RIAI

The Royal Institute of the Architects of Ireland

RIAI Guide: Sustainable Design Pathways

April 2021

The RIAI is supporting its members in making the important step-up change now required to address climate change with this design guidance.

RIAI Sustainability Award Winner 2017: Rochestown House Phase 2, Dún Laoghaire, DLR Architects Department. Photo: Donal Murphy

Contents

1. Executive Summary

Following on from the *2019 RIAI Sustainability for the Current Global Environmental Crisis Policy*, this design guide has been prepared to assist RIAI members to adopt Sustainable design principles in their projects and practice.

With the Architect's role as a built environment leader, and stemming from their unique ability to harmonise complex competing criteria, the RIAI is supporting its members in adopting Sustainable design in practice.

In the context of the *17 United Nations Sustainable Development Goals* (SDGs), all UN Member States are part of an urgent call to action to eliminate poverty, improve health, promote education and equality with economic growth under the overarching aim of addressing Climate change and protecting our natural environments. Architecture interacts with each of the 17 goals.

Current global emission levels for buildings are estimated to be almost 40% of energy related carbon with operational emission at almost 30% and just over 10% from materials and construction. As the Current Global Environmental Crisis continues, there continues to be a global rise of C02 in the atmosphere with the continued reliance of fossil fuels. The effects of Climate Change are evident in our cities, towns and villages. Incidents of increased rainfall, flooding and drought are all evidence of Climate change on our island.

In 2020, the European Commission set out targets of 55% of overall emissions reduction for 2030, with a target to reduce 60% of buildings' greenhouse gas emissions, buildings' energy consumption by 14%, and buildings' heating and cooling energy by 18%. In 2019, the *European Green Deal* was published identifying the need for no net emissions by 2050. The European Green Deal set out to protect our biodiversity, improve energy efficient buildings, the creation of a renovation wave, and adoption of a circular economy for building design. In this context in 2020, the *National Climate Action Plan* have set further targets for the next ten years to reduce emissions from buildings including a plan to retrofit homes inclusive of use of renewable fuels.

The Climate Action and Low Carbon Development (Amendment) Bill 2021 has set out further focus to 2030 and 2050 for decarbonisation.

As a further response to the 2018 Climate Challenge commitment made by the presidents of Architect's Institutes of England, Scotland, Wales, Northern Ireland and Republic of Ireland, the RIAI are currently preparing the RIAI 2030 Climate Challenge. This document is to complement this *RIAI Sustainability Pathways Guide* with a suite of design guidance and targets.

This document is intended as a compact guide to the headline sustainable design themes and issues that architects must address in order to combat the climate crisis, we are in. Additionally, this document suggests actions which align with the targets outlined in the recent publication of the Climate Action and Low Carbon Development (Amendment) Bill 2021.

The RIAI encourages you to use this guide not as an end in itself but as a launching pad to further the integration of sustainable design in your practice.

The RIAI now recommends the following 10 Sustainable Design Pathways:

1) Commit to a target of net zero emission building, with further development of metrics in line with the RIAI 2030 Climate Challenge to be published later in 2021.

2) Assign a Sustainable Design Champion within the practice and on each design team to review Sustainable design progress at key points on each project.

3) Set at least 5 sustainable design metrics in all projects going forward.

4) Aim to add another 5 metrics to each subsequent project.

5) Deliver net zero operational carbon in all projects going forward.

6) Commit to performance in use of verification in all projects going forward.

7) Commit to Simple Review Post Occupancy Evaluation in all projects going forward.

8) Plan to integrate External and Detailed Review Post Occupancy Evaluation in subsequent projects.

9) Replace 5 material products with low impact, low embodied carbon products in each project going forward.

10) Upskill further where required in the use of appropriate sustainability assessment techniques and tools during the design process.

In addition, simple design processes can be introduced to further address our Climate Challenge including to:

- Protect natural habitats, trees and biodiversity
- Reuse and readapt existing buildings where possible
- Adopt a fabric-first approach
- Prioritise energy efficiency
- Adopt net zero energy buildings target
- Eliminate CO2 emissions
- Create parkland on brownfield sites
- Adopt a circular economy approach to reduce construction waste

Sarah O'Dwyer, MRIAI Chair, RIAI Sustainability Task Force 2021

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Noel Quinn
Bill Scott
Sally Starbuck
Dara Stewart

Footnotes
[1] https://www.worldgbc.org/embodied-carbon
[2] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en#timeline
[3] https://www.oireachtas.ie/en/debates/question/2020-10-20/147/

2. A Summary of Pathway Metrics to Assess Sustainability

The metrics outlined hereunder are provided as benchmarks to assist in project goal setting; linked to the key indicators for evaluation. Part two links these metrics with the Sustainable Design Pathways and project work stages.

The RIAI 2030 Climate Challenge, to be published later in 2021, further defines and elaborates on these metrics.

2.1 Net Zero Operational Carbon Dioxide Emissions

Defined as: Carbon dioxide emissions associated with operation energy used in day to day use of building. Includes renewable energy contributions and offsets.

Measured in: kWh/m²/y and kgCOe/m²/year.

Objective: Net Zero for new buildings and retrofit buildings.

2.2 Net Zero Embodied Carbon Dioxide

Defined as: The carbon dioxide emissions associated with the energy used to extract, manufacture and transport materials from place of origin to building.

Measured in: kWh/m²/y and kgCO2e/floor area m².

Objective: Net Zero for new buildings and retrofit buildings including offsetting.

2.3 Sustainable Water Cycle

Defined as: The quantity of mains water used in day-to-day use in buildings. Includes any offset use by greywater or recycled water systems.

Measured in: m³/person/year.

Objective: To achieve 40% reduction in potable water use per person per day.

2.4 Sustainable Connectivity and Transport

Defined as: The carbon impact resulting from the travel of occupants and visitors to and from site or building to a local transport hub or local retail and community facilities.

Measured in: kgCO2e per km per person per annum.

Objective: To achieve net zero carbon emissions per person per day.

2.5 Sustainable Land Use and Biodiversity

Defined as: Improving the biodiversity of the flora and fauna on site.

Measured in (various): Increased area of green space, increased number of species.

Objective: To protect and create biodiversity with positive species impact and establishing urban green factor on all new sites.

2.6 Good Health and Wellbeing

Defined as: Metrics related to occupant health and well-being, including daylight, noise, indoor Air Quality, overheating, responsive controls, and physical contact to the outside.

Measured in (various): As per RIAI 2030 Climate Challenge metrics (pending publication).

Objective: To achieve good indoor health metrics.

2.7 Sustainable Communities and Social Value

Defined as: Improving positive impacts of good placemaking on a local community, including collaborative community design processes and capacity building.

Measured in (various): Ideally metrics and key indicators are co-created with local communities in collaborative consultation processes. Further reference should be made to the principal approaches and definitions in the RIAI Town and Village Toolkit, 2019. Additionally, the UK Green Building Council 2020 document "Delivering Social Value Measurement", a guide to measuring the social value of buildings and places, provides some useful approaches.

Objective: To create and promote cohesive inclusive societies.

2.8 Sustainable Life Cycle Cost

Defined as: Evaluation and measuring of operation building costs to ensure economic sustainability.

