Low Carbon Trafford Park 2038

Siemens Reference 76-124

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Executive Summary

Trafford Borough Council is a frontrunner in the UK for climate action and has committed to achieving net zero carbon by 2038. Siemens has been commissioned to outline a roadmap for the Borough's commercial and industrial hub, Trafford Park, to achieve this ambitious target.

Between its baseline year of 2019 and 2038, Trafford Park's business as usual energy forecast results in an estimated 48% increase in electricity consumption and a 16% decrease in natural gas consumption. Over the same period, transportation will transition rapidly away from internal combustion engine vehicles in line with UK regulations for passenger and heavy goods vehicles (HGVs).

The approach to developing a decarbonisation roadmap is based on three components. First, energy conservation measures (Category 1 measures) across the Park's commercial and industrial sectors and load profiles were modeled to estimate the maximum achievable reduction potential. The energy conservation measures were then modeled in three scenarios – conservative, moderate, and ambitious – with differing levels of rollout intensity, scope, and technology coverage, with their associated costs and benefits. Comparing the costs and benefits of each scenario, the moderate scenario is recommended as the best-fit option for Trafford Park that will help achieve the net zero carbon emissions while remaining cost-effective.

Second, alternative generation technologies (Category 2 measures) were analysed as replacements for existing electric and heat demand. These covered a broad spectrum of technologies ranging from solar PV, wind, and hydrogen, to waste heat recovery, and geothermal energy resources to supply the electricity, gas, and heating requirements of Trafford Park tenants. The net effect of these low carbon technologies is to offset and reduce the current level of electricity and gas consumption.

Finally, emissions not eliminated through Category 1 and 2 measures at Trafford Park were estimated, and further analysis was conducted identifying measures to account for or eliminate these in line with the park's net zero goal. These range from the procurement of carbon certificates to an expanded scope for hydrogen deployment, and are categorised as Category 3 measures.

The following two figures visualise the decarbonisation pathway for Trafford Park. Figure 1 shows the year-on-year decarbonisation pathway against the business as usual (BAU) carbon forecast.

Figure 2 visualises the final impact of measures in year 2038, with impacts of each measure applied against the 2038 BAU emissions for Trafford Park (245,161 tCO_2). Final 2038 impacts are affected by electric grid emissions factors, which decrease to zero by 2035, meaning low carbon electric technologies cease to provide additional carbon savings, though continue to provide revenue and financial savings through electricity generation.

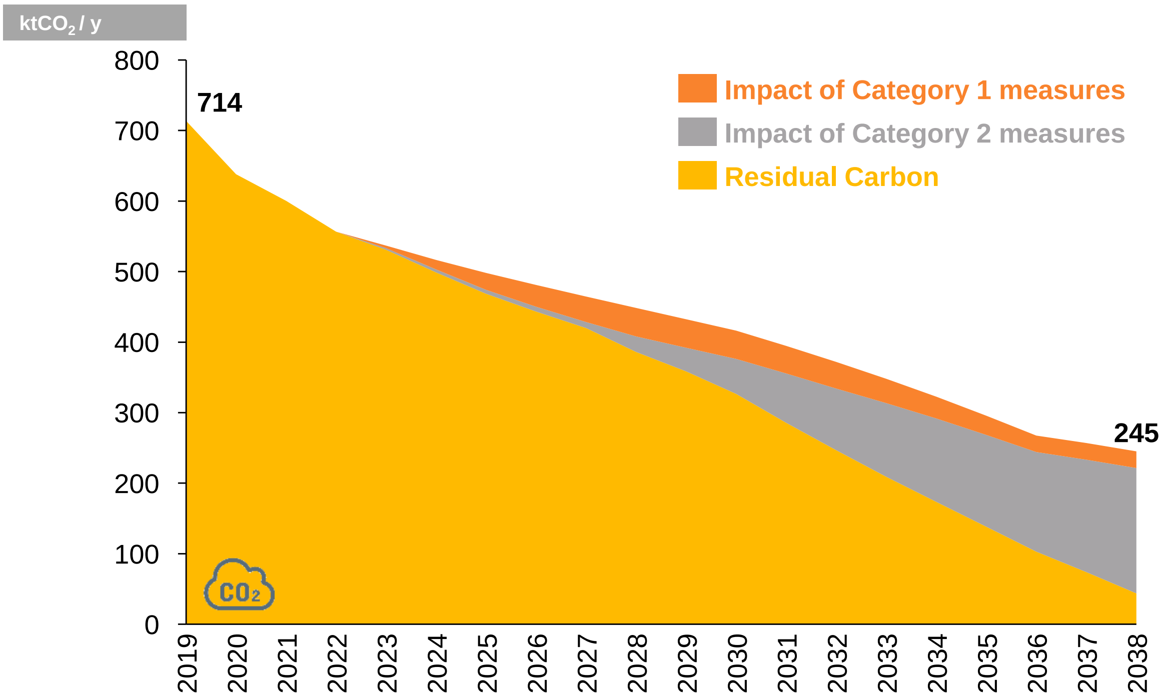

Figure 1: Trafford Park's Decarbonisation Pathway 2022-2038

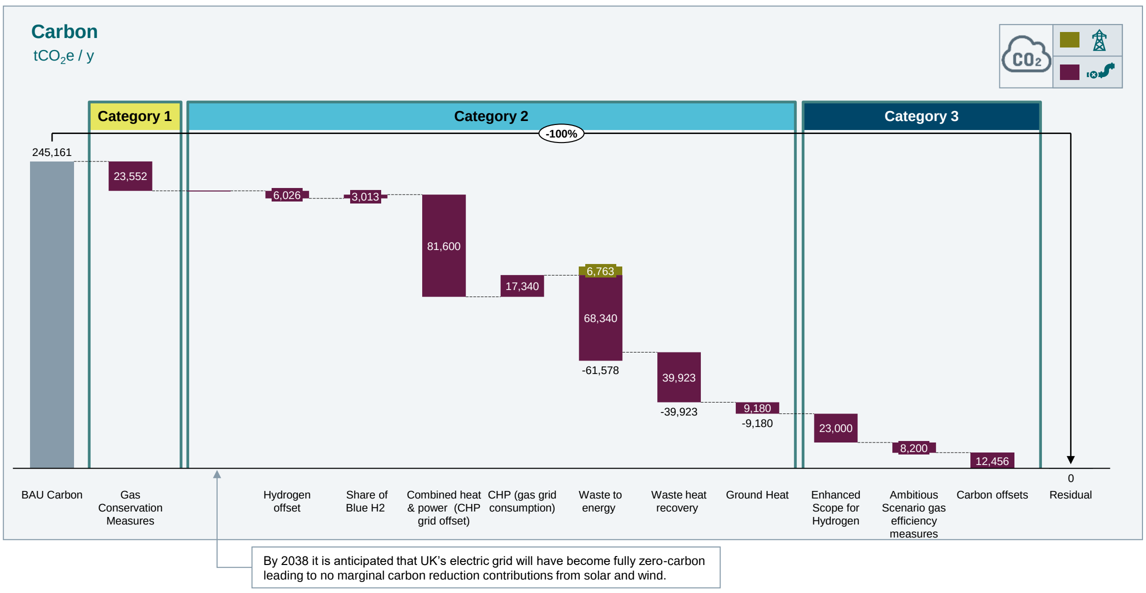

Figure 2: Impacts of All Low Carbon Measures on Trafford Park's Carbon Emissions Profile in Year 2038

