The Housing and Regeneration Agency

Homes England

West of Ifield, Crawley
Energy Statement

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West of Ifield
Energy Statement

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West of Ifield

Energy Statement

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Executive Summary

Ramboll is providing engineering and environmental support for a proposed new development, West of Ifield, on the western edge of Crawley, West Sussex. The Applicant is Homes England, the government's housing agency for England. The Site is approximately 171ha and the development proposal comprises:

- 3,000 residential units, delivery to commence in 2029.
- Non-residential units including schools, offices, leisure centre, health centre, food storage, innovation centre and retail units with delivery planned to commence in 2027.

This energy statement supports a Hybrid Planning Application (HPA) by Homes England for the proposed development at West of Ifield. This energy statement is to provide an approach that meets the needs of Horsham District Council's Local Plan and policies, national standards, and regional guidance. The statement is not intended to define a final solution for the development, but to provide the guidance for future compliant solutions to be established.

Three scenarios were examined in more detail following an overview of potential low carbon - energy resources and technology options:

- **Scenario 1: Direct electric heating** and on-site solar PV to deliver 10% of buildings' electricity demand.
- **Scenario 2: Individual ASHPs on property level**, with onsite solar PV to deliver 10% of buildings' energy demand.
- **Scenario 3: Individual ASHPs on building level with communal heating for flats**, with on-site solar PV to deliver 10% of building's electricity demand.

Each scenario was modelled to evaluate the contribution of the various energy sources/technological scenarios, with a view to determining the projected lifecycle energy consumption and carbon emissions. Table 1 provides a breakdown of the energy inflows and outflows after a period of 25 years for each of the scenarios modelled. It also provides the to

Table 1: Electricity production and consumption at full scheme build-out

In 2050	Units	Scenario 1	Scenario 2	Scenario 3
Annual Electricity consumption for heat provision	MWh	14,777	6,115	5,731
Annual Electricity Demand (excluding heat production plant, including EV)	MWh	23,576	23,576	23,576
PV Annual Power Production	MWh	1,600	1,600	1,600
Annual Electricity Import	MWh	36,752	28,091	27,707
Over entire project				
Lifecycle Electricity Demand	GWh	1,180	901	888
CO2e emissions	tons of CO2e	5,788	4,300	4,232

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In terms of carbon emissions, all three scenarios achieve similar carbon emissions by 2050 due to the decarbonisation of the grid. The analysis of the scenarios demonstrated that all of them meet the requirements of the Horsham District Planning Framework November 2015, national standards, and regional guidance.

The choice of scenario can come at a later stage considering factors such as capital and operational cost, levelised cost of energy and net zero aspirations. A high-level summary and comparison of the scenarios examined in this report is presented in Table 2.

Table 2: Pros and cons to each scenario considered

Scenario	Pros	Cons
1. Direct Electric Heating and 10% solar PV on-site generation	• Proven technology • Lower capital costs • No space for centralised plant required	• Higher running costs for consumers • Decarbonisation mostly relying on grid • Low flexibility for future technologies • High electrical infrastructure cost
2. Individual ASHPs on property level and 10% solar PV on-site generation	• Improved efficiency • Less electrical consumption • Allows different operating temperatures per building • Flexibility of asset ownership	• Higher capital costs • Does not benefit from centralised heat transformation equipment economies of scale
3. Individual ASHPs on building level with communal heating for flats, and 10% solar PV on-site generation	• Communal heating improves efficiency and costs for flats • No centralised plant required per district, only building level plantrooms • Future-proof for DHN connection at building level via heat exchanger • Allows different operating temperatures per building	• Higher complexity in communal systems • Combination of centralised plant and individual Heat Exchangers in each flat for metering and billing can lead to higher maintenance complexities

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Introduction

Background

Ramboll is providing engineering and environmental support for a proposed new development, West of Ifield, on the western edge of Crawley, West Sussex. The Applicant is Homes England, the government's housing agency for England.

The development site area is approximately 171ha and comprises c. 3,000 homes, commercial and community facilities. The site is located within the administrative area of Horsham District Council. The site is located south of Charlwood Road, beyond which lies Gatwick Airport. The site lies to the north of the Arun Valley railway line and adjoins the existing neighbourhoods of Ifield and Langley Green in Crawley. To the east, the site is bounded by trees and Ifield Village. Ifield West and ancient woodland are to the south and the River Mole and ancient woodland to the west. The Hybrid Planning Application context plan is shown in Figure 1.

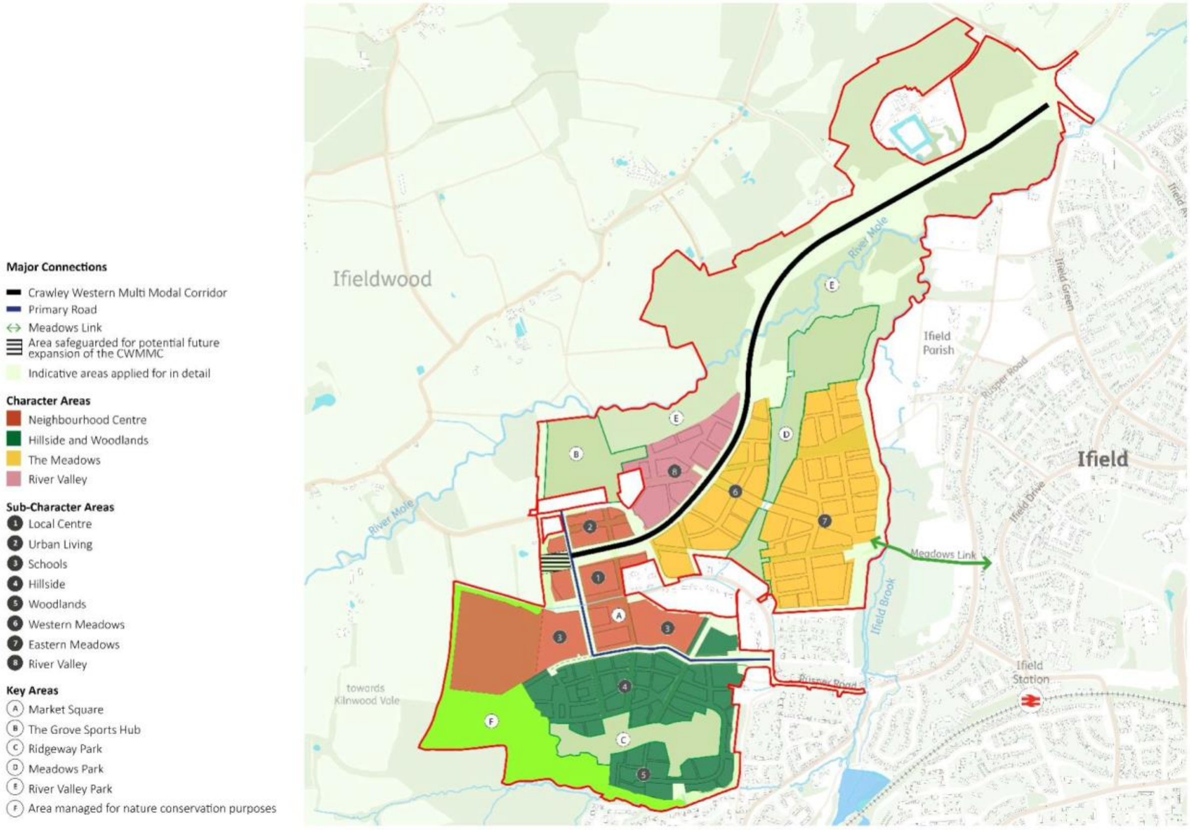

Figure 1: Hybrid Planning Application context plan

The initial phases of development are proposed to be built in six phases over a 14-year period, shown in Figure 2.