Measured in: €/m^2 . Typical build costs as well as calculated costs for heating, hot water and electricity, including electrical plug loads are included. Build cost values are as principally defined by SCSI Costs, 2020. Access to energy bills post completion will assist assessing building operation costs. Residential development could avail of the relevant "Energy costs" cost indicator in the IGBC's "Home Performance Index".

Objective: To anticipate likely building and energy costs; and ensure buildings perform as expected in design.

3. Sustainability Assessment Tools and Methods

This guide is intended as a compact introduction to the main themes, topics and aspects of sustainability architects should consider to integrate sustainability into their work. External to these guidelines, a wide variety of tools and assessment methods exist to assist the process to appraise the metrics outlined in Section 2.

It is not the intention of this guide to advocate the use of particular assessment tools, methods or techniques but to offer some guidance, resources available and how to select appropriate assessment techniques. Techniques range from:

1) Tools – Typically software based and used to evaluate designs in their final stages. E.g. IES, Designbuilder, DEAP.

2) Building Environment Assessment Methods – Offer an evaluation framework to assess and demonstrate holistic sustainability of designs, e.g. BREEAM, LEED, Passive House and HPI.

3) Processes – Linked to works stages or plans of work to promote integration of sustainability issues at key stages, e.g. Green Overlay to RIBA Plan of Work, RIBA Soft Landings.

When selecting a technique to use, consideration should be given to:

- Their overall ease of use/simplicity.
- The metrics or indicators they assess – do they focus on environmental issues only for example, or also include social and economic? Align the technique with the project type and client flexibility. It is best to keep outcome indicators or metrics for assessment as simple as possible.
- The quality of assessment offered.
- Ease of use from early-stage design.

In Part two, some simple web-tools are referred to where appropriate which make direct reference to the theme at hand.

Post Occupancy Evaluation

To lower and eliminate the ‘performance gap’ between design assessment and in use assessments, the use of Post Occupancy Evaluation (POE) is critical and should be encouraged and discussed with clients early on.

The depth and breadth of POE undertaken can range from:

Simple Review: Typically done by architect and design team during defects period, up to 12 months after practical completion. Building is visited, reviewed and its use and operation discussed with occupants to gather feedback on what has and has not worked well.

Occupants may also share their energy bills for review by the design team. Issues to review can range from systems to materials or occupancy patterns. The themes and issues to review should be set at the start of the design process.

External Review: Like the simple review, only carried out by an independent professional external to the design team and over a longer period of time – typically two years post practical completion. It can be carried out after a simple review or independent of one.

Detailed Review: Detailed building performance evaluation, typically carried out by external professional proficient in such reviews. Can assess quantitative performance issues (e.g. energy use) by use of meters and/or qualitative issues to do with lifestyle, occupancy interaction with building etc. This can be done at any time in a building's life but ideally would be completed three years post practical completion.

POE is discussed further in Part Two.

Image 1: RIAI Sustainability Award Winner 2016, Roscommon Civic Offices, AKB Architects. Photo: Christian Richters.

4. When and How to Implement Sustainability in the Design Process

It is imperative that whichever of the below topics and tools are selected that the implementation of sustainable design begins as early as possible in the design process. The figure below outlines when outcomes should be set, designed and verified in the project process. The themes in the next section are also presented in the order of the stage of the 'plan of work' that they should be considered.

RIAI plan of work

1: Inception and General Services	2. Outline Proposals	3. Scheme Design	4. Detail Design/ Building Regulations	5. Production Information	6. Tender Action	7. Project Planning	8. Operations on Site and Completion
Briefing		**Process**				**POE**	
• Set Scope of Sustainability Indicators and Outcomes to Pursue • Define Sustainable Design in Context of the Particular Project, Design Team and Client • Select Appropriate Assessment Techniques and Key Evaluation Points for Project Review • Consider Nominating a Sustainability Champion from Within the Design Team to Direct and Monitor Progress on Sustainability Outcomes • Select Scope of POE Process		• Design Incorporating Outlined Themes Below, Incorporating Best Practice • Review and Amend Design at Key Stages to Ensure Design Meets Outcomes Outlined at Briefing Stage				• Compare Building Against Outcomes Set to Evaluate and Verity Success • Consolidate Learnings from the Process and Project and Incorporate Changes to Next Design Project	

Image top: RIAI Sustainability Award Winner 2020: Bunhill 2 Energy Centre, Islington, London, McGurk Architects and Cullinan Studio. Photo: Fergal Rainey.
Image bottom: RIAI Sustainability Award Winner 2019: Georges Place Housing, Dun Laoghaire, DLR Architects and A2 Architects. Photo: Marie-Louise Halpenny.

Part Two: Pathways

The following section outlines concisely the main themes that should be considered in the design pathways hereunder to the implementation of sustainable design; and an outline of when in a project design process they should be considered.

This list is compact, not exhaustive and highlights key sustainable design themes for consideration and implementation. It is especially useful for architects just beginning to incorporate these ideas into their practice.

This section gives key design principles and approaches to each theme. The guide supports architects in taking the RIAI 2030 Climate Challenge which is to be published later in 2021.

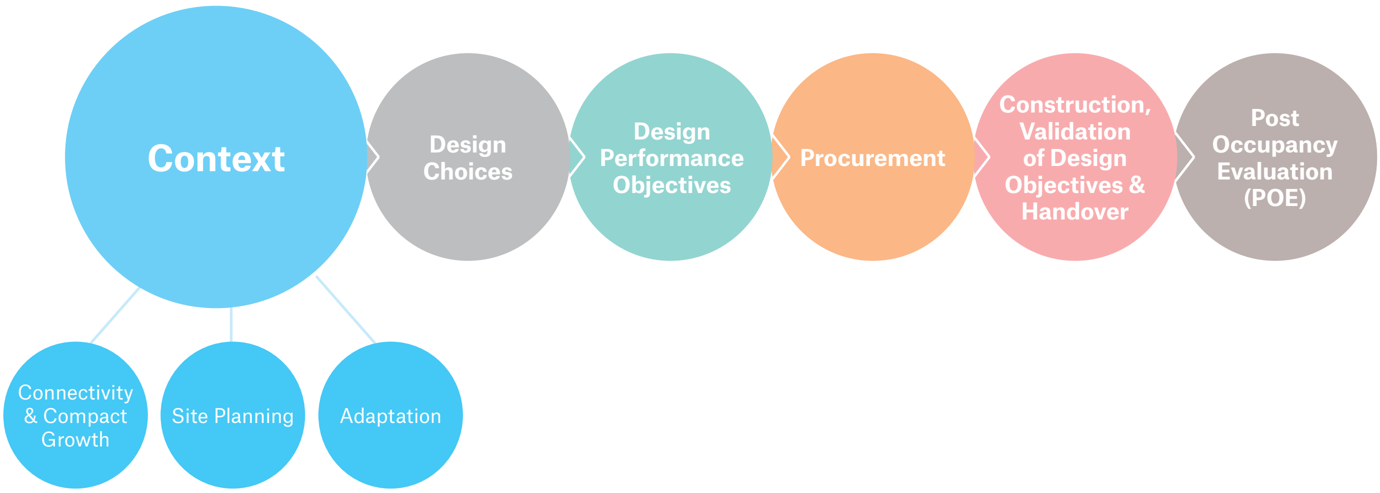
The RIAI Sustainable Design Pathways are:

