A Second Runway for Gatwick

Appendix

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Energy

YOUR LONDON AIRPORT
Gatwick

Gatwick Airport Limited

Energy

Arup

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Ove Arup & Partners Ltd
Central Square
Forth Street
Newcastle upon Tyne NE1 3PL
United Kingdom
www.arup.com

ARUP

Contents

References

Tables

Figures

Figure 13: Estimated Electricity Grid Carbon Intensity Trajectory

Appendices

Appendix A
Brief review of energy & carbon policy and national carbon factors

Appendix B
Electricity infrastructure

Appendix C
Gas meter location plan

Appendix D
Review of low & zero carbon energy technology

Appendix E
Diagrammatic plans of energy infrastructure phasing

Executive Summary

Gatwick is developing a master plan to demonstrate how the airport can grow through to 2050, thereby responding flexibly to the UK's changing aviation requirements. This growth includes the building of a second runway and associated developments including a new 'mid-field' terminal and satellite buildings, stands, aprons and taxiways, together with a broad range of airside and landside buildings, collectively called the 'R2' development.

The provision of a secure, low carbon supply of energy is a critical element of the planned development of R2, and as set out in this report Gatwick is planning to develop an aspirational yet robust energy strategy that supports the operation of R2 and brings benefits to the wider airport.

The Airport Commission requires current energy provision and the requirements of Gatwick's new proposals to be calculated and compared. This report sets out Gatwick's work in response to this requirement. Energy and CO_2 emissions for the current airport's operations have been calculated, derived from Gatwick's electricity and gas meter data and the current grid carbon intensities, and the energy requirements of the R2 proposals estimated for 2030 and 2050.

The Commission also calls for '*measures required to address any short-fall or difficulties, and associated costs'*, to be outlined, together with the identification of *'fail-safe and emergency systems that currently exist or would need to be constructed in relation to energy and utility services, and associated costs.'* Gatwick's energy strategy responds directly to these important issues.

The UK's national 80% carbon reduction target for 2050 is clear, but, given the time spans involved, there is still a lot of uncertainty around important issues such as the predictions of the future carbon intensity of the national grid, future energy prices, the definition and implementation date of 'zero carbon' and other carbon legislation, national energy security and the development and implementation of energy generation technologies.

Gatwick has strong and effective leadership and governance structures in place that is delivering positive change and improvements for energy and carbon issues across the airport. It is against this background of continuing improvement beyond its Decade of Change targets once R2 is in place, together with clear national and local carbon targets (but some uncertainty of the detail of the future direction and timeframes for legislation and national infrastructure), that Gatwick seeks to develop an energy strategy that delivers secure supplies of low and zero carbon energy into the future.

Rather than developing a completely theoretical energy strategy for R2 at 2050, the approach has been to develop a future flexible and robust energy strategy for R2 at 2030, and to describe a range of energy technologies and fuels that might be employed over time beyond this as R2 develops to 2050.

Two scenarios have been developed for the energy strategy in 2030:

1. ‘Mitigation’

A ‘do minimum’ mitigation scenario, based on an assumption that the Building Regulations requirement for zero carbon **regulated** energy from 2019 is still in place for 2030 for R2, the terminal and airside buildings; and

2. ‘Exemplar’

An exemplar scenario, which aims to provide zero carbon energy to meet the **regulated AND unregulated** energy requirements of R2, the terminal and airside buildings.

Gatwick's energy strategy is based on the energy hierarchy of:

1. **Energy efficiency** - the design, construction and operation of the new terminal and other buildings at the airport will incorporate passive design and energy efficiency approaches to reduce the peak demand and the annual consumption of energy
2. **Efficiency of energy supply** – through on-site generation and use of power and heat and the use of smart technology in the electricity and heat networks to support demand management and the matching of supply to demand.
3. **Renewable energy** – to generate zero carbon electricity and heat for the terminal and other buildings and systems.

The energy hierarchy will be supported by Gatwick’s on-going testing of the ‘need to build’ and a process of reviewing the master plan and building designs to ensure spaces are working as efficiently as possible, thus avoiding unnecessary energy consumption.

At this master planning stage, the strategy has made assumptions around energy efficiency to inform the energy consumption estimates, and has focussed on the efficiency of supply and renewables.

The energy strategy for both the mitigation and exemplar scenarios is based on a combination of wood chip biomass CHP and boilers fuelled by natural gas and biogas (derived from digestion of airport waste) in an energy centre, supplemented by a large photovoltaic array and a new main electrical feed and primary sub-station.

Leading edge passive design and energy efficiency measures will be employed in the construction of new buildings and facilities and this is represented in the energy demand estimates. This will be supplemented with smart grid technology in the power and heat networks to help with demand side management and matching energy supply to demand. The environmental impacts have been reviewed in the work on topics such as air quality and noise and no major impacts have been identified.

A new primary sub-station will be required. The energy strategy will maintain the already good level of resilience for the overall energy supply to the airport, allowing it to cope with the loss of a main electricity feed whilst still maintaining operations. Electrical network resilience could be improved with new 11kV connections between all three primary sub-stations. A separate main feed to the new primary sub-station would further enhance the airport’s resilience.

The energy systems on site will be climate resilient, responding to expected future severe weather events. Moreover, the airport's generation of a large part of its own energy will reduce its reliance on the wider electricity grid and gas supplies, as the airport will generate biogas locally from digesting its waste and wastewater sludge. There will also be carbon benefits for the airport's existing buildings beyond the improvements being delivered in the airport's 'Decade of Change' programme, through the delivery of low carbon heat.

As the airport develops beyond 2030, Gatwick will seek to build on the energy strategy by extending the provision of low or zero carbon energy to its new buildings, the Tracked Transit System and electric vehicles in the car parks belonging to passengers, as well as third party landside offices, hotels and retail units. It will also seek to export low carbon heat at equitable cost to local businesses and homes offsite, providing a large community benefit.

Political instability in oil producing countries and regions and the uncertainty about oil supplies and prices is likely to continue and is likely to underpin the shift towards alternative forms of fuel. Emerging fuels and energy generation technologies such as biofuel derived from algae and other sources, hydrogen, and fuel cells, together with new processes for fossil fuels, are expected to drive advances in combustion engines and new methods of transportation (such as rail transportation of liquid hydrogen).

Gatwick's energy centre and its location, with good road and rail links, will be well placed to respond to these changes.

Discussions have been held with the local electricity and gas network operators and this allows Gatwick to conclude confidently that there is no reason to expect that provision of supply would present any difficulties for Gatwick or affect the resilience of supply to local communities also served by the networks.

Budget costs for the energy strategy have been developed and are included in the overall business case.

As the master plan proposals develop and become more detailed, so the energy strategy will also continue to be tested to ensure it is appropriate, is the best it can be and will deliver Gatwick's required outcomes for a resilient supply of low and zero carbon energy to the airport. Detailed technical and commercial feasibility will be completed, leading to a full business case and procurement strategy for the new energy infrastructure, identifying the approach to funding, ownership, design, construction, operation and delivery. This work will also include consultation across the airport and with Gatwick's neighbours, to explore opportunities to export low carbon energy offsite.

The energy infrastructure will then be procured, designed, constructed, commissioned and operated, with Gatwick monitoring performance and seeking to maintain the technical and contractual flexibility to respond to further growth and change over time.

At this early stage it is not possible or appropriate to prescribe exactly what technology and infrastructure will be in place for 2050 but Gatwick has built flexibility into its plans and fully intends for them to be exemplar and world leading, with the aspiration to be carbon neutral in terms of both regulated and unregulated energy use across a wide range of airport energy uses.

Gatwick's plans will also address security of supply, as the development of R2 will lead to a higher level of resilience for the total airport.

Gatwick is currently exploring a range of technologies to achieve this including amongst others an integrated approach to energy, waste and water management, which would support the objectives of minimising carbon emissions in airport operation and construction as well as securing a range of other sustainability objectives such as waste management, reduced transport and effective use of resources.

1 Introduction

1.1 Growth at Gatwick

Gatwick is developing a master plan to demonstrate how the airport can grow through to 2050, thereby responding flexibly to the UK's changing aviation requirements. This growth includes the building of a second runway and associated and ancillary development including a new 'mid-field' terminal and a broad range of airside and landside buildings, collectively called the 'R2' development.

1.2 Report Aims

The provision of a secure, low carbon supply of energy is a critical element of the planned development of R2, and Gatwick seeks to develop an aspirational yet robust energy strategy that supports the operation of R2. This will extend and augment the delivery of Gatwick's medium term sustainability and carbon plans as set out in its Decade of Change document (see Section 2) by using 'Creative and Innovative Interventions' to reduce energy usage, and that inherently supports the Airport Commission's objectives, which are to:

	Airport Commission's objectives	Gatwick energy strategy
1	**To minimise carbon emissions in airport operation**	Application of energy hierarchy to new development to maximise energy efficiency in construction and operation, supply energy in an efficient way and use renewable energy sources, with on-site generation of zero and low carbon power and heat
2	**To enhance individual airport and airports system resilience**	On site generation of energy and more resilient connection to electricity grid via third primary sub-station
3	**To build flexibility into scheme designs**	Flexibility in energy infrastructure provision to allow for least disruptive changes in energy generation technology to respond to future availability and price of fuels and to emerging carbon targets and carbon taxes.

Table 1: Airport Commission Objectives

The aim of this work is to provide Gatwick with an energy baseline and a robust energy strategy that responds to the sustainability objectives of Gatwick and the Commission for the R2 development.

1.3 Scope of the Report

After this introduction, the report sets out some important background, with a review of relevant policy and the regulatory context for energy in the UK and some high level implications for Gatwick and this strategy.

This is followed in Section 3 by a description of the airport's existing energy infrastructure and resilience plans. This includes an overview of recent initiatives that are leading to operational energy and carbon emission reductions (the 'Decade of Change' programme), together with the aspects of the development of R2 that will impact on future operational energy consumption.

Current energy use is then presented in Section 4, based on metered energy data where this is available, together with estimates of R2's energy requirements in 2030 and 2050. The associated carbon emissions based on a 'business as usual' grid connected approach and predictions of what the carbon intensity of the national grid might be at these points in the future are also presented.

The energy strategy for two cases, a minimum 'mitigation' approach and an 'exemplar' approach, is then set out, including a description of the benefits of the strategy, a description of the implicit resilience provided and an overview of the environmental implications.

1.4 Mapping Airport Commission's Requirements to this Report

Airport Commission Requirement	Report Section
Calculate energy and utility requirements of proposal	4
Measure these against the current energy and utilities provision	3
Identify any short-fall or design difficulties that a new development would generate for either the airport or other local residents, businesses or amenities.	4
Outline what measures will be required to address any short-fall or difficulties, and associated costs. This may include plans to build new provision, reinforce existing local and regional supplies or route/re-route existing services, and will need to address the environmental consequences.	5, 6 & 7
Identify the fail-safe and emergency systems that currently exist or would need to be constructed in relation to the above mentioned energy and utility services, and associated costs.	6
For risks associated with power outages and reduced fuel supplies, the airport's ease of access to fuel will be considered at a strategic level, in relation to the National Grid, UK refineries and associated infrastructure.	6

Table 2: Mapping Airport Commission Requirements

2 Background

It is important that Gatwick's energy strategy for R2 is developed in the context of the UK's changing policy and legislative framework for energy and carbon. Whilst the long term national carbon targets for the UK are set out in the Climate Change Act, the practical steps and the policies and legislation required to achieve them continue to develop and emerge.

Gatwick's plans for the development of the airport look ahead to 2050, and the energy policy and infrastructure landscape at that time is likely to be very different from that which exists now. The scale of the energy and carbon challenge that the UK faces, however, is clear (see summary of Climate Change Act requirements in Appendix A) and Gatwick recognises the imperative of developing an energy strategy that is robust and ensures operational resilience, whilst also maintaining flexibility to respond to the changing context for carbon policy and fuel availability and price.

The current policy and legislative context is reviewed in Appendix A, together with an explanation of assumption's made relating to national grid carbon factors, in order to provide some background to Gatwick's developing energy strategy. It is important to note that this energy strategy is focused on energy use and carbon emissions associated with airport operations on the ground, **not** aviation emissions.

2.1 Governance

The importance of strong leadership and governance to deliver programmes of carbon reduction and future plans for low and zero carbon infrastructure cannot be over-emphasised. Gatwick understands this implicitly and provides the governance structures required throughout the airport, from the Main Board down through the corporate sustainability team responsible for delivery of outcomes related to, for example, energy, waste and noise, the operations teams for engineering and energy and the 'Carbon Council', a less formal group representing everyone with an interest in reducing carbon emissions across the airport.

2.2 Decade of Change

2.2.1 Aims

Gatwick has committed to a period of transformation at the airport over 10 years (2010 – 2020) that will improve many key indicators of sustainability associated with the operation of the airport. This commitment is enshrined within a ten point sustainability plan summarised below:

1. Demonstrate we are a trusted and valued neighbour.
2. Fulfil our role as an economic driver of local, regional and national significance.
3. Increase sustainable access options for our passengers and staff.

4. **Reduce our CO_2 emissions by 50%** (Scope 1 & 2 emissions against 1990 levels).
5. Improve air quality impacts.
6. Reduce the impact of operational noise.
7. Generate no waste to landfill.
8. **20% reduction in energy** (against 1990 baseline) and water consumption (against 2010 baseline).
9. Improve the quality of the water leaving the airport.
10. Have an award winning biodiversity approach.

2.2.2 Performance

The latest performance appraisal of the outcomes of the Decade of Change initiatives was produced in 2012[1].

The data in Table 3 below from Gatwick's on-going monitoring and reporting programme has been taken from this report and indicates that significant progress has been made, particularly with respect to CO_2 reductions.

Performance Metric	Change from 1990 Baseline
CO_2 (Scope 1)	-20%
CO_2 (Scope 2)	-38%
Electricity Consumption	-2.3%
Gas Consumption	-16.8%
Water Consumption	-24.9%

Table 3: Decade of Change Performance

Measures implemented and planned to enable this performance include:

- Improving the efficiency of lighting and installing lighting controls
- Replacing fans in air handling units with more efficient models
- Replacing boilers with more efficient models and improving controls
- Using free cooling on chillers and optimising cooling system controls
- Redesigning and replacing domestic hot water systems
- 'Health checking' & optimising Building Management Systems
- Improving the efficiency of car park & street lighting
- Replacing aged plant systems

[1] Our Decade of Change (2012 Performance)

2.3 Energy & Carbon Opportunities with Local Authorities

There is potential for the airport's energy strategy to support and make a positive contribution to the energy and carbon plans of adjacent local authorities and communities. This will require work over time to test the feasibility of the airport's ability to export energy offsite and liaison with the local authorities to test their appetite for ths. It is useful to understand where the councils are with their own low carbon plans and where the links might be made; some examples of the potential opportunities are noted below:

- Crawley Borough Council may have opportunities for a centralised district heating infrastructure serving the town centre and surrounding high density heat loads, together with the development of a biomass fuel supply chain.
- Through its Core Strategy, Mole Valley District Council is committed to exploring the opportunities for decentralised and renewable or low-carbon energy sources within the District, encourages the use of Combined Heat and Power (CHP) for large mixed developments and large buildings and recognises that considerable reductions in carbon dioxide emissions can be achieved by using biomass as a fuel for CHP.
- Reigate and Banstead Borough Council has initiatives related to the creation of a wood fuel strategy for the economic sub-region, encouraging and facilitating the implementation of renewable energy, heat networks and/or combined heat and power plant.

2.4 Implications for Gatwick

As noted in Appendix A, the UK's national 80% carbon target for 2050[2] is underpinned by interim targets to 2027 thus far (the Carbon Budgets[3]) and a range of short to medium term measures related to energy efficiency, the roll-out of energy generation technologies and the reducing carbon intensity of the national grid, to set all sectors on the right trajectory. Unsurprisingly, given the time spans involved, there is still a lot of uncertainty around important issues such as the predictions of the future gird carbon intensity, future energy prices, the definition and implementation date of 'zero carbon' and other carbon legislation, national energy security and the development and implementation of energy generation technologies.

Given what the local authorities are seeking to achieve with their own energy and carbon plans, there may be opportunities for Gatwick to support them with the export offsite of low carbon energy.

It is against this background of a strong intent for the airport to improve its carbon performance across the full airport beyond its Decade of Change targets once R2 is in place, together with clear national and local carbon targets (but uncertainty of the future direction and timeframes for legislation and national infrastructure), that Gatwick seeks to develop an energy strategy that delivers secure supplies of low or zero carbon energy into the future.

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[2] http://www.legislation.gov.uk/ukpga/2008/27/contents

[3] https://www.gov.uk/government/policies/reducing-the-uk-s-greenhouse-gas-emissions-by-80-by-2050/supporting-pages/carbon-budgets

3 Existing Energy Infrastructure

Energy is currently delivered to the airport via grid supplied electricity and gas as well as a small amount of on-site generated renewable energy, as summarised below.

3.1 Electricity

3.1.1 Arrangement

Distribution Network Operators (DNOs) own and operate the UK public distribution network that brings electricity from the national transmission network to homes and businesses.