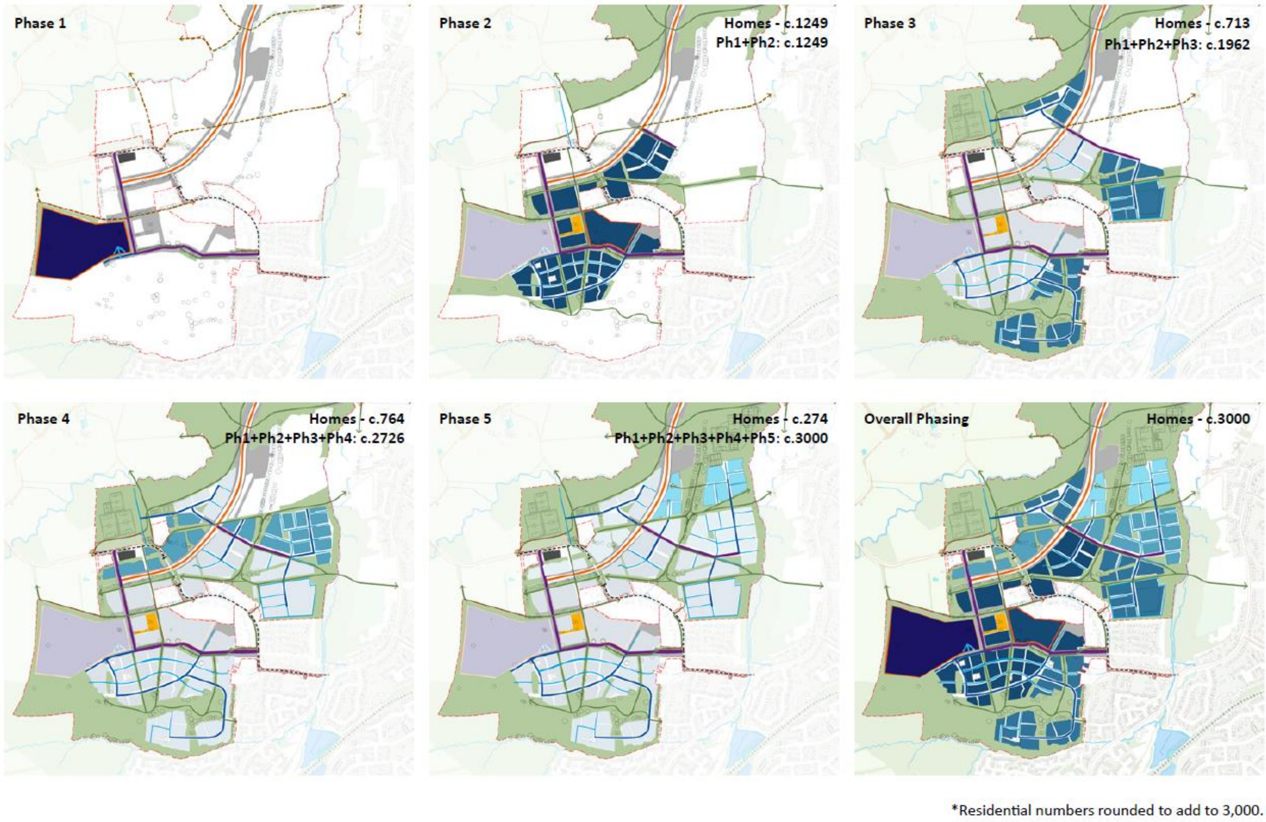

Figure 2: Indicative Phasing

The development has sustainability at its core and zero carbon is the target for both buildings and transport.

Aims and Objectives

This energy statement supports a Hybrid Planning Application (HPA) by Homes England for the proposed development at West of Ifield. This energy statement is to provide an approach that meets the needs of Horsham District Council's Local Plan and policies and national policies. The statement is not intended to define a final solution for the development, but to provide the guidance for future compliant solutions to be established.

Policy Background

To minimise the ongoing contribution of buildings to our overall GHG emissions baseline the UK Government is expected to introduce the Future Homes[1] and Future Buildings[2] Standards in 2025. These standards capture the proposed changes to Part L[3] of the current Building Regulations which relate to the conservation of fuel and power in both domestic and non-domestic buildings. The aim of these proposals is to provide a foundation upon which the rapid decarbonisation of the built environment will be supported, thereby enabling the UK Government's aim of being 'net zero' by 2050. As a means of enabling this process the UK Government is introducing transitionary updates to Parts L1 and L2[4] of the Building Regulations, which came into force on 15th June 2022. An additional change made on 15th June 2023 regarding district heat networks and community heating was the removal of the primary energy

[1] Title (publishing.service.gov.uk)
[2] Title (publishing.service.gov.uk)
[3] Conservation of fuel and power: Approved Document L - GOV.UK (www.gov.uk)
[4] Conservation of fuel and power: Approved Document L - GOV.UK (www.gov.uk)

factor as a performance standard for dwellings and other buildings[5]. This change means that the Building Regulations no longer directly require adherence to a specific primary energy factor for buildings served by these networks.

In their final forms, both the Future Homes and Future Buildings Standards are expected to demand a substantial improvement in the quality and performance of new build stock (whilst the specific detail is lacking at this stage it is, for instance, the UK Government's aspiration that the Future Homes Standard will require domestic buildings to demonstrate a 75–80% improvement in CO_2 emissions, relative to the current iteration of Part L, which was set in 2013). The final standards are expected to be published in autumn 2025[6]; however, the interim changes to the Building Regulations which will be implemented first will require:

- New domestic buildings to demonstrate a 31% improvement in CO_2 emissions relative to Part L1 2013.
- New non-domestic buildings to demonstrate a 27% improvement in CO_2 emissions relative to Part L2 2013.

Under the proposed Future Homes Standard, all space heating and hot water demand should be met through low-carbon sources. All performance requirements are based on notional buildings with an efficient air source heat pump or a 4th generation heat network that uses air source heat pumps. While direct electric and immersion heaters achieve the goal of being 'zero-carbon ready', the 2023 consultation response highlighted that they can be more expensive to run than modern heat pumps, pushing up bills for households[7]. New low carbon communal and district heat networks will likely be the preferred way of providing heating and hot water to blocks of flats under the Future Homes Standard.

The implications of emerging national policy need to be understood relative to the proposed West of Ifield development, specifically how these improvements impact diurnal, seasonal and annual energy demands. The adoption of low/zero carbon supply technologies can provide an effective means of minimising the site's projected carbon footprint, thereby helping to insulate the wider development from the risks presented by emerging national and regional policies, particularly with the next steps on the Future Homes Standards anticipated to be published in autumn 2025.

SAP 10.2 Updates for Heat Networks

An update on SAP 10 published on December 2021 regarding Heat Networks states that "*the notional building in both domestic and non-domestic Part L Building Regulations to be equal to the actual building as long as the actual is equal to or better in CO2 and PE terms than a threshold based on a gas CHP based heat network with 33% overall distribution losses. The gas CHP threshold system is assumed to be a system with 70% gas CHP (with electrical efficiency of 38% and thermal efficiency of 42%) and 30% communal gas boiler (with efficiency of 85%) giving the heat delivered thresholds below:*"

Table 3: CHP emission factor benchmark

Carbon Emissions Factor	Primary Energy Factor
0.350 CO_2/kWh	1.450

[5] Approved Document L: Conservation of fuel and power, Volume 1: Dwellings

[6] https://www.gov.uk/government/news/rooftop-solar-for-new-builds-to-save-people-money

[7] https://www.gov.uk/government/consultations/the-future-homes-and-buildings-standards-2023-consultation/the-future-homes-and-buildings-standards-2023-consultation#performance-requirements-for-new-buildings

Power Grid Decarbonisation

Decarbonisation of the UK electricity grid continues apace. Figure 3 illustrates that between 2023 and 2048 the electricity grid is projected to decarbonise by 95%, whilst the carbon content of the natural gas grid is expected to remain static. Indeed, The UK Government has committed to accelerate the process of decarbonisation, with grid generated electricity being fully zero carbon by 2035[8] (whilst the existing DESNZ (previously BEIS) and National Grid 'Future Energy Scenarios'[9] pathways to this point might not align with this aspiration, there is a strong desire to ensure the provision of clean power in support of the energy transition).

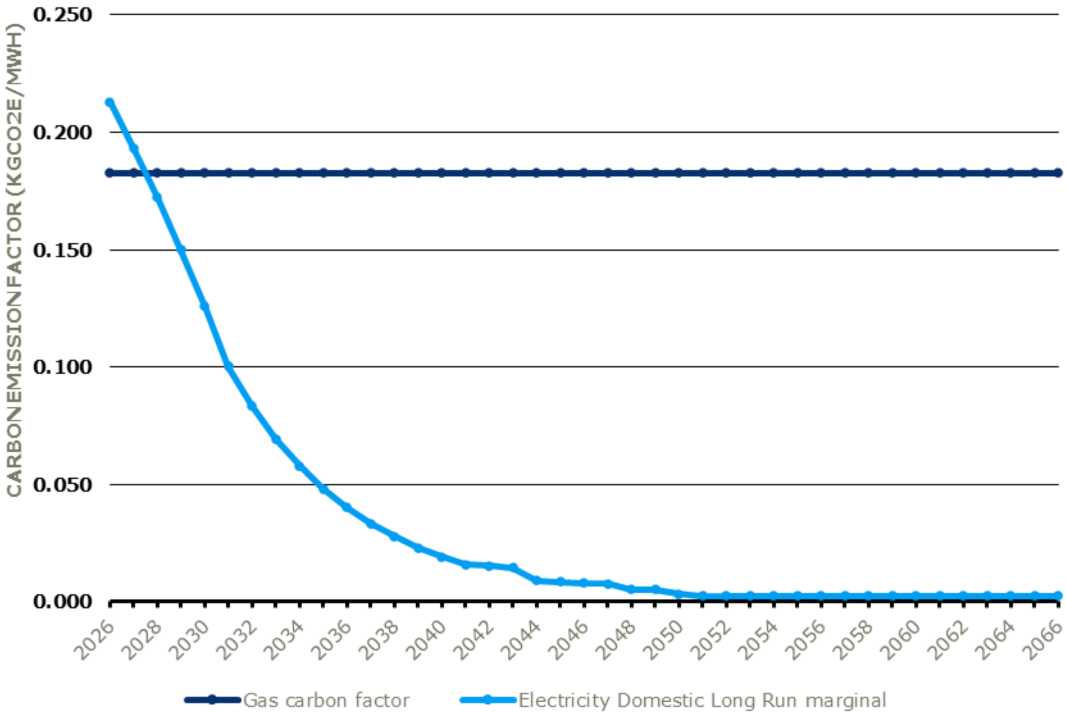

Figure 3: BEIS Projected CO2e Emissions Factors 2023 – 2050 (Natural Gas vs Electricity)[10]

