

RESIDENTIAL DEVELOPMENT CONSULTANCY

HEATING AND COOLING
STUDY 2020



A HOT TOPIC

This report brings together the collective experience and expertise of Knight Frank, MSMR and Core Five in a review of how government policy and new regulations on overheating in residential buildings is impacting decisions made by developers and buyers alike.

Here is a summary of the report's main findings:

- ◆ 2019 saw the hottest UK summer on record and in London's new-build developments, many residents found themselves in overheated apartments
- ◆ The issues surrounding overheating have been verified by HomeViews, the "Trip Advisor for property", which claim over 25% of their reviews mention ventilation and heating
- ◆ Developers and design teams now need to find innovative and affordable ways of cooling residential buildings
- ◆ Future planning submissions look set to hold developers and their designers more accountable for their approach to environmental sustainability and carbon reduction in residential development
- ◆ Gas heating systems will no longer be allowed in new homes from the middle of this decade (2025)
- ◆ With the race to become zero carbon by 2050, London's future appears to be electric
- ◆ Knight Frank has seen a growing emphasis from buyers on the "green credentials" of new buildings due to increased environmental concerns and awareness of urban pollution
- ◆ Underfloor heating is expensive, unresponsive and now starting to be replaced with more suitable and sustainable forms of heating
- ◆ Core Five note a significant rise in heat pumps being specified in new build schemes, providing greater flexibility for developers and residents
- ◆ New systems coupling the apartment ventilation to the Air Source Heat Pump (ASHP) are becoming available which can offer real affordable cooling solutions to meet these overheating and planning demands, and potentially at lower price points
- ◆ MSMR Architects believe designing buildings which mitigate heat gain, and therefore minimise cooling demand, will become increasingly important in years to come.



LONDON IS HOT AND GETTING HOTTER

The UK is now experiencing more extreme weather conditions and as we have recently experienced record temperatures for April, we prepare for yet another potential summer of extreme heat. 2019 saw the hottest UK summer on record and in London's new-build developments, many residents found themselves in overheated apartments with stuffy corridors with few options to tackle the rising temperatures. This is largely due to the improved acoustic and thermal performance as well as air-tightness of today's residential design, all contributing to an increase in heat retention.

INDEPENDENT REVIEWS

Further evidence of this has been provided by HomeViews, the independent review website. In 2019 across all new build developments, they witnessed residents frequently commenting on excessive heat in their flats during summer months.

According to their reviews, 1/2 of developments have at least one resident mentioning ventilation or heating.

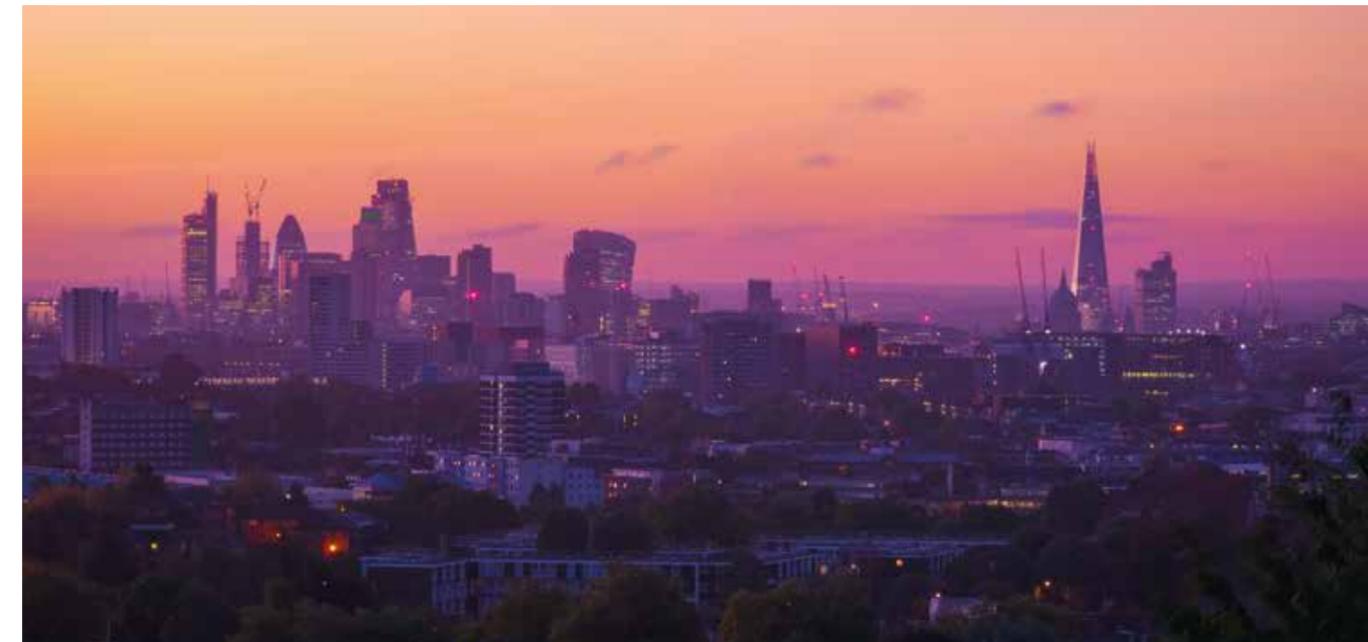
One resident from a new build scheme in Hammersmith, West London commented that, "Overall it's a really good development. However, the ventilation is rubbish. When I close the door and leave the window open it gets stuffy and I feel there's no air. No air conditioning."

