar Thermal	Photovoltaic

Notes :

1) For a comparison: American Falls Reservoir has a surface area of 87 square miles, with American Falls dam having a nameplate capacity of 92 MW. Lake Pend Oreille has a surface area of 148 square miles. Owhyee County is 2,000 square miles.

2) 2008 Source Black & Veatch Solar Feasibility Study for SW Idaho

Black & Veatch Solar Feasibility Study

	Solar Technology	
Metrics*	**Molten Salt Power Tower**	**Flat Plate PV**
Capacity, MW	100	1
Storage Hours	6.9	0
Land Area, acres	1,300	7
Annual Capacity Factor, percent	28%	17%
8:00 am to 5:00 pm Annual Capacity Factor, percent	42%	41%

Note : Black & Veatch model solar output using data from the Boise weather station.

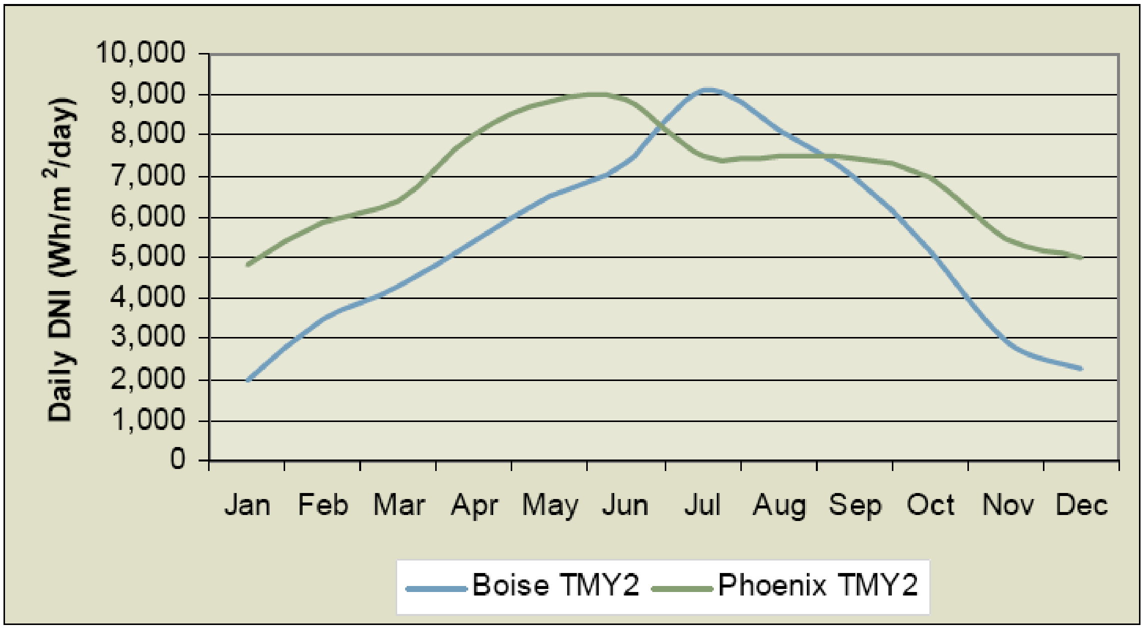
Idaho 2008 Average Load Data

8:00 AM to 5:00 PM

Load Category	Idaho Power Service Territory	Avista Service Territory	Rocky Mountain Power Service Territory	Other Service Territories[1]	Total
2008 Average Load from 8:00 AM to 5:00 PM, MW	1,908	415	438	414	2,760

Note :
1) This number is scaled based upon that the three Idaho investor owned utilities represent approximately 85% of Idaho load.

[11] http://www.energyatlas.org/PDFs/LowRes/atlas_state_ID.pdf



Direct Normal Insolation for Arizona and SW Idaho.

As can be seen in the graph above, the National Renewable Energy Laboratories (NREL) insolation data compares solar potential in Boise, ID with potential in the desert southwest, which has the highest solar potential in the United States (insolation is the measure of solar radiation reaching the earth's surface).[12] The 2008 Black & Veatch Solar Feasibility Study for Southwest Idaho summarized that during the summer, southwest Idaho's insolation is very similar to the desert southwest. During winter, it's about 50 percent less.

Solar PV in the Residential Sector

PV systems for homes and businesses are generally sized to meet some or all of the electric needs of the building or facility with which they are associated.

Distributed PV systems are being deployed rapidly in many countries including Japan, Germany and the United States (specifically in California, Arizona, New Mexico, Colorado, and New Jersey.) The U.S. solar PV market is small but growing. In 2009, the total installed PV capacity passed 1,000 MW[13] to more than 1,200 MW. Worldwide photovoltaic installations increased by 7,300 MW in 2009, up from 6,080 MW installed during the previous year, led by Germany and Italy.[14] However, the 2009 growth rate in the U.S. was 53%, compared to a global growth rate of

[12] National Renewable Energy Laboratory: http://www.wrapair.org/forums/ap2/projects/tribal_renew/TribalRE-AppC-RenewableEnergyResourceMaps.pdf, page C-15
[13] All MW numbers are in DC, unless otherwise noted.
[14] http://www.solarbuzz.com/fastfactsindustry.htm

approximately 20%. During the last five years the U.S. growth rate has ranged from 50% to 60% each year. [15]

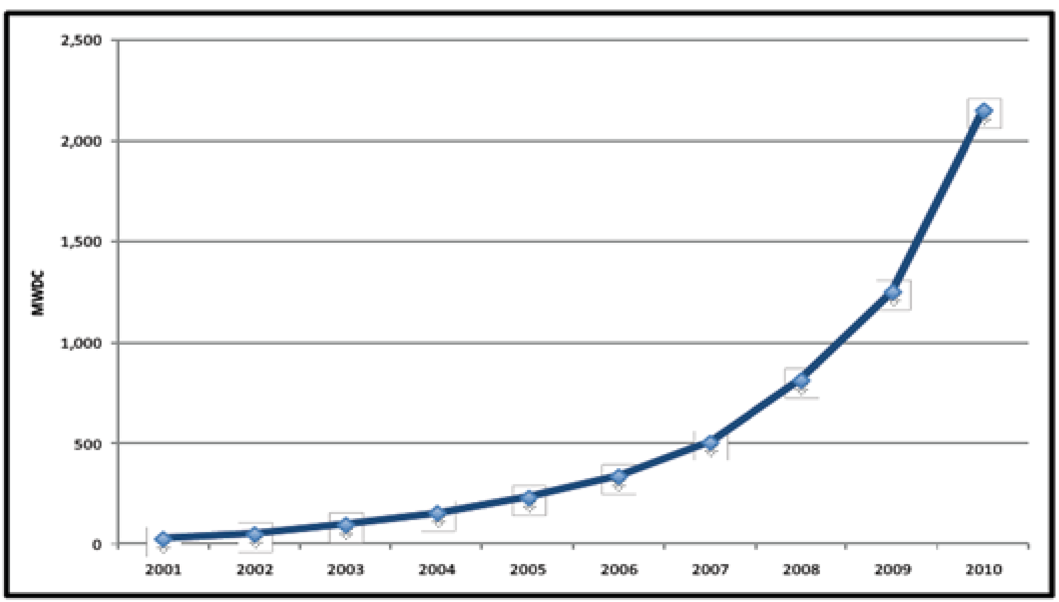
The table below shows annual and cumulative installed U.S. solar PV capacity installations for the period 2000-2009.[16]

Grid-Tied Solar PV Installation (MW)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Utility	0	3	2	3	2	1	0	9	22	66	108
Commercial	2	3	9	27	32	51	67	101	211	207	710
Residential	1	5	11	15	24	27	38	59	78	156	414
Annual Total	3	11	22	45	58	79	105	169	311	429	1,232
Cumulative Total	3	14	36	81	139	218	323	492	803	1,232	
Annual Growth Rate		*365.4%*	*157.0%*	*125.0%*	*71.6%*	*56.8%*	*48.2%*	*52.3%*	*63.2%*	*53.4%*	

The U.S. solar PV industry added approximately 429 MW of grid-tied capacity in 2009. The primary drivers of this growth were government incentives and mandates–both at the state and federal level–as well as declining solar costs. While the 2009 growth rate of 53% is above the global growth rate, it was below the 63% growth rate of 2008. This decline in growth–38% year-over-year–reflects the negative growth in the commercial sector, offset by increased growth in the residential and utility sectors. The commercial sector's decline is primarily the result of a weaker U.S. economy. Residential installations increased by 101%, primarily driven by the removal of the $2,000 cap on the Investment Tax Credit and lower installed cost.

Cumulative U.S. Grid-tied Photovoltaic Installations (2001-2010)



Source: IREC US Solar Market Trends 2010

The Solar Energy Industries Association recently released its 2009 yearly review. Total U.S. solar electric capacity from photovoltaic (PV) and concentrating solar power (CSP) technologies

[15] "U.S. Solar Industry in Review 2009," Solar Energy Industries Association. Includes only grid-tied capacity.
[16] We have divided the solar PV industry into three segments: residential, commercial, and utility. The residential and commercial sectors are primarily rooftop PV systems below 100 kW. The utility sector is primarily ground-mounted systems over 100 kW in size. There are, of course, exceptions to these broad categories.

