MITIGATION, ADAPTATION AND RESILIENCE

"Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic sea ice, snow cover and permafrost."
IPCC AR6, 9 August 2021

The Built Environment: Energy Efficiency, Building Design and Layout

20. The following considerations should be included in all developments. They are to be considered as an intrinsic part of the design process required to achieve the national target of net zero by 2050, and 75% - 80% reduction in CO_2 emissions from homes by 2025,[1] with further reductions to zero by 2030. The development of local design guides should include consideration of both mitigation and adaptation measures to future proof development proposals. RIBA also provide guidance on the topic of building design and climate action, this can be found at:
    https://www.architecture.com/about/policy/climate-action
    and
    https://www.architecture.com/about/policy/climate-action/2030-climate-challenge/resources

[1] Planning for the Future. Ministry of Housing, Communities and Local Government, August 2020

21. **The Energy Hierarchy**: It should be expected that developers will implement the energy hierarchy throughout the design and construction processes.

    i) Save energy and eliminate wasted energy, use only what is needed.
    ii) Use energy efficiently, high efficiency appliances, lighting and equipment.
    iii) Use energy from renewable sources.
    iv) Use low carbon energy and where possible, capture the carbon emitted.
    v) Use conventional (fossil fuel) energy as a last resort and participate in meaningful offsetting and carbon capture to compensate for carbon emissions.

22. The hierarchy is set out below and should be implemented through the design, construction and specification of buildings, whether commercial or domestic.

    - Consider a 'fabric first' approach to design and construction. What is the building made from and how is it constructed? What are the embedded energy and waste implications of construction and future use of the building?
    - Include high specification insulation to reduce energy demand and heat loss. This should be coupled with high levels of airtightness, moving towards standards of high energy efficiency, for example Passivhaus standard.
    - Specify and install high efficiency lighting and appliances and/or plant where fitted.
    - Include renewable energy systems where possible, roof mounted PV or thermal panels, or wind turbines for example. Consider these from the outset so that roof orientation and shading are taken into account in the design process.
    - Consider low emissions and low carbon heating options such as district heating schemes or heat pumps.

- And finally, where none of these options are possible, any shortfall in energy demand may be met from the grid connection.

23. Where no renewables can be included in a design, carbon off-setting should be considered through legal agreement and commuted sums calculated per tonne of CO_2 over the calculated building life (See Bristol City Council Local Plan Review 2019).

24. **Embedded/Embodied carbon:** Embedded carbon describes the emissions arising from sourcing, manufacture, supply and use of the materials and processes used in construction. Concrete for example has a high embedded energy derived from quarrying, transport, and particularly processing of the minerals used. In the UK, the embodied emissions from the construction of a building can account for up to half of the carbon impacts associated with the building over its whole lifecycle, it is therefore important that these are reduced as far as practicable. Where practical, the reuse of existing buildings worthy of retention may help to reduce the use of new materials, and embedded carbon, as well as maintaining their contribution to local character.

25. Design and access statements should be requested as evidence of actions taken to reduce embedded carbon and maximise opportunities for reuse and recycling of construction materials through the provision of a circular economy statement. Calculations of whole life carbon emissions should be made using a nationally recognised whole lifecycle carbon assessment methodology[2] and demonstrate actions taken to reduce lifecycle carbon emissions. The statement should demonstrate how both the design and layout of the proposal will contribute to minimising whole life GHG emissions of the proposal. A recognised

[2] RICS Whole Life Carbon Assessment for the Built Environment Professional Statement 2017 or its successor, accepting that other methodologies will evolve over time.

quality regime should be implemented to ensure that the ‘as built’ performance of the building matches the calculated, specified, performance in terms of energy use and GHG emissions. This will require post construction monitoring of the development to verify as built specification compliance. Reporting of such monitoring should be a requirement of the consent.

26. **High specification insulation:** Floor, wall, and ceiling. This can greatly reduce the energy required to heat a property. Care is required to ensure that the design allows for adequate natural shading and ventilation to prevent summer over-heating. Consider the embedded energy in the insulation materials. The need for active cooling through air conditioning systems should be avoided. While higher specification insulation will reduce energy demand, the embedded energy/emissions in the insulation materials must be taken into account. Although these issues are covered by Part L of the Building Regulations, the Planning and Energy Act 2008 does enable Local Authorities to set energy efficiency standards above those require by the Building Regulations. Where this is the case, documents supporting an application should set out how insultation specifications will contribute to energy efficiency.