The challenges developers and design teams now face are around cooling, rather than heating their buildings. With the public's ever increasing awareness of climate change, the focus on sustainable development, and flexible solutions to heating and cooling will no doubt be at the forefront of development in years to come.

CHANGING POLICIES

Following the prolonged heatwave in the summer of 2018, CBISE brought in TM59, a new guidance note to address the issue of overheating in new build apartments. Meanwhile, New Part L Regs (2020) are expected to further promote a shift away from fossil fuel and new glazing rules will adopt the G-Value system. Undoubtedly this will have a significant impact on architectural design strategies and construction methodologies. As a result, future planning submissions look set to hold developers and their designers more accountable for their approach to environmental sustainability and carbon reduction in residential development.

In this study we consider new regulations, the Draft London Plan and the technology that will impact on developers and buyers in terms of temperature control and added value.



THE FUTURE OF UNDERFLOOR HEATING

Underfloor heating was once a mark of quality and a luxurious, aspirational item to have in a home. However, it is now arguably an unnecessary luxury.

Underfloor heating is expensive, unresponsive and could be replaced with more suitable and sustainable forms of heating. A number of London developments including Riverwalk, a Ronson Capital Partners scheme, located in Westminster, have favoured fan coil heating and cooling systems over underfloor heating. This scheme achieved record prices for the location with values of up to £20,000,000, proving that prime Central London buyers are becoming increasingly comfortable with this

more efficient and sustainable form of heating. Furthermore, Knight Frank has started to notice a growing awareness from buyers regarding scheme's sustainability credentials, which they expect will become a key factor when looking for new homes in the future.

Historically, residential developers and purchasers have favoured separate underfloor heating over integrated heating and cooling via fan coil units (FCU). Considering the current extraordinary thermal qualities of our new buildings, it's not surprising that we rarely need to turn the heating on. On the rare occasion additional heating is required, an FCU provides

an efficient and quick source of heat. Developers are also seeing the positive effect of removing underfloor heating on programme, build cost and improved floor to ceiling heights.

Knight Frank expect super prime schemes and one off developments to continue to use the traditional form of 'wet' underfloor heating, coupled with electric heating to bathrooms - in particular, areas with stone flooring. However, we are beginning to see a number of developers challenging this presumed benchmark of value across London, in favour of more sustainable and efficient options.



RIVERWALK, RONSON CAPITAL PARTNERS

CURRENT HEATING AND COOLING BENCHMARKS

The table below provides a guide as to the current level of specification provided in new build developments in London, at different price points. We now expect this well established level of specification to come under review as developers look at more sustainable and efficient solutions.

