Environmental Sustainability

Check list for sport and physical activity facilities

Think of the environment. Please avoid printing this A4 document unnecessarily.

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Contents

Introduction

Climate change emergency, sport and physical activity

Sport and physical activity are very important to our society. Sport is central to our national culture and provides enjoyment and a source of passion and delight for millions. The pursuit of sport and physical activity is also a key ingredient in maintaining good personal health and mental wellbeing. Individuals' choices to walk and cycle and avoid use of polluting vehicles can also have wider benefits in making neighbourhoods more easily negotiated and better connected to amenities and places of work.

Climate change and the increased occurrence of extreme weather that it brings [1] are already affecting sports across the country [2] from coastal golf clubs falling into the sea to sports fields being unusable due to constant flooding. The impact of climate change on community-based sport is very real and the need to build-in greater resilience is an evermore pressing matter.

There is already a keen interest and awareness about environmental sustainability across the sector and a willingness to promote change to help live within the world's resources. Equally, most people now accept the rate of response needs to be faster than previously understood. This includes managing major events more effectively, creating sustainable travel policies, using recyclable materials, and creating more sustainable and energy-efficient facilities.

1 https://www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change

2 https://www.theclimatecoalition.org/gamechanger

The UK has declared a climate emergency with a net-zero carbon target by 2050. More ambitious targets are also being set. The focus is on making best use of scarce resources, looking for quick wins and finding game-changing innovations.

Scope and purpose of this guidance

This check list highlights key environmental sustainability principles to consider through the project development process, from inception through to day-to-day operation of the completed facility. Topics include site selection, transport plan, site layout, facility design, construction elements, M&E specifications, energy recovery and conservation methods.

A range of facilities for sport, recreation and leisure are included from indoor swimming pools and fitness centres to outdoor tracks and pitches.

Pathway to sustainability and net zero carbon

Environmental sustainability involves a wide range of issues that are best considered from the outset of a project. Fundamental questions might relate to the resultant environmental impacts. In some cases, these may determine whether to refurbish an existing building with its carbon already embodied or to build anew. This will involve evaluation of various carbon profiles of elements such as the proposed demolition, landfill, building materials, construction techniques and operating regimes. Generally, a building's form, orientation, construction method and its surrounding site should be developed holistically rather than relying on retrospective technological bolt-ons.

The diagram below indicates a possible framework for developing a robust strategy for any facility. It is based on a practical and cost-effective approach to achieving environmental sustainability and reducing carbon emissions. It includes:

- Establishing a sustainability strategy early on
- Reducing carbon/ energy consumption
- Improving carbon/ energy efficiency
- Using renewable energy technologies.

Sustainability strategy	Reduced energy use	Passive design	Fabric efficiency	Efficient systems	On-site renewables	Off-site renewables	Carbon offsets
Identify key issues and set out the vision and target outcomes	**Reduce energy consumption as the first measure to reduce carbon emissions and energy costs**	**Building orientation and placement on site is critical to achieving net zero targets**	**Maximise the building fabric and glazing performance**	**Invest in appropriate energy-efficient products and logistics**	**Incorporate low and zero carbon (LZC) technologies to produce energy on site**	**Only use energy providers who use renewable energy**	**If needed, offset remaining carbon by buying carbon credits**
Determine use characteristics to inform choices of construction, heating, lighting, ventilation and operating solutions	Change behaviour, eliminate energy waste and operate energy control systems more effectively at no extra cost	Harness a site's natural resources to benefit cross ventilation, natural lighting, solar gain, shelter or shading	Minimise initial energy demand to reduce demand on plant and technologies incorporated	Incorporate high-efficiency heating, ventilation, fittings, controls, sensors, heat pumps and recovery systems	Consider building-integrated photovoltaics, active solar heating, ground and air source heat pumps and hydrogen fuel cells	Purchase off-site supplies only from renewable energy providers to further minimise the overall carbon footprint	Each carbon credit purchased offsets one tonne of carbon. This money funds energy-efficient projects

Development Considerations

There are many issues that influence the overall sustainability of a project and worthy of consideration at policy level and incorporation into the project brief. Targets may also be set to reflect the level of ambition for the project and help drive forward and secure successful outcomes. The obvious sport and leisure project objectives of increased physical activity, health and wellbeing can often have a natural synergy with environmental sustainability - a healthy building contributing to a healthy environment.

Sustainability target metrics

Net zero operational carbon dioxide emissions
(Metric: $kWh/m^2/y$ and $kgCO_2e/m^2/year$)

Carbon dioxide is produced from the production and use of the energy from fossil fuels for the day-to-day operation of a building or structure. The adoption of low/zero carbon renewable energy technologies, both on and off-site, can reduce day-to-day costs and help meet the crucial targets set by the UK Government.

Net zero embodied carbon dioxide
(Metric: $kWh/m^2/y$ and $kgCO_2e$/floor area m^2)

Carbon dioxide is produced from the energy used in the extraction, fabrication and transportation from place of origin of the materials used in the construction, and carbon offset schemes. This can be significant and should be understood when the strategic decisions are taken about the creation of new sport and leisure facilities. Appropriate targets should be set (net zero for new buildings and retrofit buildings including off-setting).

Sustainable water cycle
(Metric: m^3/person/year)

It is also important to consider the amount of mains water used in the operation of a building including the options for recycling of greywater. England and Wales Building Regulations water calculator target suggests a 40% reduction in potable water use per person per day.

Sustainable connectivity and transport
(Metric: $kgCO_2e$ per km per person per annum)

This metric covers the resultant carbon impact of the travel of occupants and visitors to and from a site or building. It is defined by BREEAM 2018 Transport Credits and a suggested target of a net zero carbon emissions per person per day should be considered.

Sustainable land use and biodiversity
(Metric: increase in new flora or fauna species on site)

This outcome could be used as a measure of actions taken to maintain, protect and improve flora and fauna on a site. It is defined by BREEAM 2018 bio-diversity credits, Urban Green Factor, London Plan. A suggested target is to achieve net positive species impact and 0.3-0.4 urban green factor on all new sites.

Good health and wellbeing
(Metric: various)

There are many health and well-being variables in the makeup of ‘healthy buildings’. These include indoor air quality, daylight, overheating, acoustic comfort, responsive controls, and physical contact to the outside. They are included in many standards - CIBSE TM 40, 52, and 59, Good Homes Alliance overheating guidance and/or WELL Building Standard v2 Preconditions, 2019.

Energy statements

Many local planning authorities require an energy statement to be submitted as part of a planning application. The energy statement should set out the predicted CO_2 emissions of the development and best practice arrangements showing how they can be reduced. Most local planning authorities require at least 10% reduction through the on-site generation of renewable energy, but this can be as high as 20%. Some local authorities have set targets for achieving zero carbon between 2030 and 2040.

In preparing an energy statement, five steps should be followed:

- Determine the target energy performance of the building envelope compared to Building Regulations requirements
- Identify the energy saving measures that will be adopted to achieve the target
- Identify any further energy saving measures that will be implemented
- Estimate the likely carbon emissions from the building
- Consider the implementation of renewable energy technologies.

For any new build or refurbishment development, the selection of the most appropriate renewable energy technologies should be evaluated through a rigorous energy assessment process.

Renewable energy options

There are many renewable technologies that can improve sustainability in conjunction with passive measures. However, not all may be appropriate for a given development. See the check list for indicative relevance to different leisure facilities. See the energy assessment process diagram overleaf for indicative technology applications depending on a facility's usage requirements / loads.

