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On-Farm Energy Management and Renewable Energy

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Introduction

This handout, which accompanies a webinar on "Wind, solar, and geothermal energy production on farms", provides an overview of considerations farms should make when thinking about energy investments.

The webinar and handout are part of the Virginia Sustainable Farms and Agribusiness Education Initiative offered by Virginia Tech's Department of Agricultural and Applied Economics and Virginia Cooperative Extension. More information about the program is available at https://aaec.vt.edu/extension/va-sustainable-farms-agribusinesses.html. The webinar is available at: https://video.vt.edu/media/1_ros06lae.

Economics of Energy Investments

When considering investments into your farm operation, it is important to consider the time value (or opportunity cost) of money. In other words, farmers should consider the value of what they could have done with the money if they had not made an investment. Some on-farm energy investments might range from low-cost energy efficiency improvements (for example, sealing building gaps, cleaning maintenance of ventilation fans, etc.), to more expensive energy efficiency retrofits (for example, lighting system upgrades, unit heater replacements, etc.), to implementing renewable energy systems (for example, solar photovoltaics, etc.). The potential return on investment across this range varies widely. For example, while investments in renewable energy may be profitable in the long run, other investment strategies might yield even better outcomes depending on your decision criteria.

Overview of Energy Investments

It is very important to understand the goals of energy system investments before making investments. Some goals may include reducing system energy requirements, reducing energy costs, reducing reliance on electrical-grid energy, reducing greenhouse gas emissions, or increasing the use of renewable energy. Some goals can be achieved through a conservation strategy—simple everyday actions that reduce the amount of energy used. Other goals may benefit from an efficiency strategy—replacing elements of the existing energy system with more efficient solutions. For example, converting to LED light bulbs or investing in higher quality insulation. Other goals may require investing in additional energy systems such as wind, solar, or geothermal. As the complexity of system changes increases, the cost tends to increase as well. Often it is beneficial to invest in conservation and energy efficiency strategies prior to adoption of renewables, so that the overall energy requirements are reduced.

The USDA offers a variety of farm energy assessments and on-farm energy audits. For an energy audit, an energy auditor meets farmers onsite, requests a tour of the facility, and reports back to the farmer in two to three weeks with an energy audit summary. These summaries offer potential practices and retrofits, estimated costs, and estimated savings. Sometimes farmers can take advantage of incentives through USDA Rural Development and other entities to implement the recommendations. The Rural Energy for America Program (REAP) is also available for farmers interested in investing in energy systems. Contact your local USDA Service Center to learn more about opportunities through

USDA Rural Development and USDA Natural Resources Conservation Service.

Opportunities for Renewable Energy Conversion

Many renewable energy conversation technologies are available for farm operations. A brief description of several of these technologies follows:

1. *Ground-source heat pumps.* Ground-source heat pumps use closed-loop piping systems to circulate water underground and back into buildings to regulate temperature. These coils can be placed below ground or underwater in nearby ponds. See U.S. Department of Energy (2022a) and New York State Energy Research and Development Authority (2022).
2. *Wind energy.* The U.S. Department of Energy wind resource maps suggest that there are many areas in Virginia that are ideal for wind energy (U.S. Department of Energy, 2022b). The Center for the Advancement of Sustainable Energy at James Madison University (2022) has additional information about small-scale wind energy in Virginia. The U.S. Department of Energy (2022c) also offers a Small Wind Guidebook.
3. *Biomass energy* includes a broad category of materials that can be converted into energy through the thermal conversion process. See U.S. Department of Energy (2016) and eXtension Farm Energy (2022) for more information.
4. *Solar* is a quickly growing area of renewable energy in Virginia. The price of solar panels has decreased greatly in the recent decade. Solar photovoltaic panels can be used to generate electricity or solar collectors to heat water. These applications can vary in scale. In some cases, solar is used in small, single appliance applications, in other cases, solar is used to take all, or a portion of, energy operations off the energy grid, or developed as even larger solar power plants to service the electrical grid. See eXtension Farm Energy (2019) and National Renewable Energy Laboratory (2022) for more information.

The incorporation of energy storage systems (such as battery packs) into renewable energy systems depends on your goals. Not all energy system goals require on-site storage, but it may be a consideration for many applications, especially as battery prices decline. For example, if goals include the ability to use electricity when the grid goes down, then battery storage will be required.

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Additional Resources

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