GOLF COURSE 2030
PORTUGAL

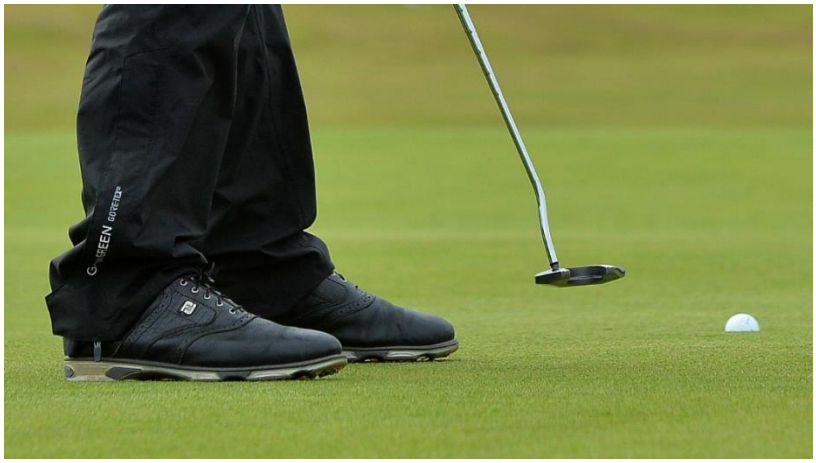




An industry roadmap addressing challenges from, and taking opportunities presented by, the changing climate, resource constraints and regulation to secure optimal golf course condition and playability for current and future generation.

February 2020

INTRODUCTION TO GOLF COURSE 2030



Golf Course 2030 was initiated by The R&A in 2018. The R&A governs the sport of golf worldwide, outside of the USA and Mexico, on behalf of over 36 million golfers in 143 countries and with the consent of 156 organisations from amateur and professional golf. The R&A is committed to investing in developing golf and supports the growth of the sport internationally, including the development and management of sustainable golf facilities. The R&A continues to lead the Golf Course 2030 initiative, supporting stakeholders to develop the initiative in their own country or region and investing in research, education and other activities to prepare the sport for what may be challenging times ahead.

The main objective of Golf Course 2030 is for industry stakeholders to agree on a roadmap that secures optimal golf course condition and playability for current and future generations by addressing challenges from, and taking opportunities presented by, the changing climate, resource constraints and regulation. The roadmap needs to meet strategic needs at regional, national and local level, and the operational needs at golf facility level.

The remit for Golf Course 2030 is the condition and playability of the main in-play areas on the golf course, from tee to green, including fairways, bunkers, green approaches and surrounds, and the primary rough. However, the roadmap will also need to highlight any impact of outcomes on biodiversity, the local community and the multi-functional capacity of the green space.

Golf Course 2030 seeks to bring the golf industry together to clearly identify the challenges and opportunities facing those developing, designing, building and managing golf courses with regards to the changing climate, increasing resource constraints, and the regulations agenda.

Golf Course 2030 centres on a range of realistic scenarios, from business as usual to, effectively, a doomsday prediction of disruption from extreme weather, water scarcity, high resource costs and limited chemical availability. In this challenging environment it is impossible to see how we can maintain the playing conditions we enjoy today without technological breakthroughs, and changes in attitudes and behaviours amongst many of the sport's stakeholders, including golf club owners, golfers, managers and greenstaff.

In addition to the production of the roadmap, Golf Course 2030 aims to prepare the sport for what may be difficult times ahead; to help ensure that current strategies and solutions are effective; to uncover new solutions which can mitigate some of the challenges; and to make the most of opportunities that arise to enhance course condition and playability.

The process for achieving the objective of Golf Course 2030 will bring stakeholders together to:

- raise awareness of the potential impact of the challenges and opportunities on course condition and playability
- agree priority issues within a region or country
- undertake analysis of current strengths and weaknesses in knowledge and understanding; practitioner education; tools for information dissemination, club engagement, knowledge sharing, tracking of progress, consumer awareness and external relations
- devise and implement forward plans across key areas of strategy
- review progress on agreed priorities and goals, and once successfully addressed, move on to other issues
- engage with decision makers at golf facilities to ensure that proposed solutions are implemented
- highlight the key role to be played by course management staff in delivering an optimal standard of golf course condition and playability.

In this way, Golf Course 2030 will build upon and guide the future development of existing industry solutions and association initiatives, including those that:

- disseminate engaging messages and raise awareness
- engage and support clubs through the provision of best practices, analytical tools, golfer engagement materials and recording of key performance data
- enable credible reporting of evidence of industry best practice and industry progress
- facilitate knowledge sharing
- recognise credible leadership activity in course management.

What is optimal course condition and playability?

Optimal course condition and playability is a subjective and variable term. It reflects the potential for any golf course to provide year-round access to firm playing surfaces which are fit for purpose. The potential of any course will be limited by many factors. Optimal condition and playability could be considered as:

Optimal course condition and playability = Potential x [Site conditions + Design + Construction + Resources (machinery, manpower, materials) + Quality of Decision-Makers/Management + Weather + Golf Objective + Amount of golf/maintenance traffic + Revenue + Regulation]

The Golf Objective in this equation reflects the target market of the course and this can range from Championship standard (challenging), through Recreational standard (appealing to all golf handicaps), to Beginner standard (introductory level to the sport, with limited challenge), or any combination of these standards.

Optimal performance delivers the potential of a course for as much of the year as possible and as consistently as possible.

The optimal performance in terms of the condition and playability of any golf course will vary through fluctuations of the limiting factors, e.g. seasonal weather. Different types of courses will be more or

less prone to some of the fluctuations, e.g. thanks to their natural drainage qualities, links will tend to retain greater consistency in terms of optimal performance than will parkland through periods of wetter weather.