Figure 3 shows that natural gas, without carbon capture, is incompatible with a net zero future. At present there is no projected pathway which supports the decarbonisation of the natural gas grid. Whilst both hydrogen and biomethane have been successfully injected into the UK's gas network the scale of these activities, both current and projected, is dwarfed by the UK's heat demand profile.

Gas consumption for heat is the dominant heating fuel in the UK, which has historically been a low-cost energy source, and far lower cost than electricity. To implement greater pricing parity, and influence consumer behaviour, the UK Government's 'Heat and Buildings Strategy'[11] is considering the shifting of levies and obligations from electricity to natural gas over the coming decade, as well as expanding the scope of carbon pricing.

[8] Plans unveiled to decarbonise UK power system by 2035 - GOV.UK (www.gov.uk)
[9] Future Energy Scenarios 2021 | National Grid ESO
[10] From Tables 1 (Commercial/Public Sector) & 2a of BEIS Green Book data-tables-1-19.xlsx (live.com)
[11] Heat and Buildings Strategy (publishing.service.gov.uk)

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Local Strategy

Horsham District Planning Framework November 2015

The Horsham District Planning Framework includes strategies and policies to direct and manage growth in the region. Those relevant to Land West of Ifield are summarised in this section.

Strategic Policy 36: Appropriate Energy Use

The energy hierarchy in Horsham supports development that contributes to clean and efficient energy. The hierarchy consists of three objectives: be lean, be clean, and be green. Preference is given to technologies with greater efficiencies and fuels with lower carbon emissions. Development proposals must demonstrate how they will provide zero and low carbon heating. For identified strategic development locations, evidence must be provided so that opportunities to meet each level of the hierarchy have been exhausted before cascading to the next level. For example, regarding district heating or cooling, the hierarchy starts with connecting to local existing or planned distribution networks, then focuses on maximising use of site wide renewable energy generation, and finally using optimum means of individual building low carbon heating. Residential or commercial development will be supported if it includes an Energy Statement demonstrating compliance with this policy. Stand-alone renewable energy schemes will also be supported.

Strategic Policy 37: Sustainable Design and Construction

The policy supports development that integrates sustainable design from the outset, with requirements including:

- Maximising energy efficiency and integrate the use of decentralised, renewable and low carbon energy.
- Achieving water efficiency standards of 110 litres/person/day
- Designing to minimise vulnerability to flooding and heatwave events
- Designing to encourage use of natural light and ventilation and encourage sustainable forms of transport
- Minimising construction and demolition waste and utilise recycled and low-impact materials
- Designing flexibly to enable future modification
- Incorporating measures that enhance biodiversity
- Providing satisfactory arrangements for storing waste and recyclables
- Provision of high-speed broadband access

Strategic Policy 24: Environmental Protection

Taking into account any relevant Planning Guidance Documents, developments will be expected to minimise exposure to and the emission of pollutants including noise, odour, air and light pollution and ensure that they:

- Address land contamination with proper site re-use and suitable remediation.
- Ensure developments are appropriate for their location, considering ground conditions and land stability.
- Maintain or improve water quality, preventing contaminated run-off.
- Minimise air pollution and greenhouse gas emissions to protect health and the environment.
- Support local Air Quality Action Plans and align with their objectives.
- Reduce exposure to poor air quality, especially for vulnerable populations.

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- Assess the cumulative impact of all relevant committed developments.

The Energy Hierarchy
Given the local planning policies summarised above, the construction sector is required to implement greater levels of sustainability into developments, placing energy performance at the centre of the design process. The energy hierarchy is a requirement of the Horsham District Planning Framework November 2015: SP36 and a holistic methodology which, when embedded in the delivery of major developments, informs the delivery of low/zero carbon approaches. The structure of this methodology is defined by three processes:

- Be Lean: use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures
- Be Clean: exploit local energy resources (such as secondary heat) and supply energy efficiently
- Be Green: maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site

In short, the approach aims to minimise energy consumption from the outset with low energy, passive measures, and efficient systems before the deployment of low and zero-carbon technologies.
This energy statement primarily focuses on the 'Be Clean' and 'Be Green' processes.

This statement does not advocate for any single set of solutions and is produced in support of a Hybrid Planning Application for the West of Ifield development. As such the focus is on providing potential pathways that could be adopted in support of realising a net zero-carbon development. Whilst it is accepted that the pathway to net zero can only be successfully enabled by a progressive attitude towards demand reduction ('Be Lean'), this statement is concerned with identifying energy solutions that, when applied in concert with an energy efficient design, help maximise the operational energy and carbon performance of buildings.

Energy Demand Assessment

The information-gathering exercise to inform energy demand is presented in this section. The Demand Analysis was carried out for the area within the site boundary only. The demand assessment assumes that natural gas does not provide a pathway to a zero-carbon future. The site comprises:

- 3,000 residential units, delivery to commence in 2029.
- Initial occupation of non-residential units planned to commence in 2028.

Figure 4 below shows the assumptions on the projected scale and rate of development for the residential units through to the anticipated completion date of 2039.

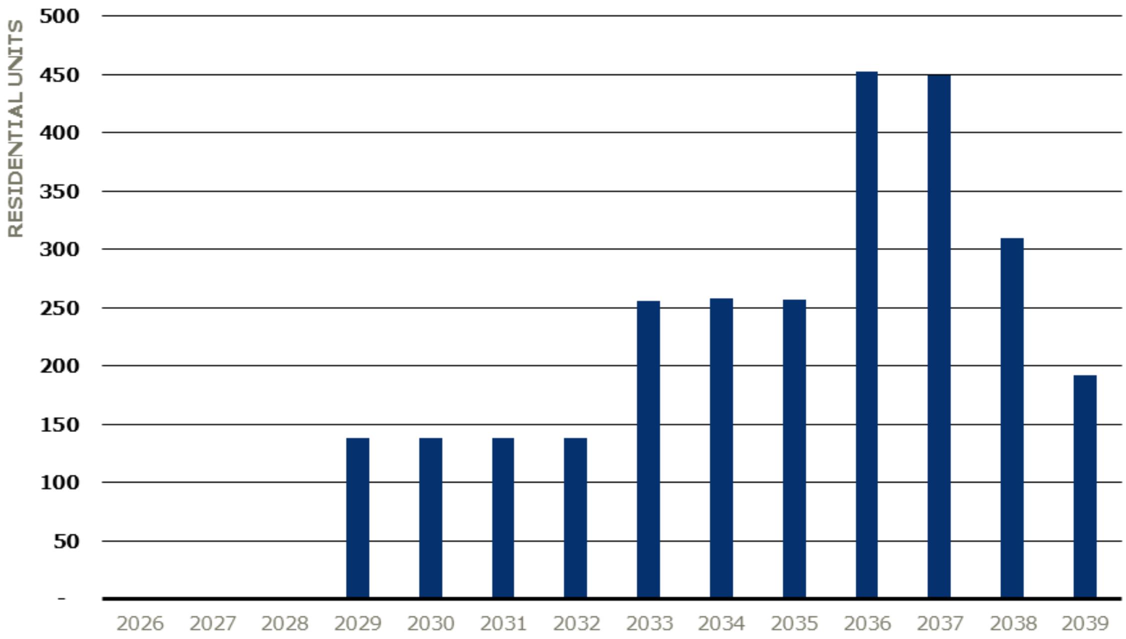

Figure 4: Delivery of residential units per year.

Figure 5 shows the assumptions on the projected scale and rate of development of the non-residential units through to the anticipated completion date of 2035.