Figure 3 outlines all measures along a suggested implementation timeline. This timeline is the critical path for achieving net zero goals by 2038. The two Category 1 measures on electricity and gas conservation are implemented from year one, along with two of the seven Category 2 electric measures on solar PV and wind energy implementation. Gas-related Category 2 measures begin to impact emissions in years five through eight as more centralised heat technologies come online. Category 3 measures are considered in the second half of the decarbonisation roadmap period, although these could be implemented in parallel with heat efficiency and hydrogen measures from Categories 1 and 2 if there is stakeholder appetite for more aggressive implementation. A 94% reduction in carbon footprint for Trafford Park compared to 2019 baseline is achievable through the developed roadmap before Category 3 measures, and a 98% reduction is achievable after technological Category 3 measures. The decarbonisation of the electric grid by 2035 and a dramatic shift in transport electrification results in the residual emissions by 2038 largely comprising of residual heat demand.

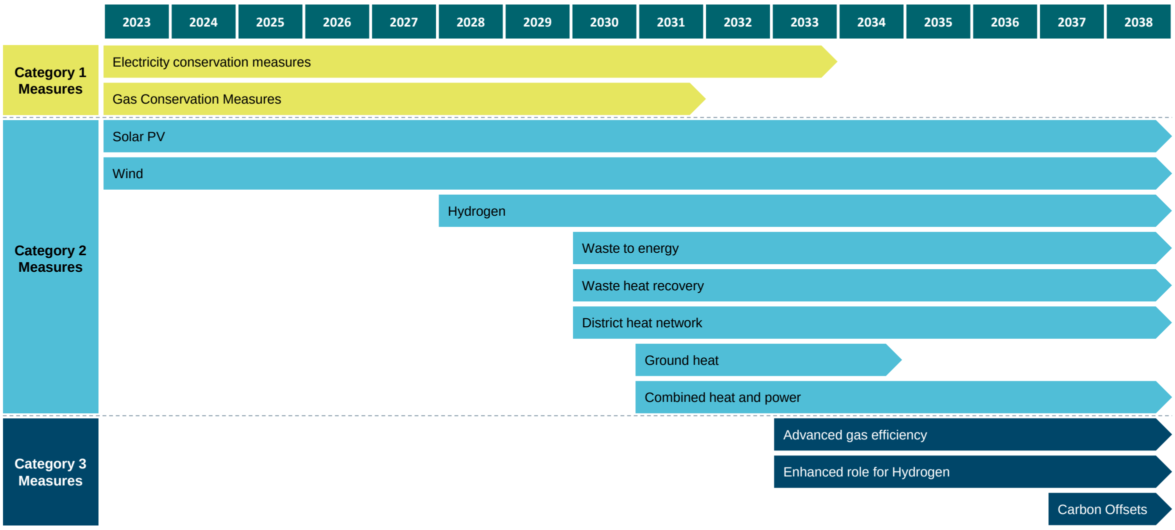

Figure 3: Impacts Timeline 2023-2038

A low carbon roadmap scenario with Category 1 and 2 measures decreases forecasted emissions to 43,656 tCO_2 from 713,566 tCO_2 2019 levels (Figure 1) at a cost of £1.2 billion. Carbon offsetting of the remaining emissions is estimated to cost between £0.655-3.5 million per year if no Category 3 measures are pursued. Category 3 technological measures can reduce residual emissions from 43,656 $tCO_2$to 12,456 tCO_2 at an additional cost of £171 million. Offsetting costs would then reduce to £0.187-0.996 million per year.

The implementation of measures provides substantial opportunities within Trafford Park for both short and long-term job creation. Initial deployment of low carbon technologies between 2022-2038 is expected to require up to 700 workers at full project scope, while longer-term operations of new facilities are expected to require more than 100 employees.

The developed Low Carbon Roadmap for Trafford Park can be a pioneering testbed for innovative next-gen technologies and business innovation that could be replicated and applied to other industrial estates and parks across the UK and globally. Strong stakeholder engagement and buy-in creates an opportunity for the Council to facilitate collaborative innovation bringing together industry, academia, and a diverse range of industrial and commercial consumers. The business toolkit created in this report should serve as signposts on this journey by bringing together the funding resources, the bankability of efficiency projects, and globally proven best practices.

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1. Introduction

Trafford Council was one of the earliest boroughs in the country in declaring a climate emergency in 2018, In the years following, the Council has been proactive in setting its climate ambitions, releasing its Carbon Neutral Action Plan in 2020, and Local Area Energy Plan (LAEP) in 2022. The documents benchmark Trafford Borough Council's emissions baseline and set out concrete actions for a transition to a low carbon economy, as well as initial potential scenarios to achieve its ambitious targets. The LAEP (2022) estimates a required capital expenditure of between £5.2 and £5.5 billion to meet its climate ambition for net zero by 2038 under these preliminary scenarios.

This is in line with the Greater Manchester Area's commitment to carbon neutrality by 2038. Indeed, as a constituency with significant impact on the Greater Manchester region and a major contributor to the local economy, Trafford Borough Council's ambitions to net zero are imperative to the decarbonisation of the entire region.

Principle amongst the Council's priorities is the decarbonisation of its economic hub, Trafford Park, Trafford Park is home to 1,300 businesses, with over 35,000 employees in a range of commercial and industrial sectors. Well-connected to Manchester and the greater Northwest region, Trafford Park is also a hub for leisure and tourism centred around Trafford Centre and EventCity exhibition space.

The Park is the largest emitter within the remit of the Council, with high concentrations of commercial and industrial operations. Therefore, a detailed assessment of the decarbonisation potential of the business park is essential to the success of the Council's wider net zero initiative.