GOLF COURSE 2030 STAKEHOLDERS

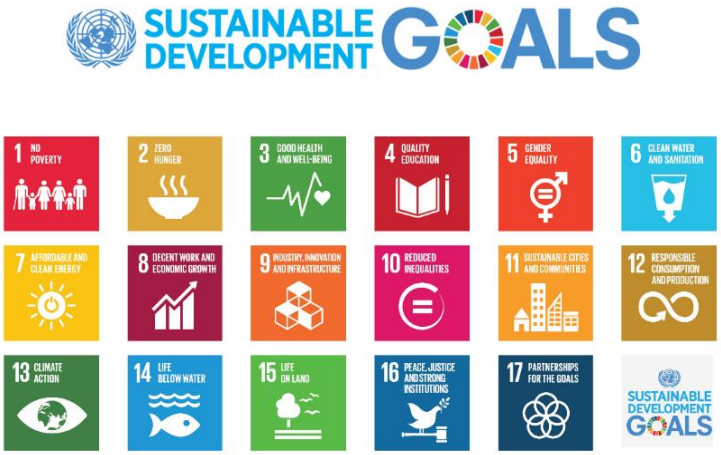
The industry stakeholders to be engaged in the Golf Course 2030 process are:

- The R&A
- GEO Foundation
- Portuguese Golf Federation
- Portuguese Golf Managers Association
- Portuguese Greenkeepers Association
- PGA Portugal
- Course owners
- Golf Clubs
- Suppliers
- Sponsors

External Stakeholders:

- Instituto Português do Desporto e Juventude, I.P.
- Turismo de Portugal, I.P.
- Comité Olímpico de Portugal
- Municipalities (308) and two autonomous regions Azores and Madeira
- Evironmental NGOs
- Researchers and Consultants
- General public and non-golf media.

DRIVERS FOR ADAPTATION



There are considered to be three main drivers impacting on our ability to secure optimal golf course condition and playability for current and future generations; climate, resources and regulation. Golf Course 2030 must assess how the impacts of climate change, availability of resources and increasing depth of regulation will affect day-to-day operations at the golf facility.

1. Climate

Country context:

Portugal comprises three different areas: the mainland in the European Continent (the Mainland) and two archipelagos in the Atlantic Ocean, the Archipelago of the Azores and the Archipelago of Madeira[1].

Portugal's territory has a total area of 92,226 km^2 and a coastline of 2,601 km. Portugal's population is estimated at 10.3 million (2015), of which 65.2% live in urban areas. In mainland Portugal, resident population is concentrated along the Atlantic coast.

The climate in mainland Portugal is predominantly influenced by latitude, orography and its proximity to the Atlantic Ocean. Portugal has a Mediterranean type of climate characterized by warm and dry summers and cool and wet winters. The average annual air temperature varies between 7◦ C in the inner highlands of central Portugal and 18◦ C in the southern coast. The average annual precipitation is around 900 mm with a strong north–south gradient, reaching values of 3000 mm in the northwest mountains and values below 500 mm in the southeastern part of the country.

Precipitation in Portugal shows high interannual variability. Most of the annual precipitation is accumulated through migratory storms during the period of November to April. On average, 42% of the annual precipitation falls in winter, from December to February, and only 7% in summer, from June to August. In the spring and autumn transition seasons the amount of precipitation is highly variable.

The SIAM (Climate change in Portugal. Scenarios, impacts and adaptation measures) projects (2002 and 2006) were the most comprehensive multi-sectoral national climate change impacts

[1] https://climateknowledgeportal.worldbank.org/country/portugal

and vulnerabilities assessments for Portugal[2]. The studies were based on future climate scenarios and associated effects on several socio-economic sectors and biophysical systems including hydrological resources, coastal areas, energy, forests and biodiversity, fishing, agriculture and health. A sociological analysis of climate change in Portugal was also performed.

Since the mid-70s the average temperature has risen in all regions of Portugal at a rate of approximately 0.3°C per decade. Out of the ten warmest years, seven occurred after 1990, with 1997 being the warmest year, followed by 2019. The last four decades have been continuously drier, the driest one being 2001-2010.

Heat waves have occurred in the years 1981, 1991, 2003, 2006, 2009, and 2010, becoming more frequent since the beginning of this century.

The tendency is of more intense and frequent extreme weather and climate events, in particular heatwaves, droughts and annual number of very wet days.

Climate predictions for Portugal suggest that there will be changes to our weather patterns such as: the increasing of the average temperature, the more frequent heatwaves and the very likely decrease in precipitation and intensification of droughts. These changes will have significant adverse effects in various socio-economic sectors, such as water resources, agriculture, forests, biodiversity, health, and tourism.

Over the years Portugal did not have serious water shortage problems under normal hydrological conditions. To date, water resources available in continental Portugal are sufficient to satisfy current needs of consumers, which are represented for 87% by the agricultural sector[3].

Usually, even in the driest years, there is no water deficit if the whole year is considered. However, in the Algarve, where the problem is more significant, a proportion of the used water comes from inter-basin water transfer. If there was no water regulation, water deficit could occur[4].

Nevertheless, seasonal and annual variability in rainfall and consequently in water availability contributes to a geographical and temporal mismatch between water availability and water demand. This is particularly accentuated in the south of the country, notably the Algarve. This irregularity is responsible for a significant number of water stress situations and complicates water resources management in Portugal.

According to a study as part of the Aqueduct project of the World Resources Institute[5] - a non-profit entity headquartered in Washington and funded by foundations, governments, non-governmental organisations and international bodies – Portugal is among the 44 countries that deplete at least 40% of their water reserves, putting the country in a situation of high risk of water scarcity. The situation is set to worsen as climate change makes precipitation more variable.

Stopping the drilling of new boreholes and promoting the use of treated wastewater in agriculture and tourism are the main measures suggested by the Portuguese government in 2019 to tackle the country's state of drought which is particularly dire in the Algarve and Alentejo.

