Thank you for joining!
This lecture will begin shortly, at 11:00am UTC, 12:00noon BST
Lecture Series

Overview of the seven lectures forming part of this series:

1. Introduction to the UN 2030 Sustainable Development Goals, Mina Hasman, SOM
   Provides an overview of the UN 2030 SDGs together with other related international agreements, and describes the importance of the Goals for Built Environment Professionals.

2. Planning for Rapid Urbanisation, Ben Bolgar, The Prince's Foundation
   Outlines a framework for use in secondary cities which are experiencing rapid growth but which may have little or no access to professional planning expertise.

3. Planned City Extensions, Alfredo Caraballo, Allies and Morrison
   Provides a reminder of key master-planning and urban design principles such as: site analysis, micro-climate design, density, mixed use, walkability etc.

4. Resilient Infrastructure, Ian Carradice, Arup
   Explains the context, relevance and drivers to develop resilient infrastructure by adopting an integrated design approach and considering planetary solutions to address climate related challenges.

5. Climate Responsive Design, Peter Clegg, Isabel Sandeman and Rachel Sayers from FCB Studios, and Rafiq Azzam, Shatotto
   Part one is focused on ‘A Manifesto for delivering Climate Responsive Design’, and Part Two, entitled ‘Collaborating for Sustainable Development’, provides a case study of how the principles of Climate responsive design have been used on a project in Bangladesh to create an inspiring and comfortable educational environment for the Aga Khan Academies Unit.

6. Heritage-led Regeneration, Geoff Rich, Feilden Clegg Bradley Studios
   Describes the value of heritage led regeneration in terms of the reuse of existing buildings, and the potential to generate social and economic development.

7. Sustainable Outcomes Guide, Gary Clark, HOK London Studio
   Provides a practical explanation of the outcomes that need to be delivered if we are to achieve development which is sustainable. Includes meaningful, measurable targets and associated metrics.
RIBA Sustainable Outcomes Guide: A Road Map to a Sustainable Future

RIBA Sustainable Futures Group

Gary Clark, HOK, London Studio
CONTEXT
7.7 Billion People

37.1 Billion Tonnes CO₂ Emissions

$80,683.79 Billion

1/3 from Buildings and Construction

Earth absorbs 1/2 total CO₂
Global CO₂ emissions by world region, 1751 to 2015
Annual carbon dioxide emissions in billion tonnes (Gt).
IPCC Climate Change Scenarios

- **Historical (42)**
- **RCP 2.6 (26)**
- **RCP 4.5 (32)**
- **RCP 6.0 (17)**
- **RCP 8.5 (30)**

**Global surface warming (°C)**

- **> 4 degC**
- **> 2 degC**
  - 2 degC (2% reduction per year)
- **< 1.5 degC**
  - 1.5 degC (7.6% reduction per year)

**ERAs:**
- **ERA 1**
- **ERA 2**
UN Habitat World Urbanisation Prospects

Source: ‘World Urbanisation Prospects, 2018’, UN Habitat
Floor area additions by 2060

Source: ‘Energy Technology Perspectives’, International Energy Agency/OECD, 2017
Building energy codes by country, 2018

Source: International Energy Agency, March 2019
Built Environment Policy

250m people
2.3bn tonnes CO²

2.27bn people
2.7bn tonnes CO²
What do we need to collectively do?

How control measures may reduce spread of Carbon emissions in the world

*Control measures: Self-isolating if ill, social distancing for vulnerable and whole household isolation if one member is ill

Source: Department of Health
What do we need to collective do?

This example shows regionally negotiated rates of C&C. It is for a 450ppmv Contraction Budget, with Convergence by 2030.
Declaration of an environment and climate emergency and support for the UK government’s commitment to put into legislation the UK Committee on Climate Change recommendation for a UK 2050 net zero greenhouse gas emissions target.

RIBA Climate Change Resolution
Zero Carbon - Energy Intensity Targets. Industry guidance for new development

Royal Institute of British Architects, 2019

UK Green Building Council, 2020

London Energy Transformation Initiative, 2020
What is zero carbon development?
Defining the scope.

- Construction embodied carbon
- Building energy use
- Renewable energy (displaced carbon)
- Operational carbon offsets
- In-use embodied carbon (replacement/refurbishment)
- Embodied carbon offsets
- End of life carbon balance (disassembly and potential reuse)

Assessment of operational carbon

Assessment of whole life carbon

Reference: UKGBC: Net zero carbon buildings – a framework definition, 2019
Assessing operational energy.

