Montana Energy and Telecommunications Interim Committee
Net Metering Questionnaire

Renewable Energy Industry Questions

Responses submitted by:

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1. Currently, what are the installed costs for typical net-metered solar PV systems of 5 KW, 10 KW, 50 KW, 100 KW, 500 KW, 1,000 KW, and 5,000 KW?

As the solar industry has grown in recent years, the costs of solar photovoltaic (PV) systems have dropped significantly. According to the U.S. Department of Energy, "reported system prices of residential and commercial PV systems declined 6%–7% per year, on average, from 1998–2013, and by 12%–15% from 2012–2013, depending on system size."[1] Installation costs in Montana have generally followed national trends.

Current median installation costs for typical net-metered solar PV systems of different sizes are shown below. Where available, Montana data are used.

Table 1. Typical installed solar PV system costs

System size	Price per watt[2]	Installed cost, pre incentives	Installed cost, post incentives[3]
5 kW	$3.65	$18,250	$11,499
10 kW	$3.32	$33,200	$21,465
50 kW	$3.27	$163,500	$108,989
100 kW	$3.27	$327,000	$217,782
500 kW	$2.54	$1,270,000	$845,820
1,000 kW	$2.54	$2,540,000	$1,691,640
5,000 kW	$2.54	$12,700,000	$8,458,200

Table 2. Typical solar PV system costs by size range, per watt

System size range	Price per watt, Montana data[4]	Price per watt, national data[5]
0 to 5 kW	$3.65	$3.71
>5 to 10 kW	$3.32	$3.71
>10 to 50 kW	$3.27	$3.71
>50 to 100 kW	$3.27	$3.71
>100 to 500 kW	N/A	$2.54
>500 to 1,000 kW	N/A	$2.54
>1,000 to 5,000 kW	N/A	$2.54
>5,000 kW	N/A	$1.95

[1] Feldman, D. et al, 2014. "Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections, 2014 Edition." SunShot, U.S. Department of Energy. Accessed via: http://www.nrel.gov/docs/fy14osti/62558.pdf

[2] Installed cost per watt based on Montana data where available and national median installed costs shown in Table 2.

[3] Incentives included in calculations are $1,000 Montana Alternative Energy Systems income tax credit for residential scale systems (5 kW and 10 kW) and 30% federal Investment Tax Credit for all systems.

[4] Data request from Montana Alternative Energy Revolving Loan Program, Department of Environmental Quality for FY2015 net metering solar PV installations. Total number of systems in sample: 24

[5] Feldman, D. et al, 2014. "Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections, 2014 Edition." SunShot, U.S. Department of Energy. Accessed via: http://www.nrel.gov/docs/fy14osti/62558.pdf

2. If the net-metered systems in question 1 were required to have separate production meters, what would be the incremental installed cost for each project size?

Most utilities in Montana equip net metering customers with a bi-directional meter that allows the utility to monitor and bill the customer for the net kilowatt hours they use from the utility over the course of a month. The meter subtracts excess kilowatt hours generated by the customer from the total amount of energy the customer draws from the utility. A utility net meter does not report the total output of the PV array because a net metering system first provides energy to meet the customer's needs on his premises, "behind the meter". Only excess energy exported to the grid is read by the utility net meter. The system inverter, which converts direct current (DC) electricity to alternating current (AC) before it feeds into the customer's distribution panel, records the system's total production.

Metering technology that displays the real-time and cumulative production of net metering systems is widely available and offered by most Montana installation businesses to their customers. Monitoring systems allow the owner to track total production and to monitor the array for inefficiencies or potential failures. Internet-connected monitoring systems range in cost from $200 for a residential system to $1,000 for a large commercial array.

Requiring an additional revenue-grade production meter, as would be found on a commercial generating station, would add approximately $670 to the cost of a net metering system, including materials and labor.[6] The highest incremental cost impact would be on small residential systems, which would see an increase in installed cost of 3.7%.

Alternative methodologies to monitor the output of solar PV systems include advanced inverters (discussed below) and fleet-wide forecasting systems that provide day-ahead and hour-ahead solar PV output projections based on weather data and the geographic location of distributed solar PV systems.

3. Nationally, what percentage of total net metered systems fall into the size ranges in question 1 (0-5 KW, 5-10 KW, 10-50 KW, etc.)?

Complete national data for net metering systems representing the requested data is not readily available. The data in Table 3 represent all solar PV systems (net metering and utility-scale) reported to the National Renewable Energy Laboratory's Open PV Project. Other types of net

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[6] Survey of revenue meter installation costs for solar systems in New Jersey. NJ Board of Public Utilities, 2012. Accessed via: http://www.njcleanenergy.com/renewable-energy/programs/metering-requirements/production-meter-requirements-solar-projects-srecs

metering systems (wind, hydro) are not included. Notably there are many more systems in the smaller size ranges, but very high cumulative installed capacity for the larger size ranges.