27. **Triple glazing:** High specification triple glazing can reduce heat loss and reduce noise transmission improving both energy performance and quality of life. Developers should consider triple glazing with low-emissivity coatings, insulated frames and the avoidance of ‘cold bridges’ in window design and specification. To prevent heat loss windows should be specified with a U value below 1.0W/m^2. Glazing products are available which claim to have U values as low as 0.5W/m^2. High transmittance value glazing can be used to ensure maximum solar gain during the winter months. Again, documents supporting an application should set out how glazing systems will contribute to energy efficiency. As stated above, the Planning and Energy Act 2008 does enable

Local Authorities to set energy efficiency standards above those require by the Building Regulations, this approach may be considered in emerging or reviewed Local Plans.

28. **Passive solar design (PSD), warmth, ventilation and cooling:** In its basic form a PSD house collects heat from the sun through south facing windows, this is absorbed by the mass of the building and slowly released into the living space. By benefitting from the collection of the available natural heat, a PSD building can greatly reduce the energy demand associated with space heating. The temperature can be controlled by roof overhangs which provide shade from the high summer sun, low-emissivity blinds and natural ventilation. Ideally a PSD building will have its principal elevation facing within 30º of South. Passive solar design principles should be applied as much as possible to contribute significantly to energy demand reduction in buildings. Where PSD features are incorporated it is important to consider the potential for overheating in a warming climate. Shading and passive, natural ventilation should therefore be considered as equally important design features if summer overheating is to be avoided. A number of residential developments across the UK have applied PSD principles resulting in attractive, comfortable homes which are low emission and have low running costs. The RIBA Stirling Prize 2019 winning Goldsmith Street development in Norwich applies many of the PSD principles while maintaining a highly attractive street scene.

29. **Highly efficient specification:** Passivhaus buildings achieve at least a 75% reduction in space heating requirements compared to standard UK house construction[3]. However, the Passivhaus Standard considers far more than heating and insulation efficiency, it provides a tried and tested approach to deliver net-zero ready new and existing buildings optimised for a

[3] Passivhaus Trust UK, The UK Passivhaus Organisation.

decarbonised grid, providing a high level of comfort using very little energy for heating, and importantly, cooling. The residual heat and energy demand can therefore be met by PSD or on-site renewables for example PV coupled with heat pumps, or solar thermal. As 'Planning for the Future' published in August 2020 and the Future Homes Standard set out, the governments intension to require significant reductions in residential GHG emissions from 2023, achieving 31% savings from 2023, and 75% to 80% reduction from 2025 based on Building Regulations 2021 standards. The introduction of higher building insulation, and construction specifications designed to achieve high standards of energy efficiency, will have to become the norm to achieve this level of emissions reduction. It is clear from the emissions trajectories required to keep global warming to between 1.5^{o}C and 2^{o}C that the introduction of significantly higher energy efficiency standards will need to be achieved as soon as possible.

30. **Green roofs:** Green roof technology has been around for some time and construction techniques and specifications are now well established. There are multiple benefits in the use of green roofs including: greater insulation and thermal mass, reduced rainfall run-off rates, and the provision of habitat. However, not all buildings will lend themselves to green roofs. Although there are methods of constructing green roofs at almost any angle, and even green walls can be constructed, the technique is more commonly applied to shallow pitch roofs. Also, the basic structure of the building must be capable of supporting the mass, including the wetted mass of the roof materials.

31. The use of green roofs should be considered as a contribution to several climate change mitigation and adaptation themes, including SuDS, flood protection, biodiversity enhancement and net gain, thermal insulation and energy demand reduction. However, they are not easily retrofitted but are capable of incorporating thermal or PV solar installations with careful selection of species.

Green roof planted with sedum and drought tolerant species

32. **Plot and block orientation:** From the outset, the layout of a development proposal can have a considerable influence on the implementation of passive solar design and measures for the utilisation of renewable energy. While building orientation can contribute to passive heating and the deployment of solar PV, it is important to consider the potential for over-heating. Designs should therefore also consider the need for shading, ventilation and cooling.

33. Buildings will ideally face south or within 30° of south to take advantage of sunlight. Where a south facing aspect is not possible, roof pitches should be orientated to provide a south facing pitch to maximise both the area available for, and the efficiency of, PV or solar thermal collectors either roof mounted or building integrated (BIPV). Asymmetrical pitch roof structures can offer a greater surface area available for solar panels and prevent shading of nearby properties. Roof overhangs can also provide additional shade during the summer months when cooling may be a priority if over-heating is to be avoided. Residential developments which include a mix of dwelling types and sizes allow greater flexibility in site layout and individual building plot orientation, to accommodate both passive solar design and the provision of solar PV installation.

34. **District heating and CHP:** District heating including Combined Heat and Power (CHP) may be feasible where there is either a local heat or fuel source from nearby industrial or agricultural activities. Typically, a district heating system will include ducting from the source to end user, and in place of a domestic boiler, each property will include a controllable heat exchange unit. Alternatives may be comprised of a centralised CHP plant making use of a local fuel source, often a waste from other businesses, providing both heat and electricity to a development.