With the drive towards London becoming a zero carbon city by 2050, developers need to change their approach. The good news is that new strategies to provide affordable cooling are available now and evolving quickly.

SALES VALUES	£500 PER SQ FT	£750 PER SQ FT	£1,000 PER SQ FT +
Heating	Radiators	Underfloor	Underfloor
Cooling	None	None	Comfort Cooling (Fan Coil)

BANKSIDE YARDS - FUTURE PROOFING

Knight Frank, MSMR and Core Five are working with Native Land on Bankside Yards, a new mixed used scheme on the Southbank. Native Land have chosen to combine the heating and cooling systems in apartments 'in response to the thermal performance of contemporary buildings and user requirements'. Combined systems allow for more efficient

building services infrastructure and facilitate incorporation of services into apartments.

At their Bankside Yards development in Southwark, fan coil units will provide heating and cooling in apartments. 'Native Land have found that demand on apartment underfloor heating is minimal and so combining heating and cooling systems is appropriate.

Although keeping spaces warm is a concern in older buildings, contemporary regulations and the prevalence of glass in new facades, and resulting solar gain, mean that now the challenge is often keeping spaces cool. When heating is required in new apartments, a combined heating and cooling system will respond more quickly than underfloor heating.'



BANKSIDE YARDS, NATIVE LAND

FUTURE LEGISLATION AND THE IMPACT FOR DEVELOPERS

- ◆ The current 'draft' London Plan wants to see less, or no use of fossil fuels (gas).
- ◆ In the Chancellor's Spring statement it was announced that gas heating systems will no longer be allowed in new homes from the middle of this decade (2025).
- ◆ SAPI0.1 - This promotes the use of electric heating, early indications are that the GLA is now expecting future planning conditions to comply or justify why not.
- ◆ The new Part L Regulations, expected in 2020, are anticipated to further promote the shift away from fossil fuels.
- ◆ CIBSE guidance note TM59, was brought in to address the overheating issue, consequently planners will expect developers to have considered and proved compliance, with cooling only considered as the final solution.
- New rules governing the G-Values are key. G-Values are a measure of how much solar heat is allowed in through building fabric, in particular glazing. This will change the design of building facades as architects will be required to balance the desire for natural daylight against the avoidance of heat gain.



- Apartments where the façade is un-openable or limited in openable area, for example in high-rise buildings, can use cooling, but developers will have to demonstrate what steps have been taken to limit overheating.

- While London planners will expect all new submissions to comply, outside of the capital there is no mandatory rule. In short, a change of approach is not optional, it will be mandatory to obtain future planning in London.

THE FUTURE IS ELECTRIC

With the race to become zero carbon by 2050, London's future appears to be electric.

Combined Heat and Power (CHP) units have been the primary system of choice for developers and designers for several years. CHP is an energy efficient technology that generates electricity, usually from a fossil fuel source, and captures the heat that would otherwise be wasted for re-use. This year however the Draft London Plan recognised that the electric grid has now achieved de-carbonisation and consequently the benefit of using CHP is all but eradicated.

DEATH OF FOSSIL FUELS

Cost consultants, Core Five have seen the majority of engineering consultants from 2019 specifying Heat Pumps (HP) as their main method to meet the carbon reduction requirements.

Notably they can provide cooling in addition to heating through one set of pipework, and can be either air source or water source, or a mixture of both. Depending upon the configuration, these systems can also offer affordable cooling solutions and offer greater flexibility, as underfloor heating can still be taken from them.

In addition, alternative systems are being developed that utilise apartment ventilation systems for heating and cooling thus avoiding the installation of fan coil units; the location of which is always problematic.

MORE SUSTAINABLE APPROACH

A typical air to water source heat pump system uses an ambient loop which circulates at 25°C as opposed to 80°C in a standard heating and hot water system. With this lower temperature, the overheating problems experienced in apartment corridors would be greatly reduced. It could also potentially remove the current need for ventilation and/or cooling installed in these spaces altogether.