Table 3. National percentages of solar PV systems (net metering and utility) by size range, number and capacity[7]

System size range	Percentage of total number of systems	Percentage of total installed capacity
0 to 5 kW	46.03%	7.52%
>5 to 10 kW	40.71%	14.05%
>10 to 50 kW	10.39%	8.67%
>50 to 100 kW	0.92%	3.18%
>100 to 500 kW	1.41%	16.22%
>500 to 1,000 kW	0.29%	9.86%
>1,000 to 5,000 kW	0.21%	17.44%
>5,000 kW	0.03%	23.05%

4. Is there a reasonable generator size threshold above which production meters should be required and payments made based on utility avoided costs? If so, identify a reasonable size threshold and describe the basis for determining it.

The generator size threshold for net metering facilities is set in Montana code for NorthWestern Energy and under a Public Service Commission-approved tariff for Montana Dakota Utilities at 50 kilowatts (kW).[8] For reference, a 50 kW solar array is large enough to generate enough electricity in a year for 7 average homes. 50 kW was chosen as a middle-of-the-pack capacity cap by Montana legislators in 1999 when the net metering law passed. Anything larger must go to the Commission for approval as a "qualifying facility" or as a utility supply resource. The avoided cost methodology used to set rates for qualifying facilities may not fully reflect the benefits of net metering systems and should be reserved for commercial qualifying facilities.

What sets net metering systems apart from commercial generators is that a net metering system is by law "intended primarily to offset part or all of the customer-generator's requirements for electricity" (MCA 69-8-103). The hallmark of net metering policies, including Montana's law, is the guarantee of a one-to-one credit for excess production. Net metering customers do not sell the energy they generate to the utility, they first supply their own needs "behind the meter" and

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[7] National Renewable Energy Laboratory. 2015. OpenPV Project. NREL is a laboratory of the U.S. Department of Energy. Total number of reported records on August 27, 2015: 420,759. Accessed via: https://openpv.nrel.gov/index.

[8] Montana Dakota Utilities, 2007. "State of Montana Electric Rate Schedule, Net Metering Service Rate 92". Montana Public Service Commission, Docket D2007.7.79. Accessed via: http://www.montana-dakota.com/docs/default-source/rates-tariffs/MTElectric92

then they are given a 1-kilowatt-hour credit on their bill for every kilowatt hour of excess energy they export to the grid (and which the utility sells to neighboring customers). The policy is simple for customers to understand, easy for utilities to account for, and a reasonably fair valuation of the benefits these customer generators provide to other utility customers.

The 50 kW cap has not proven large enough for commercial applications, a municipal parking garage and mixed-use development, military facilities or a low income housing development. In each of these cases, developers have either down-sized projects or split larger arrays, at additional cost, into multiple separately metered systems.

MREA has supported raising the net metering cap to 1 megawatt (20 times the current 50 kW cap) in order to accommodate large commercial developments, schools and government facilities within the net metering law. Thirty-seven states allow systems larger than 50 kW and 18 states allow customer generators 1 MW or larger. Several states, including Arizona and Colorado, define the capacity cap for individual projects based on the system size required to meet the owner's average annual energy usage, instead of setting a fixed cap for all systems.

In order to remain competitive in attracting and meeting the demands of businesses that wish to cover a portion or all of their electricity use with an on-site net metering system, we recommend that Montana lawmakers update the 50 kW capacity cap to, at a minimum, reflect the median of other state caps. The current median of state capacity caps, not including states that have no upper limit, no net metering statute or that use a percentage based system, is 400 kW.[9]

5. Is there a reasonable threshold or saturation point for requiring the use of smart inverters?

One of the challenges of integrating net metering systems into the grid is the variability of solar generation. However it is only at relatively high market saturation levels that the variability of output from net metered solar systems is likely to present any more of a challenge to grid operators than the existing variability caused by typical customers of a utility. Hair dryers, toasters, irrigation pumps, air conditioners, water heaters and any number of other electric appliances create constant fluctuations on the grid, similar to the variability caused by widely dispersed solar energy systems.

The installation of "smart" or "advanced" inverters may provide extra value to the utility in the form of grid reliability and support, while enabling higher saturation levels of distributed renewable energy resources. Advanced inverters have the potential to address utility concerns

[9] Based on data available at the Database for State Incentives for Renewables & Efficiency, a project of the U.S. Department of Energy and the North Carolina Clean Energy Technology Center at N.C. State University. Accessed via: http://www.dsireusa.org/.

over integration costs. The National Renewable Energy Laboratory explains advanced inverters this way:

> Advanced inverter functions allow for more elaborate monitoring and communication of the grid status, the ability to receive operation instructions from a centralized location, and the capability to make autonomous decisions to improve grid stability, support power quality, and provide ancillary services.[10]

However there are also legitimate concerns about what level of control advanced inverters would give utility grid managers over the output of privately owned solar arrays. Any degree of control or monitoring should be appropriately compensated, and alternatives to utility control of solar output, such as on-site storage systems, should be given consideration.