35. Centralised heat sources may be more suited to industrial or commercial development as the contractual arrangements between heat supplier and end user may be less complex. Where on-site renewables such as air source heating or roof mounted or building integrated PV are feasible, district heating systems may be less attractive. District heating systems, where considered, will ideally be developed and implemented at the time of construction as there is a significant level of infrastructure involved including heat ducting and domestic heat exchangers as well as contractual arrangements for the operation of the system and supply of heat. All of which will need to be in place before the development can be occupied.

36. **Small-scale renewables:** On a domestic scale, new build housing and significant extensions to existing dwellings should seek to include small scale renewables. Roof mounted or building integrated PV or solar thermal water heating, and either ground or air source heating may be considered individually or in combination. Provision should be maximised to reduce reliance of grid connection. The addition of battery storage can further reduce the need for grid connection, enabling PV generation during the day to be used in the evenings when PV generation is absent or greatly reduced. Clearly not all buildings will be suitable for the deployment of small-scale renewables and in Conservation Areas, on listed buildings or in areas affecting there setting, while not impossible, the installation of renewables will require careful consideration of its impact on the heritage asset.

37. **Controlling external lighting:** Consider the design and requirement for external lighting to avoid light being effectively wasted lighting areas that do not need to be lit, or simply being directed upward as light pollution. External lighting will ideally be directed to where needed and controlled by timer or motion sensor. External lighting is likely to be a relatively small proportion of energy use but potential negative impacts on ecology and visual amenity should also be considered. Recent studies have identified significant reductions in insect populations in illuminated areas.[4] The reduction of external light 'spill' may offer a significant advantage in realising biodiversity gain.

Image of light pollution in a rural setting, illuminated valleys and darker hills.

[4] 'Street lighting has detrimental impacts on local insect populations.' Scientific Advances 2021

38. **Substantial extensions to, existing dwellings:** The extension of an existing dwelling may provide opportunities for the installation of improved energy efficiency measures to reduce the climate change impacts of the building as a whole, or to improve the resilience of the building to the impacts of climate change, for example from flood risk or overheating. The feasibility of such opportunities should be identified in an energy assessment report to accompany a planning application. The extension of an existing building may be considered preferable to demolition and redevelopment of the site as it can represent the efficient use of the embedded energy in the existing structure. However, this requires careful and evidenced consideration, taking account of the whole life of the building including future emissions from occupation and use. The balance rests with the degree to which the fabric of the original building can be improved in thermal efficiency and the embedded carbon costs of those improvements.

39. **Refurbishment of existing dwellings:** Where refurbishment of, an existing dwelling is proposed, the new elements of the dwelling should be constructed to the highest energy performance standards so as to add the minimum additional GHG emissions to the building. The proposal should take a ‘fabric first’ approach, minimising the embedded energy, maximising efficiency and where possible adding on site renewable energy generation capacity to the building. Potential for renewable energy generation will ideally form part of the initial design brief and be reflected in the design and access statement.

40. **Non-Residential Development:** As with residential developments, where there is proposed extension to, or refurbishment of, an existing commercial building, then it should be requested that measures are taken to improve the environmental performance

of the unit as a whole by maximising the efficiency of the additional floorspace. This may be through the provision of on-site renewable energy generation capacity or improvements to thermal performance.

41. Proposals for new commercial buildings should take a fabric first approach, minimising the embedded energy, maximising efficiency and where possible adding on site renewable energy generation capacity to the building. Potential for renewable energy generation should form part of the initial design brief and be reflected in the design and access statement.

42. **Reducing energy demand:** The reduction of energy demand is critical to meeting the emissions reduction targets set by legislation. Energy efficiency in the materials, construction processes and occupation of the development are key to long term demand, and therefore emissions, reductions. An efficient building will be capable of generating a greater percentage of its energy demand on-site and in some cases may be a net exporter of energy. Demand reduction can be achieved through scheme design and the specification of fixtures and fittings.

43. **Renewable energy generation on site:** All new development should seek to maximise on-site renewable energy generation as a contribution to the goal of net zero emissions. On site generation may take the form of solar PV or thermal, wind, or hydro as appropriate to the site. Low carbon energy may include biomass, heat pumps or energy from waste, this list of technologies is not exhaustive. Where the use of low carbon and renewable energy is not possible, carbon off setting should be considered.

44. Where appropriate, information supporting an application should set out how on-site energy generation has been considered and incorporated. Where on-site generation is not included in a proposal, the applicant should be requested to provide justification for its omission in light of local and national policy to achieve net zero emissions by 2050 and the associated legal requirement. The statement should include details of the measures included which will reduce the overall energy demand of the development in line with government targets and how residual emissions will be offset.

45. Developments unable to achieve adequate emissions reductions (80% reduction be 2025 and net zero from 2030) should contribute to carbon off setting, equivalent to 20% of the ‘as built’ regulated energy demand at a negotiated rate per tonne of CO_2 equivalent for 30 years.