1. **Context**
2. **Design Choices**
3. **Design Performance Objectives**
4. **Procurement**
5. **Construction, Validation and Handover**
6. **Post Occupancy Evaluation**

A checklist can be found in Appendix A which summarises these key pathways and associated topics to address. This checklist can be used as a prompt for design or as an evaluation of a completed design. The self assessed 'score' achieved serves to aid understanding of which aspects are achieving good or best practice and which need further addressing, as well as exploring innovation through pioneering approaches. The checklist can be used in conjunction with the process outlined below.

www.riai.ie/uploads/files/general-files/RIAI_Sustainability_Pathways_Checklist.xlsx

Context



Associated Metrics:
2.3: Sustainable Water Cycle
2.4: Sustainable Connectivity and Transport
2.5: Sustainable Land Use and Biodiversity
2.7: Sustainable Communities and Social Value
2.8: Sustainable Life cycle Cost

Connectivity & Compact Growth:

- Development should be consistent with Ireland's National Planning Framework for compact growth. Consistent with policy on compact growth, higher density should be achieved not only in urban centres but also in low rise development in suburban areas. This can be achieved through innovative layouts that maximise privacy, amenity and prioritise walking/cycling over the use of cars, promoting non-car-dependent development.

- Moving to communal parking allows for future flexibility for conversion to green space as car ownership declines.

- Higher density also plays a key role in reducing heat loss and energy in homes. Terraced homes and apartments are inherently more energy efficient and have lower heat loss and carbon emissions than semi-detached or detached homes.

- If you can influence the choice of site, choose sites in locations that connect to public transport, offers alternative transport options such as walking and cycle paths, and enable home occupiers to be within 15 minutes' walk of key services such as education, healthcare, parks and amenities. Provide for cycling and walking routes within the site even if none currently exist in the wider area so as to future proof the design.

- Connectivity can be rapidly measured by tools to give an indicative score of walkability to assess suitability for development, e.g. *www.walkscore.com*

Site Planning:

- Prioritise the use of brownfield or infill sites over greenfield sites. This is to reduce soil sealing, in line with the EU Circular Economy Action plan 2020; preserve land, retain carbon in soil, preserve and enhance ecology; reduce water run-off that causes pollution of water sources and flooding.

- To mitigate flood risk downstream caused by site development, architects should seek to ensure that peak surface rainwater run-off post-development will be no greater than before development and should be sufficiently treated before leaving the site to prevent pollution of water sources.

- Use of Sustainable Urban Drainage (SUDS), green roofs, swales and other alternative methods to deal with surface water run-off should be considered.

- All plans and projects in Ireland are already required to conform with screening requirements for impact on Natura 2000 sites. Designers should aim to go beyond screening and ensure that all development projects have a net positive impact on local biodiversity relative to the predevelopment state. There are a number of methodologies such as that set out in the IGBC 'Home Performance Index' to do this. All development should proactively integrate national and local area biodiversity action plans and implement a biodiversity plan for each site.

- You should endeavour to leave the site with an enhanced biodiversity and more green cover than prior to development.

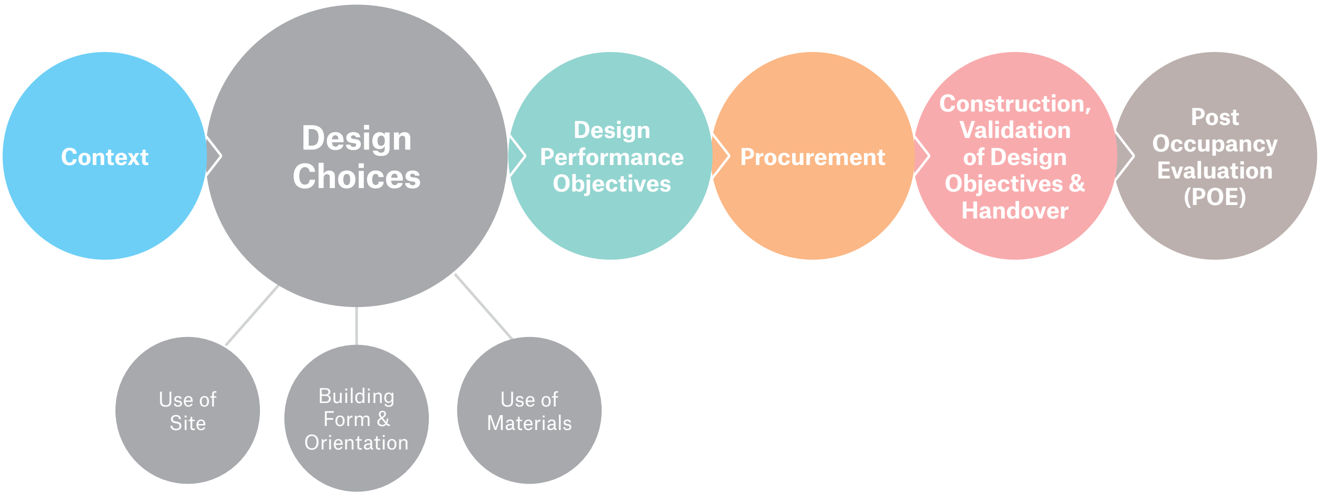
Future Change & Adaptation:

- Consideration should be given to likely future changes in local environment (e.g. Development Plans, LAPs etc.) and the broader context, which could prejudice the environmental, societal or economic sustainability of the development. Examples could include potential for floods, urban expansion, road plans, public transport, communications etc. Such changes could affect the suitability of a site for a particular use.

- Flexibility or mitigation measures may be required to future proof against such change. Nature-based solutions will be considered as the first design option where mitigation measures are required, for example flood mitigation and drainage design.

- Consider the lifespan of the building and how its function and use might change over time. Consider designing it to be easily deconstructed or re-used.

Design Choices



Associated Metrics:
2.2: Net Zero Embodied Carbon Dioxide
2.3: Sustainable Water Cycle
2.4: Sustainable Connectivity and Transport
2.5: Sustainable Land Use and Biodiversity
2.7: Sustainable Communities and Social Value
2.8: Sustainable Life cycle Cost

Use of Site:

- The use of the site is the level at which a project directly interfaces with the wider environment and public realm. In urban settings prioritise the delivery of the public realm and physical connection to the wider community.
- Wider community integration can be promoted through provision of public amenity facilities. Access to green space, both within and in close proximity to each development should be considered as part of the design development process.
- The scale of micro communities within larger developments should be carefully considered at the early design stages. A hierarchy of inter-connected public and semi-public green amenity spaces overlooked by private open space will facilitate a sense of community, social inclusion & security through passive overlooking.
- Ecological quality and biodiversity can be enhanced by consolidation of soil structure, reducing hard surfaces, use of green roofs and food growth on site.
- Use of native plant species and protection and enhancement of existing wildlife corridors or the development of new one's connection planned amenity spaces can promote biodiversity. Particular attention will be given to the design and realisation of edge conditions and boundaries as the interfaces with existing natural habitats.

Building Form & Orientation:

- Prioritise the retrofit of existing buildings over new building construction.