Montana's existing administrative rules appear to have already set a threshold at which smart inverters may be required by regulated utilities (NorthWestern Energy and Montana Dakota Utilities). In 2010 the Montana Public Service Commission adopted rules that protect regulated utilities from over-saturation with small renewable energy resources, and which provide a clear process for the review of interconnection applications for small generators. Those rules, codified in ARM 35.8.84,[11] set limits for the interconnection of small generators, including net metering systems, and establish a threshold above which the utility may monitor and control generating facilities using advanced inverters:

> [Electric distribution company] monitoring and control of a small generator facility is permitted only if the nameplate capacity rating of the small generator facility interconnecting to the [electric distribution system], or the aggregate nameplate capacity of all small generator facilities on the line section in combination with the small generator facility interconnecting to the [electric distribution system], is greater than 15% of the line section annual peak load as most recently measured at the substation or exceeds the annual minimum load of the line section.[12]

Montana utilities have not published or made available to the renewable energy industry any data indicating the aggregate nameplate capacity of line sections within their distribution system. Disclosure of that data would allow utilities, the renewable energy industry and regulators to work together in setting an appropriate timeline for the implementation of standards for advanced inverters. For reference, the aggregate nameplate capacity of all net metering systems

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[10] National Renewable Energy Laboratory, 2014. *Advanced inverter functions to support high levels of distributed solar: policy and regulatory considerations.* U.S. Department of Energy. Accessed via: http://www.nrel.gov/docs/fy15osti/62612.pdf

[11] Administrative rule subchapter 35.8.84, Small Generator Interconnection. Accessed via: http://www.mtrules.org/gateway/Subchapterhome.asp?scn=38.5.84

[12] ARM 35.8.8408(8). Accessed via: http://www.mtrules.org/gateway/RuleNo.asp?RN=38.5.8408

installed on NorthWestern's distribution system is 5.8 MW, which is about 0.33 percent of NorthWestern's 2014 utility-wide peak demand (1,740 MW).[13]

We recommend that ETIC request the Commission open a technical forum to analyze the potential impacts of policies promoting or requiring the use of advanced inverters, including in cases other than when the 15 percent small generator interconnection saturation threshold is reached. Such a forum should thoroughly assess current and projected requirements for voltage and frequency control, additional costs to consumers of advanced inverters, appropriate compensation for customer generators who provide voltage and frequency control, value to the utility and non-net metering customers of voltage and frequency control enabled by advanced inverters, policies to require or incentivize advanced inverter installations and costs of retrofitting existing installations. This forum should also investigate the implications for grid reliability of emerging distributed energy storage technologies, including electric vehicles, home battery systems and micro-grids with storage capabilities, and the role they may play in complementing the services enabled by advanced inverters.

6. Is there a reasonable generator size threshold above which distributed generators should be subject to the same resource planning and procurement processes a regulated utility uses to procure other resources? If so, identify a reasonable size threshold and describe the basis for determining it.

Pursuant to ARM 38.5.8210(2)(b),[14] utilities should perform an assessment of the "types of resources that are available and could contribute to meeting portfolio needs, including…distributed resources." Net metering systems are a type of "distributed resource," and, as such, should be included in utility resource planning processes.

The administrative rules do not indicate a generator capacity threshold at which this assessment should apply, and we support the approach that generators of *all* sizes under the statutory net metering capacity cap should be considered in utility resource planning and procurement processes. Past resource planning efforts by Montana utilities have not thoroughly considered the impacts of net metering on electric utility resource needs, likely because the electricity demand met by net metering is still relatively small. For reference, in 2014, net metering systems owned by NorthWestern Energy customers generated the equivalent of an estimated 0.1 percent of NorthWestern's total retail electricity sales. However as costs for solar generators drop and consumer interest in net metering rises, it is important for utilities to account for the aggregate capacity of net metering systems and the role those systems play in meeting customer electricity demand.

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[13] NorthWestern Energy. 2015. "At a glance Montana: an economic development fact sheet, June 2015." Accessed via: https://www.northwesternenergy.com/docs/default-source/documents/ataglance/ataglancemt.pdf.
[14] ARM 35.5.8210(2)(b). Accessed via: http://www.mtrules.org/gateway/ruleno.asp?RN=38.5.8210

To comply with the Small Generator Interconnection rules discussed above, it is imperative that Montana's regulated utilities monitor the aggregate capacity of net metering systems on individual distribution line sections. Utilities should take those loads into consideration in resource planning processes.