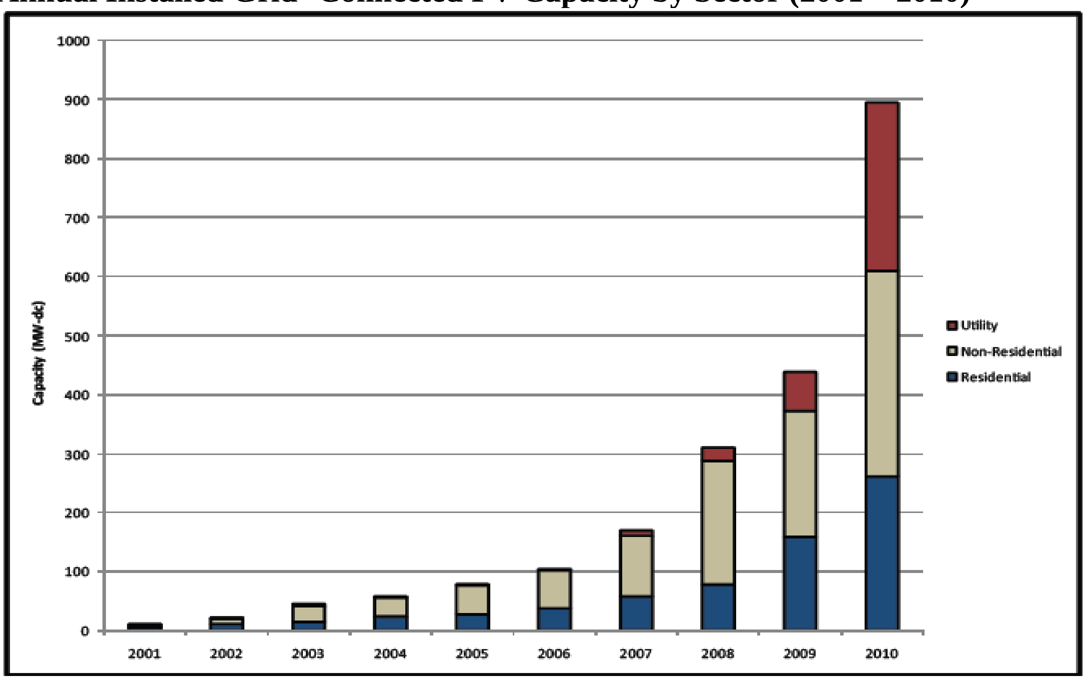
climbed past 2,000 MW, enough to serve more than 350,000 homes. Total U.S. solar thermal capacity approached 24,000 MW, primarily driven by federal policy mandates (including funding from the American Recovery and Reinvestment Act of 2009)[17] and declining solar costs. Predictably, commercial and utility projects led the way with 273 MW, but residential had a monumental push – accounting for 156 MW (double that of 2008). Also as expected, California still leads the total US solar PV market with three times the capacity of all other states combined.[18]

Cumulative Capacity (MW through 2009)[19]

1) California: 1,102 (67%)
2) New Jersey: 128 (8%)
3) Nevada: 100 (6%)
4) Colorado: 59 (4%)
5) Arizona: 50 (3%)

The capacity of photovoltaic (PV) installations completed in 2008 grew by 63% compared with installations in 2007, and the average size of PV systems is increasing. Installation growth by capacity was largest in the non-residential sector, but the residential sector continues to dominate the number of installations. Many states reported a doubling of PV capacity installed in 2008 compared with 2007 installations. Solar installations in California, the dominant U.S. market, increased by 95% in 2008.[20]

Annual Installed Grid- Connected PV Capacity by Sector (2001 – 2010)



Source: IREC US Solar Market Trends 2010

[17] http://www.seia.org/galleries/default-file/2009%20Solar%20Industry%20Year%20in%20Review.pdf
[18] www.renewableenergyworld.com/rea/blog/post/2010/05/who-are-the-leaders-in-the-us-solar-pv-integration-market
[19] *Ibid.*
[20] Larry Sherwood, "U.S. Solar Market Trends 2008", Interstate Renewable Energy Council, July 2009

Table 2: TOP TEN STATES Ranked by Grid-Connected PV Capacity Installed in 2010					
2010 Rank by State	2010 (MW_{DC})	2009 (MW_{DC})	09-10 % change	2010 Market Share	2009 Rank
1. California	252.0	213.7	18%	28%	1
2. New Jersey	132.4	57.3	131%	15%	2
3. Nevada	68.3	2.5	2598%	8%	15
4. Arizona	63.6	21.1	201%	7%	5
5. Colorado	62.0	23.4	165%	7%	4
6. Pennsylvania	46.5	4.4	947%	5%	13
7. New Mexico	40.9	1.4	2815%	5%	20
8. Florida	34.8	35.7	-2%	4%	3
9. North Carolina	28.7	6.6	332%	3%	10
10. Texas	25.9	4.2	517%	3%	14
All Other States	138.3	67.6	105%	15%	--
Total	893.3	438.0	104%	--	--

Source: IREC Solar Market Trends Report 2010

Note: Total MW installed in Idaho is currently around 1MW (7/8/2011)

Residential PV Systems in Idaho

Due to rugged and remote terrain, as well as independent-minded inhabitants, Idaho has many off-grid solar power systems. An off-grid system is very attractive when faced with the cost of extending power lines to a remote property. An off-grid system is often the only alternative that makes financial sense. Idaho Power maintains an 80 kW off-grid PV system owned by the U.S. Air Force in Grasmere, Idaho.

Idaho does not have as many on-grid systems as some neighboring states, though Idaho does have both large and small net-metered, on-grid systems. Idaho's low cost of electricity is probably the most significant factor that has limited to growth of distributed, small scale solar (discussed later). Idaho Power has a 25 kW net-metered PV array on top of the Idaho Power Headquarters in Boise.

Photo: Thin Film Solar on Teton County Home
(Photo courtesy of Andy Tyson)

A survey was conducted by the Solar Task Force (STF) which resulted in Table 1 below:

Installed, grid connected solar electric systems in Idaho				
Investor-Owned Utilities	**Location**	**# of systems**	**kW installed**	
Avista Corporation	Norther Idaho	0	125	
Idaho Power Company	Souther Idaho	77	227.8	
Utah Power & Light (Pacificorp)	South East Idaho	12	34.1	
	Totals	**89**	**386.9**	**kW**
		Average size:	**4.35**	**kW**
Rural Electric Cooperatives				
Clearwater Power Company	Lewiston	4	10.7	
East End Mutual Electric	Rupert			
Fall River Rural Electric	Ashton	11	24	
Farmers Electric Company	Rupert			
Idaho County Light and Power	Grangeville	1	5	
Kootenai Electric Cooperative	Hayden Lake			
Lost River Electric Cooperative	Mackay	1	50	
Lower Valley Energy	Afton, WY			
Northern Lights Incorporated	Sagle			
Raft River Electric Cooperative	Malta	0	0	
Riverside Electric Cooperative	Rupert			
Salmon River Electric Cooperative	Challis	0	0	
South Side Electric	Declo			
United Electric Co-Op Inc.	Rupert			
Vigilante Electric Cooperative	Dillon, MT			
Municipal Electric Utilities				
Albion Light and Water Plan	Albion			
Bonners Ferry Light and Water	Bonners Ferry	0	0	
Burley Municipal Distribution System	Burley	0	0	
Declo Municipal Electric Department	Declo			
Dubois Electric System	Dubois			
Idaho Falls Electric Light Division	Idaho Falls	2	2.7	
Minidoka Electric Department	Minidoka			
Plummer Electric Department	Plummer			
Rupert Electric Department	Rupert			
Soda Springs Electric Light & Power	Soda Springs			
Weiser Water & Light Department	Weiser			
	Totals	**19**	**92.4**	**kW**
		Average system size:	**4.86**	**kW**
	Grand Totals:	**108**	**479.3**	**kW**
		Average size:	**4.44**	**kW**

Table 1: A summary table showing total net-metered solar systems installed to date in service areas of various electric utilities operating in Idaho created by the Solar Task Force, 2010.

PV Residential System Costs

Distributed on-grid PV systems involve:

- Solar PV panels or modules
- Racking to hold the modules
- Inverter (the device that converts DC energy produced by the modules to AC power)
- Electrical wiring and conduit
- Over-current protection and disconnecting means.

The systems generally require a competent contractor to install the racking and panels and a licensed electrician to install the electrical components and wiring.

Example cost breakdown of a residential PV system (under 500 kW):

- PV Panels: 55%
- Racking/Mounting: 6%
- Inverter, conduit and wiring: 19%
- Installation: 20%

Panel prices have significantly dropped in the last few years while other expenses have not changed as rapidly. Since the panel cost is such a significant part of the system cost, total system costs have dropped significantly. Costs continue to decrease.

A February 2009 report by the Lawrence Berkeley National Laboratory found that the installed costs before tax incentives for residential and commercial photovoltaic systems had fallen to $7.60 per watt from $10.50 per watt in 2007 dollars, primarily due to decreases in non-module costs such as labor, marketing, overhead, and inverters.[21] In general, current (2011) capital costs for commercial PV are about $4.50 per watt to $6.50per watt [amended], depending on installation size. [22]

Example: 6$ per watt installed (four years ago $10 per watt was common)

- PV Panels: $3.30
- Racking/Mounting: $.36
- Inverter, conduit and wiring: $1.14
- Install: $1.20

There is some economy of scale as the systems get larger:

System size	Energy/yr	Cost	Total installed cost	Annual O&M
2 kW	2,838	$6.0 /W	$12,000	$42
20 kW	28,382	$5.5 /W	$110,000	$420
200 kW	283,824	$5.0 /W	$1,000,000	$4,000

Energy estimation produced using PVWatts in Boise, 80% DC-AC

Note: Currently many solar contractors in the state serve a large area in order to survive. Travel and mobilization costs are one of the reasons that contribute to the economies of scale; material volume discounts are another, but smaller, factor. If state and federal tax polices are enacted or continued, this will encourage the development smaller systems and the costs will likely decrease, as more dealers and contractors form to serve the increased demand.

Residential Solar PV Development

Distributed Solar PV has many obvious advantages. When deployed it:

- Uses free, unlimited, fuel
- Produces no emissions or pollution
- Has no moving parts
- Has long warranties
- Uses existing roof space (generally)

[21] http://newscenter.lbl.gov/news-releases/2009/02/19/solar-system-cost-report/
[22] http://www.allheadlinenews.com/articles/7014156574

- Offsets energy use at the point-of-use which reduces grid losses associated with the transmission and distribution of electric energy from traditional sources
- Generally does not require additional electrical infrastructure

So why are we not using it more?

- High up-front investment; small systems usually require customized sizing, equipment selection, design and installation
- It is owned and operated by individuals, not the utility
- Limited customer awareness of the costs and benefits of PV including opportunities for net metering

Please reference the general barriers section at the beginning of the report (Page 12).

55 kW grid-tied solar arrays on an affordable housing development in Ketchum, Idaho. – Photo by Andy Tyson

Options to Promote Photovoltaic Development in Idaho

(See policy discussion later in this section.)

- Educate communities about the true/real cost of solar equipment and what tax and financial incentives are available; this may include creating an official Idaho solar web site as well as advertising emphasizing the concept that installation of solar PV and solar heating systems will increase property values.
- Establish a system of specialty contractor licensing for solar electric and solar thermal installers.
- Ensure that homeowner associations cannot prohibit installation of solar energy systems; this would include enacting legislation.
- Development of site maps indicating appropriate locations for future solar development.
- Legislate a net metering law that covers all utilities requiring streamlined permitting and interconnection for net-metered systems up to 2 megawatts.

Solar Thermal in the Residential Sector

Solar Water Heating

Residential solar thermal systems are plumbing systems that absorb heat from the sun to create hot water that can be used for showers and baths, dish washing, clothes washing, space heating and other uses. A basic system has a solar collector on the roof plumbed to a hot water storage tank in the building and some form of backup energy source. Equipment required for solar hot water systems is generally less expensive than PV panels for the BTU's produced.

