

SWECO 

M

M

MOTT
MACDONALD

Approved Document L: Conservation of fuel and power

Volume 2: Buildings other than dwellings - **2021 Updates**



CIBSE
Building Simulation Group

Next event

Overheating: Approved Document O



CIBSE
Building Simulation Group



Hybrid event

Event post to be issued soon

October 2022

M	T	W	T	F
3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28
31				

Building Simulation Awards

Open for entries



CIBSE
Building Simulation Group

CIBSE BUILDING SIMULATION AWARDS 2022

ENTER NOW

- CIBSE Building Simulation Award
- CIBSE Building Simulation Young Modeller Award

Deadline - 16 October
cibse.org/BSA

Winners will be announced at an event as part of the **Build2Perform** programme, **29th-30th November**

October 2022

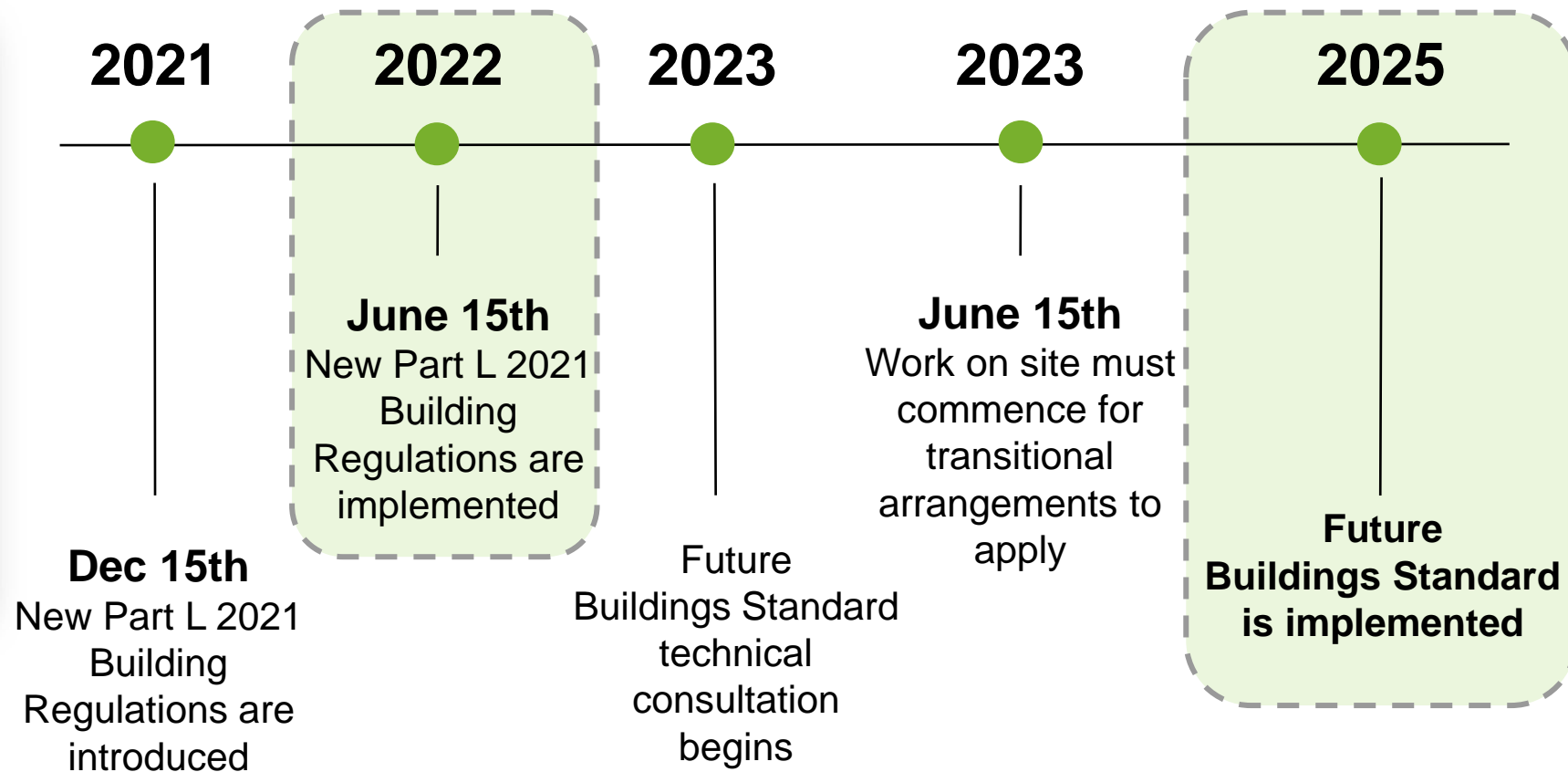
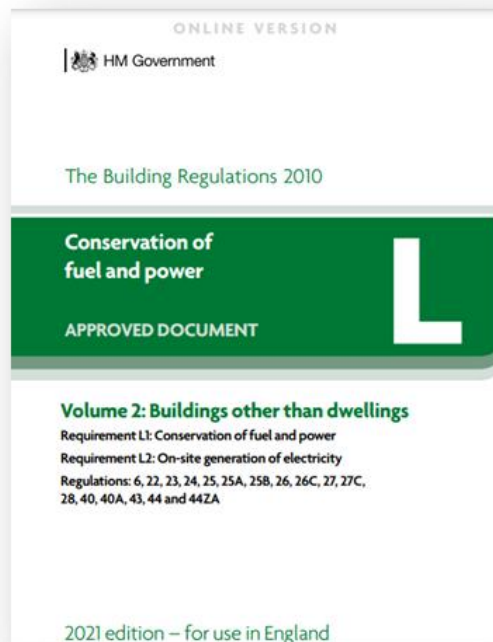
M	T	W	T	F	S	N
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Agenda

- 1 Transitional arrangements
- 2 Approved Document L: Volume 2
- 3 Case Study 1 – GLA Referable Example (Monika Potomska)
- 4 Case Study 2 - Baran Tanriverdi
- 5 Still to come
- 6 Looking ahead

1. Transitional Arrangements

Timeline



1. Transitional Arrangements

When does it apply?

New Part L 2021 regulations apply if:

- Notices or plans are submitted after **15th June 2022** (initial notice or deposited plans)
- Works on site must commence by **15th June 2023**, inclusive of:
 - Excavation for strip or trench foundations or for pad footings;
 - Digging out and preparation of ground for raft foundations;
 - Vibrofloatation (stone columns) piling, boring for piles or pile driving;
 - Drainage work specific to the buildings(s) concerned;
- What does this mean for non-domestic EPCs?