The matter of incorporating net metering in resource planning was addressed by the Public Service Commission in its response to NorthWestern's most recent Electricity Supply Resource Procurement Plan. The Commission noted the absence of NorthWestern's planning for net metering and commented that, "In order to adequately assess resource needs, NorthWestern's ongoing planning and procurement activities should account for net metering."[15]

The Montana Renewable Energy Association's comments on the same docket[16] were consistent with the Commission's conclusions: we believe that NorthWestern Energy, and all utilities in Montana, should account for the integration of net metering resources, regardless of generator size, as a routine component of their long term resource planning procedures.

<u>7. Identify the benefits of net metering that are shared between net metering customers and customers that do not net meter.</u>

MREA has conducted a preliminary analysis of net metering costs and benefits from the perspective of NorthWestern Energy ratepayers who do not own net metering systems. While still incomplete due to limited publicly available data, the analysis shows that net metering customers provide a net benefit to non-participating rate payers. This preliminary analysis is a snapshot of 2014 data and does not appropriately account for the lifetime ratepayer impacts of net metering systems. Our analysis relies on modeled net metering production data, as well as modeled residential and commercial customer usage data.

Table 4 summarizes the ratepayer costs and benefits. Please see Appendix A, "MREA Net Metering Value Model," to review the calculations and source data.

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[15] Montana Public Service Commission, 2015. "Commission Comments in the matter of NorthWestern Energy's December 2013 Electricity Supply Resource Procurement Plan," Docket No. N2013.12.84. Accessed via: http://psc.mt.gov/Docs/ElectronicDocuments/pdfFiles/N2013-12-84_OUT_20150526_PlanComments.pdf

[16] Montana Renewable Energy Association, 2014. "Comments of the Montana Renewable Energy Association in the matter of NorthWestern Energy's 2013 Electricity Supply Resource Procurement Plan," Docket No. N2013.12.84. Accessed via: http://psc.mt.gov/Docs/ElectronicDocuments/pdfFiles/N2013-12-84IN14030734576CM.PDF.

Table 4. Net metering ratepayer impacts, 2014

Benefits and Costs	Amount
Benefits	
Solar time of production premium [(hourly production x energy supply rate x time of use adjuster) - (hourly production x energy supply rate)]	$16,341
Avoided T&D line losses, residential customers. [Line loss rate (8.5%) x total residential production x residential retail electricity rate]	$41,380
Avoided T&D line losses, commercial customers. [Line loss rate (7.5%) x total commercial production x commercial retail electricity rate]	$16,758
Unclaimed BPA residential exchange credit. [BPA residential exchange credit rate x total residential production.]	$9,043
Avoided hazardous and criteria air pollutant control costs	*not quantified*
Excess net metering production sacrificed to utility	*not quantified*
Avoided transmission and distribution system capacity, operations and maintenance	*not quantified*
Avoided load following, regulation and frequency response	*not quantified*
Avoided power plant operations and maintenance costs	*not quantified*
Avoided fuel price hedging costs	*not quantified*
Avoided generation capacity investments or purchases	*not quantified*
Avoided renewable energy standard compliance costs	*not quantified*
Costs	
Residential solar lost T&D revenue. [(residential transmission rate + residential distribution rate) x residential solar production exported to the grid]	($59,781)
Commercial solar lost T&D revenue. [(commercial transmission rate + residential distribution rate) x commercial solar production exported to the grid]	($0.00)
Residential wind/hydro lost T&D revenue. [(residential transmission rate + residential distribution rate) x wind/hydro residential production x percent exported estimate (.75)]	($10,363)
Commercial wind/hydro lost T&D revenue [(commercial transmission rate + commercial distribution rate) x wind/hydro commercial production x percent exported estimate (.75)]	($7,266)
Integration costs. [$0.40/MWh x total production]	($2,683)
Totals	
Total ratepayer benefits	**$83,522**
Total ratepayer costs	**($80,094)**
Net ratepayer impact	**$3,428**

Solar time of production premium

Solar net metering customers generate energy that displaces energy the utility would otherwise produce or buy on the market. Our analysis measures the value of the energy based on hourly time of production over the course of a year.[17] The calculation employs a "time of use adjuster"

[17] Hourly production data derived from National Renewable Energy Laboratory's "PVWatts Calculator" using default system parameters and a Helena address for weather data. Accessed via: http://pvwatts.nrel.gov/

developed by NorthWestern Energy and approved by the Montana Public Service Commission for NorthWestern's smart grid demonstration project.[18] The time of use adjuster varies by hour and season. For example, heavy load hours such as an August afternoon when air conditioning loads are high, are assigned a time of use adjustment factor of 1.5. Light load hours such as early morning in October when electricity demand is low, are assigned an adjustment factor of 0.5. Medium load hours are assigned an adjustment factor of 0.8.

The solar time of production premium represents the difference between solar production valued at the standard energy supply rate, versus solar production valued at the energy supply rate with the time of use adjuster factored in.

Avoided line losses

By generating energy at the point of demand, net metering systems avoid energy losses due to inefficiencies in the transmission and distribution system. For residential customers the line loss rate is 8.5 percent and system wide, the average line loss rate is 7.5 percent.[19] For the purposes of our calculations we applied the residential rate to residential production and the system wide average to commercial production.