Achieving net zero by 2038 and meeting year-on-year reduction targets against Trafford Borough Council's established carbon budget requires a multi-level approach, designed to enable public and private interventions to reduce demand, introduce low carbon technologies, and offset emissions where required. In 2022, This is contextualised within a broader shift in Greater Manchester, and UK wide, towards increased electrification of transport and heat, and widening access to distributed generation, energy storage, and digital solutions that can empower individuals and communities, create jobs, reduce costs and generate new revenue streams.

The following report details a scoped, costed roadmap of energy conservation and low carbon technologies for Trafford Park between 2022 and 2038, considering the Park's 2019 baselined emissions and business-as-usual forecasts for electricity, heat, and transportation across major sectors. This report highlights key trends and opportunities to maximise decarbonisation throughout the next two decades, and details actions for business and the Council to collectively leverage these opportunities to achieve net zero.

2. Trafford Park's Carbon Footprint

Trafford Borough Council is committed to net zero emissions by 2038 where the Trafford Park (Figure 4) area is the source for almost half of overall borough emissions. The business park features sizeable commercial and industrial clusters, and a smaller number of leisure and tourism facilities. This chapter outlines Trafford Park's baseline and forecasted carbon footprint, followed by the development and elaboration of a framework for establishing a low carbon roadmap for Trafford Park.

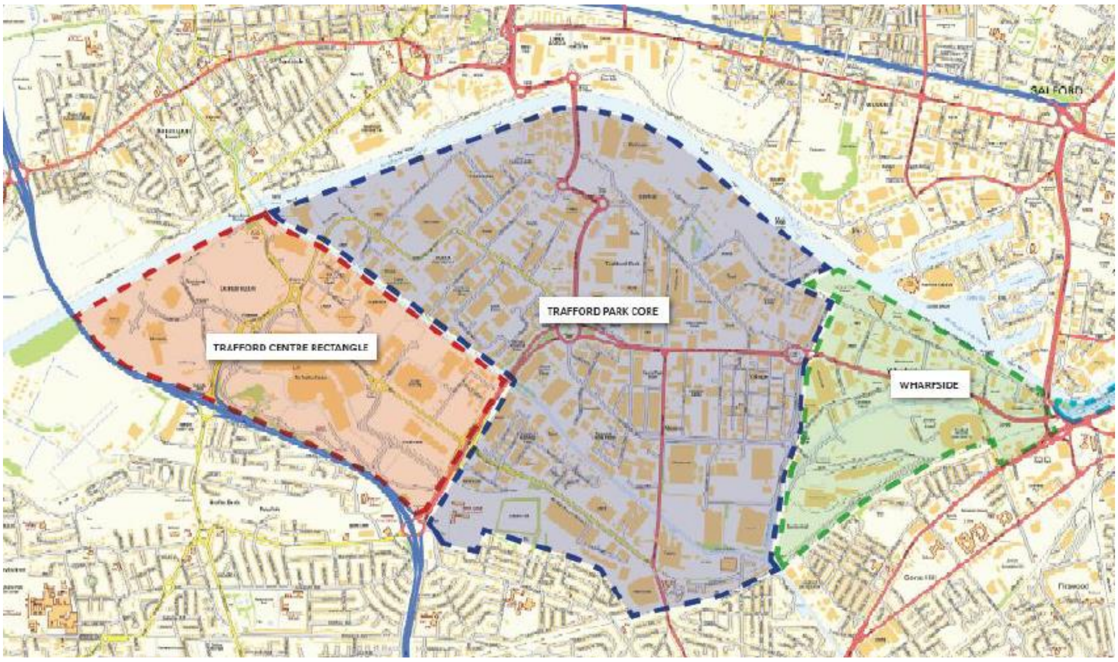


Figure 4: Trafford Park is located to the south west of Greater Manchester and is a commercial and industrial hub for the region

About one third of the Park's emissions are associated with burning natural gas for space heating and industrial processes, with the two thirds split between electric and transport related emissions. A large proportion of emissions are attributable to industrial processes. Commercial offices, retail and logistics account for the majority of remaining emissions. Longer term projections to 2038 estimate a business as usual (BAU)[1] transition to electrified transport, and decarbonisation of the electric grid in the North West and throughout the UK[2].

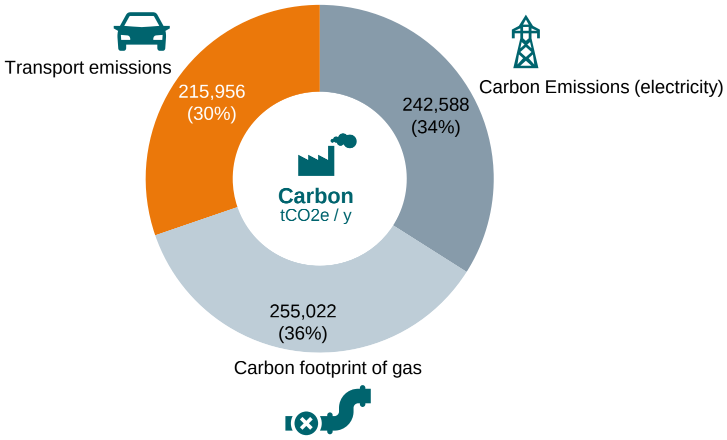


Figure 5: Trafford Park tCO_2e emissions 2019 baseline

[1] BAU is a forecasting scenario assuming no significant changes in energy consumption characteristics occur at Trafford Park within the scoped timeframe of the study. BAU is used to measure the impact of measures against a "do nothing" scenario.

[2] Electrification of transport and decarbonisation of electric grid in the UK is projected regardless of the activities enacted within Trafford Park, and therefore are integrated in the BAU baseline.

The overall emissions of Trafford Park in baseline year 2019[3] are calculated at 713,566 tCO_2[4]. Of this, emissions are attributed to gas (36%), electricity (34%), and transportation (30%)[5].

Baseline data was adjusted to align proposed decarbonisation interventions against future park consumption through to 2038[6]. As shown below, the largest forecasted shifts in energy consumption result from transportation electrification and increased electric demand.

Emissions were likewise adjusted through to 2038. Natural grid decarbonisation and transportation electrification leads to passive reductions in carbon emissions in the BAU scenario. The largest contributor to emissions under BAU conditions remains gas consumption for heating processes. Figure 6 shows the change in electricity, gas and carbon emissions under the BAU scenario between 2019 and 2038. As can be seen, gas consumption and emissions remain relatively constant between baseline and target year.