Residential Thermal Systems Around the World

By far, the largest solar thermal market in the world according to newly installed solar thermal capacity per year is China. In 2008, around 21 GW were sold in China, which was around 80% of the world global solar thermal market and 16 times greater than the European market as a whole. In Europe, Germany – the second biggest market in the world and the largest market in Europe – is dominating. With its newly installed capacity of 1.13 gigawatts-thermal in 2009, the country reached a market share of 38% within Europe.[23]

Residential Thermal Systems in Idaho

A typical solar thermal system in Idaho with two 4'x 8' solar collectors produces the equivalent of 16 kWh per day or 5,960 kWh (20,336,364 BTUs) per year.[24]

The average cost of a two panel solar water heating system is roughly $5,000. At $0.0795 per kWh the system will save $474 annually: $5,000/$474 = 10.5 years for simple payback. With the existing 30% federal tax credit, $3500/$474 = 7.4 years or faster if costs of the alternative sources of energy (e.g. electricity, propane, natural gas, etc.) increases, or the installed system price decreases. By comparison, payback against propane will be faster and against natural gas will be slower.

Please reference the general barriers section at the beginning of the report (Page 12).

Residential Solar Thermal Options for Idaho

Utilizing an average residential solar hot water system can result in reducing electricity consumption by 50% to 80% as compared to conventional electric water heating.[25] This helps reduce emissions associated with fossil fuel combustion, and will not be affected by volatile fuel

[23] Global Solar Thermal Energy Council: http://www.solarthermalworld.org/faq
[24] http://www.solar-rating.org/solarfacts/solarfacts.htm
[25] Comments from Solar Energy Industries Association; Colin Murchie, Director of Governmental Affairs; Before the Pennsylvania Public Utility Commission; Implementation of the Alternative Energy Portfolio Standards Act of 2004; Docket No. M-00051865

prices. A study in California[26] found that solar hot water systems could save more natural gas than any other technology. However, as with other solar systems, solar water heating must be purchased at a relatively high up-front cost of roughly $2,000 – $6,000 depending on the need and intensity of sunlight. A backup system will also be required because of cloudy weather. When a solar thermal system is included in financing a new home, the typical cost of the system ranges from $13 to $20 per month. The homeowner is eligible for a federal income tax credit of 30% on the total cost of installing a solar system.

Very little data exists regarding Idaho's solar hot water market. Unlike the growth of the distributed PV market in many states, the solar hot water market has been very slow to expand, even in states where incentives exist. This is in part because solar thermal is a part of energy efficiency programs in many states and must meet energy efficiency cost effectiveness tests. The cost of solar hot water is still higher than most energy efficiency measures, which results in lower incentives for systems than if solar hot water was compared to other renewable energy resources.

Solar water heating systems were popular in the 1800s and early 1900s in places like California and Hawaii, serving as an alternative to electric hot water heating, burning wood or using other fuel. But when the discoveries of cheap natural gas and oil were made, the seemingly rudimentary solar heating systems were displaced. As the price of energy increases in Idaho, installing solar water heating systems will become more attractive.

Utility-Scale Photovoltaic Systems

Utility-scale PV utilizes the same technology as previously described; however, there are major differences in both size and ownership model. Although there is no precise cutoff point as to what constitutes a utility-scale PV system, the typical utility-scale project is expected to be two megawatts (2,000 kilowatts) and larger. Utility-scale PV resources have the following characteristics that differentiate them from the other types of PV systems:

- Much larger systems (2,000 kW and larger)
- Ownership model (commercial versus individual/residential)
- Directly connected to the main distribution or transmission system (the "grid" as opposed to being installed on the customer side of the meter)
- Typically ground mounted (although some have been installed in metropolitan areas on top of large warehouses and building roofs)
- Typically installed on large blocks of property (a 1,000 kW system will require 5-10 acres of land)
- For very large PV systems (10 MW and larger) transmission system modifications may be necessary
- Transmission studies will need to be performed by the host utility and any proposed transmission path.

[26] California Statewide Residential Sector Energy Efficiency Potential Study; KEMA-X-energy study for Pacific Gas & Electric Company; by Fred Coito and Mike Rufo; April 2003

Building a large-scale PV project significantly reduces the installed capital cost, which results in a reduced cost of the energy. Based on recent panel prices and project related market information, it is expected that large PV projects can be installed at capital costs in the range of $3 to $4.50 per watt AC. Costs depend on size of the facility, technology (including type of tracking system, if employed), development costs, land costs and transmission interconnection costs. Utilizing preassembled modular racking, ground mounting systems, and larger lower cost/capacity inverters it is possible to achieve lower total capital costs. Typically in utility systems the inverter output voltages will need to be raised to interconnect to the utility system, which is typically operated at 12.47 kV or 34.5 kV or at even higher voltages for very large utility-scale projects.

In a utility-scale PV project, the PV resource operates as a utility resource; the energy from the resource serves the receiving utility's customers as opposed to a single customer, as is the case in the previous types of PV. A utility-scale PV resource can be owned directly by the receiving utility, in which case the cost of the resource is held as an asset just like the utility's other generation assets in its pool of generating resources. Alternatively, and more typical for large PV projects, the PV resource is owned by a third party who sells the energy output to the receiving utility via a long-term power purchase agreement (PPA). These are project financed arrangements and occasionally result in lower effective costs because of the project owner's ability to more effectively realize available tax incentives. In either event, the output of the PV resource serves all of the utility's customers. Typically, the renewable energy credits (RECs) transfer to the receiving utility, which applies the REC to meet a portion of its renewable portfolio standard (RPS) if the receiving utility is obligated to meet a regulatory or state RPS mandate.

A utility-scale PV project will typically require five to ten acres of land for each megawatt of capacity[27]. Land requirements for utility-scale PV can vary from tens of acres for 1-5 MW systems to thousands of acres for very large PV projects. Even though these PV resources occupy large tracts of land, they can be located in areas to maximize space usage or in an area with limited alternative use. Such areas include siting the PV panels adjacent to interstate clover-leafs, rooftops of large commercial buildings, on land that has limited agricultural, urban or scenic value or even as part of a large development. Note that the fuel for solar energy generation is provided directly to the site with no land impacts, an important distinction for most renewables. Fossil fuel electrical generation plants may have a smaller footprint per megawatt, but land footprint of fuel collection, transportation and storage should be included for a more accurate comparison.

Utility-Scale PV Systems Around the World

Global utility-scale solar PV is growing, led by Europe. In 2009, global installations grew to 7,300 MW, led by Germany and Italy.[28] The U.S market is much smaller, but growing. In 2009, utility-scale solar PV installations grew by 200% to 119 MW, primarily driven by policy mandates and declining solar costs.[29]

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[27] http://www.powerscorecard.org/tech_detail.cfm?resource_id=9; http://www.amonix.com/content/better-use-land

[28] "Report on Barriers to Solar Power", World Bank Energy Sector Management Assistance Program, 2010

[29] "U.S. Solar Market Trends: 2009", Larry Sherwood, July 2010, for Interstate Renewable Energy Council: http://irecusa.org/wp-content/uploads/2010/07/IREC-Solar-Market-Trends-Report-2010_7-27-10_web1.pdf

Utility-Scale PV Systems in the United States

The U.S. utility-scale solar PV business is growing. With only 77 megawatts (MW) of utility-driven PV projects operating by mid 2010, U.S. utilities have announced a pipeline of more than 4.8 gigawatts (GW) of large, utility-scale photovoltaic PV projects.[30] There are more than 30 utility-scale solar power plants of one megawatt or larger under various stages of development in the U.S. In 2009, the first utility-scale PV power plants (35 MW in total) were built in Florida. NV Energy in Nevada has contracted for 46 MW from two projects that came on line in 2010. And in California, both Pacific Gas and Electric and Southern California Edison launched programs that will result in 750 MW of larger-scale distributed PV generation from projects owned both by the utilities and non-utility developers. Utility-scale PV projects are also moving forward in Texas, Colorado, Illinois, Maryland, New York, North Carolina, Arizona, New Mexico and Ohio.[31]

Growth has been driven by six primary factors: regulatory mandates, favorable tax incentives, widespread cost reductions in the PV sector, fossil fuel price volatility, overarching carbon concerns and PV's siting flexibility.

In the immediate term, the primary driver for PV utility deployment is state-level Renewable Portfolio Standards (RPSs) or Renewable Energy Standards (RESs). Of the top 20 states in which utilities have signed PV agreements, 18 have an RPS or RES in place, and 13 have a distributed generation or solar carve-out. A solar carve-out is an addition to an RPS/RES which requires that a portion of the Standard be met with solar.[32]

Utility-Scale PV Systems in Idaho and the Pacific Northwest

At present there are currently no utility-scale solar projects in operation or under construction in Idaho. A 20 MW solar PV project has been proposed in Elmore County that has an executed an interconnection and a PURPA agreement with Idaho Power (Grandview Solar 1 project). There are other announced projects as well, though significant steps are necessary before groundbreaking.

There are no utility-scale projects permitted or in operation over 2 MW in the Pacific Northwest. However the passage in Oregon of HB3039 is expected to result in the construction of a number of utility-scale projects.

Idaho is an attractive location for utility-scale solar plants. The state has a strong solar resource, available land suitable for solar PV development, a constructive permitting environment, and a summer daytime load peak.

Utility-Scale PV System Costs

Utility-scale PV plants use the same or similar panels and equipment that small-scale solar uses. However, the economies of scale for a utility-scale plant are significant. Compare $3 per watt installed for a 5 MW plant with the approximately $5.50 per watt for smaller systems.

[30] http://www.sustainablebusiness.com/index.cfm/go/news.display/id/19367
[31] http://blog.appliedmaterials.com/2010-surge-utility-scale-photovoltaics-coming
[32] *Ibid.*

Regarding operations and maintenance (O&M) expenses, for single-axis tracking PV, the 10 MW O&M is $30,000 to $40,000/MW (AC) installed/year. That includes both standard O&M and selling, general, and administrative expense (property taxes, insurance, etc.). The cost breakdown is about 60% O&M and 40% SG&A.