Unclaimed BPA residential exchange credits

As part of the Northwest Power Act of 1980, investor owned utilities within the service territory of BPA receive payments representing the benefits of the Federal Columbia River Power System. Those benefits are returned to residential and small farm customers in the form of a credit on customer bills.[20] Because net metering customers buy less energy from the utility, the credits that what have been ascribed to these customers are distributed to other customers in the form of a higher rate credit.

Avoided hazardous and criteria air pollutant costs

Avoided marginal compliance costs for mercury, NOx, SOx, particulates and CO_2, required due to current or imminent regulations, is a savings to all ratepayers. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

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[18] "NorthWestern Energy Residential Smart Grid Demonstration Electric Tariff," 2011. Accessed via: http://www.northwesternenergy.com/account-services/whats-included-in-your-total-bill/tariffs-and-rates/montana-tariffs-and-rates

[19] Montana Public Service Commission staff, 2012. "Electric supply and residential rates of NorthWestern Energy." Montana Public Service Commission. Page 4. Accessed via: http://psc.mt.gov/Consumers/energy/pdf/NorthWesternElectricRateGraphs.pdf

[20] Montana Public Service commission staff. 2015. "Memorandum regarding D2015.1.5 —BPA residential exchange program credit." Accessed via: http://psc.mt.gov/Docs/ElectronicDocuments/getDocumentsInfo.asp?docketId=11559&do=false

Excess net metering credits sacrificed to utility
At the end of a 12-month billing cycle a net metering customer must sacrifice to the utility the value of any remaining bill credits they've accumulated. Those bill credits represent kilowatt hours the utility received from the net metering customer and sold to a neighboring customer. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Avoided transmission and distribution system capacity, operations and maintenance
Reduced transmission and distribution demands due to energy being generated on-site may reduce required costs for construction, operation and maintenance of transmission and distribution infrastructure. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Avoided load following, regulation and frequency response
The potential for net metering systems to provide ancillary services and grid support, as discussed in Question 5, should be investigated. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Avoided power plant operations and maintenance costs
Reduced energy demand due to net metering may reduce the marginal operating and maintenance costs at utility-owned generating facilities. This benefit is not quantified in our preliminary analysis.

Avoided fuel price hedging costs
Lower demand for energy as a result of net metering, especially during peak demand hours, may allow utilities to avoid costs of hedging against the volatility of fossil fuel supply prices. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Avoided generation capacity investments or purchases
Construction, financing and/or purchase costs for new generation capacity may be avoided with increased supply from net metering systems. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Avoided renewable energy standard compliance costs
By reducing utility electricity sales, net metering reduces the amount of eligible renewable energy resources or credits a utility must purchase to comply with Montana's renewable energy standard. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Lost transmission and distribution revenue

The primary cost to ratepayers from net metering is the lost transmission and distribution revenue portion of the credits net metering customers receive on their bills. A customer generator receives a credit for every kilowatt hour of energy that he "exports" to the grid at times when he is generating more energy than he is using on-site. Exports do not include the energy that is consumed behind the meter, and which looks to the utility like the customer is simply using less energy.

We modeled exports to the grid by netting hourly solar production and hourly average customer energy usage.[21] Residential solar customers in 2014 exported approximately 1,579,377 kilowatt hours to the grid in exchange for bill credits. 64 percent of total solar production was consumed behind the meter. Our model showed that commercial solar customers, because they have much higher energy loads, used all of their energy behind the meter and exported nothing to the grid. Wind and hydro net metering facilities follow less of a predictable production model so we used a conservative estimate that 25 percent of energy from wind and hydro systems was used behind the meter and 75 percent was exported to the grid.

These cost calculations assume that the utility does not shift lost energy *supply* costs to other ratepayers because the utility is able to re-sell the energy value of exported kilowatt hours to neighboring customers or on the market, or they are able to reduce expensive peak load generation, with no net impact on other ratepayers.

Integration costs

The costs to the utility of managing a variable resource like net metering systems vary depending on the total installed generating capacity and the output of the resource. Our estimate of integration costs is based on an integration cost study performed by Idaho Power for solar resources within its service territory.[22] We are not aware of a similar study for any Montana utilities. For generating capacity of 0 to 100 MW of solar (total net metering capacity for NorthWestern Energy is 5.8 MW), Idaho Power calculated it would need to spend $0.40 per megawatt hour of production to cover integration of the variable resource. We applied that rate to the total annual output of net metering systems to arrive at the cost noted above. A utility specific integration cost should be accounted for by a full cost benefit analysis.

