Memorandum

Date: May 1, 2013

To: South Cooper Mountain Technical Advisory Committee

From: Becky Hewitt, Shayna Rehberg, Serah Breakstone, and Joe Dills, APG

cc: South Cooper Mountain Project Management Team

Re: South Cooper Mountain Existing Conditions: Energy Opportunities

EXECUTIVE SUMMARY

This memo summarizes opportunities to integrate energy production and energy conservation into the South Cooper Mountain Concept Plan. Although existing power facilities adjacent to the South Cooper Mountain Study Area appear to have capacity to serve the projected growth in the study area, additional renewable energy supply and reduced energy demand will contribute to creating a sustainable community over the long term.

The orientation of streets and houses can affect opportunities for use of passive solar energy for light and heating as well as opportunities to install rooftop photovoltaic or solar thermal systems. Aligning residential streets to maximize access to solar resources generally means orienting streets (and hence front lot lines) within 30 degrees of an east-west axis. Much of the study area slopes to the southwest, which increases the availability of sun, particularly in the afternoon. Flatter areas and hillsides facing roughly south are the best opportunities for integrating solar orientation. The City of Beaverton's existing regulations could be modified to more broadly address solar access and orientation.

Several types of renewable energy can be developed at a scale that could theoretically be incorporated at the Concept Planning level, including community wind power facilities and micro-hydro power. A brief analysis of various locations within the study area reveals that the top of the Cooper Mountain ridge has generally good wind potential, while the hillsides and lower reaches of the study area have fair to poor wind potential. While most of the streams are likely too small and shallow to allow for micro-hydro power, there may be locations in the lower reaches of the hillsides where there is an appropriate mix of volume (flow) and pressure (vertical drop) to allow for micro-hydro; however, further study will be necessary to determine which locations may be most appropriate. Because micro-hydro involves access to and the use, control, and diversion of water flows as well as potential alterations of a stream channel or bank, projects are subject to local, state, and federal regulations and permitting. The permitting process should be simpler for small projects with minimal disruption. However these regulatory considerations, particularly any potential environmental impacts of diverting water from streams, should be part of the determination of feasibility of micro-hydro systems in the study area.[1]

In addition, heat production could theoretically be centralized at the neighborhood scale, potentially resulting in efficiencies. District heating/cooling is used in a wide variety of settings, but usually in higher density settings than South Cooper Mountain. Beaverton operates its Central Plant at the Round, serving high density residential, office and other development totaling about 1,000,000 square feet.

There are opportunities to apply transportation and land use strategies in South Cooper Mountain that can help minimize fossil fuel consumption and greenhouse gas emissions produced by vehicle use in the area. Many of these strategies overlap with other “smart development” concepts that will be incorporated into the Concept Plan, including: compact, mixed-use development; walkable school locations; short block lengths; connected bicycle and pedestrian facilities; and “complete streets” that provide safe access for all modes.

INTRODUCTION

Project Overview

The South Cooper Mountain Concept Plan will establish a vision that serves as a long-term guide for future growth and development of the South Cooper Mountain area. The Concept Planning process provides an opportunity to identify long term needs of the area and proactively address future challenges. This process will recognize the unique needs of the three distinct subareas (North Cooper Mountain, the Urban Reserve Area, and the South Cooper Mountain Annexation Area) while developing a holistic understanding of how the three areas could integrate and grow sustainably. The Concept Plan area totals 2,290 acres.

Community plans identifying appropriate comprehensive plan and zoning designations that implement the overall vision in the Concept Plan will be developed for the areas that are currently within the UGB.

[1] Oregon Department of Energy hosts a website on hydropower, http://www.oregon.gov/ENERGY/RENEW/Pages/hydro/Hydro_index.aspx, accessed 4/30/13. The website specifies that two feet of vertical drop for creating pressure is considered a minimum but does not specify a minimum stream flow or volume. The department advises to first contact the county engineer when planning hydropower.

The South Cooper Mountain Annexation Area Community Plan will designate specific areas for a range of housing types and densities, commercial and civic uses, and parks; preserve natural resources; provide for green infrastructure; and plan for new utilities, streets, trails and paths. The North Cooper Mountain Community Plan will reflect the needs of current residents in this already developed area, and result in an appropriate plan for the area's future. Planning for the Urban Reserve Area will guide how best to protect natural areas and Cooper Mountain Nature Park, where future urban development may occur, and where connecting streets, water lines, and other utilities should be located. A Finance Plan will identify realistic strategies for paying for infrastructure to serve the area.