- Building form significantly influences the energy input that will be required to achieve satisfactory lighting, thermal and ventilation conditions for the project. Early-stage comparative studies between different design options should evaluate the impacts of massing, built form, orientation, solar access, glazing ratio etc.

- Key considerations include: positioning the building on site to:
  - Maximise solar gain and avail of views out.
  - Consider the direction of prevailing wind and available shelter; as well as
  - Show sensitivity to existing rural housing patterns, urban form and notable historic and natural features.

- Existing ground conditions should also be considered on brownfield sites where poor soil conditions can considerably impact, costs, performance & embodied carbon associated with the superstructure.

- Building modelling should be incorporated into the design process as early as possible to mitigate overheating risks.

- Efficient building form is compact, minimising complex junctions which compromise the thermal envelope.

- Room depths should be sized for natural daylighting and ventilation.

- Buildings should be designed to Universal Design Guidelines with flexibility to adapt to future change of use demands.

Use of Materials:

- The robustness, lifespan, embodied carbon, potential to pollute, thermal and hygroscopic properties and appearance of building materials influence the environmental impact of a project.

- Materials with low embodied carbon should be chosen.

- Consider use of recycled materials and designing assemblies which can be dismantled.

- Thermal performance can be achieved inherently by some envelope enclosing materials or by layered constructions incorporating synthetic or natural material-based insulation.

- Low VOC-emitting materials and finishes enhance indoor air quality.

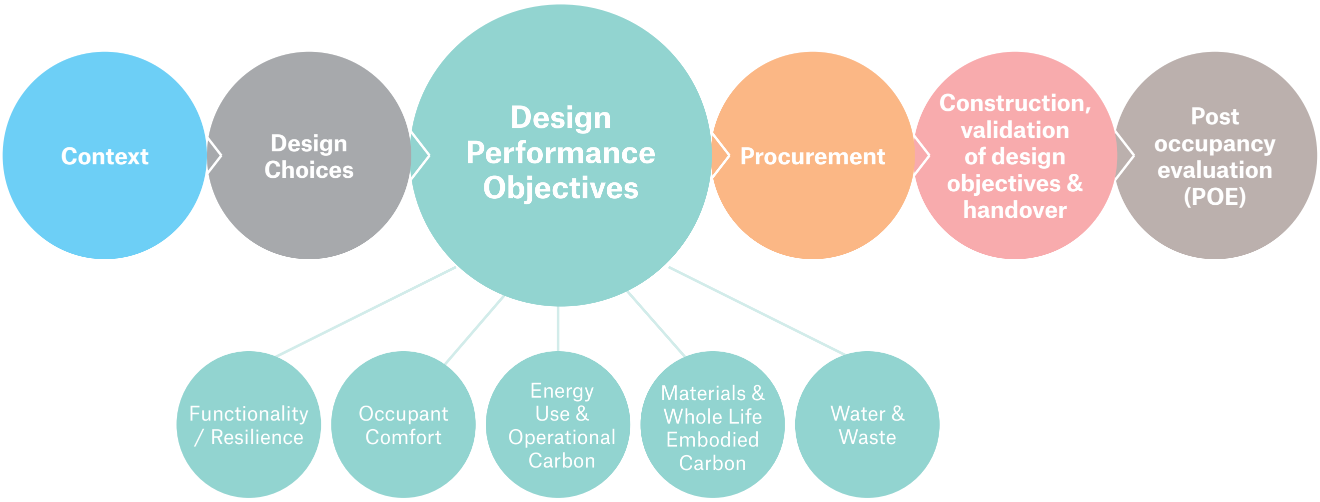
- Life cycle analysis of fitout should assess cost versus durability.

- Exposure of primary envelope materials reduces requirement for applied paints and finishes, and thermal capacity can dampen swings in temperature.

- Early-stage modelling and comparative analysis of site strategies, building mass and orientation and construction approaches is critical to achieving longer term project objectives in terms of operation and embodied energy & occupant comfort.

- As we move to considering embodied energy of materials more closely and their life cycle analysis, selection of materials which encourage a circular rather than a linear use is required.

Design Performance Objectives



Associated Metrics:

2.1: Net Zero Operational Carbon Emissions
2.2: Net Zero Embodied Carbon Dioxide
2.3: Sustainable Water Cycle
2.6: Good Health and Wellbeing
2.8: Sustainable Life Cycle Cost

Functionality and Resilience:

- The buildings and the systems within them should be easy to use, fit for purpose, be easily maintained and easily adapted in the future.
- The completed performance outputs need to match the design performance.
- Systems and controls need to be appropriate for the user.
- Design proposals must take consideration of projected changes to Ireland's climate, over the design life of the development. EPA modelling of expected Climate change forecasts increased winter precipitation, wind, incidence of summer heat waves and drought in the mid-21st century.
- The location of specific developments will be considered with regard to specific climate impacts. Nature based solutions should be considered as the first design option where mitigation measures are required, for example flood mitigation and drainage design.

Occupant Comfort:

- To maintain a comfortable healthy environment in our buildings careful design is required to make sure that Noise, Air quality, Lighting, Heating or Space do not have a detrimental effect on the occupant.

- Design targets for occupant comfort should be set at an early stage in the design process. The sensitivities and expectations of the users should be assessed to identify particular needs of the users.

- Fan noise, glare, drafts, mould growth can have serious implications on people's enjoyment of their buildings. If the space is not suitable for the intended activity it can make the building unusable.

- The degree of control occupants have over the spaces they inhabit needs consideration, including the placement of any sensors, manual override controls or centralised systems. Early co-ordination with building services engineers and building facilities managers is recommended.

Energy Use & Operational Carbon:

- Aim to meet as much of energy needs passively before meeting additional loads with efficient services design.

- Integrate use of renewables to offset energy demands.

- This refers to energy and carbon related to the heating, cooling, lighting, ventilation and domestic hot water. It should be noted that the current regulations do not cover the white goods and other electrical goods purchased by the home occupier which is now a significant percentage of energy use (up to 50%).

- Architects at the outset of each project should set specific benchmarks for annual net space heat demand to guide an integrated approach to design, and should be clear about client's expectations in terms of energy performance.

- The RIAI recommends the use of rigorous design for performance methods such as CIBSE TM5412 or Better Building Partnership Design for Performance 13.

- The approach to site layout and building plays a key role in energy efficient homes with compact form helped by density. Apartments and terrace homes are inherently efficient due to very low exposed surface area.

- A higher performance should be delivered with less materials through analysis and optimisation at the design stage considering the trade-off between the five principles of insulation, airtightness, thermal bridging, windows and ventilation.

- In adopting a fabric-first approach to high performance homes, designers should go beyond typical levels of airtightness and thermal bridging as a means of reducing the over-reliance on insulation levels of opaque elements by adopting a design strategy at the earliest stage to significantly reduce heat losses through air sealing and optimised thermal bridging, thereby reducing quantities of materials, such as insulation without compromising the operational emissions.

- Greatly improving airtightness and thermal bridging can generally be done at or close to cost-neutrality.

The difference between an air permeability test result of 2.5 and 0.6 m3/hour.m2 is more about attention to detail, training of site staff and quality assurance than about additional materials and labour input.

