AET Flexible Space
Under Floor Air Conditioning

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HVAC COMPARISON STUDY

EXECUTIVE SUMMARY

HVAC SYSTEM COMPARISON STUDY

EXECUTIVE SUMMARY

The purpose of this HVAC comparison study is to compare the AET Underfloor Air Conditioning (UfAC) system to competitive alternatives on the market for application in a typical office refurbishment and new build schemes. The study aims to 1) compare the performance of each HVAC system within a typical office across whole life carbon, operational energy, upfront costs, as well as across wellbeing and circular economy indicators. And 2) to then compare the savings to the superstructure and façade resulting from differing service void requirements for each HVAC alternative.

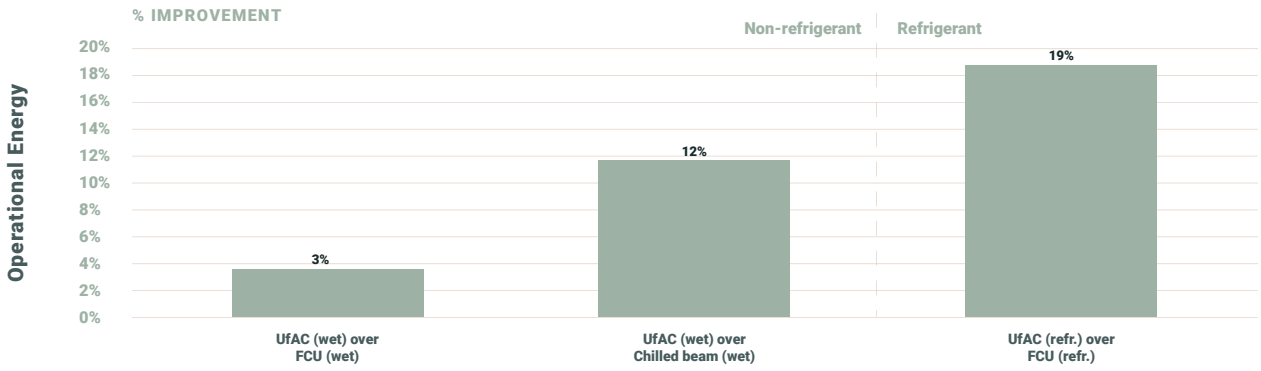
The benefits of using an underfloor air conditioning system have been assessed considering the performance against each of the previously mentioned indicators. The benefits beyond the HVAC systems were assessed considering impacts to the typical office building design. Savings to the superstructure and façade are captured across whole life carbon and upfront costs. These savings are associated with changing slab-to-slab height within the typical office building, which is a consequence of the varying service void requirements within the office floor plate, where floor-to-ceiling height is fixed.

The findings of the study are as follows.

BENEFITS OF THE UfAC SYSTEM

OPERATIONAL ENERGY

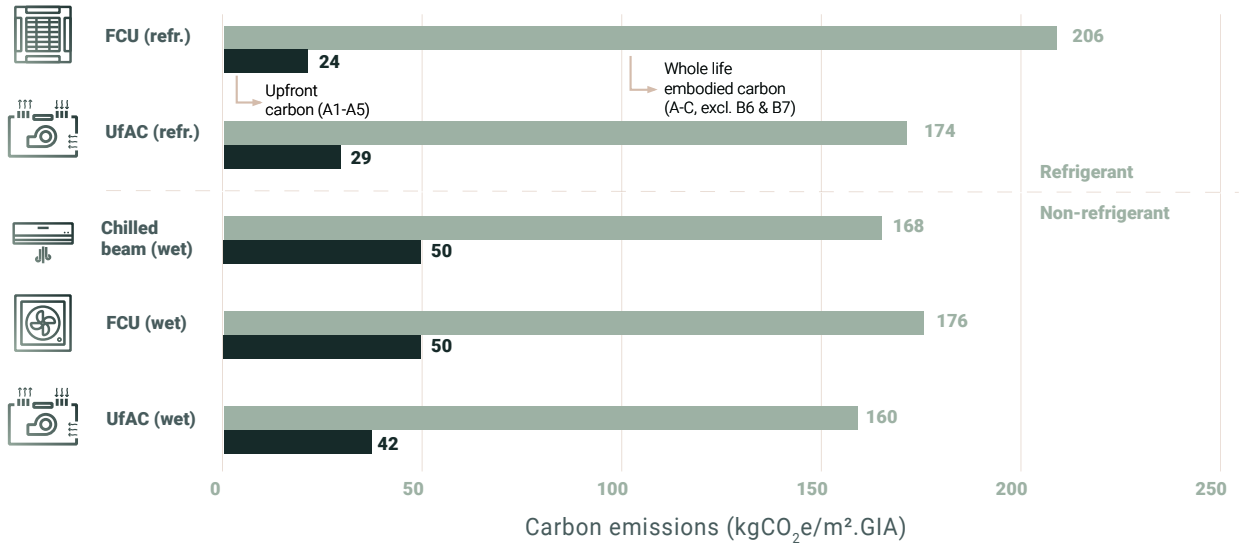
3-19%
saving in total operational energy