Purpose

There are a number of opportunities to integrate energy production and energy conservation into the South Cooper Mountain Concept Plan. This memorandum provides an overview of a few of those opportunities including solar access, neighborhood- / community-scale renewable energy facilities, district heat and power, and strategies that address both energy conservation and greenhouse gas (GHG) reduction.

ENERGY TRANSMISSION AND DISTRIBUTION FACILITIES

There is an existing Portland General Electric (PGE) substation sited adjacent to the study area, just south of SW Scholls Ferry Road, that has been sized to accommodate future development of South Cooper Mountain. A 115 volt regional electric transmission line owned by the Bonneville Power Administration (BPA) runs north-south just over a quarter mile east of the study area.

As the energy grid is expanded to serve future development in the study area, there may be opportunities to increase energy efficiency through development of a "smart grid". According to the US Department of Energy, a "smart utility grid" marks a transition from "a centralized, producer-controlled network to one that is less centralized and more consumer-interactive."[2] A smart grid seeks to integrate technology into the utility grid, including adding two-way digital communication technology to devices associated with the grid, allowing for remote monitoring and management of the system. PGE is working to implement components of a smart grid in various areas. For example, a pilot project in southeast Salem will implement several smart-grid technologies designed to improve the electric

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[2] US Department of Energy, "The Smart Grid: An Introduction", http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages%281%29.pdf, accessed 4/30/13.

system's operation and reliability, including remote-operated power-line switches, energy storage, demand response, dispatchable standby generation, and solar generation for about 500 homes and businesses. All of these technologies together will create a "micro-grid" — an area able to generate, store and sustain its own power.[3] A similar approach could be considered for the study area. Beaverton's Vision Action Plan identifies implementation of a locally-integrated smart utility grid as an action item to advance the target of building a sustainable community, in partnership with PGE. The South Cooper Mountain Concept Plan may provide an opportunity to pursue implementation of this action.

RENEWABLE ENERGY PRODUCTION OPPORTUNITIES

PGE currently draws power largely from natural gas (28%), coal (25%), long-term hydropower contracts (16%), and wind (11%).[4] Several types of renewable energy can be developed at the neighborhood or individual site scale, including solar electric systems, community wind power facilities and micro-hydro power. These opportunities are described in brief below.

Solar Orientation and Access

The orientation of streets and houses can affect opportunities for use of passive solar energy for light and heating as well as opportunities to install rooftop photovoltaic or solar thermal systems. Aligning residential streets to maximize access to solar resources generally means orienting streets (and hence front lot lines) within 30 degrees of an east-west axis.

Much of the study area slopes to the southwest, which increases exposure to the sun, particularly in the afternoon. Otherwise, the following represent general opportunities for solar access in subareas of the South Cooper Mountain study area:

- North Cooper Mountain – This portion of the study area is largely developed. Many of the existing residential streets are oriented roughly east-west.

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[3] Portland General Electric, "Smart Grid", http://www.portlandgeneral.com/our_company/energy_strategy/smart_grid/default.aspx, accessed 4/30/13.

[4] PGE 2011 Resource Mix, http://www.portlandgeneral.com/our_company/corporate_info/how_we_generate_energy.aspx, accessed 4/30/13.

- Urban Reserve Area – Much of the URA has fairly steep slopes, some of which face south to southwest. There are limited opportunities for solar orientation, but where developable areas fall on south-facing slopes and where tree canopy patterns permit this should be considered.
- South Cooper Mountain Annexation Area – The northern and northeastern part of this subarea is relatively sloped with hillsides generally facing south to southwest. The southern and southwestern part of the subarea features flatter land. In both sections there are opportunities for solar orientation.

Solar orientation for streets is just one consideration. It should be evaluated along with ownership patterns, location of natural areas, how the orientation of the street grid can best support transportation options, and other community design factors. In addition, there are many other factors at the site scale that impact the feasibility of developing a solar electric system, including the type and location of trees that create shade and provide wind protection.

