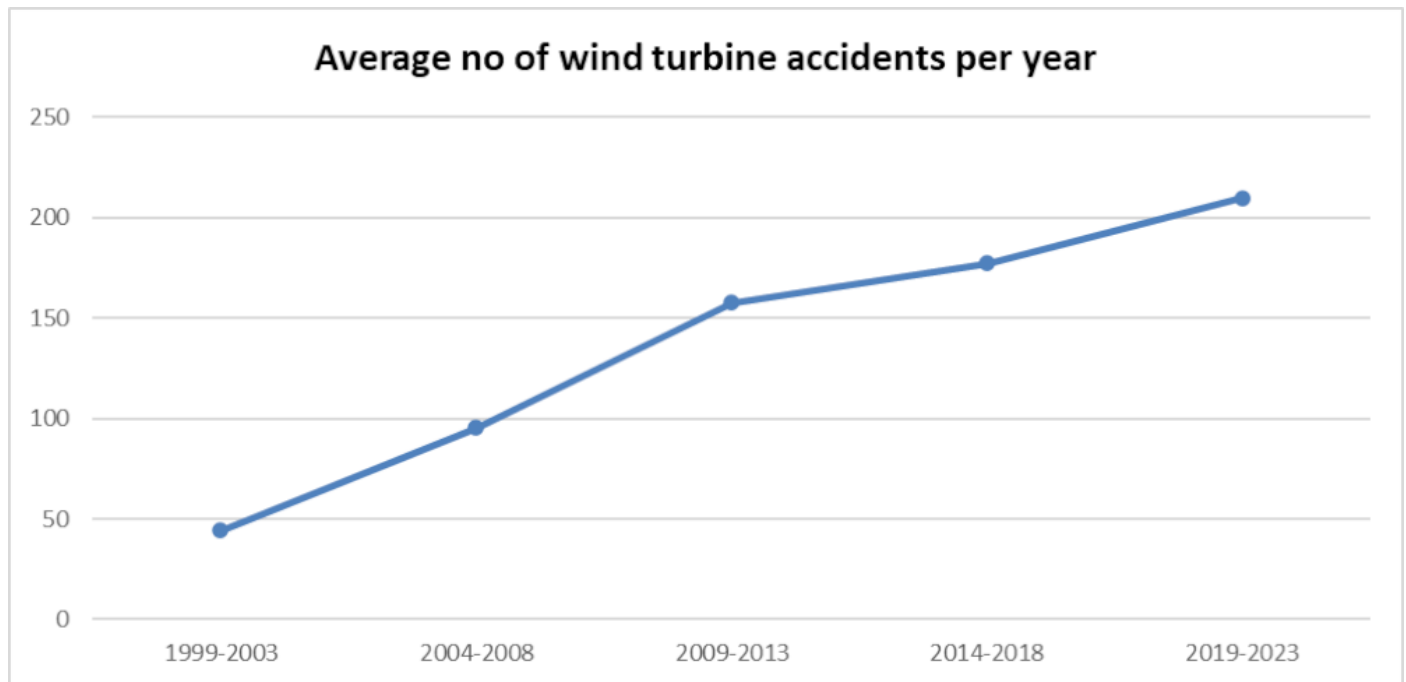


Summary of Wind Turbine Accident data to 31 December 2023

The table includes all documented cases of wind turbine related accidents and incidents which could be found and confirmed through press reports or official information releases up to 31 December 2023. Scotland Against Spin (SAS) believe that this compendium of accident information may be the most comprehensive available anywhere.



Data in the detailed table attached is by no means fully comprehensive – we believe that what is attached may only be the “tip of the iceberg” in terms of numbers of accidents and their frequency. Indeed, on 11 December 2011 the Daily Telegraph reported that RenewableUK confirmed that there had been 1500 wind turbine accidents and incidents in the UK alone in the previous 5 years. In July 2019 EnergyVoice and the Press and Journal reported a total of 81 cases where workers had been injured on the UK’s windfarms since 2014. Our data has only 15 of these (<19%). In February 2021, the industry publication Wind Power Engineering and Development admitted to 865 off-shore accidents during 2019 – SAS only have 4 of these (<0.5%). Finally, EnergyVoice published a report containing details of over 500 UK onshore wind turbine accidents in 2020 – we have only 5 of these (1%).