[21] Our model netted hourly residential and commercial production data (based on NREL's PVWatts Calculator) and residential and commercial (GS-1) load profiles respectively. The load profiles were generated by NorthWestern Energy. Accessed via: http://www.northwesternenergy.com/for-suppliers/customer-load-profiles

[22] Idaho Power, 2014. "Solar integration study report." Accessed via https://www.idahopower.com/AboutUs/PlanningForFuture/SolarStudy/default.cfm

8. Identify additional net metering benefits (employment, taxes, societal, environmental, etc.) and explain, in the industry's opinion, how best to account for those benefits.

The benefits of net metering programs in Montana extend well beyond the rate impacts seen by utility customers and far outweigh state incentives for net metering. MREA's preliminary analysis shows the net monetary value to Montana's economy from the net metering systems installed to date is more than $19,699,732.

The Legislature should account for this economic benefit by expanding Montana's net metering statute and extending the law to cover other utilities with the goals of 1) making private investments in solar more affordable and accessible to a broader base of Montana residents and businesses, 2) widening the economic development impact already demonstrated by this industry.

Our preliminary calculations use only net metering systems installed in NorthWestern Energy service territory and represent the simple accumulation of benefits, not a net present value estimate, which would be higher. Benefits for the system lifetime are not quantified but should be accounted for in a full cost benefit study of net metering.

Table 5. Net metering economic impacts for 2014 and 2000-2014

Benefits and Costs	2014	2000-2014
Benefits		
Bill savings, 2014	$597,650	--
Bill savings, 2000-2014	--	$2,673,305
Installation sales revenue, 2014	$3,538,384	--
Installation sales revenue 2000-2014	--	$29,949,178
Increased residential property value, 2014	$2,830,707	--
Increased residential property value, 2000-2014	--	$9,987,000
Value of avoided CO2 emissions, 2014	$125,337	--
Costs		
Montana income tax credits, 2014	($161,000)	--
Montana income tax credits, 2000-2014	--	($1,095,000)
USB renewable energy and R&D allocations, 2014	($1,427,821)	
USB allocations, renewable energy and R&D, 1999-2014	--	($19,141,446)
Totals		
Total benefits	**$6,494,428**	**$39,936,178**
Total costs	**($1,588,821)**	**($20,236,446)**
Net economic impact	**$4,905,607**	**$19,699,732**

Bill Savings

Savings on electrical bills is one of the primary factors driving sales of net metering systems. Bill savings were calculated using an estimate of annual production from net metering systems, multiplied by average annual electricity prices for residential[23] and commercial[24] customers. The additional economic impact of returning these bill savings to the Montana economy is not accounted for in this analysis but should not be ignored by the Legislature. Future bill savings, already guaranteed by current net metering systems, should also be included in a full analysis of benefits.

Installation Sales Revenue

Solar installation business revenue figures are not publicly available, however the gross revenue from sales of net metering solar systems can be estimated by multiplying the average installed cost[25] by total installations each year. This business revenue enters the Montana economy in the form of wages, equipment purchases, office rentals, building permits, corporate and payroll taxes, etc. Given the broader variability in system types and installation costs for wind generators, we have not been able to estimate the installation revenue from that market sector. The additional economic impact of wind energy systems should also be taken into account by the full analysis of benefits.

A survey of renewable energy installation businesses conducted by MREA in December 2014 identified at least 92 full time jobs and 71 part time or seasonal jobs in the industry. [26] The median salary for full time positions was $40,000-49,000. The median wage for part time employees was $20-29/hour. The respondents hired a total of 284 subcontractors each year, including electricians, roofers, engineers, architects, excavators and concrete contractors.

Increased property market value

Recent research published by the U.S. Department of Energy shows that the resale price of a home with solar PV increases by approximately $3 per watt of installed capacity.[27] For example, a 5 kW solar PV system would increase the sale price of the home by $15,000. Residential solar PV installations in Montana total 3,329 kW, which translates to increased home values of $9,987,000. The methodology for valuing small wind generators or solar arrays on commercial

[23] Average annual residential electricity rates were provided by Montana Public Service Commission staff, August 2015.

[24] Average annual commercial electricity rates derived from U.S. Energy Information Administration. Accessed via: http://www.eia.gov/electricity/data.cfm

[25] Feldman, D. et al, 2014, "Photovoltaic System Pricing Trends: Historical, Recent, and Near-Term Projections, 2014 Edition." SunShot, U.S. Department of Energy. Accessed via: http://www.nrel.gov/docs/fy14osti/62558.pdf

[26] Montana Renewable Energy Association, 2014. Survey of renewable energy businesses. 49 respondents, 49% response rate.

[27] Hoen, Ben and Ryan Wiser, Lawrence Berkeley National Laboratory, 2015. "Selling into the sun: price premium analysis of a multi-state dataset of solar homes." U.S. Department of Energy. Accessed via: http://emp.lbl.gov/publications/selling-sun-price-premium.

properties is less well established but the increased market value from those sectors should not be ignored by a complete analysis of net metering benefits.