[2] https://climate-adapt.eea.europa.eu/countries-regions/countries/portugal
[3] overview and assessment of climate change adaptation in Portugal
https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/portugal_climate_change_en.pdf
[4] COMMISSION STAFF WORKING DOCUMENT Report on the implementation of the Water Framework Directive River Basin Management Plans Member State: PORTUGAL https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52015SC0055
[5] https://www.wri.org/aqueduct

Climate changes will amplify the vulnerability to desertification that already affects 36% of the continental territory. Another major concern is the increase in the risk of inundation and land loss in the Portuguese continental coast (where erosion is already significant in about 67% of its length) due to sea-level rise.

The total coastline of Portugal measures 1187 km. The Portuguese coast has a wide variety of features which can be classified in 4 main types: beaches, wetlands, hardened and cliffed coasts. About 60% of the population inhabits the coastal zone, where most of the larger cities are situated, rising up to 80% in the touristic summer months.

The mainland is mainly at risk of Sea Level Rise (SLR) and changes in both the direction and the power of waves and storm surges. Consequently, the main climate change impacts for the Portuguese coastal zone include the risk of (permanent) flooding and erosion, freshwater shortage and potential loss of eco-systems.

The high rates of erosion make the Portuguese coastal zones increasingly vulnerable to climate change and especially to rises in sea level. The coastal zones north of Lisbon and the Algarve barrier coast are considered most exposed, and some marshes and wetland areas may cope with the increased sea level through upward and landward displacement. Examples of areas under threat and facing serious problems are: Ofir, south of Espinho, south of Aveiro and Costa da Caparica on the west coast, and Quarteira-Vale do Lobo and Ria Formosa National Park on the south coast.

The effect of climate changes is expected to contribute to increasing the extent, intensity and frequency of rural fires in certain areas of the country[6]. Warmer spring and summer temperatures, coupled with reduced availability of water, dry woody materials in forests and increase the risk of rural fires. The months of June 2015–2017 along with the four-year period 2003–2006 were the hottest since record keeping, coinciding with years of larger fires.

Climate changes could also contribute to an increase in the severity of future insect outbreaks. Rising temperatures may allow some species of insects to develop more rapidly, alter their seasonal life cycles, and expand their activity to other latitudes than usual.

In addition, higher temperatures may also increase the transmission risk levels of zoonoses that are currently endemic to Portugal like leishmaniasis, Lyme diseases, and Mediterranean spotted fever[7].

The impacte of Climate change on golf courses in Portugal:

Changes in the climate and more climatic extremes cause problems for course managers in Portugal. Extremes like heat and drought that result from climate change are starting to impact the game - both the players' comfort and the course conditions.

Turf does best in an environment with limited variability, and changes in weather patterns will result in the need for course management to adjust to such circumstances, to make sure that golf courses and golfers have the most sustainable conditions – ecologically and economically – possible, and that means to increase resiliency to climate change extremes.

[6] The Evolution of Climate Changes in Portugal: Determination of Trend Series and Its Impact on Forest Development https://www.mdpi.com/2225-1154/7/6/78/htm

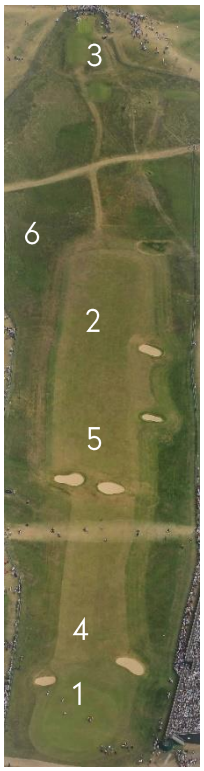
[7] https://journals.lww.com/epidem/Fulltext/2006/11001/Human_Health_Impacts_of_Climate_Change_in.1128.aspx

Turfgrass management to ensure more efficient water and turf practices, including adequate root zone soil water, and the selection of more resilient turfgrasses and new versions of salt-resistant grasses with greater drought tolerance, allowing the use of desalinated or recycled water for irrigation, which has more salt content than freshwater, will provide opportunity to increase climate resilience.

Contingency planning should be part of the golf sector at all scales, from national policy and planning to local application by course managers.

Contingency plans have the potential to increase adaptive capacity by enabling more rapid and efficient response to climate change risk events. Contingency plans, containing pre-agreed processes to be followed in response to a particular risk event, can be a key risk management tool in efforts to reduce the level of risk from projected climate change, saving money and preventing further damage.

2. Resources



The resources considered essential for today's golf course are likely to become scarcer and cost more. This applies to water, pesticides, fertilisers, sand, energy, labour, etc. Resource use on the golf course varies dependent on the type of course, e.g. links or parkland, and on the intensity of management related to the area of the course being treated. A golf hole (see image to left) is made up of a number of different areas, which tend to receive different levels of treatment.

The greens (1 on image) are the most intensively managed part of the golf course, yet only take up around 1 hectare of the 60 hectares of an average 18-hole golf course. Fairways (2) are less intensively managed but cover around 16 hectares, so any single input will amount to a greater quantity than a similar application to greens. The teeing grounds (3) and green approach/surround (4) are each of a similar area as the greens and generally receive an intermediate level of management between that of the greens and that of the fairways. The bunkers (5) are a sand-filled hazard, whose number can vary on any individual golf hole. The maintained rough (6) receives very limited management, mainly mowing. Up to 50% of the area of a golf course can be natural habitat, providing a haven for wildlife.

Under this driver, the golf facility itself needs to be considered as a resource in how it contributes towards issues such as community (multi-functionality), health/well-being, and biodiversity.

The resources whose limited availability or quality might impact on golf course condition and playability in the future would include – irrigation water, fertilizers, chemicals, gas, oil and lubricants, utilities (electrical), topdressing sand, seed/sod/sprigs and labour.