Material Specification & Whole Life Embodied Carbon:

- Architects should take a 'whole life' carbon approach to construction of new buildings, meaning that carbon reduction should be considered not just for the operational energy as measured through the Building Regulations TGD Part L and Part F but at all building life stages from construction through to end of life.

- For homes built to the current Part L 2019 regulations and particularly for apartments, the upfront carbon emissions embodied in the construction can be much greater than the carbon emissions from the operational regulated energy of the homes emitted over the assumed lifetime of 60 years.

- Architects should request transparency from suppliers of products and expect provision of verified EN 15804 compliant data through Environmental Product Declarations (EPDs) particularly for high impact materials such as steel, cement, concrete, bricks etc.

- EPDs provide the carbon intensity and other environmental impacts of the material and allow comparison.

- Specialist software can be used to calculate the embodied impacts (including carbon) of the material specification chosen to work toward an optimum.

Water:

- SEAI in its impact assessment for the revised Building Regulations Part L estimated that for apartments, domestic hot water is responsible for 75% of regulated energy use.

- Water efficiency is essential to save water as a resource and for energy savings. Architects should design for water efficiency in all buildings by, for example:
    - Minimising water demand.
    - Prioritising potable water. efficiency through efficient sanitary ware using 'A' rated taps, showers and WCs.
    - Use of dual flush w.c's and aerated taps.
    - Investigating potential integration of rainwater or greywater harvesting.

Waste:

- Include in tender documentation requirement for appointed contractor to have a clear waste management strategy and a clear ambition to divert stated percentages of generated construction waste from landfill.

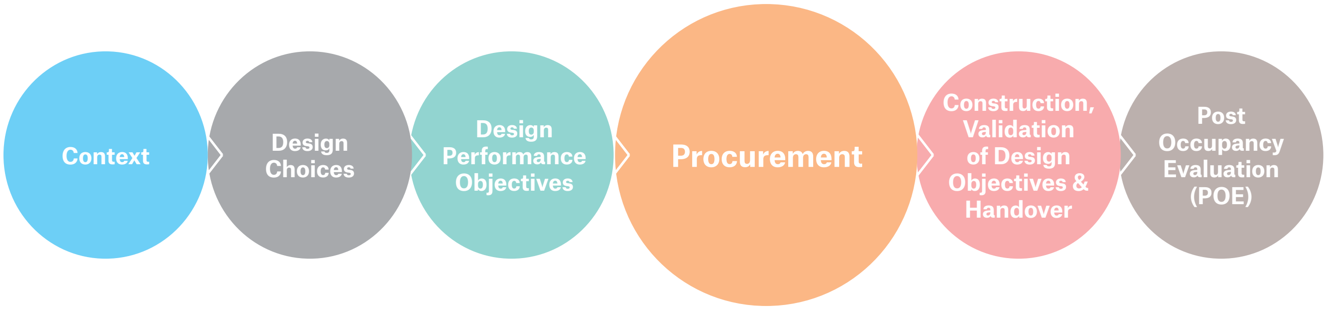
- Waste generated through the use of a building includes rainwater, foul water, liquid wastes, gas emissions (not including CO2 included in energy above) and solid waste/ refuse & recycling. Some wastes are inevitable, some are manageable and some are avoidable.

- The building's ability to deal with waste and emissions have a direct impact on how the building affects the environment.

- Nature based solutions such as swales and natural drainage systems for flood mitigation are preferred over heavy engineering works such as retaining walls. They also have more positive ecological outcomes.

Image top: RIAI Sustainability Award Winner 2017, PassivHaus Pharmacy and Apartment, The PassivHaus Architecture Company. Photo: Paul McNally.
Image bottom: RIAI Sustainability Award Winner 2018: The Mews, Dun Laoghaire, DLR Architects Department. Photo: Donal Murphy.

Procurement



Associated Metrics:
2.1: Net Zero Operational Carbon emissions
2.2: Net Zero Embodied Carbon Dioxide
2.8: Sustainable Life cycle cost

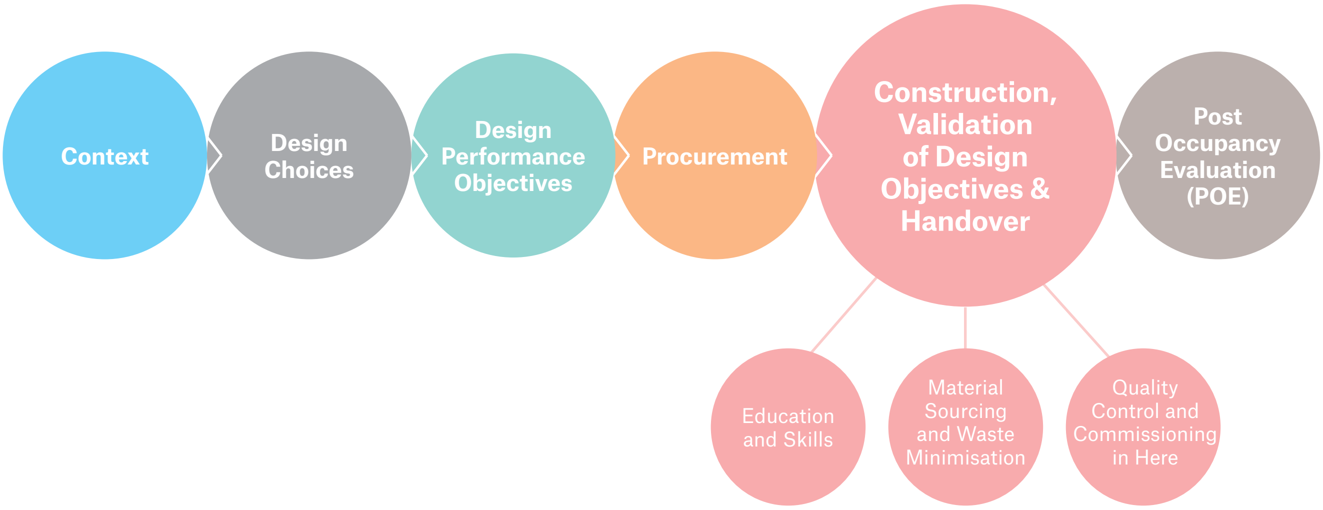
Tender Documentation:

- Make clear in tender documentation the importance of the sustainable design principles, techniques and materials being used in the project to ensure tenderers understand the importance and priority being given to this aspect.
- To ensure that skills-based procurement of contractors trickles down to the different levels of sub-contractor consider what procurement clauses could encourage follow through.
- Consider use of specific reporting metrics to ensure that deep upskilling is occurring at every level on sites down to subcontracted operatives.
- Consider performance-based contracting based on post occupancy evaluation of previously constructed homes by contractors and developers.
- Apply the principles of Green Public Procurement in application of weightings and metrics to consider tenders received.

