Feasibility Study

City of Oakridge

Willamette Activity Center

April 8, 2024

Executive Summary

The Willamette Activity Center is a suitable location for a rooftop 125 kW solar and battery system. Together with a generator, the system would create a single-building microgrid, allowing the building to continue to have power during a grid outage. The system would be allowed by the local electric utility, and reduce the building's electric bill, but there are still questions to be resolved about the building's structural capacity to support the solar panels. There are several potential sources of funding for the system, including the Oregon Department of Energy and the U.S. government.

Introduction

The City of Oakridge is planning on remodeling and upgrading its Willamette Activity Center to allow it to serve as a community center, house a community health center, and function as an Emergency Operations Center (EOC) in the event of a wildfire or other natural disaster.

Figure A Willamette Activity Center

This Feasibility Study looks at the potential for the building to generate and store some of its own power, allowing it to have power during natural disasters when the utility grid is down, and reducing the City's electric bills.

Building Usage

The appropriate size of a solar and battery system for a building depends on three factors:

- How much electricity is needed to run the building
- How much roof space is available
- The amount of funding available

Calculating the amount of solar needed to power an existing building is typically done by looking at how much power it has used in the past. In the case of the WAC, that is complicated by the changes to the building and potentially by changes to how the building may be used. The building currently has old-fashioned florescent lighting. Upgrading that with energy-efficient LED fixtures will reduce the amount of electricity needed. However, replacing the current electric baseboard heating with heat pumps may add to the electric load. While heat pumps are highly efficient, they also provide cooling in the summer as well as heat in the winter, so their total usage would probably be higher than the baseboard heating. The net result would probably be that the amount of electricity used stays roughly the same as in the past.

In 2019, before the building was closed, the building used about 167,000 kWh of electricity, as shown in Figure B.

January	21,075
February	21,680
March	19,673
April	18,556
May	12,983
June	9,552
July	8,790
August	8,938
September	9,202
October	9,038
November	12,989
December	14,924
12 Month Total	**167,400**

Solar Size and Net Metering

According to the U.S. Dept. of Energy's PVWatts solar estimating tool, each 1,000 Watts, or one kilowatt (kW) of solar in the Oakridge area will produce about 1,200 kWh of electricity over the course of a year.

To generate 167,400 kWh of electricity, therefore, would require about 140 kW of solar panels.

Solar panels will produce more power during the summer than in the winter. The Net Metering policy of the local electric utility, Lane Electric Cooperative, allows credits for the solar electricity from the peak summer months to be carried forward to offset electric bills in the fall and winter. The Net Metering Year resets annually at the end of March.

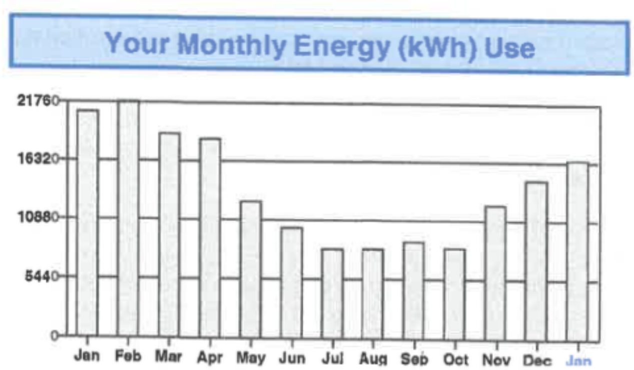

Figure B. 2019 electric usage at the WAC.

However, if the credits for a given year are not used up by April, Lane Electric caps the credit that can be refunded to the customer at $600. It's important therefore to size the solar system so it doesn't over-produce over the course of a year.

To avoid over-producing, we recommend installing about 90% of the maximum, making the solar array about 125 kW in size.

