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Can golf courses store carbon?

New STERF research project estimates the carbon status of land used by Icelandic golf courses

By Edwin Roald and Jón Guðmundsson

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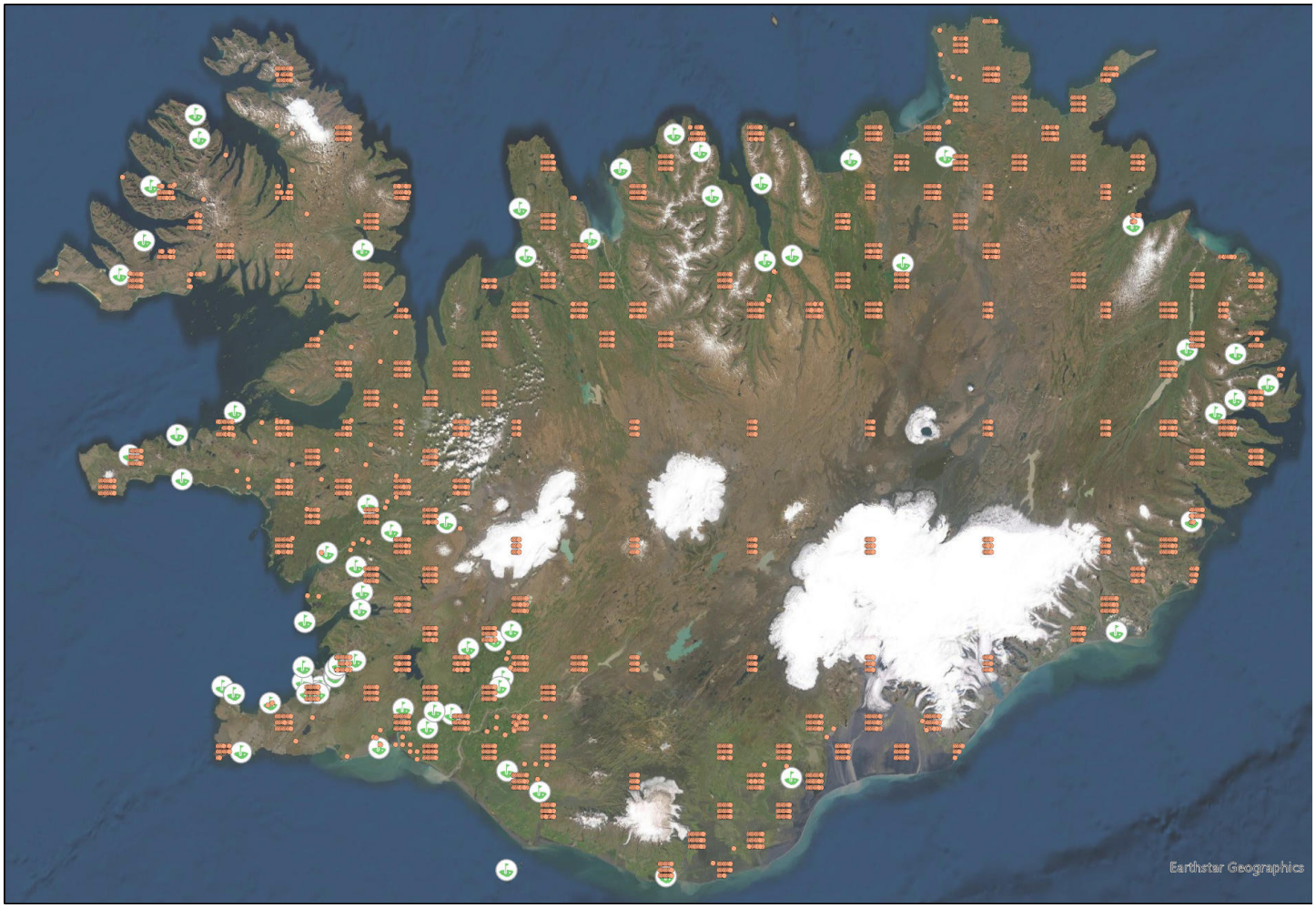


Iceland has just over sixty golf courses. The picture shows their location (white and green icons) and soil samples listed in AUI databases (orange). Some of these can prove useful and reduce the number of new samples required to estimate the golf courses' carbon status. Courtesy of The Agricultural University of Iceland.

Climate change is among the world's most critical issues. An increase in greenhouse gases, including CO_2, is directly linked to rising temperatures and sea levels, declining air quality and unstable, extreme weather.

Carbon sequestration, the process of capturing and storing atmospheric carbon dioxide, is key to mitigating climate change. Common sequestration methods are forestry, various geoengineering techniques and changes in land use. The latter includes reclaiming or avoiding the draining of wetlands, which releases CO_2. This loss can be estimated using default emission factors issued by the IPCC or by applying refined country specific emission factors.

