

ABSTRACT

The state of Vermont intends to pursue the goal of 75 percent of retail electric sales obtained from renewable sources by 2032. Public decision makers and stakeholders require a clear understanding of the potential detrimental impacts involved in this renewable energy transition, both within and beyond the state borders. The broad goal of this research is to support large-scale renewable energy generation in Vermont while avoiding degradation of environmental conditions.

I adapt a social-ecological systems framework to guide research on Vermont's renewable energy systems. I calculate number of facilities required and use spatial modeling and simulation to assess solar photovoltaic and wind resource potential, suitable siting patterns and tradeoffs between resource productivity and biodiversity. I review and apply life cycle assessment methodology to assess indirect life cycle impacts of solar photovoltaic and wind technologies.

Vermont will require from 178 to 1,527 - 2.2 MW solar photovoltaic facilities and an additional 9 to 76 - 20 MW wind facilities by 2032. Vermont's solar photovoltaic resource potential is equivalent to 18.9 percent of the state's total land area, and wind resource potential is equivalent to 3.1 percent of the state's total land area. Sufficient solar and wind resource potential is available in Vermont to support the state's electricity policy goals. Renewable electricity development in Vermont will require confronting a tradeoff between use of areas with either lower resource potential or moderate biodiversity value. While offering significantly less impact as compared to conventional fossil fuel-based energy systems, the choice of either solar photovoltaic or wind technologies presents tradeoffs among life cycle impacts. Wind-generated electricity is the most or one of the most sustainable sources of electricity. Vermont's energy-land-environmental policy nexus can be strengthened through further research and increased understanding of the state's renewable energy system through a social-ecological framework.