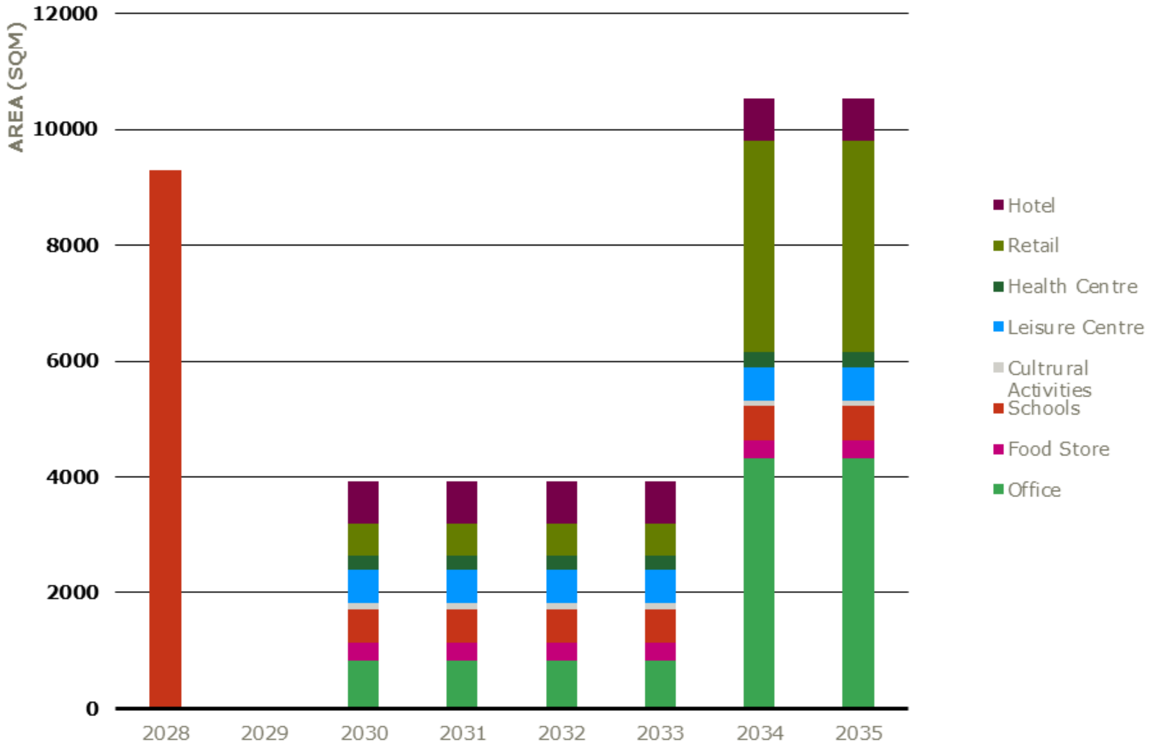

Figure 5: Delivery of non-residential units.

Heating benchmarks for residential buildings were drawn from recent Ramboll projects in London, based on thermal simulation modelling, and taking account of future improvements proposed by the Future Homes Standard. The estimates are aligned to recent benchmarks developed for Net Zero Carbon buildings by CIBSE and others through the London Energy Transformation Initiative (see - https://www.leti.london/one-pager). A summary of residential heating benchmarks used in the analysis is shown in Table 4 below.

Table 4: Residential Heat Benchmarks

Residential Heat Benchmarks		
Annual Heat Demand	**Value**	**Unit**
Heating Benchmark	16.8	kWh/m²/yr.
DHW	28.5	kWh/m²/yr.
Peak Demand	**Value**	**Unit**
DHW Benchmark for flats	35.0	kW/apartment
DHW Benchmark for detached houses	45.0	kW/house
Weighted Average DHW Benchmark	37.6	kW/dwelling
Heating Benchmark	45.0	W/m²

Benchmarks for non-residential buildings are taken from the BEIS Building Energy Efficiency Survey (BEES) conducted in 2014-15. A reduction of 40% was applied to take account of likely improvements required through future building standards aligned to the UK Government's current Net Zero buildings ambitions.

A summary of non-residential heating benchmarks is shown in Table 5 below.

Table 5: Non-residential Heat Benchmarks

Non-Residential Heat Benchmarks		
Type of Building	**Annual Demand (kWh/m²/yr.)**	**Peak Demand (W/m²)**
Retail	30	60
Office	44	42
Community	82	60
School	76	52
Leisure	82	41
Health	142	41
Hospitality	136	52
Food	25	41

A provision for electric vehicle charging was made using the currently proposed car parking allowance within the site masterplan, and in line with existing relevant Building Regulations.

Diversification
With large masterplan schemes it is important to recognise the importance of diversification as a means of ensuring that peak demand (both heating and power) is appropriately sized. Current UK design standards result in theoretical peak demands that are typically far more than the actual operational peak demands. The primary consequence of overestimating peak demands is that it lowers the cost-efficiency of the associated energy network, as:

1. Primary plant/network infrastructure is oversized relative to operational peak demand.
2. Operational performance is impaired as network losses increase and capacity to operate efficiently under part-load conditions is impaired.

When considering the total demand (heat and power) of multiple consumers, the summation of the expected peak demands of each consumer will overestimate the peak demand of the group. There are two reasons that the peak demand of the group will be less than the aggregated peak loads:

1. When considering a single consumers' peak demand, it is not appropriate to average the demand of many similar consumers because there is a reasonable probability that the consumer will have a higher peak demand than the average. As more consumers are considered in a group it is less likely that all the consumers will have a high peak demand. For the same level of risk, a lower peak demand per consumer can be assumed. As more consumers are considered, the group peak demand of these consumers will converge to the average of the population. This has the effect of reducing the expected peak demand of a group of consumers as the number of consumers within the group increases.
2. Not all consumers will be consuming their peak demand at the same time. The peak demand figure calculated for a consumer is measured over an extended period. Although the peak demand of different consumers is likely to occur at a similar time, the peak consumption will not always occur on the same day or at the same time of the day.

In instances, such as West of Ifield, where there are a range of building/consumer typologies it is reasonable to assume that diversity must be applied to peak demand loads to accurately reflect the cumulative peak demand of the wider site, thus diversification was applied as follows at West of Ifield:

- For the domestic buildings that comprise the masterplan a diversity factor of 0.7 was applied.
- For the non-domestic buildings that comprise the masterplan a diversity factor of 0.8 was applied in accordance with CIBSE Guide A, 2015 (Table 5.13) to all peak heat demands.

Total Energy Demand
The resulting energy demands for heat and power per project phase are presented below in Figure 6, Figure 7 and Figure 8, which display the development of Heat Demand, Heat Peak and Electrical Demand respectively.

