CARBON AND SEQUESTRATION IN FINNISH GOLF

2025

SUOMI GOLF BY GOLFLIITTO

GEO Foundation for Sustainable Golf

SUSTAINABLE GOLF INSIGHTS

As the impacts of accelerating climate change become more evident, golf has both a responsibility and an opportunity to take meaningful climate action. This includes reducing emissions through sustainable practices, enhancing carbon sequestration in landscapes, and credibly offsetting unavoidable emissions. Golf can also raise awareness and inspire action among golfers and the wider community. By calculating their carbon footprint, facilities can identify key areas for improvement, consider offsetting, and lead the way in sustainability.

This insights report covers carbon emissions and sequestration, primarily designed to provide relevant decision-makers in golf with valuable information relating to the sustainability performance of golf in their region. The report is part of a series available across the Sustainable Golf Framework: Fostering Nature, Conserving Resources, Strengthening Community, and Taking Climate Action.

Emissions Reduction

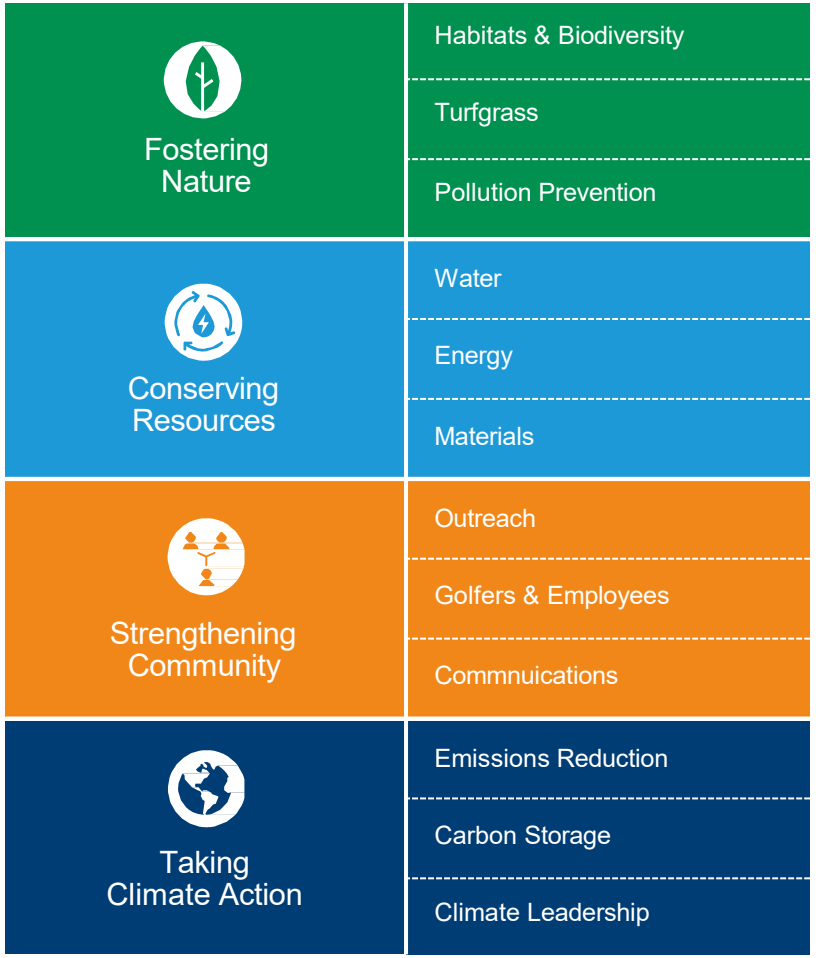
Reducing carbon emissions involves using energy efficiently, adopting renewable sources, recycling water and materials, avoiding single-use items, reducing landfill waste, and shortening supply chains. Sustainable travel and environmentally friendly food choices also play a role.

Carbon Storage

Carbon sequestration involves storing carbon in plants and soils. Golf courses can enhance sequestration by introducing native vegetation, planting trees and shrubs, protecting wetlands, and managing turfgrass carefully. These actions capture carbon and also improve biodiversity and ecosystem health.