Poor accuracy

Benchmarking
CIBSE Guide F
Building
Regulation
Assessment

Good accuracy

EPC
Passivhaus
Planning
Package (PHPP)
Dynamic
modelling
CIBSE TM54
Design for
Performance
(BBP framework)
UN Sustainable Development Goals
UN Sustainable Development Goals
UN Sustainable Development Goals

- Good Health and Well-being
- Sustainable Water Cycle
- New Zero Carbon Emissions
- Sustainable Life Cycle Cost
- Sustainable Connectivity and Transport
- Sustainable Communities and Social Value
- Net Zero Embodied Carbon Emissions
- Whole Life Carbon Emissions
- Sustainable Water Cycle
- Sustainable Land-use and ecology

RIBA Sustainable Outcomes
Net Zero Operational Carbon

**METRIC:**
- kWh/m²/y
- kgCO²e/m²/y

- Retrofit First
- Fabric First
- Regenerative Engineering
- On-Site Renewables
- Off-site renewables to achieve net zero emissions
Net Zero Embodied Carbon

METRIC: kgCO\textsubscript{2}e/m\textsuperscript{2}
RICS A-C

- Retrofit First
- Whole Life carbon analysis
- Local low embodied materials
- Healthy and Ethical Materials
- Offset by off-site renewables

Branch shrine of the Ise Grand Shrine, Japan
Sustainable Water Cycle

METRIC: Litre/person/year Potable Water

- Low flow appliances
- Leak detection
- Rainwater recycling and attenuation
- Sustainable Urban Drainage
- Natural aquatic habitats
Sustainable Connectivity & Transport

METRIC: kgCO\textsubscript{2}e/km/per Occupant

- green transport and digital plan
- proximity to public transport
- high quality pedestrian links
- end of journey cycle provision
- electric vehicle infrastructure

Copenhagen, Denmark
Sustainable Land Use & Ecology

METRIC: Species added Enhancement

- Leave site with better ecology
- Retrofit First
- Brownfield site
- Increase green cover
- Increase bio-diversity
- Productive Food Landscapes
Good Health & Well-being

METRIC: Various Metrics

- Contact to outside and plants
- Good Density
- Indoor Air Quality
- Good Lighting
- Adaptive Thermal Comfort
- Good acoustics
- Inclusive and accessible/active circulation

Rathbone Square, London
Sustainable Communities & Social Values

METRIC: Various Metrics

- Mixed Use and Tenure
- Identity and territory
- Secure places
- Social places and amenities
- Permeability
- High quality pedestrian links
- Inclusive community Places

Granary Square, King's Cross
Sustainable Life Cycle Cost

METRIC: £/m² value

- Whole life cycle analysis
- Energy costs
- Materials costs
- Operational costs
- Added value of health/Wellbeing
- Added value of social value
RIBA 2030 CLIMATE CHALLENGE

Sign up to take the RIBA 2030 Climate Challenge at www.architecture.com/2030challenge
RIBA 2030 Climate Challenge Trajectories

- **Baseline regulatory minimum**
- **RIBA 2020 Targets**
- **RIBA 2025 Targets**
- **RIBA 2030 Targets**

- **Best Practice Trajectory**
- **Satisfactory Trajectory**
- **Minimum Trajectory**