The DNO that operates the off-site electricity network is UK Power Networks (UKPN).There are currently two separate incoming 33kV supplies taken from UKPN's surrounding infrastructure to the Gatwick site. They are converted to 11kV HV supplies via two primary sub-stations and transformers (AF and BF), which then serve the on-site HV/LV private electricity infrastructure.

The airport's 11KV network is a private electricity distribution network (not owned by the DNO), which is leased to, operated and maintained by UK Power Networks Services (UKPNS) and is contractually arranged under a Raglan Agreement, which is discussed below.

A location plan indicating the position of the primary sub-stations and a schematic of the main HV/LV system outlining the connection and distribution arrangement for the airport site is set out in Appendix B. Sub-station AF is in a parcel of land to the north and separate from the airport site and is relatively constricted in terms of running new cables into or from the sub-station. Sub-station BF is located relatively centrally on the airport site and is fed from a 33kV supply cable that comes up from the south, under the existing runway.

3.1.2 Current capacity & maximum demand

The primary transformers AF and BF are currently rated, under normal operation, to provide a total connection capacity of 29MVA, arranged as follows:

- **AF:** 14 MVA
- **BF:** 15 MVA

The current maximum electrical demand is estimated to be approximately **23.9MVA**.

3.2 Gas

3.2.1 Arrangement

Gas is supplied to a range of boiler plant and commercial cooking facilities across the airport via 30 No. gas meters located throughout the site. A location plan illustrating the meter positions is included in Appendix B.

3.2.2 Maximum demand

The current maximum gas demand from metered data is **21.7MW**.

3.3 Renewable Energy

There is a modest photovoltaic (PV) array installed at the northwest corner of the airport.

The primary performance data for the array is given in Table 4 below.

Peak Output (kW)	Annual Output (kWh)	Array Size (m^2)	Yield ($kWh/Annum/m^2$)
50	46,000	302	152

Table 4: PV Array Performance Data

There is also a PV array and a solar water heating installation on the new airfield operations building which is an exemplar in terms of practical, low carbon building.

3.4 Operational Resilience

3.4.1 Electricity

In the event of failure of the grid connection at sub-stations AF or BF, or on-site grid failures, it is possible to maintain the operation of the airport from the remaining grid connection, following manual 11kV switching.

Agreements are in place with UKPN to increase supply capacity available at either AF or BF in response to a network connection failure at the other sub-station. The actual electrical supply availability at each grid connection at the time of a failure, however, will vary as a function of the nature of the fault and the needs of other off-site customers.

Gatwick has load shedding procedures in place to react to off-site and on-site network disruption and this switching of loads from one sub-station to another is estimated to take up to a full working day (approximately 8 hours) to carry out. Once complete, however, the airport can maintain business continuity, albeit with disruption to some services.

Electricity generators provide back-up power for life-safety and air traffic control related equipment. Generators are also installed to provide power to the surface and foul water pumps.

3.4.2 Gas

Currently there is no on-site resilience for gas systems providing heating to buildings at the airport. It is estimated, however, that in the event of a total gas supply failure from the gas grid then the heat inherent in the heating pipe network could provide heat for several hours before it is fully exhausted. Electrical immersions heaters are installed to provide domestic hot water (DHWS) in the event of a gas or main heating plant failure.

3.5 Raglan Agreement

Gatwick has a Raglan Agreement in place with UKPNS, which obliges the airport to use all reasonable endeavours to persuade tenants and other relevant third parties to take electricity supplies through the Raglan Distribution System rather than through a Local DNO, and for Gatwick itself (and its Affiliates) to ensure that all of its distribution system developments at the airport become part of the Raglan Distribution System (even if the same is not directly connected to the Raglan Distribution System).

Neither Gatwick nor UKPNS consider the Raglan Agreement will present a constraint to the airport's proposed development of a second runway and the energy strategy needed to support it.

4 Estimated Energy Use

4.1 Overview

Estimates of future energy use for the airport site in 2030 and 2050 have been made to inform the development of an energy strategy to deliver the energy demand.

The process has involved the analysis of current energy use across the airport to produce a baseline and then to extrapolate from this baseline using the master plan proposals and development schedule setting out areas of airport facilities and buildings, together with assumptions around energy efficiency measures that are expected to be in place in the future.

Energy estimates have been made for the following:

1. **Existing Facilities:**

   The existing terminals, airside and specific landside facilities – **'R1'**

2. **Proposed Facilities:**

   The proposed terminals, airside and specific landside facilities - **'R2'**

4.2 Methodology

The approach to understanding the existing energy and associated CO_2 emissions for the existing and proposed development facilities is described below.

The areas of the airport facilities are broken down into three main categories:

- Terminals (Gatwick ownership and operation)
- Airside (Gatwick ownership and operation; and Gatwick ownership and 3rd party operation)
- Landside (Gatwick and 3rd party ownership & operation)

The areas and the categorisation is summarised in Table 5 below.

Category	Areas/systems
Terminals	Terminals, aprons, piers, stands, baggage, people movement, aircraft ground power units, pre-conditioned air units
Airside	Gatwick ownership & operation - runway lighting, apron lighting, control tower, navigation aids, signage, water/sewage infrastructure
	Gatwick ownership / 3rd party operation - hangars, cargo, industrial supply, fuel infrastructure, parking & maintenance
Landside (Gatwick & 3rd Party ownership & operation)	Multi-storey car parking lighting
	Tracked Transit System (TTS)
	Hotels, offices

Table 5: Energy use definitions by category

4.3 Existing Facilities (R1)

4.3.1 Data sources

A number of data sources were gathered to support the energy use estimates for R1, as listed in Table 6 below:

Data	Type / Nature
Gas Boiler / Generator / Mains	Asset List
Gas Meters	Location Plan
Gas Consumption	½ hourly metered data
Heat Network	Schematics
HV Consumption	½ hourly metered data
HV Network	Schematics
Site Information	Plan Drawings

Table 6: Gatwick Data Sources

Electricity: Metered data for 2012-13 was taken from primary sub-stations (AF & BF) that serve the entire airport site and was disaggregated across end uses based upon comparator airport design information and energy profiling benchmarking data to give electricity consumption for the main components of Gatwick's operations.

Gas & Heat: Metered data for 2012-13 was taken from 30 No. site gas meters and this data matched to building heating loads where this could be determined from site plans. Areas of the site with no metered data were benchmarked against 'typical' industry benchmarks to obtain an estimate of the full site's gas consumption.

4.3.2 Annual energy consumption estimates

Table 7 below sets out the estimated 'regulated' and 'unregulated'[4] annual energy consumption for R1 and is split into the three area categories.

Area	Energy Consumption		
	Regulated		Unregulated
	Heating (MWh / Yr)	Electricity (MWh / Yr)	Electricity (MWh / Yr)
R1 Terminals Only	59,900	50,100	44,600
R1 Terminals + Airside Buildings	74,500	52,100	45,200
R1 Terminals + Airside + Landside Buildings	227,500	86,700	67,000

Table 7: Estimated R1 Annual Energy Consumption

4.3.3 Maximum Demand Estimates

Table 8 below sets out the estimated maximum energy demand for R1.

Area	Utility	Maximum Demand (MW)
R1 Terminals + Airside + Landside Buildings	Electricity	23.9
	Heat	17.3
	Gas	21.7[Note 1]

Table 8: Maximum Demand Estimates (R1)

***Note 1:** Maximum heat demand incorporates assumed 80% system efficiency for heat production & delivery.*

[4] See Appendix A for explanation of regulated and unregulated energy

4.4 Proposed Facilities (R2)

A methodology was developed to estimate energy use for R2 and is summarised below:

Electricity:

Benchmark 'best practice' industry data incorporating anticipated future energy efficiency measures for lighting and other systems (as part of the overall energy strategy following the energy hierarchy) was applied to the R1 baseline and this data was then extrapolated for the 2030 and 2050 scenarios for R2, leading to estimated annual consumption profiles based on a typical day per month.

Gas & Heat:

A 40% improvement factor was applied to R1 gas and heat consumption for the terminal buildings to account for expected improvements in energy efficiency of building envelopes and heating systems as a function of the Building Regulation Part L requirements. This future heat consumption figure was then used in conjunction with the R2 midfield terminal floor area, leading to estimated annual consumption profiles based on a typical day per month.

For other airside & landside areas where current gas consumption data is not available, current 'best practice' benchmark data has been used, also with a 40% improvement as a function of expected Building Regulation improvements.

4.4.1 Annual Energy Consumption Estimates

Table 9 below sets out the estimated regulated and unregulated annual energy consumption for R2 for **2030** and is split into the three area categories.

Area	Energy Consumption		
	Regulated		Unregulated
	Heating (MWh / Yr)	Electricity (MWh / Yr)	Electricity (MWh / Yr)
R2 Terminals Only	9,300	17,600	13,600
R2 Terminals + Airside Buildings	16,200	19,300	15,300
R2 Terminals + Airside + Landside Buildings	85,300	35,900	27,900

Table 9: Estimated R2 Annual Energy Consumption (2030)

Table 10 below sets out the estimated Regulated and Unregulated annual energy consumption for R2 for **2050** and is split into the three area categories.

Area	Energy Consumption		
	Regulated		Unregulated
	Heating	Electricity	Electricity
	(MWh / Yr)	(MWh / Yr)	(MWh / Yr)
R2 Terminals Only	27,300	72,200	55,800
R2 Terminals + Airside Buildings	37,200	74,800	58,400
R2 Terminals + Airside + Landside Buildings (not including APM)	142,800	97,800	75,600

Table 10: Estimated R2 Annual Energy Consumption (2050)

4.4.2 Maximum Demand Estimates

Table 11 below sets out the estimated maximum energy demand for R2.

Energy type	Maximum Demand (MW)	
	2030	2050
Electricity	11.8	21
Heat	8.6 Note 1	22.6 Note 1
Gas	9.5 Note 2	25.1 Note 2

Table 11: Estimated R2 Maximum Energy Demands

Notes

1. *The maximum heat demand has been estimated from the average maximum heat demand from energy consumption profiles for a typical day for each month – see Section 4.4. A peaking factor of 1.42 has then been applied to account for the difference between the average daily demand and the absolute peak anticipated demand estimated for the peak heating month. This peaking factor has been calculated based on the difference between average daily consumption and maximum peak consumption as defined by the existing metered data for terminal R1.*

2. *Gas maximum demand incorporates 90% efficiency of heat production plant.*

The flow diagrams (Figure 1 & Figure 2) below set out in more detail the approach for developing the baseline electrical and thermal energy consumption and peak demand and extrapolating this to 2030 and 2050 based on the development of R2.

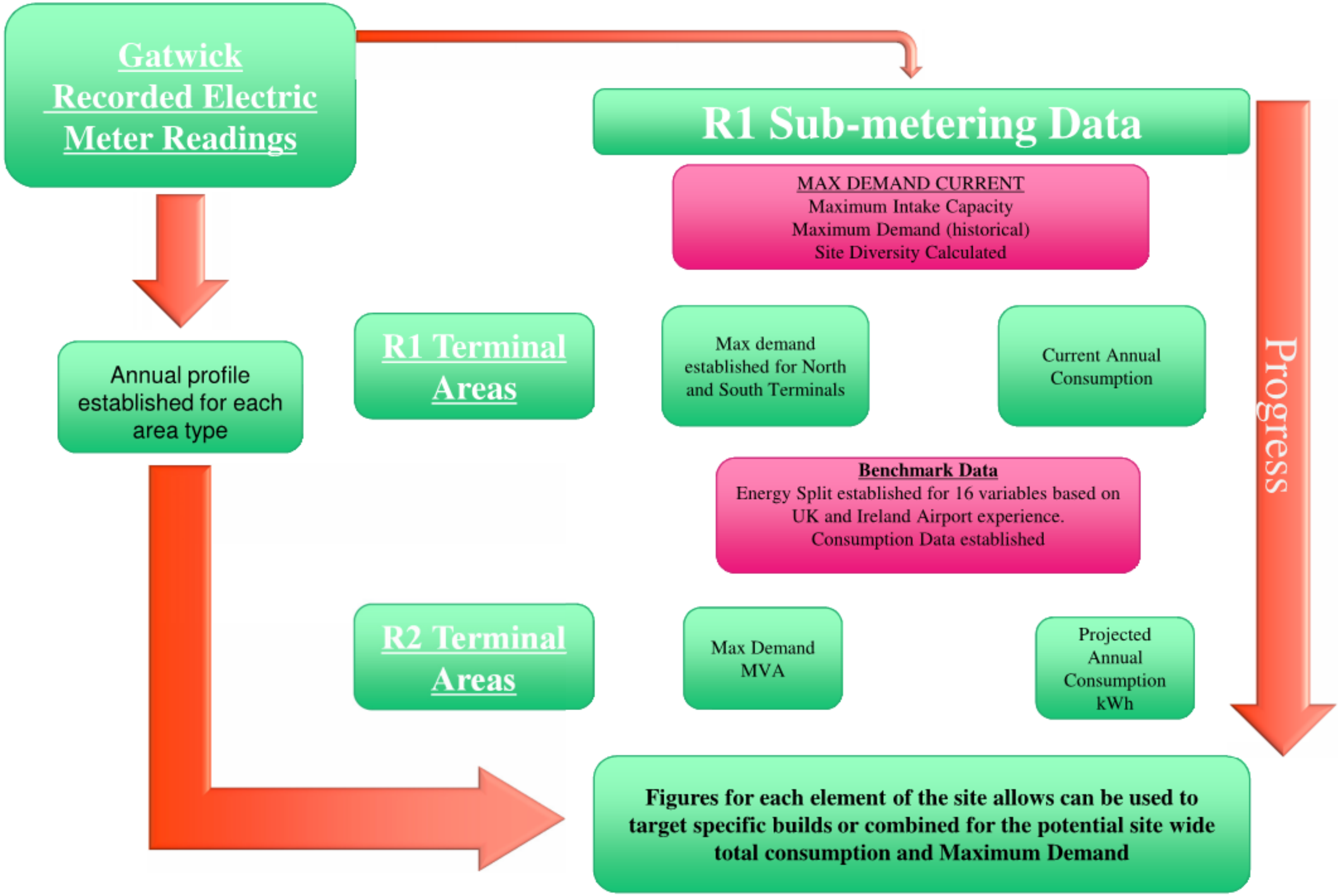


Figure 1: Electrical Energy – Baseline & Estimated Future Consumption & Max Demand Methodology

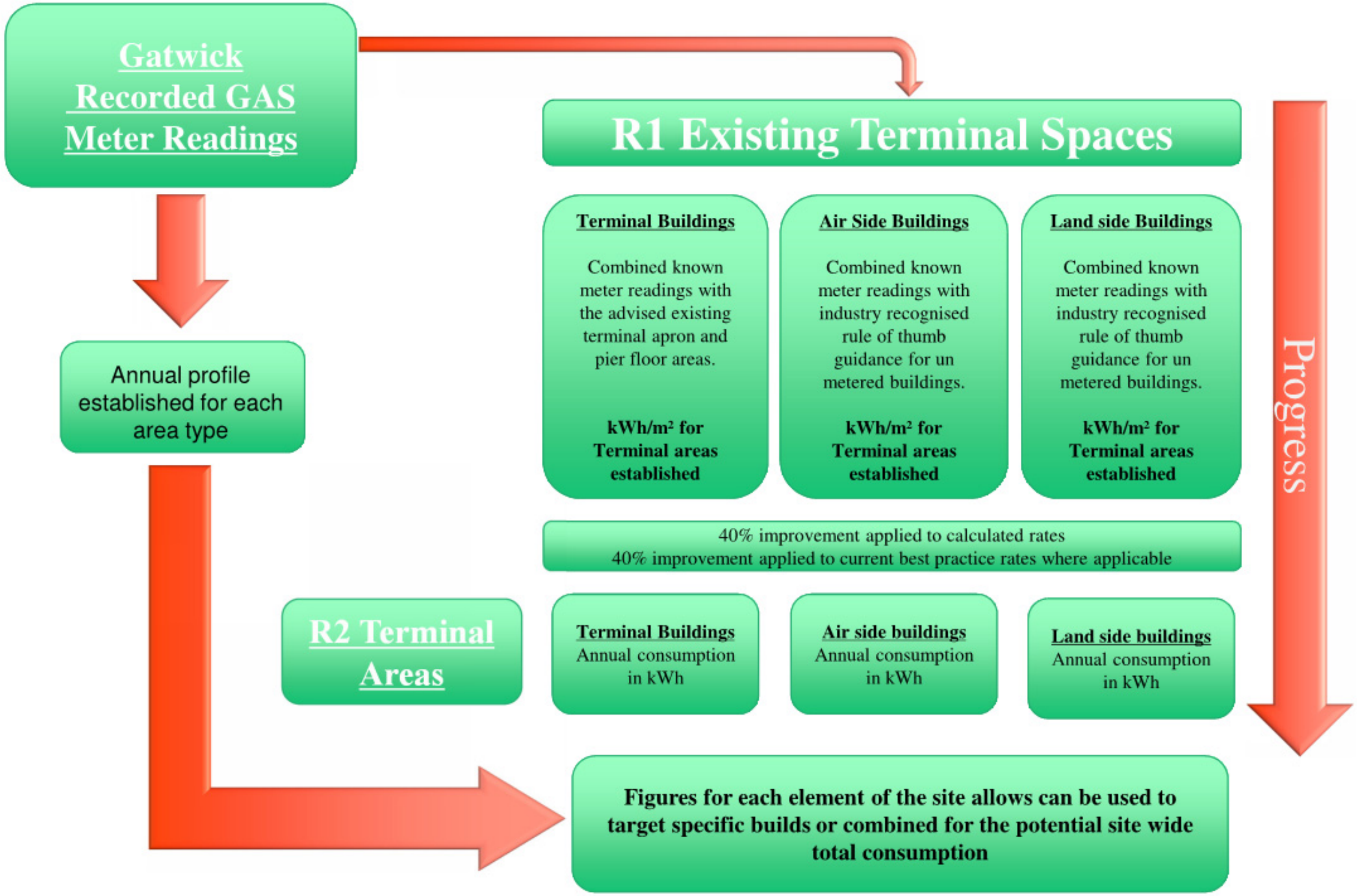


Figure 2: Thermal Energy – Baseline & Estimated Future Consumption & Max Demand Methodology

5 Energy Strategy for 2030

5.1 Overview

It is an intriguing prospect to look forward as far as 2050 with any certainty in terms of the energy technologies that will be in use at that time. It is similarly true for the carbon intensity of the national electricity and gas grids, energy prices and carbon legislation at that time. Although the Carbon Plan (see Appendix A) suggests that during the fourth Carbon Budget period (up to 2027) emissions from electricity generation could be between 75% and 84% lower than 2009 levels, current in-use predictions of electricity grid carbon intensity extend only to 2030 and the grid is not expected to be totally decarbonised by 2050 (see discussion in Section 2).