Although the cost of installing PV systems is declining, the key factor impeding utility-scale solar PV projects in the United States is access to capital, both debt and equity. Most solar project developers need to attract outside capital for most of the project costs. Even projects that benefit from a power purchase agreement with a utility have difficulty obtaining financing in the current capital market environment. These and other factors are currently barriers to solar development.[33]

Advantages of Utility-Scale PV Systems:

- Uses free, unlimited, fuel
- Produces no emissions or pollution while generating
- Can reduce energy requirements during peak demand periods
- Requires minimal water
- Has minimal operating and maintenance costs
- Ease of development compared to other types of generation
- Possible to site near load
- Rapid installation and deployment compared to most other utility-scale resources

Obstacles to Development of Utility-Scale PV in Idaho

Please reference the general barriers section earlier in this report (page 12)

- Solar PV has a high initial capital cost. Solar PV still has one of the highest initial capital costs of any renewable technology, though costs are declining.
- Regulatory recovery is major barrier – utilities are mandated to lowest cost/lowest risk standards. Utilities will not invest in solar PV either directly or through a PPA unless these costs can be recovered in electric rates.
- Idaho does not have an RPS. In states with a RPS, utilities would typically meet their RPS requirements with wind-based renewables due to its lower energy cost. Wind based renewables are typically lower cost in comparison to solar PV. Even with an RPS mandate, PV has to compare favorably against other renewable technologies.
- Energy payments may not be appropriately structured in specific areas to monetize the benefits of PV. Pricing mechanisms for qualifying facility payments may need to address the specific deliverability of energy from a solar PV resource, which tends to be more predictable than wind based renewables and also provides energy during the peak periods in many locations.
- State/ local permitting processes can be complicated.
- Other states have much higher opportunities for development and investment in utility-scale PV due to their higher electric rates or a solar carve out for solar PV.

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[33] http://www.renewableenergyworld.com/rea/news/article/2010/02/the-u-s-solar-market-assessing-the-potential

- Federal IRS regulations do not allow for utility ownership of solar PV to fully recognize investment tax credit benefits to flow completely through to customers.

How Idaho Can Encourage Utility-Scale PV Development:

Please see general policy section at the end of the document.

- Foster development of a voluntary ratepayer funded PV power program
- Make tax incentives available (property, sales tax, investment tax, production tax, etc.)
- Create a carve-out for solar PV for utilities either building or acquiring solar PV resources. Alternatively, in the context of a state RPS, provide for REC multiples to apply for the use of solar PV.
- Review qualifying facility rates to ensure that rates paid recognize the resource pattern of solar PV resources.
- Federal IRS regulations do not allow for utility ownership of solar PV to fully recognize investment tax credit benefits to flow completely through to customers.

Utility-Scale Solar Thermal

As discussed previously, concentrated solar power (CSP) systems use lenses or mirrors to focus a large area of sunlight onto a small area. Concentrated solar thermal (CST) is used to produce renewable heat or electricity (generally, in the latter case, through steam).

Benefits of CSP:[34]

See general benefits section earlier in the document.

- Zero long-term fuel costs: the utilities' other options (coal, nuclear or natural gas) have significant long term risks with cost implications; solar provides a hedge against price volatility as well as carbon cap legislation
- Ideally suited for multi-megawatt central power plants
- Dispatchable power for peaking and intermediate loads through hybridization and/or thermal storage
- Proven technology with 354 MW operating successfully in California for the past 15 years
- Rapidly deployable because it uses conventional items such as glass, steel, gears, turbines, etc.
- Able to hybridize with fossil fuel sources providing back up or supplemental energy

Barriers to CSP:[35]

See general barriers section earlier in the document (page 12)

Options to Help Overcome Barriers to CSP:

- Legislate a long term Investment Tax Credit (it currently expires in 2016).

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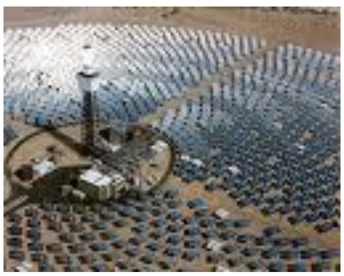
[34] U.S. Department of Energy "Why California Should Develop Its Renewable Energy Resource", September 2003, http://www.oilcrisis.com/us/ca/CaliforniaCSP_Potential200309.pdf

[35] Michael Lotker, "Barriers to Commercialization of Large-Scale Solar Electricity: Lessons Learned from the LUZ Experience", Sandia National Laboratory, November 1991, http://www.nrel.gov/csp/troughnet/pdfs/sand91_7014.pdf

- Project finance with long-term low-interest debt for CSP plants and the associated required additional transmission required
- Renewable energy projects must be provided with a competitive environment (i.e., the rules for bidding in utility capacity procurements) which recognize and value these technologies environmental and diversity benefits, fuel risk reduction benefits, and their capital intensive nature
- Support filtered resource maps to identify optimal CSP site locations
- Support transmission studies that consider solar sites
- Support studies on dispatch of solar output, both with and without thermal energy storage
- Identify environmental issues and solutions
- Provide objective information on CSP to policy makers

Utility-Scale Solar Thermal in Idaho



Idaho has some experience with large-scale solar. From 1994 to 1999, Idaho Power and Rocky Mountain Power were part of a consortium that funded and operated the Solar Two demonstration project located in Barstow, California. This 10 MW molten salt power tower used thousands of small, flat two-axis mirrors, called heliostats, to reflect the concentrated sunlight onto a receiver at the top of a central tower in which molten salt was heated. The heated molten salt was then piped to ground level, where steam was produced for power generation. Solar Two proved it could run continuously around the clock producing power. Solar Two was decommissioned in 1999. It was not designed to be a long-term power producer but rather as a research and demonstration project.

Today, SolarReserve (a California-based developer of utility-scale solar power projects), hopes to take what was learned at the Solar Two Project and build a 100 MW molten salt solar power tower generation plant near Tonopah, Nevada. SolarReserve expects this plant to be in operation by 2013.[36]

In the 2009 Idaho Power Integrated Resource Plan, a solar portfolio with two 100 MW power tower resources was among the four final portfolio candidates for the 2010-2019 time frame. While the solar portfolio showed energy generation promise, the capital costs were the highest of all the portfolios.[37] Please reference graph on page 19 regarding the direct normal solar insolation in Arizona and Idaho.

Southwestern Idaho is a prospective site for CSP development, though many areas along the southern portion of the state may be appropriate.

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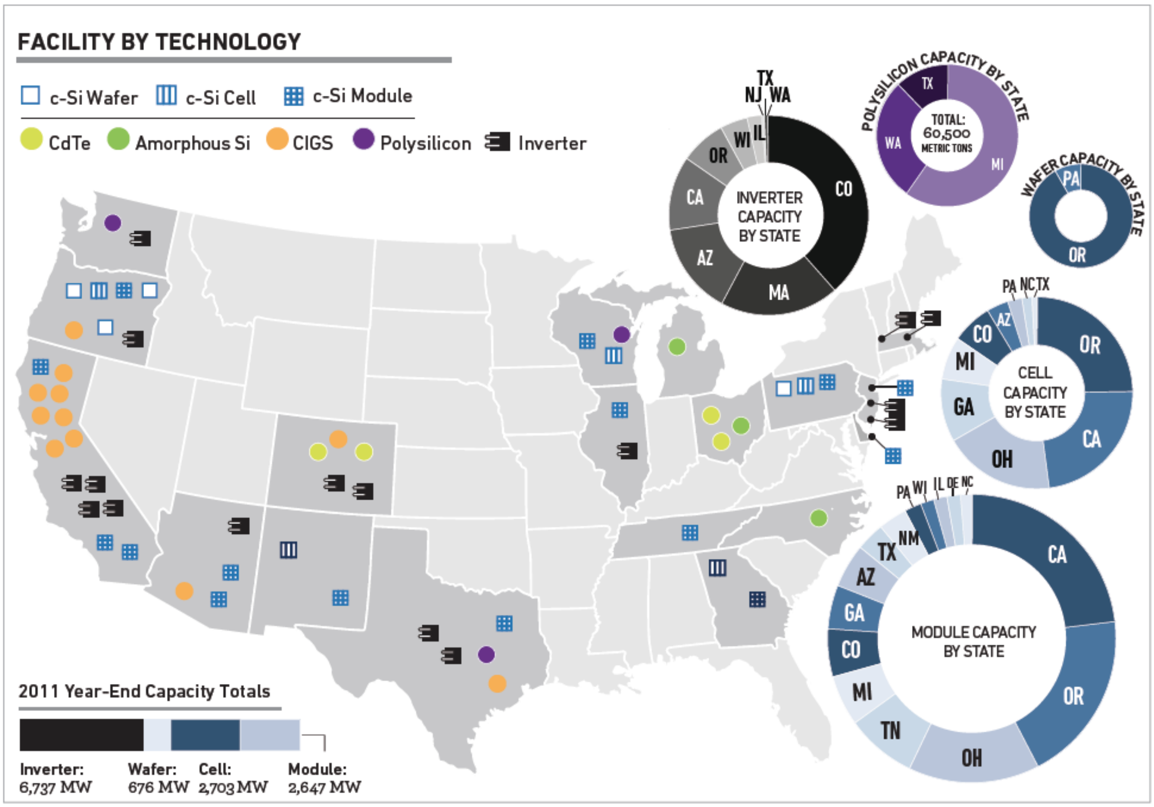
[36] http://www.tonopahsolar.com/

[37] Solar Generation Feasibility Study for Southwest Idaho, Black & Beach, August 2008; Idaho Power Company's Draft 2009 Integrated Resource Plan

Manufacturing and Industry

Solar Manufacturing Around the World

Solar manufacturing creates high-tech, stable jobs for professionals and skilled labor. The skills required to manufacturing solar PV panels and inverters are similar to the skills needed by the semiconductor industry to fabricate and process silicon wafers. Most manufacturing facilities purchase raw materials and specialized equipment from U.S. and local suppliers. In addition, local manufacturing facilities generate tax revenues for federal, state and municipal governments.



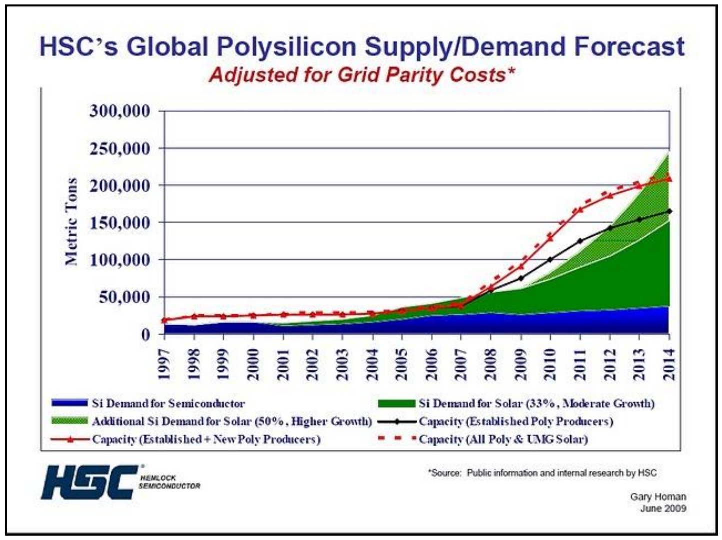
Source: www.seia.org/cs/research/solarinsight

Note that solar manufacturing is happening in states that are also installing the most solar power. Missing from this graph are the Hoku c-Si plant in Pocatello and the developing Micron/transform solar plant in Boise.