EMBODIED CARBON

Up to 18%
saving of Upfront carbon (A1-A5)

9-16%
saving of Whole life embodied carbon A-C (excl. B6 & B7)

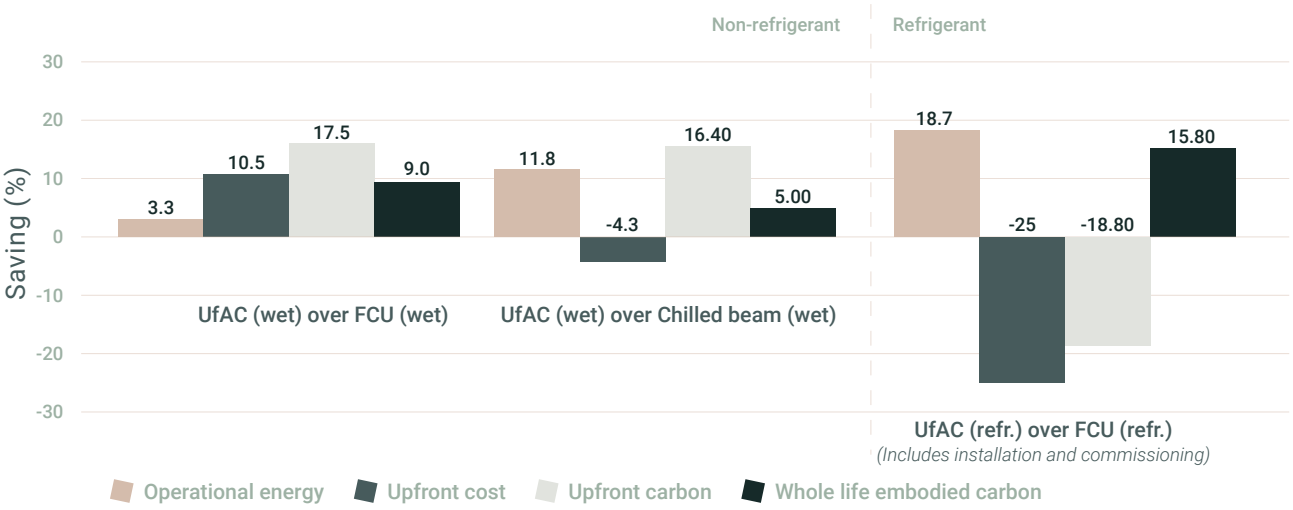


HVAC SYSTEM COMPARISON STUDY

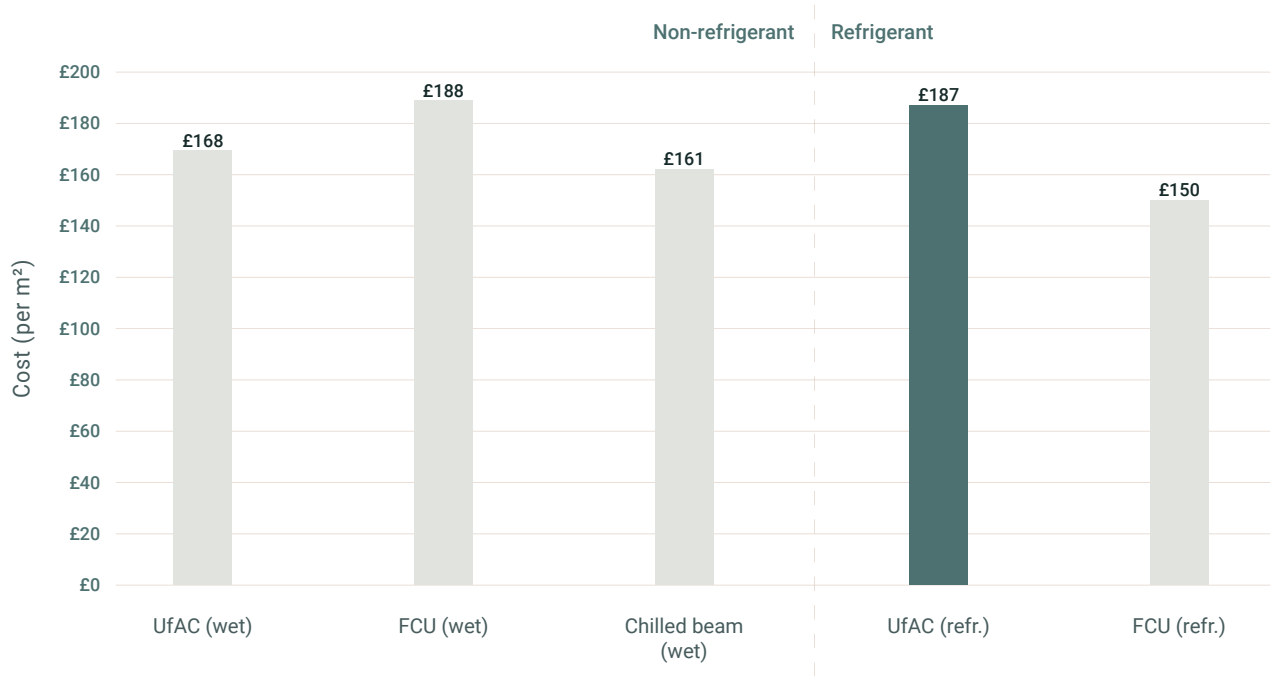
EXECUTIVE SUMMARY — REFURBISHMENT

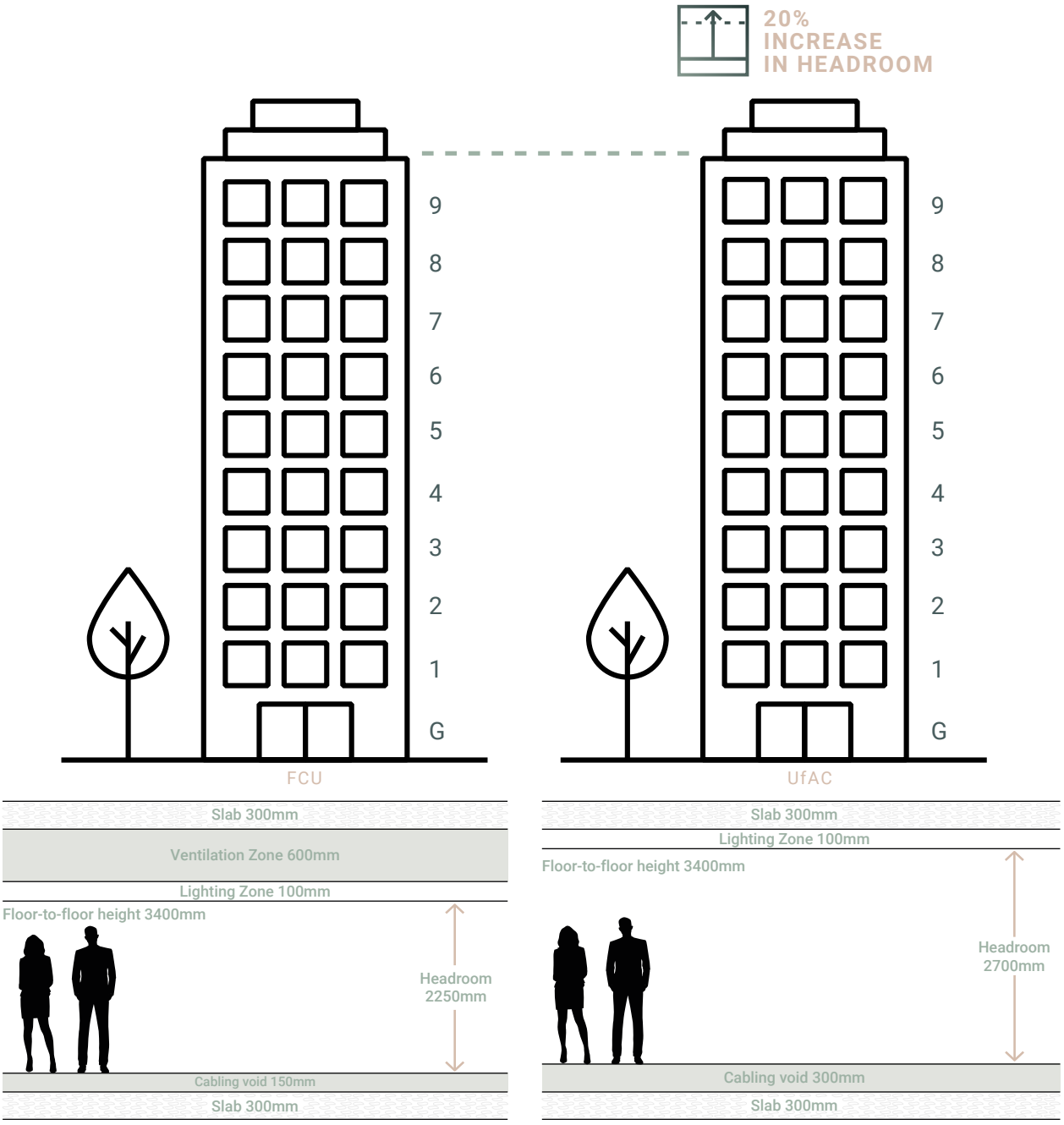
REFURBISHMENT PROJECTS

System-to-system comparison highlights the performance of the various HVAC systems within a refurbishment project where HVAC is provided. The below figure shows percentage savings associated with operational energy, upfront cost, upfront carbon and whole life embodied carbon comparing UfAC to alternatives.



The table below compares the upfront cost, per square metre, between the competitive alternatives. The cost outlined for the UfAC (ref.) system includes the installation of the refrigerant pipework, whereas the cost for the FCU (ref.) does not. The percentage differences are reflected in the table above.