Base data on estimated energy demand for typical facilities as well as custom benchmarks for combinations of facilities are available at: https://www.carbontrust.com/

For data on how much electricity, gas or oil will be displaced by using renewables to power a leisure facility and the resultant CO_2 savings, see the latest version of Guidelines to Defra's GHG Conversion Factors at: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

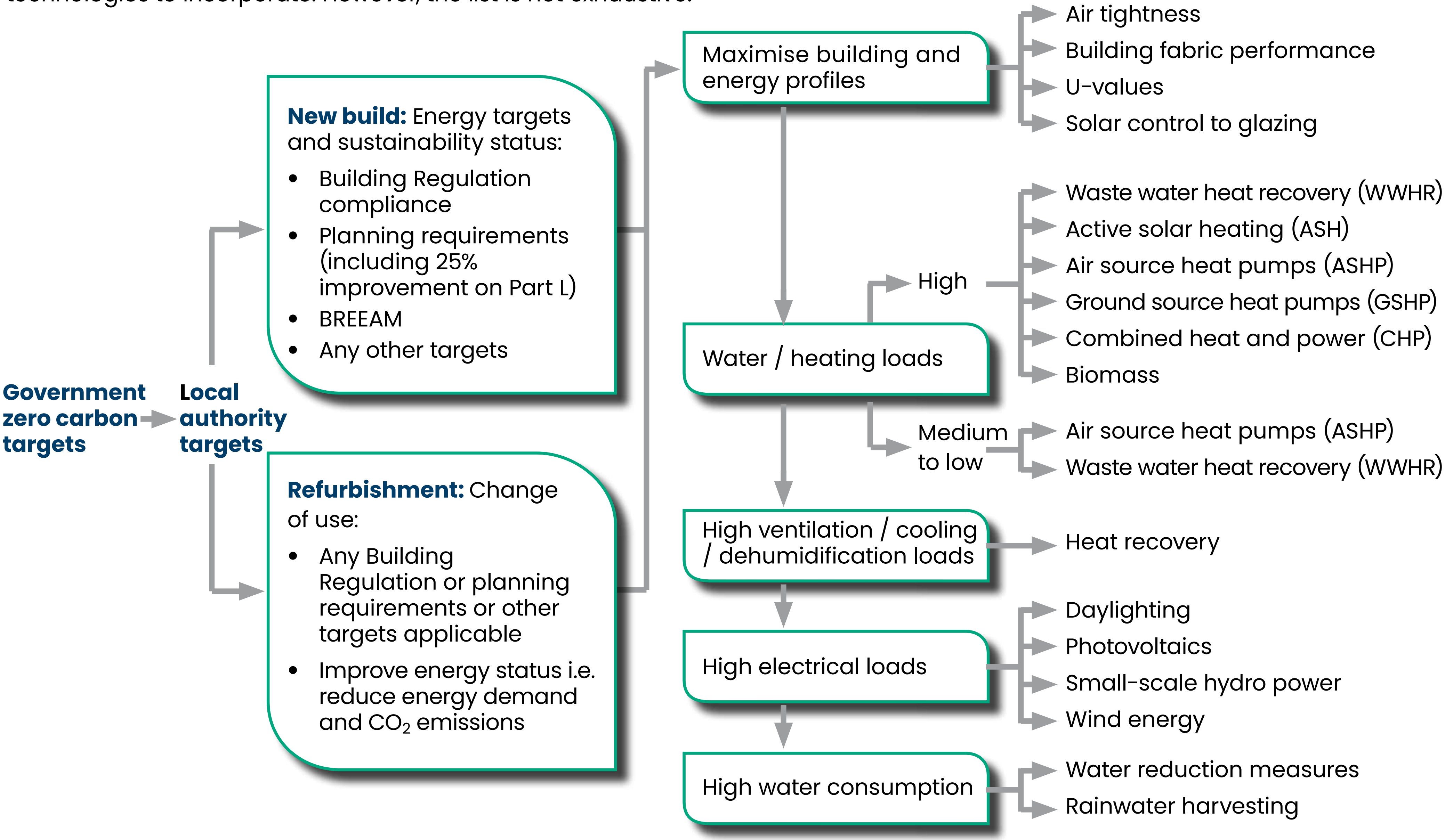
See Appendix 1 for advantages and disadvantages of the main renewable technologies.

Check government website for latest incentive schemes at:

https://www.gov.uk/green-taxes-and-reliefs

Energy assessment process

The diagram below sets out an indicative framework to establish the most appropriate selection of renewable energy technologies to incorporate. However, the list is not exhaustive.



Check list

Project inception

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Awareness	The project team should consider the importance of all issues relating to sustainability and environmental protection. A sustainability champion should be appointed to monitor and control the sustainable issues in a project and take responsibility for the environmental implications.	●	●	●	●	●	●
Contractual agreements	Review the contractual obligations for sustainability and to protect and/or enhance biodiversity. Design to make best use of the natural features of the site including sun, wind and landscape; select efficient and controllable engineering building systems, such as heating, ventilation, air conditioning and lighting; use building materials from renewable sources with low environmental impact and minimum maintenance requirements. Identify an effective strategy for waste minimisation and management on site and ensure facilities are built to a high standard with low air permeability to ensure energy is not wasted.	●	●	●	●	●	●
Design team experience	Designers play a key role in helping to deliver projects that are environmentally sustainable. Design professionals and Architects should identify and build the business case that is agreed with the client to maximise the project's design and environmental sustainability to achieve the required targets. The design team should maximise design to achieve waste minimisation through a range of methods that 'design out' waste.	●	●	●	●	●	●
Targets and target setting	Clear sustainability targets should be incorporated into the project. Specific targets should be set and agreed to consider they are met throughout the construction programme and during operation. For example, a target for construction is the site waste management plans (SWMP) should be implemented to go beyond compliance and substantially reduce waste to landfill. The targets should be challenging but achievable and set for renewable energy, annual energy use, annual water use, and annual material recycling and reuse. Regular review and audit points should be agreed to consider targets continue to be met and are updated when necessary.	●	●	●	●	●	●

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Building Research Establishment Environmental Assessment Method (BREEAM)	Consider the use of the BREEAM methodology to deliver and validate sustainability values in a cost effective tried-and-tested and robust standard. It helps manage and mitigate risk through demonstrating sustainability performance during planning, design, construction, operation or refurbishment, helping to lower running costs, maximise returns through market value and attract and retain tenants with desirable places to live and work. Some of the BREEAM credits include management, health and wellbeing, energy transport water, materials, land use, ecology and pollution. See report that highlights how Sport England's high-level Active Design Principles can be delivered in practice through the use of BREEAM Certification at: https://www.breeam.com/engage/research-and-development/consultation-engagement/active-design-and-breeam/	•	•	•	•	•	•
RIBA climate change targets	The RIBA encourages net zero whole life carbon by 2030 for all new and retrofitted buildings. This should cover operational energy, embodied energy, potable water use, overheating, daylighting, CO_2 levels, total VOCs (volatile organic compounds), formaldehydes etc. See https://www.architecture.com/about/policy/climate-action/2030-climate-challenge	•	•	•	•	•	•
Site selection							
Community involvement	Local community consultations should be held on the proposed development and concerns or aspirations regarding sustainable development should be established. The process should take place over a period and at varying times of day to ensure a wide community involvement. Early opportunities should be given for the community to engage and comment on evolving proposals.	•	•	•	•	•	•
Environmental Impact Assessment (EIA)	A screening opinion from the local authority can identify whether an EIA scope is necessary and key environmental issues.	•	•	•	•	•	•