Solar Manufacturing In Idaho

In 2006, Hoku Scientific, a materials science company focusing on clean energy technologies, selected Idaho for its polysilicon manufacturing facility. This facility is expected to cost more than $250 million. It is slated to come on line in 2011 and produce 4,000 tons of silicon.

In 2009, Transform Solar, a company formed by Boise-based Micron Technology Inc. and Origin Energy of Australia, will begin manufacturing solar cells at a plant in Boise where Micron once made computer chips. The cells will be combined into solar panels at another plant owned by Micron in Nampa. Transform Solar has hired 70 employees and expects to hire up to 50 more, with most of the jobs based in southwest Idaho. The firm's manufacturing and research will be based in southwest Idaho, and more research and development will be done in Adelaide, Australia. Boise Mayor Dave Bieter announced in June, 2010 that solar panels using the technology will be used in a $45 million 10 megawatt facility proposed by Sunergy World near the Boise Airport.[38] Transform Solar technology uses less silicon in each cell, which it hopes will lower the cost of its product.



Benefits to Manufacturing in Idaho

- Idaho offers a good environment for many manufacturers due to low cost power, attractive labor rates, skilled labor, supportive permitting processes and tax structure, and a good logistic base. There are barriers to entry, as with all projects/businesses, but through cooperation and partnerships, Idaho can establish itself as a role model for alternative energy manufacturers and businesses.
- A solar manufacturing industry in Idaho can establish itself as an alternative energy hub with a good cost structure, both near-term and long-term. Idaho has the second lowest energy cost in the nation.[39] Labor in Idaho is relatively inexpensive compared to other states. For example, Pocatello's per capita personal income is roughly 30% less compared to the U.S. average. Personal income for the state of Idaho is approximately 18% below the U.S. average.[40]
- Idaho offers logistical advantages due to the easy access to road, rail and air.
- There are many benefits to encouraging industry of all kinds to build manufacturing facilities in the state: creating a labor pool that caters to the industry can prevent educated citizens from leaving the area; major manufacturing companies can create long-term stability by creating synergies and encouraging compatible manufacturing/businesses to locate here as well; and the transition of Idaho toward the industrial sector has potential for vertical integration among industrial users.
- Solar energy lays a good foundation for energy research/commerce, cross industrial synergies and supply chain integration. Businesses in Idaho (including polysilicon plants) can be competitive globally while based here in Idaho.

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[38] http://www.manufacturing.net/News-Transform-Solar-To-Build-Solar-Panels-In-Idaho-062510.aspx

[39] http://cfed.org/knowledge_center/research/DRC/

[40] http://www.bea.gov/newsreleases/national/pi/pinewsrelease.htm

- Another consideration is that manufacturing in Idaho offers a discrete advantage in gaining access to the emerging U.S. federal and stimulus-driven markets. Department of Defense and other federal projects will likely require "Made in America" products. Idaho is well positioned to develop a U.S. manufacturing base to serve this market.
- Idaho has low cost labor, currently low energy costs, convenient logistical access via air, rail and road, supportive permitting environment, available land with suitable building conditions, and tax and training incentives.
- Idaho has educational and technical resources, including INL, CAES and public universities, as well as established tech businesses.

Barriers to Manufacturing Solar in Idaho

- Expected increase in power prices driven by increased load
- Complimentary industries where resources can be shared are not as common in Idaho. In order to grow or expand, manufacturing facilities may either import or produce their own resources as an option.
- Idaho's labor pools are more developed in agriculture as compared to industry and technology. This is a growth limiting factor for the alternative energy sector. Depending on the industry, experience and/or training may be needed for prospective employers.

Policy Recommendations

To grow Idaho's distributed PV and solar thermal market, even modest changes in public policy have the potential to significantly increase the number and size of system installations in the state. The major barrier to Idaho's distributed PV and solar thermal market is cost, followed by the lack of trade development and public awareness about the benefits of the resource.

PV and Solar Hot Water Option: Provide Additional Tax Incentives and Loans

Concern

The largest barrier to the growth of the distributed PV market in Idaho is the cost of PV in comparison to other renewable and conventional forms of energy generation. While the installed cost of distributed PV systems is declining, today's costs to install a PV system has a direct financial impact on the residential or business consumer interested in having a system serve their on-site load. It can also impact utilities and their ratepayers.

Current Status

Currently, the federal investment tax credits (30% of the facility cost, with no dollar cap)[41,] the 5-year Modified Accelerated Cost Recovery System (MACRS)[42], and 50% first-year bonus

[41] Residential Renewable Energy Tax Credit: 26 USC § 25(D). Expires December 31, 2016. Business Energy Investment Tax Credit: 26 USC § 48. Systems must be installed by December 31, 2016.
[42] 26 USC § 168(e)(3)(B)(vi)

depreciation[43] significantly reduces costs to install a solar system. However, the federal incentives alone are not sufficient to reduce costs enough to drive significant consumer demand in Idaho. Furthermore, the window of opportunity for these available incentives may close before viable projects can be successfully developed, permitted and constructed.

Varying types of incentives at the state or utility level that reduce costs for consumers have been a key driver in strong solar growth markets. Idaho offers two direct incentives and a loan program for distributed PV. For residential consumers, Idaho provides a personal alternative energy tax deduction (an "off-the-top" subtraction from gross income) of 40% of the system cost in the first year and 20% per year for the next three years with the system cost capped at $20,000 ($5,000 per year)[44]. For systems over 25 kW in size, Idaho provides a 100% sales-and-use tax rebate for qualifying PV equipment.[45] Idaho's Office of Energy Resources also administers low-interest loan programs for PV systems[46]. For off-grid projects, the use of a renewable energy resource must be the least-cost alternative. Loans for PV systems are limited to $15,000 and cannot be built with the intention to sell the energy generated. The program offers 4% interest with a 5-year repayment requirement. Idaho's personal alternative energy tax deduction and loan programs also apply to solar hot water, as long as there is a simple payback of 15 years or less. Loans for solar hot water are up to $15,000 for residential systems and up to $100,000 for commercial and agricultural systems.

Recommendation
To expand the number and type of distributed PV and solar hot water installations in the state, Idaho should first consider key changes to the state's incentive structure that will drive customer interest. One option is to make modifications to the tax-based incentives in place. For the residential market, a tax credit or rebate rather than the current tax deduction would make the incentive available to a much wider scope of customers.

PV Option: Increase Net Metering Limits

Concern
The current net metering structures do not encourage additional PV development. Although Idaho's existing policy has resulted in a number of system installations, Idaho's distributed PV market (<1 MW installed) is very small in comparison to neighboring states in the Northwest and across the country. For example, Oregon's distributed PV has grown dramatically in the past few years, with approximately 15 MW installed to-date (versus 3 MW in June 2008). Oregon's electricity prices are not dramatically different than Idaho's; it is Oregon's public policies – incentives, net metering and utility cost recovery – that have made a major difference in the state's market growth.

Current Status
In addition to direct incentives, Idaho's three IOUs – Avista, Idaho Power and Rocky Mountain Power – have developed net metering tariffs that have been approved by the Idaho Public Utilities Commission (IPUC). Each utility offers net metering to customers that generate electricity using

[43] 26 USC § 168(k). The property must have been placed in service during 2008 or 2009.
[44] Idaho Code 63-3022C
[45] Idaho Code 63-3622QQ. Expires July 1, 2011.
[46] http://www.energy.idaho.gov/financialassistance/energyloans.htm

PV. Avista has a net-metering size cap of 100 kW. Idaho Power and Rocky Mountain Power limit residential systems to less than 25 kW. Idaho Power allows for large commercial and agricultural systems up to 100 kW and Rocky Mountain Power allows for non-residential systems up to 100 kW. Each utility limits aggregate net metering capacity in the utility's service territory to 0.1% of the utility's peak demand in a baseline year (1996 for Avista, 2000 for Idaho Power, 2002 for Rocky Mountain Power), and restricts any single customer from generating more than 20% of such peak production.[47] How the net excess is treated varies by utility. For Avista, net excess is credited to the customer's next bill and then granted to the utility at the end of the 12-month billing cycle. For Idaho Power and Rocky Mountain Power, the net excess is credited to the customer's next bill at the retail rate for residential and small commercial customers and at 85% of the PURPA avoided-cost[48] rate for large commercial and agricultural customers (all non-residential customers for Rocky Mountain Power). Currently net metering applies only to the three IOUs and not to consumer-owned utilities.

Recommendation
Idaho's net metering tariffs could be modified to better drive market demand for distributed PV.

1) Idaho could require all utilities (not just IOUs) to provide net metering as an option for their customers. For example in the state of Washington, all utilities are required to allow customers to net meter systems up to 100 kW in size.

2) Idaho's IOUs could also increase the current system size limits for net metering. In Oregon, IOUs are required to allow customers to net meter systems up to two MW in size.

3) The net excess requirements could also be better structured to drive customer demand for distributed PV. One option is for the utility to pay the customer a credit at current residential and commercial retail rates if there is net excess at the end of a 12-month billing period, rather than have the net excess credited back to the utility. At minimum customers should be credited at retail rate for energy used to offset use on an annual basis.

In addition, Idaho's utilities could develop standard interconnection agreements and requirements for net-metered systems. These standard agreements streamline the interconnection process for utilities and provide certainty for system owners.

PV Option: Sales-and-Use Tax Exemption Reinstatement

Concern
The sales-and-use tax rebate expired July 1, 2011. The expired sales-and-use tax rebate excluded most residential solar systems.

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[47] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ID01R&re=1&ee=1

[48] PURPA is the federal Public Utility Regulatory Policy Act (1978), which requires utilities to purchase power from certain types of energy producers, termed Qualifying Facilities (QF), at a price up to the utility's avoided cost. The avoided cost is the incremental cost that the utility would otherwise have to incur had the utility not purchased the power from the QF. In Idaho, the avoided cost is established by the IPUC for systems under 10 MW in size and negotiated between the power producer and the utility for systems between 10-80 MW in size.

Current Status
The expired sales and use tax rebate only applied to solar systems 25 kW and larger. Most residential systems are in the 2-10 kW range.

Recommendation
Reinstate the incentive and remove the system size requirement of at least 25 kW for the sales-and-use tax rebate. Alternatively, the legislature could enact legislation exempting sales-and-use tax for solar systems.

PV Option: Make Tax Credits Transferrable

Concern
Lack of transferable tax credits inhibits solar projects.