So, rather than developing a completely theoretical energy strategy for R2 at 2050, the approach has been to develop a future flexible and robust energy strategy for R2 at 2030 based on the energy hierarchy, and to describe a range of energy technologies that might be employed over time beyond this as R2 develops to 2050.

On this basis, two scenarios have been developed for the energy strategy in 2030:

1. **'Mitigation'**

   A 'do minimum' mitigation scenario, based on an assumption that the Building Regulations requirement for zero carbon **regulated** energy from 2019 is still in place for 2030 for R2, the terminal and airside buildings; and

2. **'Exemplar'**

   An exemplar scenario, which aims to provide zero carbon energy to meet the r**egulated AND unregulated** energy requirements of R2, the terminal and airside buildings.

5.1.1 Energy strategy boundary

Energy uses included for the basis of the mitigation strategy are summarised in Table 12 below.

Category	Included areas/systems	Mitigation Strategy	
		Sizing of energy generation plant	Sizing of energy centre
Terminals	Terminals, aprons, piers, stands, baggage, people movement, aircraft ground power units, pre-conditioned air units	Yes	Yes
Airside	Runway lighting, apron lighting, control tower, navigation aids, signage, airside (electric) vehicles, water/sewage infrastructure	Yes	Yes
	Hangars, cargo, industrial supply, fuel infrastructure, parking & maintenance	Yes	Yes
Landside	Multi-storey car parking (long & short stay) - lighting & electric vehicle charging	No	No
	Tracked Transit System	No	No
	Hotels, offices	No	No

Table 12: Energy Use Areas Included for R2 Energy Strategy

5.2 Scenario Descriptions

5.2.1 Mitigation -2030

The strategy for the mitigation scenario is based on the expectation that the Building Regulations will require all **regulated** energy for the R2 terminal and airside facilities to be zero carbon.

This scenario represents a very significant step change in comparison with current energy and carbon requirements for buildings[5] and in itself presents a significant challenge, particularly for the generation of renewable electricity on site. It will lead to a situation where the airport offsets the carbon emissions associated with its regulated carbon emissions over the year. The airport will still be reliant on connections to the electricity and gas grids to enable this.

[5] See section 2 for Building Regulation Part L requirements now and future

Gatwick's energy strategy for 2030 is based on the recognised energy hierarchy of:

1. **Energy efficiency** - the design, construction and operation of the new terminal and other buildings at the airport will incorporate passive design measures and approaches to reduce the peak demand and the annual consumption of energy, such as:
    - Super insulation and high performance windows to reduce heat loss and unwanted heat gain.
    - Solar shading and natural ventilation and cooling where internal spaces and external conditions allow, to reduce mechanical cooling and the risk of overheating.
    - High levels of air tightness and low levels of air leakage, to reduce unnecessary heat loss
    - Good levels of daylight to reduce the need for electric lighting
    - High efficacy lighting throughout, with daylight control and absence detection
    - Integrated smart controls, energy management and metering systems
2. **Efficiency of energy supply** – through on-site generation and use of power and heat for R2, with low carbon heat exported to R1 and the use of smart technology in the electricity and heat networks to support demand management and the matching of supply to demand.
3. **Renewable energy** – generated via imported biomass (CHP), biogas from on-site waste, and photovoltaics integrated into the new terminal.

Gatwick will build on the energy hierarchy with a continuous process of rigorously testing the 'need to build' by driving up the efficient use of space in all new buildings, thereby inherently reducing the need for energy in construction and operation. Moreover, the airport's strong governance structures (see Section 2) have already demonstrated what can be achieved in terms of driving positive action around energy and carbon and the energy strategy moving forward will continue to build on the good work achieved thus far.

It is also important to the note the inherent resilience of the infrastructure and energy, which will respond to the local climate risks, primarily:

a. **Flooding** - through resilience of energy centre and fuel supply chain logistics
b. **Heat waves –** through passive design of R2 buildings to reduce overheating risk and requirement for cooling.

At this master planning stage, the strategy has made assumptions around energy efficiency to inform the energy consumption estimates, and has focussed on the efficiency of supply and renewables.

A number of different low and zero carbon energy generation technologies in different configurations have been assessed, using the assumed carbon factors in Appendix A. This assessment has been based on budget capital costs and the ability of the technology mix to meet the carbon requirements, whilst maintaining flexibility to change fuel types and generation plant over time to 2050 and beyond.

A key driver of the strategy is based on the fact that Gatwick seeks to generate as much of its energy requirements **on-site** and not to rely on carbon offsetting or ‘allowable solutions.’[6] Using the on-site approach extends to using other airport resources that could support the energy strategy, such as biogas produced from anaerobic digestion of waste from the airport waste processing centre and sludge from the wastewater treatment plant –see the high level schematic diagram in Figure 3 below for Gatwick’s proposed approach to integrated resource management across the site.

Based on the analysis, the technology mix set out in Table 13 provides a summary of the energy strategy for the **2030 mitigation scenario**:

Technology	Capacity
Biomass (woodchip) CHP	3 MWe
Photovoltaics	3 MW
Gas Boilers (on-site biogas & natural gas)	6 MW
New primary sub-station (CF)	11 MVA

Table 13: Mitigation Scenario Technology Configuration - 2030

5.2.2 Exemplar

The exemplar strategy will ensure that all **regulated AND unregulated** energy for the R2 terminal and airside facilities will be zero carbon at 2030. This is a highly ambitious approach and goes far beyond the currently anticipated requirements of the Building Regulations. It also provides a solid platform from which Gatwick can continue to develop its energy strategy beyond 2030.

Based on the same approach to energy efficiency and analysis of low and zero carbon technologies, the technology mix set out in Table 14 provides a summary of the 2030 exemplar scenario:

[6] Allowable solutions can be used where it is impossible to generate all the renewable energy required on site. Final details of Government’s allowable solutions are awaited, but are expected to include, for example, financial contributions to local infrastructure funds for low carbon projects.

Technology	Capacity
Biomass (woodchip) CHP	4.2 MWe
Photovoltaics	3 MW
Gas boilers (on-site biogas & natural gas)	6 MW
New primary sub-station (CF)	11 MVA

Table 14: Exemplar Scenario Technology Configuration -2030

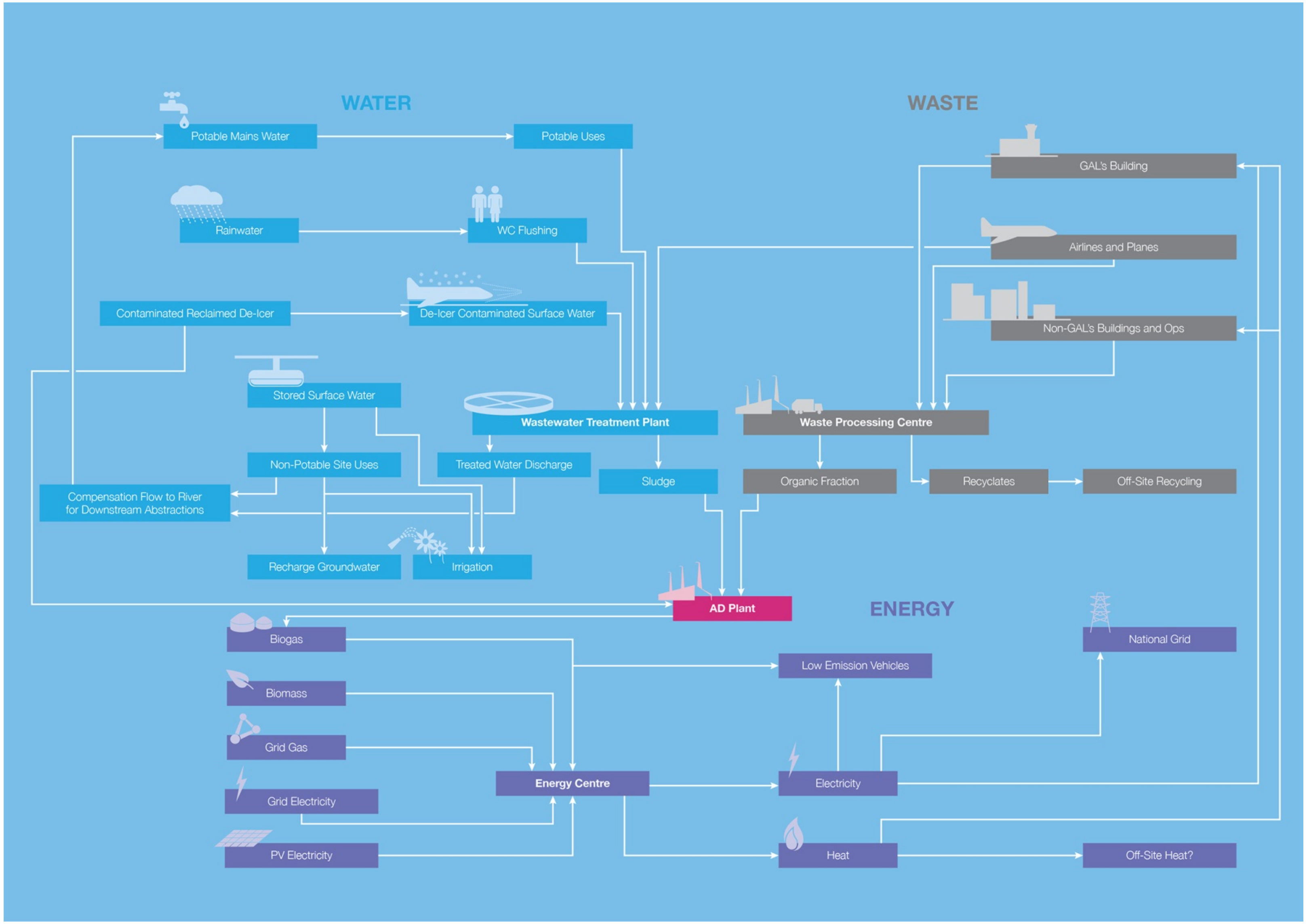


Figure 3: Sustainable resource management strategy for Gatwick

6 Energy Strategy – Requirements & Impacts

6.1 Energy Technology Options Appraisal Summary

A range of existing and robust, and emerging and 'expected to be robust' electricity and heat generation technologies have been reviewed and grouped in various configurations to test their potential to meet the zero carbon regulated energy requirement for the mitigation and exemplar scenarios. The technologies, together with simple pros and cons, are set out in Appendix D.

6.2 Technologies for the Energy Strategy

6.2.1 Mitigation scenario

Woodchip biomass CHP combined with PV is the most pragmatic means of delivering the mitigation and exemplar scenarios, based on the need to generate large quantities of electricity from renewable sources, the ability of the various technologies in combination to offset sufficient carbon emissions, and preliminary budget costs of plant.

For the mitigation scenario, zero carbon regulated energy is achieved by offsetting grid electricity, gas fuel and biomass related emissions through generating low carbon electricity and heat. Large quantities of heat are generated by the CHP and not all of this heat can be utilised by R2, so it is proposed that the excess heat is delivered to the terminals and other buildings in R1.

This heat could provide around a third of R1's annual heat requirement by extending the heat network to the existing terminals. It is important, however, not to double count the carbon benefit of this heat as this benefit is already taken by R2 in achieving the zero carbon requirement for regulated energy.

During the summer months there is little demand for heat other than that required for hot water and consequently there is likely to be little demand for the CHP to run between May and September. During this period, electricity and heat will be provided via the PV and grid electricity, with the small heat demand met by the gas boilers (potentially from biogas).

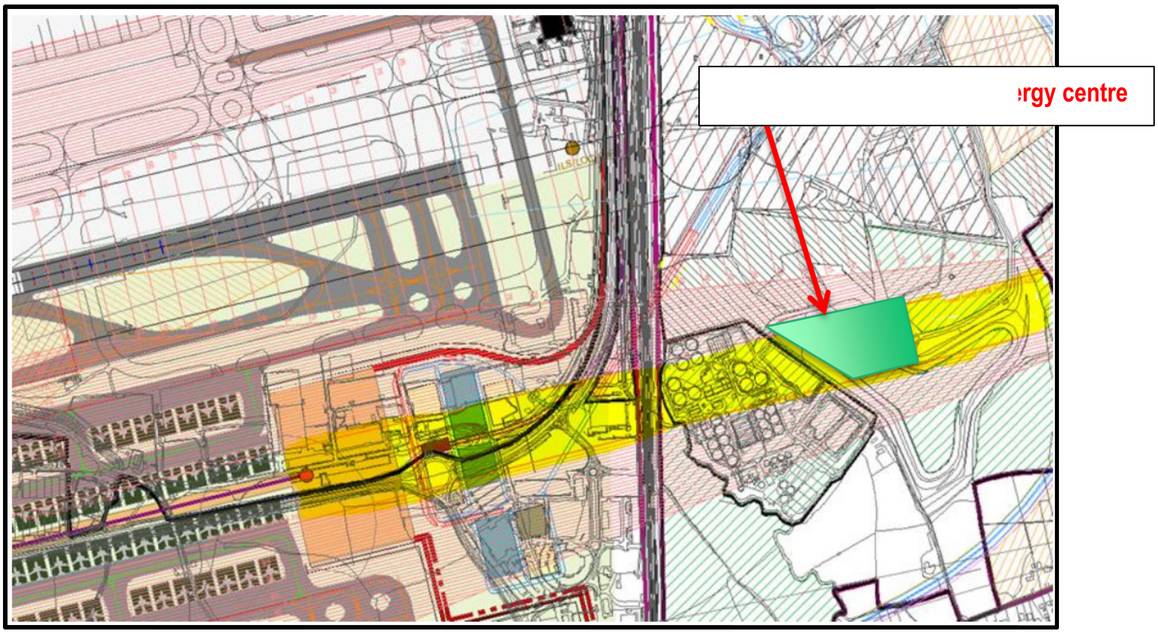
Biogas will be available from digesting waste and sewage sludge from airport (estimated to be sufficient to generate up to 1.5MWe by 2050), but it has a higher carbon intensity than biomass, leading to the conclusion that biogas should only be used to off-set natural gas fuel in the energy centre's boilers or for vehicle use.

6.2.2 Exemplar scenario

The strategy developed for the mitigation scenario ensures that for a modest increase in the biomass CHP capacity the new terminal and airside building energy demands can deliver the exemplar scenario and be made fully carbon neutral, with the added advantage that R1 receives low carbon heat.

6.2.3 Energy centre

The energy strategy requires a centralised energy centre with appropriate access for biomass fuel delivery vehicles. The intention is to co-locate the energy centre with the new primary sub-station (CF) and the anaerobic digestion plant for the airport's organic waste. A zone to the east of the railway line and adjacent to the existing wastewater treatment plant has been identified as the likely location, taking into account the airport's operational requirements – see Figure 4 (yellow area shows zone suitable for flue given airport's operational constraints).



The floor area of the energy centre will be approximately 2,500m². A vertical flue of approximate height of 25-35m will be required (subject to detailed modelling) to ensure dispersal of combustion gases and compliance with the Clean Air Act.

6.2.4 The future for biomass as a fuel in the UK

Developing a biomass based energy centre at Gatwick is a step forward from the current, more traditional methods of supplying energy to the airport and raises a number of important issues. Securing long term supplies of fuel will be essential and it is useful to look forward to how the biomass supply chain is expected to develop in the UK and the Southeast in particular, to give a sound basis to Gatwick's proposed energy strategy.

Bioenergy is an important contributor to meeting the EU target of 20% renewable energy by 2020[7] and the Department for Energy and Climate Change (DECC) outlines the importance of biomass in contributing to UK government carbon emission objectives to 2050 and beyond in its UK Bioenergy Strategy[8].

[7] DEFRA (May 2007), UK Biomass Strategy
[8] DECC (2012), UK Bioenergy Strategy

There are, however, a number of market constraints acting as barriers to the widespread implementation of biomass in the UK, including uncertainty over sustainability standards, the production capacity of the UK, yields and public acceptance[9].