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Ecological assessments	Statutory and non-statutory nature conservation areas should be considered. The specified distance of the buildings/pitches from the recognised nature area should depend on the key ecological features. Specific surveys of plants and wildlife should be undertaken by a qualified ecologist and at different times of the year, to assess the likely impact of the proposed development on species, habitats and/or site features that have biodiversity value. Assessment of the site's ecological value should consider all precautions are taken to reduce harm to existing flora and fauna on the site. See the Joint Nature Conservation Committee (JNCC) website at https://jncc.gov.uk/	•	•	•	•	•	•
Archaeology	The value of development on brownfield sites, the renovation of existing buildings and the need to protect heritage value should be recognised. The feasibility for an existing building to be incorporated into the new build should be undertaken by a qualified archaeologist.	•	•	•	•	•	
Opportunities for on-site renewables	Consider the natural landscape and topographical features that might optimise or degrade the feasibility and performance of on-site renewables. Distance from nearby dwellings and general visual and acoustic impacts on surrounding environments should be fully taken into account.	•	•	•	•	•	•
Visual impacts	Landscaping should be considered to integrate the facility with the particular setting and the natural environment. Low carbon re-useable materials, such as wood and recycled aggregates could be considered as part of a sustainable design.	•	•	•	•	•	•
Noise impacts	Advice from a specialist acoustic consultant should be obtained for facilities near to dwellings, and if applicable, mitigation measures put in place to reduce noise disturbances during construction and operation. See Sport England's AGP Acoustics Planning Impications Guidance available at: https://www.sportengland.org/how-we-can-help/facilities-and-planning/design-and-cost-guidance/outdoor-surfaces	•	•	•	•	•	
Light impacts	Consider the visual impacts in the local area of light spillage from the leisure buildings. The site location and design of external floodlighting should mitigate disturbance. See Sport England's Artificial Sports Lighting Design Guidance Note available at: https://www.sportengland.org/how-we-can-help/facilities-and-planning/design-and-cost-guidance/artificial-lighting	•	•	•	•	•	•

Transport issues		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Sustainable transport planning	Information on websites, posters, leaflets etc. should promote awareness of bus and train routes and other sustainable forms of transport. Workplace travel planning should help promote more sustainable travel options and reduce transport costs. See https://www.gov.uk/guidance/travel-plans-transport-assessments-and-statements	•	•	•	•	•	•
Car sharing	Car sharing should be considered for a new facility or as an extension of existing schemes set up through the Energy Saving Trust and other organisations.	•	•	•	•	•	•
Electric vehicle charging	The provision of electric vehicle charging points should be considered. Charging points can be fed from any on-site renewable energy sources.	•	•	•	•	•	•
Cycle access provision	The facility should be accessible by safe cycle routes with adequate signposting, road markings and cycle-friendly features to encourage users to cycle to the facility. Cycle routes and journey planners should be provided in the facility.	•	•	•	•	•	•
Cycle to work schemes	Use the cycle to work schemes, government incentives through tax-free bikes and pool bikes to encourage employees to cycle to work. See https://www.cyclescheme.co.uk/	•	•	•	•	•	•
Cycling facilities	Simple measures should be incorporated in the facility design to cater for cyclists such as covered, secure cycle storage facilities and the provision of one or more staff showers.	•	•	•	•	•	•
Pedestrian access provision	The facility should be accessible by safe pedestrian routes that easily link with a wider neighbourhood network. The routes should be adequately signposted, and journey planners should be provided on websites and in the facility to encourage users to walk to the facility.	•	•	•	•	•	•

Site layout

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Planning for sustainable transport access	Safe, accessible infrastructure/access for buses, cyclists and pedestrians to enter into and around the site of the facility should be included.	•	•	•	•	•	•
Active environments	Consider the principles of an active environment - encouraging people to be active – walkable communities – connected walking and cycle routes – co-location of facilities – network of open spaces – high-quality street spaces – appropriate infrastructure – active buildings. See: https://www.sportengland.org/how-we-can-help/facilities-and-planning/design-and-cost-guidance/active-design	•	•	•	•	•	•
Solar gain	Manage the building's solar gains through thoughtful design and optimal site layout arrangement. The location of the building and its surrounding landscape should consider the absorption of solar energy through direct radiation from south-facing glazing that is not overshadowed by vegetation, and the north-facing windows are to provide shelter. Consider orientating elements of the building east-west to enable the long sides to face the sun.	•	•	•	•		
Maximising water conservation	Surface water run-offs should be designed in ways that help to conserve water and follow best practice for sustainable urban drainage systems. For example, by channeling water from paving (including car parks), roofs, and pitches to soakaways, balancing ponds or existing water courses. See The SUDS Manual (C697) by Woods Ballard B; Kellagher R et al (2007).	•	•	•	•	•	•
Potential for heating networks	Consider the opportunities for connecting to a local district heating scheme or sharing the outputs from a combined heat and power plant with other adjacent buildings, particularly in buildings with large demands for hot water such as swimming pools.	•	•	•	•	•	
Potential for ground source heat pumps (GSHP)	Consider the feasibility of using a heat pump to extract heat from the ground. A GSHP will need space outside the building for the ground loop to be buried, so the topographical features and site location should be identified to establish the performance of GSHPs and reduce reliance on mechanical services for heating.	•	•		•	•	

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Potential for air source heat pumps (ASHP)	Consider the feasibility of using ASHPs. Buildings in locations with less space are more suited to ASHP. ASHP can either provide hot air or heat water acting as a renewable source of thermal energy.	●	●	●	●	●	
Landscape schemes	During construction, existing trees, hedgerows and all other significant landscape features should be adequately protected. The landscape plan should be prepared showing proposals for trees, shrubs and other plants, including the time of year when each is to be planted, and completed with a maintenance schedule. Tree felling should be done only when absolutely necessary and after ascertaining that no tree preservation orders (TPOs) are in force. See https://www.gov.uk/guidance/tree-preservation-orders-and-trees-in-conservation-areas	●	●	●	●	●	●
Landscape maintenance	Consider low-maintenance landscape options such as wildflower meadows instead of grass. Generally, drought-resistant plants reduce the need for watering.						●
Composting	Consider the potential for on-site composting and use of organic waste during construction and future operation.						●
Habitat creation	Establishing new habitats should be considered to enhance the ecological features and biodiversity surrounding the facility and to compensate for any unavoidable damage. Where the site has limited biodiversity value, opportunities to create features that can enhance existing flora and fauna should be taken. See http://www.businessandbiodiversity.org/publications.html	●	●	●	●	●	●

Facility design

Topic	Guidance	Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Building shape and form	Consider orientating the building east-west so the long side of the building faces the sun, and with a three-dimensional shape that reduces heat losses. Such building designs exploit the natural light and ventilation and reduce the need for artificial lighting, heating, cooling and ventilation loads while avoiding glare and overheating. See BRE's The Green Guide to Specification (4th Edition) 2009 available at: https://www.bregroup.com/a-z/the-green-guide-to-specification/	•	•	•	•	•	
Internal layout	Consider grouping together spaces (zoning) with similar heating or cooling demands and maximising the benefits from orientation. For example, fitness facilities that require cooling systems might be placed on the north elevation and swimming pools that require heating placed on the south.	•	•	•	•	•	
Highly insulated and air tight	Building specifications should allow for high levels of insulation and low air permeability to reduce heating costs and provide a comfortable internal environment.	•	•	•	•	•	
Passive ventilation	The building design should consider the best use of natural ventilation to enhance the building performance.	•	•	•	•	•	
Natural light	Building design and materials should be specified to support optimum use of natural light to reduce artificial lighting requirements and energy consumption. Glazing, orientation, three-dimensional shape and size should be designed to optimise natural light exposure while minimising unwanted solar gains, glare and e.g. reflections in pool halls. Rooms needing optimal daylight should be located on external walls. Opportunities to include lightwells, light pipes and rooflights should be considered.	•	•	•	•	•	
Paintwork	Internally, light-coloured paint should be chosen to improve natural and artificial lighting levels, subject to compatibility with the needs of games such as badminton that require contrast between shuttlecocks and adjacent walls.	•	•	•	•	•	