3. Regulation

Often directly related to resource issues, water, pesticide and biodiversity regulations are already having an impact on course condition, playability and cost. Regulation on other issues such as fertilisers, energy and waste will also influence the future management of our golf courses. As with the other drivers, the impact of regulation will vary dependent on the type of course, e.g. links or parkland, and on the intensity of management related to the different parts of the course.

Legislation in Portugal will need to be considered when assessing impacts on course condition, playability and cost and in devising potential solutions to regulation-led limiting factors.

Course managers operate to strict internal standards and practices in line with local, national and international regulations, this includes the Environmental Authorities. The main regulatory agencies responsible for enforcing environmental legal framework are the following[8]:

1) The Portuguese Environment Agency (APA)'s mission is to propose, develop and monitor the integrated and participated management of environmental and sustainable development policies, in tandem with other sectorial policies and in cooperation with public and private entities seeking the same purpose taking into view a high level of environmental protection and the rendering of high-quality services to citizens.

   The main functions of this regulatory body are:

   - to propose, develop and monitor environmental policies, especially as regards climate change, management of water resources, waste, ozone layer protection, air quality, recovery and remediation of contaminated sites, integrated pollution prevention and control, noise prevention and control, prevention of major industrial accidents risks, environmental and population safety, ecological labelling, voluntary environmental compliance systems, as well as environmental impact assessment and environmental assessment of plans and programmes;

   - act as national water, waste and dam authority;

   - develop and ensure the implementation strategic options, policies and measures envisaging a low-carbon economy, in particular the mitigation of greenhouse gas emissions and adaptation to climate change, and to act as national authority for the EU emissions trading system and as national authority for the implementation of the Kyoto Protocol;

   - act as national authority for integrated pollution prevention and control and for strategic environmental assessment; and

   - act as competent authority for the environmental liability regime. The APA is subject to the control of the Minister of the Environment and Energy Transition.

2) The General Inspection of Agriculture, Sea, Environment and Spatial Planning The General Inspection of Agriculture, Sea, Environment and Spatial Planning (IGAMAOT) is the main

[8] The Environment and Climate Change Law Review 3rd edition, Chapter 12 – Portugal, Editor Theodore L Garrett

environmental inspection body. It carries out inspections regarding all activities and all public and private entities with environmental relevance, imposing the measures that prevent or eliminate situations of severe danger to human health, safety of persons, of goods and of the environment.

- It may act and carry out inspections without previously being informed by other entities of a possible breach of environmental legislation and may enter any premises and carry out the inspections it deems necessary.

- The IGAMAOT is hierarchically dependent of the Deputy Minister to the Prime Minister, of the Minister of the Environment and Energy Transition, of the Minister of Agriculture, Forests and Rural Development and of the Minister of the Sea.

3) The Institute for Nature Conservation and Forests (ICNF)'s mission is to propose, develop and ensure the execution of nature conservation and forests policies, taking into view the conservation, sustainable use, recovery, use and recognition of the natural assets. Its main functions are to act as a national authority for nature and biodiversity conservation and as a national forest authority; and to ensure the management of the national network of protected areas and the implementation of the Natura 2000 network, including marine protected areas.

   The ICNF is subject to the control of the Minister of the Environment and Energy Transition, the Minister of Agriculture, Forests and Rural Development, and the Minister of the Sea.

4) Regional spatial planning commissions There are five regional spatial planning commissions (CCDRs) within the Portuguese continental territory. Their mission is to execute the environment, planning, cities and regional development policies.

   They are responsible for executing, assessing and inspecting, at a regional level, the environmental and planning polices, in tandem with the other regulatory bodies of the Ministry of Environment.

   As regards environmental issues, their competences include, at a regional level, environmental assessment of projects, licensing, licensing of waste operations, air quality management and air pollution prevention, noise prevention, integrated pollution prevention and control, environmental assessment, etc.

   The CCDRs are subject to the control of the Minister of Planning and Infrastructure, the Deputy Prime Minister, and the Minister of the Environment and Energy Transition.

Environmental protection and climate change laws and regulations originate mainly from three sources: international treaties or conventions; EU law; and national law.

The main legislation in Portugal expected likely to impact on golf course condition and playability are:

Building permit

In Portugal, a building permit refers to the authorization granted by local authorities under the provisions of specific legislation, for the execution of works (including new construction, enlargements, conversions, refurbishments and demolition of buildings).

The Portuguese Institute of Sport and Youth has competences on golf facilities projects under the Decree-Law no. 141/2009, of June 16, as amended by Decree-Law No. 110/2012, of 21 May. The institute is responsible for giving an opinion prior to the location consent for a new golf course. The general criteria followed by this authority for basing its opinion include the compliance of the proposed location with the municipal master plans (PDM) and a favourable Environmental Impact Assessment (EIA) decision.

Environmental impact assessment

The EIA Directive was initially transposed into national law in 1990, and the national legal system, like the European, has been the subject of several revision procedures. The last revision was in 2017 with the publication of the current EIA Decree-Law. The Decree-Law 152-B/2017 enacted Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment. The amendments introduced apply as of 1 January 2018.

Under this legal system, all projects likely to have significant impacts on the environment must be subject to an environmental assessment prior to their licensing or authorisation. A multidisciplinary procedure is established to conduct the assessment, involving several organisations and stages.

Golf courses projects that have 18 or more holes or an area of 45 ha or more, or that are located within sensitive areas, are subject to Environmental Impact Assessment (EIA). The locations overlapping Natura 2000 sites, national protected areas, aquifer protection zones and the National Ecological Reserve (REN) are, in principle, subject to strong restrictions.

Water

The Water Law (Law 58/2005), which enacted the EU Water Framework Directive (Directive 2000/60/EC) and the Water Use Legal Regime (Decree-Law 226-A/2007) are the two key legal regimes regarding water management, use and protection.