Grass can store carbon

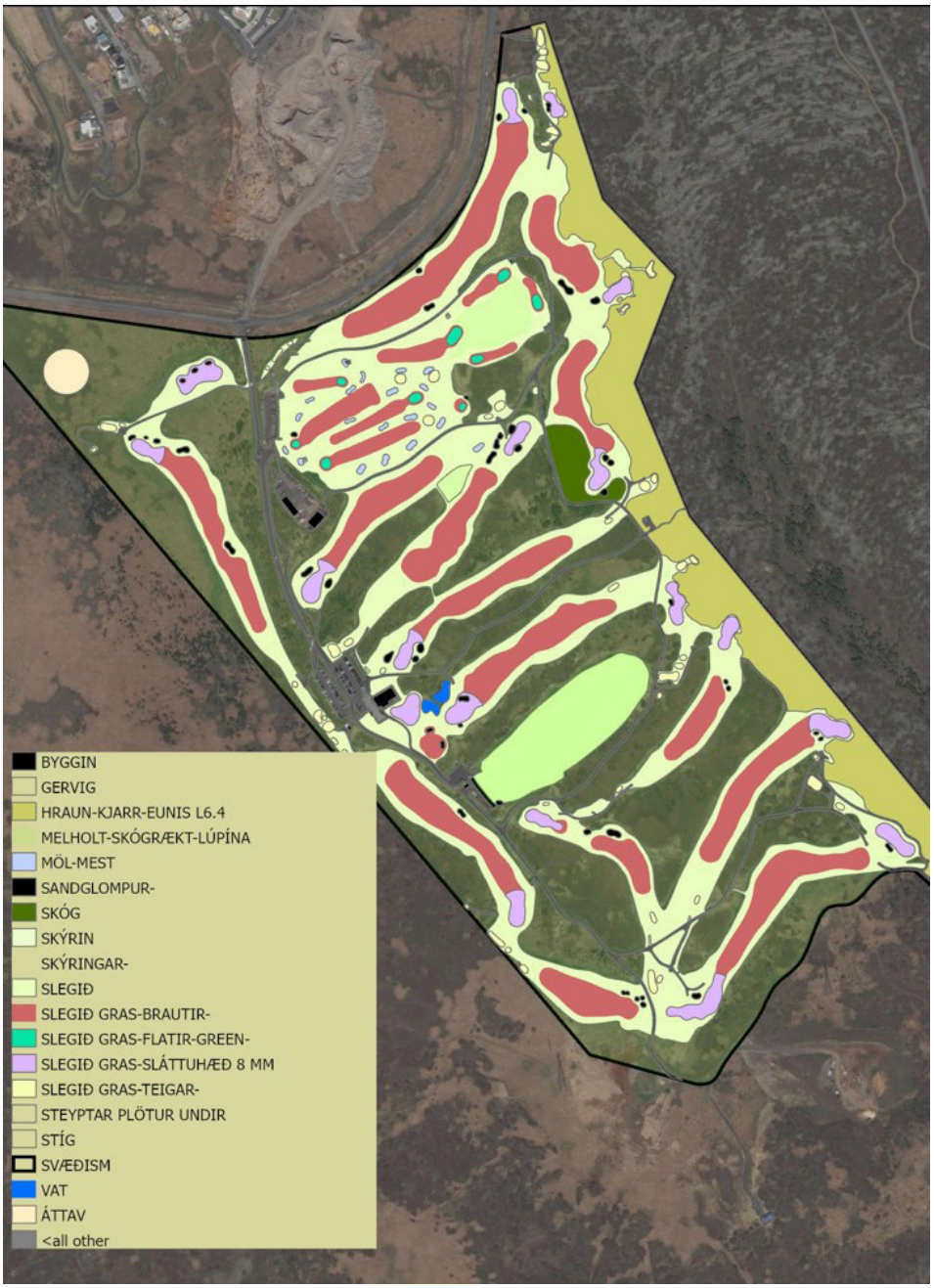
Generally, golf courses can be considered large land users. The development of some of them has included wetland drainage or the use of previously drained wetlands. By this many clubs have unintendedly caused large emissions of greenhouse gases. Emissions from golf courses on drained organic soils can thus be very high, while courses on mineral soils can sequester carbon. Grass, golf's quintessential playing surface, can sequester considerable levels of carbon (Zirkle et al, 2011). Furthermore, managed grasslands, or turf, can sequester more carbon than unmanaged (Bandaranayake, 2003).

Obviously, the calculation of a golf facility's complete carbon footprint must account for management inputs, including emissions from mowers, energy used to pump irrigation water and the manufacturing and delivery of products such as fertilizer and seeds. However, with recent breakthroughs in electric, autonomous mowers and continued innovation in renewable energy, such as small wind turbines and solar cells, a new reality may present itself.

Drawing on new knowledge from research performed by Pirchio et al (2018), the hypothesis is that the more frequent mowing made possible by robots may speed up carbon sequestration or achieve equal sequestration with lower fertilizer applications. This indicates that well located golf courses, thoughtfully planned, designed and built, have a reasonable chance of becoming net carbon sinks.