June 2022

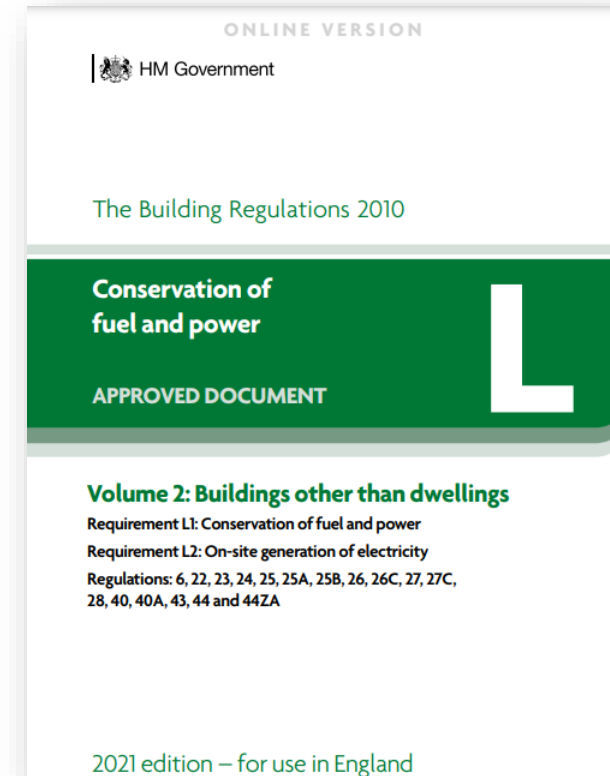
M	T	W	T	F
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	

2. Approved Document L: Volume 2

Buildings other than dwellings (commercial)

2. Approved Document L: Volume 2 Building other than dwellings (non-domestic)

- An average 27% reduction in CO2 relative to 2013 standards
- Introduction of a new performance metric measuring energy efficiency. 'Primary energy' will be used in combination with CO2 metrics to assess compliance.
- An energy forecasting methodology such as CIBSE's TM54.
- Use of SAP 10.2 now required, SAP 2012 carbon factors are now scrapped.



2. Approved Document L: Volume 2

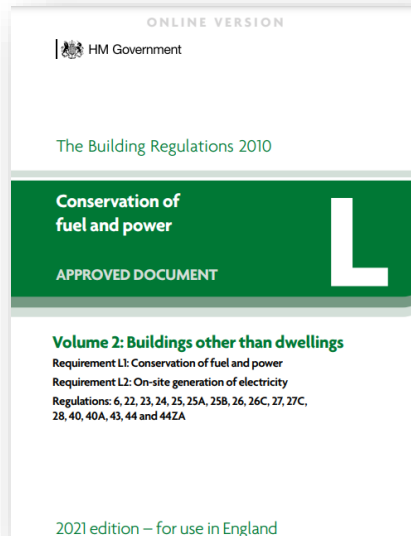
Fabric Performance: Limiting Values

Part L2A 2013 with 2016 amendments:

Roof	0.25 W/(m ² ·K)
Wall	0.35 W/(m ² ·K)
Floor	0.25 W/(m ² ·K)
Swimming pool basin ¹	0.25 W/(m ² ·K)
Windows, roof windows, roof-lights ² , curtain walling and pedestrian doors ^{3,4}	2.2 W/(m ² ·K)
Vehicle access and similar large doors	1.5 W/(m ² ·K)
High-usage entrance doors	3.5 W/(m ² ·K)
Roof ventilators (inc. smoke vents)	3.5 W/(m ² ·K)
Air permeability	10.0 m ³ /(h·m ²) at 50 Pa

Part L 2021: Volume 2

Element type	Maximum U-value ⁽¹⁾ W/(m ² ·K) or air permeability
Roof (flat roof) ⁽²⁾	0.18
Roof (pitched roof) ⁽²⁾	0.16
Wall ⁽²⁾⁽³⁾	0.26
Floor ⁽⁴⁾⁽⁵⁾	0.18
Swimming pool basin ⁽⁶⁾	0.25
Windows in buildings similar to dwellings ⁽⁷⁾⁽⁸⁾	1.6 or Window Energy Rating ⁽⁹⁾ Band B
All other windows, ⁽⁸⁾⁽¹⁰⁾⁽¹¹⁾ roof windows, curtain walling	1.6
Rooflights ⁽¹²⁾⁽¹³⁾	2.2
Pedestrian doors (including glazed doors) ⁽¹⁴⁾	1.6
Vehicle access and similar large doors	1.3
High-usage entrance doors	3.0
Roof ventilators (including smoke vents)	3.0
Air permeability (for new buildings)	8.0m ³ /(h·m ²) @ 50Pa



27% improvement

APPROVED DOCUMENT L: Conservation of Fuel and Power 2021
Volume 2 – Buildings other than Dwellings

2025?

2. Approved Document L: Volume 2

Fabric Performance: Notional Values

2013 Edition:

Exposed element	U-value (W/m ² K)	Thermal capacity ⁴ (kJ/m ² K)
Roofs ⁵ (irrespective of pitch)	0.18	88.3 (1.40 if metal-clad)
Walls	0.26	21.8 (1.40 if metal-clad)
Exposed floors and ground floors (subject to paragraph 33)	0.22	77.7
Windows*	1.60	-
Roof windows and roof-lights*	1.80	-

2022 Edition:

Element	U-value (W/m ² K)		Thermal capacity ³ (kJ/m ² K)
	Side-lit and unlit activities	Top-lit activities	
Roofs ⁴ (irrespective of pitch)	0.15	0.18	88.3 (1.40 if metal-clad)
Exposed walls	0.18	0.26	21.8 (1.40 if metal-clad)
Exposed floors and ground floors (subject to paragraph 36)	0.15	0.22	77.7
Windows*	1.4	-	-
Roof-lights*	-	2.1	-
Vehicle access and similar large doors	1.3		2.1
Pedestrian doors and high usage entrance doors	1.9		54.6
Internal walls	1.8		8.8
Internal floors/ceilings	1.0		71.8 from above / 66.6 from below

*This is the overall U-value of the complete unit, including the frame and edge effects, and it relates to the performance of the unit in the vertical plane for windows (and roof windows), and in the horizontal plane (i.e., already adjusted for flat roofs) for roof-lights (BR443²) so, where applicable, the U-value must be adjusted (from the vertical plane) for the slope of the roof by +0.3 W/m²K if the roof is flat, and +0.2 W/m²K if the roof is pitched. All the roof-lights in the Notional building are assumed to be conical or domed, and hence, for the purposes of heat transfer calculations, their developed to projected ratio is set to 1.3, i.e., the area of the roof-light is 1.3 times the area of the opening in the roof.

2. Approved Document L: Volume 2

Fabric Performance: Notional Values

Parameter		Part L2A 2013 Limiting Value	Part L2A 2021 Limiting Value	Part L 2021 – Notional Values	Passive House 	2025 Future Buildings Standard
U- values	Wall	0.35 W/m ² K	0.26 W/m ² K	0.18 W/m ² K	0.15 W/m ² K	Under consultation in 2023
	Roof	0.25 W/m ² K	0.18 W/m ² K	0.15 W/m ² K	0.15 W/m ² K	
	Floor	0.25 W/m ² K	0.18 W/m ² K	0.15 W/m ² K	0.15 W/m ² K	
	Curtain wall	2.2 W/m ² K	1.6 W/m ² K	1.4 W/m ² K*	0.85 W/m ² K	
Glazing U-value		2.2 W/m ² K	1.6 W/m ² K	1.4 W/m ² K	0.85 W/m ² K	

* Notional Building may not apply curtain walling in certain scenarios

2. Approved Document L: Volume 2

Changes to the Part L Methodology

- The carbon factors are now SAP10.2 which considers further decarbonisation of the grid from SAP10
- The notional building will have PVs applied to offset any heat not provided by the heat pumps.
- **Space heating:** The model will use the same heat/DHW sources as designed, but the efficiencies will match the notional efficiencies.
- **DHW:** Has the systems as designed with NCM efficiencies.