As regards quality standards, Decree-Law 236/98 establishes the rules, criteria and quality objectives with the purpose of protecting water quality. The annexes of this legal regime contain:

- the emission limit values to be observed in relation to the discharge of wastewater to the water or to the soil taking into view their protection against pollution;
- the maximum values for the different parameters in water considering its use;
- and c the environmental objectives for water resources.

Quality standards vary according to the type of water (surface water, groundwater, bathing water, fishing water, etc.) and to its purpose (e.g., human consumption, irrigation, etc.). according to Decree-Law 236/98, the direct discharge into groundwater of certain hazardous substances is also prohibited.

In relation to permits, the use of water resources and the occupation of the public hydric domain is subject to the previous obtainment of a water use title, which, depending on the type of use, can be a licence, a concession or an authorisation, issued by the APA, which is the National Water Authority. The discharge of wastewater is also subject to a licence.

A new National Water Plan was published under Decree-Law 76/2016. This plan is foreseen in the Water Law and its purpose is to establish the strategic options of the national water policy to be implemented by the river basin management plans for the 2016–2021 period and by the associated specific measure programmes.

Water management under this plan envisages three main objectives: the protection and recovery of the status of aquatic ecosystems and also land ecosystems and wetlands dependent therefrom, as regards water necessities; the promotion of a sustainable, balanced and equal use of water of a good-quality status, considering its various uses and its economic value, based on a long-term use of available water resources; and the mitigation of the effects of flood and droughts.

Chemicals

Decree-Law 82/2003 (as amended) approved the Regulation on Classification, Labelling, Packaging and Safety Data Sheets of Dangerous Mixtures. According to the Regulation, the mixtures can only be placed on the market if they are classified, labelled or packaged under the terms of the Decree-Law and of the Regulation.

This Decree-Law also establishes the obligation to provide information to the Directorate General for Economic Activities, to the Poison Information Centre and to the National Institute for Medical Emergency, to be carried out by the person or entity responsible for the placement of the mixture in the market.

Decree-Law 98/2010 establishes the regime on Classification, Labelling, Packaging of Hazardous Substances for human health or the environment taking into view their placement in the market. This legal regime transposes Directive 2006/121/EC to adapt it to the Council Regulation (EC) No. 1907/2006 of 18 December related to the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH Regulation); guarantees the execution of Article 55 of Regulation EC 1272/2008 of 16 December regarding the classification, labelling and packaging of substances and mixtures (CLP Regulation); and enacts, in part, Directive 2008/112/EC.

Further, Decree-Law 293/2009 ensures the implementation and execution of the obligations arising from REACH Regulation, which establishes a European Chemicals Agency and aims to ensure a high level of protection of human health and of the Environment, including the promotion of alternative methods for assessment of hazards of substances, as well as the free circulation of substances in the internal market while enhancing competitiveness and innovation.

Sustainable use of pesticides

Portugal is included in the Zone C (South) along with Bulgaria, Cyprus, France, Greece, Italy, Malta and Spain). The application of the European Directive 2009/128 / EC in Portugal took place in two phases. The Decree-Law no. 86/2010 of July 15, 2010, which turned compulsory the inspection of equipment for application of plant protection means. In 2013 the Law 26/2013 of April 11, regulates all aspects of the sale, distribution, marketing, transportation, storage and application of plant protection products.

The application of these legal documents was made progressively, as foreseen by the European Directive 2009/128 / EC and began in November 2014 (January 1, 2014), with the obligatory agricultural production under the principles of Integrated protection. This passage to the principles of integrated protection, required the review of all plant protection products approved by the General direction of Agriculture and Veterinary (DGAV) of the Ministry of Agriculture, namely the list of active substances accepted in integrated protection.

The DGAV also is responsible for the product registration.The Law no. 26/2013 of April 11 implied the training of everyone involved in the sale and / or application process. In this context, all users of any plant protection product must have an applicator card and their number must be recorded in the act of sale by the reseller.

The act of sale, now defined as a responsible selling act, requires compliance with several requirements, namely: to alert the buyer to the possible risks that the plant protection products contain; to inform the buyer of the precautions to be taken to avoid risks to the use of plant protection products and to advise on the correct conditions for the use, transport and storage of plant protection products, in particular procedures for the treatment of packaging waste and surplus plant protection products.

This Law strengthens the role of the entity providing services in the field of land application of plant protection products, which must be recognized by the DGAV for work in both agricultural and forestry areas, or in non-agricultural areas. The article 8 of the European Directive 2009/128 / EC was transposed to PT legislation by the Decree-Law no. 86/2010 of 15 July.

This document establishes the obligation to inspect all equipment for the application of plant protection products in use, based on the European Standard NPEN 13790: 2003. The equipment for the application of new and inspected plant protection products is valid for 5 years until the next inspection is carried out, a period that decreases to 3 years after January 1, 2020.

The Spraying Periodic Inspection Centers (CIPP) are recognized by the DGAV and its list as well as the list of all authorized inspectors is disclosed by DGAV on its website.

Solid and hazardous waste

The Waste Management Legal Regime (Decree-Law 73/2011 as amended) is the framework legal regime regarding waste management, applicable to both hazardous and non-hazardous waste. Waste management activities are subject to a licensing procedure directed by the APA or by the CCDRs.

As regards waste streams, a new legal regime named Unilex was published through Decree-Law 152-D/2017, setting new rules for the management of waste streams and enacting Directive 2015/720/EU on lightweight plastic carrier bags and Directives 2016/774/EU and 2017/2096/EU on end-of-life vehicles.

All the rules on the management of specific waste streams (packaging, used oils, used tyres, electrical and electronic equipment, batteries and accumulators, and end-of-life vehicles) have been grouped together in this new legal regime.