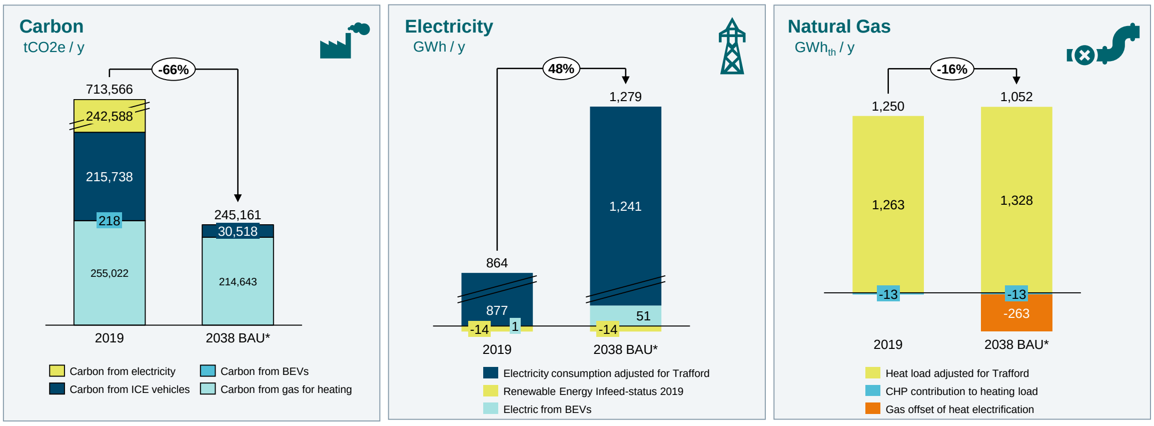


Figure 6: Business as Usual Carbon, Electricity, and Natural Gas 2019-2038

The breakdown of consumption by sector in 2038 is shown in the figure below. Gas consumption is expected to grow proportionally slower than electric consumption, but still makes up the larger of the two energy categories by 2038 under BAU conditions. Electric consumption is higher for commercial assets, while gas is a higher proportion in industrial heating processes.

[3] A baseline year of 2019 is used to avoid baselining against subsequent years affected by the covid pandemic

[4] Derived from BEIS mixed emissions factors for petrol and diesel vehicles, natural gas and electricity grid intensity estimates for baseline year 2019. An error factor of 7-10% is attributable to estimations of vehicle miles driven and assignment of energy data to Trafford Park's geographic area.

[5] Based on data from Distribution North West (DNW), and adjusted for the area codes of Trafford Park. Transport emissions are calculated based on average vehicle miles per year and vehicles in Trafford Borough Council, DNW future energy scenarios (FES), and Trafford LAEP, adjusted for Trafford Park area and commuting base.

[6] Based on gas, electric, and transportation forecasts by DNW FES and BEIS

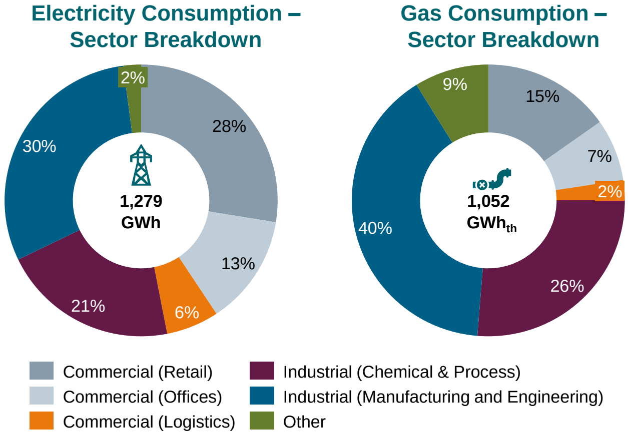
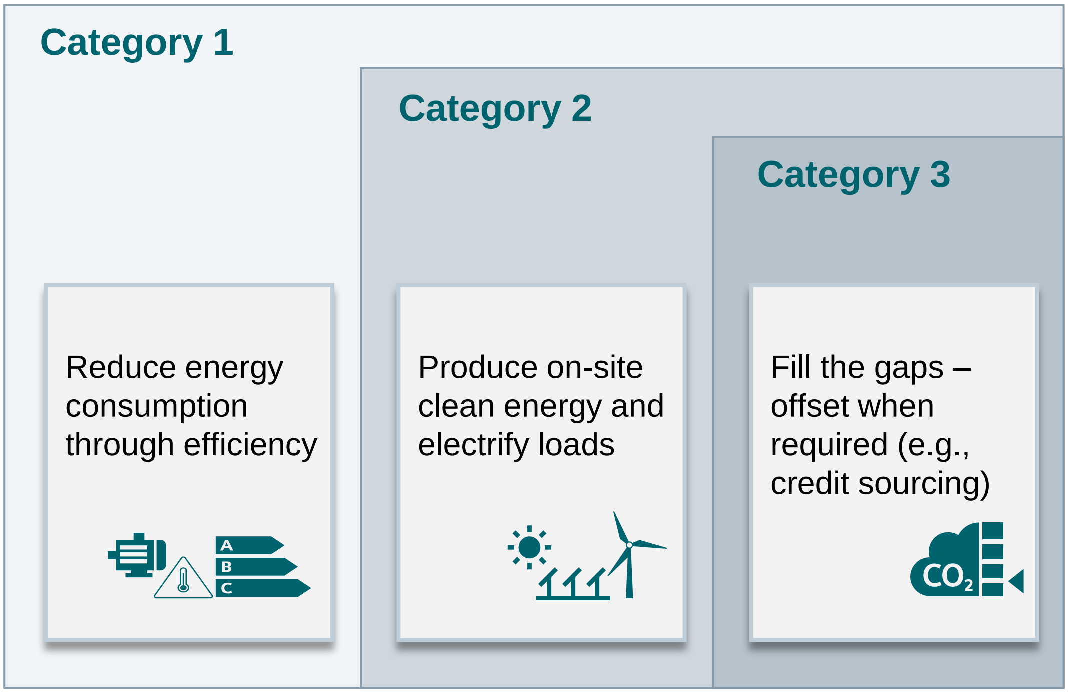


Figure 7: BAU sector split for electricity and gas consumption by 2038

2.1 Decarbonisation Concept Model

To apply maximum forward pressure to decarbonise Trafford Park in line with net zero goals and carbon budget targets, the decarbonisation model focusses on three intervention categories:

1. **Reduce energy demand**: decrease electric and fossil fuel use with energy efficiency measures, smart technologies, and behavioural change.
2. **Renewable and low carbon technological solutions**: determine the scale and business case for implementation of low carbon electric and heat technologies throughout Trafford Park, and how these technologies align to Park activities and capabilities.
3. **Offset where required**: in certain scenarios, offsetting carbon will be required in order to meet net zero targets.