It is estimated that in order to meet the UK's 2050 targets, bioenergy will need to account for around 10% of total UK primary energy. It currently accounts for only 2%[10]. 10% is thought to be a reasonable objective for 2050 based on scenarios considering land use, required food production and the implementation of carbon capture and storage (CCS) as a 'feasible technology'[11].

The Committee on Climate Change (CCC) state it would be "unsafe at present to assume any higher levels of bioenergy supply, and even the 10% level might require some trade-offs versus other desirable environmental and social objectives"[12]. If in the coming years it becomes evident that the 10% bioenergy target is unrealistic, other bioenergy technologies such as algae and changes in consumer behaviour will be critical to meeting 2050 targets.

Currently, the majority of biomass used in the UK is imported and this is a trend that is thought likely to continue to 2020 and beyond[13]. Current estimates from DECC assume domestic feedstock currently equates to in excess of 75TWh of bioenergy with the potential to increase to 90TWh by 2020 (an increase of 20%) and 110TWh by 2030 (a low estimate)[14]. Higher biomass prices and the removal of market barriers could further increase UK biomass production. Agricultural residues and perennial energy crops are expected to present the greatest growth in biomass supply in the UK[15].

6.2.5 The future for biomass in the South East

The South East is England's most wooded region. Many woodland areas are currently under-managed but offer high potential for sustainable management and use as biomass[16].

There is already an extensive number of biomass producers in the region[17] and the Forestry Commission continues to work to increase the use of wood fuel as an energy source in south east England[18], estimating the potential for around 500,000 tonnes of wood fuel per year from the South East alone.

The wood fuel capacity in the region and the work being done to develop supply chains provides Gatwick with a good level of confidence that biomass can provide a significant part of its energy strategy in 2030 and beyond.

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9 DECC (September 2013), Use of UK Biomass for electricity and CHP, slide 2.
10 Committee on Climate Change (December 2011), Bioenergy Review, page 9
11 Committee on Climate Change (December 2011), Bioenergy Review, page 9
12 Committee on Climate Change (December 2011), Bioenergy Review, page 9
13 DECC (2012), UK Bioenergy Strategy
14 DECC (2012), UK Bioenergy Strategy, page 27
15 DECC (2012), UK Bioenergy Strategy, page 28
16 Forestry Commission England (2014) - http://www.forestry.gov.uk/forestry/infd-7d6fn7
17 Woodheat Solutions SE England - https://maps.google.co.uk/maps/ms?ie=UTF8&hl=en&msa=0&msid=112016510990366938432.00046cb26b5d97d10dd3b&z=8
18 Forestry Commission England (2014) - http://www.forestry.gov.uk/forestry/infd-7d6fn7

6.2.6 Fuel deliveries

In addition to sourcing long term secure supplies of fuel, one of the other challenges for large biomass energy centres is the logistics of fuel delivery and handling. Table 15 below gives a high level summary of the likely fuel requirements associated with a 3MW biomass (woodchip) CHP operating at full capacity.

This demonstrates the need for the energy centre to be located with good access for fuel deliveries, and whilst this is currently based on road, options for rail deliveries into the rail head to the south of R2 will be explored.

Capacity	Metric
3,500	kWh/Tonne
30	m^3 (truck volume)
0.2	T/m^3 (biomass density)
3,000	kWe capacity of wood chip gasification CHP
504,000	kWh/week for CHP @ 100% Operation
144	Estimated peak Tonnes/Week
24	Deliveries/Week

Table 15: Biomass fuel delivery data

6.2.7 Photovoltaics

The modular nature of PV systems allows for large arrays to be built up and designed to be installed in a range of locations ranging from building facades and roof spaces to standalone field arrays.

Approximately 3,000m^2 of PV could be installed on the roofs of the R2 terminal buildings, whilst allowing for rainwater harvesting. This would constitute approximately 50% of the available roof area, allowing for mounting efficiency, access and maintenance.

As the design of R2 and the buildings develops, so careful assessment will be needed of the potential for the array(s) in terms of issues for the air paths and other buildings at the airport. Particular aspects to be considered will include:

- Relative location of the installation to any sensitive observer, such as aircraft pilots, surrounding buildings and control towers.
- Geometry of the installation and location of predicted sunlight reflections. A series of animations and diagrams demonstrating the extent and the directionality of reflected sunlight by the proposed PV systems will demonstrate the presence of the reflections across sensitive areas (for example whether the reflected sunlight intersects with the fly paths)
- The effects of reflected sunlight will be considered with a 'disability glare metric', for example by predicting the threshold increment for observers at selected scenarios. This analysis will be carried out considering the location of the sensitive observer relative to the PV panels for a significant selection of time steps (across seasons and times of the day).

6.3 Utility Networks

The development of R2 will require additional supplies of electricity and gas to the airport. Discussions have been held with the gas and electricity district network operators and the current status is summarised below.

6.3.1 UK National Power Network Services

Discussions with UKPNS have been positive and no major constraints to Gatwick's plans have been identified.

UKPNS have confirmed that in principle the airport's loads could be serviced from the existing 33kV feeds to sub-stations AF and BF.

A new primary sub-station (CF) will be required. UKPNS have advised that this could be connected to the existing 33kV feeders that supply sub-station BF, with this connection made as part of the diversion works that will be required when the second runway is constructed.

Diagrammatic plans for the phasing of the engineering works to provide electricity in the transition phase and the 2030 to 2050 scenarios are included in Appendix E.

6.3.2 Scotia Gas Network

As with UKPNS, discussions with Scotia Gas Networks have been positive and no major constraints to Gatwick's plans have been identified.

6.3.3 Resilience of Energy Supply

The resilience of the incoming 33kV feeds to the existing sub-stations AF and BF and the new sub-station CF will remain the same, if CF is fed from the current feeder to BF.

The 11kV linkages between the existing sub-stations will be improved and extended to the third sub-station, with the potential to improve the overall electrical resilience of the airport's operations.

Work is progressing with UKPNS to understand the opportunity for an independent 33 kV supply to sub-station CF, which would further improve the resilience of the electricity supply to the airport. This investigation will also improve the understanding of the resilience of the offsite grid from 33kV up to 132kV.

6.4 Next steps

This report sets out the preliminary work completed to develop a robust and flexible energy strategy to support the master plan for R2 at this early stage. Budget costs for the energy strategy have been developed and are included in the overall business case.

As the master plan proposals develop and become more detailed, so the energy strategy will also continue to be tested to ensure it is appropriate, is the best it can be and will deliver Gatwick's required outcomes for a resilient supply of low and zero carbon energy to the airport.

As details of buildings become available then detailed technical and commercial feasibility will be completed, leading to a full business case and procurement strategy for the new energy infrastructure, identifying the approach to funding, ownership, design, construction, operation and delivery. This work will also include consultation across the airport and with Gatwick's neighbours, to explore opportunities to export low carbon energy offsite.

The energy infrastructure will then be procured, designed, constructed, commissioned and operated, with Gatwick monitoring performance and seeking to maintain the technical and contractual flexibility to respond to further growth and change over time.

7 Energy Strategy Pathway from 2030 to 2050

By 2020, Gatwick will have reduced its energy use across R1 by 20% and CO_2 emissions by 50% (Scope 1 & 2) from 1990 levels through its Decade of Change programme.

As R2 is developed for 2030, Gatwick's energy strategy will ensure that the new terminal and airside buildings will meet the expected building regulation's minimum requirements for zero carbon for 'regulated' energy and potentially will exceed them, by ensuring **all** energy use in the new R2 terminal and airside buildings will be zero carbon.

This strategy brings additional benefits:

1. Improved 11kV linkages between the existing sub-stations and the new third sub-station, bringing the potential to improve the overall electrical resilience of the airport's operations.
2. Maintaining the current resilience of the incoming 33kV feeds to the existing sub-stations AF and BF and the new sub-station CF, if CF is fed from the current feeder to BF.
3. Potentially improving the overall level of resilience for the airport if the work with UKPN shows that an independent 33 kV supply can feed sub-station CF.
4. Increased resilience in terms of gas supplies, as the airport will generate biogas locally from digesting its waste and wastewater sludge for use in boilers and its vehicles potentially.
5. Low carbon heat provided to buildings in R1, which further improves R1's carbon performance.
6. Reduced gas use for R1.

As the airport develops beyond 2030, Gatwick will seek to build on the energy strategy and to extend the on-site generation of low or zero carbon energy beyond that required to make the R2 terminal and airside vehicles zero carbon. This will cover the energy requirements of the other buildings on the site, the APM's and the electric vehicle charging infrastructure for passenger vehicles. This will lead to a requirement for the generation of more zero carbon electricity than heat and, owing to the ways much of this electricity might be generated, a wider market for low carbon heat, including to customers off-site in local communities.

The energy centre will have the flexibility and space to expand over time and include new systems to generate these additional demands.

7.1 Changing Fuels & Technology

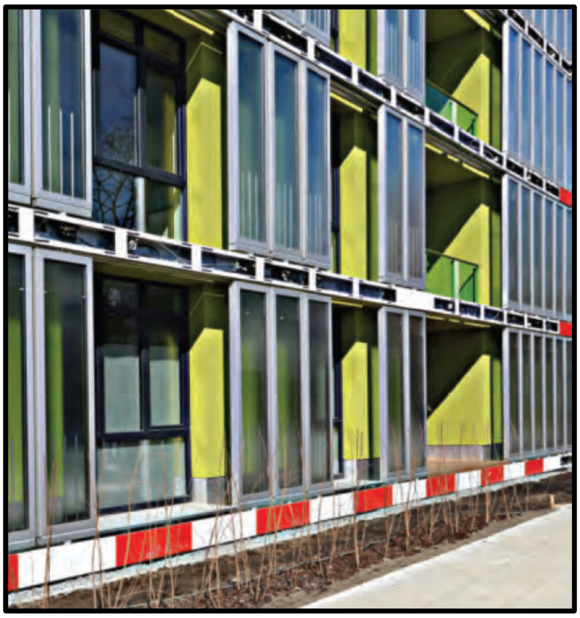
Political instability in oil producing countries and regions and the uncertainty about oil supplies and prices is likely to continue and is likely to underpin the shift towards alternative forms of fuel. New fuel technologies such as biofuels (including algae), hydrogen, new fossil fuels and processing methods are expected to drive advances in combustion engines and new methods of transportation (such as rail transportation of liquid hydrogen). Gatwick's energy centre and its location, with good road and rail links, will be well placed to respond to these changes.

7.1.1 Algae

The main applications for algae as a fuel are for power and heat generation. Research is on-going for both production and use, and prototype projects are emerging, but it is expected to be 10-15 years from now before algae as an energy resource begins to be utilised on a more widespread scale.

grated into

It is an approach that could provide Gatwick with a biomass based fuel in the future, from 2030 and beyond, with either production on site and/or as an imported fuel, as and when the current challenges are overcome. Micro-algae bioreactors were utilised in a project in 2013 in Hamburg and provide approximately one third of the total heat demand of the 15 residential units. Integrating this technology into Gatwick's new buildings really could lead to the development of a 'green airport', with biofuel grown in bio-reactors adjacent to the energy centre and harvested for use as a fuel in the energy centre.



açade

7.1.1 Anaerobic digestion

Although anaerobic digestion plants have traditionally been associated with smaller scale power generation, typically in conjunction with wastewater treatment works or private installations for villages and farms, applications are becoming more prevalent and larger in scale. This trend is expected to continue and by 2050 it might be expected that most if not all digestible waste in the UK is segregated and used in AD plants to produce biogas.

Figure 7: Large scale AD plant

Estimates of digestible waste available from across the airport in 2050, including from airlines and non-Gatwick buildings, suggest that it could produce biogas sufficient to support up to 1.5MWe of CHP. Depending on the carbon intensity of biogas in comparison with other renewable or biofuels (such as woodchip and algae) after 2030 then AD derived biogas could provide a significant element of the fuel mix for AIRPORT’s energy strategy.

7.1.2 Hydrogen fuel cells

Currently, hydrogen fuel cells show most promise in the transport sector, powering buses and cars, and their applicability to power generation for buildings is limited, as a function of cost and the general lack of hydrogen distribution infrastructure in the UK.

By 2030 and beyond, this may have changed, with hydrogen being shipped or piped more widely to support vehicle refuelling and other stationary power installations such as fuel cell CHP.

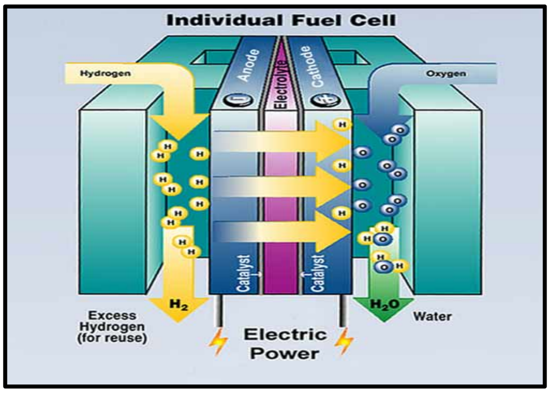


Figure 8: Hydrogen fuel cell schematic diagram

Large scale hydrogen fuel cell CHP systems could replace or sit alongside CHP engines fuelled by other renewable fuels such as woodchip and renewables in the Gatwick energy centre.

7.1.3 Piezoelectric technology

Piezoelectric devices require mechanical motion to generate power and surfaces need to allow flex to enable this mechanical movement. Applications to date have been limited to small-scale power supply, such as harvesting motion from chairs and floor movements to generate power for sensors. It has also been installed on a nightclub dance floor in London which powers the LEDs to make it light up.

Figure 9: Piezoelectric power lighting an LED dance floor

Research is on-going but could be applied in the next 5-10 years on a small scale. By 2050 it might be working in large scale commercial applications and given the floor area of the airport's buildings and the annual footfall, it might be applied to new buildings and perhaps the refurbishment of older buildings to provide local generation of power.

7.1.4 Nanotechnology

Nanocarbon materials and technology show great potential and there are various research and development programmes looking to apply them within the energy sector, all of which might feature in the airport's energy infrastructure from 2030 and beyond.

Graphene could improve the conductivity and efficiency of the airport's electrical transmission and distribution cables and is also expected to enable renewable energy sources such as solar PV to become more affordable and efficient. Combining thin-film solar technology with graphene could allow paper-thin see-through solar panels to be applied to windows, both in new buildings and in the retrofit of older airside and landside buildings. Another possible application is using thin-film solar as an externally applied insulation for buildings, improving energy efficiency and reducing energy use, again both in a new build and retrofit scenario.

7.2 Flexibility to Respond to Change Up To & Beyond 2050

The energy strategy proposed for 2030 provides a resilient and flexible base from which to respond to future change. If the national electricity grid does not fully decarbonise to the point that new buildings can simply 'plug-in' to a zero carbon energy source, then Gatwick's energy centre and smart networks for electricity and heat will provide flexibility to expand and if necessary change fuels and energy generation technology in response to:

1. Increases in energy demand
2. Changes in energy markets, costs and fuel availability
3. More onerous carbon legislative and tax regimes
4. Plant and systems coming to the end of their useful life

This will continue to develop Gatwick's resilience and robustness and reduce its reliance on external grid supplies, which themselves may be vulnerable to, for example, shocks imposed by extreme weather such as extremes of heat or floods.

Underpinning the energy strategy will be Gatwick's use of the energy hierarchy as it works to improve energy efficiency, generate and use energy efficiently, and generate renewable energy.

7.2.1 Energy efficiency

Demand side management of electricity and heat through Gatwick's smart energy networks and the application of new as yet untried approaches to energy efficiency will continue to be critical in terms of reducing energy consumption, matching supply to demand and optimising the use of the various energy systems at the airport.

7.2.2 Efficiency of supply & renewables

Gatwick will seek to develop its sustainable resources strategy to the point of it being a 'closed loop', ensuring that resources are kept as high in the waste hierarchy as possible, but using them for energy where there are no more sustainable alternatives. The energy centre provides an excellent resource for expansion in generation capacity and a greater production of biogas from waste from areas beyond the airport, as well as the export of surplus low carbon heat from energy generation, not only to landside buildings at the airport but also potentially to businesses and homes off-site.

This could be extended, with the testing of opportunities for Gatwick to be a net importer of digestible waste, for growing a portion of its own fuel in building integrated algae reactors or via woody biomass, for importing hydrogen for fuel cell CHP and for installing new solar PV technology on buildings and across the airfield.

8 Conclusions

This report provides an assessment of the airport's current energy use and a flexible energy strategy that responds to the sustainability objectives of Gatwick and the Commission for the development of the second runway at Gatwick. Moreover, the report responds directly to the Commission's requirements set out in its Appraisal Framework and the 'components of updated scheme design' under 'Energy and Utilities'.

The Commission requires current energy provision and the requirements of Gatwick's new proposals to be calculated. Any '***short-fall or design difficulties that a new development would generate for either the airport or other local residents, businesses or amenities***' should be identified. This report sets out Gatwick's work in response to this requirement. Energy and CO_2 emissions for the current airport's operations have been calculated, derived from Gatwick's electricity and gas meter data and the current grid carbon intensities, and the energy requirements of the R2 proposals estimated for 2030 and 2050.