Decree-Law 152-D/2017 is intended to contribute to more sustainable production and consumption by empowering the different participants in a product's life cycle (production,

marketing, consumption and waste management), reducing the amount of waste to be disposed of, using resources more efficiently, recovering raw materials with economic value and making managing procedures of these wastes more effective. This Decree-Law came into effect on 1 January 2018.

There are new measures and targets for the reduction of the use of plastics, currently being planned or already approved by Parliament Resolutions or by Resolutions of the Council of Ministers, regarding the end of single-use plastic disposable cutlery and specific measures for the reduction of plastic use.

FUTURE SCENARIOS

Golf Course 2030 also has to take a global perspective and its objectives are aligned with the UN's 2030 Agenda for Sustainable Development[1]. The United Nations Sustainable Development Goals (UN SDGs) provide a valuable reference and golf can contribute directly to the following goals:

6 Clean Water and Sanitation
Water quality and pollution prevention.

7 Affordable and Clean Energy
Transition to cleaner and renewable energy.

9 Industry Innovation and Infrastructure
Innovation to mitigate against challenges.

12 Responsible Consumption and Production
Safe and responsible use of resources.

13 Climate Action
Adaptation, ecosystem services and carbon sequestration.

14 Life Below Water
Protection of water bodies and their wildlife, pollution prevention.

15 Life on Land
Habitat protection, enhancement of biodiversity and pollution prevention.

17 Partnerships for the Goals
The industry working together so it is speaking with one voice, to ensure that there is commonality of language and messaging.

[1] Transforming our world: the 2030 Agenda for Sustainable Development

To produce a roadmap that secures optimal golf course condition and playability for current and future generations, there needs to be a consideration of what might be. The drivers for adaption pose many potential scenarios. Presented here are three 2030 scenarios, from business as usual to a potential doomsday prediction of extreme weather, water scarcity, high resource costs and no chemical availability. These scenarios should be related to the current optimal performance of golf courses. It should also be borne in mind that there is a sliding scale between the two extremes cited in scenarios 1 and 3:

Scenario 1. Limited change from the environment that now exists as alternative technologies, management solutions and behavioural change address the challenges posed by climate, resources and regulations and optimal golf course condition and playability is secured.

Course condition and playability is comparable to that available today. Drivers for change are weak and opportunities to enhance the potential of golf courses, their performance and environment will not be realised. There could be extra costs for golf businesses that position themselves as early adopters of new technologies, which may be passed on to the customer, so golf could be more expensive.

Scenario 2. Severe restrictions in the availability and use of synthetic chemical plant protection products, together with 50% less water being available for irrigation compared with current levels. Alternative technologies, management solutions and behavioural change partially address the challenges posed by climate, resources and regulations.

More months of the year will see greater course closure due to extreme weather events, notably flooding, and more damage and scarring to turf from water and pesticide restrictions, related to hotter summers and wetter winters.

The condition and presentation of surfaces will see periodic troughs, with golfers having to accept a different style of golf and course performance, notably in terms of reduced green speed. There is also the prospect that course condition will improve as turf naturally adapts and firmer surfaces become the norm. Golfers will appreciate and enjoy the seasonal change in course appearance and playability.

There will be increasing pressure on golf facilities to survive as the cost of maintenance increases. This will lead to opportunities for a greater flexibility in course design, e.g. fewer holes, less maintained turf, and an increase in diversification to provide multi-functional green space.

Golf businesses will need to spend more on new technologies and more expensive resources to sustain course condition and playability. Golf will be more expensive to play. Golf facilities will also see a decline in income as deteriorating conditions reduce the attractiveness of the sport, though those that embrace the opportunities for a different type of golf and diversification of land use will thrive.

There will be some course closures, notably those wholly reliant on water and synthetic chemical plant protection products to keep a grass cover, and this will impact on the contribution of golf to the local, regional and national economy.

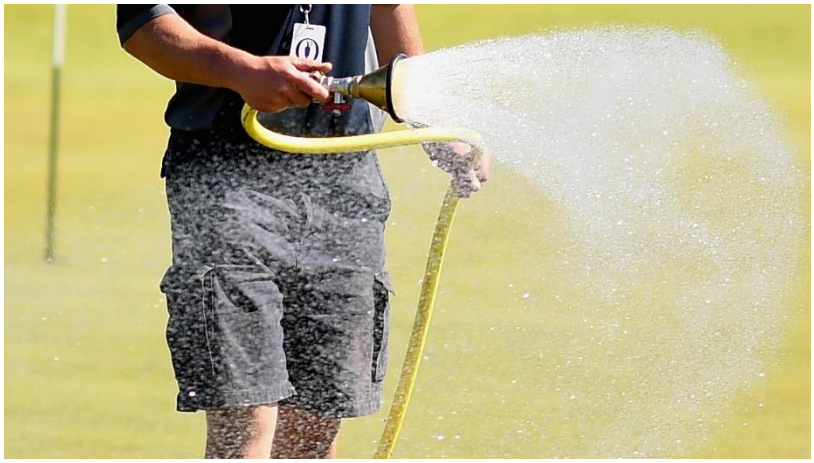
Scenario 3. The banning of all chemical plant protection products and fertilisers, together with 75% less water being available for irrigation compared with current levels. Alternative technologies, management solutions and behavioural change fail to address the challenges posed by climate, resources and regulations.

There will be longer periods of course closure, damage from extreme weather events and disease/pest/weed incidence and the high cost of resources results in loss of customers and permanent closure of many facilities. There are serious consequences for the contribution from golf to the local, regional and national economy.

The combination of hotter summers and less water being available means that only those with sustainable sources of water for irrigation can retain a reasonable cover of grass. Only those that can afford course renovation, a secure water supply and significant levels of extra labour or automation of certain maintenance practices will be able to cope with these pressures and, even in such situations, golf will be regularly played on inferior surfaces compared to what we enjoy today. The use of artificial turf increases for those that can afford it as the problems in managing natural turf become insurmountable.