This comprehensive approach enables prioritisation of measures to maximise greenhouse gas (GHG) reductions in the most cost-efficient way. Throughout Trafford Park's implementation roadmap to 2038, quick wins and more dynamic modular technologies are targeted for early implementation, with more centralised, large capex solutions to be developed over multiple years.

In the following chapters, each energy efficiency and low carbon intervention is reviewed in detail. Following this, a matrix and roadmap for the implementation of recommended interventions is presented, communicating total annual emissions reductions through to 2038, costs and benefits to Trafford Park, and a delineation of roles, responsibilities, and tools for public and private stakeholders in the Park to facilitate these interventions.

3. Category 1 Measures: Energy Efficiency

This chapter outlines an array of energy efficiency measures which can be undertaken at Trafford Park in order to decrease its carbon emissions. Using energy more efficiently will be vital to achieving Trafford Park's decarbonisation ambitions and is an effective first step for businesses to optimise their energy usage, achieve process optimisation, and lower their energy costs.

The potential for power and heat efficiency has been modelled across all sectors in Trafford Park as part of the Trafford Park decarbonisation concept. Decarbonisation impacts of the proposed energy efficiency interventions are measured against the 2038 Business-as-usual (BAU) forecast for electricity and heat consumption, and are presented and discussed for subsectors in this chapter. The annual load profile for each subsector is forecasted and visualised, with details on individual and combined impact of energy efficiency interventions.

3.1 Methodology and Approach

Error! Reference source not found. shows the proportion of electricity and heat consumption by subsector in the 2038 BAU forecast that serves as a baseline for modeling the impacts of energy efficiency measures. This was derived from categorised Ordinance Survey Master Map (OSMM) floor area data for Trafford Park, applied to Chartered Institution of Building Services Engineers (CIBSE) energy intensity benchmarks and Siemens project database.

The impact of 48 energy (power and heat) conservation measures[7] was modelled across Trafford Park (see Appendix A). The impact calculation methodology evaluates how each measure targets specific loads within each sector. The sector split across the Park is summarised was previously displayed in Figure 7 and the load categories within each sector summarised in Figure 8 and Figure 9.

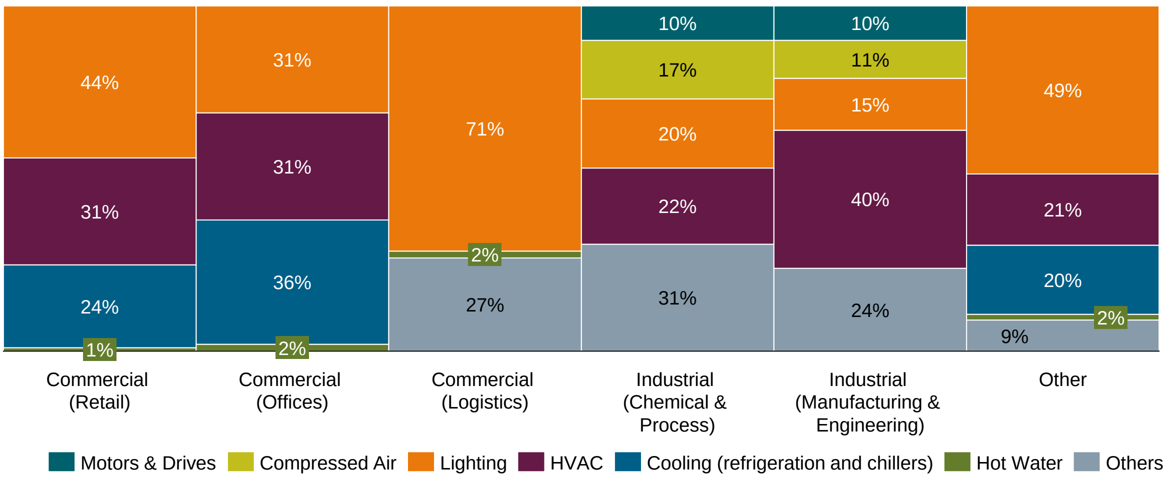


Figure 8: 2038 BAU forecast – Compositions of electricity consumption by load category

[7] Top Energy Conservation Measures across Industrial, Commercial, Logistics Sectors based on Siemens Energy Efficiency Performance Tool (SEE-PT), which was developed as an extension to the City Performance Tool.

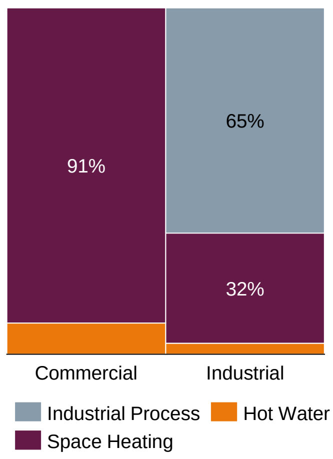


Figure 9: 2038 BAU forecast – Compositions of heat consumption load category

Decarbonisation impacts of each energy efficiency measure on energy, GHG, and cost savings are calculated using our impact assessment method shown in Figure 10. This approach covers a wide range of aspects of energy efficiency measures in Trafford Park, including technical specifications, status of implementation, technical potential of energy savings, and interest of stakeholders in implementation.

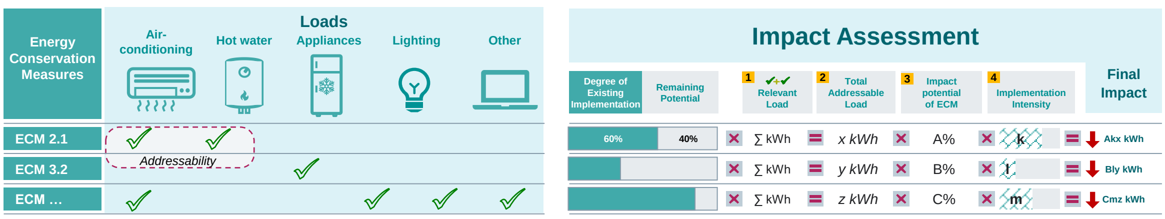


Figure 10: Impact Assessment Method for projecting decarbonisation impacts of energy efficiency measures

The impact assessment relies on four key impact factors:

1. **Relevant load**: the sum of all the relevant individual loads is mapped to the given energy efficiency measure (see Appendix A). Attributed to the specifications of energy efficiency measures, the relevant load can be classified either as load-specific or of general applicability. Load-specific measures target single relevant load categories, such as efficient lighting (LED) measures designed to reduce lighting loads and variable frequency drives to optimize motor loads in response to changing demand (part load conditions). General measures can be equally applicable across different load categories and therefore impact multiple relevant load categories. This includes, primarily, process-related or design-related improvements like preventive maintenance measures, behaviour change, awareness initiatives, and correct sizing of equipment.