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Planning for waste heat recovery	Identify heat sources and sinks, flow rates and temperatures. Consider if the door specifications can reduce unwanted draughts and heat losses, especially revolving doors or draught lobbies and that the building is well insulated.	●	●	●	●	●	
Solar gain	Consider maximising the benefits of solar gains through sustainable building design. The absorption of solar energy is most effective through direct radiation from south-facing glazing. By using clerestories and rooflights, the depth of penetration of solar radiation can be extended further into the building.	●	●	●	●	●	
Solar energy	Solar thermal panels can be used to pre-heat hot water using an economically-viable system. Photovoltaic (PV) panels are suitable for urban and rural locations and used to produce electricity. Both types only require daylight and are optimal when in south-facing locations.	●	●	●	●	●	●
Wind power	Consider the facility design and surrounding spaces for potential harnessing of wind energy.	●	●	●	●	●	●
Energy strorage	See carbon trust website at https://www.carbontrust.com/resources/energy-storage-guide	●	●	●	●	●	●
Heat pumps	Consider the building design to optimise the eligibility for air source, ground source and/or water source heat pumps, and consider better control so the maximum energy efficiency of the product is capitalised significantly.	●	●	●	●	●	
Renewable fuel systems	Consider the availability and possible benefits of fuels produced from renewable resources that have a low contribution to the carbon cycle. Examples include vegetable oil, ethanol, methanol for clean energy systems.	●	●	●	●	●	
Grey water collection and re-use	The feasibility of rainwater harvesting should be investigated to demonstrate opportunities for grey water to be filtered, treated, stored and recycled e.g. recycled and used for irrigation systems for the surrounding landscape.	●	●	●	●	●	

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Zoning	High temperature rooms should be grouped together with low temperature zones used as buffer spaces to reduce heat losses to the exterior. Adjoining walls should be insulated or well ventilated to minimise unwanted transfer of heat or humidity. Temperature and time zone controls should be set to be specific to the different zones. Make the most of natural light by locating light-demanding rooms, such as offices or swimming pools, parallel to the windows.	•	•	•	•	•	
Design for plant location	Consider the optimum servicing strategy and the location of plant spaces in relationship to the servicing locations. Long runs of ductwork and pipework should be avoided. The plant should be located carefully to reduce impact from pollution and noise affecting health of occupants/ users.	•	•	•	•	•	
Design for management	Consider meter/sub-meters for electricity, gas and water to encourage effective monitoring and management, particularly for areas of high energy intensity (swimming pools, health suites, and kitchens) and larger usage plant items (air handling units, humidifiers). Ideally, metering/sub-metering should be at plant item or motor control centre/panel level, and linked to the BEMS.	•	•	•	•	•	•
Design for maintenance	The plant room layouts should have adequate space for safe inspection, maintenance and upgrading or replacement of equipment and plant. External emergency access should also be considered.	•	•	•	•	•	•
Energy Performance Certificate (EPC)	Consider the mandatory requirements in England and Wales to make tenants aware of energy-efficiency performance as part of a letting process.	•	•	•	•	•	
Artificial or natural turf pitches	Specific playing requirements and the potential of artificial grass to cater for more intensive use than natural grass should be considered. The design should incorporate measures to minimise dispersion of infill from within the field to the surrounding environment. All materials should be capable of being recycled at the end of their lifespan. For more information on pitch design requirements, see Sport England's 'Natural Turf for Sport' and 'Artificial Surfaces for Outdoor Sports' design guidance notes at: https://www.sportengland.org/how-we-can-help/facilities-and-planning/design-and-cost-guidance/outdoor-surfaces						•

Construction

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Site waste management plans (SWMP)	All construction projects over £300k (excluding VAT) in England are legally required to have a SWMP. A SWMP is the responsibility of the client in the pre-construction phase, but responsibility may transfer to the principal contractor when construction commences. Consider the SWMP to be targeted at being implemented at the design stage of the project to ensure effective materials resource efficiency and to go beyond compliance.	•	•	•	•	•	•
Materials re-use	Consider all opportunities for using local recycled, re-used and recovered materials in the facility design wherever possible. Manage and minimise waste quantities and re-use, recycle and recover any construction waste wherever possible (subject to avoiding re-use of hazardous materials). If services for re-using waste materials are provided, ensure they are managed and used appropriately. See publication Achieving Good Practice Waste Minimisation and Management at: https://www.ciria.org/Resources/REK/Guidance/Achieving_good_practice_waste.aspx	•	•	•	•	•	•
Earthworks minimisation	All possible efforts should be made to protect, retain and re-use existing topsoil on the site, rather than importing it or disposing of it in landfill. Poor-quality topsoil can be improved by the addition of peat-free compost, or plants chosen that do not require high-quality topsoil.						•
Insulation and air tightness	Consider floor, loft, ceiling, wall, tank and pipe insulation and improved air tightness to achieve energy efficiency in the building. Reduce heat loss through material specification in design, and high or very high levels of fabric insulation, especially in pool halls.	•	•	•	•	•	
Glazing	Consider specification for double or triple-glazing for windows/ rooflights and for interstitial blinds.	•	•	•	•	•	
Sustainable materials and local supply	Consider using locally-produced sustainable materials wherever possible, to reduce travel distances and help support local suppliers. Keep in contact with nearby construction sites to support material recovery, re-use and recycle. Consider using local materials that are sustainably produced. For example, timber should be supplied from sustainable and legal sources, and materials and components should be selected after comparing their environmental profiles. Consider using local recycling and waste transfer stations found through Smartwaste Bremap. See: https://www.bresmartsite.com/products/smartwaste/	•	•	•	•	•	•

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Waste licenses	It is current legislation that: a registered carrier must be able to produce a current certificate of registration; anyone who treats, stores or disposes of your business waste has an appropriate environmental permit, waste management licence, or exemption certificate; suppliers for all construction elements must provide independent certification. You can check these licenses on the Environment Agency's Public Register at: https://www.gov.uk/guidance/access-the-public-register-for-environmental-information	•	•	•	•	•	•
Natural materials	Identify and consider building products made from natural materials.	•	•	•	•		
Hazardous materials	Hazardous materials should be avoided wherever possible such as paints, adhesives and coverings that release volatile organic compounds (VOCs) or semi-volatile organic compounds (SVOCs). To determine what is hazardous, refer to The Hazardous Waste (England and Wales) Regulations 2005, Statutory Instrument 2005 No. 894 and The List of Wastes (England) Regulations 2005, Statutory Instrument 2005 No. 895.	•	•	•	•	•	•
End-of-life recyclability	For components needing replacement over the lifetime of the facility, the materials should be chosen on the basis that they can be recycled at the end of their useful life, reducing waste going to landfill. Lifecycle assessments can be carried out to assess the recyclability, the chosen materials must be robust and durable in use, decreasing the need for costly maintenance and replacement. Any vulnerable components should be adequately protected.	•	•	•	•	•	
Construction nuisance (dust, noise, smoke, odour)	The Control of Pollution Act 1974, Office of Public Sector Information (1974) Chapter 40 contains specific provisions for dealing with noise from construction sites. Methods to reduce the risk of causing dust or smoke nuisance include erecting barriers or sheeting around works and using chutes to move materials. The Environmental Protection Act 1990, Office of Public Sector Information (1990) Chapter 43 contains cases where a statutory odour nuisance are found to exist.	•	•	•	•	•	•
Vehicle movements	During construction, site access should be planned at a location away from dwellings and other locally-occupied buildings to reduce construction nuisances and keep noise levels and disturbance to a legal minimum. Vehicle speeds should be reduced.	•	•	•	•	•	•
Plant location	Plant produces noise and pollutes the environment. On-site plant should be located in an area to reduce impact affecting health of occupants/users, including its immediate environment.	•	•	•	•	•	•