- **+1.5°C**
- **> +2°C**
- **> +4°C**

**Business as Usual Worst Case Climate Change Outcomes**

- +4°C
- +2°C
- +1.5°C

- **RIBA 2020 Targets**
- **RIBA 2025 Targets**
- **RIBA 2030 Targets**

35
### RIBA 2030 Climate Challenge: Domestic Building Targets

<table>
<thead>
<tr>
<th>RIBA Sustainable Outcome Metrics</th>
<th>Current Benchmarks</th>
<th>2020 Targets</th>
<th>2025 Targets</th>
<th>2030 Targets</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational Energy</strong> kWh/m²/y</td>
<td>146 kWh/m²/y (Ofgem benchmark)</td>
<td>&lt; 105 kWh/m²/y</td>
<td>&lt; 70 kWh/m²/y</td>
<td>&lt; 0 to 35 kWh/m²/y</td>
<td>UKGBC Net Zero Framework&lt;br&gt;1. Fabric First&lt;br&gt;2. Efficient services, and low-carbon heat&lt;br&gt;3. Maximise onsite renewables&lt;br&gt;4. Minimum offsetting using UK schemes</td>
</tr>
<tr>
<td><strong>Embodied Carbon</strong> kgCO₂e/m²</td>
<td>1000 kgCO₂e/m² (M4i benchmark)</td>
<td>&lt; 600 kgCO₂e/m²</td>
<td>&lt; 450 kgCO₂e/m²</td>
<td>&lt; 300 CO₂e/m²</td>
<td>RICS Whole Life Carbon (A-C)&lt;br&gt;1. Whole life carbon analysis&lt;br&gt;2. Using circular economy strategies&lt;br&gt;3. Minimum offsetting using UK schemes</td>
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<td><strong>Potable Water Use</strong> Litres/person/day</td>
<td>125 l/p/day (Building regulations England and Wales)</td>
<td>&lt; 110 l/p/day</td>
<td>&lt; 95 l/p/day</td>
<td>&lt; 75 l/p/day</td>
<td>Using CIBSE Guide G</td>
</tr>
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### Best Practice Health Metrics

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<th>Health Metrics</th>
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<tr>
<td>Overheating</td>
<td>25–28 °C maximum for 1% of occupied hours&lt;br&gt;CIBCE TM52, CIBSE TM59</td>
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<tr>
<td>Daylighting</td>
<td>&gt; 2% av. daylight factor, 0.4 uniformity&lt;br&gt;CIBSE LG10</td>
</tr>
<tr>
<td>CO₂ levels</td>
<td>&lt; 900 ppm&lt;br&gt;CIBSE TM40</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>&lt; 0.3 mg/m³&lt;br&gt;Approved Document- F</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>&lt; 0.1 mg/m³&lt;br&gt;BREEAM</td>
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## RIBA 2030 Climate Challenge: Non-domestic Building Targets

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<td><strong>Operational Energy</strong> kWh/m²/y</td>
<td>225 kWh/m²/y DEC D rated (CIBSE TM46 benchmark)</td>
<td>&lt; 170 kWh/m²/y DEC C rating</td>
<td>&lt; 110 kWh/m²/y DEC B rating</td>
<td>&lt; 0 to 55 kWh/m²/y DEC A rating</td>
<td>UKGBC Net Zero Framework 1. Fabric First 2. Efficient services, and low-carbon heat 3. Maximise onsite renewables 4. Minimum offsetting using UK schemes</td>
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<td><strong>Embodied Carbon</strong> kgCO₂e/m²²</td>
<td>1100 kgCO₂e/m²² (M4i benchmark)</td>
<td>&lt; 800 kgCO₂e/m²²</td>
<td>&lt; 650 kgCO₂e/m²²</td>
<td>&lt; 500 CO₂e/m²²</td>
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<tr>
<td><strong>Potable Water Use</strong> Litres/person/day</td>
<td>&gt; 16 l/p/day (CIRA W11 benchmark)</td>
<td>&lt; 16 l/p/day</td>
<td>&lt; 13 l/p/day</td>
<td>&lt; 10 l/p/day</td>
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## Best Practice Health Metrics

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**RIBA Plan for Use**

**Graduated Post Occupancy Evaluation**

**Light-touch Review** - End of Stage 6
Walkround, Read Meters, Light User Survey

**Diagnostic Assessment** - Year 2
As above, and TM22, BUS Survey etc

**Detailed (Forensic) Investigation** - Year 3
As above, and focussed studies etc
PLAN FOR USE

RIBA
Architecture.com
Why Plan for Use?

Performance gap studies show many buildings fail to meet in-use expectations.
Long term value of buildings in-use.

Whole life cost evaluation of a typical workplace
(Source: Outcome Led Procurement, Constructing Excellence, 2015; estimates based on 20 year appraisal)
Soft Landings

- **Late 1990s:** devised as ‘Sea Trials’ for new buildings, by architect Mark Way

- **2004** scope of service documentation developed with construction sponsorship

- **2008** Open-source documentation developed into a Framework by industry task group led by BSRIA

- **2009** The *Soft Landings Framework* authored by BSRIA and the Usable Buildings Trust.