The Commission then calls for ***'measures required to address any short-fall or difficulties, and associated costs'***, to be outlined. It notes that ***'this may include plans to build new provision, reinforce existing local and regional supplies or route/re-route existing services, and will need to address the environmental consequences'***. Finally, the Commission requires the identification of ***'fail-safe and emergency systems that currently exist or would need to be constructed in relation to energy and utility services, and associated costs.'*** Gatwick's energy strategy responds directly to these important issues.

Given the UK's targets for an 80% reduction in carbon emissions by 2050, an on-going process of change in energy technologies and fuels, the carbon intensity of the national electricity and gas grids, energy prices and carbon legislation can be expected.

Rather than developing a completely theoretical energy strategy for R2 at 2050, the approach has been to develop a flexible and robust energy strategy for R2 at 2030, and to describe a range of energy technologies that might thereafter be employed to provide low or zero carbon energy across the airport over time beyond this as R2 develops to 2050.

The energy strategy forms an important part of Gatwick's plans for sustainable resource management and its aims to close the resource loop as far as possible across the airport, by using resources that could support the energy strategy rather than transporting them off-site. This includes biogas produced from the anaerobic digestion of waste from buildings and planes taken from the airport waste processing centre and sludge from the wastewater treatment plant. Moreover, Gatwick seeks to generate as much of its energy requirements on-site and not to rely on carbon offsetting or off-site solutions.

On this basis, two scenarios have been developed for the energy strategy in 2030:

1. **‘Mitigation’ -** a ‘do minimum’ mitigation scenario, which will provide the R2 terminal and airside buildings with zero carbon ‘regulated’ energy.
2. **‘Exemplar’** - an exemplar scenario, which aims to provide zero carbon energy to meet the ‘regulated and unregulated’ energy requirements of R2, the terminal and airside buildings and vehicles.

At all times Gatwick will apply the energy hierarchy, seeking to reduce the use of all energy, before seeking to generate it as efficiently as possible and using renewable energy sources. Passive design and best practice energy efficiency measures will be employed in the design and construction of new buildings and facilities and this is represented in the energy demand estimates. This will be supplemented with smart grid technology in the power and heat networks to help with demand side management and matching energy supply to demand. Moreover, the energy strategy will be supported and delivered via all levels of Gatwick's governance structure, from the Main Board down through the various teams responsible for the airport's operations, energy systems and overarching sustainability performance.

The energy strategy for both scenarios is based on a combination of wood chip biomass CHP and boilers fed by natural gas and biogas (derived from the site) in an energy centre, supplemented by a large photovoltaic array and a new main primary sub-station.

The early feasibility work reported here will be developed in detail both technically and commercially leading to full business case, a procurement strategy and actual procurement of the new energy infrastructure, with the selection of final plant, full design, construction, commissioning and operation.

A new primary sub-station will be required. The energy strategy will maintain the already good level of resilience for the overall energy supply to the airport, allowing it to cope with the loss of a main electricity feed whilst still maintaining operations. Electrical network resilience could be improved with new 11kV connections between all three primary sub-stations. A separate feed to the new primary sub-station would further improve the airport’s resilience to off-site electricity grid failures.

The energy systems on site will be climate resilient and, moreover, the airport’s generation of a large part of its own energy reduces its reliance on the wider electricity grid and gas supplies, as the airport will generate biogas locally from digesting its waste and wastewater sludge. There will also be carbon benefits to existing buildings in the airport’s existing buildings beyond the improvements being delivered in the airport’s ‘Decade of Change’ programme, through the delivery of low carbon heat.

As the airport develops beyond 2030, Gatwick will seek to build on the energy strategy by extending the provision of low or zero carbon energy to R1, other new buildings across the site, the new APM’s and for the charging of passenger’s electric vehicles whilst in the car parks, as well as third party landside offices, hotels and retail units. There will also be the opportunity to export low carbon heat at equitable cost to local businesses and homes offsite, providing a large community benefit.

Gatwick is currently exploring a range of technologies to achieve this including amongst others an integrated approach to energy, waste and water management, which would support the objectives of minimising carbon emissions in airport operation and construction as well as securing a range of other sustainability objectives such as waste management, reduced transport and effective use of resources.

The energy centre and smart electricity and heat networks provide excellent resources for expansion in low and zero carbon energy generation and delivery, together with flexibility to deal with a range of emerging and innovative fuels, ranging from algae based biofuel in CHP engines to hydrogen for large stationary fuel cells.

Discussions have been held with the local electricity and gas network operators and this allows Gatwick to confidently conclude that there is no reason to expect that provision of energy supply and a third primary sub-station would be a problem for Gatwick.

Appendix A

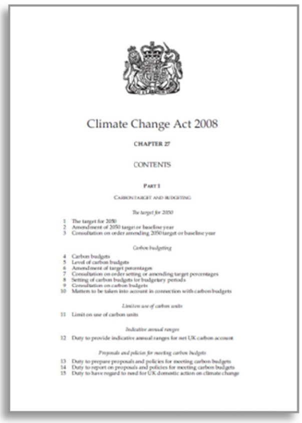
Brief review of energy & carbon policy and national carbon factors

A1 National energy policy

A1.1 Climate Change Act 2008

The Climate Change Act[19] has two key aims:

1. To improve **carbon management**, helping the transition towards a low-carbon economy in the UK; and
2. To demonstrate **UK leadership** internationally, signalling that the UK is committed to taking our share of responsibility for reducing global emissions


Climate Change Act 2008

CHAPTER 27

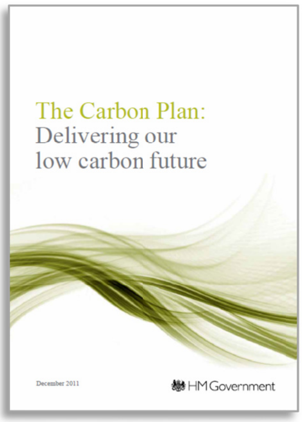
CONTENTS

Its most significant provision is a legally binding target of at least an **80% cut in greenhouse gas emissions by 2050 against a 1990 baseline**.

This is supported by a carbon budgeting system that caps emissions over five-year periods, with three budgets set at a time, to help the UK stay on track for its 2050 target, and, in terms of developing the UK's resilience to the impacts of climate change, an Adaptation Sub-Committee (ASC) of the Committee on Climate Change (CCC), providing advice to and scrutiny of the Government's adaptation work.

A1.2 The Carbon Plan 2011

Following on from the Climate Change Act, the UK Low Carbon Transition Plan was published in 2009, detailing national actions to be taken to cut carbon emissions.



This has been superseded by the Carbon Plan[20], which revises the plan for how the UK will achieve 'decarbonisation within the framework of our energy policy', so that the UK is less reliant on imported fossil fuels and less exposed to higher and more volatile energy prices in the future.

It notes that to 2030 and beyond, emissions from the hard-to-treat sectors (including aviation) will need to be tackled, requiring 'a range of solutions to be tested by at the latest, the 2020s, including: greater energy efficiency; switching from oil and gas to bioenergy or low carbon electricity; and carbon capture and storage for industrial processes.'

It also recognises the need for the UK potentially to double its electricity generation capacity to deal with peak demand, as a function of the electrification of heating, transport and industrial processes.

[19] http://www.legislation.gov.uk/ukpga/2008/27/contents

[20] https://www.gov.uk/government/publications/the-carbon-plan-reducing-greenhouse-gas-emissions--2

A1.3 UK carbon budgets

The Committee on Climate Change has set out the first three carbon budgets[21] running from 2008-12, 2013-17 and 2018-22 and has released advice on the fourth carbon budget 2023-2027.

Current progress towards the targets is shown in Figure 10 and the overall Carbon Budget trajectory is set out in Figure 11 below.

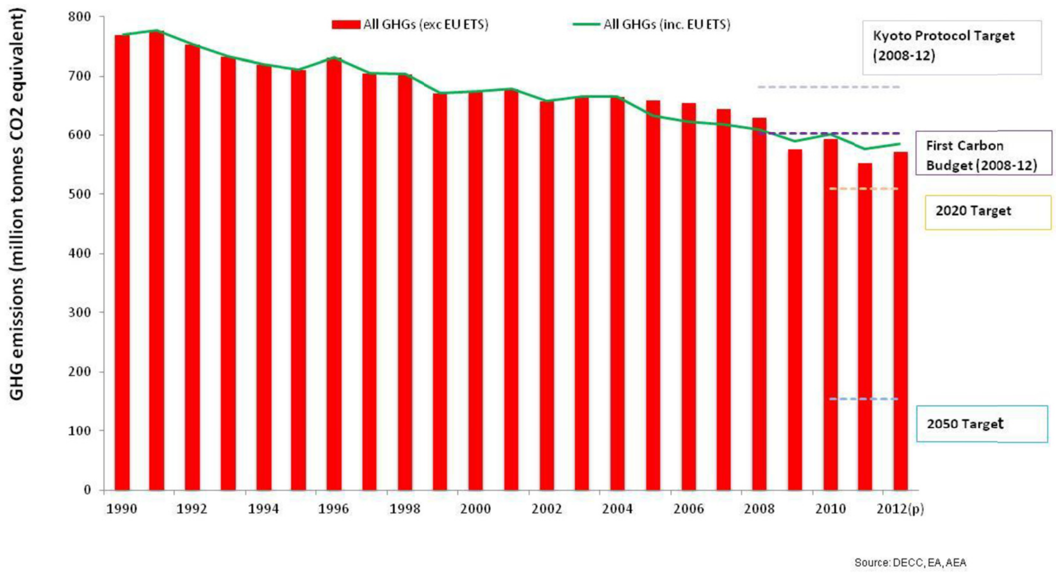


Figure 10: UK GHG Emissions: progress towards targets – from DECC[22]

Headlines on the expectations for carbon reductions for buildings are:

- Energy efficiency improvements through 2020's – insulation retrofit and heat pumps as grid reduces in carbon intensity
- District heating extended but technical and economic limitations recognised
- Cautious approach to biofuels – under review
- Emissions reduced significantly by 2030
- Beyond 2030 – similar approach, with more district heating where heat pumps not possible
- Feasible to almost fully decarbonise heat in buildings by 2050

Gatwick's energy strategy responds to these expected reductions, whilst maintaining flexibility for the period beyond 2030 to respond to emerging technologies.

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[21] https://www.gov.uk/government/policies/reducing-the-uk-s-greenhouse-gas-emissions-by-80-by-2050/supporting-pages/carbon-budgets
[22] https://www.gov.uk/government/publications/progress-towards-emissions-targets

A1.4 Energy Bill 2012-13

The Energy Bill 2012 -2013 aims to reduce the UK's dependence on fossil fuels, close a number of coal and nuclear power stations over the next two decades, and it sets out financial incentives to reduce energy demand.

The first targets for renewable energy, 5% of by the end of 2003 and 10% by 2010 'subject to the cost to consumers being acceptable' were set in 2000. Beyond this, Government targets are to produce 30% of electricity from renewable sources by 2020, 12% of its heat and 10% of fuels from renewables, to support the cut in greenhouse gas emissions by 50% on 1990 levels by 2025 and by 80% on 1990 levels by 2050.

A1.5 Aviation & climate change

In April 2013 the Aviation Commission produced a paper[23] that discusses the appraised of the impact of aviation on the UK's CO_2 emissions.

Aviation is estimated to account for 2-2.5% of total annual anthropogenic CO_2 emissions at the global level.

In the UK, aviation emissions account for about 6% of greenhouse gas (GHG) emissions or about 22% of the transport sector's GHG.

To ensure that the UK remains on an overall emissions trajectory consistent with the 80% target, both the CCC and the Government have taken the approach of assuming emissions pathways that include international aviation and shipping emissions. This is graphically summarised in Figure 11 below.

[23] Airports Commission: Discussion Paper 03 – Aviation and Climate Change (2013)

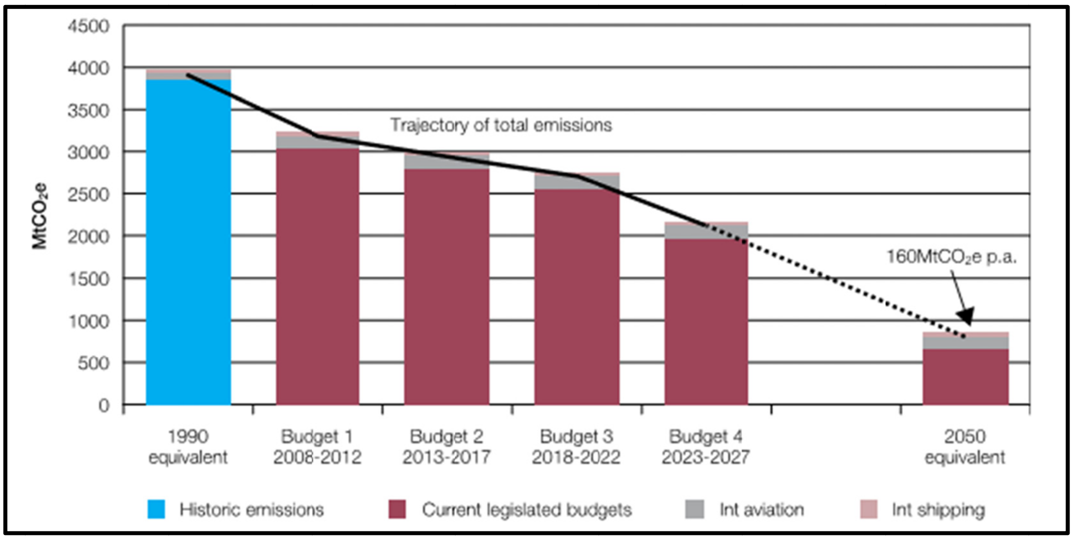


Figure 11: Carbon Budget Trajectory

A1.6 Building Regulations

A1.6.1 Part L

Building Regulations are statutory instruments that seek to ensure that the policies set out in the relevant legislation are carried out.

Part L of the Building Regulations covers the '**Conservation of Fuel & Power'** and the associated Approved Document sets out requirements for topics such as the insulation values of building envelope elements, the allowable area of windows, doors and other openings, air permeability of the structure, the heating efficiency of boilers and the insulation and controls for heating appliances and systems together with hot water storage and lighting efficiency.

In addition to insulation requirements and limitation of openings of the building fabric, this part considers solar heating and heat gains to structures, it controls heating, mechanical ventilation and air conditioning systems, lighting efficiency, space heating controls, air permeability, solar emission, the certification, testing and commissioning of heating and ventilation systems, and energy metering.

A1.6.2 Regulated & Unregulated Energy

It is important to be clear on the difference between 'regulated' and 'unregulated' energy as defined by the Building Regulations as there can be as a significant difference between the two (Figure 12) and current Government definitions of 'zero carbon' refer only to regulated energy use.

Regulated:

Regulated energy use includes that from all fixed building services to enable a building to be functional and comfortable for occupants and includes energy used for ventilation, heating, hot water, lighting and cooling.

Unregulated:

Unregulated energy use includes that from all ‘plug-in’, process and fit out loads. For the airport’s facilities a large component of the energy use is likely to fall within this category such as baggage handling, people movers and the Tracked Transit System, runway lighting and other airport operation systems.

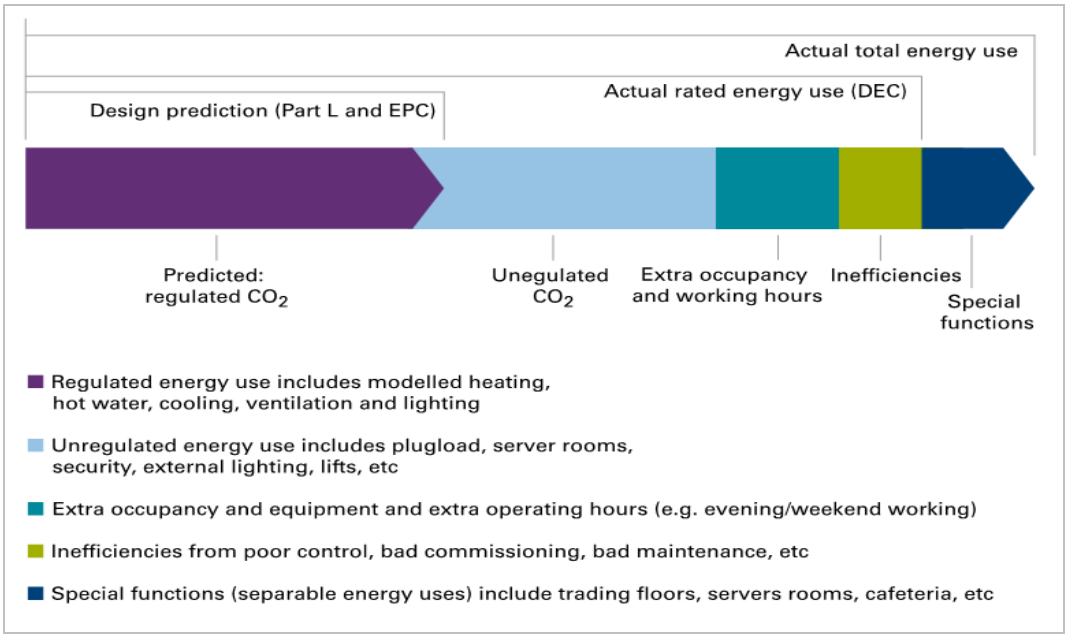


Figure 12: Actual Total Energy Use

A1.6.3 ‘Pathway’ to zero carbon buildings

Under the previous government the target set out ambitions for all new homes and schools to be zero carbon from 2016, other public sector buildings from 2018 and private sector buildings from 2019. Under the Coalition Government, however, the date has been adjusted so now the zero carbon standard will apply to all non-domestic buildings built from 2019. Moreover, an interim improvement in the Part L standards moving closer to the zero carbon standard was expected in 2013, but Government has postponed this to 2014.