Life Cycle Costing:

- Encourage the use of whole Life Cycle Costing (LCC) as a means of assessing projects. In particular design teams will be encouraged to:
  - Estimate the cost at all stages of the building's life cycle from construction, maintenance, repair, replacement cycles, operation and projected end of life disposal costs.
  - Consider the service life of each element, roofs, walls, finishes, and services over 60-year life cycle.
  - Integrate simple robust solutions that reduce cost at construction, maintenance, operation of homes and end of life.
  - Prioritise robust fabric first approach with at least a 60-year building life span over complex technical systems with a regular 15-year replacement cycle.
  - Consider a strategy for compliance with regulations that prioritises direct cost benefit to the occupiers and owners over the lifetime of the homes. This should also reduce maintenance and replacement cycles.

Construction, Validation and Handover



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Education and Skills:

- The contractor's and sub-contractor's staff need to have a working knowledge and experience relevant for the work that they are to undertake.
- Everyone on site needs to be aware of the basic principles of the construction so that performance is not compromised by poor execution.
- Pre-contract meetings, site meetings and communications should include reference to sustainability principles and progress.
- Consider the appointment of a sustainability champion on the construction team.

Material Sourcing and Waste Minimisation:

- The impact of what the materials are made from and where they are coming from should be assessed in relation to performance of the building, health impacts on users, transport impacts, supporting the local economy and supply of labour.
- Materials that are natural, local, renewable and reusable have a much lower impact on the environment and tend to have more positive impacts on the building users.
- Producers of high impact and high-volume materials such as, cement bricks, facades, insulation should be asked for Environmental Product Declarations to ensure transparency (note in Ireland local materials can mean petrochemical insulations and cement products, as transport is usually a small % of total life cycle emissions, most occur at manufacturing stage so sometimes it can make more sense to ship in low carbon materials).

Material Substitution

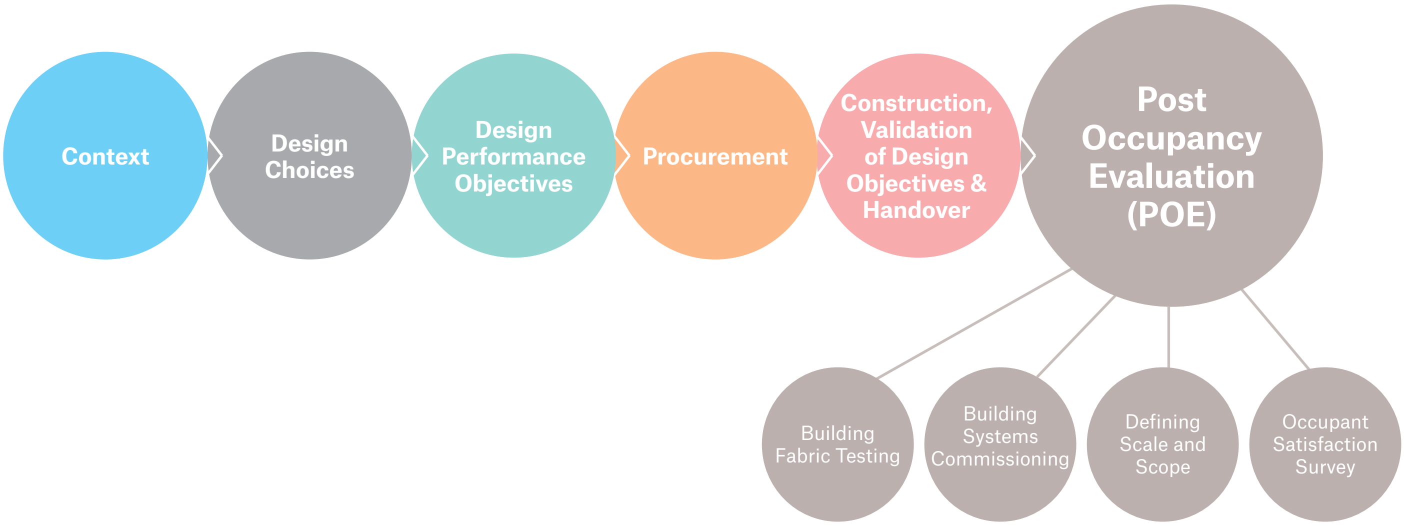
- Ensure that where product substitution occurs that the contractor demonstrates that the products meet the same environmental standard. This includes specification of sanitary ware, sustainable chain of custody timber, use of Environmental Product Declarations, Low VOC paints.

Substitution of specified products and materials frequently occurs either unintentionally or intentionally so contractor should provide documentation to confirm products meet same environmental standards.

Quality Control and Commissioning:

- Testing performance on site is critical to achieving design objective e.g. radon testing, VOCs and water quality.
- These tests can include air tightness, light quality, air quality, thermal bridge identification and leak/flood testing.
- Commissioning, handover training and documentation will also provide the building user with the information that they need to use the building efficiently.
- Keeping building elements clean and in good condition on site requires careful management but will also improve test results. Achieving design performance requires quality workmanship on site.

Post Occupancy Evaluation (POE)



Associated Metrics:
2.1: Net Zero Operational Carbon Emissions
2.2: Net Zero Embodied Carbon Dioxide
2.8: Sustainable Life Cycle Cost

Defining Scale and Scope:

- Post Occupancy Evaluation (POE) is the process of measuring the performance of a building after it has been handed over to the end user and evaluating how the 'in-use' scenario compares to the design objectives.

- The data which helps us to validate how a building performs in use can either be:
  - Objective data - Collected from sensors, meters, utility bills etc.
  - Subjective data - Collated through questionnaires filled out by occupants.

- Careful consideration, at the outset of a project, of the information that should be collected and the purpose for which it is collected can facilitate the integration of sensors etc. into the design at little or no extra cost.

- The scale and format of data to be collected should be agreed with the client at the outset of the project and any data protection issues clarified.

- Objective data can not only provide information on the building's and its systems' performance but can also reveal information on occupancy and usage patterns and the buildings impact on the wider environment as well as the health and wellbeing impacts on occupants.

Metrics and Monitoring:

- VOCs (these are impacted by cleaning regime), CO2, daylighting, temperature, humidity and even drinking water quality can be measured to make sure the building is performing as designed.

- Monitoring should be carried out on a regular basis and reported on annually to ensure optimum performance of the building and its systems.

- For commercial buildings where a facilities manager is employed - liaising with the group in charge of maintaining the building on completion is critical at a sufficiently early stage.

- Subjective data must be subject to closer scrutiny and interpretation but can provide invaluable insight into end-user experiences in terms of access, comfort, wellbeing etc.

- All of this information is invaluable in pinpointing issues which may arise in terms of building performance/ defects and assisting in educating occupants in the efficient use of the building. It is also invaluable in informing the development of design criteria/objectives for future projects.

5. Summary

The RIAI recommends the following 10 Sustainable Design Pathways:

1) **Commit to a target of net zero emission building,** with further development of metrics in line with the RIAI 2030 Climate Challenge to be published later in 2021.

2) **Assign a Sustainable Design Champion** within the practice and on each design team to review sustainable design progress at key points on each project.

3) Set at least **5 sustainable design metrics** in all projects going forward.

4) Aim to **add another 5 metrics** to each subsequent project.

5) Deliver **net zero operational carbon** in all projects going forward.

6) **Commit to performance** in use verification in all projects going forward.

7) Commit to **Simple Review Post Occupancy Evaluation** in all projects going forward.

8) Plan to integrate **External and Detailed Review Post Occupancy Evaluation** in subsequent projects.