Climate Leadership

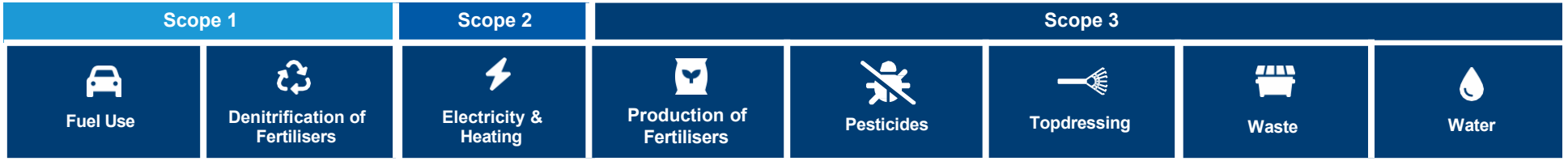
Since it's not possible to eliminate all emissions, carbon offsetting can balance the remainder by investing in credible climate projects. Golf can also raise awareness and inspire action among players, staff, and the wider community. By leading in these areas, golf can set an example for other sports to follow.



EMISSIONS SCOPING

Boundary Mapping

To categorise carbon emissions, they are divided into scopes. Scope 1 are direct emissions from the activities of an organisation or those under its control (e.g., emissions associated with fuel combustion in vehicles, denitrification of fertilisers, etc.). Scope 2 emissions are more indirect associated with purchases of electricity, heat or cooling. Scope 3 encompasses all other emissions, including those further into the supply chain.



Fuel Use

Includes fuel and oil used for utility vehicles, generators, and any other machinery.

Electricity & Heating

Includes renewable and grid electricity as well as heating for club house and other facilities.

Pesticides

Upstream manufacturing including the release of VOCs and greenhouse gases.

Waste

Includes waste diverted through recycling, compost, incineration, and waste sent to landfill where applicable.

Denitrification of Fertilisers

Soil-based process where microbes convert added nitrogen into greenhouse gases.

Production of Fertilisers

Upstream manufacturing from minerals, chemicals, and organic sources.

Topdressing

Includes the sourcing whether by mining or on-site as well as any transportation.

Water

Includes water used for course management, club house, and maintenance facility operations.

REPORT DEVELOPMENT

Methodology

GEO Foundation developed our methodology in alignment to established global best practices, including:

- IPCC Methodology for Greenhouse Gas Inventories (2006 Guidelines, 2019 Refinement)
- ISO 14067: Requirements and Guidelines for Carbon Footprint Quantification of a Product (2018)
- PAS 2050: How to Assess the Carbon Footprint of Goods and Services (2008)
- Bilan Carbon Method
- Greenhouse Gas Protocol: Corporate Standard
- United Nations Sports for Climate Action Framework

Data Source

The primary data source for this analysis is OnCourse®, golf's online platform for tracking sustainable golf performance, delivered for the industry by GEO Sustainable Golf Foundation and aligned to the Sustainable Golf Framework. Through the platform, individual golf courses track best practices undertaken and the resulting annual data across action areas in the Sustainable Golf Framework: Nature, Resources, Community, and Climate Action.

Relating to Climate Action, detailed quantitative and qualitative information is gathered relating to:

- Land and water stewardship
- Resource efficiency and usage
- Turfgrass maintenance through irrigation and plant protection
- Waste disposal
- Habitat conservation

Data are selected from self-reported as well as fully verified and certified data sets. Data are collated and aggregated across 2023 and 2024 unless otherwise shown.

Emissions Factors

In order to convert the data metrics into carbon equivalents, emissions factors must be applied. The majority of emissions factors cited in this report are from the UK Department of Environment, Food, and Rural Affairs (DEFRA), which are applicable at an international level as most factors have universal chemical and thermogenic conversion rates. For country specific factors, like grid electricity, a bespoke value is researched and typically sourced from a similar national-level environmental authority.

Analysis

After cleaning and determining statistical relevance, data were collated by year, allowing for trended data to be summarised. For snapshot analysis, the most recent year of submitted data for each course was used with all data being from within the last three years. To better account for performance of a standard golf course and eliminate differences in total land area, some data were normalised per 18-holes when applicable.

