

# Effects of Onshore Wind Energy on Semi-Domesticated Reindeer



Reindeer grazing in Svalbard, Norway. Photo from Getty Images 534983534

## SUMMARY

Reindeer or caribou (*Rangifer tarandus*) are native to the Northern Hemisphere, where indigenous people have been domesticating herds for centuries. Reindeer herding requires extensive and continuous pasturelands to support a seasonal migration and life cycle. However, the development of wind farms in reindeer pasturelands significantly affects their habitat use and movement. It raises concerns among reindeer herders about the sustainability of the indigenous culture tied to reindeer husbandry. This summary provides a general overview of current research on the effects of wind energy on semi-domesticated reindeer.

## SPECIES

The reindeer or caribou (*Rangifer tarandus*) is a circumpolar species native to the Northern Hemisphere. They inhabit upland and tundra areas in the (sub-)Arctic. Indigenous people in the Northern Hemisphere have domesticated reindeer for centuries. Reindeer herding follows a free-ranging seasonal cycle, with multiple stages, including migration between winter forage areas, spring calving sites, summer pastures in higher terrain,

and culling two times in a herding year to balance herd size and economic returns. It is primarily practiced in Finland, Norway, Sweden, Russia, and to a lesser degree in China, Mongolia, Alaska, and Canada. The development of wind energy in semi-domesticated reindeer pasturelands has raised concerns about its effects on reindeer and indigenous herding practices. An example of the Sami people's dispute over wind energy development on the Fosen peninsula in Norway underscores the socio-cultural concerns of indigenous people.



A group of deer in Norway. Photo from Getty Images 684758036

## MAIN RISKS AND EFFECTS

The mountainous areas are good sites for onshore wind farms, but they are also critical for reindeer grazing, migration, and calving. The effects of wind energy on semi-domesticated reindeer include habitat degradation, fragmentation of pastureland, and socio-economic and cultural impacts. Some studies demonstrate that reindeer habitat use will likely have a minimal effect if wind farms are built on poor-quality habitat for reindeer. Most studies show that human activities during the construction phase significantly affect reindeer habitat use and migration. Studies on the effects of wind energy development on reindeer habitat use yielded mixed results. While some studies showed that wind farms harm reindeer during the calving season and winter grazing and has adverse effects on their habitat use with avoidance of wind turbines and related infrastructure by three to five kilometres, other studies state that the density of reindeer did not change during the periods before, during, and after the construction of wind farms and power lines. The magnitude of these impacts may partly depend on local conditions, such as topography, infrastructure, forage availability, population density, climate, and study design. However, reindeer herders report that visual and acoustic effects of the wind turbines reduce grazing activities near the wind farms, as advocated by some studies, and that reindeer exhibit more active and vigilant behaviour when closer to the wind farms. Related

infrastructure, such as roads and power lines, also negatively affects reindeer habitat use and migration, with higher movement rates near larger roads. Unlike potential effects on wild reindeer or other wildlife, such as birds or mammals, semi-domesticated reindeer effects involve multidisciplinary interactions with social, political, ecological, and economic aspects. In addition, reindeer herding is linked to the deep culture and livelihoods of the Sami people (Box 1) and their identity. Reindeer herders in the vicinity of onshore wind farms raise concerns that the development of wind energy infrastructure may threaten changes in reindeer herding and migration routes, thereby disrupting the continuation of traditional ecological knowledge and culture closely tied to reindeer husbandry. In addition, increased area avoidance by reindeer near wind energy infrastructure may subsequently increase herders' stress, travel costs, and time spent herding, thereby increasing economic vulnerability.

### Box 1: Sami People

The Sami are an indigenous population residing across Finland, Norway, Sweden, and Russia. Of their estimated 80,000 members, nearly half reside in Norway. Their primary livelihoods include reindeer herding, fishing, and hunting.