APPROVED DOCUMENT L: Conservation of Fuel and Power 2021 Volume 2 – Buildings other than Dwellings:



The guidance is heavily in favour of PVs



Heat pumps for space heating



Façade optimization

2. Approved Document L: Volume 2

Section 5 – Controls for space heating systems

- Uplifted Notional and Limiting performance
- Fixed building services efficiency and performance standards
- In Existing Buildings, in addition to minimum standards, comparison against existing systems emission required
- Control systems, including thermostatic controls for individual rooms
- Further requirements in existing buildings not covered herein
- On-site electricity generation – Notional Building
- Bridging the performance gap – energy submeters
 - Metering should enable the comparison of forecast energy use and in-performance energy and facilitate energy reporting, among other requirements

Controls and zoning for new and replacement space heating systems

5.11 Heating systems should have all the following controls.

- a. The systems should be subdivided into separate **control zones** for areas of the building in which any of the following are significantly different.
 - i. Solar exposure.
 - ii. Pattern of use.
 - iii. Type of use.
- b. For each **control zone** it should be possible to control both of the following independently of other **control zones**.
 - i. Timing.
 - ii. Temperature.
- c. The service should be appropriate to the requirements of the space. If both heating and cooling are provided, the controls should prevent them operating simultaneously.
- d. Central plant should operate only when the zone systems require it. The default condition should be off.
- e. Where appropriate and technically feasible, heating systems should have **weather compensation**.

5.12 System controls should be wired so that when there is no demand for space heating, the **heating appliance** and pump are switched off.

2. Approved Document L: Volume 2

Sections 5 and 6 – Space Heating

Fuel	System	Notional Building 2021 - Efficiency	Part L 2021 - Minimum Efficiency	Part L 2013 - Minimum Efficiency
Natural Gas	Single-boiler ≤ 2 MW output	95.6%	93%	91%
	Single-boiler > 2 MW output		88%	86%
Electricity (Heat pump)	Air-to-air (Space heating < 12kW)	293.3%	Seasonal SCOP 'D' *	Seasonal SCOP 'D' *
	All types (except air-to-air with output ≤ 12 kW, absorption and gas engine) for space heating		250% (COP)	250% (COP)
Electric (Direct)		148.9%**	100%	100%
Oil	Single boiler	95.6%	93%	84%

* A seasonal coefficient of performance (SCOP) rating for the median temperature range in BS EN 14825 of at least D.

** 100% efficiency for modular/ portable building with a planned time of use in a single location ≤ 2 years.

2. Approved Document L: Volume 2

Sections 5 and 6 – Space Heating

- Control systems not covered herein
- Further requirements around how to calculate Seasonal Efficiency not covered herein
- New specifications for Radiant Heaters

Table 6.2 Minimum heat generator seasonal efficiency for boiler systems in existing buildings⁽¹⁾⁽²⁾

Fuel type	System	Boiler seasonal efficiency (gross calorific value)
Natural gas	Single-boiler ≤400kW output	91%
	Single-boiler 401kW–2MW output	88%
	Single-boiler >2MW output	84%
	Multiple-boiler	84% for any individual boiler 91% for overall multi-boiler system
LPG	Single-boiler ≤2MW output	93%
	Single-boiler >2MW output	88%
	Multiple-boiler	88% for any individual boiler 93% for overall multi-boiler system
Oil	Single-boiler	93%
	Multiple-boiler	88% for any individual boiler 93% for overall multi-boiler system

NOTES:

- Seasonal efficiencies should be calculated in line with paragraphs 6.3 to 6.6.
- Non-condensing boilers should be fitted with a flue condensing kit where feasible and where the boiler is likely to be able to operate in condensing mode (e.g. variable temperature circuits).

2. Approved Document L: Volume 2

Sections 5 and 6 – DHW

System	Notional Building 2021 – Efficiency	Part L 2021 - Minimum Efficiency	Part L 2013 - Minimum Efficiency
Direct-fired -NG	93%	91%*	90%**
Indirect-fired -NG		91%	80%
Electrically-heated	286%	100%	

* If condensing boiler cannot feasibly be fitted in an existing building, a boiler with minimum seasonal efficiency of 80%.

** Natural gas minimum efficiency of $73\% \leq 30 \text{ kW}$ output

2. Approved Document L: Volume 2

Sections 5 and 6 – Comfort Cooling

System	Notional Building 2021 – Efficiency	Part L 2021 – Minimum SEER for comfort cooling	Part L 2013 – Minimum SEER for comfort cooling
Packaged air conditioners		3	2.6
Split and multi-split air conditioners	5.5*	5	2.6
VRF/VRV systems		5	2.6

*In mixed-mode operation, the Notional building 2021 will have a cooling SEER of 2.7 with a cooling set-point of 27°C.

2. Approved Document L: Volume 2

Sections 5 and 6 – Comfort Cooling

- Uplifted Limiting performance
- Control systems not covered herein
- Further requirements around how to calculate SEER for bespoke applications not covered herein
- On variable volume systems, variable speed glandless circulators should be used
- If a water pump is used on a closed loop circuit and the motor is rated at more than 750W, then it should be fitted with or controlled by an appropriate variable speed controller on any variable volume system

Table 6.6 Minimum seasonal energy efficiency ratio (SEER)⁽¹⁾ for comfort cooling

Type	Cooling unit SEER	
Packaged air conditioners	Single-duct type	3.0
	Other types	3.0
Split and multi-split air conditioners >12kW		5.0
Split and multi-split air conditioners ≤12kW		5.0
Variable refrigerant flow/volume (VRF/VRV) systems ⁽²⁾		5.0
Water-to-water chillers <400kW		5.0
Water-to-water chillers 400–1500kW		6.0
Water-to-water chillers ≥1500kW		6.5
Vapour compression cycle chillers, air-cooled <400kW		4.0
Vapour compression cycle chillers, air-cooled ≥400kW		4.5
Absorption cycle chillers ⁽³⁾	EER 0.7	
Gas-engine-driven variable refrigerant flow		1.6

NOTES:

1. Seasonal space cooling energy efficiency as defined by the Ecodesign Commission Regulation No. 206/2012 Annex II, at average rating conditions where applicable.
2. For VRV/VRF systems, SEER is for the full system including indoor units.
3. For absorption chillers an EER (energy efficiency ratio) has been used instead. This should be determined according to **BS EN 14511-2**.