Overheating in corridors has become a common issue in new build developments as referenced by many residents on HomeViews, one of which stated *'there is no ventilation in the corridors and so it gets very hot.'*

In conclusion, future London residential developments will no longer be able to utilise gas for their heating and hot water. With falling electricity prices the gap between gas and electric consumption has never been closer, coupled with the fact that less heat is now required. A source that provides instantaneous heat either through fan coil units or electric underfloor or radiators, appears for now, the future.



FLEXIBLE HEATING AND COOLING SOLUTION

AIR SOURCE IS HERE TO STAY

An air source heat pump (ASHP) provides a flexible method of heating and cooling for both residential and commercial units. Generally, a central ASHP unit is being used in residential units. It supplies heat via an ambient loop to individual heat pumps within each apartment. These units in turn can supply heating and cooling via smart radiators or fan coil units.

Whilst it is still new, certain suppliers' models have the capacity for providing hot water that meets the requirements of most GLA standard sized apartments. However, on the large units (3 bed+) the need to provide multiple heat pump units in each apartment will be required, subject to the hot water demand. Heat pumps have the potential to offer significant opportunities for low carbon heating (and cooling) in London. During the course of 2019, the draft London Plan has ensured that most designers have to comply with its usage in place of CHP and there has been a noticeable increase in the carbon reductions being achieved over the 35% minimum threshold set.

The Committee on Climate Change suggest that by 2030, 2.5 million heat pumps should be installed in UK homes, compared to 20,000 in 2016. In Norway, heat pumps represent 95% of heating systems in new homes and are installed in one third of households. According to 'Low Carbon Heat: Heat Pumps in London' by Greater London Authority (September 2018).

Heat pumps are not only installed in individual homes and small apartment blocks, but have the capacity to serve larger more complex residential developments, providing space is available for the external plant. These systems are currently being proposed on several tower blocks over 45 stories in height and while care needs to be taken over pressure drops, their usage appears to be growing daily. While the heat pump is more carbon friendly, a point frequently forgotten is that the ambient loop to the apartment heat pumps is supplied at 25°, rather than the previous 80° required by a conventional boiler/CHP alternative. This means that the likelihood of the apartment corridor overheating is greatly diminished, providing better comfort for residents and less cost for the developer.

While it is still possible to provide underfloor heating through the heat pump, the need is reduced as the apartments are so well insulated, very little heat is actually required. Many developers have cited that apartment heating is rarely turned on. Consequently with little heat being required, other than bathrooms and/or shower rooms, having the ability to provide an immediate heat 'boost' facility can be accommodated more easily through a fan coil unit or smart radiator, being a more affordable solution to both residents and developers alike.