9) **Replace 5 material products** with low impact and low embodied carbon products in each project going forward.

10) **Upskill further** where required in the use of appropriate sustainability assessment techniques and tools during the design process.

In addition, simple design practices can be adopted to further progress our Climate Challenge including the following:

- **Protect natural habitats, trees and biodiversity**
- **Reuse and readapt existing buildings where possible**
- **Adopt a Fabric-first approach**
- **Prioritise energy efficiency**
- **Adopt net zero energy buildings target**
- **Eliminate CO2 emissions**
- **Create parkland on brownfield sites**
- **Adopt a circular economy approach to reduce construction waste.**

Pathway	Context	Design Choices	Design Performance Objectives	Procurement	Construction, Validation and Handover	Post Occupancy Evaluation
Principles	Connectivity and Compact Growth Site Planning Future Change and Adaptation	Use of Site Building Form and Orientation Use of Materials	Functionality and Resilience Occupant Comfort Energy Use and Operational Carbon Material Specification and Whole Life Embodied Carbon Water Waste	Tender Documentation Life Cycle Costing	Education and Skills Material Sourcing and Waste Minimisation Quality Control and Commissioning	Defining Scale and Scope Metrics and Monitoring
Primary Associated Metrics	**2.3:** Sustainable Water Cycle **2.4:** Sustainable Connectivity and Transport **2.5:** Sustainable Land Use and Biodiversity **2.7:** Sustainable Communities and Social Value **2.8:** Sustainable Life Cycle cost	**2.1:** Net Zero Operational Carbon Emissions **2.2:** Net Zero Embodied Carbon Dioxide **2.3:** Sustainable Water Cycle **2.6:** Good Health and Wellbeing **2.8:** Sustainable Life Cycle cost	**2.1:** Net Zero Operational Carbon Emissions **2.2:** Net Zero Embodied Carbon Dioxide **2.3:** Sustainable Water Cycle **2.6:** Good Health and Wellbeing **2.8:** Sustainable Life Cycle Cost	**2.2:** Net Zero Embodied Carbon Dioxide **2.8:** Sustainable Life Cycle Cost	**2.1:** Net Zero Operational Carbon Emissions **2.2:** Net Zero Embodied Carbon Dioxide **2.3:** Sustainable Water Cycle **2.4:** Sustainable Connectivity and Transport **2.5:** Sustainable Land Use and Biodiversity **2.6:** Good Health and Wellbeing **2.7:** Sustainable Communities and Social Value **2.8:** Sustainable Life Cycle Cost	**2.1:** Net Zero Operational Carbon Emissions **2.2:** Net Zero Embodied Carbon Dioxide **2.8:** Sustainable Life Cycle Cost
RIAI stage of work	**1.** Inception and General Services **2.** Outline Proposals	**3.** Scheme Design	**4.** Detail Design/ Building Regulations	**5.** Production Information **6.** Tender Action **7.** Project Planning	**8.** Operations on-site and Completion	**8.** Operations on-site and Completion

6. Further Reading

Climate Action and Low Carbon Development (Amendment) Bill 2021 Available at:
www.gov.ie/en/publication/984d2-climate-action-and-low-carbon-development-amendment-bill-2020/

Please note, this includes targets such as:

- Places on a statutory basis a 'national climate objective', which commits to pursue and achieve no later than 2050, the transition to a climate resilient, biodiversity-rich, environmentally-sustainable and climate-neutral economy.

- Embeds the process of carbon budgeting into law, Government are required to adopt a series of economy-wide five-year carbon budgets, including sectoral targets for each relevant sector, on a rolling 5-year basis, starting in 2021.

- Provides that the first two five-year carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% emissions over the period to 2030, in line with the Programme for Government commitment.

European Commission, 2010. Buying Social: A Guide to Taking Account of Social Considerations in Public Procurement

Guide to Post Occupancy Evaluation, HEFCE, AUDE, University of Westminster (2006). Available at:
www.smg.ac.uk/documents/POEBrochureFinal06.pdf

IGBC Home Performance Index. Available at:
homeperformanceindex.ie/

Irish Green Building Council learning hub. Available at:
www.igbc.ie/learning-hub/

Living Building Challenge, International Living Future Institute. Available at:
living-future.org/lbc/

Net-Zero Operational Carbon: Ten key requirements for new buildings, London Energy Transformation Initiative (2019). Available at:
www.leti.london/

Occupant Satisfaction Survey, BUS Methodology (2019). Available at:
busmethodology.org.uk/index.html

Occupant Wellbeing Survey, BUS Methodology, (2019). Available at:
www.arup.com/news-and-events/arup-and-delos-launch-new-tool-to-track-building-designimpact-on-wellness

RIAI Sustainability Policy (2019). Available at:
www.riai.ie/uploads/files/general-files/Sustainability_for_the_Current_Global_Crisis_RIAI_2019.pdf

RIAI 2030 Climate Challenge: to be launched in 2021

RIAI Town and Village Toolkit, 2019;
www.riai.ie/whats-on/news/riai-launches-town-and-village-toolkit

UN Sustainable Development Goals:
www.architecture.com/knowledge-and-resources/resources-landing-page/un-sustainable-development-goals-in-practice

SCSI Tender Price Index:
scsi.ie/new-figures-show-construction-price-inflation-has-slowed-dramatically-due-to-covid-19/

Whole Life Carbon Assessment for the Built Environment, 1st edition, RICS (2017). Available at:
www.rics.org/uk/upholding-professional-standards/sector-standards/building-surveying/wholelife-carbon-assessment-for-the-built-environment/

UKGBC,2021: Delivering Social Value: Measurement A Guide to Measuring the Social Value of Buildings and Places

Appendix A:

RIAI Sustainable Pathways Checklist
www.riai.ie/uploads/files/general-files/RIAI_Sustainability_Pathways_Checklist.xlsx

RIAI Sustainable Pathways Checklist

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RIAI Sustainable Pathways Checklist

This document is based on the published work of Bill Bordass (Usable Buildings Trust), Tony Chapman (RIBA Head of Awards) and Bill Gething (RIBA President's Adviser on Sustainability). The RIAI is grateful for their assistance.
21 April 2021 version 0

INSTRUCTIONS FOR COMPLETING THIS CHECKLIST

This checklist can be used as a prompt for design or as an evaluation of a completed design. The self assessed 'score' achieved is to aid understanding of which aspects are achieving good or best practice and which need further addressing, as well as exploring innovation through pioneering approaches.

1. Complete Section A on general information for reference.
2. Complete Section B, rating your project and describing your response to each criterion:
-Apply your own numerical rating to the criterion ... -2 to +3 as appropriate (see rating guidelines adjacent)
-If the criterion is not appropriate to the project, state why.
-Add additional description if desired
3. Count total no. of each rating and note on last line.