2. **Addressable load:** This impact factor covers the total remaining loads in Trafford Park, i.e., the loads using inefficient technologies and without the specific efficiency measure in place. This impact factor is obtained as a product of two factors: (i) the relevant load quantity measured previously, and (ii) the degree or percentage of current implementation of the energy conservation measure. This helps derive the maximum impact that can be achieved by a further rollout of the efficiency measure.

3. **Impact potential:** the typical reduction in energy consumption that can been achieved by the given measure based on industrial best practice.

4. **Implementation intensity**: the targeted degree of rollout of the given measure and serves to reflect the interests and concerns of Trafford Park's stakeholders. This impact factor reflects the degree of ambition within its context and the interests of relevant stakeholders.

Modelling the impacts of energy efficiency was conducted using three implementation rates that consider the targeted degree of rollout for any given measure and serves to reflect the interests and concerns of Trafford Park's stakeholders.

- **Conservative Scenario** only adopts energy efficiency measures that have a low implementation complexity, are relatively cheap to implement, and are adopted at a somewhat slower pace.

- **Moderate Scenario** only adopts energy efficiency measures of low to medium complexity and/or cost intensity and with moderate adoption speeds. The set of measures included in the moderate scenario include the ones already covered under the conservative scenario and extends the implementation scope to additionally consider moderately more complex measures.

- **Ambitious Scenario** adopts energy conservation measures of all levels of complexity and cost intensity and with fast adoption speeds.

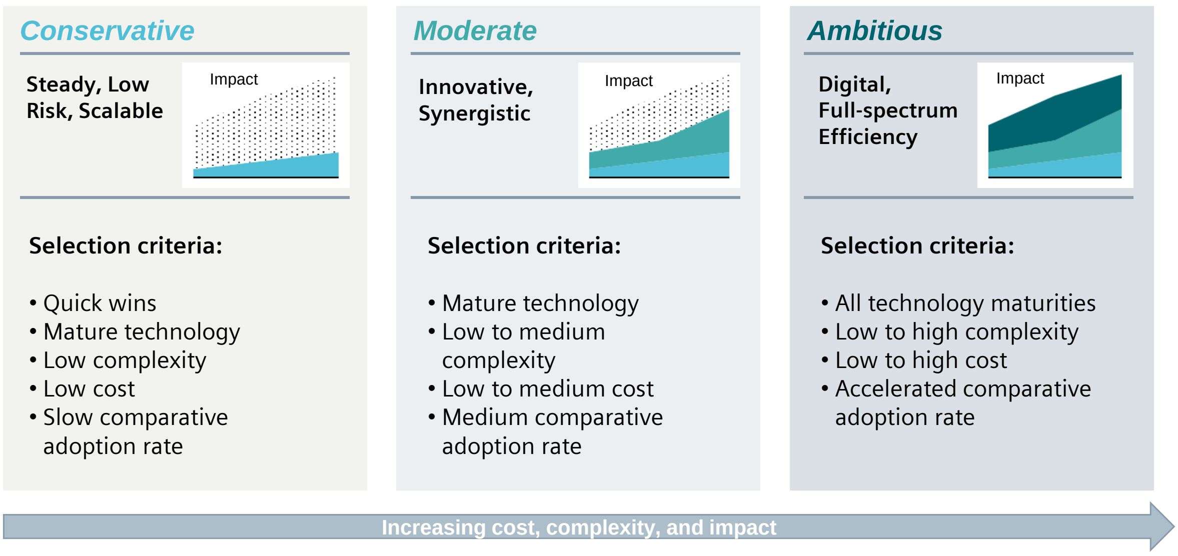


Figure 11: Three implementation scenarios for modelling decarbonisation impacts of energy efficiency measures in Trafford Park

3.2 Impacts of energy efficiency

Potential reduction in electricity and heat consumption was calculated based on the parameters defined in section 3.1. The moderate scenario was used as the basis for Trafford Park's Low Carbon Roadmap as it takes a realistic view to implementation costs that businesses are likely to incur, implementation complexity (e.g., disruption to processes), as well as the maturity of utilised technologies. In this regard, the moderate scenario is balance between achievability and the net zero goals of Trafford Council[8]. In the moderate scenario, a potential reduction of 247 GWh/yr (20%) and 115 GWh_{th}/yr (11%) in respective power and heat consumption is achievable through the roll out of energy efficiency measures[9] this would account for a cumulative emissions savings of 470,047 tCO_2 between 2023-2038 when compared against BAU. The contribution of each measure in the moderate scenario is presented in Figure 12 and Figure 13. The top performing energy efficiency measures for the moderate scenario are as shown in Table 1.

Top 5 Electricity Efficiency Measures	Top 5 Heat Conservation Measures
Behavioural change and awareness	Behavioural change and awareness
Energy monitoring and evaluation	Window glazing
Efficient lighting technology	Building envelope
Building Automation and Controls (BACS) Class A	Building Automation and Controls (BACS) Class B
Building Efficiency Monitoring (BEM)	Furnace and oven wall insulation

Table 1: Top Energy Efficiency Measures for Power and Heat

[8] While the conservative scenario is the most achievable, the scope and speed of implementation is out of step with Trafford Council's goal of net zero by 2038. Additionally, lesser reductions in electricity and gas through energy efficiency measures directly impacts the required size of on-site generation systems (Category 2 measures), leading to increased capex in other implementation areas.

[9] Comparatively, a conservative implementation scenario would yield savings of 113 GWh/yr for power and 50 GWh/yr for heat, and an ambitious scenario 351 GWh/yr for power and 155 GWh/yr for heat.