At the time that urban zoning in South Cooper Mountain is considered, changes to the zoning code related to solar access may be considered as well, along the lines of what other jurisdictions in Oregon and around the country have adopted. Existing provisions in the City of Beaverton Development Code (Section 40.65) address solar access for detached housing in the City's Standard and Low Density Residential zoning districts. Existing standards for detached housing in the Washington County Community Development Code are more detailed and extensive; the County is also considering amendments to facilitate permitting of solar electric systems, including roof-mounted and free-standing systems.[5] Additional resources for assessing solar access and establishing regulations for solar access are available at the local, state, and national level.[6]

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[5] Washington County, "Greening the Code: Solar Energy Systems", http://www.co.washington.or.us/LUT/Divisions/CurrentPlanning/GreeningCode/EnergyGeneration/solar-energy-systems.cfm, accessed 4/30/13.

[6] For example, refer to the Shade Effect Evaluation Form from the Energy Trust of Oregon: http://energytrust.org/library/solar-charts/SLE_CH_P_Por_180_090_Year.pdf; the Database of State Incentives for Renewables and Efficiency clearinghouse of solar access policies and regulations from around the country: http://www.dsireusa.org/incentives/index.cfm?EE=1&RE=1&SPV=0&ST=0&searchtype=Access&technology=Passive_solar&sh=1; and the City of Ashland solar access code, which can serve as a model for solar access setbacks, performance standards, and permits: http://www.ashland.or.us/Code.asp?CodeID=3338. All links accessed 4/17/13.

Community Wind Power

Community wind power refers to relatively small wind turbine projects that are larger than a single turbine sized to serve a single home but smaller than a utility-scale wind farm. Energy Trust of Oregon provides incentives for development of this type of facility for sites that are at least one acre with good wind potential and suitable distance from property lines, power lines and habitable buildings. Towers must be at least 70 feet tall.[7] Energy Trust of Oregon also has an online tool for evaluating wind power potential for specific sites. A brief analysis of various locations within the study area reveals that the top of the Cooper Mountain ridge has generally good wind potential, while the hillsides and lower reaches of the study area have fair to poor wind potential. Ownership in the ridge area is both private and public, including Metro (Cooper Mountain Nature Park) and the City of Beaverton (water tank).

Conflicts could arise around locating wind turbines along a ridge top where they might interfere with views. City of Beaverton Development Code does not currently address siting or design of wind generators so establishing such regulations, particularly regarding potential visual impacts of wind projects, will be important in the implementation phase of the planning process. Washington County has identified a need to improve development code regulation of wind turbines, and notes that Polk County provides the best local example of regulations for solar and wind energy facilities.[8] It would be helpful to have these kinds of regulations in place, also, to guide small wind generator projects serving individual properties or civic uses so that these could be sited where appropriate.

Micro-Hydro Power

Micro-hydro refers to small hydroelectric turbines (generally under 100 kilowatts) used to generate electricity from flowing water. It can be developed in even relatively small streams if there is enough vertical drop. Streams, irrigation ditches, and pipelines are the most likely locations for a micro-hydro system. For streams, most micro-hydro systems will be "run-of-the-river" systems where water is diverted from a stream or canal; these typically have much less impact on wildlife habitat, fish passage,

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[7] Energy Trust of Oregon, "Program Guide for Small Wind Trade Allies", http://energytrust.org/library/forms/SMW_PG_ProgramGuide.pdf, accessed 4/17/2013.
[8] Washington County, "Greening the Code: Wind Energy Systems", http://www.co.washington.or.us/LUT/Divisions/CurrentPlanning/GreeningCode/EnergyGeneration/wind-energy-systems.cfm, accessed 4/30/13.

water flow, and water quality than hydroelectric systems that utilize a dam or impoundment. The following characteristics help to identify locations that are more likely to be viable for micro-hydro:[9]

- Adequate head – Although vertical drops of as low as three feet can be viably harnessed, sites with at least 10 feet are generally needed to be economically viable.
- Existing infrastructure – Locations that have existing diversions, dams, or penstocks will often have lower development costs.
- Proximity to electricity demand – Transporting electricity over long distances increases cost and reduces efficiency.
- Minimal environmental disturbance

Hydroelectric generators for Net Metering through PGE usually need a minimum flow of 12 GPM and a minimum fall of 3 feet, but a site with more than 3 feet of fall can have a minimum flow as low as 3 GPM (at 200 feet of fall).[10] The study area has numerous small streams and relatively steep slopes. While most of the streams are likely too small and shallow to allow for micro-hydro power, there may be locations in the lower reaches of the hillsides where there is an appropriate mix of flow and vertical drop to allow for micro-hydro; however, further study will be necessary to determine which locations may be most appropriate.