Lane Electric Co-op's net metering policy limits solar systems to 25 kW. However, in a Feb. 8, 2024 call, Lane Electric General Manager Debi Wilson authorized increasing the limit for the WAC. A later call with a Lane Electric engineer, Tara Davis, indicated that the Lane Electric grid in that area could support a larger solar system on the WAC. Increasing the amount of solar would require upgrading the Lane Electric transformer for the building. A transformer which could handle up to 150 kW of solar would cost about $10,000. The WAC shares the transformer with three nearby residences, so a solar array would need to be slightly smaller than the maximum capacity of the transformer.

Roof Capacity, Structure and Solar Placement

The WAC's roof is flat and generally open, and the building is oriented on a north-south axis, making it well-suited for solar panels. A design for a 125 kW solar system is shown in Figure C[1] and detailed in Figure D. The design should be considered preliminary, because of the potential changes to the roof discussed below, but there appears to be sufficient room for the solar panels.

Figure C 125 kW Solar rooftop design

There are two other key factors that must be considered in addition to having enough space for the solar panels: the roof's age, and its structural capacity, or whether it can handle the additional weight of the solar system, including snow and wind loads.

The age of the WAC's roof is not an issue, since the building will receive a new roof as part of the upgrades. Putting solar on a new roof is ideal, because solar panels today are warrantied for 25 years or longer, and while it's possible to take them off temporarily to replace the roof, it's expensive and best avoided if possible.

The structural capacity of the WAC's roof is complicated. The building was built before Oregon's

[1] Generated using Folsom Labs HelioScope software.

structural codes were implemented and different sections have different structural designs. For example, the solar panels are laid out in rows running east-west, with the solar panels facing south, but the roof beams in a number of the classrooms run north-south, making it harder to use them for mounting the solar racking.

Roof Section	Location	# of Modules	Solar kW
1	NW	48	27
2	SE	75	42
3	SW	48	27
4	W	18	10
5	W	33	19
Total			**125**

Figure D Size of solar sections

The building remodel will likely also make changes to the roof, which will affect its weight in different areas. Wilson architecture has suggested removing some of the existing structures on the roof, such as the one shown in Figure E, and the switch to heat pumps may add rooftop HVAC units. As a result, the racking approach for the solar in each of the sections will probably need to be determined individually, and the structural evaluation will probably need to be conducted on ongoing basis over the next couple of months, as the roof plan evolves.

There are solutions to challenges like those posed by roof beams oriented the wrong way. It may be possible to add either a layer of plywood sheathing, or a separate solar racking support structure, supported by load-bearing walls, to sections of the roof.

Figure E. “Penthouse” roof structure

Solar Production

The amount of electricity produced by solar panels is a function of many factors, including shading, azimuth (compass orientation to the sun), tilt or angle, and efficiency of the solar panels. It is measured in kilowatt hours (kWh) per kilowatt of solar (kW), and our estimates, as shown in Figure F, are that the solar will generate around 150,480 kWh in the first year[2]. Solar panels’ efficiency decreases slightly each year from light-induced degradation, with most panel

[2] Generated using U.S. Dept. of Energy’s PVWatt’s model..

manufacturers offering performance guarantees that their panels will produce 80% of the original amount after 25 years.

Solar kW	kWh/kW	Annual Generation (kWh)
125	1,200	150,480

Figure F. Solar Generation

Energy Resilience / Backup Power

One of the City of Oakridge and Lane County's goals for the building is to make it usable in the event of natural disasters, including using part of the building as an Emergency Operations Center (EOC) and shelter for area residents. The area in purple in Figure G is where the EOC would be located, the gym / theatre area, in green, is the proposed shelter location.

Figure G, WAC EOC & Shelter areas

Solar and batteries, combined with a fossil-fuel generator, can create a single-building microgrid (Figure H), allowing part of the building to be usable when the utility grid is down. The different technologies complement each other: the generator can provide power year-round, as long as fuel is available, and can run overnight. The solar and batteries can provide power during the day and evening, reducing the generator's run times to the night hours, allowing it to run much longer between refueling. And when it's not possible to refuel the generator, for example after a Cascadia Event earthquake, the solar and batteries can continue to provide power indefinitely, although likely at a reduced level depending on the time of the year and weather.

