



The Wind Energy Potential of Iceland

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While Iceland has an abundant wind energy resource, its use for electrical power production has so far been limited. Electricity in Iceland is generated primarily from hydro- and geothermal sources, and adding wind energy has so far not been considered practical or even necessary. However, wind energy is becoming a more viable option, as opportunities for new hydro- or geothermal power installations become limited.

In order to obtain an estimate of the wind energy potential of Iceland, a wind atlas has been developed as part of the joint Nordic project “Improved Forecast of Wind, Waves and Icing” (IceWind). Downscaling simulations performed with the Weather Research and Forecasting (WRF) model were used to determine the large-scale wind energy potential of Iceland. Local wind speed distributions are represented by Weibull statistics. The shape parameter across Iceland varies between 1.2 and 3.6, with the lowest values indicative of near-exponential distributions at sheltered locations, and the highest values indicative of normal distributions at exposed locations in winter. Compared with summer, average power density in winter is increased throughout Iceland by a factor of 2.0 - 5.5. In any season, there are also considerable spatial differences in average wind power density. Relative to the average value within 10 km of the coast, power density across Iceland varies between 50 - 250%, excluding glaciers, or between 300 - 1500 W m⁻² at 50 m above ground level in winter. At intermediate elevations of 500 - 1000 m above mean sea level, power density is independent of the distance to the coast. In addition to seasonal and spatial variability, differences in average wind speed and power density also exist for different wind directions. Along the coast in winter, power density of onshore winds is higher by 100 - 700 W m⁻² than that of offshore winds. The regions with the highest average wind speeds are impractical for wind farms, due to the distances from road infrastructure and the power grid, as well as due to the harsh winter climate. However, even in easily accessible regions, wind energy potential in Iceland, as measured by annual average power density, is among the highest in Western Europe.

Based on these results, 14 test sites were selected for more detailed analyses using the Wind Atlas Analysis and Application Program (WAsP). These calculations show that a modest wind farm of ten medium size turbines would produce more energy throughout the year than a small hydro power plant, making wind energy a viable additional option.