PRACTICAL ACTION

Guiding Principles for resilient and sustainable golf courses



The main objective of Golf Course 2030 is the production of an industry roadmap that secures optimal golf course condition and playability for current and future generations by addressing challenges from, and taking opportunities presented by, the changing climate, resource constraints and regulation. There are, however, a number of fundamental, universal practical principles for golf course development and management which extend across the decision-making culture, agronomic practices, and broader considerations of golf's impact on and contribution to nature and local communities. The following is offered as a guide to those in decision-making positions.

1. Plan over the longer-term and operate under consistent policies, which are documented.

2. Prepare for future challenges. Consider the predicted impact of the changing climate (such as flooding, coastal erosion or drought), the availability and costs of vital resources and the constraints placed by regulation.

3. Recognise the professionalism of well qualified course managers and their staff. They will play a vital role in securing optimal course condition and playability.

4. Safeguard the reputation and well-being of employees, employers, golf facilities and the sport itself through strict compliance with the law. Decision makers at golf facilities must support their greenkeepers in adhering to this policy.

5. Create the right environment to produce healthy turf, which is fit for purpose, with adequate access to light and air, and good drainage and a biologically rich growing medium. Select and manage for grass species best adapted to local conditions.

6. Water scarcity and cost are going to be increasing issues for golf. Golf courses should be designed, built and managed to conserve water, using the least required to produce healthy turf and firm playing surfaces. Where feasible, water for irrigation should be generated in situ, through recycling drainage, rainwater harvesting, irrigation reservoirs and other technologies. Where feasible, water derived from non-potable sources should provide the irrigation source. Grass selection should be targeted at species which are fit for purpose, but which require the least amount of irrigation water.

7. The trend is for increasing pressure on pesticide availability and use. It is likely that they will continue to be removed from use. Eliminate reliance on pesticides, identify and transition to

alternative solutions to prevent and manage disease, pest and weed problems. Select and manage for grasses which are fit for purpose and which have the greatest natural resistance to disease infection, pest attack and weed ingress.

8. Fertiliser use is likely to be regulated as part of pollution prevention measures. Select grasses which are fit for purpose with minimal nutritional input and use products which offer the greatest protection to the environment.

9. Excessive organic matter accumulation creates weak turf, prone to stress and susceptible to disease infection, pest attack and weed ingress. Management practices used to control organic matter accumulation, e.g. various forms of scarification and top dressing, cause stress to turf. Select and manage for grasses which are fit for purpose, but which have a slow natural rate of organic matter accumulation and implement management practices, i.e. irrigation and fertiliser, responsibly in a manner which minimises organic matter build up.

10. Cutting height has a major influence on turf health and the requirement for maintenance, with over-close mowing inducing turf stress which requires greater water, fertiliser and pesticide inputs to correct. Mowing heights should be implemented to sustain grasses which are fit for purpose, but which are inherently healthy.

11. Energy derived from fossil fuels is going to become more expensive and golf facilities should be transitioning to cleaner, renewable sources of energy. Course design, construction and maintenance should be focused on energy efficiency, utilising grasses which are fit for purpose, but which require the least input of maintenance resource.

12. Disposal of waste to landfill will become increasingly expensive and socially unacceptable. Course design, construction and maintenance should focus on preventing waste and maximising reuse and recycling.

13. Biodiversity loss is a major global concern and golf courses have the potential to conserve and protect wildlife. Golf courses should be designed and managed to provide quality habitat for as wide a variety of native wildlife as possible.

14. Golf has a responsibility to wider society and the design, construction and maintenance of facilities should focus on making a positive contribution to local communities, such as by providing a multi-functional venue for wider community integration and recreation.

15. Objective assessment of the condition of playing surfaces, particularly the putting surfaces, on the golf course is required to monitor the impact of the challenges facing greenkeepers, the implementation of research outcomes and adaptations in management. This could include firmness, smoothness, trueness, reliability, speed, etc.

16. The recording of key resource metrics for course management, e.g. water, chemicals, energy, waste and biodiversity. Sustainability reporting on course operations is required on a facility, country, region and international level. This is necessary to monitor the impact of the challenges facing greenkeepers, the implementation of research outcomes, adaptations in management and compliance with regulations.

PROCESS

The main objective of Golf Course 2030 is to help stakeholders develop a roadmap and specific action plans that will help those developing, designing, building and managing golf courses to address the challenges and opportunities from the changing climate, increasing resource constraints, and the regulations agenda facing the industry over the coming decade.

There will be a number of necessary steps in the roadmap towards the production of action plans. The detail of this process will vary depending on the nature of the challenges and opportunities faced by any region, country or facility. Pulling this together should be a collaborative industry effort.

The following process is suggested as a guide:

1. Bring together (or further develop) stakeholder group to ensure the initiative is relevant to the region or country. Ensure group membership is balanced with strategic and technical representation of people focussed on the long-term interests in the future of the sport.

2. Stakeholders identify the challenges and opportunities and agree on priority issues to be addressed over the next 3-5 years.

3. An action plan to be produced which outlines activities to address priority issues. The activities could be awareness raising/communication, campaigns, stakeholder education, research, demonstration projects, etc.

4. Implementation

   Action Plans to be taken forward over an agreed time period (3 to 5 years is suggested), with regular (annual) review. Progress should be monitored using Key Performance Indicators.