Installing enough batteries to power the whole building is expensive, so we recommend using the batteries to feed the EOC and shelter areas. The generator would also be connected to this section of the building. It is difficult to calculate the amount of power needed for just part of the building, but we estimate that it would be about ¼ of the total building's usage. The whole building used 167,000 kWh in 2019, or an average of around 450 kWh / day. One quarter of that is about 115 kWh.

Oversizing the batteries is better than undersizing them, both because they generally won't operate at peak rating and because that will allow them to store more energy during the seasons when solar production is lower. We provide a cost estimate below for a 120 kWh battery system.

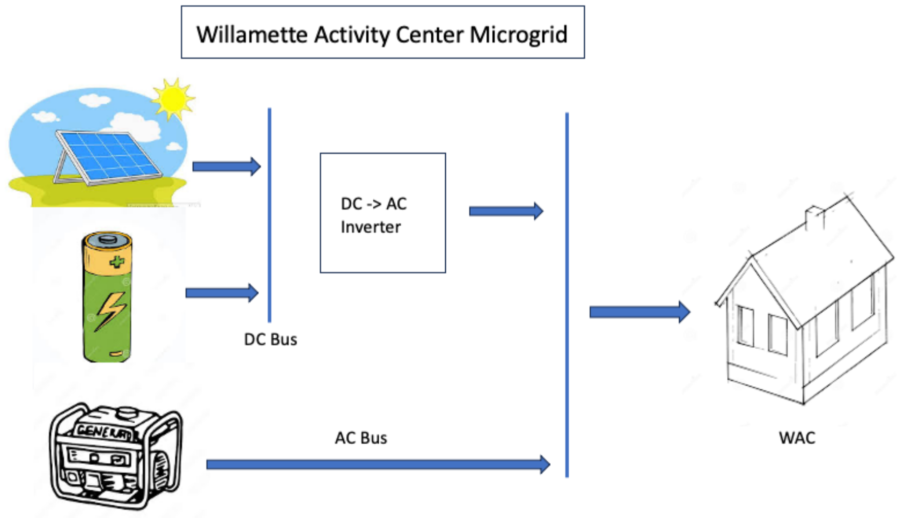

Figure H. WAC Microgrid design schematic

The batteries could potentially be located in the storage room adjacent to the electrical room on the north end of the building, and next to the location proposed for a generator.

System Costs and Financing

Pricing of solar systems can vary significantly, depending on solar contractor, location of the system, tariffs on imported solar panels, type of solar panels and other factors. Because it will be installed on a public building, the system will be bid out, but based on a pricing we have seen for similar sized systems, we estimate the cost will come in at between $2.50 and $3.50 per Watt, including the upgrades to the Lane Electric grid, and the cost of the inverters, which could also be budgeted as part of the battery system.

We estimate the cost of a 90 kW / 120 kWh battery system at around $100,000. This should include the microgrid controller components needed to connect the solar, batteries and generator. We estimate the total cost of the system, as shown in Figure I, at about $475,000.

Component	$/W	Size	$$
Solar	3.00	125 kW	375,000
Batteries		120 kWh	100,000
Total			**$475,000**
Federal refund	30%		$142,500
Total			**$332,500**

Figure I. Budget for 125 kWSolar & battery system

With the passage of the Inflation Reduction Act in 2022, local governments will now receive a refund of 30% of the cost of the solar installation from the U.S. government. It is possible that this could be increased to 40% if domestically-manufactured equipment is used, although there is not a lot of equipment available yet that meets the requirements. There is also a 10% adder for projects located in low-income communities, but the amount of money available for that is capped, and the fund currently has a waiting list.

The Oregon Department of Energy Community Renewable Energy Program (C-REP) grant is another potential source of financing. It provides funding for Oregon local governments and Tribes for solar and battery systems. The maximum grant amount is $1 million, although the grants are competitive.

The Oregon Clean Power Cooperative can also provide funding for the project, in the form of investment from community members. This would be provided to the City as a low-cost loan, and could be paid back from the energy savings generated by the solar panels. Grant funding is always the first choice, however, since it does not need to be repaid.