Avoided societal costs of greenhouse gas emissions

Energy prices do not fully account for the societal impacts of carbon emissions from energy generation on Montana agriculture, public health, fisheries and wildfire severity. The Northwest Power and Conservation Council, the regional energy planning agency covering the Columbia River basin including western Montana, applies a "social cost of carbon" to their energy resource modelling to account for these costs. The Council's 20-year power planning process currently underway utilizes a range of values for avoided carbon dioxide emissions, developed by the Interagency Working Group on Social Costs of Carbon, ranging from $12 per metric ton to $117 per metric ton.[28] Our analysis used the low-mid range value, $40 per metric ton. The fleet-wide carbon dioxide emissions intensity for NorthWestern Energy, after including their recent purchase of hydroelectric dams, is 1030 pounds per megawatt hour.[29] Our calculations do not reflect the avoided emissions over the lifetime of each net metering system and the escalating value of those avoided emissions to Montana's economy. This benefit should be accounted for by a full cost benefit study.

Increased tax revenue

As noted above, the installation of net metering systems increases the property value of private homes and businesses. A subsequent increase in property tax revenue for the State of Montana should be expected, but according to Montana Department of Revenue staff, property tax revenue from net metering systems is not currently accounted for.

Two property tax exemptions applicable to net metering systems limit but do not negate new tax revenue received by the state. Montana's property tax code exempts small electrical generators under 1 megawatt in size for a period of 5 years (MCA 15-6-225). Alternatively, the owner of a residential system may claim an exemption for up to $20,000 of the appraised value for ten years or the owner of a commercial system could claim an exemption for up to $100,000 of the appraised value for ten years (MCA 15-6-224). The useful life of most solar PV systems is more than 25 years, meaning that these investments will generate property tax revenue for more than half of their installed life. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

[28] Interagency Working Group on Social Cost of Carbon, 2015. "Technical support document: Technical update of the social cost of carbon for regulatory impact analysis under Executive Order 12866." July 2015 revision. Accessed via: http://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

[29] NorthWestern Energy, 2014. "Appendix A--Comments on the Proposed Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units", page A-4. Accessed via: http://northwesternenergy.com/docs/default-source/documents/2014-south-dakota-electric-integrated-resource-plan/AppendixA.pdf

Corporate income tax payments by solar installation businesses are not public but should not be ignored as an additional benefit to the State of Montana's net metering policy. Further investigation by the Department of Revenue may be necessary to identify this value. This benefit is not quantified in our preliminary analysis but should be accounted for by a full cost benefit study.

Income tax credits

An individual income tax credit of $500 (up to $1,000 for a couple filing jointly) is available to homeowners who purchase a net metering system (MCA 15-32-201). Because the tax credit is also available for purchases of solar heating systems, low-emission wood stoves and off-grid systems, it is difficult to know how much of the expenditures for the Alternative Energy Systems Tax Credit reported by the Department of Revenue is attributable to net metering systems. For the purposes of our calculations we estimated that every owner of a net metering system claimed the full $1,000. It is likely that our estimate is high. Montana installation businesses consistently point to the tax credit as a useful incentive that leverages private investments in energy saving technologies. A full cost benefit study should identify the actual historical tax credit expenditures.

Universal System Benefits expenditures

Universal System Benefits (USB) funding has historically played a significant role in leveraging private investments in net metering systems, but as the market matures, that role is diminishing. The USB charge on NorthWestern Energy customer bills was established in 1999 following deregulation to provide funding for low income energy assistance, energy efficiency measures and customer-owned renewable energy projects. USB renewable energy funding is further divided into educational expenditures, safety and technical training for NorthWestern Energy-qualified installation businesses, and incentive grants for renewable energy systems. Annual USB allocation levels are reported to the Department of Revenue by NorthWestern Energy.[30]

Consistent with MREA's recommendations, NorthWestern has gradually reduced the USB funding level for residential systems and increased the matching requirement for commercial projects. The percentage of net metering systems funded by USB grants has dropped from 88% in 2000 to 47% in 2014, however USB funding continues to play an important role in supporting the construction of systems on local government facilities, non-profit organizations, fire stations and schools. Following the passage of Senate Bill 150 by the 2015 Montana Legislature, which directed NorthWestern to allocate 50 percent of its USB collection to low income purposes,

[30] NorthWestern Energy. 2015. "NorthWestern Energy Universal System Benefits Activities, 2014 Report." Accessed via: http://leg.mt.gov/content/Committees/Interim/2015-2016/Energy-and-Telecommunications/Meetings/June-2015/NWE%20Report.pdf.

NorthWestern has proposed to the PSC that annual USB funding for renewable energy purposes be reduced by more than 44 percent.[31]

9. Identify one or more methods for quantifying the benefits of net metering. In your opinion, what are the advantages and disadvantages of each method?

