

1 **Q. Please state your name, business address and present position with PacifiCorp,**  
2 **dba Rocky Mountain Power (“the Company”).**

3 A. My name is Douglas L. Marx. My business address is 1407 West North Temple,  
4 Salt Lake City, UT 84095. I am the director of Engineering Standards and Technical  
5 Services for Rocky Mountain Power (“RMP”).

6 **Qualifications**

7 **Q. Briefly describe your educational and professional background.**

8 A. I have worked for the Company for 35 years in various engineering, operations and  
9 management positions. I hold a bachelor’s degree in electrical engineering from the  
10 University of Utah and a master’s degree in business administration from Utah  
11 State University. I am a licensed professional engineer in the state of Utah.

12 **Q. Please describe your present duties.**

13 A. I oversee all non-routine technical studies including distributed generation, power  
14 quality and smart grid reports. I am responsible for the development of all material  
15 and equipment specifications and standards used in the construction and  
16 maintenance of the transmission and distribution systems.

17 **Purpose and Summary of Testimony**

18 **Q. What is the purpose of your testimony in this proceeding?**

19 A. In support of the Company's need to ensure adequate cost recovery from residential  
20 customers with private generation, I present the operational issues associated with  
21 private customer generation, specifically rooftop solar, and the system changes that  
22 will be required with increasing levels of distributed generation on the electrical

23 distribution system. In addition, I explain the process and costs incurred in  
24 reviewing interconnection requests for net metering applications in support of the  
25 proposed changes to the application fees.

26 **Q. Please summarize your testimony.**

27 A. My testimony demonstrates that rooftop solar generation does not reduce the peak  
28 demand on the distribution system to a degree that could warrant a reduction in  
29 infrastructure. Instead, rooftop solar may actually increase the requirements for  
30 infrastructure at the local level. Further, residential net metering customers use the  
31 electric grid at a level higher than other residential customers. The total amount of  
32 energy transferred to and from the electric grid by net metering customers can  
33 exceed the amount of energy delivered to other customers by a significant amount.  
34 In addition, the Company incurs additional costs associated with applications for  
35 rooftop solar generation and their interconnection.

### 36 **System Impacts**

37 **Q. Please describe the studies you have done on neighborhood rooftop solar.**

38 A. In 2014 in Docket No. 13-035-184 ("2014 GRC"), I presented the results of a  
39 neighborhood rooftop solar study for the area served by the Northeast #16 circuit.  
40 This study evaluated the viability of rooftop solar to offset utility infrastructure  
41 upgrades by modeling high efficiency solar panels on every viable roof space on  
42 the circuit. The study showed that, under a best case scenario, solar generation

43 offsets only seven percent of the peak demand on the circuit, which means that the  
44 utility still needed to provide 93 percent of customers' demand.<sup>1</sup>

45 In response to questions raised about the relevance of the findings of the  
46 Northeast #16 study to other locations within the Salt Lake valley, the Company  
47 initiated a new study in 2015. We selected the Bingham #11 circuit located in the  
48 southwest quadrant of the valley in South Jordan, Utah. A copy of the study report  
49 is attached as Exhibit RMP\_\_ (DLM-1). This study shows that the effects of rooftop  
50 solar reduced the peak circuit loading by only 3.6 percent. Due to this small  
51 reduction, and considering the interaction between variable customer load and  
52 variations in solar production due to cloud cover and other interference, our  
53 distribution planning guidelines will continue to be based on peak load  
54 requirements without including solar generation reductions.

55 **Q. Can increased levels of rooftop solar generation reduce the size of local**  
56 **distribution infrastructure?**

57 A. No. As the studies show, increasing levels of rooftop solar can actually force the  
58 Company to increase the local distribution system including distribution  
59 transformers, secondary cables and service conductors to handle the excess  
60 generation. If customers install the level of rooftop solar required to offset their  
61 annual electric energy usage, also known as net zero-electric energy customers, the  
62 Company will need to increase the size of the local distribution system to handle  
63 the reverse energy flow delivered to the grid by the customers.

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<sup>1</sup> See Docket No. 13-035-184, Rebuttal Testimony of Douglas L. Marx (June 2014).

64           The peak output for the rooftop solar systems in Utah will occur during the  
65           spring months, typically April or May. This is the time of year the solar insolation  
66           is approaching its peak level for the year, and the ambient temperatures are  
67           relatively moderate. This combination allows the solar system to maximize its  
68           output. As the temperatures increase through June and July, the output will actually  
69           decrease. This decrease occurs at the same time a residential customer's load is  
70           reaching its peak demand, typically July. The peak demand typically occurs in the  
71           evening when the rooftop solar system's output is near its lowest point of  
72           production for the day.