2. Approved Document L: Volume 2

Ventilation

- All supply and extract systems should have heat recovery where this is technically feasible
- Air handling systems should be capable of achieving a specific fan power (SFP) at 25% of design flow rate no greater than the SFP achieved at 100% design flow rate
- Further requirements, such as controls, not covered herein

System type	Part L 2021 – Existing buildings - SFP (W/(l*s))	Part L 2021 - New buildings - SFP (W/(l*s))	Part L 2013 - SFP (W/(l*s))
Central balanced mechanical ventilation system with heating and cooling	2.6	2.0	1.6
Central balanced mechanical ventilation system with heating only	2.2	1.9	1.5
All other central balanced mechanical ventilation systems	2.0	1.5	1.1
Zonal supply system where fan is remote from zone, such as ceiling void or roof-mounted units	1.4	1.1	1.1
Zonal extract system where fan is remote from zone	0.5	0.5	0.5
Zonal balanced supply and extract ventilation units, such as ceiling void or roof units	2.3	2.3	1.9
Local balanced supply and extract ventilation system, such as wall/roof units	2.0	2.0	1.6
Local supply or extract ventilation units, such as window/wall/roof units (e.g. toilet extract)	0.4	0.3	0.3
Other local ventilation supply or extract units	0.5	0.5	0.5
Fan assisted terminal variable air volume (VAV) unit	0.5	0.5	1.1
Fan coil unit (rating weighted average)	0.4	0.4	0.5
Kitchen extract, fan remote from zone with grease filter	1.0	1.0	1.0

2. Approved Document L: Volume 2

Sections 5 and 6 – Lighting

System	Notional Building 2021 – Lumens per circuit -watt	Part L 2021 Minimum Efficiency – Lumens per circuit -watt	Part L 2013 Minimum Efficiency – Lumens per circuit -watt
General Lighting	95	95	60
Display Lighting	95	80*	60
High excitation purity light sources		65	

* rated power usage no greater than 0.3W/m² in each space

- Approved Document L2 - Appendix B explain Lighting Energy Numeric Indicator (LENI) method, which should not exceed the lighting energy limit specified in Table B1 of the ADL2 2021
- Building automation and control system requirements exist

2. Approved Document L: Volume 2

Sections 5 and 6 – On-site Electricity Generation

The Notional building will have a roof-mounted PV array whose peak power (kWp) is the product of 0.2 kWp/m² and an array area (m²) calculated using the following equation:

$$APV = (A_{foundation} \times 20\% \times A_{side-lit\&unlit}/A_{total}) + (A_{foundation} \times 40\% \times A_{top-lit}/A_{total})$$

If any HVAC system in the Actual building provides space heating using a heat pump, then the area of the PV array in the Notional building calculated in Equation 9 is reduced pro-rata by the proportion of the building's space heating demand which is met by a heat pump in relation to the building's total space heating demand.

In the **Actual building**:

Where on-site electricity generation is installed, such as photovoltaics, systems should be sized appropriately for the site, available infrastructure and on-site energy demand.

- In short, for a side-lit building with 100% heat (space & DHW) provided by heat pump (any source), no PV is specified in the Notional building model

2. Approved Document L: Volume 2

Sections 5 and 6 – District heat networks and community heating

- The central heat source for community heating systems should comply with the relevant minimum standards outlined throughout Section 6 of ADL2 2021
- A district heat network that is being connected to a new building should not have either of the following:
 - A CO₂ emission factor for delivered heat to the building greater than 0.350kgCO₂/kWh
 - A primary energy factor for delivered heat to the building greater than 1.450kWhPE/kWh

2. Approved Document L: Volume 2

NCM 2021 – Primary Energy Factors

Fuel Type	CO2 Emission Factors (kgCO2/kWh)	Primary Energy Factors (kWh/kWh)
Natural Gas	0.21	1.126
Grid Supplied Electricity	Monthly Factors	Monthly Factors
Grid Displaced Electricity	Monthly Factors	Monthly Factors
Biomass	0.029	1.037
Fuel Oil	0.319	1.18
LPG	0.241	1.141

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grid Supplied Electricity	kgCO2/kWh	0.163	0.16	0.153	0.143	0.132	0.12	0.112	0.122	0.122	0.136	0.151	0.163
	kWh/kWh	1.602	1.593	1.568	1.53	1.487	1.441	1.41	1.413	1.449	1.504	1.558	1.604
Grid Displaced Electricity	kgCO2/kWh	0.196	0.19	0.175	0.153	0.129	0.106	0.092	0.093	0.110	0.138	0.169	0.197
	kWh/kWh	1.715	1.697	1.645	1.567	1.478	1.389	1.33	1.336	1.405	1.513	1.623	1.718

2. Approved Document L: Volume 2

Primary Energy

- The proposed CO₂ emission factor is lower for electricity than for fossil fuels, including Natural Gas;
- The proposed PE factor is higher for electricity than for Natural Gas;
- That results to high PE energy impact in some cases where electricity has been chosen as heating fuel. In some cases lower reduction in PE is achieved for Electricity rather than for Natural Gas