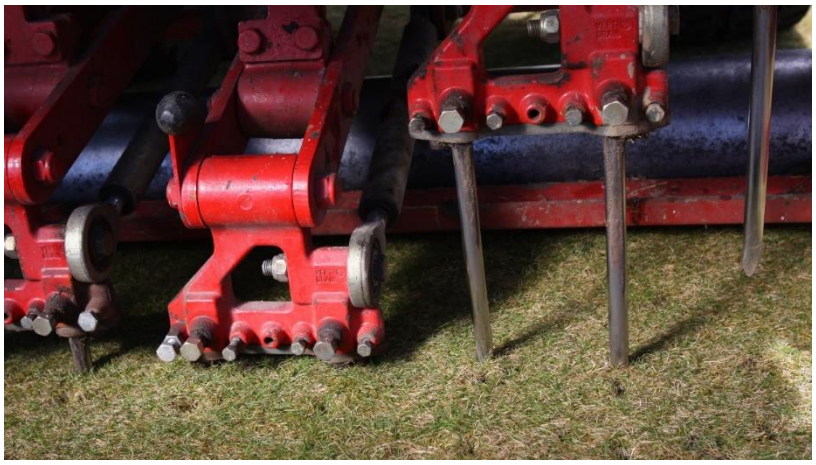
5. Communicate and educate

   Ensure that all stakeholders are aware of the implementation plan and monitoring process. Provide education and interim communications as and where necessary to achieve ongoing stakeholder buy-in.

6. Reporting

   Report on progress and level of success in addressing priority challenges. If the priority challenges have been addressed at the end of implementation, return to Step 2 in the Process.

ANALYSIS OF GAPS, STRENGTHS AND WEAKNESSES



For golf to prepare itself for the future, possibly the immediate future, there is a clear need for stakeholders to consider how the sport can address the challenges and opportunities to how we perceive and enjoy the sport today. An analysis of gaps in knowledge, and strengths and weaknesses of approach and solutions should be undertaken to identify what needs to happen in relation to the identified drivers of climate, resources and regulations, if we are to maintain playing surfaces in line with those we enjoy today. This process should include a review of the likely scenario(s) over the next 50 years, so that the gap analysis can list priorities for identifying solutions. The devised solutions should include the adoption of known best practice, technological innovation, greenkeeping adaptation, attitudinal approach by stakeholders, behaviour change, research, education, etc.

The strengths and weaknesses analysis can inform the structure of pathways for innovation, research, behaviour change and education, as well as ongoing development of club support programmes - together with stakeholder roles, responsibilities and accountability

PRIORITY ISSUES

Climate change will likely:

- Increase water scarcity due to changes in precipitation patterns and intensity, reduced precipitation in some regions could trigger exponentially larger drops in groundwater tables.
- Contaminate coastal surface and groundwater resources due to sea level rise, resulting in saltwater intrusion into rivers, deltas, and aquifers.
- Increase extreme precipitation and flooding, which will increase erosion rates and wash soil-based pollutants and toxins into waterways.
- Increase water demand for course maintenance, primarily for irrigation, due to prolonged dry periods and severe drought.

Business impacts may include:

- Decreased amount of water available for business activities
- Higher costs for water.
- Regulatory caps for water use.
- Conflicts with local communities and other large-scale water users.
- Growing demand for water efficient products and technologies.
- Increased costs for pre-treatment to obtain desired water quality.

- Regulatory restrictions for specific activities and investments.
- Increased responsibility (and costs) to implement water infrastructure and watershed restoration projects to mitigate reputational risks.

The aforementioned water scarcity problems, water quality problems, and climate-related impacts will be a major challenge to golf courses in the years ahead. It must be noted that climate change will likely exacerbate all three types of risks: physical, reputational and regulatory[9].

Physical Risks:

- Golf sector is very water-intensive. Increasing water scarcity and climate change may disrupt or raise cost of water supply.
- Changes in precipitation patterns due to climate change may negatively affect golf course condition and playability.
- The golf sector is susceptible to disruption or increased cost of energy supply due to water scarcity (The electric power industry uses vast amounts of water overall, but there are wide disparities in water usage between different types of power production. For example, renewable energy sources such as wind and solar typically use low amounts of water compared to coal, nuclear, hydropower and biofuels; Desalination, increasingly considered an option to meet growing water demand, is extremely energy intensive; First-generation biofuel production has an especially large water footprint…)
- Climate change may increase risk of forest fire, due to increased temperature, drought and water shortages for fire fighting.

Reputational Risks:

- The golf sector uses chemicals to maintain course condition and playability, which can lead to significant financial and reputational risks in case of spills and leaks.
- Greenkeeping operations can have negative impacts on local water resources, which can damage clubs' brand image and reputation.

Regulatory Risks:

- Water scarcity, increased demand and competition may raise the price for water, cap amount of withdrawal, or suspend license to use water sources.
- Since a high volume of water is required for course irrigation, the impact of price increases or water supply disruptions can be significant.
- Stringent wastewater reuse regulations may increase cost for wastewater treatment.

Mitigating water-related business risks will require action, both by the federation and golf clubs themselves. Golf clubs have a clear economic incentive to closely assess their relationship to their water inputs and outputs and to proactively address and manage them.

The agreed priority issues for Portugal over a period of 5 years (2021 – 2025) are:

1. Assess golf clubs' water footprint.

[9] Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, A Ceres Report, February 2009

2. Assess the physical, regulatory and reputational risks associated with golf clubs' water footprint, and seek to align findings with national and regional (Southern Europe) climate risk assessments.

3. Engage key stakeholders (e.g., local communities, NGOs, government bodies, clubs, course managers, greenkeepers, Southern European federations and associations, GEO and The R&A) as a part of the water risk assessment, long-term planning and implementation activities, namely:

- Training & Education on climate risk management;
- Investment in more efficient water and turf practices;
- Research and selection of more resilient turfgrasses (new versions of salt-resistant grasses with greater drought tolerance);
- Drought Preparedness and Water Shortage Contingency Plan to manage course condition and playability in the event of a water shortage.

4. Integrate water issues into strategic golf development planning and governance.

5. Disclose and communicate water performance and associated risks.

GOLF COURSE 2030
PORTUGAL





An industry roadmap addressing challenges from, and taking opportunities presented by, the changing climate, resource constraints and regulation to secure optimal golf course condition and playability for current and future generations.

February 2020