73           To handle the higher level of energy flow experienced in the spring months,  
74           the local distribution system must be sized to accommodate the greater of the two  
75           values. Consequently, the system may be sized up to 30 percent greater than normal.  
76           In a few cases, the reverse power flow could approach 50 percent more as compared  
77           to the customers' peak load demand.

78           If a customer installs the level of rooftop solar required to offset all of their  
79           energy usage, including conversion of their gas appliances and gasoline vehicles to  
80           electric, the magnitude of exported energy demand can be much greater and the  
81           reverse flow effect becomes even more dramatic.

82   **Q.   Is the distribution system capable of handling increasing levels of distributed**  
83   **generation without any modification?**

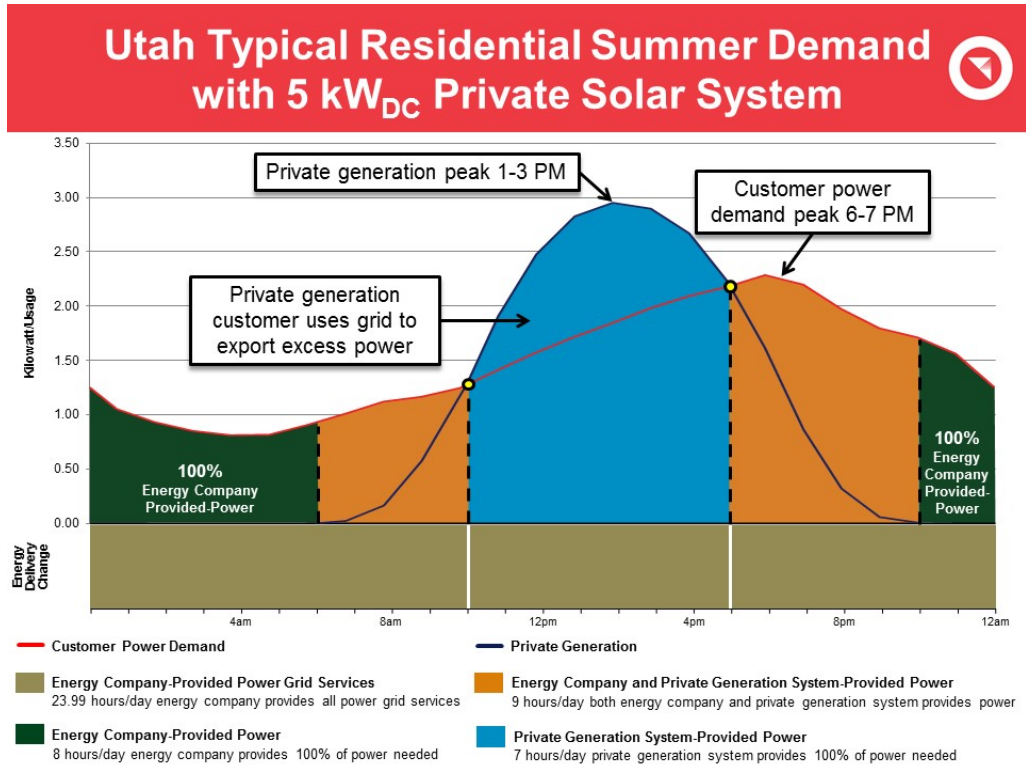
84   A.   No. In addition to the local distribution system, increasing levels of distributed  
85   generation will require several changes. Advanced metering to monitor the system,

86 updates in regulator, relay and recloser controls to account for two-way power  
87 flows and protect the system, increased levels of voltage management equipment  
88 and dead-line checking systems will be required. Retrofitting these systems can  
89 range in price from a few thousand dollars per device to several hundred thousand  
90 per substation for updated protection schemes. Most of these increased costs were  
91 discussed in my rebuttal testimony filed in the 2014 GRC.

92 **Q. Please explain how a net metering customer uses the electric grid as**  
93 **compared to other customers.**

94 A. Figure 1 below illustrates the power flow between the electric grid and a net  
95 metering customer. The figure demonstrates that the net metering customer utilizes  
96 the grid 24 hours per day except for two instantaneous points, shown by the small  
97 circles, when the direction of current flow changes from energy delivered to energy  
98 received. What the figure does not do is quantify the absolute level of grid  
99 utilization by the customer.

Figure 1



101 I have already explained that a net metering customer’s peak utilization of  
 102 the local distribution system occurs during the spring months and can be much  
 103 higher than their summer peak load demand. This effect necessitates an increase in  
 104 size of the local distribution facilities in order to accommodate the peak output for  
 105 the solar facility. To illustrate the magnitude of grid utilization, one must calculate  
 106 the absolute value of the energy flow between the customer and the electric grid.  
 107 The absolute value is the sum of energy at the point of interconnection irrespective  
 108 of the direction of flow. This is the level of energy that the Company must manage  
 109 on each customer’s behalf.