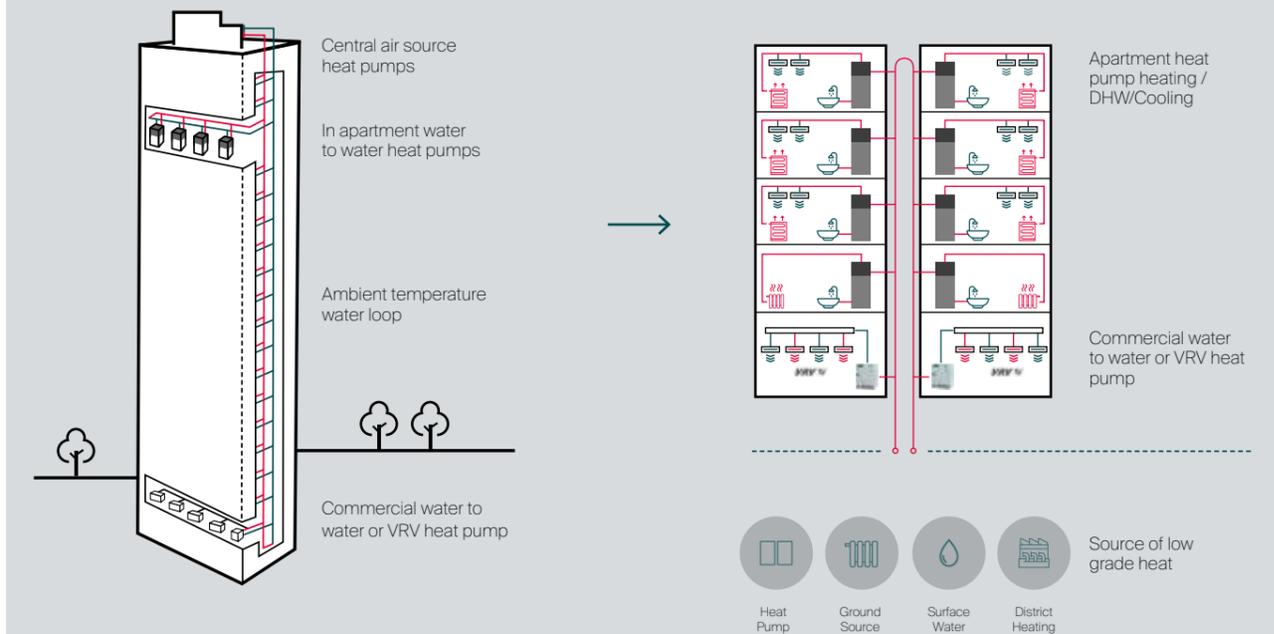
FLEXIBILITY FOR DEVELOPERS AND RESIDENTS

Each heat pump can be metered, allowing energy costs to be attributed to individual apartments. This avoids the issues with more traditional, centralised heat and power systems, where the costs are typically rolled into the service charge. Residents can also use the heat pump's instantaneous heat function, rapidly and efficiently warming the apartment, and allowing heating to be used on an 'as and when needed' basis. Together with the meter, residents would benefit from more accurate and potentially cheaper energy bills.

Developers can use a basic standard of heat pump across mixed tenure schemes, with the flexibility to add varying levels of heating, cooling and hot water options within different apartments.

Historically where development sales values have not supported the provision of cooling, nothing has been installed. With the advent of planning conditions that stipulate the need to mitigate overheating in new developments, the issue can no longer be ignored, and the flexible options offered by the ASHP will become an essential part of long term, strategic development planning.

Diagrams show Daikin's air source heat pump set up for large developments. Typically the heat pumps are connected to an energy loop which is a water circuit maintained at between 0°C and 30°C. Due to the wide temperature range, the energy loop can be warmed or cooled via several different means, including via an air source heat pump.



THE PRICE OF COMFORT

From Knight Frank's experience, buyers have an increased awareness of climate change and the risk of pollution. We have found that pollution levels are being referenced when searching for new build developments in London. According to Knight Frank New Homes, some of the north facing smaller units at the Gasholders, King's Cross do not have cooling installed. This has led them to subsequently look at the future buildings and infrastructure being provided, giving buyers the opportunity to pay £10,000-£15,000 extra to choose cooling. This has proven to be quite popular at King's Cross, especially with international buyers.

Historically heating an apartment via an electric system is more expensive than using gas. However, with the cost of gas rising, the variance between the two energies have dropped and considering that the electric systems are instantaneous, then less will be used because of no 'warming up period'. Over a 10 year life cycle, electric heating will be cheaper through its lower capital costs and reduced usage.

To-date the ASHP system described, is offering small savings in capital cost, £2ft² on GIA, additional savings are available through reduced carbon tax £1ft² on GIA and the potential to remove ventilation in apartment corridors £1ft² on GIA. (NB all costs are subjective and subject to development massing) But as ASHP technology is evolving quickly, increased heating and cooling options are being developed and capital costs are reducing as more manufacturers enter the market. As this happens it is anticipated that these cost benefits will only increase in line with competition.

New systems coupling the apartment ventilation to the ASHP are becoming available which have the ability to offer real affordable cooling solutions to meet these overheating and planning demands at lower price points.



**DAIKIN AIR SOURCE HEAT PUMP
DOMESTIC SET-UP**

Each apartment has a compact heat pump (c.600 x 650mm) unit which can be connected to a range of emitters including fan coils, radiators, underfloor heating or fan convectors. Hot water is provided by an integrated cylinder which is charged by the heat pump.