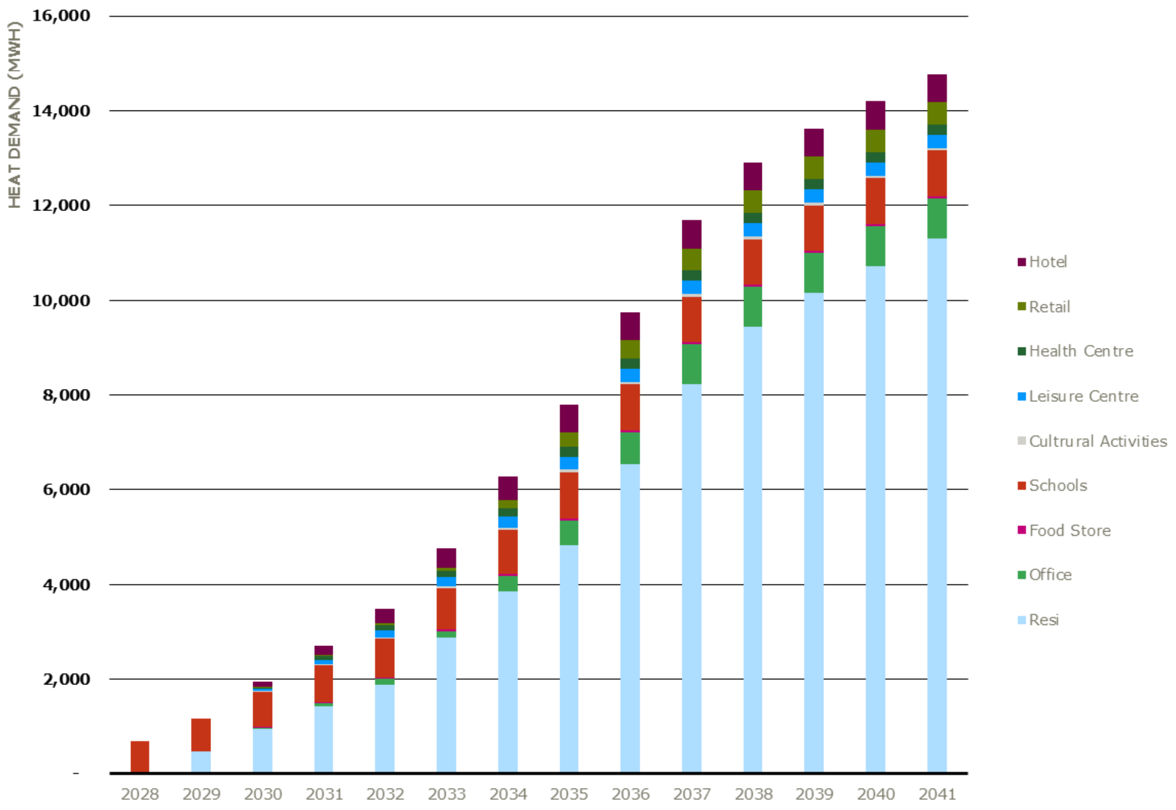

Figure 6: Heat Demand Development

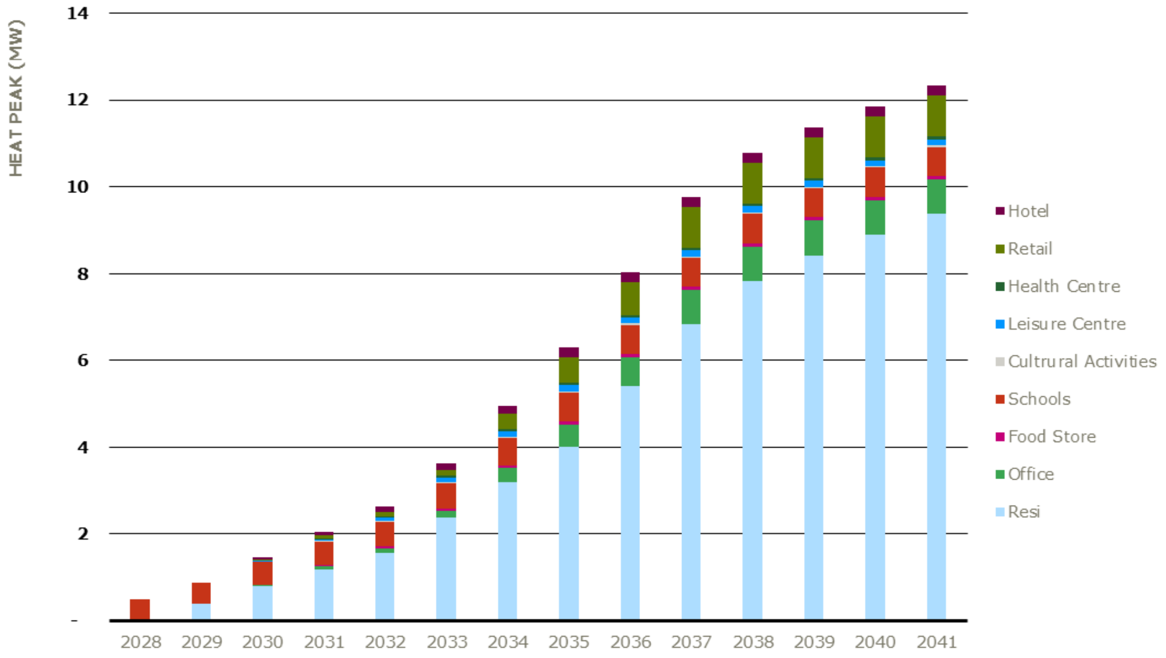

Figure 7: Cumulative Heat Peak Demand Development

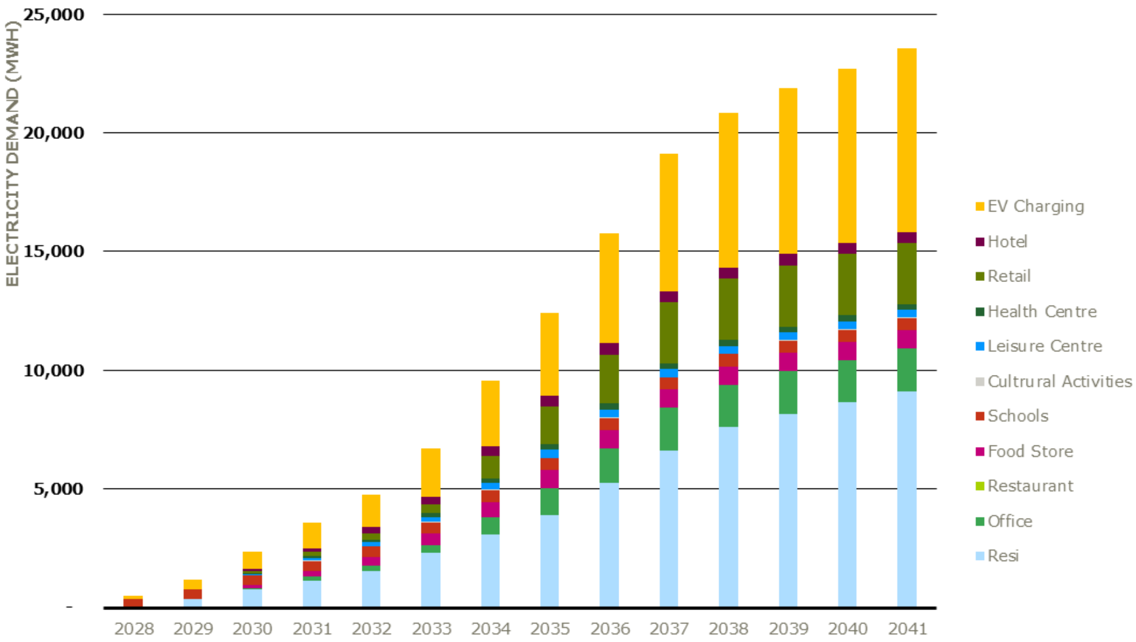

Figure 8: Cumulative Electricity Demand Development

The key points to note are summarised as follows:

- Residential buildings are the dominant heating load and electrical load at West of Ifield, accounting for 77% of the site's total heat demand and 76% of the site's peak heat demand, and 39% of the electrical demand. The residential portion of the development represents a good base load upon which a heat network could be established.
- The second largest heat demand is the School typology accounting for 7% of the total heat demand and 5% of the heat peak demand.
- The Retail typology is the second largest electrical load at West of Ifield. It accounts for 11% of the site's total power demand.
- The demand assessment assumes building level heating solutions.

Energy Supply Assessment

Methods

Energy supplies were considered in three categories:

- Existing energy supply assets.
- Planned energy supply assets.
- Potential low carbon energy resources – i.e., opportunities for the creation of new low carbon supply assets, e.g. exploiting local renewable energy resources.

Existing supply assets were identified through a desktop investigation based on the following information sources:

- BEIS Renewable Energy Planning Database[12];

[12] https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

- Environment Agency databases[13];
- BEIS's Combined Heat and Power (CHP) Database[14].

Existing Energy Supply Assets

The River Mole offers a potential energy source for a centralised water source heat pump supplying heat into a heat network. Flow data was obtained for the river from the National River gauging station 39054 - Mole at Gatwick Airport[15]. It is also assumed that a local sewage system could provide heating via a centralised heat pump. There is also a range of resources that can be used as a heat source. Electrically driven compression cycle heat pumps utilise low grade heat from the air (air source heat pumps) or ground (ground source heat pumps) and upgrade it to a higher-grade heat via a simple compression cycle. No other existing potential energy supply assets were identified.

Planned Energy Supply Assets

No planned energy supply assets were identified.

Potential Low Carbon Energy Resources and Technology Options

Opportunities for the creation of new supply assets exploiting low carbon energy resources and technologies were explored within the project area and the detailed results are discussed in Section 3. A longlist of potential technologies was identified including centralised and decentralised approaches.

In line with the policy requirements set out in Policy 36, the development is not located in a Heat Priority Area nor is it a strategic development location, which are defined in Policy 2 of the HDPF, and therefore, is not expected to be connected to district heating networks.

Emerging local and national policy and guidance, such as the upcoming Heat Network Zoning regulations, favours existing or new heat networks utilising waste heat as the primary consideration for providing a low carbon heating supply. Where a heat network is not viable, the presumption should be to install building-level heat pumps, air source, or where conditions permit, ground source. Ground source heat pumps and water source heat pumps are likely to be viable only for large buildings or heat networks (including shared ground loop arrays).

The following technologies were considered as high potential and were considered for further assessment:

- Electric Boiler
- ASHP
- Solar PV
- Heat Network with Heat Pumps
- Ambient Loop
- Electric Vehicle Charging

Energy Supply Technology Shortlist

Electric Boilers

Electric boilers use the heat produced from electrical resistance and/or induction, are a simple method of heating water and are typically 99% efficient at converting electricity to heat. Due to the simplicity of the electric boiler equipment, the heat generation is very dependable and is safe. For this reason, electric boilers are commonly used in larger buildings to provide peak load requirements and back-up. Maintenance costs are typically low when compared to other technologies.