110 The average Utah residential customer consumes approximately 8,601  
 111 kilowatt-hours of energy annually. The absolute value of the energy flow for the

112 electric net-zero energy customer used in this example is 11,558 kWh. This equates  
113 to a 134 percent higher level of energy managed on their behalf than for other  
114 customers. If customers install rooftop solar at a level to offset all of their energy  
115 usage on a net basis, including gas appliances and vehicles, the level of managed  
116 energy increases even more dramatically.

117 **Proposed Application Fee**

118 **Q. Please explain the costs associated with processing net metering applications.**

119 A. There are two cost categories associated with net metering applications: application  
120 processing and interconnection. Four departments are involved with the review and  
121 processing of net metering applications: customer call center, customer generation,  
122 and engineering and operations. The costs associated with each department are  
123 discussed below.

124 The customer call center incurs costs associated with creating work  
125 requests, handling customer information calls, processing net meter exchanges and  
126 production meter installs within the customer service system, handling suspended  
127 statements and reviewing related reports.

128 The customer generation department incurs costs related to application  
129 processing, database entry, billing, tracking, mapping and other regulatory  
130 reporting requirements. With the increase in applications, the need to automate the  
131 application process and receive payments must be part of the solution. These costs  
132 are incurred whether the customer's generation system is ultimately connected or  
133 not.

134                   Once the application is accepted and entered, each application is reviewed  
135                   by engineering to determine if the interconnection will create operational issues.  
136                   These issues are typically limited to equipment and component overload or voltage  
137                   and reliability problems. If the engineering review shows that system issues will  
138                   occur, in accordance with applicable Commission rules, the customer must pay for  
139                   the necessary corrections before her application is approved and before we will  
140                   interconnect the generation system.

141                   After the net metering application has been approved and the rooftop solar  
142                   installation is completed, there are further costs associated with completing the  
143                   interconnection and setting up the correct configurations within our Customer  
144                   Service System ("CSS") for the net metering customer.

145                   The operations department is responsible for completing the interconnect  
146                   process with an inspection and installation of the net meter as well as constructing  
147                   any required system modifications. If any issues are noted during the inspection,  
148                   the installation of the net meter is postponed until all noted deficiencies have been  
149                   corrected. After the meter exchange is completed at the customer's premise, the  
150                   customer service group creates a virtual meter in CSS to reflect the measured  
151                   delivered energy to the grid from the customer's solar panels. The operations  
152                   department then reviews the CSS system to validate the exchange, and verifies  
153                   billing determinants are accurate to ensure a correct bill is presented.



154 **Q. Are there differences in processing net metering applications under Levels 1,**  
155 **2, and 3?**

156 A. Yes. The key difference is the time that may be required by the engineering  
157 department to review the application for operational issues. Level 1 is defined as  
158 distributed energy systems of 25 kilowatts or smaller that operate with an inverter.  
159 These are the systems most commonly used in residential and small commercial  
160 applications. For Level 1 applications, the distribution system components  
161 generally reviewed are the service conductor, secondary cables and the distribution  
162 transformer and, in some circumstances, the distribution feeder and protection  
163 schemes. Level 2 is defined as systems 2 megawatts or less that don't otherwise  
164 qualify for Level 1. Level 3 is defined as systems 20 megawatts or less that don't  
165 otherwise qualify for Level 1 or 2.

166 The time required to review each application varies by complexity and  
167 location. While Level 1 interconnections are typically less complex to review, the  
168 majority of time spent by the engineering department is spent on Level 1 due to the  
169 volume of applications. Approximately eighty percent of applications reviewed are  
170 satisfied at Level 1.

171 The customer call center and customer generation group costs are similar to  
172 Level 1 for Level 2 and Level 3 applications. The engineering time for these higher  
173 level reviews are significant. These reviews can be as simple as a grounding review  
174 but can evolve into full system impact studies and require anywhere from two times  
175 up to and sometimes greater than eight times to review as a Level 1.

176                   Level 2 reviews can be completed with a fairly simple engineering analysis  
177                   and usually without using complex electrical models. The existing generation  
178                   levels, along with the proposed new generation, are compared to several limits  
179                   including circuit peak load, daytime light load, fault current at the point of  
180                   interconnection as well as existing circuit protection schemes. A review of the  
181                   grounding and protection requirements is also completed at this time. If any limits  
182                   are exceeded, the application fails the analysis and referred to a Level 3 review.