This is the topic of Carbon Par, one of STERF's newly funded research projects, operated by Eureka Golf in collaboration with The Agricultural University of Iceland (AUI), and the first ever STERF-funded project operated entirely in Iceland.

The project, which runs from 2020 to 2022, will estimate the carbon status of land used by Icelandic golf courses, setting a benchmark for each golf club to improve upon and hopefully play a meaningful role in combating climate change.



This is what the golf course maps look like after an initial import by The Agricultural University of Iceland, AUI. Picture courtesy of AUI.

Can the carbon status of existing golf courses be improved?

The project's aim is to answer the following research questions:

a) What is the CO_2 loss and carbon storage from land use of cultivated and managed areas on Icelandic golf courses, in total and by facility?

b) Can the estimation process be streamlined beyond the project description? If yes, how?

c) What is required in terms of funding, time and other resources to produce a similar estimation for other Scandinavian countries?

d) Are there marked trends revealing or suggesting how golf facilities can, in a general sense, easily improve their carbon status from land use without negatively influencing the playing experience? If yes, what are they?

Jón Guðmundsson discusses soil sampling at Selfoss Golf Club, with greenkeeper Gunnar Marel Einarsson and AUI colleague María Svavarsdóttir. Photo: Edwin Roald.

Par is also found in nature

The name, Carbon Par, is obviously inspired by the well known terminology in golf, par, meaning a benchmark in scoring desired by many, and one which may be likened to carbon neutrality. Furthermore, PAR is also an abbreviation for photosynthetic active radiation, the amount of light available for photosynthesis.

It is through this process which plants are able to extract carbon dioxide from the atmosphere and store it in soils and biomass as carbon.

The carbon leaderboard

To estimate the carbon status of land used by all golf courses within the Golf Union of Iceland, a variety of methods will be used, including mapping, references to national soil databases, soil sampling, interviews and analysis. Perimeters of various golf course land use elements, such as fairways, managed roughs and native areas will be drafted up in architectural software, using underlying georeferenced aerial photographs. Each golf course area will be broken down into 3-4 basic soil types.

Soil samples will be collected from a selection of golf facilities and analysed by dry combustion, delivering %C and %N content. Access to IGLUD (Icelandic Geographic Land-Use Database) and the ÝMIR-soil database will allow soil C content to be compared to corresponding areas near the perimeter of the golf facilities. This should indicate a loss or sequestration of C during the golf courses' lifetime, compared to surrounding areas and land use. The project will then produce:

a) a "leaderboard" of Icelandic golf facilities, by carbon status, or carbon par, from land use.

b) a breakdown of each/all courses by the chosen 3-4 basic soil types.

c) a report on the estimation process and recommended protocol for estimation in other countries.

d) an identification of wetlands that can be reclaimed.

e) general recommendations as to how golf facilities can make quick and easy improvements to their carbon status from land use.

A special effort will be made to avoid that suggestions in items d and e will negatively influence the golf playing experience. Scapegoating is not an objective. Rather, the aim is to present an opportunity to improve upon unintended harm to the climate.

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The researchers:
Golf architect meets climate scientist

Edwin Roald, the project leader and co-ordinator, is the director of Eureka Golf, an environmentally focused golf course design, planning, consulting, research and data analytics company. Edwin has worked independently and internationally as a golf course architect for 18 years and has eight years of experience from turfgrass and environmental research as a board member of STERF. He is a member of The European Institute of Golf Course Architects (EIGCA), a past EIGCA board member and EIGCA's Sustainability Committee Chairman. Edwin is an accredited verifier for the GEO Certified-Operations ecolabel, an international speaker and author of golf course land-use concepts such as Why18holes.com.

Jón Guðmundsson is a researcher and assistant professor in the Faculty of Environmental Science at The Agricultural University of Iceland. Jón has led and participated in a variety of research projects on carbon stock and greenhouse gas fluxes, e.g. in relation to different land use and land cover. Since 1998, Jón has been responsible for reporting the LULUCF-sector for Iceland to the UNFCCC and Kyoto Protocol, both at the Agricultural University and its predecessor, The Agricultural Research Institute. Jón also plays a key role in active collaboration between the university and the SCSI. Jón will lead the work performed by the university, e.g. by advising on the selection of golf facilities for soil sampling, interpreting lab analysis, advise on the number of basic soil categories for breakdown, provide appropriate emission factors and co-author disseminated results.

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Project emissions to be offset

In addition to communicating scientific results, dissemination will aim to provide inspirational leadership and raise awareness among golf course managers on climate change and realistic mitigation methods, as well as informing authorities and the non-golfing community on golf's potential in this area. CO_2 emitted by the project will be offset through annual payments to the Icelandic Wetlands Fund and/or the Kolvidur Carbon Fund.

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