Mechanical and electrical specifications

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Metering	Metering is essential for benchmarking and diagnosing usage. Metering systems should be included for electricity, gas and water that are appropriate for the size of the facilities and the data needed. Consider using smart monitoring and targeting (M&T) techniques to monitor and control energy use.	•	•	•	•	•	•
Building energy management systems (BEMS)	Well-designed electronic BEMS can be very effective in large buildings as a means to good management. In smaller buildings, they should not be overly complicated and should suit the level of management skills available. Automated systems, such as lights linked to motion sensors, will reduce energy wastage. For information on how to implement a BEMS, see: https://www.carbontrust.com/news-and-events/news/carbon-trust-introduces-new-iso-50001-advisory-support-services	•	•	•	•	•	
Combined heat & power (CHP)	Consider the feasibility of CHP on a site-by-site basis. Key factors include; running time, fuel price, the ability to use the heat generated, total capital cost etc. CHP is particularly suited for swimming pools with their year-round demand for heat. CHP is effective in reducing wasted energy or capitalising on the additional energy output.	•	•	•	•	•	
Heating, ventilation & air conditioning (HVAC)	This system controls the temperature, humidity and quality of air in buildings to a set of chosen conditions. The HVAC system transfers heat and moisture into and out of the air as well as controlling the level of air pollutants either by directly removing them or by diluting them to acceptable levels. Variable speed fans and a humidistat controller minimise the quantity of ventilation air consistent with adequate supply of fresh air and removal of contaminated air. These services should be zoned according to patterns of use, heating and ventilation requirements and quantity of specific spaces. For example, less energy would be used with HVAC systems in multi-purpose sport halls than in pool halls. See CIBSE Guide F: Energy Efficiency in Buildings available at: https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008I7oTAAS	•	•	•	•	•	
Motors/ drives	Consider the use of higher-efficiency direct-drive motors and regular maintenance in accordance with the manufacturer's requirements. Install motors with variable-speed controls.	•	•	•	•	•	

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Power factor	Power factor is the ratio of kilowatt (kW) to kilovolt-amps (kVA) in air conditioning electrical circuits relating useful power to reactive power. Values below unity may attract a financial penalty from the electrical supply company. Power factor correction can save money, although it does not reduce electricity use.	•	•	•	•	•	•
Exterior lighting	Energy-efficient exterior lights should be selected and/or self-contained solar-powered lamps to reduce the need for mains connections. Artificial lighting should be well focussed on the areas needed for circulation and security, with minimum spillage into the night-time sky.						•
Interior lighting	Consider LED light fittings for their efficiency and lifespan, and the potential for savings on energy and maintenance. Intrinsically efficient lamps together with reflectors and fittings make maximum use of the light output, including in overlooked areas like corridors and WCs. Consider ease of access to allow scheduled maintenance of light fittings to be cleaned, checked and replaced. Artificial lighting provision should be designed in conjunction with natural lighting measures incorporated (see page 14). Over-lighting should be avoided, with areas of focussed needs met locally.	•	•	•	•	•	
Lighting controls	Select the appropriate level of standard for illumination that will provide the required quantity and quality of light consistent with the minimum energy demand. Install occupancy sensing controls, daylight-linked controls and/or timing controls in all suitable areas where lights may otherwise be left on. Smart lighting controls could be used for multi-use areas where different levels of illumination are required for different activity zones.	•	•	•	•	•	•
Plant control	To reduce frequent switching on-off, intrinsically efficient plant controlled by timing and/or sensors should be specified. Status indicators should be specified to indicate the status of plant and enable easy checks that it is operating in compliance with design intentions, for example, that heating and ventilation are not in conflict. Leak detection should be installed via plant control for all mains supplies.	•	•	•	•	•	•

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Whole-life asset costing	To determine what products are cost-effective, calculate the payback period for any asset investment. Assets should be selected that are robust and durable in use, decreasing the need for costly maintenance and replacement. Assets with vulnerable components should be adequately protected. Products should be selected with A-rating energy certification for energy efficiency and performance.	•	•	•	•	•	•
Refrigerant	Refrigerants with the lowest global warming potential (GWP) should be selected. At the time of writing, for air-conditioning or refrigeration, the refrigerant should be R32. If a refrigerant with a lower GWP becomes available then that should be used.	•	•	•	•		
Enhanced capital allowances (ECA)	Check the eligibility of an ECA for energy-saving plant or machinery specified on the Energy Technology List (ETL) managed by the Carbon Trust on behalf of the Government. See: https://www.carbontrust.com/	•	•	•	•	•	•
Recovery and conservation measures							
Energy strategy	An overall energy and carbon reduction strategy should be developed for the facility that integrates recovery and conservation technologies in with passive design measures, high levels of insulation and airtightness mentioned in this document.	•	•	•	•	•	
Heat recovery	Heat recovery systems should be considered such as dehumidification systems, ventilation heat recovery and heat exchangers. For example, heat can be recovered regularly from waste water during backwashing of swimming pools. Appliances, such as catering equipment, should have heat recovery, where appropriate. See: https://www.carbontrust.com/	•	•	•	•	•	
Pool covers	A pool cover should be considered for use at night to help reduce both heat and water losses and also allow night ventilation rates to be lowered. Pool cover materials should be carefully selected to avoid emissions of semi-volatile organic compounds (SVOCs). See: https://www.carbontrust.com/	•					

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Water conservation measures	Water conservation measures should be adopted throughout the facility, such as: tap restrictors, spring-loaded taps, sensors operating automatic taps, shower regulators, push-button shower controls, urinal flush controls, and/or low-flow WCs.	•		•		•	
Controls on leisure facilities	Leisure facilities such as wave machines, flumes, Jacuzzis, saunas and similar energy-intensive features should have indicators showing when they are in use, and be designed to be easily switched off when not required. Install timers on vending machines to conserve energy.	•			•	•	
Water conservation and treatment in pools	In swimming pools, intrinsically efficient systems to encourage water conservation should be practiced. These include planning to consider bathers shower before entering the pool and carefully managing pool hall air temperature. To monitor pool water circulation, flow meters should be installed. Water from automatic sampling should be returned to the pool and an agreed rate for fresh water dilution should be established. Non-chlorine based systems for pool water treatment should be assessed for their feasibility. See: https://www.carbontrust.com/	•				•	

In use

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Building log book	The design team should assemble systematically all material relevant to a building log book and the operating & maintenance manuals. The log book should give a summary overview of the facility and purpose of the building services, the zoning arrangements, the location and features of the relevant plant and equipment, and a schedule of the building's energy supply meters and sub-meters including their location, fuel type, and how to read them. It should also describe the operational and control strategies of the energy consuming services and provide instructions on how to achieve the specified performance including the actions required daily, monthly, seasonally and annually. Information should also be provided on how to calculate the energy performance of the facility from the individual metered energy readings and comparison with published good-practice benchmarks.	•	•	•	•	•	•