WHOLE LIFE SAVINGS

Maximising floor-to-ceiling heights are achieved due to the omissions of ceiling voids, therefore **improving the internal environmental and wellbeing of occupants.** UfAC also provides **operational energy and whole life embodied carbon savings** over alternatives.

PREVENTS BUILDING OBSOLESCENCE

UfAC prevents building obsolescence due to the ability to be **integrated within areas with reduced floor-to-ceiling heights** and in buildings that require exposed soffits. This means **UfAC can expose architectural building characteristics** at ceiling level due to the omission of the ceiling void.

FLEXIBILITY

UfAC systems give flexibility enabling spaces to be easily reconfigured. For example, adding/removing partitions without the need to re-route services at high level, accommodating changing needs and **flexible working practices.**

SYSTEM COMPARISON

SYSTEM-TO-SYSTEM COMPARISON	KEY BENEFITS	POTENTIAL TRADE OFFS
UfAC (wet) over FCU (wet)	~3% energy saving ~18% saving in embodied carbon ~11% saving in capital cost ~9% saving in WLEC	FCUs have lower fan and heating energy requirements
UfAC (wet) over Chilled beam (wet)	~12% energy saving ~16% embodied carbon saving ~5% saving in WLEC	Capital cost uplift for installation. However, significant cost and carbon savings can be achieved due to the UfAC system's ability to overcome building obsolescence and repurpose existing buildings
UfAC (refr.) over FCU (refr.)	~19% energy saving ~16% embodied carbon saving over the whole life	Upfront cost and upfront carbon uplift, however savings to in-use embodied carbon and operational energy will provide cost and carbon savings over the operation of the building