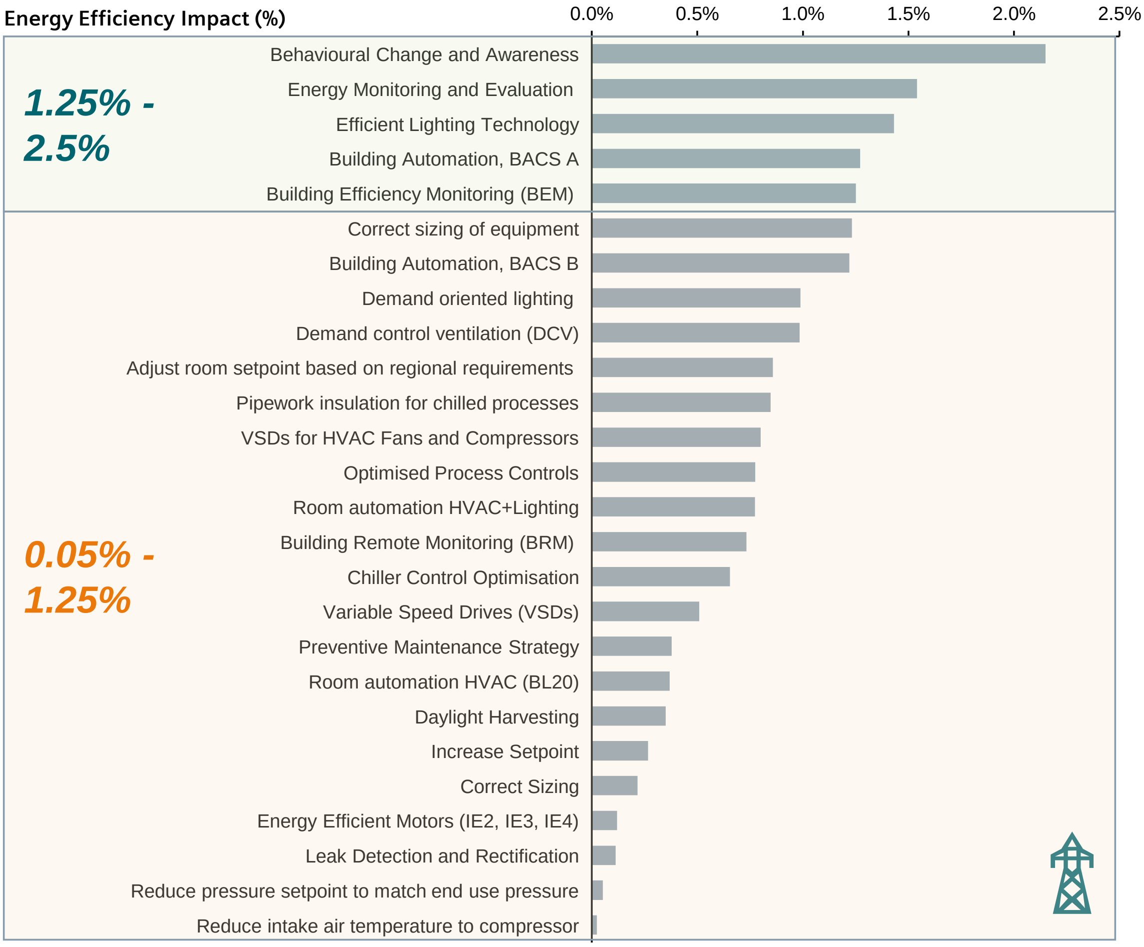


Figure 12: Impact of electricity efficiency measures 2023-2038 (moderate)

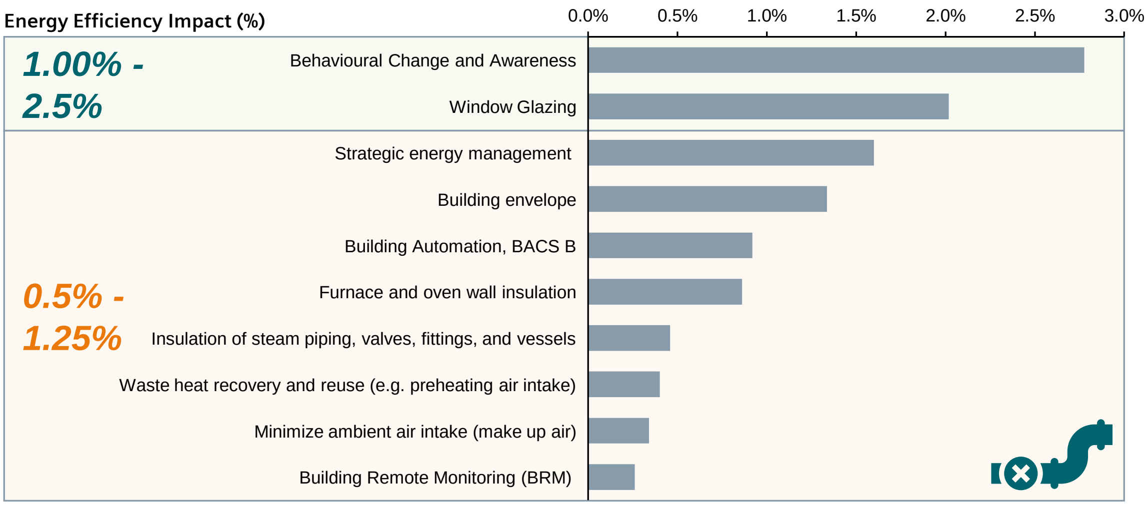


Figure 13: Impact of heat efficiency measures 2023-2038 (moderate)

In total, energy efficiency measures between 2023 and 2038 can result in a decrease of 247 GWh/yr of electric consumption and 115 GWh_{th}/yr of heat consumption by 2038. The breakdown of these totals, along with costs and expected savings per measure, are shown in Table 2 Table 3 for electric and gas conservation measures respectively. A weighted payback[10] of 8-15 years is calculated to capture the diversity of energy conservation measures, which can pay back over a period of 1-15 years, influenced by the scope of addressed loads and current state of implementation.