13 https://environment.data.gov.uk/public-register/view/index
14 https://chptools.decc.gov.uk/chp/public
15 https://nrfa.ceh.ac.uk/data/station/meanflow/39054

The principal disadvantage of an electric boiler is fuel cost, compared to air source heat pumps. A heat pump would be expected to be two to three times more efficient than a similar sized electric boiler and thus an electric boiler would require two to three times more electricity to satisfy the same thermal demand. In addition, the electrical infrastructure required to support electric boilers would also be significantly greater, larger cables, switchgear, etc.

Air Source Heat Pumps (ASHPs)
Air source heat pumps use low-grade heat from the ambient air to evaporate the refrigerant gas. Due to a heat pump extracting free heat from the air, in the UK, efficiencies are typically 250 to 300% (coefficient of performance of 2.5 to 3.0) depending on the ambient air temperature (the higher the ambient air temperature, the higher the efficiency of the heat pump).

One of the disadvantages of an air source heat pump is the potential for frost to build upon the evaporator coil. This can occur if the evaporator coil is below 0°C and the reduction in air temperature causes water vapour in the air to condense out of the air and freeze onto the coil. During the UK winter, it is common for frost to build upon the evaporator coil. The frost build-up can clog the evaporator coil and negatively affect the performance of the heat pump. To prevent this, air source heat pumps undergo a defrost cycle which removes the frost. During a defrost cycle the heat pump refrigeration cycle is reversed, and the evaporator fan is turned off which causes the evaporator coil to heat up and melt the frost. The heat is transferred from the building system to the evaporator, so it is important to have an appropriately sized buffer tank, so the building comfort levels are not affected during a defrost cycle.

Solar Photovoltaic Systems
Solar photovoltaic (PV) systems collect direct and diffused radiation emitted from the sun and convert the solar energy into electricity. There is the potential to install solar thermal or solar PV systems on the following locations: roof spaces, building facades, ground arrays where available space allows and potentially panels above the carparks.

Depending on the operating temperature of the solar thermal panels, solar thermal typically has a higher energy yield than solar PV. However, the pipe system required solar thermal introduces additional complexities.

The maximum roof space that can be used by PVs could be impacted by other utilities/items on the roof and shading from other buildings (if adjacent buildings are taller).

Electric Vehicles
Electric vehicles (EV) are powered by electricity, and they can provide a green alternative to the conventional vehicles. The vehicle can be charged by a supply point (charging point). Given the decarbonisation of the grid, the use of electric vehicles is one step towards a carbon net zero future. In the UK there are plans to end the sale of new petrol and diesel vehicles by 2030 and all vehicles to have zero emissions by 2035[16].

Air Quality Management Constraints
The existence of Air Quality Management Areas (AQMA) is an important consideration in the assessment of the potential for new energy supply assets as limitations on emissions can significantly reduce the viability of technologies such as natural gas and biomass.

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[16] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf

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Each local authority in the UK must conduct air quality review and assessment in their area. This is to ensure that all councils are in-line with the national air quality objective and timeline. Air Quality Management Areas (AQMA) highlight the areas which are not meeting the targeted air quality objective set up by the local authority.

Heat supply scenario techno-economic analysis

Using the most feasible supply options determined from the above appraisal, we have considered three scenarios for high-level techno-economic modelling:

- Scenario 1 -> Building level direct electric heating/cooling solutions.
- Scenario 2 -> Individual ASHPs at property level
- Scenario 3 -> Individual ASHPs at building level with communal heating for flats using a centralised ASHP

Solar panels and EV charging have been included for all the scenarios. In each scenario solar panels provide 10% of the buildings' electricity demand and require around 9% of the available roof space. A solar panel yield of 17.5% is assumed. For scenario 2 and 3, roof space will be allocated for dry air coolers (DACs).

In line with existing relevant Building Regulations, provision for electric vehicle charging was made using the currently proposed car parking allowance within the site masterplan. It was assumed that:

- A total of 3,537 EV spaces have been estimated for residential buildings across the site. Using suggested interim ratios, it is estimated 345 spaces will be required across non-residential sites. 20% of all non-residential spaces are to have passive provision for EV charging.
- A provision for a 7kW charging infrastructure per residential space and 22kW for non-residential is assumed with each space requiring 2000kWh of electricity.

The creation of parking spaces follows the residential construction.

Scenario 1
For this scenario, direct electric heating is installed to deliver the buildings' heat demand. On-site solar PV is set to deliver 10% of buildings' electrical energy demand (including heating/cooling, electricity, and transport – EV's). This is the simplest solution involving the least complex energy infrastructure. This scenario represents a minimum baseline position. The pathway to net zero is dependent almost entirely on grid decarbonisation.

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Building level direct electric heating/cooling solutions

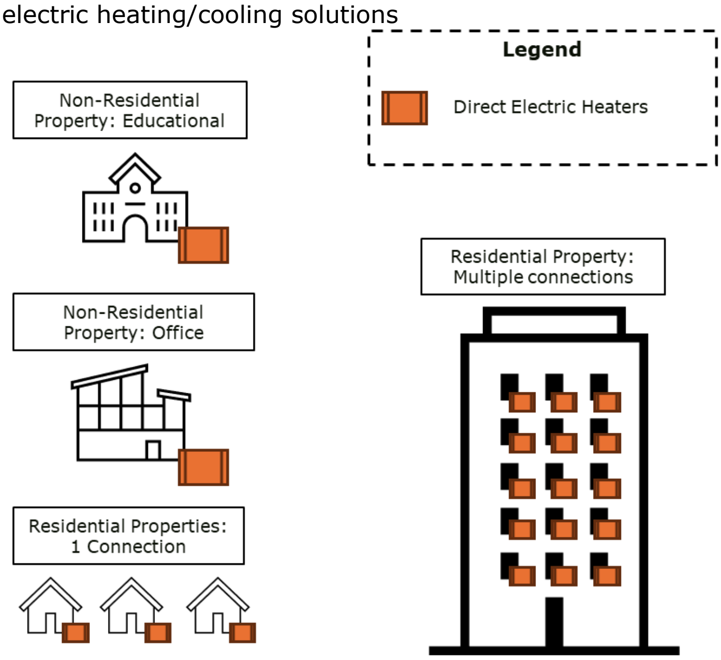

Figure 9: Building level direct electric heating/cooling solutions

Scenario 2

This scenario features a decentralised approach where individual ASHPs are installed in every dwelling unit or building. Roof mounted PVs are meeting 10% of the properties' residential demand. Each building is fitted with a 'wet' system, where water is heated through a heat pump and is then carried through the property. For residential block of flats, the individual ASHPs provide a flexibility of asset ownership. However, they incur issues with maintenance since access to the flat is required and large numbers of kit leading to high replacement and maintenance costs.

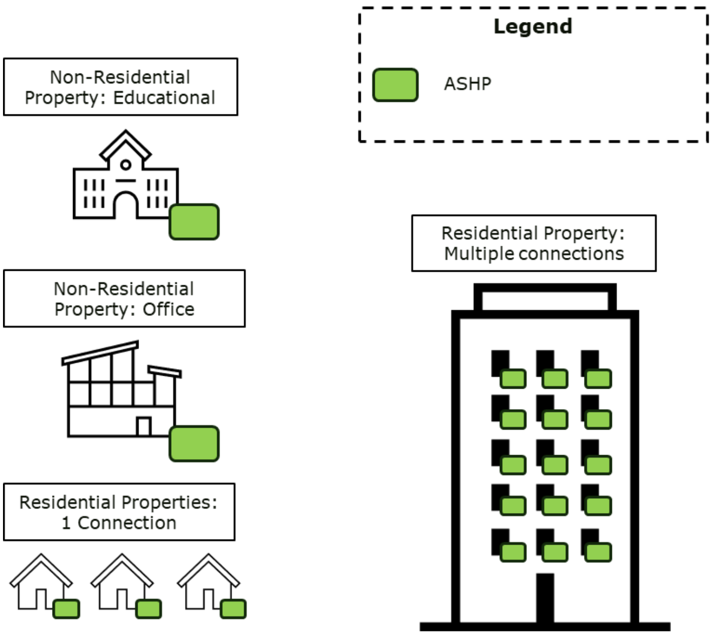

Figure 10: Individual ASHPs at property level

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Scenario 3
This scenario is the same as scenario 2 and uses decentralised ASHPs for commercial and residential houses however for flats it uses a centralised communal heating approach. Communal heating systems are prevalent in future policy recommendations and implementing these centralised systems can create more efficient and cost-effective systems. Rather than individual boilers or heat pumps, each flat will be fitted with a much smaller Heat Interface Unit (HIU) system which will control and meter their heat usage. This is particularly useful for larger buildings containing multiple dwellings, as this will future proof the building for future connection to an incoming district heat network. Because water risers are already present in the property, the individual ASHPs will only need to be replaced by a heat exchanger connecting into the heat network.