Because micro-hydro involves access to and the use, control, and diversion of water flows as well as potential alterations of a stream channel or bank, projects are subject to local, state, and federal regulations and permitting. The permitting process should be simpler for small projects with minimal disruption. However these regulatory considerations, particularly any potential environmental impacts of diverting water from streams, should be part of the determination of feasibility of micro-hydro systems in the study area.[11]

[9] Montana University, E3A:Exploring Energy Efficiency and Alternatives, “Micro Hydro”: http://e3a4u.info/energy-technologies/micro-hydro, accessed 4/17/13.
[10] Portland General Electric, “Renewables & Efficiency: Costs & Incentives”, http://www.portlandgeneral.com/renewables_efficiency/generate_power/home/costs_incentives.aspx, accessed 4/30/13.
[11] Oregon Department of Energy hosts a website on hydropower, http://www.oregon.gov/ENERGY/RENEW/Pages/hydro/Hydro_index.aspx, accessed 4/30/13. The website specifies that two feet of vertical drop for creating pressure is considered a minimum but does not specify a minimum stream flow or volume. The department advises to first contact the county engineer when planning hydropower.

DISTRICT HEATING AND POWER

District heating centralizes the distribution of heat, in both residential and commercial settings, for uses such as space heating and water heating. The heat is usually produced by burning fossil fuels but increasingly biomass and solar sources are being used. District heating is being explored and developed for potential greater efficiencies and improved pollution control over localized systems. The efficiency of the system is greater when a cogeneration plant – one that simultaneously produces heat and energy – is used in parallel with a boiler. There may be opportunities to capture and use waste heat from businesses within the study area, such as restaurants and coffee roasting shops, to heat water in the building in which they are located, if not the block.

District energy systems require steep initial investments in infrastructure, a geographically concentrated cluster of service users, potentially complicated service agreements (when users are private entities separate from the service provider), and a dedicated supply of fuel. Systems may be leased to or owned by a public utility, non-profit or for-profit corporation; privately owned & operated municipal cogeneration systems; or operation may be an unregulated subsidiary of an investor-owned utility. [12]

Systems developed thus far have served developments ranging from 20 housing units up to entire cities. There are a number of local examples:

- The Beaverton Central Plant at the Round serves high density residential, office and other development totaling about 1,000,000 square feet. Designed as a highly efficient heating and cooling system, the Beaverton Central Plant provides cost-effective space conditioning and domestic hot water to the entire Round development area.[13]
- Portland District Cooling Company (PDCC) operates a district cooling system for downtown Portland that serves all of the buildings in the Pearl District's Brewery Blocks. Through a distribution piping network running underground and in the Brewery Blocks parking garage, PDCC offers on-demand chilled water to meet the air conditioning cooling needs of the Brewery Blocks. The PDCC system allows building owners and tenants to avoid the capital, energy, operating, and maintenance costs associated with owning and operating their own chilled water

[12] Washington County's Department of Land Use & Transportation, "Greening The Code: Final Report", October 2012, p. 29, http://www.co.washington.or.us/LUT/Divisions/CurrentPlanning/GreeningCode/loader.cfm?csModule=security/getfile&PageID=678668.
[13] City of Beaverton, "Beaverton Central Plant", http://www.beavertonoregon.gov/index.aspx?NID=239, accessed 5/1/13.

system. The system also provides energy savings and net reductions in water and sewer usage and charges for its customers.[14]

- The Energy Center at Oregon State University generates almost half of the campus' electricity.[15]

Within the study area, the best potential for a district heating/cogeneration facility would likely be in areas that are designated for higher densities through the Concept Plan process and sites such as shopping centers or multi-unit housing where there is a single property owner and numerous tenants. In a higher density environment, more units could share the district heating system with greater efficiency.

STRATEGIES TO REDUCE TRANSPORTATION-RELATED FOSSIL FUEL CONSUMPTION

There are opportunities to apply transportation and land use strategies in South Cooper Mountain that can help minimize fossil fuel consumption and greenhouse gas emissions produced by vehicle use in the area. Many of these strategies overlap with other "smart development" concepts that will be incorporated into the Concept Plan. Generally, the strategies relate to development types, bicycle and pedestrian facilities and connectivity, and street design. Strategies include:

- School location. This approach emphasizes making strategic decisions on where to build new schools so that they are integrated into the transportation network and community, thus providing more bicycling and walking opportunities for students. Schools in South Cooper Mountain have the potential to serve as community focal points that are centrally located and easily reached by foot and bike.