Additional evidence that our data only represents the “tip of the iceberg” can be found in the 13 August 2018 publication by Power Technology <https://www.power-technology.com/features/golden-hour-paramedics-saving-lives-offshore-windfarms/> The article reports 737 incidents were reported from UK offshore windfarms during 2016 alone, with the majority occurring during operations rather than development. 44% of medical emergencies were turbine related. In comparison, only 4 UK offshore incidents are listed in our data – equivalent to 0.5%.

The SAS data does however give an excellent cross-section of the types of accidents which can and do occur, and their consequences. With few exceptions, before about 1997 only data on fatal accidents has been found.

The trend is as expected – as more turbines are built, more accidents occur. Numbers of recorded accidents reflect this, with an average of 44 accidents per year from 1999-2003 inclusive; 95 accidents per year from 2004-2008 inclusive; 158 accidents per year from 2009-2013 inclusive; 177 accidents per year from 2014-2018 inclusive, and 210 accidents per year from 2019-2023 inclusive.

This general trend upward in accident numbers is predicted to continue to escalate unless HSE make some significant changes – in particular to protect the public by declaring a minimum safe distance between new turbine developments and occupied housing and buildings.

Summary of Wind Turbine Accident data to 31 December 2023

In the UK, the HSE do not currently have a database of wind turbine failures on which they can base judgements on the reliability and risk assessments for wind turbines. This is because the wind industry “guarantees confidentiality” of incidents reported. No other energy industry works with such secrecy regarding incidents. The wind industry should be no different, and the sooner RenewableUK makes its database available to the HSE and public, the better. The truth is out there, however RenewableUK don’t like to admit it.

Some countries are finally accepting that industrial wind turbines can pose a significant public health and safety risk. In June 2014, the report of the Finnish Ministry of Health called for a minimum distance of 2 km from houses by concluding: “The actors of development of wind energy should understand that no economic or political objective must not prevail over the well-being and health of individuals.” In 2016 Bavaria passed legislation requiring a minimum 2km distance between wind turbines and homes, and Ireland are considering a similar measure. In 2023, Buffalo County Nebraska voted to have a 3-mile separation distance between wind turbines and churches, hospitals and agricultural residential property, and a 5-mile separation distance between wind turbines and villages/towns

Our data clearly shows that blade failure is the most common accident with wind turbines, closely followed by fire. This is in agreement with GCube, the largest provider of insurance to renewable energy schemes. In June 2015, the wind industry’s own publication “WindPower Monthly” published an article confirming that “Annual blade failures estimated at around 3,800”, based on GCube information. A GCube survey in 2013 reported that the most common type of accident is indeed blade failure, and that the two most common causes of accidents are fire and poor maintenance. A further GCube report in November 2015 stated that there are an average 50 wind turbine fires per year, and this remains unchanged in the latest 2018 GCube publication <http://www.gcube-insurance.com/reports/towering-inferno/>.

The 50 fires per year is over double the reported SAS data below, further underpinning that data presented here may only be “the tip of the iceberg”. Turbine fire prevention company FireTrace International estimate that 91% of wind turbine fires go unreported. https://www.thecheyennepost.com/news/turbine-fire-at-new-roundhouse-industrial-wind-facility-west-of-cheyenne/article_cebaf080-423a-11eb-bebe-97b85cbceb3f.html.

The 2018 GCube report also notes the following:

- Wind turbine fires are greatly outnumbered by problems relating to blades and gear boxes;
- Failure of operators to undertake sufficient due diligence through maintenance checks is of increasing concern, and;
- Operating wind farms outwith their design parameters has been noted as a significant contributor to fires.

Summary of Wind Turbine Accident data to 31 December 2023

Incident data is presented chronologically. It can be broken down as follows:

Number of Accidents

Total number of accidents: 3493

Year	Before 2000	2000-2005	2006-2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	109	316	602	174	175	182	169	163	166	189	199	235	318	181	180	135

Fatal Accidents

Number of fatal accidents: 168

Year	Before 2000	2000-2005	2006-2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	24	16	37	16	17	5	3	8	6	9	4	5	9	3	3	3

Please note: There are more fatalities than accidents as some accidents have caused multiple fatalities.