The below RAG ranking is based on the quantified results calculated within this report:

SYSTEM-TO-SYSTEM COMPARISON		OPERATIONAL ENERGY	UPFRONT COST	UPFRONT CARBON	WHOLE LIFE EMBODIED CARBON
Wet systems	UfAC	1	2	1	1
	FCU	2	3	2	3
	Chilled beams	3	1	2	2

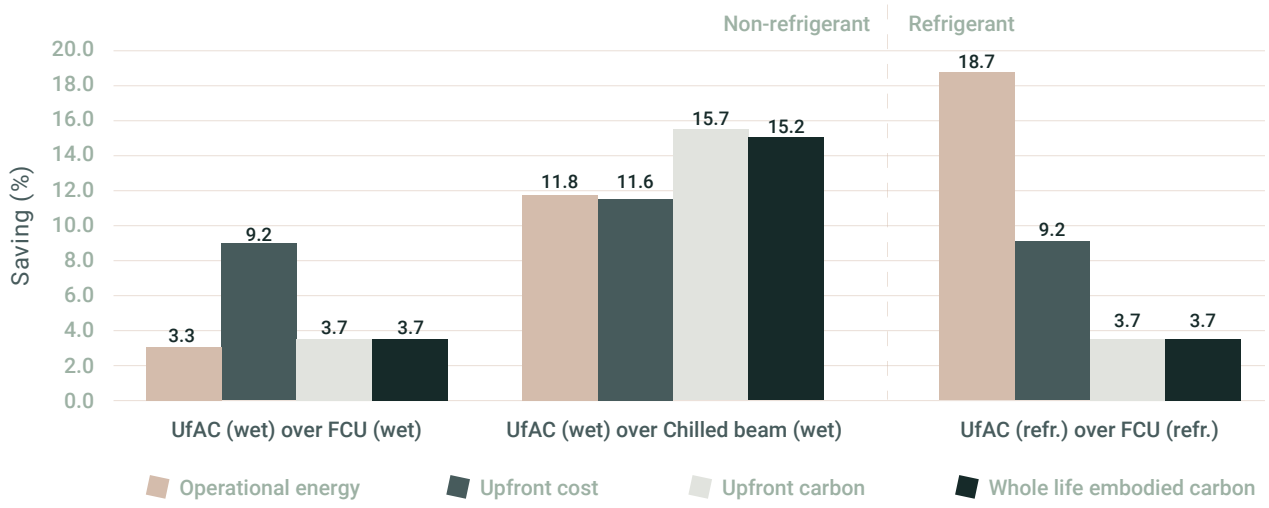
SYSTEM-TO-SYSTEM COMPARISON		OPERATIONAL ENERGY	UPFRONT COST	UPFRONT CARBON	WHOLE LIFE EMBODIED CARBON
Refrigerant systems	UfAC	1	2	2	1
	FCU	2	1	1	2

HVAC SYSTEM COMPARISON STUDY

EXECUTIVE SUMMARY — NEW BUILD

NEW BUILD PROJECTS

The results presented here highlight the savings when considering the various systems installed within a typical new build office space. This captures savings in carbon and cost associated with structural framing and façade elements resulting from reducing slab-to-slab height.



NEW BUILD PROJECTS

UPFRONT COST

~£1.7m savings*

Reduced service void requirements result in savings to superstructure elements incl. structural walls and columns, building envelope and internal wall assemblies.