For best practices, the total count per facility was determined, then further broken down by the proportion of courses implementing the top practices associated with responsible water management. Key takeaways were presented through infographics, tables, and charts for better synthesis.

From the full list of self-reported entries, data cleaning was conducted to eliminate potential irregularities and outliers, while prioritising verified data form Certified courses. The ultimate sample size was found to be 35 clubs, which assuming 130 golf facilities in Finland, gives a 14% margin of error to maintain a 95% degree of confidence.

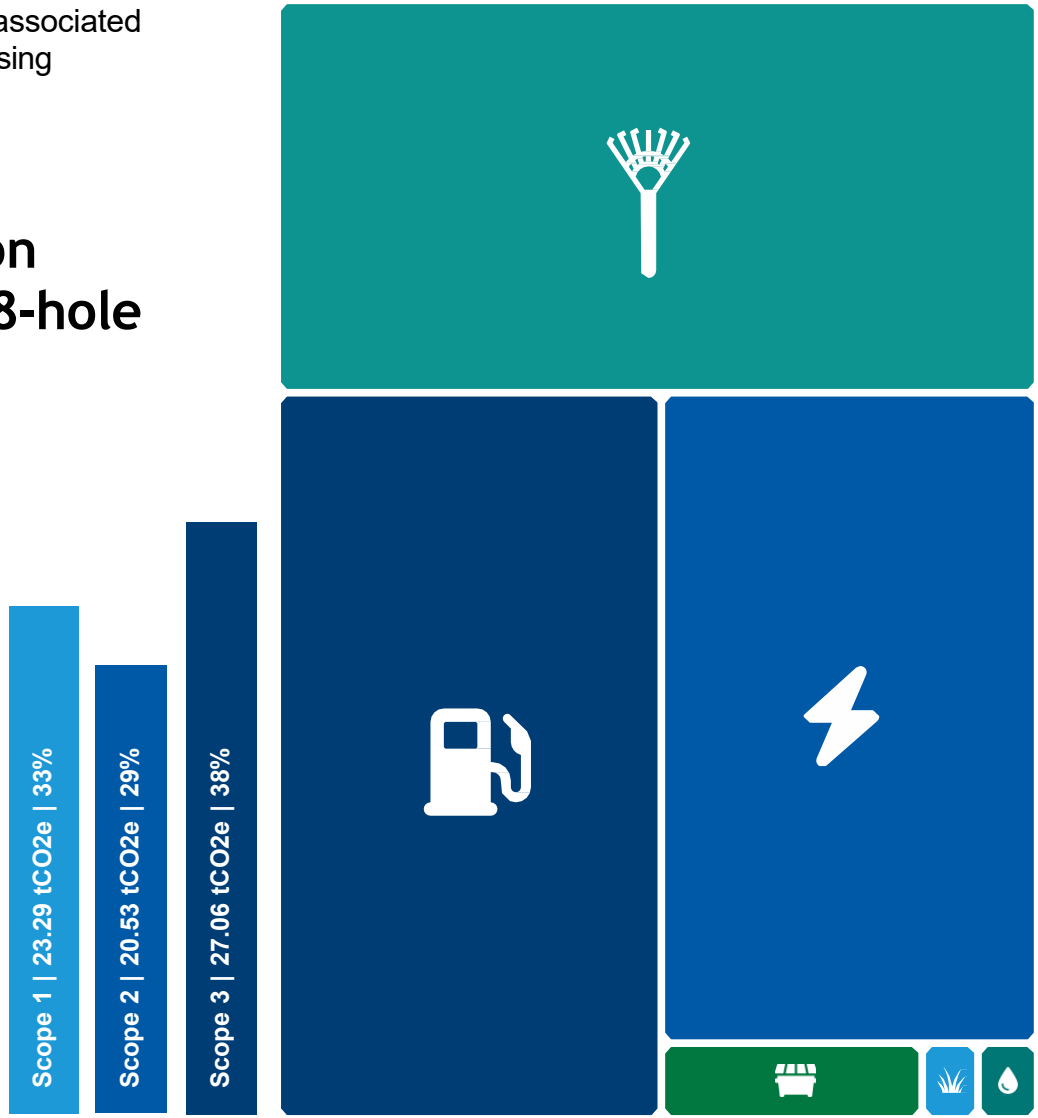
Assumptions

- **Energy:** Country-specific grid factors are applied, unless a green energy provider is noted with a specific emissions rate.
- **Fertilisers:** An average emissions factor is applied across both organic and non-organic sources.
- **Pesticides:** If Active Ingredient and Product Name are not provided, an assumed concentration is applied.
- **Topdressing:** An average distance is embedded into the emissions factor related to transportation.
- **Sequestration:** Average emissions factors are applied based on habitat type and turf age.

EMISSIONS OVERVIEW

Based on the data provided, the associated carbon footprint was calculated using country-specific carbon emission conversion factors for 2025.