3. Case Study 1

– GLA

Referable Example



THE NEW LONDON PLAN 2021

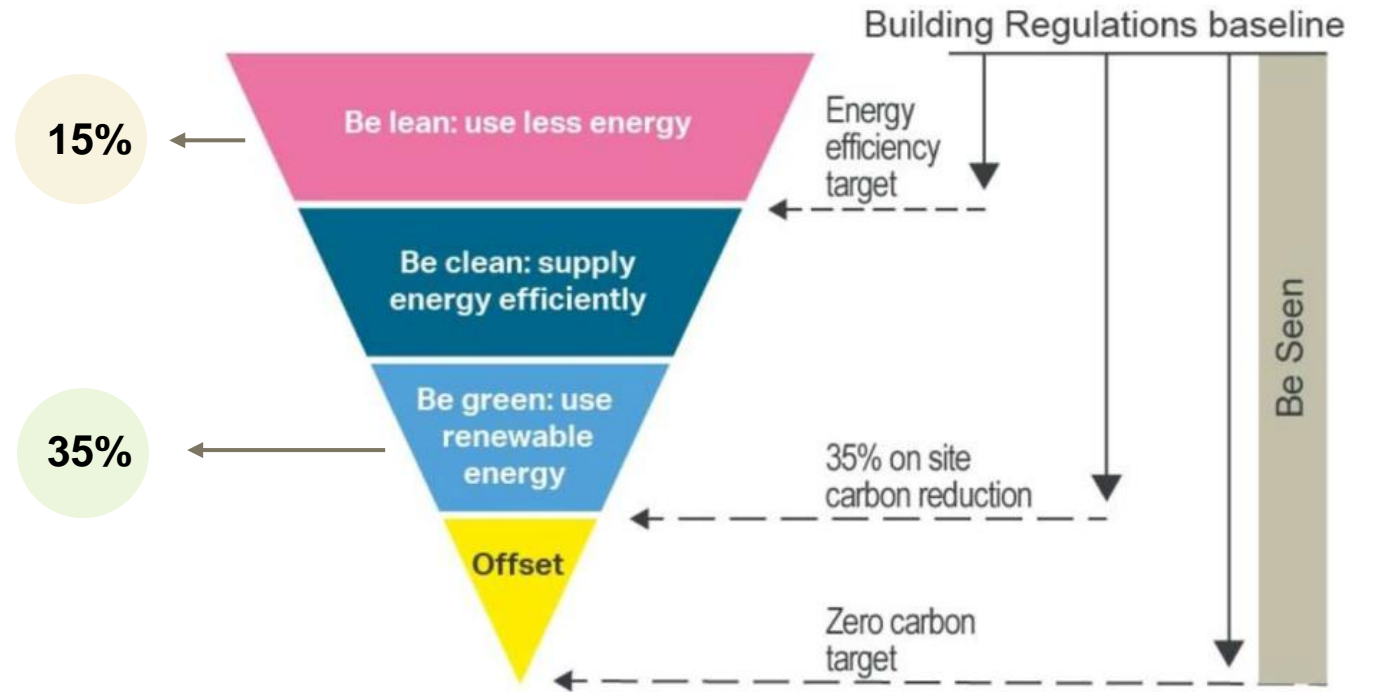
3. GLA Requirements

London Plan 2021 addresses CO2 emissions/GLA Requirements

Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

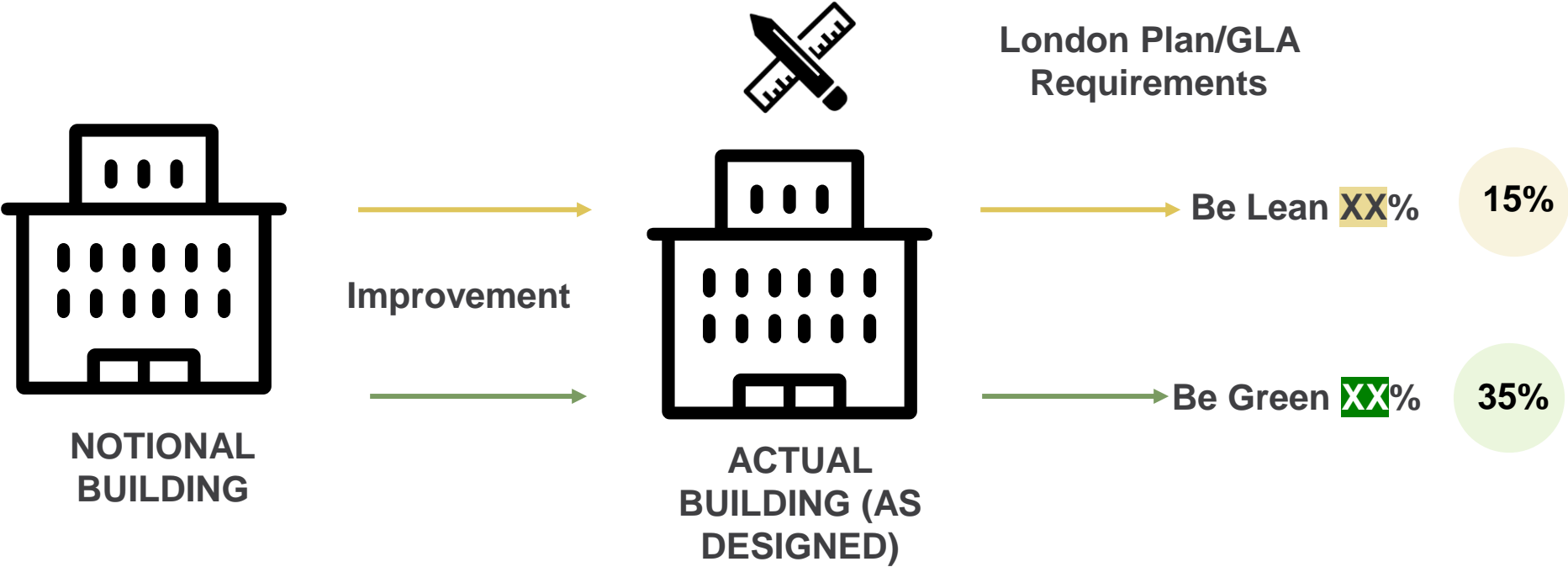
- **Be Lean:** Use Less Energy
- **Be Clean:** District Heating
- **Be Green:** Renewable energy by producing on-site
- **Be Seen:** monitor, verify and report on energy performance, 5 years from construction

LONDON PLAN 2021: POLICY SI 2 MINIMISING GREENHOUSE GAS EMISSIONS



3. GLA Requirements

Changes to the Part L Methodology



3. GLA Requirements

Reporting Energy Use Intensity (EUI) and space heating demand

- Introduced requirements for applicants to report the Energy Use Intensity (EUI) and space heating demand of the development.
- It **does not** include energy reductions from renewable energy generation on site
- There currently is no target required to achieve, although GLA recommends 55 kWh/m²/year for offices.*

Building type	Energy Use Intensity (kWh/m ² /year)	Space Heating (kWh/m ² /year)
Residential	35	15
School	65	15
Office	55	15
Hotel	55 ²³	15
All other non-residential	55	15

Scope	Metric	Interim Targets			Paris Proof Target
		2020-2025	2025-2030	2030-2035	2035-2050
Whole building energy	kWh _e /m ² (NLA) / year	160	115	90	70
	kWh _e /m ² (GIA) / year	130	90	70	55
	DEC rating	D90	C65	B50	B40
Base building energy	kWh _e /m ² (NLA) / year	90	70	55	35
	kWh _e /m ² (GIA) / year	70	55	45	30
	NABERS UK star rating	4.5	5	5.5	6
Tenant energy	kWh _e /m ² (NLA) / year	70	45	35	35

NLA = net lettable area GIA = gross internal area

Design Metric – Pre-2019

Planning
Requirement

CO₂ %

reduction CO₂ emissions
(vs notional building)

Simplified methodology
non-representative energy metric

Gas vs Electric Led Design

Design Metric – 2019+

Design for
Performance
(New Industry Standard)

kWh/m²/yr

Energy Use Intensity
(EUI)

Actual energy use
informs
design decisions to
reduce demand

3. Case Study 1

GLA Referable Example, Grade 'A' Office

- Building is in Central London.
- Office building, containing a retail floorspace.
- It's an all-electric building using 4-pipe multi-purpose air source heat pumps.
- No PVs were included in this building.
- The façade and system efficiencies were designed in line with the NCM 2021 guidance.