- Compact, mixed-use development. Planning a compact development pattern that includes strategically placed commercial and institutional uses can help promote alternative transportation modes and reduce vehicle miles traveled. Meeting the targets established by Metro will contribute to reduced fossil fuel consumption and GHG emissions.

- Short block lengths. Shorter block lengths (300 feet or less) in a grid pattern are generally considered friendlier to pedestrians and bicyclists because they provide more opportunities for crossing the street, allow more options for route planning, and enhance perceptions of safety

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[14] The Brewery Blocks, "Brewery Blocks Office Tenants", http://www.breweryblocks.com/office/, accessed 5/1/13.
[15] This was a featured story on the home page of the U.S. Department of Energy Northwest Clean Application Center, an organization dedicated to the promotion of combined heat and power (CHP), district energy, and waste heat recovery (http://www.chpcenternw.org/), accessed 4/17/13.

because users can see to the end of the block while traveling through it. Such block lengths will be most applicable within any future "Main Street" areas of South Cooper Mountain.

- Pedestrian and bicycle facilities and connectivity. Planning for a comprehensive pedestrian and bicycle network will promote those modes of transportation and help reduce vehicle miles traveled. This includes provision of on-street bike lanes and similar bike facilities, bicycle parking, sidewalks, curb cuts, multi-use paths, connections through cul-de-sacs, pedestrian lighting, marked or signalized street crossings and directional signage. It also includes substantial efforts to connect the undeveloped areas to the path and sidewalk systems of adjacent developed areas.

- Complete streets. A complete street is one that is designed and operated to enable safe access for all users including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. This strategy de-emphasizes the motorist as the primary user of a street and helps promote alternative transportation modes. Complete streets may also include "green" elements such as swales for collecting stormwater runoff and street trees.

- Electric vehicle (EV) charging stations. Providing conveniently-located charging stations for electric vehicles can make their use more attractive. As the street grid and neighborhood commercial services are planned, there will be opportunities to identify potential locations for EV charging stations.

- Advanced telecommunications infrastructure. With greenfield construction it may be possible to provide for enhanced communications infrastructure, such as fiber optic lines and wireless communication technology that will allow residents in the study area to work, shop, and access other services from home. Current patterns show that the adjacent areas of southwest Beaverton have some of the highest shares of residents working from home in the city. Coordination with service providers such as Comcast would be required to encourage provision of the best available technology and communication lines.

ENERGY EFFICIENCY MEASURES

There are several energy efficiency measures that can be considered in developing the South Cooper Mountain Concept Plan. The measures address both private development and public facilities.

- Enhanced energy efficiency requirements/incentives for new construction. New buildings in the study area will have useful lifespans of decades. Washington County has identified incentives for use of the Oregon Reach Code, a set of optional statewide building standards and construction practices designed to increase the energy efficiency of buildings and allow for the implementation of renewable energy technologies beyond the state's mandatory building codes, as an opportunity to promote energy efficient construction.[16]

- Street lights. The City of Beaverton is in the process of upgrading existing street lighting to higher efficiency lighting. These retrofits are costly but significantly reduce the City's energy use. The development of a new street grid and installation of new street lights within the South Cooper Mountain Annexation Area provide an opportunity to integrate high-efficiency street lighting systems at time of development. High efficiency street lighting provides the additional benefit of reduced light pollution, and new street lighting offers the opportunity for possible co-location of solar and wind power facilities.

- Tree cover. There is a growing body of research the demonstrates the savings in heating and cooling costs associated with tree cover. This is primarily due to shading, particularly of west-facing building facades, and in forming breaks to reduce cooling from winds.[17]

- Reduced water consumption. Reducing water consumption provides not only the benefit of conserving water but potentially saving energy. The amount of energy used to construct and operate water system infrastructure, such as pumps and storage facilities, could be reduced in the case of significant reductions in water consumption.

[16] Washington County's Department of Land Use & Transportation, "Greening The Code: Final Report", October 2012, p. 15, http://www.co.washington.or.us/LUT/Divisions/CurrentPlanning/GreeningCode/loader.cfm?csModule=security/getfile&PageID=678668.

[17] One research example is "Energy Conservation Potential of Urban Tree Planting" from the Journal of Arboriculture (November 1993), http://actrees.org/files/Research/mcpherson_energy_conservation.pdf, accessed 4/30/13.