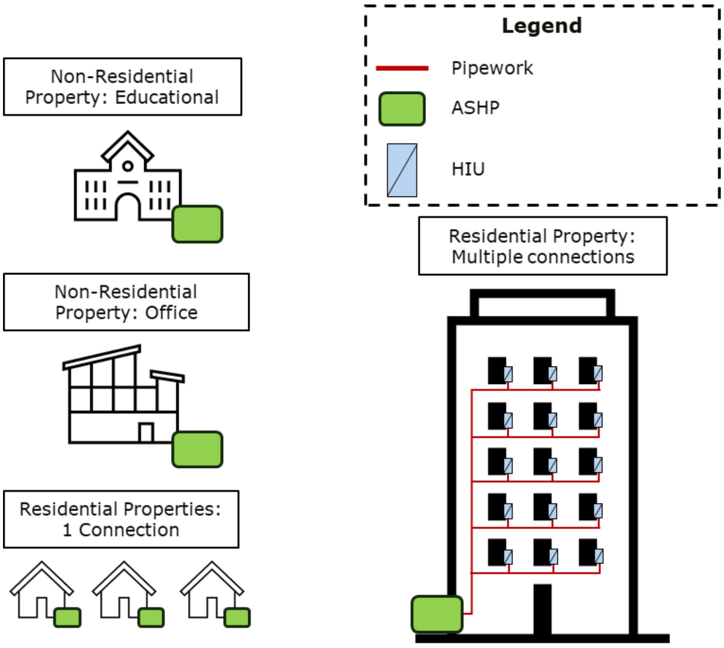

Figure 11: Individual ASHPs at building level with communal heating for flats using a centralised ASHP

It is noted that the scenarios are indicative solutions provided based on what could be achievable at West of Ifield. They are not fixed, and the options/composition therein will be subject to change as the project progresses to a more detailed and comprehensive feasibility study. Within each scenario we have elected to nominate several different technological solutions, the contribution of which can be adjusted as heat source availability is better quantified. This ensures that the options appraisal process embraces a flexible approach.

Energy and Carbon Assessment

Assumptions

For the outline energy modelling, electrical grid emission factors were extracted from BEIS Green Book, Table 1: *Electricity emissions factors to 2100, kgCO2e/kWh (*Domestic Long Run marginal - Commercial/Public sector Long Run marginal). The Carbon content of gas was extracted from BEIS Green Book, Table 2a: *Converting fuel types to CO_2 and CO_2e (emissions factors),* Natural Gas, 0.184

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kgCO_2e/kWh. For all scenarios, it was assumed that Solar PV should cover 10% of the on-site electrical demand.

Energy Assessment

Each scenario was modelled to evaluate the contribution of each energy source within the technological scenarios to determine the projected lifecycle energy consumption and carbon emissions. Table 6 below provides a breakdown of the energy inflows and outflows in the year 2050 for each scenario (25 years after the start of the project).

Table 6: Energy Balance by Scenario in 2050

In 2050	Units	Scenario 1	Scenario 2	Scenario 3
Annual Electricity consumption for heat provision	MWh	14,777	6,115	5,731
Annual Electricity Demand (excluding heat production plant, including EV)	MWh	23,576	23,576	23,576
PV Annual Power Production	MWh	1,600	1,600	1,600
Annual Electricity Import	MWh	36,752	28,091	27,707
Over entire project				
Lifecycle Electricity Demand	GWh	1,180	901	888
CO2e emissions	tons of CO2e	5,788	4,300	4,232

Figure **12** is showing the lifecycle (40 years) total electricity demand for each of the scenarios. Scenario 1 has a significantly higher electricity consumption because it employs direct electric heating, which has a lower coefficient of performance with respect to heat pumps. The ASHPs used in scenarios 2 and 3 have a Seasonal Coefficient of Performance of 3.0 compared to a 1.0 efficiency of a direct electric system used in scenario 1.

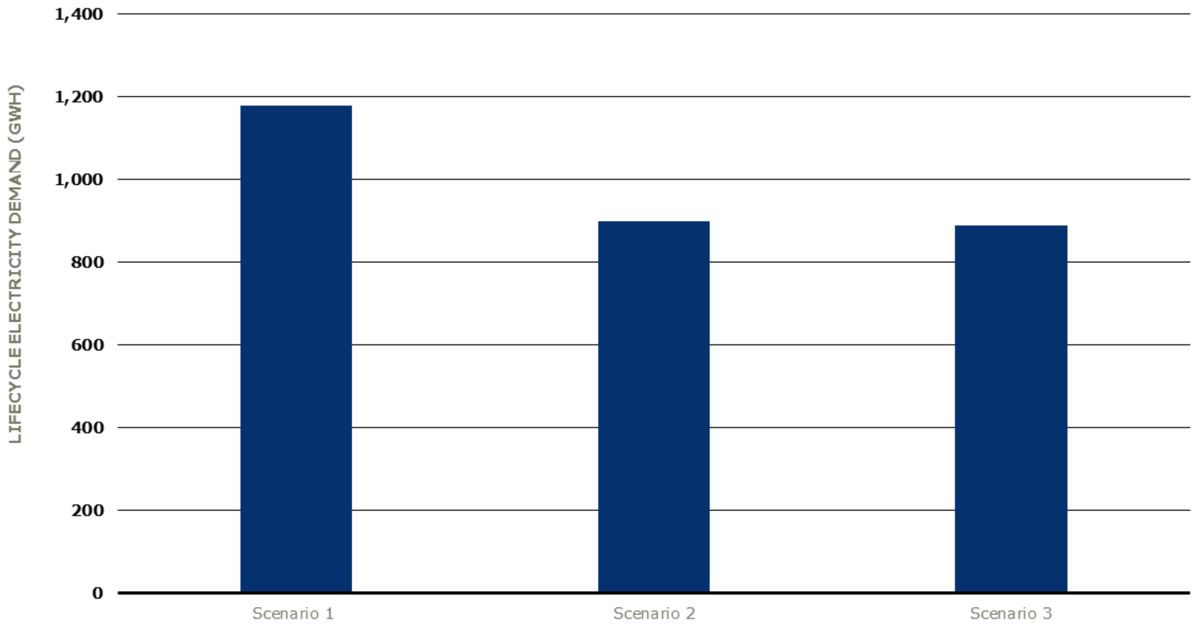

Figure 12: Lifecycle Energy Demand

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Carbon Assessment

Further to the energy assessment conducted in Section 3.1, an analysis was undertaken to evaluate the carbon performance of each scenario.

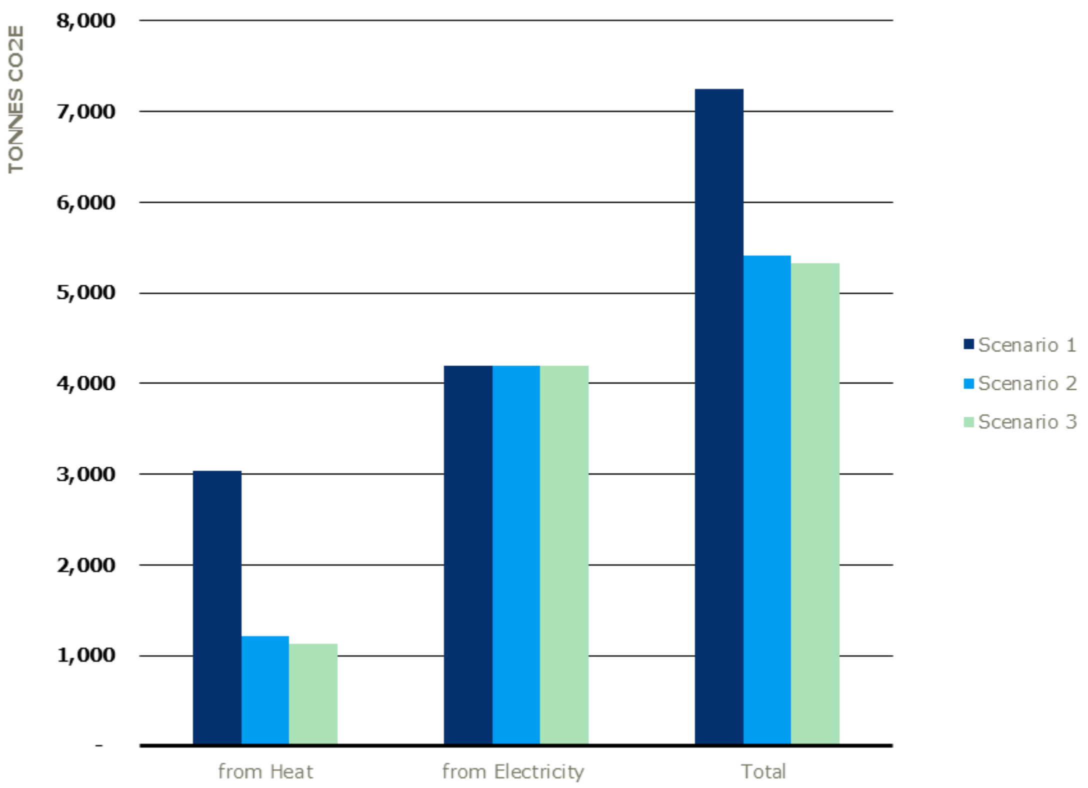

Figure 13: Total CO2 Emissions in the Different Scenarios

Figure 13 above shows that scenario 1 has the highest total carbon emissions. As mentioned, scenario 1 has higher electricity consumption from heat generation due to its use of direct electric heating.