The definition of zero carbon and how it can be achieved is also subject to change and debate. Currently a new building is recognised as zero carbon if the regulated energy component of its energy use results in no carbon emissions; the unregulated energy use is not considered. This is an important factor in the definition of a ‘do minimum’ or ‘**mitigation**’ option for R2, which might be expected to cover regulated energy only, and an ‘**exemplar**’ scenario, which delivers net zero carbon emissions for regulated and non-regulated energy use.

A2 Carbon intensity factors

Despite the accepted need to reduce the carbon intensity of the UK national grid (see below), predictions of the carbon intensity to 2050 do not exist yet and it has been necessary to make some assumptions to support the energy and carbon modelling work for the R2 development.

Using 15 year average projections up to 2025-2027 from the SAP (2012) methodology[24], a logarithmic curve has been fitted to the projections and extrapolated to give estimated carbon intensity factors for grid electricity out to 2050, see
Figure 13.

Gatwicks's carbon footprint and energy strategy work are aligned with these assumed factors.

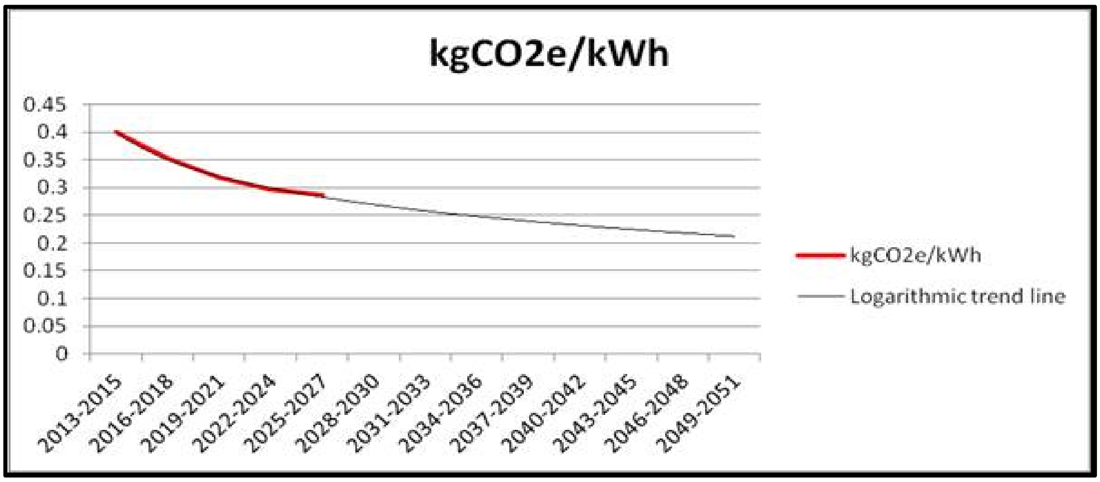


Figure 13: Estimated Electricity Grid Carbon Intensity Trajectory

A summary of the carbon intensity factors used within the energy strategy modelling are given in Table 16: Energy Strategy Carbon Intensity Factors below.

[24] Proposed Carbon Emissions Factors and Primary Energy Factors for SAP 2012 (2011)

	Carbon Intensity Factors ($KgCO_2/KWh$)		
Fuel	**2028**	**2040**	**2050**
Electricity	0.286	0.275	0.220
Gas	0.221	0.221	0.221
Biomass (woodchip)	0.016	0.016	0.016
Bioethanol (from biomass)	0.138	0.138	0.138
Biogas from site waste	0.098	0.098	0.098

Table 16: Energy Strategy Carbon Intensity Factors

A3 National grid decarbonisation

It is imperative for the national grid to carbonise to support the achievement of the Climate Change Act national target. In its White Paper 'Planning Our Electric Future'[25] Government notes that the decarbonisation of electricity generation will form a major part of the reduction in carbon emissions required under the Climate Change Act. Reducing the carbon intensity of the National Electricity Grid is essential before other sectors of the economy can be successfully decarbonised.

National Grid supports this, and produced a document in 2012[26] setting out potential strategies for decreasing the level of CO_2 emissions associated with heat generation. As part of this strategy the document states that central to this strategy is:

'Electrification of heat in buildings, facilitated primarily by heat pumps, is a critical component of decarbonising heat and meeting the 2050 target.'

In terms of how it might be done, the CCC produced a document[27] in May 2013 detailing the appraisal undertaken to understand the most cost effective and logistically viable method of electricity grid de-carbonisation. This document makes clear the case that:

[25] Planning Our Electric Future: A White Paper for Secure, Affordable and Low-Carbon Electricity (2011)
[26] Pathways for Decarbonising Heat (September 2012)
[27] Next Steps on Electricity Market Reform – Securing the Benefits of Low Carbon Investment (May 2013)

‘There is a clear benefit in committing to invest in low-carbon generation over the next two decades. This extension of the time frame beyond 2020 will encourage the necessary investment at a very limited additional cost to the consumer, adding £20 to the annual household energy bill in 2030 compared to 2020, while offering significant cost savings thereafter.’

‘Government should state clearly that it intends to support investments in low-carbon technologies through the 2020s. We think that the best way to do this is to set in legislation this Parliament a target to reduce 2030 carbon intensity to 50gCO_2/kWh. Industry has been clear that this would provide them with the confidence that they need to invest large amounts of money in project development and the supply chain.’

Appendix B

Electricity infrastructure

B1 Electrical infrastructure diagrams

Appendix C

Gas meter location plan

C1 Gas meters location plan

Appendix D

Review of low & zero carbon energy technology

D1 Low & zero carbon energy technologies

A range of existing and robust, and emerging and 'expected to be robust' low and zero carbon electricity and heat generation technologies have been reviewed and grouped in various configurations to test their potential to meet the zero carbon regulated and unregulated energy requirement for the mitigation and exemplar scenarios.

The groups of technologies reviewed at this preliminary stage are:

Option 1: Biomass boilers, PV, Gas boilers, Grid electricity connection

Option 2: Biogas CHP (biogas from EfW), PV, Gas boilers, Grid electricity connection

Option 3: Wood chip gasification CHP, PV, Gas boilers, Grid electricity connection

Option 4: Liquid biofuel CHP, PV, Gas boilers, Grid electricity connection

Option 5: Ground Source Heat Pumps, PV, Gas boilers, Grid electricity connection

Option 6: Fuel Cells, PV, Biomass boilers, Gas boilers, Grid electricity connection

Option 7: Fuel Cells, PV, Gas boilers, Grid electricity connection

The carbon emissions for each option were calculated based on the energy consumption estimates and then compared to the baseline emissions and requirement for zero-carbon regulated and un-regulated emissions. Budget costs for each option were also estimated.

The technologies, together with simple advantages and disadvantages, are set out in Table 17 below.

Technology	Gatwick Advantages	Gatwick Disadvantages
Biomass CHP	• Heat and power generation, widely proven large scale combustion based technologies (>5MWe) • Significant contribution to generation of zero carbon electricity & achievement of CO_2 reduction strategies	• Land area for energy centre • Flues required which will be 30-40m in height • Logistics & impacts associated with solid fuel deliveries • Significant heat output that needs to be used • Less proven gasification technology (but should be proven by 2030) • Fire risk

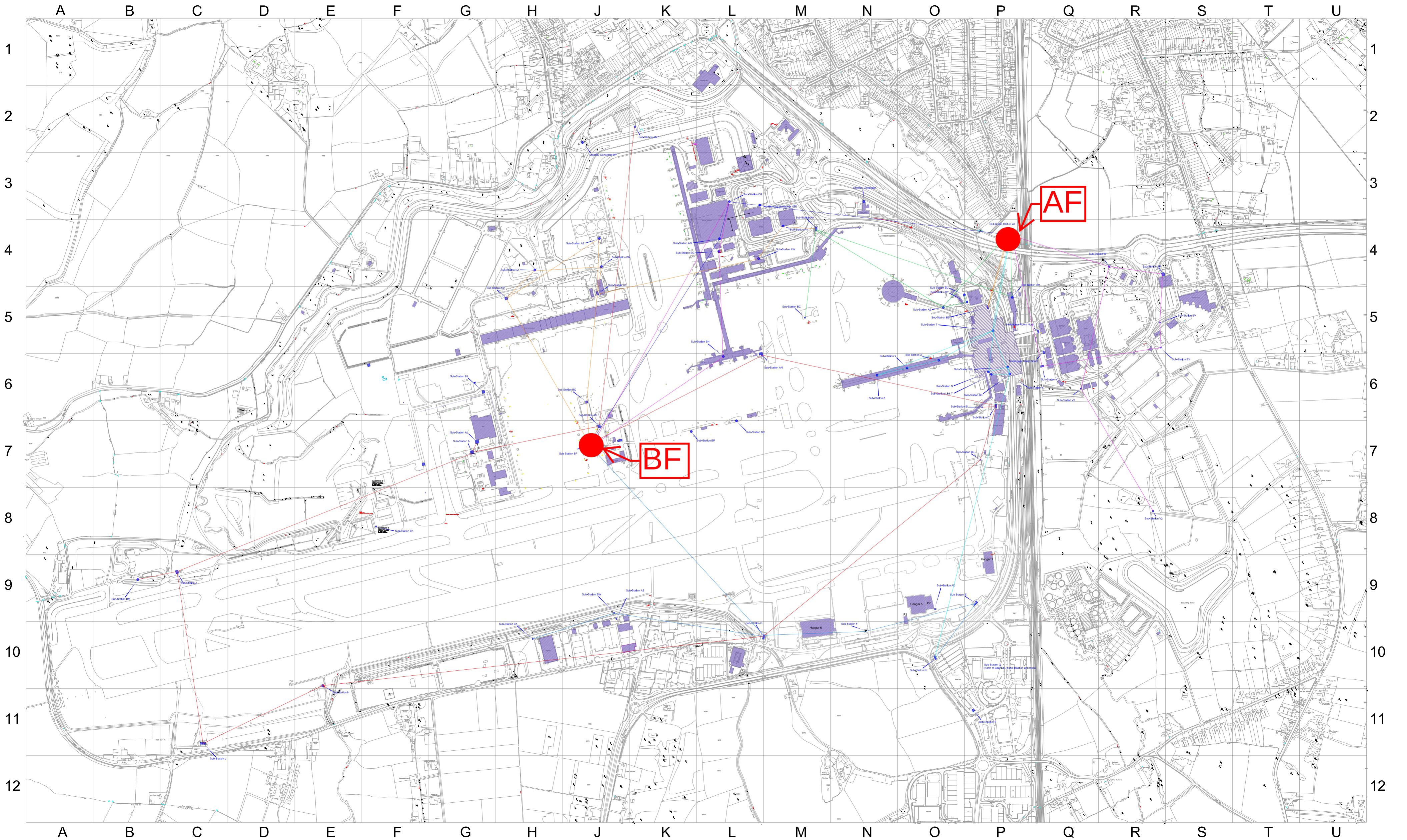
Technology	Gatwick Advantages	Gatwick Disadvantages
Liquid bio-fuel CHP	• Familiar tanking technology, proven technology, potentially aligned with renewable aviation fuel. • Significant contribution to generation of zero carbon electricity & achievement of CO_2 reduction strategies • More manageable to operate, supply and store than biomass.	• Carbon intensity factor not as good as wood biomass, therefore a larger capacity is required to get to the same point in carbon saving terms. This would mean fewer operating hours over the year and a less viable technical option. Source of biofuel is also less certain in terms of availability and sustainability.
Biogas CHP or boilers	• Quantities of biogas could be sourced from on-site, via digestion of waste from across the airport site & sludge from Thames Water • Contribution towards waste-reduction and landfill charges • Large contribution to generation of zero carbon electricity & achievement of CO_2 reduction strategies	• Carbon intensity greater than for biomass in CHP, so better to use on-site biogas in vehicles and/or to offset natural gas use in boilers
Biomass boilers	• Robust, proven technology,	• Would need large scale low or zero carbon electricity generation in addition, to get close to carbon targets
Wind energy	• Significant electricity generation without heat • True zero carbon energy	• Comprehensive feedback from Gatwick operations details risks associated with this technology on or near-site (<30km).
Building Integrated Photovoltaics	• True zero carbon energy and major contributor to achievement of CO_2 reduction strategies • Low maintenance	• Spatially constrained • Potential glare from arrays would need careful consideration
Electricity storage	• Provides storage of excess renewable electricity for use at times of need	• Emerging at scale technologies market

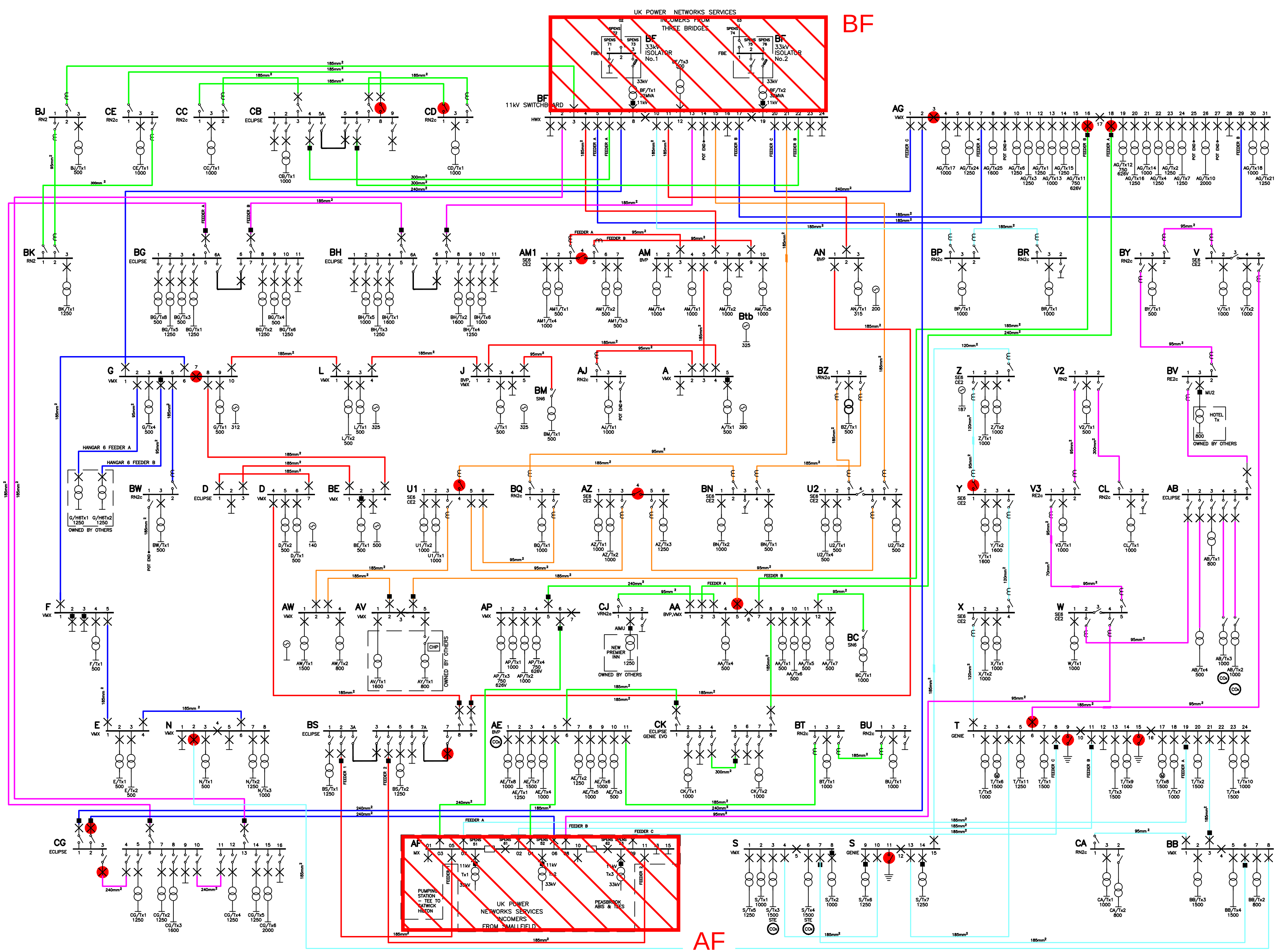
Technology	Gatwick Advantages	Gatwick Disadvantages
Electrolyser H_2 production and H_2 storage	• Provides storage of excess renewable electricity for use at times of need, facilitates use of fuel cells without the need for natural gas reforming	• Spatial constraint, explosive risk
Fuel cells	• Utilise stored renewable H_2 without need for reforming technology. • Low carbon contribution dependent on fuel source	• Still emerging technology in UK at scale in major CHP role. • Carbon intensity too high to make significant contribution
Thermal storage	• Heat store allows prolonged CHP electrical generation and therefore carbon reduction. • Store serves peak heating periods.	• Spatial constraint
Grid electricity	• Third main feed significantly improves airport resilience. • Minimal spatial needs	• Carbon intensity too high to meet carbon targets alone. • Reliance on grid decarbonisation
Ground, water or air source heat pumps	• Robust, proven technology	• Carbon intensity of electricity required means other biofuel based technologies are required to meet overall carbon targets, but then combination of heat pumps with other technologies that produce heat is difficult due to conflict of heating type and load take up.
Solar thermal	• Robust, proven technology • Low Maintenance	• Not necessary given the amount of heat available from the other energy generation technologies