Current Status
Idaho tax code does not allow for the transfer of tax credits. This disincentivizes some parties, like non-profits, from installing solar systems. In contrast, Oregon's Residential Energy Tax Credit (50% of system cost, credit is capped at $6,000)[49] and Business Energy Tax Credit (50% of system cost, credit is capped at $10 million)[50], especially when coupled with ratepayer-funded rebates from the Energy Trust of Oregon[51], has been a major driver of the state's dramatic growth in distributed PV and solar hot water. In Oregon, system owners without sufficient tax liability are able to transfer the tax credit to another taxpayer in return for a cash payment. The transferability of the tax credit has been essential to many homeowners and especially critical for commercial systems. If Idaho were to develop income tax credits as an incentive tool, transferability will need to be a key component for the incentive to be effective.

Recommendation
Change the tax code to allow the transfer of tax credits.

PV Option: Property Tax Exemptions

Concern
High initial cost of PV systems

Current Situation
No program currently exists in Idaho.

Recommendation
An additional tax incentive worthy of consideration for distributed systems is a property tax exemption. In Oregon, net-metered renewable energy systems (<2 MW in size) are exempt from property taxes.

[49] http://egov.oregon.gov/ENERGY/CONS/RES/RETC.shtml
[50] http://egov.oregon.gov/ENERGY/CONS/BUS/BETC.shtml
[51] www.energytrust.org

Idaho cities or counties could also establish incentives via a Property Assessed Clean Energy (PACE), in which the city or county offers a customer a loan to finance a solar system and the loan is paid back through reductions in property tax payments. These programs are typically funded through municipal or county bonds.

PV Option: Ratepayer Funded Programs

Concern
High initial cost of PV systems

Current Status
No program currently exists in Idaho.

Recommendation
Idaho should also consider a wide variety of other non-tax based incentive mechanisms for distributed PV and solar thermal. Ratepayer-funded programs are one such incentive, and there are a variety of options in this regard. One incentive option is the establishment of a system of rebates that pay for the systems' above-market costs. These rebates are typically funded by utility ratepayers and administered by the utility, a third-party non-profit, or a state agency. Idaho utilities could establish this fund via a surcharge as part of the utility demand side management programs or create a separate renewable energy fund.

PV Option: Production-Based Incentives

Concern
Limited PV implementation in the state

Current Status Situation
No program currently exists in Idaho.

Recommendation
An alternative to a rebate option is a production-based incentive, which pays the system owner a specific incentive based on every kWh or BTU produced. A more specific form of production-based incentive is a feed-in tariff or standard offer contract, where the utility enters into a contract to purchase the energy at a specified rate from a system over a set period of time. Washington's production-based incentive for PV and solar thermal, which is funded by a utility tax credit, has supported at least 1.5 MW of installed PV systems, primarily in the residential market. Washington recently expanded the maximum incentive to $5,000 a year and made the incentive applicable to community solar projects up to 75 kW in size. Oregon also recently established a 25 MW pilot solar PV feed-in tariff for systems under 500 kW in size in IOU service territory.

PV Option: More Favorable Regulatory Environment

Concern
In any ratepayer-funded incentive structure, it is important to recognize that the IOUs will need approval from the IPUC for rate-recovery. The current least-cost, risk-adjusted decision-making criteria process may not appropriately capture the value of distributed PV. A decision-making

process in which the IPUC also considers resource diversification, transmission and distribution savings, peak demand savings, energy independence and reduced price volatility could more appropriately value the benefits of distributed PV to ratepayers.

Current Status
IPUC is held to least-cost decision making basis for rate making purposes.

Recommendation
Changes to the IOU regulatory environment from simply a least-cost, risk-adjusted decision-making to a decision-making process in which the IPUC also considers resource diversification, transmission and distribution savings, peak demand savings, energy independence and reduced price volatility could more appropriately value the benefits of distributed PV to ratepayers. This concept will play an important role in all energy development in the state. Some concepts for enhanced rate structure / rate design / rate recovery / regulatory environment include:

- Recognize the peak demand value of the resource in any energy payments. (Value can be incorporated into the price of power as well as in developing levelized costs)
- Consideration of social and environmental externalities

PV Option: Education

Concern
While policies to reduce cost barriers to distributed PV are needed, Idaho should also consider developing a well established, credible trade network and robust public education program about the benefits of PV. Tools to build a strong trade network would allow Idaho's universities, community colleges and trade unions to develop training programs for solar installers, system designers and project developers and to establish a specialty solar contractor license. Idaho could also establish a solar trade ally network. The Energy Trust of Oregon's network of solar trade allies are experienced contractors who meet specific criteria and with whom consumers can feel confident.

Current Status
Currently there are no state programs in place, though efforts are beginning on a few of the topics.

Recommendation
Public education is an essential ingredient to grow market demand. The best incentives will make little difference without broad public awareness. One option to fund this public awareness program is for the state to commit funding to the Office of Energy Resources to establish a distributed PV education and outreach program. Another option is for the utilities or a third-party program manager to establish such a program. This program could be funded as part of a utility's general marketing budget or, alternatively, as a small part of the utility Demand Side Management budget or even as a separate renewable energy fund budget. To ensure limited funds are well spent, marketing or public outreach programs should be tailored to specific customer groups that are likely to be interested in investing in solar energy.

PV Option: Streamline Permitting

Concern

In general, building codes and construction permits for distributed PV and solar thermal systems are not a major barrier to market growth. However, establishing best practices to standardize roof structure, system weight and appropriate zoning in building codes make project development a less costly and timelier process. Another challenge to residential solar can be restrictive homeowner's association requirements.

Current Status

Permits for solar electric systems are required, but no best practice guidelines are established. There is currently no preferential treatment for solar or renewable projects in the permitting process. Homeowners associations can currently prohibit solar electric and solar thermal panels.

Recommendation

Establish best practices to standardize roof structure, system weight and appropriate zoning in building codes. Pass legislation to ensure homeowner's associations cannot restrict installation of distributed PV or solar thermal systems

Utility-Scale PV and CSP

Concern

There are three primary barriers to the growth of the utility-scale PV and CSP markets in Idaho: cost, utility rate-recovery and permitting challenges. Changes to public policy in Idaho can make a major difference in addressing these barriers, particularly if Idaho works closely with regional and federal partners.

Current Status

Even more so than distributed PV, the installed cost of utility-scale PV declined dramatically in the United States in late 2009 and early 2010. This is in large part due to drops in solar panel prices. Utility-scale PV systems are commonly being priced at under $4 per installed watt, and many are in the $2-$3 range. Utility-scale CSP costs vary significantly depending upon technology type and resource.

Recommendation

Although utility-scale PV and CSP are not yet competitive with new natural gas, wind, geothermal or biomass projects in the Northwest, PV and CSP resources become more cost competitive when the lack of fuel required (and associated fuel price volatility) and peak demand benefits are taken into consideration.

Utility-Scale Option: Tax Credits

Concern
Currently, the federal tax credits (30% of the facility cost, with no dollar cap)[52], the 5-year Modified Accelerated Cost Recovery System (MACRS)[53], and 50% first-year bonus depreciation[54] make a major dent in capital costs. However, the federal incentives alone are generally not sufficient to reduce costs enough to attract Idaho utilities to purchase new resources investments in utility-scale PV and CSP.

Current Status
Varying types of incentives in individual states have helped drive development of utility-scale solar. Idaho offers two incentives in this market. Idaho's primary incentive is a 100% sales-and-use tax rebate for qualifying equipment used to generate solar electricity[55]. Idaho also allows independent power producers (IPPs) to request financing from the Idaho Energy Resources Authority, a state bonding authority, which also provides bonding authority to utilities for generation and transmission projects.

Recommendation
Idaho should consider modifications to current policy and income tax incentives for utility-scale solar to attract project development to the state. First, Idaho should extend the sales-and-use tax rebate, which currently expires July 1, 2011. An extension should be a minimum of five additional years, given long project development timelines. Second, Idaho should expand the 3% tax on gross energy earnings in lieu of property taxes to include solar energy. The incentive currently only applies to wind and geothermal resources. The establishment of an income tax credit for utility-scale solar in Idaho is also worthy of consideration. Oregon's Business Energy Tax Credit (50% of system cost, credit is capped at $10 million)[56] has spurred several utility-scale PV project proposals in the range of 2-10 MWs each across the state.

Utility-Scale Option: Rate Recovery Assurance/Regulatory Environment

Concern
For an IOU to make an investment in any new generation resource, particularly a generation resource that is less cost-competitive with other sources of power, the IOUs will need some assurances that they are likely to receive rate-recovery from the IPUC for their investment.

Current Situation
IOU regulatory environment is simply a least-cost, least-risk decision-making structure in which the IPUC does not consider resource diversification, transmission and distribution savings, peak demand savings, energy independence, and reduced price volatility.

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[52] Residential Renewable Energy Tax Credit: 26 USC § 25(D). Expires December 31, 2016. Business Energy Investment Tax Credit: 26 USC § 48. Systems must be installed by December 31, 2016.
[53] 26 USC § 168(e)(3)(B)(vi)
[54] 26 USC § 168(k). The property must have been placed in service during 2008 or 2009.
[55] Idaho Code 63-3622QQ.Expires July 1, 2011.
[56] http://egov.oregon.gov/ENERGY/CONS/BUS/BETC.shtml

Recommendation
Changes to the IOU regulatory environment from simply a least-cost, least-risk decision-making to a decision-making structure in which the IPUC also considers resource diversification, transmission and distribution savings, peak demand savings, energy independence, and reduced price volatility could more appropriately value the benefits of distributed PV (as well as other renewable energy options) and will play an important role in encouraging development of these resources in Idaho.

Utility-Scale Option: Implement a Renewable Energy Standard (RES)

Concern
Another key policy for utility rate-recovery is a Renewable Energy Standard (RES). An RES requires a utility to purchase a certain percentage of energy from renewable resources to serve load by a designated year. Oregon's RES is 25% renewable energy by 2025, Washington's RES is 15% by 2020, and Montana's RES is 15% by 2015. All of these states have interim standards, whereby smaller percentages of renewable energy are required in earlier years, gradually increasing the percentage of renewable resources over time.

Current Status
No RES currently legislated in Idaho.

Recommendation
As utility-scale solar becomes more cost-competitive, an RES in Idaho would help ensure that Idaho utilities receive rate-recovery for investments in solar energy. Many states have also established solar carve-outs or solar procurement standards as part of a RES policy. For example, Oregon has a solar procurement standard requiring IOUs to cumulatively purchase power from 20 MW of solar energy by 2020, from projects between 500 kW – 5 MW in size. Oregon's solar procurement standard also allows utilities to receive double credit for the Renewable Energy Credits (RECs) associated with the projects used to meet the standard. The utilities can then use these RECs to comply with the state's 25% by 2025 RES. Idaho should consider an appropriate RES target with solar carve out for the state.