Table 7: Total CO2 Emissions per scenario

	Total tons CO2e emissions up to 2050	Total tons CO2e emissions over 40 years	Savings on total CO2e emissions over 40 years
Heating BAU	54,878	106,661	0%
Scenario 1	5,788	7,246	89%
Scenario 2	4,300	5,412	92%
Scenario 3	4,232	5,329	92%

To demonstrate the relative efficacy of the three scenarios, the heating load was isolated and compared relative to a gas boiler counterfactual (which aligns with SAP 2012 and Part L 2013). Figure 14 below provides comparison of the carbon intensity of each scenario against a notional Part L-

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compliant gas CHP-based heat network[17] with a carbon factor of 0.35kgCO_2/kWh. This comparison demonstrates that all three options achieve significant lower emissions than a gas CHP heat network.

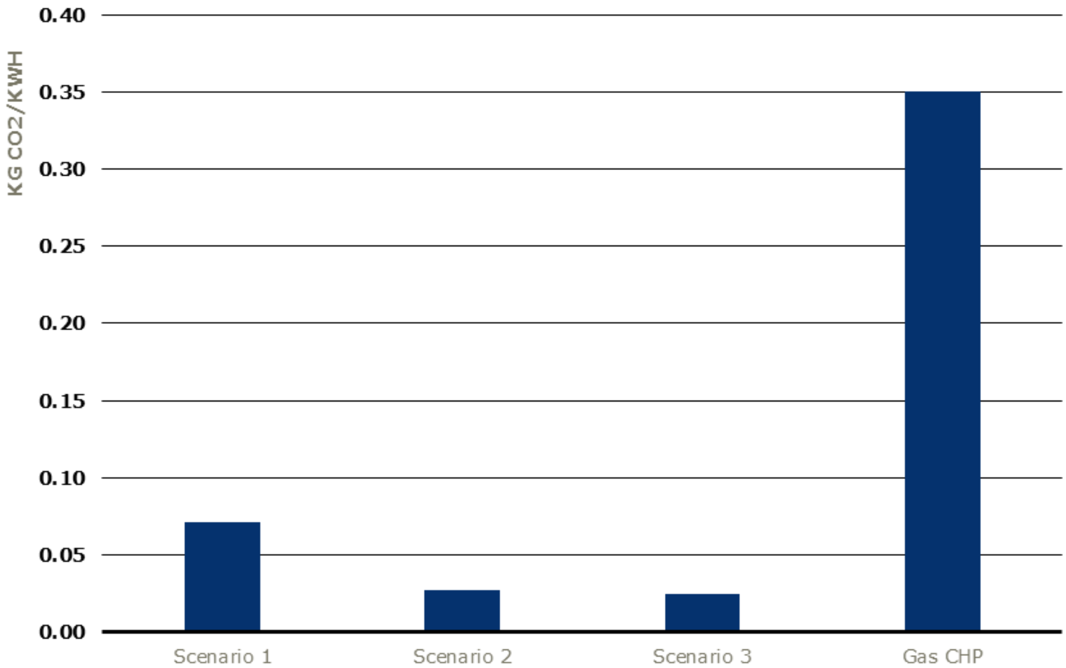

Figure 14: Carbon intensity of heat (2026)

In a broad sense the results comply with Local Policies, although to fully comply with national policies will require application of the Standard Assessment Procedure (SAP)[18] (the assessment provided here is from an operational emissions perspective as opposed to a compliance-based analysis).

Discussion

Policies – Scenarios Comparison

Within Horsham District Planning Framework November 2015, the key policies relevant to the scenarios analysed were: SP36 Appropriate Energy Use, SP37 Sustainable Design and Construction, SP24 Environmental Protection. Upon comparing the three energy statement scenarios in the report against the local plan policies listed above, it was deemed that all scenarios are compatible with local plan policies.

Energy Price Imbalance

At present there is a UK-wide drive supporting the decarbonisation of heat[19]. There remains, however, a significant imbalance in the cost differential between gas and electricity tariffs - irrespective of the consumer type. This imbalance means that, in the short-medium term, organisations/consumers must bear the cost of additional operating expenses when transitioning from natural gas to electricity. This imbalance is a barrier to the wider uptake of many low/zero carbon heat technologies.
Whilst the process of rebalancing energy costs has not yet begun, there is a desire from UK Government to tackle this issue.

[17] Conservation of fuel and power: Approved Document L - GOV.UK (www.gov.uk)
[18] The Standard Assessment Procedure (SAP) is the methodology used by the government to assess and compare the energy and environmental performance of dwellings.
[19] Heat and buildings strategy - GOV.UK (www.gov.uk)

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It is to be noted that the current volatility in the energy market has not been accounted for in our analysis. It remains to be seen whether these issues are transient, short-term issues or whether the volatility is reflective of an upward stabilisation in the energy market (which will have a commercial impact of the viability of all proposed scenarios in the short-medium term).

Conclusion

Scenario Comparison

From this initial analysis undertaken, it appears that all scenarios are compliant with local planning policies, national standards and regional guidance. The choice of scenario can come at a later stage considering factors such as capital and operational cost, levelised cost of energy and net zero aspirations. A high-level summary and comparison of the scenarios examined in this report is presented in Table 8 below.

Table 8: Comparison of Scenarios with Pros and Cons

Scenario	Pros	Cons
1. Direct Electric Heating and 10% solar PV on-site generation	• Proven technology • Lower capital costs • No space for centralised plant required	• Higher running costs for consumers • Decarbonisation mostly relying on grid • Low flexibility for future technologies • High electrical infrastructure cost
2. Individual ASHPs on property level and 10% solar PV on-site generation	• Improved efficiency • Less electrical consumption • Allows different operating temperatures per building • Flexibility of asset ownership	• Higher capital costs • Does not benefit from centralised heat transformation equipment economies of scale
3. Individual ASHPs on building level with communal heating for flats, and 10% solar PV on-site generation	• Communal heating improves efficiency and costs for flats • No centralised plant required per district, only building level plantrooms • Future-proof for DHN connection at building level via heat exchanger • Allows different operating temperatures per building	• Higher complexity in communal systems • Combination of centralised plant and individual Heat Exchangers in each flat for metering and billing can lead to higher maintenance complexities

Upon review, scenario 3 is preliminarily proposed for its ability to deliver heat efficiently without needing an Energy Centre. Setting up a 'wet' system on the buildings tertiary units (radiators with water),

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makes buildings ready for future district heat network connections, requiring only the replacement of ASHPs by thermal substations. Localised electricity generation from PVs can be utilised near the point of production, enabling smart controls and demand-side management. Additionally, centralising energy equipment for residential towers diversifies demands (especially impactful for domestic hot water), reduces the number of energy transformation units, and lowers maintenance requirements as well as fuel costs for operation. Scenario 3's impact on the electricity grid is less than scenario 1, potentially avoiding large capital costs for grid reinforcement.

Next Steps

The energy statement will be further refined as the design develops. On the basis that the Proposed Development will be delivered over a number of years, with initial occupation of the secondary school anticipated in 2028 and the occupation of first homes in 2029, no preferred solution has been chosen at this stage. However, Homes England commit to the minimum Future Homes Standards to ensure homes are "zero carbon ready", above the standards set out in the current Building Regulations.

A more detailed techno-economic assessment of the scenarios will need to be undertaken to determine the preferred solution, covering the following:

1. **A detailed technical feasibility** study of the options to refine and de-risk the assumptions incorporated up to this stage, and to explore in further detail factors such as heat demand estimation, heat generation and supply, phasing of build out, environmental factors, notably air quality and noise, access, and utilities. The study should also assess delivery risks.
2. **Economic and financial modelling** should be developed, and commercial delivery models considered to establish the most appropriate procurement strategy and delivery model.
3. **Concept Design** of the preferred option to establish outline requirements and implications for the development design and phasing.

Therefore, subject to agreed wording, Homes England agree to the principle of a prior to occupation condition requiring the submission of a Site-Wide Energy Statement.

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