The benefits of net metering may be quantified using a variety of methods that represent the varied perspectives of interested stakeholders (net metering customers, utilities, non-participating rate payers, Montana residents and businesses as a whole.) The Interstate Renewable Energy Council (IREC) provides a useful framework for conducting a detailed solar value analysis: "A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation" This resource takes into account the methodology of more than a dozen previous studies that have assigned values solar resources and net metering.[32] A thorough analysis of the benefits and costs of net metering should combine a rate payer impact measure and societal cost test.

A ratepayer impact measure accounts for the costs and benefits of net metering as they affect the utility bills of non-participating rate payers. This is an important consideration for policy makers and has been the basis of much of the Legislature's debate of Montana's net metering policy. The shortcoming of this approach is that it does not account for the broader economic costs and benefits of net metering that should inform any policy decisions related to net metering. The societal cost test incorporates economic impacts on citizens and businesses affected by utility resource planning or energy policies (in this case, net metering policies). Montana's net metering statute includes legislative findings that state, "it is in the public interest to promote net metering" (MCA 69-8-601), which suggests the importance of employing a societal cost test. In combination, these two methodologies provide the perspective policy makers need to evaluate net metering.

IREC's "Regulator's Guidebook" provides a detailed explanation of *how* and *why* to account for each potential benefit and cost of net metering. The guide would be a useful framework for further consideration of net metering by the Legislature.

[31] NorthWestern Energy. 2015. "NorthWestern Energy Revised Electric USB Allocations Post SB 150." Docket No. D2015.7.58, Montana Public Service Commission. Accessed via: http://psc.mt.gov/Docs/ElectronicDocuments/pdfFiles/D2015-7-58_IN_20150717_NWEUSB.pdf

[32] Jason Keyes and Karl Rabago, 2013. "A regulator's guidebook: calculating the benefits and costs of distributed solar generation." Interstate Renewable Energy Council. Accessed via: http://www.irecusa.org/a-regulators-guidebook-calculating-the-benefits-and-costs-of-distributed-solar-generation/

10. In your opinion, is all or part of the utility or cooperative revenue impact or customer bill impact of net metering a subsidy? If so, describe the basis for determining that the impact is a subsidy.

Based on our initial analysis it is clear that the economic benefits of net metering far outweigh the revenue impact of net metering. We do not consider the revenue impact of net metering for NorthWestern Energy customers to be a subsidy. We found the ratepayer benefits to slightly exceed the costs, however both the costs and benefits are negligible and essentially show no ratepayer impact.

Due to insufficient data and resources, we have not completed a similar analysis for Montana Dakota Utilities or each of the state's rural electric cooperatives.

It is important to note that cost shifts are inherent throughout utility ratemaking and are accepted as a matter of public policy. For example, rural customers cost a utility more to serve than urban customers. Rural customers live farther apart and farther from substations, resulting in increased distribution line losses and increased service costs (more poles and wire per customer, more miles for service trucks to drive, more hours for service personnel). The extra costs of serving rural customers are not reflected in different electric rates. Rather, they are shifted to urban customers, or customers living closer to utility substations.

Another example of a cost shift built into utility rates is the difference in cost to serve an efficient customer (for example a residential customer using 500 kWh per month) versus a high energy user (a residential customer using 2,000 kWh per month). While the heavy energy user pays more per month than the light energy user, the proportional difference is not reflective of the actual cost of serving each of these customers. That's because a heavy energy user drives up the utility's incremental energy supply and distribution infrastructure costs at peak hours more than the efficient customer. Those incremental costs are not reflected in the flat volumetric rate that most utilities charge per kilowatt hour. Flathead Electric Cooperative is one exception to that rule in Montana: they charge higher volumetric rates for larger energy users, [33] a rate structure called "inclining block" rates.

The practical fact of these cost shifts in utility rate making, which could be construed as subsidies, and their broader policy and economic development impacts, should be taken into careful consideration before the Legislature alters Montana's net metering policy.

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[33] Flathead Electric Cooperative's inclining block rates for residential members can be accessed here: http://www.flatheadelectric.com/rates/rates.html

11. What are the pros and cons of extending Montana's net metering policy to apply to rural electric cooperatives and all regulated utilities? Is it appropriate to treat rural electric cooperatives and certain regulated utilities differently in relation to net metering requirements under specific circumstances in Montana? If yes, explain.

The inconsistency of net metering policies and programs across Montana creates confusion for consumers and puts extra administrative burden on installation businesses tasked with wading through a different net metering policy for every utility service territory they work within. Extending Montana's net metering statute to all rural electric cooperatives and regulated utilities would give every Montanan the same opportunity to invest in a private energy system and would guarantee a fair credit for the excess energy they generate.

A standardized policy for all utilities, modelled after Montana's existing statute, would allow for utilities to individually examine whether net metering creates a cost shift to other customers that should be corrected with additional charges. At the very least, utilities within the same class (regulated utilities, rural electric cooperatives) should be treated consistently.