Apartment MVHR Unit

Apartment Water Source Heat Pump

Apartment control



BENEFITS OF THE HEAT PUMP



There is less pipework. For a small additional cost to the WSHP, cooling can be provided, to be fitted by the tenant retrospectively.



Heating and Cooling Interface Units (HIU's & CIU's), typically required on Boiler and Chiller installations, will no longer be required with the ASHP to WSHP system, as this will provide all the apartments heating, hot water and cooling needs.



Developers can use a basic standard of HP across mixed tenure schemes, with the flexibility to add varying levels of heating, cooling and hot water options within different apartments.



It's a cost effective solution compared to the previous Boiler/CHP/Chiller arrangement.



Lower circulation temperatures reduce unwanted heat build-up as well as offering savings through their increased efficiency and sustainability.



It is anticipated that the use of heat pumps could far exceed the current minimum 35% carbon reduction required by London planners. This in turn could significantly reduce the carbon tax payments due to the developer.



Heat pump technology is developing fast with the latest models requiring less and less central plant.



The technology is developing quickly with improvements all the time, consequently the capital cost will reduce as demand increases.



Preferred solution by London planners.



The heat pump convector can also be run at low flow temperatures (similar to underfloor) and therefore maximise the efficiency of the heat pump.

CONS WORTH CONSIDERING



The current HP systems only become cost effective when utilising them for cooling, as well as heating and hot water. When installed for heating and hot water only they are more expensive than a traditional boiler and CHP approach.



The requirement for additional external space to accommodate the current range of large-sized HP systems is likely to be a challenge, particularly on restricted inner city sites.



Considering cooling carries a premium of £10ft² -£12ft² on GIA, depending upon the system selected, a typical HP system may well offer a more affordable cooling solution, but still be £4ft² - £6ft² on GIA.

LONDON PLAN: 6 STEP ANALYSIS

LONDON PLAN: 6 STEPS	OPTIONS	COSTS	SUMMARY
Limit internal gains	<ul style="list-style-type: none"> Reduce heat from inside the building Efficient electric devices Low-energy lighting 	<ul style="list-style-type: none"> £0 Most items already included 	Standard in London projects. On its own, unlikely to meet TM59 overheating criteria
Limit solar gains	<ul style="list-style-type: none"> Reduce heat entering the building Shading measures, blinds Glass treatments or less glass 	<ul style="list-style-type: none"> £4 - £5ft² Glass treatment and blinds can be expensive 	Realistic proposal
Reduce internal temperatures	<ul style="list-style-type: none"> Higher ceilings 	<ul style="list-style-type: none"> Would make the scheme uneconomical 	Not practical as floors will be lost
Passive Ventilations	<ul style="list-style-type: none"> Purge ventilation Openable windows 	<ul style="list-style-type: none"> £2 - £3ft² To increase the volume of openable windows 	Standard in London projects, as in Step 1
Mechanical Ventilations	<ul style="list-style-type: none"> Purge ventilation Mechanical with heat recovery 	<ul style="list-style-type: none"> £3 - £4ft² But most London projects require mechanical ventilation 	Standard in London projects, as in Step 1
Mechanical Cooling	<ul style="list-style-type: none"> Cooling 	<ul style="list-style-type: none"> £10 - £15ft² Depends on system 	Realistic proposal

Core Five has assessed the cost implications of The London Plan's six steps for planning against overheating risks. These are set out alongside possible options and the likely cost and viability of each approach.

While the introduction of new heating and cooling strategies will help to achieve the emerging targets, residential specialists, MSMR Architects believe designing buildings which mitigate heat gain, and therefore minimise cooling demand, will become increasingly important.

Does a Mediterranean climate lead to Mediterranean architectural strategies? The six stage London Plan suggests it might; extent of glazing, solar shading and the passive ventilation will certainly become essential drivers. Technology alone will not provide the answer and these strategies will surely begin to influence appearance.