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Operating & maintenance manuals	The following should be included; make and model numbers of all significant items of plant and equipment together with manufacturers' contact details; manufacturers' instructions for all significant items of plant and equipment, with clear indications of the equipment actually installed in the building and all maintenance and servicing schedules and requirements; schematic diagrams of the building services; and commissioning records, including demonstration of compliance with specified energy efficiency standards, for example, for specific fan power.	•	•	•	•	•	•
Commissioning	Effective commissioning is vital to consider services are operating efficiently and are delivering the performance specified or required. Elements that need commissioning should include mechanical and electrical systems, and the controls that govern them. Constructional elements such as opening windows and solar shading devices may also require commissioning.	•	•	•	•	•	•
Building system staff training	Sustainability training during staff inductions and regular meetings should inform updated procedures for using the facility's building systems and reducing energy consumption. Staff should generally be encouraged to be energy efficient as part of the facilities environmental sustainability team.	•	•	•	•	•	•
Staff involvement	Employees should be asked for their ideas and feedback on the buildings energy/ carbon policy. Employees should be encouraged to work together and speak to their colleagues to find solutions on how they can reduce energy costs. If energy bills are large, financial bonuses may be appropriate. All staff efforts should be recognised and celebrated when energy and water-use targets are met.	•	•	•	•	•	•
Good housekeeping	Good housekeeping practices should be identified that prevent unnecessary waste of energy and water, and drawn together into a walk-round energy check list and staff training material. Good housekeeping practices should be routinely promoted through staff awareness campaigns.	•	•	•	•	•	•

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Energy labelling schemes	The highest efficiency standards of the EU Energy Labelling scheme have an economy setting, and the controls should clearly indicate when the equipment is switched on or running. The size of equipment should be well matched to the needs of the user. See: https://www.gov.uk/government/publications/the-new-eu-energy-label-explained	●	●	●	●	●	●
Awareness	Handbooks and manuals that educate on the effective measures should be provided in staff induction, in all staff meetings and at the facility reception for users. Staff and users awareness leaflets and posters should promote energy saving practices and/or identify new opportunities. They should be placed around the facility and changed periodically to demonstrate the importance of collective action in reducing energy consumption and carbon emissions.	●	●	●	●	●	●
Monitoring and targeting	Consider a routine for reading meters regularly and analysing energy and water use in a spreadsheet. This will enable benchmarking against typical buildings of the same type, and the identification of unexpected changes in the pattern of consumption, together with their probable causes. Ideally, stringent but realistic targets for reducing consumption should be set. Staff members should be involved in the energy auditing and monitoring.	●	●	●	●	●	●
Energy surveys	Staff should be kept motivated and encouraged to take action. Energy walk around surveys should be undertaken by staff periodically at different times of day (and night) with the energy check list to identify sources of energy waste on the premises such as heating, lighting or ventilation operating when not required. Targets should be set and reports written at regular intervals on the management progress. Controls should be readily accessible and appropriate to the skills of site staff and maintenance contractors. See: https://www.carbontrust.com/	●	●	●	●	●	●
Ecological management plan	An 'ecological management plan' should be prepared either independently or as part of the 'landscape plan'. It should set out good practice guidelines for the management and maintenance of biodiversity features. This plan should consider the monitoring and report of the facility's biodiversity.	●	●	●	●	●	●

		Swimming pools	Sports halls/ spaces	Clubhouse/ community buildings	Fitness/ health suites	Changing/ WCs	Courts/ pitches/ tracks
Local sustainability champion and team	A sustainability champion should be appointed to manage energy and water use and the other aspects of environmental sustainability. Staff should be able to volunteer to be part of the sustainability team and help the sustainability champion monitor, manage and enforce the facility's environmental sustainability.	●	●	●	●	●	●
Waste management	A waste champion should be appointed to manage and take responsibility for the facilities waste. Requirements should be set, including colour-coded waste segregation bins and packaging from delivered items returned to the supplier, when possible.	●	●	●	●	●	
Composting	Peat-free composts should be used, as many types of compost are made from peat from sensitive ecological wetlands and whose removal is unsustainable. Off-site composting facilities should be investigated, as the local authority may have a collection of green waste and organic rubbish. If off-site composting facilities are provided, they should be used and managed appropriately.						●
Waste minimisation and recycling	All opportunities should be taken to prevent waste being created in the first instance. All opportunities should be taken to conserve natural resources by recycling and reducing demand for virgin materials. For example, yard trimmings and food residues should be managed and minimised where possible.	●	●	●	●	●	●
New technologies	Undertake periodic inspections and research to look for opportunities to improve efficiency through investment in energy saving technologies.	●	●	●	●	●	●
Monitoring in use	All opportunities should be taken to monitor performance against the targets set in the energy and zero-carbon strategy.	●	●	●	●	●	●

Appendix 1: Renewable Technologies

Analysis of the various renewable energy technologies.

Analysis of the respective advantages and disadvantages enable a considered approach to help assess which technologies may be applicable, with strengths, weaknesses, opportunities and threats (SWOT) indicated for the following:

- Active solar heating
- Air source heat pumps
- Biomass
- Combined heat and power
- Ground source heat pumps
- Photovoltaics
- Small-scale hydro power
- Wind energy.

See earlier Development Considerations section on the energy assessment process.

Analyse site characteristics, renewable technological options, funding and incentive schemes to achieve net zero targets and long-term sustainability.

Active solar heating

Active solar heating (ASH) comprises a roof-mounted system to collect the direct heat from the sun into water circulating through the system. At its simplest, ASH can comprise two black metal plates through which water is circulated. More sophisticated systems use coated glass plates, or evacuated tube systems.

ADVANTAGES

Strengths

- In the UK, ASH offers the best economic performance of the solar technologies.
- Can be used for a wide range of applications including supply of domestic hot water and boiler water pre-heating applications.
- In new build or refurbishment applications, ASH can be fully integrated with the roof structure and hot water supply systems at relatively low cost, such as swimming pools.
- Increasing number of suppliers making the market competitive and driving costs down.

Opportunities

- The roof construction needs to be able to handle the weight of ASH systems.
- ASH can be effectively combined with other heat generating technologies such as biomass heating or GSHP's (to boost output during the day).
- The building design would enhance the effectiveness of ASH systems with south facing roofs.
- Current new build activities create the ideal opportunity to install ASH systems.

DISADVANTAGES

Weaknesses

- A truly intermittent technology that can only ever function during the day.
- As a heat-only application, is not eligible for Renewables Obligation Certificates (ROCs).
- Systems are based on glass tubes or sheets comprising the energy collectors and these can be prone to physical damage.
- Solar water heating is technically not good at producing high temperature heat.

Threats

- May be insufficiently physically robust leading to high operating expenditure and frequent component replacement.
- Recent concerns over solar water heating systems harbouring Legionella may increase the operating costs in the future.

Air source heat pumps

Heat pumps extract thermal energy from a variety of renewable sources, including the air, earth or water, and upgrade it to a higher, more useful temperature. There are two types of air-source heating systems: Air-to-air systems provide warm air and air-to-water systems provide heat water.

ADVANTAGES

Strengths

- Air source heat pumps (ASHPs) can be used for a wide range of applications including space heating and/or cooling and water heating.
- Heat pumps consume little energy in order to deliver 3-4 times as much energy as heat i.e. for every unit of electrical energy consumed, 3-4 units of heat energy is provided.
- Not visible and quiet when running.
- Small costs required to fit the heat pump and cheaper than those for ground source heat pumps (GSHPs).
- Heat pump technology is improving and costs are dropping with increased volume.
- The equipment can be easily incorporated into existing new build activities.

Opportunities

- ASHPs can be used to heat radiators but underfloor heating is more effective due to the lower temperature of the air/water produced.
- Can often be effectively combined with other heat generating technologies such as solar water heating.
- Some heat pumps can be reversed and used as a cooling mechanism. This can considerably improve the cost/benefit of a heat pump system.
- Combine the technology with other sources of energy

DISADVANTAGES

Weaknesses

- As a heat producing technology, ASHPs are not eligible for ROCs.
- Still economically marginal as a retrofit measure due to installation costs, though new build installations offer better economic performance.
- Still requires some electrical energy input.
- Not as effective in cooler periods or climates, and so the heat output is not as consistent as the GSHP.
- Not as much heat can be produced compared to the GSHP, as the heat is converted from air which is less dense.