**Based on 10 storey building.*
Savings will vary based on number of storeys.

REDUCED SLAB-TO-SLAB HEIGHT

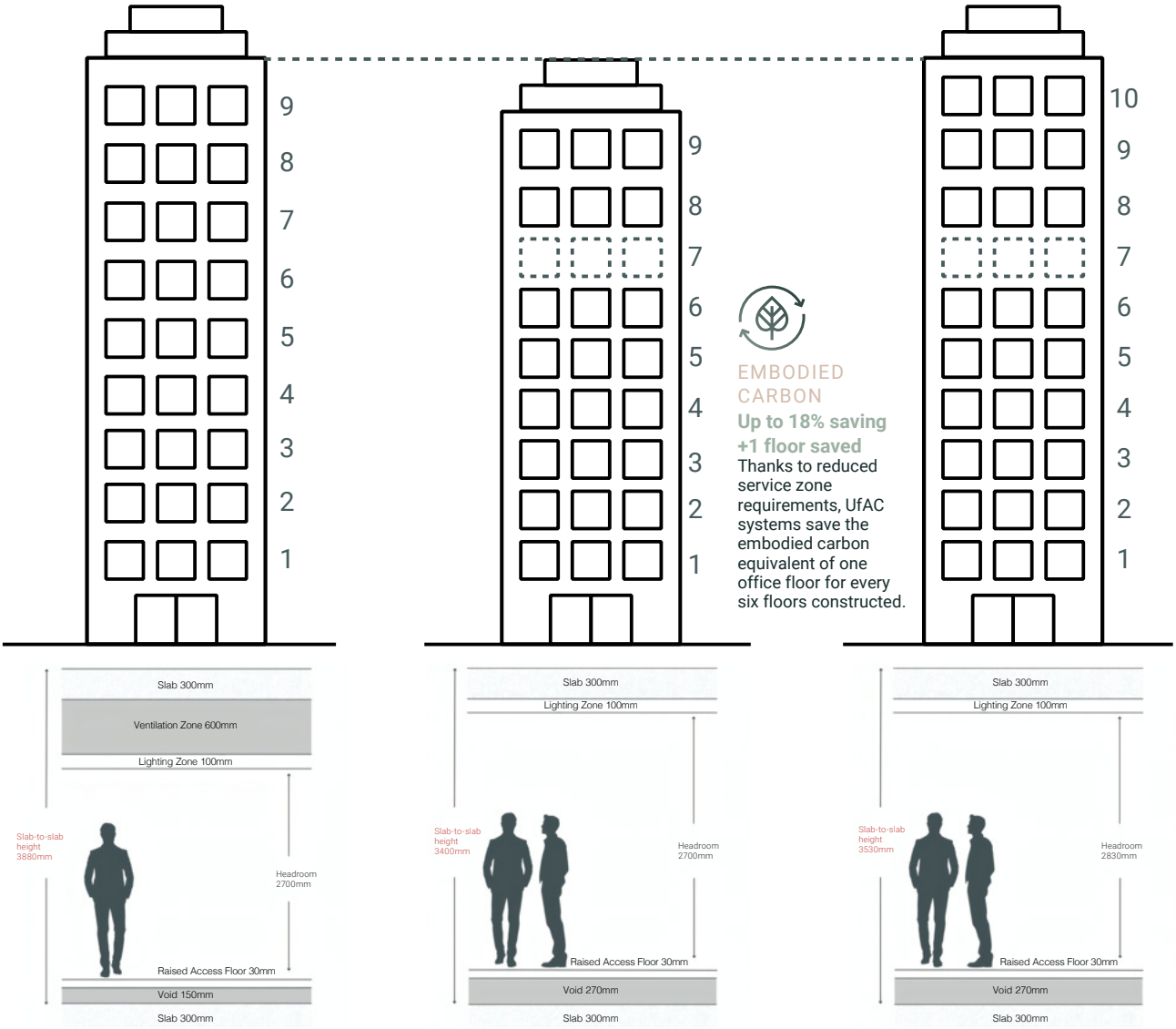
14% height reduction

UfAC systems help to reduce slab-to-slab heights whilst maximising floor-to-ceiling heights.

ADDITIONAL FLOORS

+1 floor constructed

UfAC systems allow for the construction of an additional office floor for every eight floors within the same overall building height, due to reduced slab-to-slab heights.



SIGNIFICANT SAVINGS ON BUILDING-LEVEL COST & CARBON

Slab-to-slab **height savings** result in reduced structure and façade quantities and enable significant embodied carbon and upfront cost savings.