A NEW DESIGN AGENDA

FACTORS AFFECTING SOLAR GAIN:

- ◆ Window orientation
- ◆ Shading
- ◆ G-Value
- ◆ Area of glass

A low G-Value indicates that a window lets through a low percentage of solar heat. The G-Value can be improved by having the outer glass pane coated with an infrared-reflecting surface. This will help to reduce the cost of cooling the property. Typically a glass G-Value of between 0.4-0.7 is achievable, but must be balanced against a range of factors.

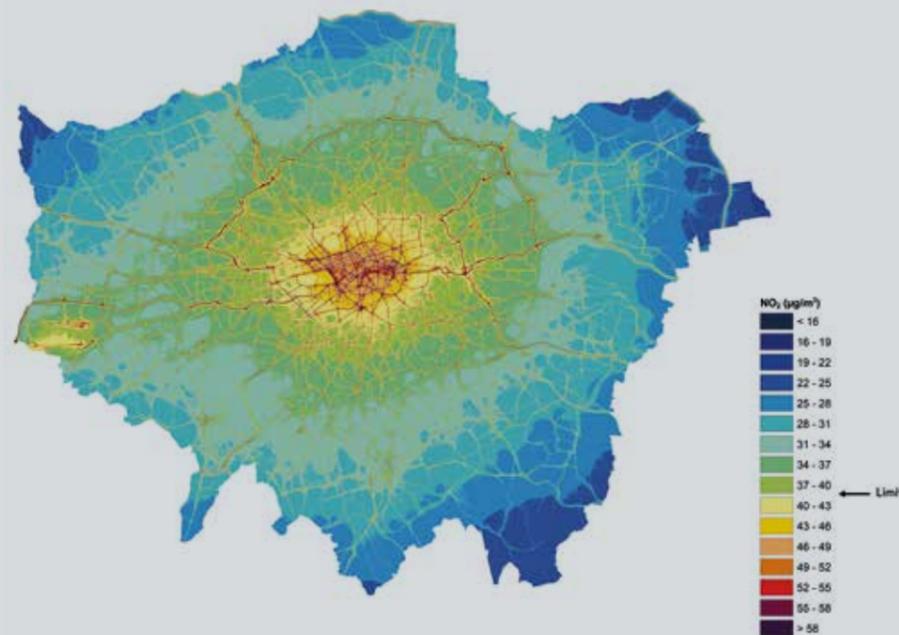
The lower the G-Value, the greater the effect on the opacity of the glass, which must then be balanced against the requirement for internal daylight/sunlight levels and external visual appearance.

Developers and their designers will need to create innovative responses to these issues.

VENTILATION

In most apartments, unwanted heat can be purged by simply opening windows. However, in urban environments where pollution and external noise are issues this may not be an option. Cooling via air source heat pumps in these instances can be an effective solution.

The map right shows the extreme levels of pollution in London, especially Central London. Inadequate internal ventilation allows for the circulation of pollutants yet by opening windows for natural ventilation residents are affected by air pollution.



A qualified resident in an East London development recently commented on HomeViews that *'the flat gets very warm in summer and we need to get all the windows open all day and night long for ventilation, but it allows all the noise and the pollution in from the high street'*. This is a common concern voiced by residents in new build schemes in central London and needs to be a more serious consideration in building design within cities.



WHO WE ARE



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Knight Frank has unrivaled knowledge and experience following decades of working on London's best residential developments.

Tom Dailey and the residential development consultancy team provide market leading advice on a range of product across London, helping developers optimise their schemes and maximise value.



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HomeViews is the dedicated property review platform. Their mission is to provide trusted insights from tenants and owners about what it is really like to live, rent or buy in a development. Launched in February 2019, HomeViews have now published over 10,000 reviews from more than 900 developments in eight cities.



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MSMR Architects is one of London's leading residential design practices with an extensive portfolio of successfully delivered projects. These include numerous central London developments together with a range of mixed-use, new build, prime, super-prime and historic building developments. Alongside a comprehensive range of architectural and interior design services, MSMR also provides residential consultancy and specialist space planning advice.



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Core Five are 6 times finalists (2014-2019) and 3 times winners (2015, 2016, 2018) of Building Magazine's Consultant of the Year Award.

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