Table 17: Technology Options and advantages and disadvantages

Appendix E

Diagrammatic plans of energy infrastructure phasing


A B C D E F G H J K L M N O P Q R S T U
1 2 3 4 5 6 7 8 9 10 11 12
AF
BF
Hangar 8



UK POWER NETWORKS SERVICES
INCOMERS FROM
THREE BRIDGES
BF
BF 33kV ISOLATOR No.1
BF 33kV ISOLATOR No.2
BF 11kV SWITCHBOARD
AF
UK POWER NETWORKS SERVICES INCOMERS FROM SMALLFIELD
PUMPING STATION - TEE TO GATWICK HILTON
PEASBROOK ABIS & TEES
BJ
CE
CC
CB
CD
AG
BK
BG
BH
AM1
AM
AN
BP
BR
BY
V
Btb
G
L
J
BM
AJ
A
BZ
Z
V2
BV
HANGAR 6 FEEDER A
HANGAR 6 FEEDER B
OWNED BY OTHERS
BW
D
BE
U1
BQ
AZ
BN
U2
Y
V3
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AB
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AW
AV
AP
CJ
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NEW PREMIER INN
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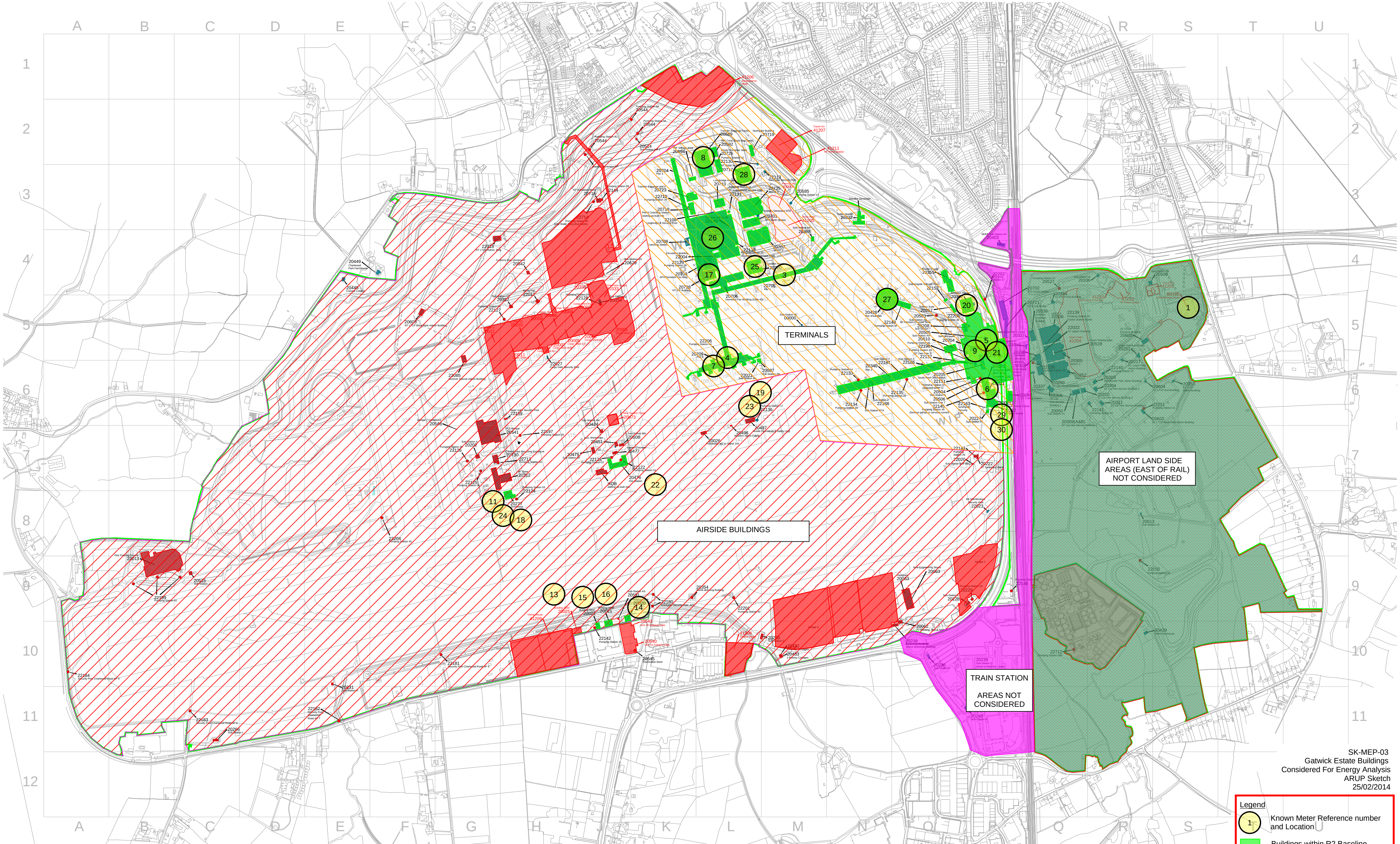


SK-MEP-03
Gatwick Estate Buildings
Considered For Energy Analysis
ARUP Sketch
25/02/2014

Legend

- 1 — Known Meter Reference number and Location
- Buildings within R2 Baseline
- Buildings without R2 Baseline
- Station Areas Not Considered
- Land Side Areas Not Considered
- Terminal Areas Grouping
- Air Side Building Grouping

20001 Cargo Shed A....J5
20002 Cargo Shed B1....J5
20003 Cargo Shed B2....J5
20004 Cargo Shed C1....J5
20005 Cargo Shed C2....H5/J5
20006 Cargo Shed D1....H5
20007 Cargo Shed D2A....H5
20008 Cargo Shed D2B....H5
20009 Cargo Shed E1....H5
20010 Cargo Shed E2....H5
20011 Cargo Shed G....H5
20012 Cargo Shed H....G5/H5
20020 Building 583A....J9
20021 Building 583B....J9/J10
20023 Building 583C....J10
20025 Building 583D....J10

20050 Sub-Station V1....Q6
20062 Marco Admin, P2 Building....Q10
20063 New Engineering Stores....O9
20202 Sub-Station A....G7
20204 Norfolk House....P5
20205 South Roof Office Block...P5
20206 South Terminal....P5/P6
20208 Sir Winston Churchill Suite....P5
20212 ST Boiler House...P6
20213 Services Control Centre....P6
20217 ST Coach Park Admin Bldg....R5/R6
20222 ST Sanitation Block....P7
20227 Sub-Station D....P6
20228 Sub-Station E....P9
20229 Pumping Station 24....P9
20230 Sub-Station G...L10/M10

20231 Sub-Station H....E10
20233 Sub-Station K....Q5
20236 Sub-Station N....O10
20238 Marco Workshop Building....O10
20239 Sub-Station Q....P10 (Undetermined)
20240 Sub-Station R....P11
20251 Virgin Check-In Facility....R5
20257 Sussex Suite....O5
20266 Sub-Station L....C11
20277 Snowbase....H8
20280 Engineering Stores....??
20290 ST Car Rental Building....Q6
20294 ST Chilling Station....P5
20298 Southern Entrance Bldg....Q6/Q6
20303 Taxi Feeder Park Admin Bldg....R6
20304 ST Car Hire Service Building 4....R6

20305 Multi Storey Car Park 2....Q5
20306 Multi Storey Car Park 3....Q5
20308 ST Car Hire Service Building 1....Q6
20309 ST Car Hire Service Building 2....R6
20310 ST Car Hire Service Building 3....R6
20311 ST Car Hire Service Building 5....R6
20312 MT Base....G7/H7
20313 Walkway MSCP1 - MSCP2....Q6
20317 Switchgear Room North....Q5
20318 Switchgear Room South....Q6
20320 Concorde 2000 North Wing....P6
20321 Concorde 2000 South Wing....P6
20322 Police Station....N3
20333 Timberham House....J4/J5
20334 Sub-Station U1....J5
20335 Stokers House....J5

20336 Sub-Station W....R4
20337 Sub-Station V....Q6
20338 Northern Entrance Building....Q5
20340 Pier 2....N6/O6
20344 ST STCP Accommodation....Q5
20352 Multi Storey Car Park 1....Q6
20353 ST LTCP Admin Building....S6
20354 Bomb Defusing Building....L9
20355 Atlantic House....O4
20362 Ashdown House....P5
20387 Sub-Station U2....H5
20388 Sub-Station AA....M4
20403 SEEB Sub-Station AF....P4
20424 Sub-Station AM....J7
20428 Pier 3/Satellite....N5/O5
20429 Rolls Farmhouse....R10

20432 No.1 Rowley Cottages....M10
20433 No.2 Rowley Cottages....M10
20448 Crangal Cottage....E4
20449 Charlwood Park Farmhouse....F4
20451 AGL Workshops....J7
20473 New Control Tower....J6
20475 Sub-Station BF....J7
20476 Fire Station....J7
20477 Smoke Chamber....J7
20496 Western Apron Toilets....L7
20497 Airside Ops & Safety Unit....L6
20503 Sub-Station AE....O5
20504 Sub-Station S....P6
20505 Sub-Station T....P5
20506 Sub-Station Link T....P6
20507 Sub-Station AN....L5/L6

20508 Sub-Station Btb....J7
20509 Sub-Station AB....R4
20511 Sub-Station (Police Station)....N3
20513 Sub-Station V2....R8
20514 Sub-Station AM1....K2
20515 Sub-Station J....C9
20527 Pumping Station 23....Q4
20528 ST Coach Park....Q5
20540 Unit 1A Gatwick Gate....J10/K10
20541 FLS Hangar 7 (MA2)....G7
20542 Customs Dog Compound....H4
20543 Unit 1D Gatwick Gate....J10/K10
20544 Pumping Station 9....J2/K2
20548 Hangar 7 Compound....G7
20585 Pumping Station 13....M3
20589 Transfer Baggage Facility....L2/L3

20591 Sub-Station AS....J10
20592 T.B.F. Coral (Early Bag Store).....L2/
20594 T.B.F. Stillage Area....L2/L3
20602 ST LTCP Block Park Admin Bldg....R6
20603 NT LTCP Block Park Admin Bldg....F5
20604 ST LTCP Exit Building....R6
20605 ST LTCP Entrance Building....S6
20610 Sub-Station AH....P5
20629 Sub-Station BN (was U3)....J4
20700 North Terminal....L3/L4
20701 TTS North Station....L3
20702 TTS South Station....P5
20703 APV/Domestic Pax Building....L4
20704 Pier 5....K3/K4/L4/L5
20705 Pier 4....L4/M4
20706 Domestic Pax Building (Gate 45)....L4

20707 Multi Storey Car Park 5....L4/M4
20709 Pier 6....L5/L6
20710 Longbridge House....L3
20716 NT Sanitation Block....J3
20717 NT Boiler House....L3
20718 NT Transfer Baggage Unit 1 ....K3/L3
20719 Northgate Building....L2
20720 Jubilee Hse/BA Crew Report Centre....L4
20721 ITTS Link Bridge....P5
20723 NT Transfer Baggage Unit 3....K3/L3
20726 Empty Container Store....L2
20728 NT CIP Building....L4
20730 Central Area Recycling Enclosure....G7
20735 MSCP 6....L3
22001 Sub-Station North Hazard....off drawing
22002 Sub-Station South Hazard....off drawing

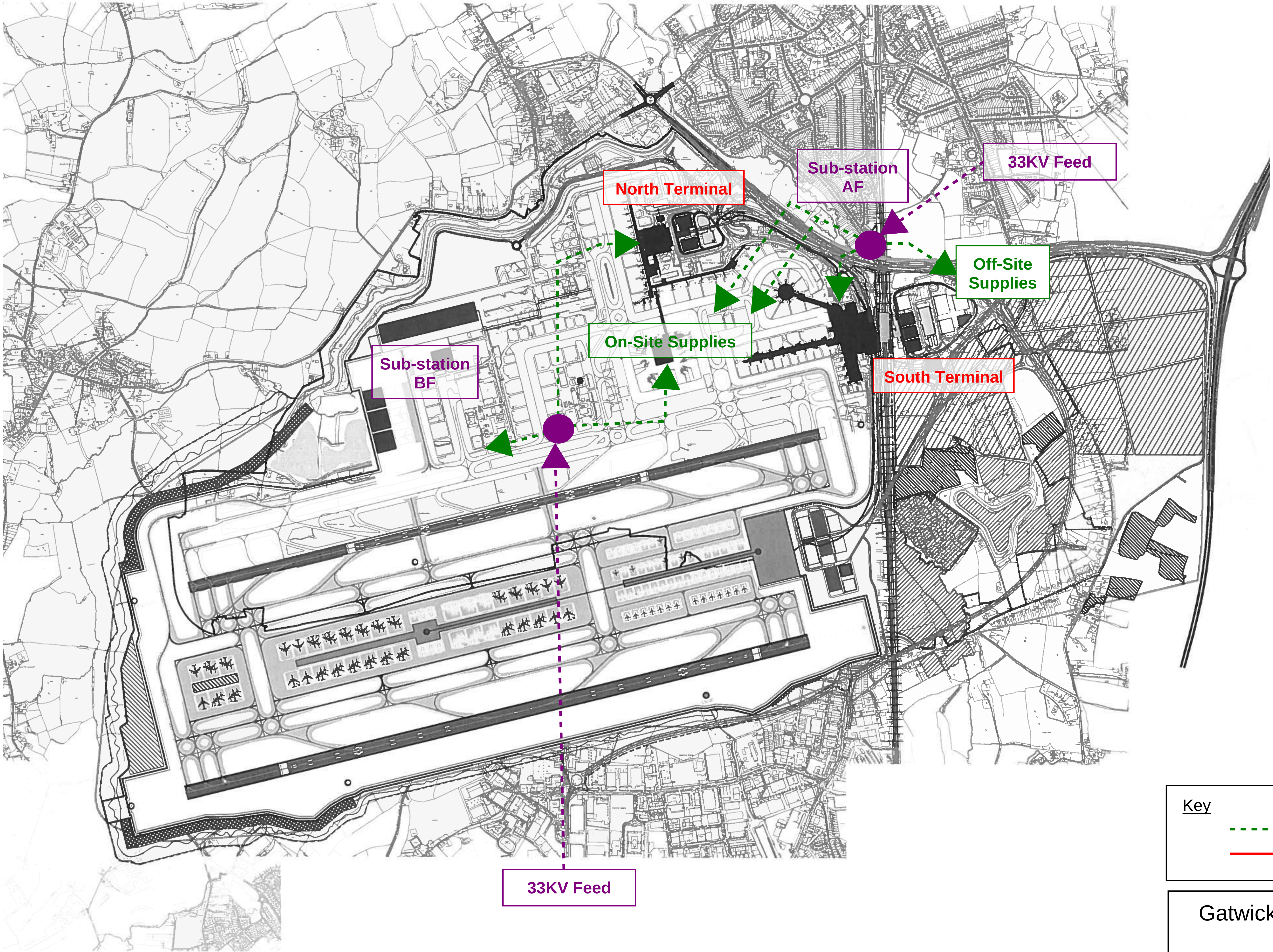
22004 Circulation Building....L4
22012 Flying Pan....H5
22018 NT LTCP Admin. Bldg....G4
22020 Sub-Station BTF (BE)....P7
22021 Sub-Station BTC....L5/L6
22022 ST Upper Forecourt....Q5
22023 BA Maint. Security Post....P8
22027 Cargo Gate Security Post....H5
22085 Summer Special Admin' Building....G5
22108 Longbridge B Security Post....L3
22113 Northgate Sec. Post (AP 1)....M3
22122 Pump Station 01....J7
22123 Pump Station 02....J7
22124 Pump Station 03....H8
22125 Pump Station 04....G7
22126 Pump Station 05....G7

22127 Pump Station 06....H5
22128 Pump Station 07....J5
22129 Pump Station 08....K4
22130 Pump Station 10....L2
22131 Pump Station 11....L3
22132 Pump Station 12....L4
22133 Pump Station 14....N6
22134 Pump Station 15....N6
22135 Pump Station 16....O6
22136 Pump Station 17....L6
22137 Pump Station 18....P6
22138 Pump Station 19....Q6
22139 Pump Station 20....Q5
22140 Pump Station 21....R6
22141 Pump Station 22....R6
22142 Pump Station 25....J10