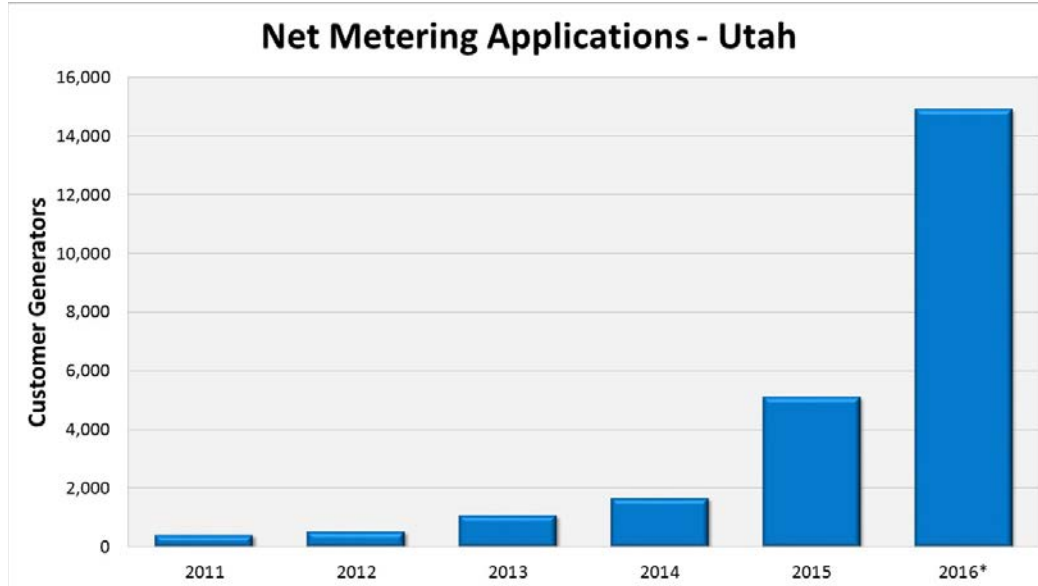
183                   A Level 3 review expands upon the Level 2 analysis by including those  
184                   results in complex engineering models that provide a detailed analysis of the  
185                   interaction of the proposed generation with the electric system and with other  
186                   generation points currently operating on the circuit. Load flow, short circuit, and  
187                   protection scheme analysis studies are typical, and may require project  
188                   management to develop and scope the solution before the application is approved.

189                   Once approved and accepted by the customer, the operations department  
190                   will complete the interconnect process as noted above, including constructing any  
191                   required system modifications.

192   **Q.    Are net metering applications increasing?**

193   A.    Yes. The volume of applications throughout Rocky Mountain Power has increased  
194           exponentially since 2011. Most of this increase is in the Utah service territory. The  
195           following Figure 2 shows the actual number of new customer generators by year  
196           through 2015 and the forecasted level for 2016.

Figure 2



198 **Q. What is the impact of this increase on the Company?**

199 **A.** Due to the current level of applications, we have begun investigating ways to  
200 automate the application process in order to both manage the volume to meet our  
201 customers' expectations and to reduce the overall costs associated with processing  
202 these applications.

203 In addition, as the number of installations increase, the impact to the  
204 distribution system will increase and drive the required upgrades and modifications  
205 discussed earlier in my testimony. This includes protection and control systems,  
206 voltage regulations, transformer upgrades, etc. A change to operating equipment  
207 standards will be required to make them fully functional when two-way energy  
208 flows become more common.

209 **Q. Are you aware of other states that have application fees for Level 1?**

210 A. Yes. Net metering application fees are not new to the industry. For example, the  
211 state of California provides for the collection of application fees for solar  
212 installations. Fees up to \$150 per Level 1 application to cover administration and  
213 engineering expenses have been reported. In the state of Washington, Pacific Power  
214 collects \$100 from each applicant installing a system rated less than 25 kilowatts  
215 and \$500 for systems rated from 25 to 100 kilowatts.

216 **Conclusion**

217 **Q. Please summarize your testimony.**

218 A. Rooftop solar generation does not reduce the distribution peak demand experienced  
219 by the electric grid to a degree that could warrant a reduction in infrastructure and  
220 could actually increase the base requirements for infrastructure at the local level.  
221 Furthermore, the total amount of energy transferred to and from the electric grid by  
222 residential net metering customers exceeds that of other customers by a significant  
223 amount. This is energy that must be stored, accounted for and managed by the  
224 Company on the customer's behalf. In addition, the Company incurs significant  
225 costs associated with applications for rooftop solar generation and their  
226 interconnection.

227 **Q. Does this conclude your direct testimony?**

228 A. Yes.