Threats

- If the fuel is replacing gas, payback will not be as favourable.
- ASHPs are effective when the air temperature is warmer, therefore this technology does not offer a consistent baseload generation all year round.

Biomass

Biomass is a term to describe materials such as wood and straw used as a renewable fuel. In biomass combined heat and power (biomass CHP) the fuel can be used to generate warm air to heat water for typical 'wet' heating applications or to raise steam for process or power generation.

ADVANTAGES

Strengths

- Biomass technology is flexible and can be used for heat, power and CHP applications.
- The plant can be scaled to even a modest size, especially if it supplies a continuous baseload heat requirement.
- If untapped wood fuel resources are available closeby, especially if owned by the organisation, operating costs will often be lower, although this is unlikely to be realised due to the distribution networks for biomass fuels.
- A swimming pool makes an ideal heat load.
- Technology readily available from a wide range of suppliers and sizes to service all potential energy applications.
- Creating a market for wood fuel enables environmentally advantageous harvesting, thinning, etc of poor quality trees of no value as a timber crop.

Opportunities

- The energy generated offers long-term price stability and good carbon performance.
- Capital grants may be available for certain biomass projects.
- May lead to lower cost woodland management in the area by creating a market for brash and poor-quality wood products.

DISADVANTAGES

Weaknesses

- Biomass is a solid fuel that requires a high number of lorry movements for delivery and at the site of use.
- Due to fuel storage/ handling requirements, biomass CHP system capital costs are higher than fossil-fuelled equivalents.
- As yet, there are no 'heat ROCs' available.
- Planning permission is likely due to the large plant and flue.
- Air quality in biomass plant area is impacted by particulates.
- Small-scale biomass CHP can only be economically efficient using advanced conversion techniques such as gasification, which are not yet fully commercialised.
- Power generation from biomass CHP via traditional steam cycles has poor efficiency and economics but can be partly overcome using organic ranking cycle systems.

Threats

- Robust, technically and commercially proven biomass supply infrastructures are not readily available but are likely to be in place in the future.
- Poor quality or non-specification fuel can lead to plant failure.
- Solid fuel combustion and the potential for local smoke generation is a potential local issue especially in relation to air quality.
- Biomass plant will require manual intervention adding to staff costs.
- Increased lorry movements onto site will pose an increased security risk and cost.
- Additional maintenance required to ensure plant remains operational.

Combined heat and power

CHP involves the combustion of gas normally used for heat through either a gas turbine or gas engine whereby electricity is generated at the same time as heat. In the case of larger (multi MW) applications using gas turbines, the exhaust from the turbine can also be used to raise steam for expansion through a steam turbine, creating highly-efficient 'combined cycle' power generation.

ADVANTAGES

Strengths

- A well understood, low risk technology.
- Maximises the efficiency of fuel use.
- There are many suppliers, few technology risks and an internationally competitive market.
- Can operate across a range of project sizes.
- Requires little routine maintenance.
- Can support the sport facilities HAVAC systems all year round.
- More recently, tri-generation systems are being introduced offering combined heat, power and cooling.

Opportunities

- Heating a swimming pool is an ideal opportunity for using CHP.
- The relatively high baseload heat demand at the sport facilities increases the attractiveness of CHP.
- Feed-in tariffs and other support mechanisms may become available to CHP systems.
- In some cases CHP can be 'added' into existing heat generation processes

DISADVANTAGES

Weaknesses

- As a fossil fuel-based technology, CHP is not eligible for ROCs.
- High gas fuel prices make the economic attractiveness of CHP marginal in many cases, especially in a market where gas prices are rising faster than electricity.
- The potential for interruptions to gas supplies will introduce additional risk of electrical supply interruptions from gas CHP.
- CHP is not a renewable technology and contributes little to CO_2 saving other than through increased fuel-use efficiency.
- Investment in fossil CHP may detract from investment in renewables, which offer far higher carbon benefits.
- Increased maintenance requirements and costs.

Threats

- Continuing fossil fuel price volatility introduces economic risk for any investments made.
- The increasing potential for interruptions to gas supplies will introduce additional risk of electrical supply interruptions from gas CHP. This may be an unacceptable operational risk.

Ground source heat pumps

Ground source heat pumps (GSHP) make use of the fact that at below about 1m depth, the earth maintains a virtually constant temperature year round. This heat can be captured using recirculation pipe work systems either laid into trenches, or sunk in boreholes. This recirculation system is then connected to a heat pump, which can be designed to operate either in heat or chill mode.

ADVANTAGES

Strengths

- Can be used for a wide range of applications including space heating and/or cooling.
- Heat pumps consume small amounts of electrical energy in order to deliver many times as much heat energy e.g. for every unit of electrical energy consumed, 3-4 units of heat energy can be provided.
- Not visible and is quiet when running.
- Groundworks can be easily incorporated into existing new build activities offering a substantial cost saving.
- The technology offers baseload energy.
- Most efficient in producing slightly lower temperature water, for example for underfloor heating.
- Operational efficiency can be improved by having a large heat store to 'dump' heat into such as a swimming pool.

Opportunities

- When groundworks are being undertaken for construction purposes, these can include the installation of collection networks for ground source heat pumps at minimal cost.
- The collection pipes can be installed in a bore hole in some locations.
- Combined with other heat generating technologies such as solar water heating.
- The recirculation system is connected to a heat pump, which can be designed to operate either in heat or chill mode to produce space heating or cooling.

DISADVANTAGES

Weaknesses

- As a heat producing technology, is not eligible for ROCs.
- Still economically marginal as a retrofit activity due to trenching costs, though new build offers better economic performance.
- Still requires some electrical energy input.
- Need space surrounding the building to for the ground loop to be buried in.
- Inhibits potential future development of land.

Threats

- Trenching and groundwork other than for new build can cause operational disruption.
- May limit the capacity for new trenching and the installation of new services in the future.
- Potential for pipework to be prone to prolonged severe freezing weather depending on installation and location.

Photovoltaics

Photovoltaics (PV) is the term used to describe the direct generation of electricity from solar cells. These cells are made from silicone wafers held between glass plates.

ADVANTAGES

Strengths

- The electricity produced can be utilised close by negating distribution losses or use of systems charges.
- Eligible for ROCs.
- No fuel is required.
- A 'fit and forget' system other than for periodic cleaning.
- The supplier base is increasing.

Opportunities

- All roofs can potentially become PV arrays.
- The energy produced can be integrated into any building.
- Commercial systems are generally connected to the national grid which allows excess electricity to be sold.

DISADVANTAGES

Weaknesses

- Poor economic performance leads to long payback periods.
- A truly intermittent technology that can only ever function during daylight hours.
- Little prospect of capital costs falling significantly in the foreseeable future.
- Best suited to low voltage applications.
- Surface dust contamination can significantly reduce performance.
- PV systems must be located on un-shaded roofs.

Threats

- Poor performance in relation to the amount of cost invested compared to the amount of CO_2 reduced can undermine efforts to meet carbon abatement targets using PV alone.
- PV arrays can be refused planning permission in certain locations.
- Being glass based, PV cells may be insufficiently physically robust for some applications.
- Longevity of PV system performance can vary.