22143 Pump Station 26....P7
22144 Pump Station 28....J3
22145 Pump Station 30....P6
22146 Pump Station 32....P9
22148 Pump Station 34....05
22149 Pump Station 35....L3
22150 Pump Station 36....S9
22151 Pump Station 37....P6
22152 Queensgate Sec. Post (AP 3)....O5
22163 Southgate Sec. Post (AP 4)....P6
22169 Tower Gate Sec. Post (AP 11)....H6
22180 Monksgate Sec. Post (AP 5)....K9
22181 Sec. Post Charlwood Rd (AP 6)....G10
22182 Sec. Post Charlwood Rd (AP 7)....E11
22183 Sec. Post Charlwood Rd (AP 8)....C11
22184 Sec. Post Charlwood Rd (AP 9)....A10

22186 Sub-Station X....O6
22187 Sub-Station Y....O6
22188 Sub-Station Z N6
22197 Pump Station 39....H7
22199 Pump Station 41....B9/C9
22201 Pump Station 42....L9
22202 Pump Station 27....P5
22204 Pump Station 45....F8
22205 Pump Station 38....P5
22206 Pump Station 44....L5
22710 Pump Station 29....K3
22711 Pump Station 31....R6
22712 Pump Station 36B....Q10
22713 Pump Station 43....G7
22714 Pump Station 46 (Grey Water)....J3

41201 First Point....R4/S4
41204 Hilton Hotel....Q5
41205 Arora Hotel....M3/M4
41206 Renaissance Hotel....L1
41207 Travel Inn....M2
41208 Tinsley House....L10
41209 Viking House....H10
41210 McDonalds Drive Thru....R4
41211 Petrol Station NT....M2/M3
41213 Petrol Station ST....R4
41216 New Hotel
B0195 Schlumberger House....S5

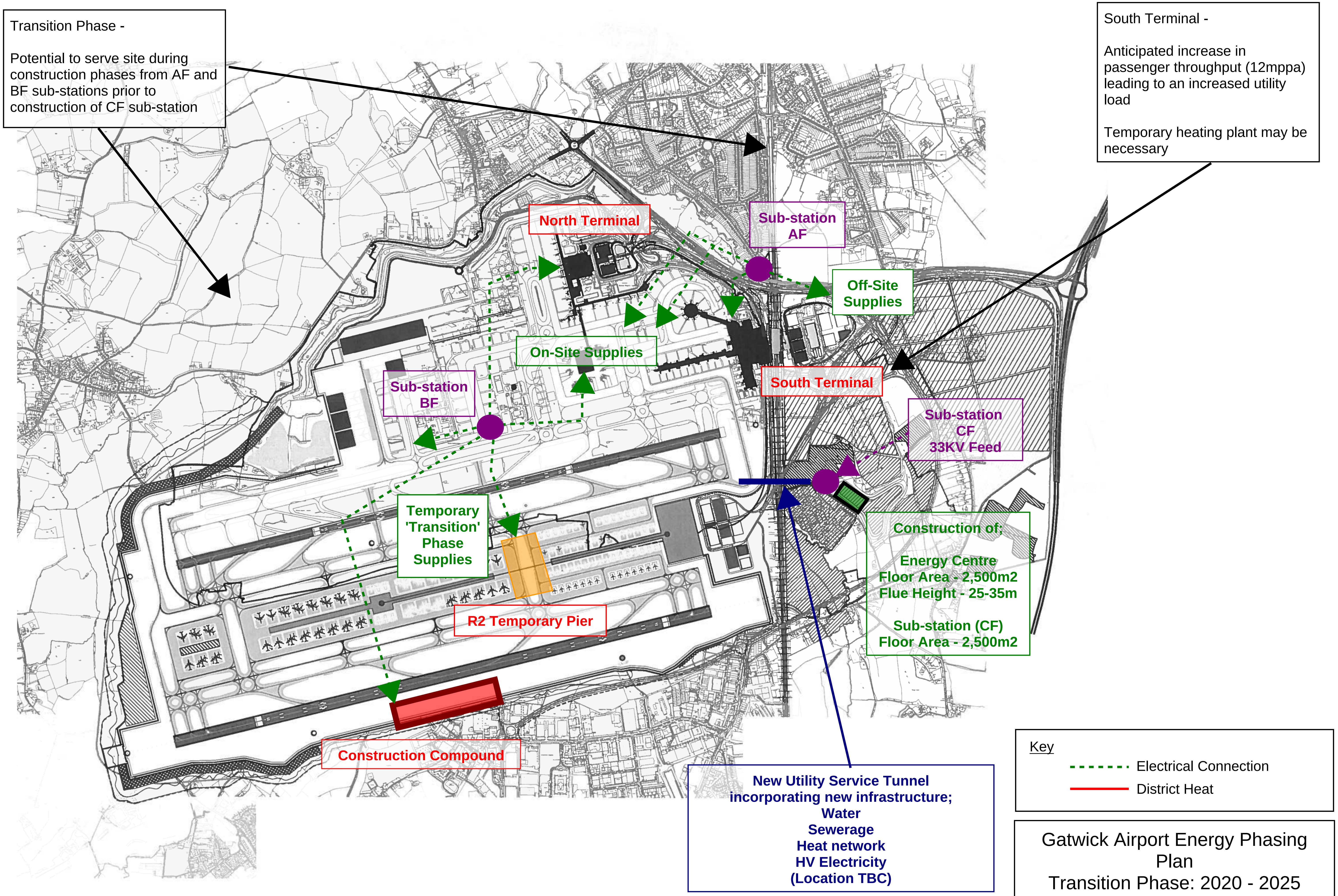


Key

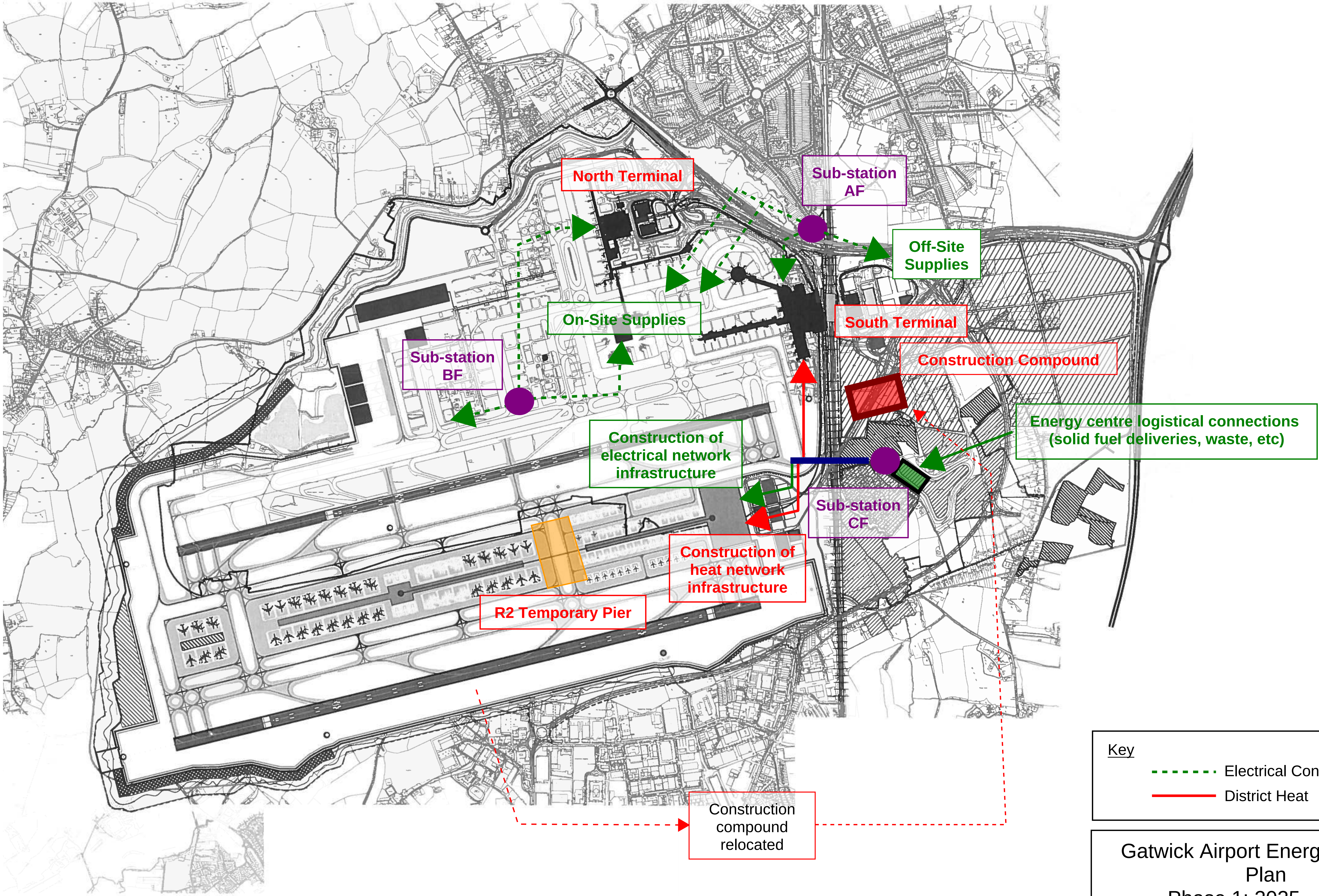
Electrical Connection

District Heat

Gatwick Airport Energy Phasing Plan
Current: 2014 - 2020
Sheet 1 of 5

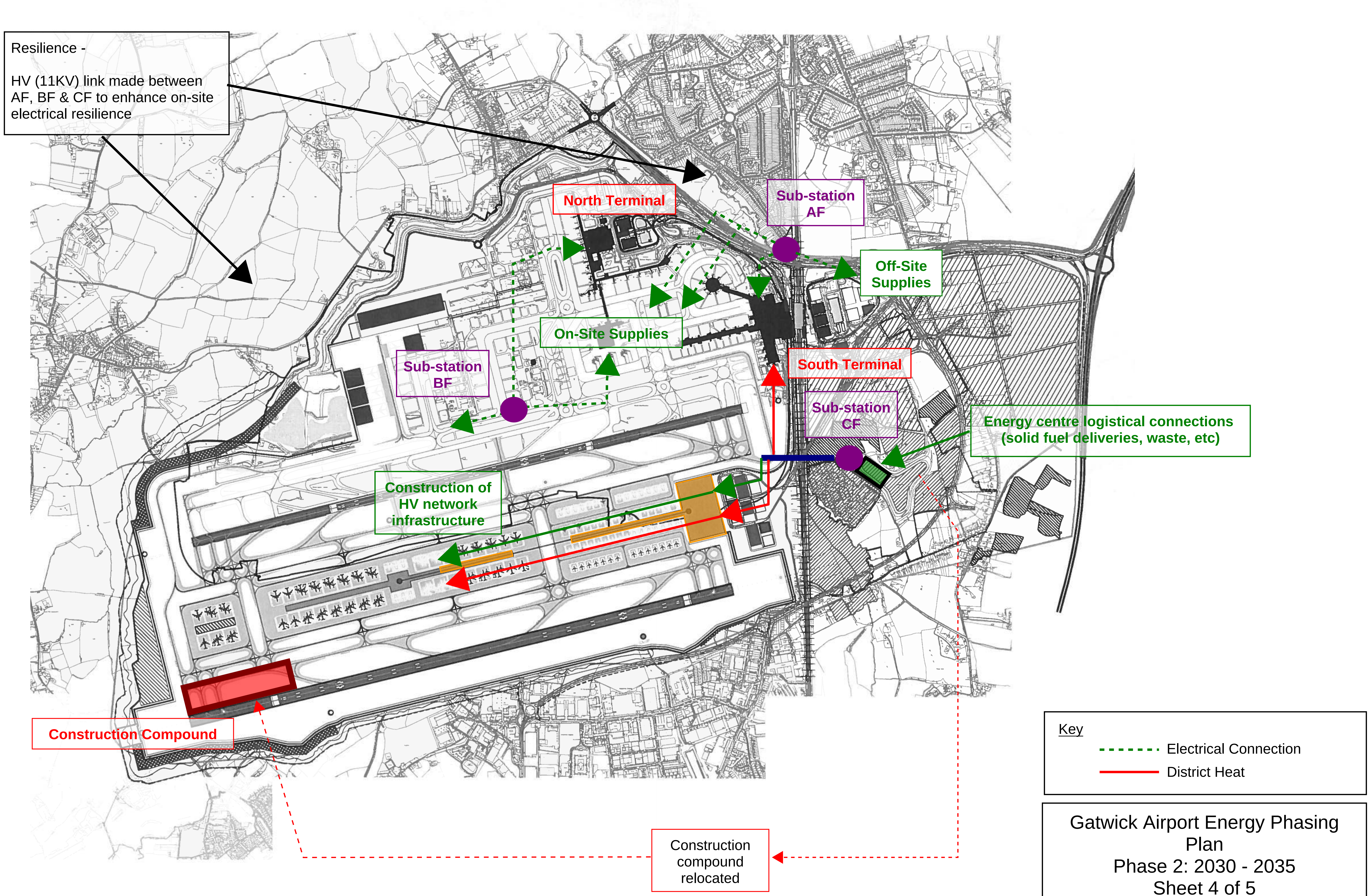


Gatwick Airport Energy Phasing Plan
Transition Phase: 2020 - 2025
Sheet 2 of 5

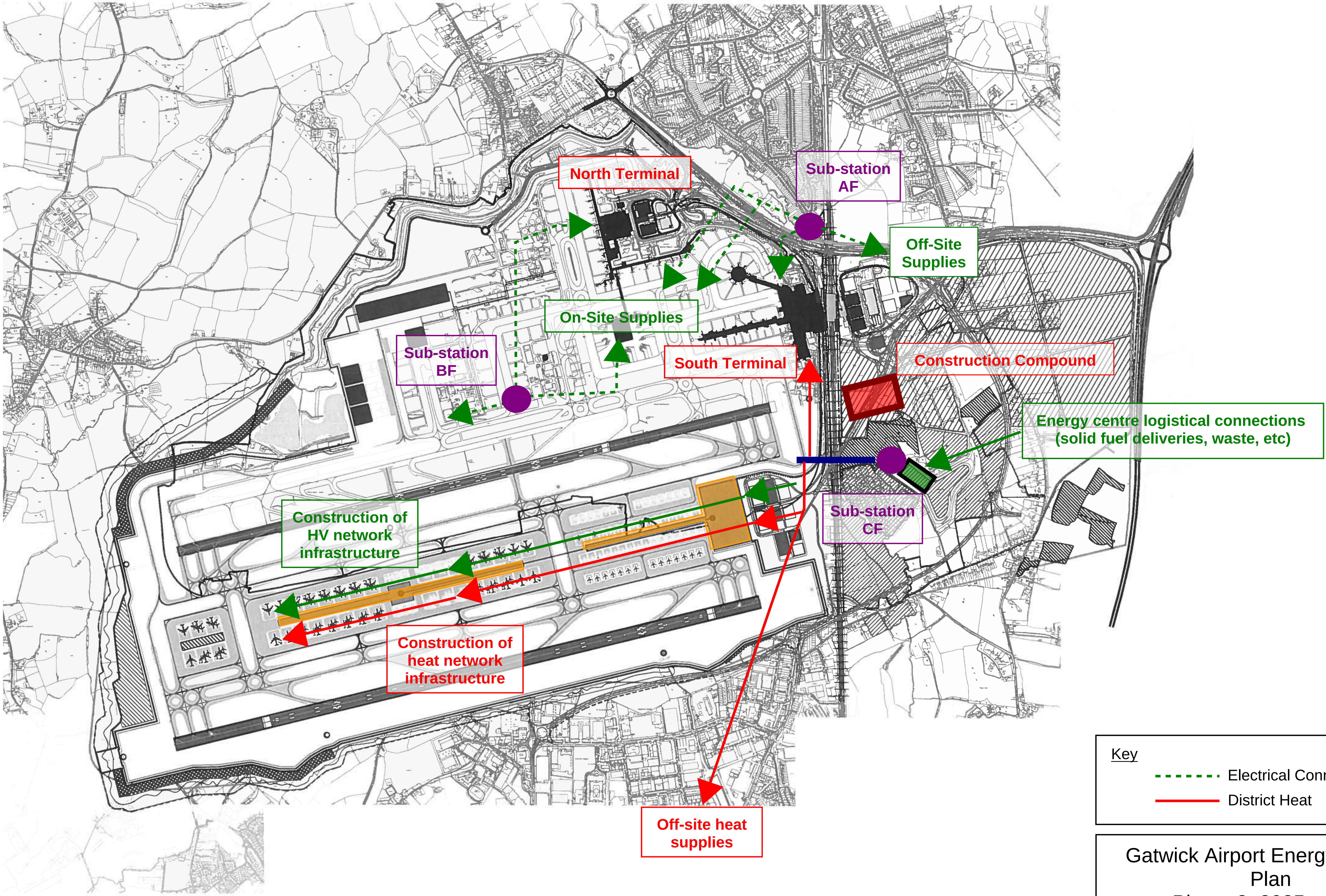


Key
Electrical Connection
District Heat

Gatwick Airport Energy Phasing Plan
Phase 1: 2025 - 2030
Sheet 3 of 5



Gatwick Airport Energy Phasing Plan
Phase 2: 2030 - 2035
Sheet 4 of 5



Key
Electrical Connection
District Heat

Gatwick Airport Energy Phasing Plan
Phase 3: 2035 - 2040
Sheet 5 of 5