The average carbon emissions for an 18-hole golf facility was 70.87 tCO2e



Fuels
23.28 tCO2e - 32.85%

Electricity
20.53 tCO2e - 28.96%

Turf inputs
0.34 tCO2e - 0.48%

Topdressing
24.79 tCO2e - 34.97%

Water
0.34 tCO2e - 0.50%

Waste
1.59 tCO2e - 2.25%

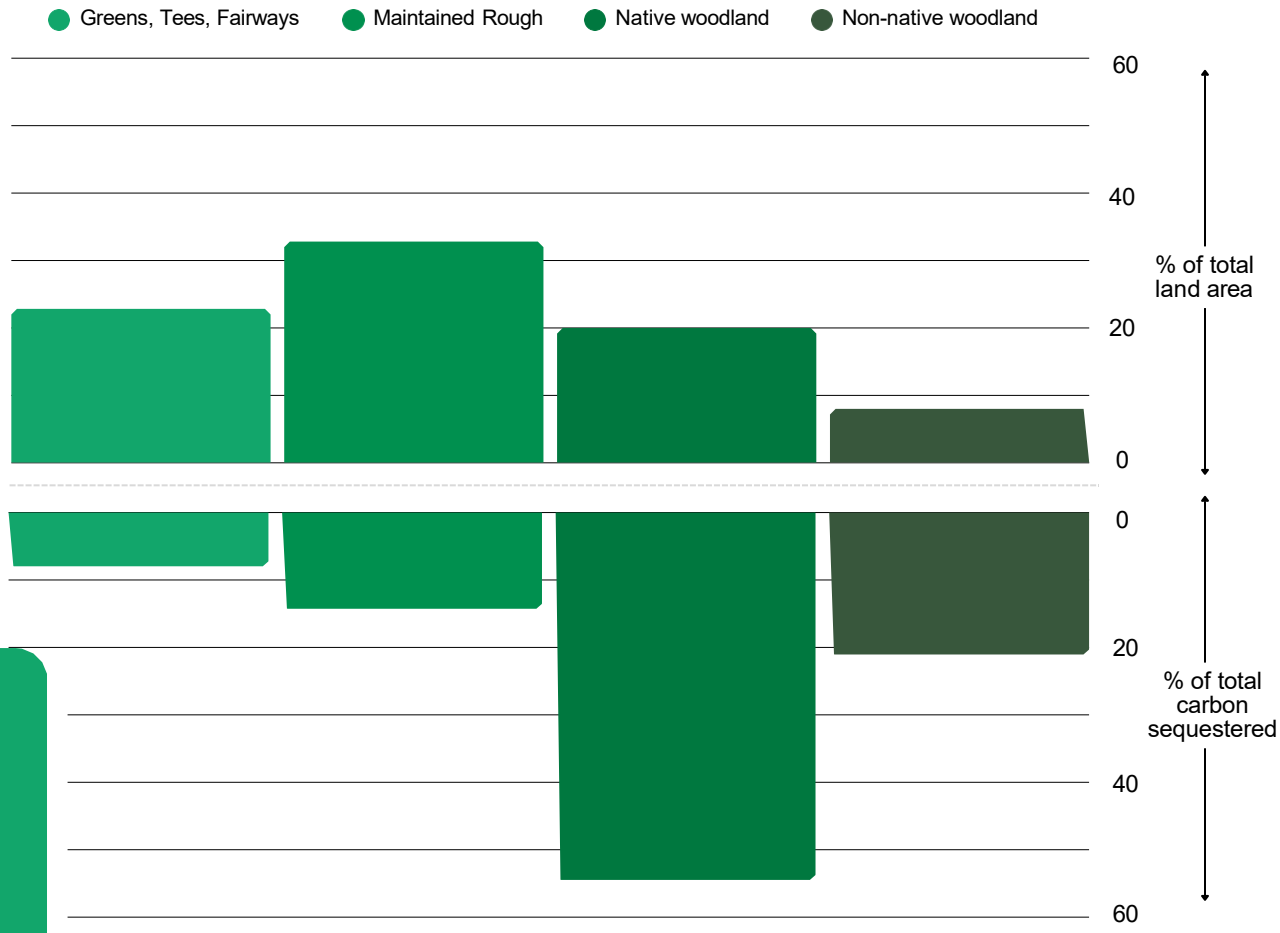
SEQUESTRATION OVERVIEW

Based on the data provided, the associated annual sequestration rate was calculated using habitat-specific factors.

The average carbon annual sequestration for an 18-hole golf facility was

160.21 tCO2e

Carbon sequestration potential of land types



Average 18-hole facility sequesters the equivalent of

16

hectacres of European forests in one year

Average 18-hole facility sequesters

2.26

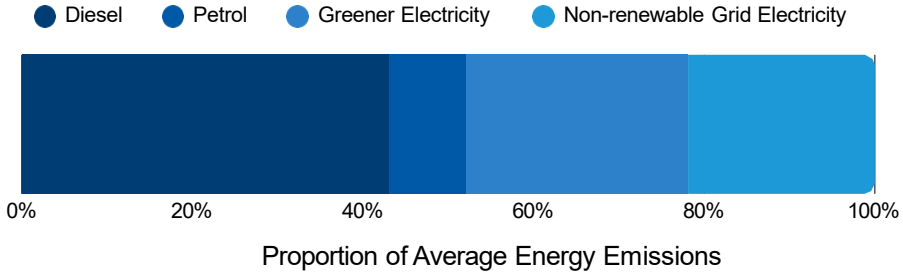
times the amount of carbon they emit per year

INSIGHTS

Energy

Energy (electricity and fuels combined) is responsible for the majority of emissions at golf courses in Finland, accounting for roughly 60% of its total carbon footprint.

Specifically, Diesel was the largest source of Fuel emissions, contributing 26.5 tCO2e each year for the average golf facility, compared to just about 5.5 tCO2e for Petrol. This is due to not only greater use of Diesel but that comparatively it is roughly 20% more carbon-intensive than Petrol.