Utility-Scale Option: Streamline Permitting

Concern
The cost and time associated with project permitting can quickly become a major roadblock if the project requires land grading (slope adjustment), is in sensitive habitat area, requires access to water (in the case of CSP) or is located on federal or state property.

Current Status
In Idaho, utility-scale PV and CSP projects need to obtain a host of land use and construction permits. The permitting process can be relatively straightforward and streamlined if a project is on private land and the primary permitting jurisdiction is the local county via a Conditional Use Permit.

Recommendation
To address these challenges, Idaho should consider establishing a working group to identify best practices for siting and permitting and to develop approaches to streamline the permitting processes. Another option worthy of consideration is the establishment of an Idaho energy facility siting council. In Washington and Oregon, where the states have an energy facility siting council, some developers have chosen to request a site certificate from the state facility siting council rather than seek a local conditional use permit. The benefit of a facility siting council is that the council members, who are typically appointed by the Governor, are required to make decisions by looking holistically at the costs and benefits of a project to the entire state and are less likely to be influenced by local issues.

Utility-Scale Option: Transmission Expansion Should Consider Solar

Concern
Any considerable expansion of renewable resources serving the grid will certainly require the construction of new transmission lines.

Current Status
New major transmission lines have not been built in about 20 years, despite the fact that most existing transmission lines in the West have been at or near capacity for quite some time. Fortunately, several new transmission lines have been proposed for construction in Idaho and throughout the West.

Recommendation
Responsibly sited transmission in areas with strong renewable resources will be essential to the long-term growth of utility-scale solar.

A major expansion of utility-scale solar will likely require new tools for integrating solar energy into the grid, given that solar is a variable resource. The good news is that although solar energy is variable, it is relatively predictable. A dearth of research on grid integration of solar energy makes it difficult to assess exactly what challenges we will face and how best to address them.

Solar Manufacturing Options

Concern
State incentives for renewable energy component manufacturing could influence growth of the solar manufacturing sector in Idaho, particularly given the capital-intensive nature of polysilicon manufacturing facilities.

Current Status
Idaho currently does not have any incentives that are tailored to renewable energy component manufacturing.

Recommendation

Washington and Oregon's manufacturing incentives are worthy of consideration for Idaho. Washington offers a discounted business and operation (B&O) tax rate (43% lower than the standard manufacturing B&O tax rate) for Washington manufacturers and wholesale marketers of solar-electric (photovoltaic) modules or silicon components of these systems. Oregon offers a Business Energy Tax Credit (50% of facility cost, credit is capped at $20 million)[57] for renewable energy component manufacturers. These incentives have helped entice several solar manufacturers to establish operations in both states, including manufacturers with a global presence, such as REC Silicon in Washington and SolarWorld in Oregon.

[57] http://egov.oregon.gov/ENERGY/CONS/BUS/BETC.shtml

Appendix 1: Solar Economic Matrix

Excel file available

	Resource Type		Costs and Risks			Attributes								Attributes			
	Solar	Primary Attribute	Cost & Economics (1)	production cost	tax base enhancement	development risk	deployment time	transmission requirements	business friendly process	capital intensity		Reliability & Security (2)	electricity grid robustness	resource/fuel security	dispatch ability	flexibility of generation scale	National security
Totals	1	Utility Scale PV (>1MW)	5.5	3.0	3.6	7.0	8.4	6.6	6.8	2.8		6.2	5.6	8.6	2.0	5.8	9.0
	2	Distributed PV (<1MW)	6.1	2.0	5.0	8.0	8.4	9.0	8.0	2.2		6.5	7.2	8.6	1.8	6.0	9.0
	3	CSP	4.4	3.0	4.6	4.4	4.2	5.6	5.8	3.0		6.1	6.0	8.0	3.4	4.2	9.0
	4	Hot Water	6.4	3.2	4.8	8.0	8.0	9.8	7.8	3.2		7.4	8.6	8.6	4.4	6.6	9.0

	Resource Type		Benefits		Attributes							Attributes				
	Solar	Primary Attribute	Preserve Natural Environment (3)	water	footprint	carbon dioxide	other GHG	health and safety		Sustainable Growth (4)	job impacts (number of jobs)	Job impacts (Quality)	public acceptance	Local renewable sources		Overall Score
Totals	1	Utility Scale PV (>1MW)	7.8	9.4	2.6	9.2	9.2	8.8		6.9	3.8	6.8	8.4	8.4		6.6
	2	Distributed PV (<1MW)	8.8	9.4	8.0	9.2	9.2	8.4		7.5	6.2	6.6	8.8	8.4		7.2
	3	CSP	6.8	5.4	2.6	8.8	8.4	8.6		6.7	4.2	7.2	7.0	8.2		6.0
	4	Hot Water	9.1	9.4	8.6	9.4	9.4	8.6		7.3	6.2	6.2	8.4	8.4		7.6

Score Method: **Score Range 0 -- 10**
Please fill grey boxes with score of 1 to 10. 10 = best
A five is compairable to a gas fired combined cycle power plant.
NOTE: It is assumed that the CSP process includes storage and/or natural gas fired backup.

Energy Plan Objectives:
1. Ensure a secure, reliable and stable energy system for the citizens and businesses of Idaho
2. Maintain Idaho's low-cost energy supply and ensure access to affordable energy for all Idahoans
3. Protect Idaho's public health, safety and natural environment and conserve Idaho's natural resources
4. Promote sustainable economic growth, job creation and rural economic development
5. Provide the means for Idaho's energy policy to adapt to changing circumstances

Appendix 2: Definitions and Technology Descriptions

Photovoltaic (PV) panels

A solar panel is composed of a series of photovoltaic (PV) cells wired together. Each cell is a thin sandwich of material, commonly silicon. The top layer of the clear cell is produced with a few extra electrons. The lower layer of the cell is produced with a few less electrons. When sunlight photons hit the cell, the added energy allows the extra electrons to migrate to the layer in need of electrons. A conductor (metal wire) is attached to the back and front of the cell, which completes the circuit, and the excited electrons flow right back to where they started. But that small flow of energy (current) is captured. The PV cells are wired in series, so that the small voltage each cell produces is added to the next, creating a usable voltage and a small current from the whole panel. One panel can be joined with others to increase voltage or current, creating a solar array. The solar array can be sized to run a traffic sign, a house or a business depending on how many panels are combined together.

<u>Notes</u>:

- A PV panel works best in cold temperatures. PV panels do not produce heat, they produce electricity.
- Shading or clouds can cause the energy to stop flowing and greatly reduces output from a panel.
- Panels produce the most energy when they are oriented directly at the sun (normal to the incoming sunlight).
- The best mounting orientation for a fixed rack solar module is facing due south at an angle equal to the site latitude. A panel facing slightly southwest will in some cases provide a better contribution towards the utility system peak, which often occurs later in the day.
- A shade free solar window from 9 a.m. to 3 p.m. is important for best production.
- Local insolation data is used for estimating production. Insolation data has been collected for 30+years and is considered reliable.
- Production: 2kW PV x 5 hours of full insolation (1000w/M^2) = 10 kWh per day average or 300 kWh per month average.
- 20kW PV X 5 hours of full insolation = 100 kWh per day average or 3000 kWh per month average.
- Solar panel performance degradation ranges from 0.8 to 0.4%/yr. Some historic PV arrays (30 years) are still performing at their name-plate rating. (Clean Power Research, L.L.C., 2006)
- Warranties typically allow for 20% degradation over 20 years; most field studies indicate that the actual degradation is half that amount. [58]

Panels: Crystalline Silicon
Also known as c-Si -Traditional PV
Efficiency between 15% and 23%

[58] http://homepower.com/article/?file=HP118_pg12_AskTheExperts_1

Scalable and established manufacturing processes
Cost tied to silicon prices which skyrocketed with demand from 2003-2007 and have declined significantly in the past couple years

Higher efficiency translates to lower "balance of systems" cost (or BOS, which encompasses all components of a photovoltaic system other than the photovoltaic panels. This includes wiring, switches, support racks, an inverter, and batteries in the case of off-grid systems. In the case of free-standing systems, land is sometimes included as part of the BOS.)

Currently about 70% of the market
Example manufacturer: SunPower Corp.

Thin Film
Non-silicon (or very low silicon) based technologies developed in recent years
Lower efficiency than c-Si but cheaper to manufacture; appropriate for large installations where space is not an issue
Cadmium Telluride (CdTe): Efficiency of 10-16%; well established
Amorphous Silicon (a-Si): Efficiency of 6-12%, degrades faster than other technologies. Most common thin film technology
Example manufacturer: First Solar

Concentrating PV (CPV)
Uses lens or mirrors to concentrate sun on PV material
Uses less PV material so cheaper, but requires precise tracking. Still in early stage
Low Concentration: Efficiency of 15-20%
High Concentration: Efficiency of 20-35+%; requires precise tracking and direct radiation, so only effective in best solar resource areas

Inverter
PV panels produce Direct Current (DC) electricity.
The distributed electricity is generally Alternating Current (AC).
An inverter is used to convert the DC power into AC power.

Tracking
It is possible to have a solar array move and "track" the sun to increase yield. For small systems the extra expense of the hardware and motor to move the panels is generally not worth the gain. Rather than spend the dollars on tracking equipment, a couple more panels can be purchased and the larger fixed system will produce a bit more energy, without the added O&M of a moving array. Many utility-scale installations are single axis tracking systems. On this scale the cost of maintaining the motorized equipment is worth the increased energy production, especially because the extra energy is often contributed during peak demand.

On-grid
A system that has panels and an inverter connected to the utility grid that will produce when the sun is out, delivering power to the grid (on-grid). If the customer requires power that is greater than the output of the solar PV system, electric energy is delivered from the grid. These simple

systems do not require batteries, though the utility does have to be informed of the system and be party to a "net metering agreement" and the system has to have the required protection and isolation equipment. These types of systems have many merits:

- Anyone can produce some or all of their electric energy requirements depending on the customers requirements and the size of the PV system
- No batteries are required to be maintained or ultimately disposed
- No moving parts and little maintenance

Off-grid
If power is needed when there is no sun, and the PV system is not connected to the utility grid (off-grid), then batteries must be used to store the solar generated electricity for use later. Off-grid systems come in many sizes, from a hand held calculator to a large home.

With off-grid systems, batteries are used to run the electric loads (often through an inverter to take the battery DC and convert it to AC). These batteries can be charged from a variety of sources, PV is one of them. Critical systems will generally have a back up charging source (like a diesel generator, or a wind generator.)

Off grid solar electric systems can be economical in those cases where the costs of interconnecting to the grid are high. This results in avoiding the cost of the utility line extension as well as the ongoing electric utility bill.