## MONITORING AND ASSESSING IMPACTS

Previous research, mostly performed in Norway and Sweden, have assessed the potential effects of wind farms using a variety of methodological approaches. These ranged from the use of control-impact enclosures to record behavioural responses, to tracking area use with GPS collars, to direct observations (e.g., binoculars), to faecal pellet-group counts, and to interviews with herders. Pre- and post-construction monitoring of GPS-tagged semi-domestic reindeer can provide long-term data on the effects of wind farms on their use of the area. There are a few studies that integrate local traditional knowledge with ecological studies. These factors indicate the effects of wind farms on semi-domesticated reindeer require long-term research and cross-border comparison studies that integrate with herders' traditional ecological knowledge.

## RECOMMENDATIONS AND RISK MANAGEMENT MEASURES

Research indicates that wind energy development in poor habitats for semi-domesticated reindeer poses a lower risk to their habitat use. It is important to identify poor habitats that are unsuitable for reindeer herding to avoid potential land-use conflicts. In addition, the implementation of ecological and cultural sensitivity mapping will contribute to developing

### Box 2: The Fosen Case

**The Fosen peninsula**, located in central Norway near Trondheim, became the site of the Roan and Storheia wind farms following license approval by the Norwegian Water Resources and Energy Directorate under the Ministry of Petroleum and Energy (Olje-og energidepartementet, OED) in 2010. These wind farms occupy semi-domesticated reindeer's winter grazing areas traditionally used by the South-Fosen Sijte and North-Fosen Siida, two Sami family groups. The Sami reindeer herders asserted that wind energy development adversely affected their herding practices and cultural traditions. The OED dismissed these concerns in 2013, leading to construction between 2016 and 2020. The herders pursued multiple court proceedings. In 2021, the Norwegian Supreme Court revoked the wind farm licenses, determining that the loss of winter pasture threatened the viability of reindeer husbandry in Fosen. Despite this ruling, local disputes persisted as the wind farms continued to operate. In 2023, the OED initiated mediation involving a National Mediator, a District Court Judge, and a representative of the reindeer herders. Settlement agreements were ultimately reached between the wind energy company and South-Fosen Sijte in late 2023, and with North-Fosen Siida in early 2024.

maps for identifying critical reindeer habitats – winter grazing, migration routes, and calving grounds – by incorporating both traditional ecological knowledge from herders and GPS tracking data. As human activities negatively impact reindeer, the road network for wind energy should be minimized in pastureland. Such roads should be closer to established areas with higher human disturbance. Better migration and movement of reindeer along their grazing land are imperative for the species' fitness and for herding practice. Therefore, physical barriers such as fences or steep roads that deter reindeer migration should be minimized. Due to the loss of grazing land and increased herding time and forage costs for reindeer herders, a compensation scheme for the affected community should cover their actual losses resulting from wind energy development. The Fosen case in Norway (Box 2) was resolved through State mediation, which provided local Sami communities with additional winter grazing areas, financial compensation, support for reindeer herding, and a veto right over future wind energy projects. A holistic regional land-use plan, close collaboration, and direct communication among municipal authorities in reindeer herding areas and districts, wind energy developers, and reindeer herders in the early phase of a wind energy project will strengthen trust and minimize land-use conflicts among relevant stakeholders. It will also promote inclusive governance, adaptive management, and co-management to ensure the balance between sustainable renewable energy development and indigenous rights.

## RESEARCH PRIORITIES

Existing research on the impacts of wind energy on semi-domesticated reindeer has mainly been conducted in Norway and Sweden, indicating that more large-scale studies are needed across countries with wind energy development in reindeer herding areas. Previous studies predominantly focused on quantitative analyses of biological and ecological effects on reindeer. However, reindeer husbandry is involved in the socio-economic, cultural, and indigenous identities of the Sami people. Future studies should integrate local knowledge from herders' experience and traditional ecological knowledge, and empirical knowledge from biological studies. Furthermore, studying the effects of turbine acoustic and visual impacts on reindeer will enhance understanding of grazing activities adjacent to wind energy facilities.

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