output capacity (a typical new utility-scale wind turbine is about 2 MW).[5]

technological advancements such as sound-absorbing turbine materials have been able to reduce the noise generated by wind power facilities.[13]

Wind energy generation itself does not produce carbon emissions. But the related manufacturing and installment of turbines can produce harmful emissions.[14] See Table 1 below for full chart of emissions statistics including the emissions associated with the manufacturing and deinstallment of wind turbines.

In order to build wind turbines in the most wind-effective areas in the Vermont Green Mountains, roads and access ways must be constructed. Wind turbines that are built on mountainous ridgelines typically produce the most efficiency, with a variety of environmental consequences as a result. Constructing these roads requires large-scale

Coal—PC	670/760/870	9.6			

Many solar systems are built in former agricultural areas as well as on “high elevation ridgelines, floodplains and low lying meadows dominated by wetlands” in Vermont.[20] Nationally, solar projects are less commonly found on agricultural lands and more commonly found in low-quality areas such as abandoned mining land, along transportation routes, along existing transmission corridors (areas cut out for transmission power lines) and in brownfields. A brownfield is a property that may be tainted by the presence of a hazardous substances, pollutants, or contaminants.

(usually based on latitude and wind conditions).[30] Tracking systems rotate according to location of the sun. Single-axis can be rotated on a single axis (vertically) and duel-axis tracking is able to follow the sun all day because it can rotate both vertically and horizontally.[31] CPV solar systems use lenses and mirrors to concentrate focused sunlight onto cells.[32]

Data from: Sean Ong, Clinton Campbell, Paul Denholm, Robert Margolis and Garvin Heath, "Land-Use Requirements for Solar Power Plants in the United States," Washington, DC: National Renewable Energy Laboratory, 2013, accessed April 2016, http://www.nrel.gov/docs/fy13osti/56290.pdf.

Renewable generation can have an impact on wetlands in many ways. Wetlands, are "commonly known as bogs, fens, marshes, wet meadows, shrub swamps, vernal pools and wooded swamps," and can help filter and store water during natural events such as storms.[33] Wetlands also provide habitat for wildlife and rare plant species in some cases. In

[30] Joe Simon and Gail Mosey, "Feasible Study of Economics and Performance of Solar Photovoltaics."
[31] Simon and Mosey, "Feasible Study of Economics and Performance of Solar Photovoltaics."
[32]

Vermont, wetlands are protected by Title 10 of the V.S.A, but areas on agricultural properties that are wet and unusable for farming are considered class two wetlands or

systems.[62] Small-scale hydropower plants have generating capacities of 30 MW or less.[63] These systems can be further classified into categories. Low-head hydropower means that water falls less than 65 feet before hitting the turbine to generate electricity. Micro-hydropower systems are those that generate capacities of less than 100 kW. Future development of hydroelectricity in the U.S. will be considerably more focused on smaller systems and will increase the number of run-of-river hydroelectric plants.[64] Run-of-river plants are smaller scale hydropower systems that only utilize reservoirs some of the time.[65] They also are known for utilizing a river's natural current to push water through the turbines, allowing for the current below the dam to be similar, if not the same as, the current upstream.[66] Not only do these plants require less land to develop, they also maintain the natural current of the river limiting the impacts on riparian (riverside) habitat.[67]

The land use requirements for hydroelectric plants are highly subjective on plant capacity, configuration, and the installation site.[68] The

released. Improved turbine design can also increase dissolved oxygen content and allow fish to pass through with a reduced chance of being harmed.[89]

Data from: National Renewable Energy Laboratory, "Renewable Electricity Futures Study," Golden, CO: U.S. Department of Energy, 2012, accessed April 19, 2016, http://www.nrel.gov/docs/fy12osti/52409

Often times reservoirs are designed to be able to store excess water, which can be released when demand for electricity is highest. These systems can also raise the water level behind the dam to increase the current of the water as it hits the turbines to create more electricity.[90] Reservoirs can be used for purposes other than electric generation such as flood protection, irrigation water supply, recreation. and navigation.[91] Additionally, the eutrophication of reservoirs can limit the effectiveness for these purposes if the water quality becomes poor enough.[92] Reservoirs that are used for multiple purposes can diminish overall generating capacity of the system because some water must be allocated for other purposes.[93] Table 4 outlines potential barriers to the construction and production of hydroelectricity.

Biomass energy or “bioenergy” refers to energy derived from plant and animal based materials.[94] Biomass can come from several different sources including: wood, grass, oilseeds, small grains, animal waste, and oil-rich algae, as well as municipal and industrial wastes with organic matter.[95,96] Bioenergy is the third largest form of renewable generation after hydroelectric and wind generation.[97]

Data from: National Renewable Energy Laboratory, "Renewable Electricity Futures Study," Golden, CO: U.S. Department of Energy, 2012, accessed April 19, 2016, http://www.nrel.gov/docs/fy12osti/52409-2.pdf.

While some sources of bioenergy are byproducts of other industries, such as mill residues or wood waste, others such as corn and oilseeds require large amounts of land dedicated to them.[101] This can become an issue when energy and food crops need the same piece of land. Another issue is what is so-called the "food-vs.-fuel" debate.[102] Many traditional food crops are also used for biomass energy including: corn, sugar cane and vegetable oils. Agricultural crops may be shifted from producing food crops to producing crops dedicated to energy needs. Similar to food crop production, run off from synthetic fertilizers and pesticides can enter the environment if overused. This can negatively impact soil quality, water resources, biodiversity and ecosystems in surrounding areas.[103]

[101] National Renewable Energy Laboratory, "Renewable Electricity Futures ' ur Á C

When heat is extracted from geothermal energy plants gases such as