Of the 232 fatalities:

- 138 were wind industry and direct support workers (divers, construction, maintenance, engineers, etc), or small turbine owner/operators.
- 94 were public fatalities, including workers not directly dependent on the wind industry (e.g. transport workers, ecologists).

Human Injury

355 accidents regarding human injury are documented

Year	Before 2000	2000-2005	2006-2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	5	17	67	13	15	9	9	9	10	14	5	48	118	3	7	6

Please note: **There are more injuries than accidents as some accidents have caused multiple injuries.**

During the accidents, 388 wind industry or construction/maintenance workers were injured, and a further 84 members of the public or workers not directly dependent on the wind industry (e.g. fire fighters, transport workers, fishermen) were also injured. Eleven of these injuries to members of the public were in the UK.

Human Health

Since 2012, 219 incidents of wind turbines impacting upon human health are recorded.

Year	12	13	14	15	16	17	18	19	20	21	22	23
No.	6	27	19	13	17	36	28	22	20	14	9	8

Since 2012, human health incidents and adverse impact upon human health have been included. These were previously filed under “miscellaneous” but we believe that they deserve a category of their own. Incidents include reports of ill-health and effects due to turbine noise, shadow flicker, etc. Such reports are

Summary of Wind Turbine Accident data to 31 December 2023

predicted to increase significantly as turbines are increasingly approved and built in unsuitable locations, close to people's homes.

Blade Failure

By far the biggest number of incidents found was due to blade failure. "Blade failure" can arise from a number of possible sources, and results in either whole blades or pieces of blade being thrown from the turbine. A total of 526 separate incidences were found.

Year	Before 2000	2000 2005	2006 2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	35	65	106	20	29	37	32	22	21	19	28	25	32	18	23	13

Pieces of blade are documented as travelling up to one mile. In Germany, blade pieces have gone through the roofs and walls of nearby buildings. This is why we believe that there should be a minimum distance of at least 2km between turbines and occupied housing or work places, in order to adequately address public safety and other issues including noise and shadow flicker.

Fire

Fire is the second most common accident cause in incidents found. Fire can arise from a number of sources - and some turbine types seem more prone to fire than others. A total of 475 fire incidents were found:

Year	Before 2000	2000 2005	2006 2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	7	77	86	23	24	26	21	24	28	26	27	25	25	21	19	16

The biggest problem with turbine fires is that, because of the turbine height, the fire brigade can do little but watch it burn itself out. While this may be acceptable in reasonably still conditions, in a storm it means burning debris being scattered over a wide area, with obvious consequences. In dry weather there is obviously a wider-area fire risk, especially for those constructed in or close to forest areas and/or close to housing or work places. Five fire accidents have badly burned wind industry workers.

Structural Failure

From the data obtained, this is the third most common accident cause, with 263 instances found. "Structural failure" is assumed to be major component failure under conditions which components should be designed to withstand. This mainly concerns storm damage to turbines and tower collapse. However, poor quality control, lack of maintenance and component failure can also be responsible.

Year	Before 2000	2000 2005	2006 2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	15	39	56	13	10	15	13	12	11	15	9	8	10	13	16	8

While structural failure is far more damaging (and more expensive) than blade failure, the accident consequences and risks to human health are most likely lower, as risks are confined to within a relatively short distance from the turbine. However, as smaller turbines are now being placed on and around buildings including schools, the accident frequency is expected to rise.

Summary of Wind Turbine Accident data to 31 December 2023

Ice Throw

47 reports of ice throw were found. Some are multiple incidents. These are listed here unless they have caused human injury, in which case they are included under "human injury" above.

Year	Before 2000	2000 2005	2006 2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	9	12	11	1	1	0	1	1	3	1	2	3	1	0	0	1

Ice throw has been reported to 140m. Some Canadian turbine sites have warning signs posted asking people to stay at least 305m from turbines during icy conditions.

These are indeed only a very small fraction of actual incidences – a report* published in 2003 reported 880 icing events between 1990 and 2003 in Germany alone. 33% of these were in the lowlands and on the coastline.

**("A Statistical Evaluation of Icing Failures in Germany's '250 MW Wind' Programme – Update 2003", M Durstwitz, BOREAS VI 9-11 April 2003 Pyhänturi, Finland.)*

Additionally, one report listed for 2005 includes 94 separate incidences of ice throw and two reports from 2006 include a further 27 such incidences. The 2014 entry refers to multiple YouTube videos and confirmation that ice sensors do not work.