Proportion of Average Energy Emissions

Reducing Energy Emissions

In order to mitigate the emissions from electricity and fuels, it is important to not only examine the sources of this energy but also the practices used to reduce demand.

In general, courses are very proactive at installing LED lightbulbs to reduce electricity demand and many have looked into greener energy providers, especially for their Clubhouse. Actions that require more change to existing infrastructure like better insulation of walls and ceilings, window glazing, and heat pumps are understandably less common, likely due to their expense but can help save money and emissions over time by reducing energy demand for heating and cooling.

Practice	Maintenance Facility
LED lightbulbs	90.24%
Explore possible greener energy providers	58.54%
Low U-Value insulation (walls, ceilings/roofs)	43.90%
Air source heat pump	41.46%
Energy audit by external professional	4.88%
Photovoltaics	14.63%
Ground source heat pump	9.76%

Electric Machinery & Photovoltaics

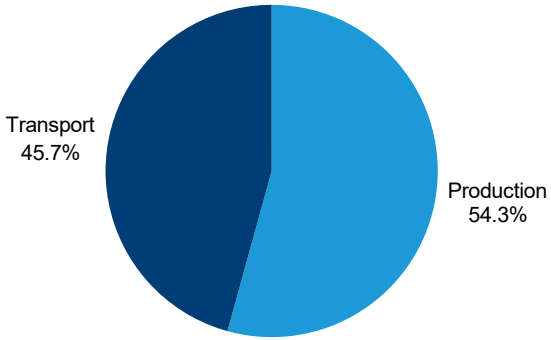
While photovoltaics (or solar panels) are a great investment to promote renewable energy across a golf facility, they can provide added benefit to Maintenance Facilities where electric course management equipment are stored and charged.