Parameter		Part L2 2021 Limiting Value	Part L2 2021 Notional Value	Case Study Design Values
U-values	Wall	0.26 W/m ² K	0.18 W/m ² K	0.20 W/m ² K
	Roof	0.18 W/m ² K	0.15 W/m ² K	0.15 W/m ² K
	Floor	0.18 W/m ² K	0.15 W/m ² K	0.15 W/m ² K
	Curtain wall	1.6 W/m ² K	1.4 W/m ² K	1.3 W/m ² K
Glazing U-value		1.6 W/m ² K	1.4 W/m ² K	1.3 W/m ² K

Part L 2013

Be Lean: 21%
Savings from energy reductions

Be Clean: 0%
Savings from heat network

Be Green: 47%
Savings from renewable energy

Carbon Offset Payment:
GLA recommended £95 / tonne of carbon dioxide

Part L 2021

Be Lean: 15%
Savings from energy reductions

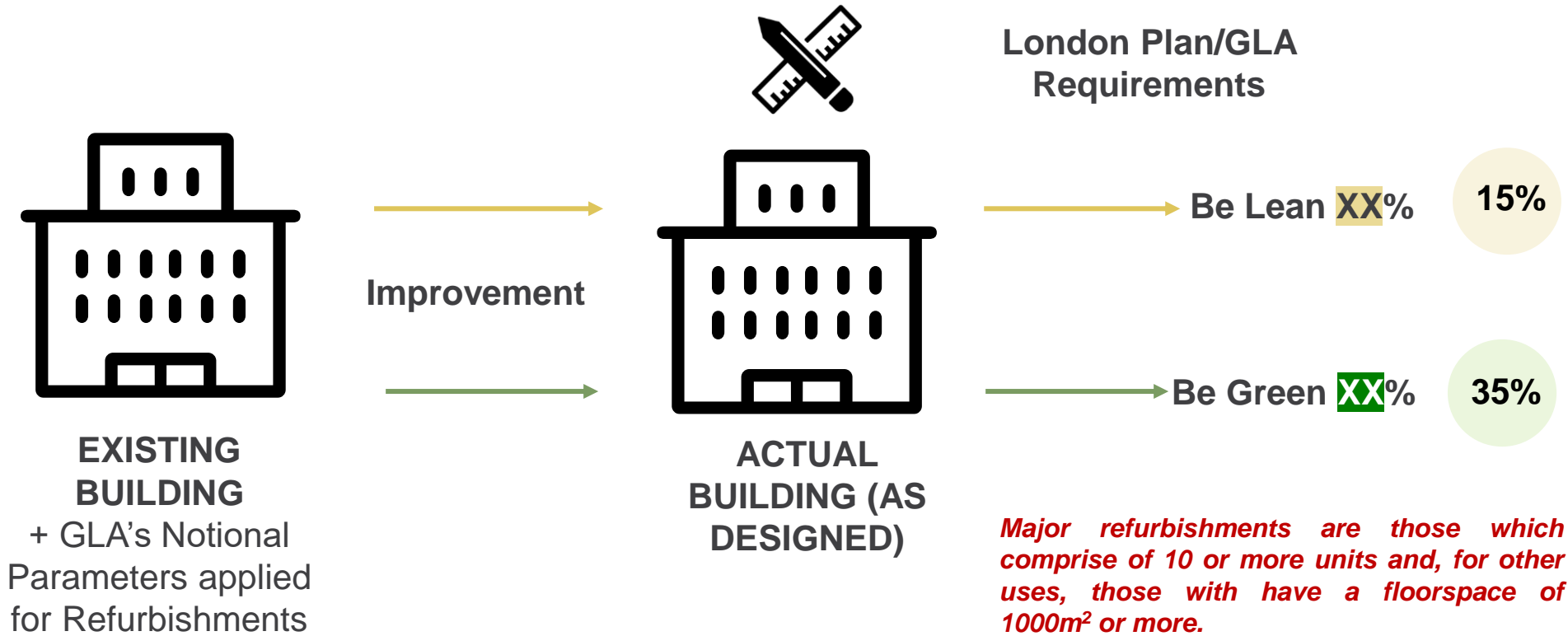
Be Clean: 0%
Savings from heat network

Be Green: 20%
Savings from renewable energy

Carbon Offset Payment:
49% reduction from Part L 2013 results

3. GLA Requirements

Refurbishments



4. Case Study 2

4. Case Study 2

Confidential Transportation Terminal Project - Overview

Project

Confidential Transportation Terminal Project

Location

United Kingdom

Client

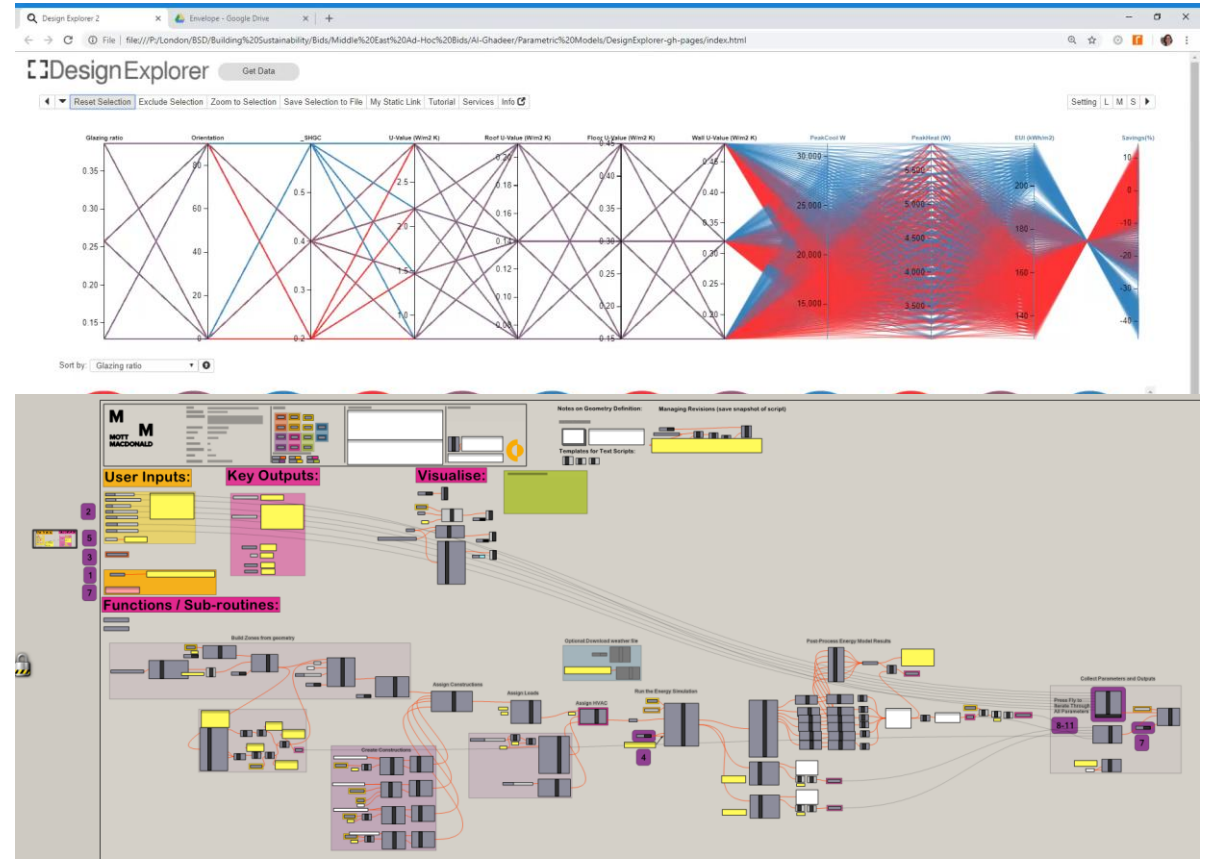
Confidential

Expertise

Net Zero Operational Energy

Parametric Modelling

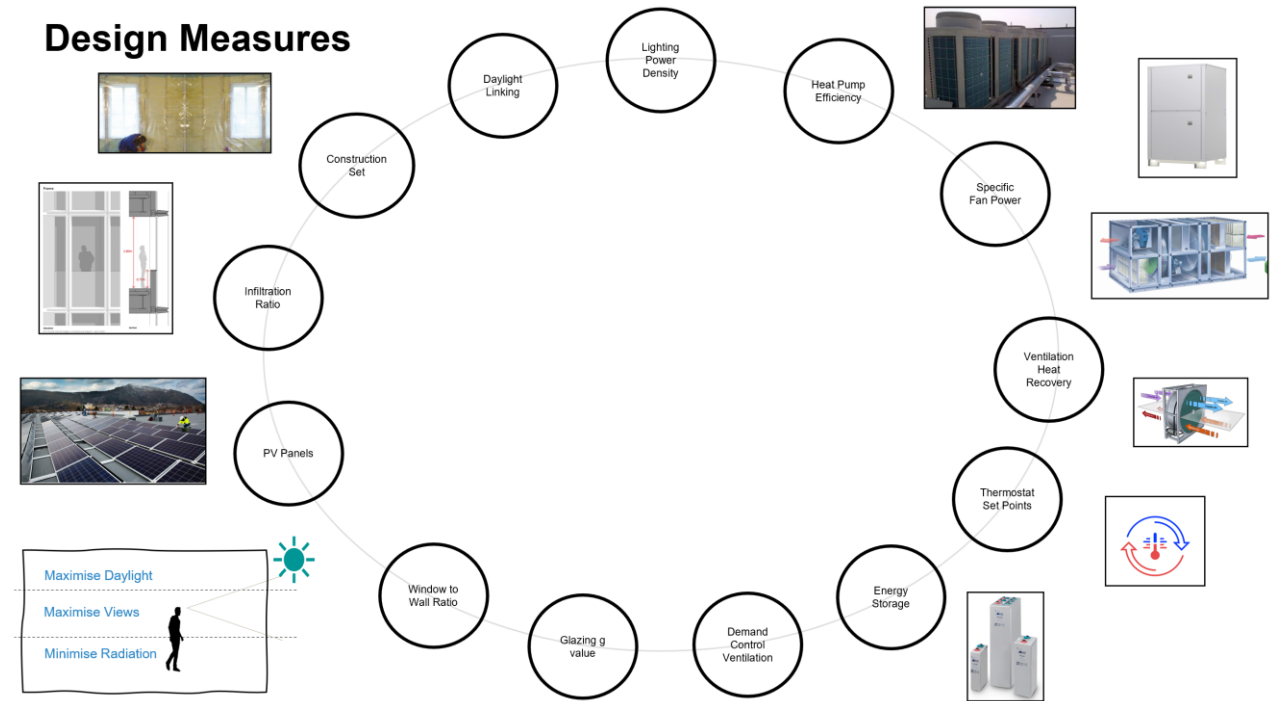