Small-scale hydro power

Harnessing power from water flow can be an efficient and convenient form of small-scale renewable electricity in areas with fast flowing water. Advances in technologies such as 'pump-as-turbine' (PAT), 'Pelton', 'Turgo' and 'Vortex' systems can also increase feasibility and cost effectiveness in locations with reduced 'head' of water. However, appropriate selection and design are critical.

ADVANTAGES

Strengths

- Potential as good long-term investment for off-grid sites and isolated locations.
- High conversion efficiency and capacity factors relative to other renewable technologies.
- High level of predictability following annual rainfall patterns.
- Slow rate of change i.e. the output power varies only gradually from day to day.
- A good correlation with demand i.e. output is maximum in winter.
- 24-hour generation i.e. works at night.
- Long-lasting and robust technology.
- Low environmental impact.
- Low visual and acoustic impact.

Opportunities

- Increasing decentralised electricity source market interest.
- Following the closure of the feed-in tariff (FIT) incentive scheme, the Smart Export Guarantee (SEG) scheme came into force on 1 January 2020. It pays a fair rate for electricity exported to the grid. Currently, hydro installations up to 5MW are eligible.
- If there is good water flow most of the year, annual output can exceed that of equivalent alternatives.
- Potential to assist with erosion and flood mitigation measures with appropriate selection and design e.g. by providing additional flood plain storage or using a penstock whereby water is routed through a pipe instead of down the streambed, accordingly reducing water speed and flooding.

DISADVANTAGES

Weaknesses

- Potential locations for hydro installations less prevalent than for alternative renewable technologies such as PV.
- Early engagement with the Environment Agency (EA) is required. An abstraction license must be sought from the EA who will assess effects on river ecology. Certain environmental protection measures will generally be linked to the permission given.
- Planning applications for hydropower should normally be accompanied by a flood risk assessment.
- Upfront installation and associated cabling costs can be quite high compared with other renewable technologies.
- Installations are extremely site-specific.
- Most schemes are 'run-of-river' fed i.e. water available from a stream rather than continuously from a reservoir.

Threats

- Effectiveness susceptible to periodic drought or low rainfall
- Potential to increase risk of flooding with inappropriate selection and design e.g. by introducing a barrier or catchment area into the river system that can lead to a build-up of sediment.
- SEG require a suitable type of smart meter that is able to measure exported electricity which many first generation smart meters cannot do.
- There are no set or minimum tariffs for the SEG.
- For SEG eligibility, the technology and installer must be certified under the Microgeneration Certification Scheme (MCS) or equivalent. Energy suppliers may request a MCS certificate to prove your installation meets this standard.

Wind energy

Wind energy is captured using turbines mounted on tall towers (40-100 m) or buildings. Specifications depend on energy demand and scale. Installations on or near to playing fields may have a detrimental effect on use of the fields or pitches and therefore any proposals will fall within the scope of the statutory requirement for local planning authorities to consult with Sport England.

ADVANTAGES

Strengths

- Wind is the most-developed renewable energy technology.
- There is a good supplier base and plenty of specialist constructors with strong competition in the market.
- A relatively small footprint is required per turbine making it possible for co-location with compatible development buildings/features.
- No fuel supply issues.
- As the price of electricity rises, the economic threshold for a viable project will also fall.

Opportunities

- The electricity generated offers long income growth against a background of steadily increasing 'brown' energy costs.
- Considerable income can be gained from the ROCs generated and this income can rise as the obligation on electricity distributors increases.
- Planning guidance has been relaxed which may make planning permission easier to obtain.
- There are a number of developers who can work in partnership to develop on- or off-site wind energy opportunities.

DISADVANTAGES

Weaknesses

- Wind is an intermittent source of electricity with typical availabilities of around 20-30%.
- There is still the potential for strong local opposition to any proposed developments, especially for large turbines.
- To increase cost effectiveness, turbines are becoming larger and higher, with increased negative visual impacts.
- The location of wind technology can be restricted by local conditions, proximity to housing, airport and radar installations etc .
- Given the intermittency of wind energy, 100% back-up will be required, leading to no saving on the cost of electricity supply to the sites.

Threats

- Potential for local stakeholder opposition mobilised in response to wind developments.
- The local conditions surrounding facility will reduce the potential height of the tower and may increase wind shear and reduce yield (period of weather monitoring required to establish average, min and peak wind speed durations).
- The capital for installing wind will inevitably vary greatly from one site to another. Turbine prices alone mean very little - an estimate for a complete wind power system is much more important.

Appendix 2: Further information

Sport England guidance

Clubhouses

Design Guidance Note - 4 Sustainability

The guide covers key sustainability issues to consider when planning clubhouse facilities. It looks at statutory requirements, passive design, water and electrical supply and installations, heating, drainage and reduction in consumption.

Sustainability Display Panels S1-3

S1 Passive Design gives a quick guide to ways of reducing energy demands.

S2 Renewable Energy gives a quick guide to renewable energy sources that avoid contributing to climate change.

S3 Water Saving Measures gives a quick guide to design measures that harness or reduce consumption of water.

https://www.sportengland.org/how-we-can-help/facilities-and-planning/design-and-cost-guidance/clubhouses

Case studies - sustainability project examples

A range of case studies are available where sustainability features have been incorporated. They identify underlying objectives to delivering facilities with reduced energy use and provide a description and performance criteria for achieving reduced carbon footprints and Passivhaus certification.

Flood and drought guidance

Dealing with floods

Severe floods can have devastating impacts on sports clubs causing significant damage to changing and social facilities as well as depositing harmful sediment and waste on pitches. While floods of such magnitude are relatively rare, many clubs are regularly affected by moderate flooding such as on the corner of a playing field or in the grounds shed. Preventative measures can be taken to help reduce the risk of flood damage and lessen its impact when it occurs.

Dealing with droughts

Climate change has disrupted our traditional weather patterns resulting in some sites becoming unusable. We have worked with Cranfield University and national governing bodies (NGBs) of pitch-based sports to produce a report that sets out preventative measures that can be taken for projects affected by droughts. It covers the importance of good club/facility management, how a hosepipe ban can affect turf and alternative methods to minimise the effects of drought.

https://www.sportengland.org/how-we-can-help/facilities-and-planning/sustainability

Other information sources

- BREEAM
  www.breeam.com
- Building Regulations Part L – Conservation of Fuel & Power
  https://www.gov.uk/government/collections/approved-documents
- Committee on Climate Change
  https://www.theccc.org.uk/
- Green Building Council
  https://www.ukgbc.org/
- London Energy Transformation Initiative
  https://www.leti.london/cedg
- London Plan
  https://www.london.gov.uk/what-we-do/planning/london-plan
- Royal Institute of British Architects
  https://www.architecture.com/-/media/files/Climate-action/RIBA-2030-Climate-Challenge.pdf
- Simplified Building Energy Model (SBEM)
  https://www.bre.co.uk/page.jsp?id=706
- Standard Assessment Procedure (SAP)
  https://www.bregroup.com/sap/standard-assessment-procedure-sap-2016/
- Sustainable Urban Drainage Systems (SuDS)
  https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards
- UK Government 2050 Pathways
  https://www.gov.uk/guidance/2050-pathways-analysis
- UK Government Environmental Targets
  https://www.gov.uk/government/publications/25-year-environment-plan/25-year-environment-plan-our-targets-at-a-glance
- UK Passivhaus Trust
  http://www.passivhaustrust.org.uk/

Alternative languages and formats

This document can be provided in alternative languages, or alternative formats such as large print, braille, tape and on disk upon request. Call the Sport England switchboard on 08458 508 508 for more details.

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User guide

Before using this design guidance note for any specific projects all users should refer to the User Guide to understand when and how to use the guidance as well as understanding the limitations of use.

Click here for **User guide** and other
Design and cost guidance

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