Transport

There have been 287 reported accidents - including a 45m turbine section ramming through a house while being transported, a transporter knocking a utility pole through a restaurant, and various turbine parts falling off and blocking major highways. Transport fatalities and human injuries are included separately. Most accidents involve turbine sections falling from transporters, though turbine sections have also been lost at sea, along with a £50M barge. Transport is the single biggest cause of public fatalities and injuries.

Year	Before 2000	2000 2005	2006 2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.		13	59	24	17	14	17	14	16	19	15	25	23	15	13	3

Environmental Damage (including Bird Deaths)

407 cases of environmental damage have been reported.

Year	Before 2000	2000 2005	2006 2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	1	18	69	20	20	16	21	18	22	16	25	27	27	30	36	40

All involved damage to the site itself, or reported damage to or death of wildlife. 133 incidents reported here include confirmed deaths of protected species of bird. Deaths, however, are known to be far higher. At the Altamont Pass windfarm alone, 2400 protected golden eagles have been killed in 20 years, and about 10,000 protected raptors (Dr Smallwood, 2004). In Germany, 32 protected white tailed eagles were found dead, killed by wind turbines (Brandenburg State records), and a total of 158 dead sea eagles were found between 2002 and 2019 as victims of collisions with wind turbines. In Australia, 22 critically endangered Tasmanian eagles were killed by a single windfarm (Woolnorth). Further detailed information can be found at: <https://www.iberica2000.org/Es/Articulo.asp?Id=1228>.

Up to 1 million bats are estimated to be killed annually by turbines across Canada and the United States. 1.4 million bird fatalities per annum are estimated if the US reaches it's 20% target for wind generation.

Summary of Wind Turbine Accident data to 31 December 2023

Between 2 million and 4 million birds and bats are estimated to be killed annually by wind turbines in Spain alone.

1,500 birds are estimated to be killed per year by the MacArthur wind farm in Australia, 500 of which are raptors.

Also included are thirty-six reported whale deaths off the New York/New Jersey shore from December 2022 to June 2023, attributed to offshore wind turbine construction operations. The effects of microplastics upon humans and our food chain, from disintegrating wind turbine blades, has also started to appear as a recurring topic.

Other (Miscellaneous)

746 miscellaneous incidents are also present in the data.

Year	Before 2000	2000-2005	2006-2010	11	12	13	14	15	16	17	18	19	20	21	22	23
No.	13	59	111	43	36	33	33	42	32	34	56	47	53	64	52	37

These include planning breaches, bribery, breaches of consent and others not able to be easily attributed to other categories. Component or mechanical failure has been reported here if there has been no consequential structural damage. Also included are lack of maintenance, electrical failure (not led to fire or electrocution) etc. Construction and construction support accidents are also included, also lightning strikes when a strike has not resulted in blade damage or fire. A separate 1996 report** quotes 393 reports of lightning strikes from 1992 to 1995 in Germany alone, 124 of those direct to the turbine, the rest are to electrical distribution network.

** (Data from WMEP database: taken from report "External Conditions for Wind Turbine Operation – Results from the German '250 MW Wind' Programme", M Durstewitz, et al, European Union Wind Energy Conference, Goeteborg, May 20-24, 1996)

Summary of Wind Turbine Accident data to 31 December 2023

Resources

This Turbine Accident Summary is available online at <https://scotlandagainstspin.org/turbine-accident-statistics/>.

This is Global data – see Detailed Accident List (<https://scotlandagainstspin.org/wp-content/uploads/2024/01/Detailed-incidents-to-31-December-2023.pdf>), which includes sources and locations.

Acknowledgements

For the 15 years prior to June 2021, this data has been collected and reported on by **Caithness Windfarm Information Forum**. We gratefully acknowledge the time and effort spent gathering the data and hope that we can continue their good work and keep reporting these statistics on a quarterly basis.

Contact Us

If you have any information, you think we should be aware of, please email us at accidents@scotlandagainstspin.org.

Copyright SAS, 2024

The data may be used or referred to by groups or individuals, provided that the source (Scotland Against Spin) is acknowledged and our URL ***scotlandagainstspin.org*** quoted at the same time. Scotland Against Spin is not responsible for the accuracy of Third-Party material or references.