Part L2A Assessment



4. Case Study 2

Confidential Transportation Terminal Project - Overview

- High efficiency thermal envelope which minimises heat loss and heat gain, while optimising daylight availability
- Energy efficient lighting system, including daylight linking
- A high-efficiency heating and cooling system which includes Air Source Heat Pumps (ASHP) and a closed loop Ground Source Heat Pump (GSHP) system
- High efficiency HVAC distribution systems, including Displacement Ventilation and Active Chilled Beams
- Roof mounted PV system



4. Case Study 2

Confidential Transportation Terminal Project – Results Comparison

	% Saving ADL 2013	% Saving ADL 2021	% Uplift in Notional Building Systems
Heating	74%	66%	13%
Cooling	69%	58%	52%
Auxiliary	-	-	18%
Lighting	28%	-	65%
Hot Water	10%	-	15%

ADL 2013

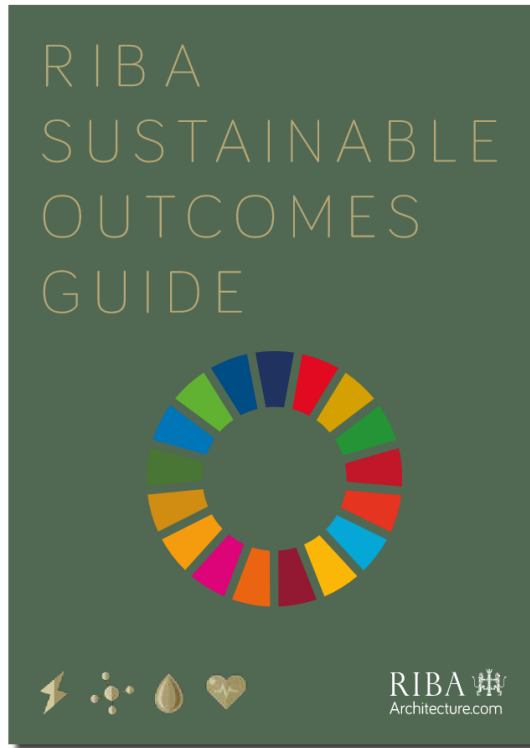
- 32% improvement against notional building regulated CO2 emission rates

ADL 2021

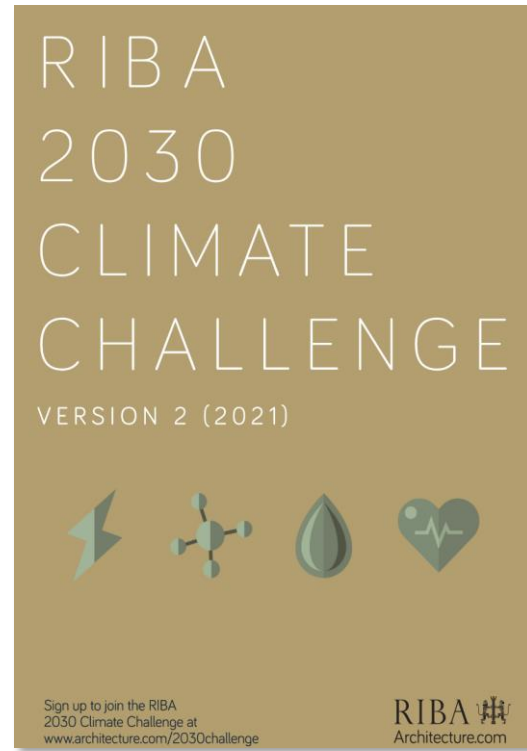
- 14.8% improvement against notional building regulated CO2 emission rates
- 15.6% improvement against notional building regulated primary energy rates