UfAC offers in-use carbon **savings associated with refrigerant usage** as well as **increased operational energy efficiency for new builds.**

SYSTEM COMPARISON

SYSTEM-TO-SYSTEM COMPARISON	KEY BENEFITS *Considers savings to superstructure and façade*	POTENTIAL TRADE OFFS
UfAC (wet) over FCU (wet)	~4% saving in upfront carbon ~9% saving in capital cost ~4% saving in WLEC ~3% saving in operation energy	Due to superstructure and façade savings, the UfAC wet and refrigerant-based systems provide clear cost and embodied carbon savings over alternatives
UfAC (wet) over Chilled beam (wet)	~16% upfront carbon saving ~12% saving in capital cost ~15% saving in WLEC ~12% saving in operation energy	On a system-to-system level, UfAC provides operational energy savings compared to alternatives. In some cases, UfAC is more costly to procure and install. However, savings to other building elements significantly outweighs this cost uplift
UfAC (refr.) over FCU (refr.)	~4% upfront carbon saving ~9% saving in capital cost ~4% saving in WLEC ~19% saving in operational energy	

The below RAG ranking is based on the quantified results calculated within this report:

SYSTEM-TO-SYSTEM COMPARISON		OPERATIONAL ENERGY	UPFRONT COST	UPFRONT CARBON	WHOLE LIFE EMBODIED CARBON
Wet systems	UfAC	1	1	1	1
	FCU	2	2	2	3
	Chilled beams	3	1	2	2

SYSTEM-TO-SYSTEM COMPARISON		OPERATIONAL ENERGY	UPFRONT COST	UPFRONT CARBON	WHOLE LIFE EMBODIED CARBON
Refrigerant systems	UfAC	1	1	1	1
	FCU	2	2	2	2

COST
~£1.7M SAVINGS*

To superstructure elements incl. structural walls and columns, building envelope and internal wall assemblies.
**Savings will vary based on number of storeys.*

CARBON
UP TO 16% SAVING

In upfront and whole life embodied carbon of superstructure elements due to reduced slab-to-slab height.

ENERGY
3-19% SAVING

Of total operational energy use.

UfAC SYSTEM BENEFITS

SYSTEM BENEFIT	PROJECT STAKEHOLDERS						
	DEVELOPER	ARCHITECT	QS	M&E CONSULTANT	CONTRACTOR	LETTING AGENT	END USER
Architectural design freedom	√	√				√	√
Bright, spacious working environments	√	√				√	√
Centralised and localised UVGI filtration	√			√		√	√
Clean, uncluttered soffits		√					√
Differentiates market offering	√					√	√
Easily integrated with existing building plant				√			
Eradicates cold drafts from high level	√			√		√	√
Eliminates impact of up and downstand beams		√		√			
Enhanced Grade A office space	√					√	√
Incorporates historical building characteristics	√	√		√		√	√
Ergonomical design and operation	√			√		√	√
Flexible and adaptable	√					√	√
Futureproof	√			√		√	√
Gain additional floors at no extra cost	√		√				
Helps achieve exceptional rental rates	√		√			√	
Ideal for double height spaces (Atriums)		√		√			
Improves indoor air quality	√			√		√	√
Increases natural light levels	√	√				√	√
Lowers building churn/waste	√		√			√	
Maximises floor to ceiling heights	√	√	√	√		√	√
Modular design and application				√			
Quiet operation				√		√	√
Reduces duct and pipework work (TM65)	√	√	√	√			
Reduces construction materials and costs	√		√		√		
Reduces building heights (new builds)	√	√	√	√	√		
Quick and easy installation (CAT-A & B)	√		√		√	√	√
Reduces construction costs (£1.7m per floor)	√		√				
Reduces operational costs	√		√			√	√
Reduces Service & Maintenance costs	√					√	√
Reduces Upfront Carbon, WLEC, and Operational Carbon	√	√	√	√	√	√	√
Subtle and unobtrusive	√			√		√	√
Sustainable and environmentally friendly	√	√	√	√	√	√	√
User friendly	√					√	√

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