SECTION A

		-2	-1	0	1	2	3
	PROJECT NAME:						
	PROJECT LOCATION:						
BUILDING FORM	**Ratio floor/building envelope (floor, wall and roof) =**						
	Plot Ratio =						
	Site Coverage =						
	Glazing ratio =						
BENCHMARKS	**Acoustic benchmark/goal and source:(e.g. 45dBA max, source: CIBSE):**						
	Air quality benchmark/goal and source: (e.g. 10 l/s/p, source: CIBSE):						
	Daylighting benchmark/goal and source: (e.g. 200 lux, source: CIBSE):						
	Thermal comfort benchmark/goal and source: (e.g. 18-24 deg C, source: CIBSE):						
	Energy benchmark/goal (e.g. 120 kWh/m²/year):						
		Significantly deficient response	**Mediocre response**	**Standard response**	**Good practice/enhanced response**	**Best practice/significant response**	**Pioneering and rare example response**

Rating guidelines:

-2: Significantly deficient response - (example; buiilding in an unsuitable context requiring significant transport, without adequate public transport)

-1: Mediocre response - (example; Building Regulations compliant but with significant / unnecessary high embodied energy or toxicity)

0: Standard response - or the criterion is not applicable to the subject building or site - (example; competent response to Building

+1: Good practice, innovative or enhanced response to standard requirements yielding modest performance improvements - (example; heat recovery from applicances / processes, BREEAM "very good")

+2: Best practice, comprehensive and signifcant response yielding excellent performance - (example:BREEAM "excellent", LEED "PLATINUM")

+3: Pioneering and rare example, demonstrating signifcant innovation or holistic response - (example; Passivhaus standard or better)

SECTION B

1 CONTEXT

		-2	-1	0	1	2	3	
	Choice of site	-2	-1	0	1	2	3	**Additional description if desired**
1. 1	Demolish & rebuild/Greenfield/ Brownfield/Refurbishment							
	Connectivity	-2	-1	0	1	2	3	
1. 2	Proximity of public facilities and services							
1. 3	Transport policy, proximity to public transport							
1. 4	Proximity to housing and/or employment							
	Use of site	-2	-1	0	1	2	3	
1. 5	Robustness against impacts of site change (e.g. flooding, urban expansion)							

2 DESIGN CHOICES - site, form and materials

		-2	-1	0	1	2	3	
	Use of site: how well does your project restore and enhance the site?	-2	-1	0	1	2	3	**Additional description if desired**
2. 1	Ecological quality of site after development							
2. 2	Biodiversity after development							
2. 3	Use of site to improve existing site conditions (e.g. protect from flooding, provide amentiy, recover a backland site)							
2. 4	Impact on community integration and facilities							
2. 5	Impact on enhancing infrastructure							
	Building form: how well does your project respond to orientation and environment?	-2	-1	0	1	2	3	**Additional description if desired**
2.6	Building orientation and site geometry							
2.7	Building location on site							
2.8	Impace of building on external environment/surroundings (visual, light, sunlight, noise, wind, microclimate)							
2.9	Re-use of existing buildings							
2.10	Potential for building to be adapted for different use/lifetime adaptability of building							
	Use of materials in shell, core and fitout: how big a proportion of your buidling is made from local, low emission materials?	-2	-1	0	1	2	3	**Additional description if desired**
2.11	Good thermal performance							
2.12	Low embodied energy							
2.13	Low toxicity and pollution							
2.14	Uses recycled materials							
2.15	Potential for re-use and recycling of materials at end of building's life							
2.16	Sustainability of fit out - materials and design life							

		-2	-1	0	1	2	3	
3	**DESIGN PERFORMANCE OBJECTIVES**							
	Functionality: how easy is it for users to control, maintain and adapt your buidling?	-2	-1	0	1	2	3	**Additional description if desired**
3.1	Controllability and manageability of systems (e.g. lighting, heating, cooling,ventilaiton, solar shading)							
3.2	Provisions for maintenance							
3.3	Design / strategy for waste management							
3.4	Adaptaptability to climate change (e.g. potential to enhance cooling needed)							
3.5	Durability							
3.6	Strategy for performance monitoring							
	Indoor environment - how comfortable for users is your building acoustically, thermally, visually, spatially?	-2	-1	0	1	2	3	**Additional description if desired**
3.7	Acoustic quality performance againste benchmark in Section A							
3.8	Air Quality performance againste benchmark in Section A							
3.9	Natural daylighting quality and quantity performance againste benchmark							
3.10	Thermal comfort							
3.11	Spatial envrionment							
	Energy, CO2 and Utilities - how much energy and resources will your project use and produce?	-2	-1	0	1	2	3	**Additional description if desired**
3.12	Energy performance against benchmark - compare against benchmark/goal in Section A							
3.13	Building Services: Heating and Ventilation Load (kWh/m2/y) - Describe strategy - Delivered Energy - Primary Energy							
3.14	Building Services: Cooling and Ventilation Load (kWh/m2/y) - Describe strategy - Delivered Energy - Primary Energy							
3.15	Building Services: Electrical Load (other than above) (kWh/m2/y) - Describe strategy - Delivered Energy - Primary Energy							
3.16	Process and Appliances: Energy Load (other than above) (kWh/m2/y) - Describe strategy - Delivered Energy - Primary Energy							
3.17	U-values : Area weighted average for - Walls - Windows - Roof - Heat Loss Floor							
3.18	Airtightness (ac/hr at normal pressure; state test result only, otherwise standard result)							
3.19	Artificial lighting and controls strategy							
3.20	Daylighting / sunlighting strategy							
3.21	Energy recovery							
3.22	Renewable energy sources							
3.23	On-Site energy generation / CHP							
	Emissions	-2	-1	0	1	2	3	**Additional description if desired**
3.24	Rain water							
3.25	Foul water							
3.26	Liquid wastes							
3.27	Gaseous emissions							
3.28	Solid waste							
4	**PROCUREMENT**							
	Education & skills	-2	-1	0	1	2	3	**Additional description if desired**
4.1	Briefing and design reviews: sustainability							
4.2	CIRI registered contractor?							
4.3	Personnel have skills appropriate to tasks required of them							
	Materials sourcing & waste minimisation	-2	-1	0	1	2	3	**Additional description if desired**
4.4	Environmental impact of operations on site							
4.5	Environmental impact of transport to site							
4.6	Sourcing of materials, components and labour							
4.7	Waste minimisation during construction							
	Quality control on site	-2	-1	0	1	2	3	**Additional description if desired**
4.8	Incorporating post - occupancy evaluation and feedback							
5	**CONSTRUCTION, VALIDATION AND HANDOVER**							
	Building fabric testing	-2	-1	0	1	2	3	**Additional description if desired**
5.1	air tightness testing							
5.2	Indoor environmental quality - light (lux measurements)							
5.3	Indoor environmental quality - air (CO2 testing)							
5.4	Thermal imaging							
	Building systems commissioning, demonstration & training	-2	-1	0	1	2	3	**Additional description if desired**
5.5	Commissioning, handover,							
5.6	Use of energy and utilities (update section 7)							
5.7	Quality of building and facilities management							
5.8	Occupant training							
6	**POST OCCUPANCY EVALUATION**	-2	-1	0	1	2	3	**Additional description if desired**
6.1	Post occupancy evaluation methods & agreements for collection of data & formats							
6.2	Impact on local environment, community, townscape, transport etc.							
6.3	Response to brief - client assessment							
6.4	Appropriateness of space - client assessment							
6.5	Appropriateness of fit-out - client assessment							
6.6	Usability and manageability							
6.7	Occupant satisfaction							
	TOTAL							

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