5. Still to come

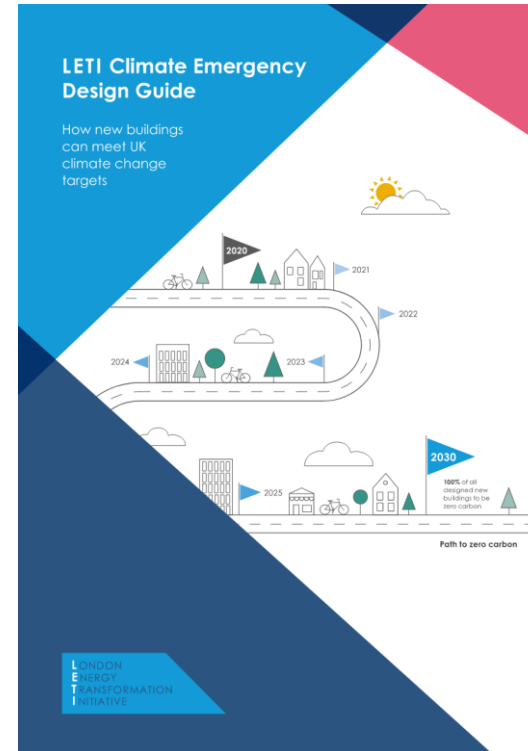
- Introduction of operational energy as a metric
- Regulated embodied carbon targets



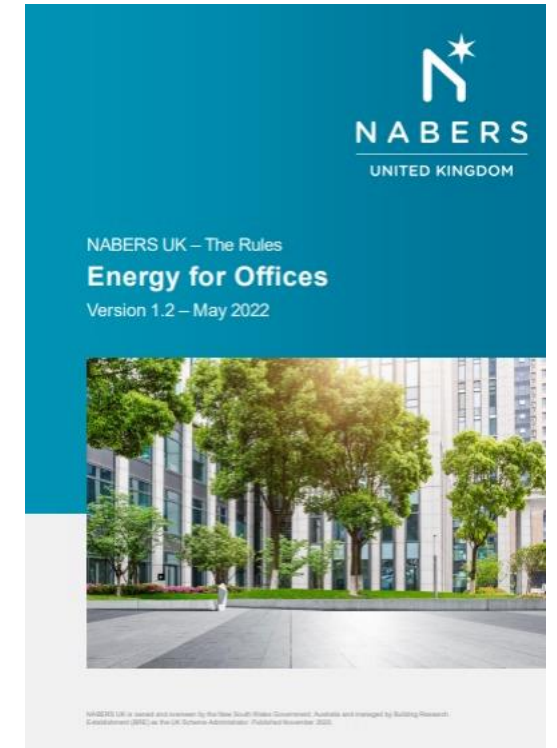
RIBA SUSTAINABLE OUTCOMES, 2019



RIBA CLIMATE CHALLENGE, 2021



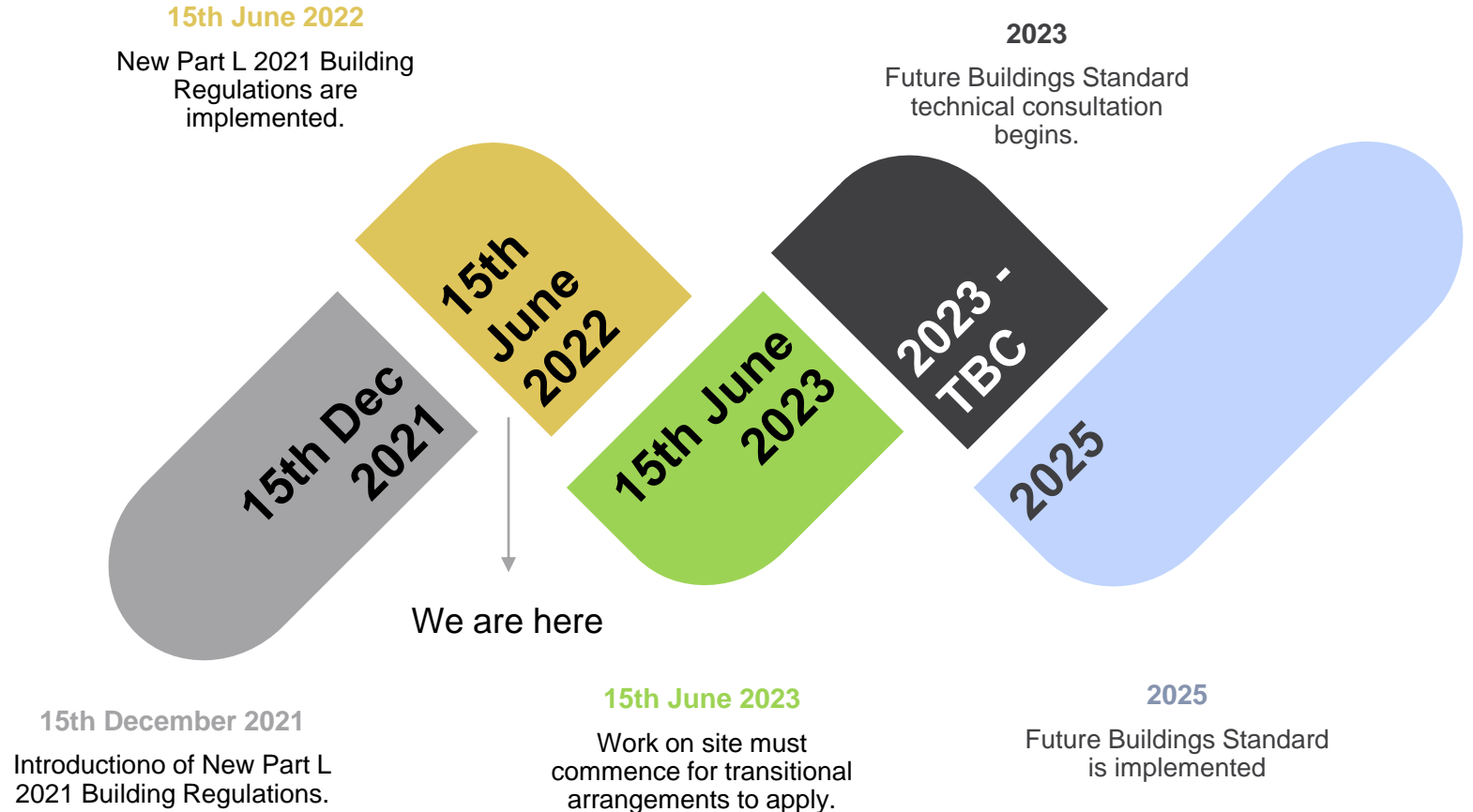
LETI CLIMATE EMERGENCY DESIGN GUIDE



NABERS UK CERTIFICATION - OFFICES

6. Looking ahead: Future Building Standard

- The updated Building Regulations are paving the way for the Future Homes and Buildings Standard in 2025.
- To be implemented in 2025.
- A full technical consultation on the Future Buildings Standard is planned to start in 2023, including proposals for the technical detail and associated draft guidance.
- THE FHS sets out a **75%-80%** reduction in carbon emissions over AD L 2013 to be achieved by 2025.



Questions?