- **2011** Soft Landings covered in *BREEAM New Construction*, the IGT report, and Government strategy
The trajectories of energy performance from design to operation

- **0**: Strategic Definition
- **1**: Preparation and Briefing
- **2**: Concept Design
- **3**: Spatial Coordination
- **4**: Technical Design
- **5**: Manufacturing and Construction
- **6**: Handover
- **7**: Use (Year 1, Year 2, Year 3+)

**01**: Benchmark model
**02**: Compliance model
For regulated loads

**03**: Energy performance model iterations
Allowable approximations including unregulated loads

**06**: Energy model re-calibration

**07**: Energy use refinement

**3**: Better

Performance factor

- Regulatory or client target
- High client and design ambitions (i.e. DECA) plus assumed LZC benefits

**0**: Poor risk assessment

**2**: Loads and operating hours rise, product substitution

**3**: Emerging gap (often goes undetected)

**4**: Initial gap

**5**: Dynamic gap

- **a**: Poor commissioning
- **b**: Inadequate set-up
- **c**: Lack of fine-tuning

Diagram: Roderic Bunn, RIBA Overlay ©RIBA

RIBA Architecture.com
2020 RIBA Plan of Work

Without Soft Landings or RIBA Plan for Use interventions

A wide variety of functional and comfort variables can conspire

Unlike energy analysis, movement in occupant satisfaction cannot be tracked through procurement

Evidence of widespread occupant dissatisfaction only apparent upon user survey
CASE STUDIES
Total Energy Consumption
-31.1kWh/m2/y
Improvement on typical
121% reduction
Net Positive

Bere architects | Lark Rise, Buckinghamshire
Predicted Total Energy Consumption
16kWh/m²/y
Reduction from typical
90% reduction

Embodied Carbon
336kgCO₂/m²
Reduction from Typical - 67%
Predicted Total Energy Consumption
0kWh/m²/y
Reduction from typical 100% reduction
Actual Energy Consumption
63 kWh/m²/y
Improvement on typical 70% reduction
Inc renewables

Allies and Morrison | Ash Court, Girton, Cambridge
Built at Median cost of University buildings

- 3,400 m² GIFA
- Total Energy Consumption: 70 kWh/m²
- Improvement on typical: 68% reduction
AECOM | GSK Sustainable Lab, University of Nottingham

4,200 m² GIFA
Actual Total Energy Consumption
292 kWh/m²
Improvement on typical 60% reduction inc Renewables
3,400 m² GIFA
Total Energy Consumption
107 kWh/m²/y
Reduction from typical
52% reduction
Without renewables
Total Energy Consumption: 186.5kWh/m²/y
Reduction from typical: 67%
Without renewables
European examples.

Energy 64 kWh/m².yr (calculated)
**Miljohuset, Oslo, Norway**
Passivhaus, MVHR, heat pump.

Energy 76 kWh/m².yr (calculated)
**Horizont-Building Strassen, Luxembourg**
Biomass boiler, chiller with night cooling, variable speed ventilation control.
Office buildings – evidence review of measured energy.

Data Sources: Carbon Buzz (Blue), Innovate UK (Green), the Green Construction Board Building Mission 2030 (Yellow), Landsec benchmark assessment (Purple).

Measured total energy consumption (kWh/m² yr)

Modern good-practice air conditioned office

Zero carbon office target

150 kWh/m² yr

55 kWh/m² yr

Offices - kWh/m².year (GIA)
Rwanda, **Land of a Thousand Hills**
Develop your own local sustainable outcomes guides

Target Net zero operational carbon

Target Net zero embodied carbon

Target sustainable water use

Deliver indoor air quality
- Protect old growth forests
- Increase density of existing settlements
- Target significantly enhanced biodiversity and green cover
- All new cities should be net zero carbon
Thank you

www.architecture.com/2030challenge

Guides downloadable from here:


www.architecture.com/-/media/GatherContent/Test-resources-page/Additional-Documents/2020RIBAPlanofWorkoverviewpdf.pdf?la=en
Commonwealth Association of Architects
Engaging with the UN 2030 Sustainable Development Goals

We hope you found this lecture of interest and that you will be interested in the other lectures in this series:

1. Introduction to the UN 2030 Sustainable Development Goals
2. Planning for Rapid Urbanisation
3. Planned City Extensions
4. Resilient Infrastructure
5. Climate Responsive Design
6. Heritage-led Regeneration
7. Sustainable Outcomes Guide

The Commonwealth Association of Architects would like to extend its thanks to all the contributors for their support in the creation of this pilot programme. The CAA welcomes feedback together with suggestions for future topics and would be pleased to hear from subject matter experts from around the Commonwealth who may be interested in contributing future material.

For this or any other issue, please contact: admin@comarchitect.org
Thank you for joining!

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www.commonwealthsustainablecities.org/cpd