Batteries
Batteries are required if small-scale electricity storage is desired. They:

- Store electricity in a chemical reaction
- Often require periodic maintenance
- Have a finite lifespan dependent on their construction
- Depending on battery type, they may produce flammable hydrogen gas requiring venting and contain hazardous chemicals like sulfuric acid.

Net Metering
An on-grid system that works in parallel with the utility and is installed to produce electric energy on the customer's side of the meter. During the day the PV panels produce electricity. If the building is using electricity, the solar electricity will be consumed by the building. If the building is not using electricity when the solar array is producing, the electricity will leave the building and go onto the utility grid, spinning the utility meter "backward" as it leaves the property. At night, if the building needs electricity, the meter will again spin "forward" as energy is drawn from the grid. At the end of the month the net energy use by the customer is billed or credited. While some energy may be exported from the building at times, on a monthly or yearly basis the building will generally be a consumer or very small producer of electricity. These systems are generally not designed to produce excess production for a revenue stream (see Utility-Scale Solar).

- Systems without batteries will not work without grid power
- It is possible to have a grid tie system with battery back up for outages

Utility-Scale PV
Utility-scale PV uses much of the same technology as residential or distributed PV:

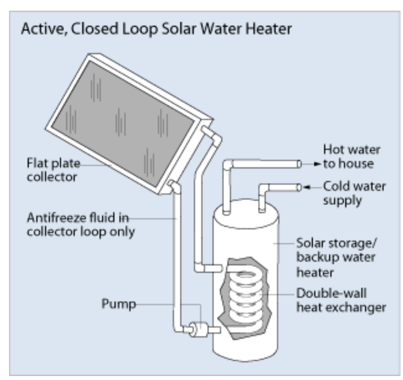
- Solar panels
- Racking / mounting
- Inverters
- Wiring, over-current protection, and electrical equipment

DC electricity from many solar panels is aggregated and, through an inverter, conditioned and synchronized with grid electricity. The differences between distributed and utility-scale solar are:

- Utility solar plants produce electric energy that is connected directly to the utility grid.
- A utility or third party, like an independent power producer, rather than an electrical consumer, owns the plant.
- The nameplate capacity of the plant is usually greater than 1 MW and more likely larger than 5 MW
- System operation and maintenance is critical to maintain cost of power.
- Transmission and distribution system modifications may be necessary depending on the size of the resource
- The plant generally occupies 5-10 acres per MW of PV capacity.

Operation and Maintenance (O&M)
Solar panels are generally warranted on their production for 25 years. The inverters are generally warranted for 10 years. The wiring and racking system is very robust and when installed correctly should last a minimum of 25 years. Though production can vary by up to 10% with periodic panel cleaning, the cost benefit or periodic cleaning has not proved beneficial. The long warranties, no moving parts (fixed, non moving arrays) and little maintenance required result in very low operation and maintenance costs. It is common to budget for inverter replacement over the life of the system (which is commonly calculated based on warranted panel time of 25 years).

Solar Hot Water
In Idaho, where temperatures generally go below freezing in winter, one preferred way to transfer the heat from a pair of 4’ X 8’ panels to the hot water system is through a “closed-loop system” which circulates a freeze-proof and food grade liquid, like propylene glycol, to a specially designed water heater tank that isolates the heat collection loop from the fresh hot water system. The roof panels are slim, insulated, flat copper panels covered with glass or another transparent glazing and framed in a box with black copper tubes running in and out to a water heater. The thin tubes heat water that is circulated in the system and the water heater tank holds water that is warmed by the closed loop that runs through it. This would be backed-up with gas or electric heating. Another way to heat the water is in a number of evacuated tubes that warm the internal liquid and transfer heat in a closed loop, similar to flat plate collectors.



Each of these systems require a backup of gas or electric water heating elements that are triggered when the water temperature hits a pre-set low temperature; this ensures that hot water will always be available. The advantage of using evacuated tubes is that they may raise the water to a higher temperature, substantially above the boiling point in many cases, and are superbly insulated because of the vacuum inside the tubes. The disadvantage is that they are fragile, expensive, and may require a cooling mechanism. Flat plate collectors can raise the water temperature to about 130 degrees above room temperature.

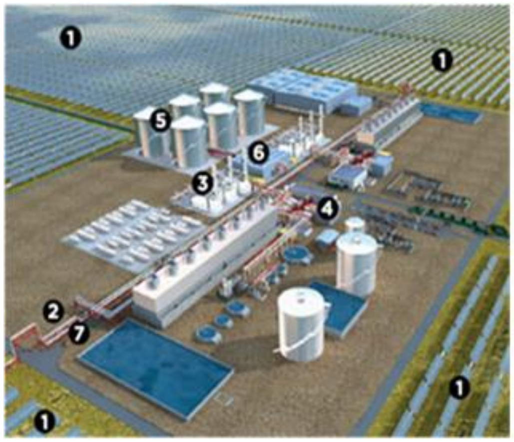
Solar panels may also directly or indirectly provide space heating. For example, two standard 4x8 foot collectors or sets of evacuated tubes may provide hot propylene glycol which provides radiant heat to the floors of buildings. Another option is for the glycol solution to give its heat to radiators in rooms of a building. By contrast, a third style of collector--this one using an air-to-air exchange--may bring in cool air by convection from the outdoors and put out warm air by being in direct contact with a heated metal sheet. A fan and thermostats may control this simple system; they can be very inexpensive and effective in smaller areas such as one or two rooms.
Each square meter in a solar hot water collector has a capacity of approximately 667 watts thermal. Two 4’x8’ solar panels are about 6 square meters. On an average summer day in Idaho there are 5 hours of full sun or five times the output of the 6 square meters or 20,000 watts/day. Multiply this by 365 days and the output of two panels is an average 7,300 kilowatt hours per year.

Concentrating Solar Power (CSP) Plants
Three major types of CSP plants - trough, power tower, and dish are described below. Other types include Linear Fresnel reflector technology and Solar Chimney technology, along with other variations.

Trough
Long rows of parabolic mirrors focus sunlight onto a suspended pipe. A heat transfer fluid or steam is heated and is circulated to either generate steam or used directly to drive a traditional steam turbine.

A parabolic trough system concentrates solar energy using long trough-shaped collectors. A parabolic trough collector consists of parabolic mirrors (also known as reflectors or concentrators), heat collection elements (HCEs), and a support structure. The HCEs are vacuum-insulated steel and glass tubes that contain a heat transfer fluid (HTF). The HCEs are located at the focal line of the mirrors, maximizing the direct normal insolation (DNI) from the sun that is concentrated onto the HCEs. The support structure is a pedestal-based mounting structure that employs a drive system to allow the collector to track the sun across the sky throughout the day.

A simplified schematic of a parabolic trough flow diagram is shown in the following figure,
The collectors are located on areas with very little slope and are arranged in parallel rows that run from north to south. These parallel rows of collectors are referred to as the solar field. With this north-to-south arrangement, single-axis tracking allows the collectors to follow the sun and maintain the reflector’s focus on the heat collection elements. After passing through the collectors in the solar field, the heated HTF flows to steam generator at a central plant, where it is cooled and returned to the solar field for re-heating. High-pressure superheated steam generated from the heat in the HTF is used to generate electricity via a conventional power cycle.



1) Single-axis parabolic mirrors heat the transfer fluid.
2) Hot fluid returns from the solar field.
3) The hot fluid transfers its heat energy to water, creating steam at 700° F.
4) Steam is used to drive a turbine, creating electricity.
5) The hot fluid also heats molten salt.
6) If the sun is not shining, the fluid can be heated by the molten salt.
7) The fluid is sent back to the solar field.

- Advantages:
  - Proven & reliable technology since the 1980s.
  - Can be hybridized (i.e. provided with natural gas-fired backup top generate steam during cloudy conditions or at night) or with thermal storage.
- Disadvantages:
  - Requires extensive piping, which creates system losses and potential maintenance issues.
  - Requires relatively flat land (i.e. a land slope of 1% or less).
  - Requires high levels of direct normal insolation

Power Tower
Mirrors (heliostats) located on the ground focus light onto a receiving point on a tower. The heat is used to create steam to drive a traditional turbine. The power tower configuration has been applied using both direct water-steam configurations and molten salt (which incorporated storage).

1) Thousands of small, flat, two-axis mirrors (called heliostats) reflect the sun’s rays onto a boiler atop the central tower.
2) Concentrated sunlight strikes the boiler’s pipes, heating the water inside to 1000°F.
3) High temperature steam is piped from the boiler to a standard turbine where electricity is generated.

In a molten-salt solar power tower, liquid salt at 290ºC (554ºF) is pumped from a ‘cold’ storage tank through the receiver where it is heated to 565ºC (1,049ºF) and then on to a ‘hot’ tank for storage. When power is needed from the plant, hot salt is pumped to a steam generating system that produces superheated steam used to drive a conventional turbine/generator system. From the steam generator, the salt is returned to the cold tank where it is stored and eventually reheated in the receiver.

Power tower energy is dispatchable since energy can be stored in the ‘hot’ tank until it is needed. Because of the storage capability, power output from the turbine generator remains constant through fluctuations in solar intensity and until all of the energy stored in the hot tank is depleted. Energy storage and dispatchability are very important for the success of solar power tower technology, and molten salt is believed to be the key to cost effective energy storage because the sun’s energy can be stored at very high temperatures.

Dish

Mirrors are arranged on a pedestal to focus sunlight onto a receiver. The heat is used to drive a Sterling or Brayton cycle engine.

A Dish Sterling engine uses heat provided from an external source (like the sun). It includes two components; the solar dish, which is simply a parabolic mirror or set of mirrors, and a Sterling engine, a closed-cycle engine that operates silently using any heat source to move pistons and make mechanical power, similar to the internal combustion engine in a car. The mechanical work, in the form of the rotation of the engine’s crankshaft, is used to drive a generator and produce electrical power. Unlike conventional photovoltaic (PV) solar cells which register at between 10% and 18% efficiency, Dish Sterling systems are capable of converting around 25% of available energy from sunlight into electricity. Dish Sterling systems are commonly called Solar Thermal Electric systems, to distinguish them from conventional solar panels. Dish-Sterling systems are mounted on motorized pedestals programmed to ensure the mirrors continue to face the sun throughout the day.[59]

1) Two-axis parabolic dish (see above right) focuses all the sunlight that strikes the dish up onto to the collector above the dish.
2) Collector is connected to a Sterling engine (see above right), which uses the thermal power generated by the focused solar energy to heat hydrogen in a closed-loop system.
3) Expanding hydrogen gas creates a pressure wave on the pistons of the Sterling engine which spins an electric motor creating electricity.

[59] http://www.wisegeek.com/what-is-a-dish-Stirling-system.htm