46. **Modern Methods of Construction and materials:** Proposal design should include a ‘fabric first’ approach to reduce embedded carbon in the fabric of the development and in the methods of construction while driving up energy efficiency in the finished building. Modern methods of construction can include innovative off-site and modular construction techniques where the quality control benefits of factory production can greatly reduce energy demand and whole life emissions.

47. Information setting out how the design and construction of the development contributes to climate change mitigation and adaptation should be requested in support of an application.

48. **Net Zero Ready:** There are many definitions of a 'Net Zero Ready' building but in its simplest form it can be applied to any building which does not require modification to become a zero emissions building other than connection to a zero-emission energy supply such as an air source heat pump or the provision of solar PV on the roof.

49. Thermal insulation levels and glazing efficiency should at a minimum be capable of achieving 80% emissions reductions based on 1990 base line and high standards of efficiency will be expected through revised building regulations standards. Roof orientation and structure should be designed to accommodate solar PV or thermal installation without alteration, including the provision of suitable cable ducting where necessary. A net zero ready building will enable the occupier to make the switch to net zero at a later date by replacing a gas boiler with air source heat or adding solar PV for example. Cabling should also be provided to enable a fast EV charging point to be installed if an EV charge point is not provided.

50. **Natural cooling and ventilation:** In a warming world with greater likelihood for heatwaves the potential for buildings to overheat should be considered from the outset. Roof overhangs, window recesses, louvres and external blinds, when used in conjunction with effective natural ventilation, can significantly reduce the risk of overheating. Careful design of landscaping, including the planting of appropriate species of street trees can also greatly influence both air quality and temperature.

51. **Horticulture and recycling:** It is not possible for the planning system to require that residents participate fully in horticulture or recycling, however, the provision of adequate outdoor space in gardens may encourage or facilitate a culture of cultivation of fruit and vegetables off setting some 'food-miles'. While minor in its direct contribution to climate change mitigation, it does

have an educational benefit and may raise a better awareness of some related issues. Similarly, the provision of adequate space for the storage of recycling and composting bins will not necessarily mean that they will be used, it does however make their use less problematic and more likely. As with horticulture, the direct contribution of individual actions may be small and cannot be enforced through the planning system, only encouraged and facilitated. Where adequate bin storage is not provided there is a clear detriment to the amenity of the area and recycling rates are reduced.

52. For commercial developments the provision of adequate waste bin/skip storage space may assist in on-site waste segregation, reducing waste being sent to landfill and assisting in recycling.

53. **Building for Life:** Published by the Design Council, Building for Life (BfL12) provides a guide to well-designed homes and neighbourhoods. The guide has been redesigned to reflect the NPPF and help local planning authorities assess the quality of proposed designs. While not specifically aimed at addressing the issues of climate change, the principles of good design can contribute to the creation of an attractive, popular and desirable neighbourhood incorporating many of the features that will contribute to reducing the negative impact of the development on climate change.

Historic Built Environment

54. **Heritage and the environment:** It is possible to adapt and retrofit historic buildings to reduce energy use and the resultant greenhouse gas emissions with little or impact on the external appearance, but specialist advice is needed. Guidance and case studies on the retrofitting of climate change mitigation measures to historic assets can be found on the Historic England and

RIBA websites, it is considered to be more appropriate to provide links to the Historic England and RIBA websites than reinterpret the detailed guidance here.

https://historicengland.org.uk/research/heritage-counts/heritage-and-environment/, Energy Efficiency and Historic Buildings | Historic England
and
https://historicengland.org.uk/content/heritage-counts/pub/2020/heritage-environment-2020/

Recycling historic buildings to tackle climate change: https://historicengland.org.uk/whats-new/news/recycle-buildings-tackle-climate-change/

The RIBA and Climate Action:
https://www.architecture.com/about/policy/climate-action

There are a raft of supporting climate change guidance documents supporting this by the RIBA available here: https://www.architecture.com/about/policy/climate-action/2030-climate-challenge/resources

55. **Historic and cultural environmental assets:** Renewable energy development has the potential to disturb or damage historic or cultural environmental assets, or to adversely affect their setting. Proposals should therefore be accompanied by an assessment appropriate to the nature and scale of the proposal, this might relate to visual impact, or the physical impacts associated with the development of archaeological sites. Ground mounted PV development will be accompanied by the creation or roadways, cable routing and sub-stations. There may also be battery storage facilities and drainage work in addition to the fixing of the PV panel mountings them-selves, all of which have the potential for direct impact on archaeological assets over an extensive area, whether known or otherwise. Similarly, wind turbines may have a relatively small footprint individually, but are also accompanied by roadways and cable routing and associated infrastructure.