While 14% of Maintenance Facilities reported having photovoltaics, over three-quarters of golf clubs in Finland reported having electric buggies and carts. This not only avoids the need for fossil fuels like diesel but when in combination with solar charging, results in renewably powered vehicles. Further promoting the use of electric mowers, tools and other utility vehicles along with photovoltaics could significantly reduce energy demand and associated emissions in Finland.

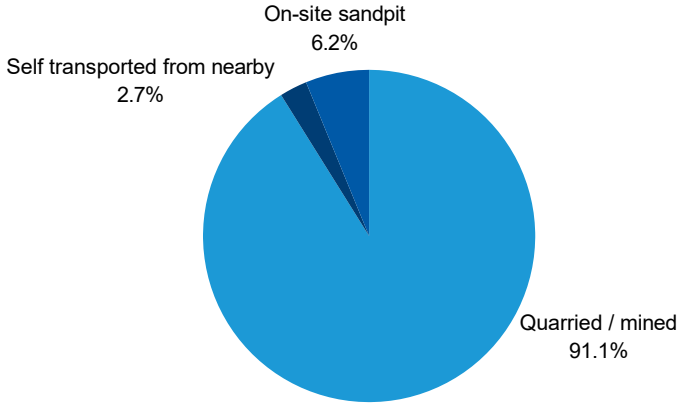
Electric buggies and carts	75.61%
Electric mowers	36.59%
Electric robotic mowers	31.71%
Electric tools (strimmers, leaf blowers etc.)	26.83%
Electric utility vehicles	17.07%

Topdressing

Topdressing was the single largest source of emissions, accounting for roughly 35% of total emissions. The way that topdressing is sourced has a significant effect on emissions generated.



With over half of emissions related to topdressing coming from its production, quarried/mined topdressing produces more than double the carbon of on-site / self-transported material.



In Finland, over 90% of golf courses topdressing is quarried or mined. Reducing this percentage would have a significant effect on reducing carbon emissions.

70.73%

of facilities modify or remove energy intensive features like sand bunkers

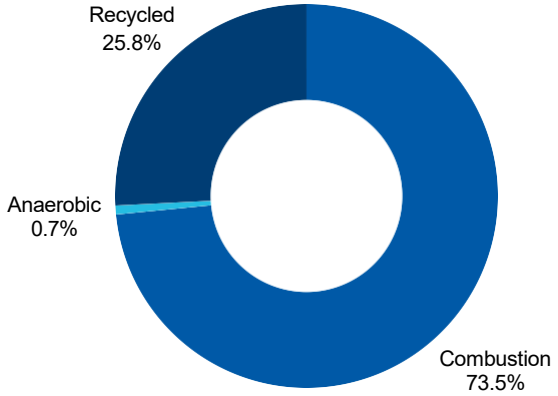
39.02%

monitor patterns of play to identify underutilised bunkers

Sourcing is not the only way to reduce emissions. Implementing best practices on the golf course can reduce the need for topdressing and limit the amount of material required.

Waste

On average, an 18-hole golf facility in Finland will produce roughly 10.67 tonnes of waste each year. The majority of this waste is sent to combustion. This process still results in greenhouse gases being released, but it does allow for energy capture to support electric grid demand away from other fossil fuels. Recycling accounted for over a quarter of the waste produced which helps support a circular economy and reduce future upstream emissions by avoiding the production of new materials. Anaerobic digestion, like composting, represented less than one percent but this still equates to about 70 kgs each year which could be converting food waste into nutrient rich soil for the facility.







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