Measure	GWh savings	Costs (£ Million)	Savings (£ Million)
Behavioural Change and Awareness	27	2.8	79.1
Energy Monitoring and Evaluation	19	10.1	56.7
Efficient Lighting Technology	18	18.8	41.4
Building Automation, BACS A	16	16.7	40.1
Building Efficiency Monitoring (BEM)	16	16.5	32.9
Correct sizing of equipment	15	13.0	42.1
Building Automation, BACS B	15	12.8	25.7
Demand oriented lighting	12	10.4	18.2
Demand control ventilation (DCV)	12	7.8	18.1
Adjust room setpoint based on regional requirements	11	3.4	33.8
Pipework insulation for chilled processes	11	5.6	29.0
VSDs for HVAC Fans and Compressors	10	7.4	25.2
Optimised Process Controls	10	8.1	20.4
Room automation HVAC+Lighting	10	10.2	18.3
Building Remote Monitoring (BRM)	9	9.6	27.0
Chiller Control Optimisation	8	6.9	18.9
Variable Speed Drives (VSDs)	6	4.7	16.1
Preventive Maintenance Strategy	5	1.0	15.0
Room automation HVAC (BL20)	5	2.9	10.7
Daylight Harvesting	4	5.5	9.2
Increase Setpoint	3	0.0	10.5
Correct Sizing	3	2.3	7.4
Energy Efficient Motors (IE2, IE3, IE4)	1	2.2	4.1
Leak Detection and Rectification	1	0.3	4.4
Reduce pressure setpoint	1	0.0	1.9
Reduce intake air temperature to compressor	0	0.2	0.9

Table 2: Ranked Electric Conservation Measures, Costs, and Savings – Moderate Scenario

[10] Each individual energy conservation measure has a defined impact and payback period. The payback period of each individual measure is weighted against its delivered impact to derive the overall payback period for all measures.

	GWh_{th} savings	Costs (£ Million)	Savings (£ Million)
Behavioural Change and Awareness	29	1.1	31.1
Window Glazing	21	19.4	19.4
Strategic energy management	17	2.6	19.2
Building envelope	14	12.8	13.9
Building Automation, BACS B	10	2.9	5.9
Furnace and oven wall insulation	9	2.1	8.9
Insulation of steam piping, valves, fittings, and vessels	5	0.7	4.8
Waste heat recovery and reuse	4	1.9	4.2
Minimize ambient air intake	4	0.8	3.0
Building Remote Monitoring (BRM)	3	1.0	2.9

Table 3: Ranked Gas Conservation Measures, Costs, and Savings – Moderate Scenario

Based on scale of measures identified in the moderate scenario for electricity and heat conservation, short-term job opportunities for ~30 professionals providing installation services between years 2022-2038, and around ~25 positions conducting regular audit, maintenance, monitoring, and reporting are anticipated[11]. Variance is expected in the scope and duration of required implementation on an asset-by-asset basis, and long-term jobs may be undertaken intermittently or on a part-time basis depending on scope of assets under management and the measures undertaken.

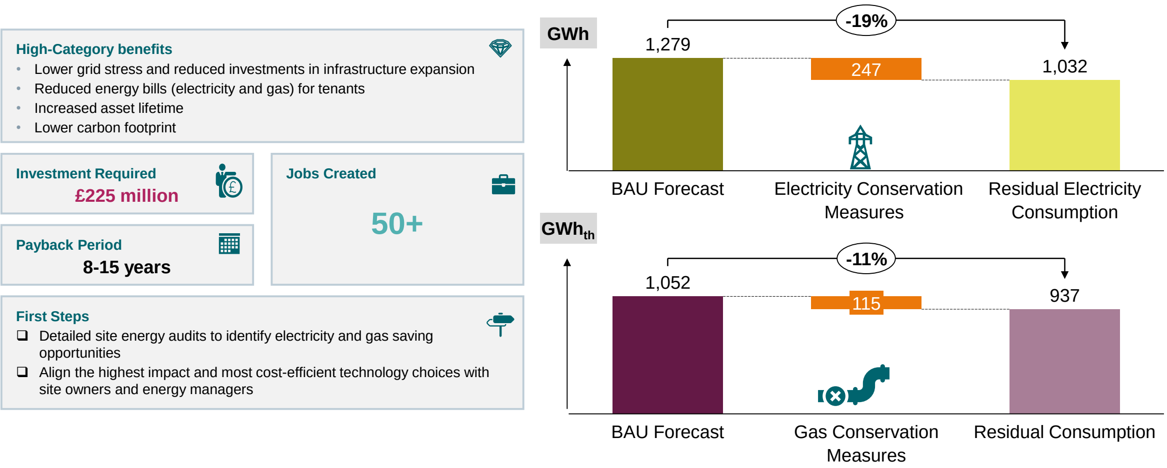


Figure 14: Impact of electricity and gas conservation measures (moderate) by 2038

3.3 Financial Savings Projections

Financial savings were derived based on calculated electricity and heat savings, as well as a weighted cost basis for electricity and natural gas. Total financial savings between 2023 and 2038 are estimated at £61 million per year. Annual savings are attributable to owners and tenants of commercial and industrial buildings within Trafford Park.

[11] Job creation is measured by full time equivalent (FTE) estimated hours allotted to installation (short-term), and service and maintenance (long-term). FTEs assume 240 working days of 8 hours during a year. Industry benchmarking was used to supplement Siemens' global project experience across Category 1 and 2 measures, adjusting for the scale (measured by GWh savings and/or number of buildings) of implementation at Trafford Park.

Figure 15 shows the annual financial savings for end-customers as a result of consuming less electricity and gas in the three scenarios.

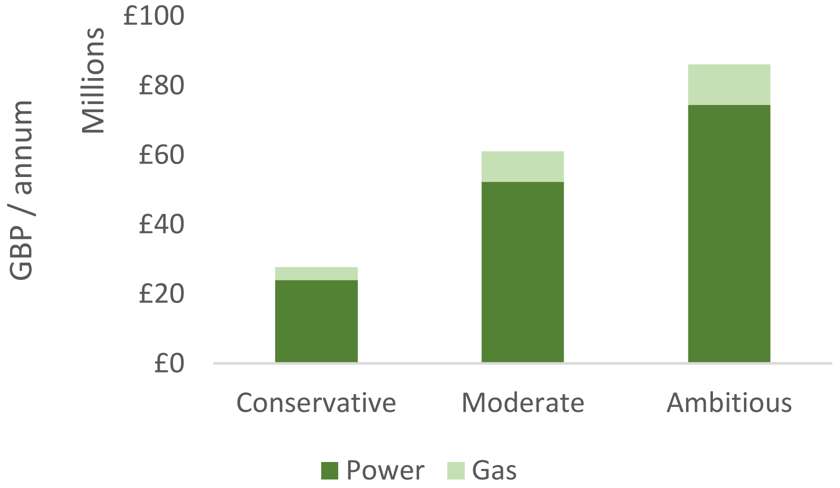


Figure 15: Annual projected savings by scenario

3.4 Investment Required

Total capex investment between 2023 and 2038 is estimated at £225 million for Category 1 energy efficiency measures. Investment is attributable to owners and tenants of commercial and industrial buildings within Trafford Park to implement the energy and gas efficiency measures including device and installation costs. Costs are incurred throughout the estimated duration of implementation by measure, therefore will not be fully payable in year one.

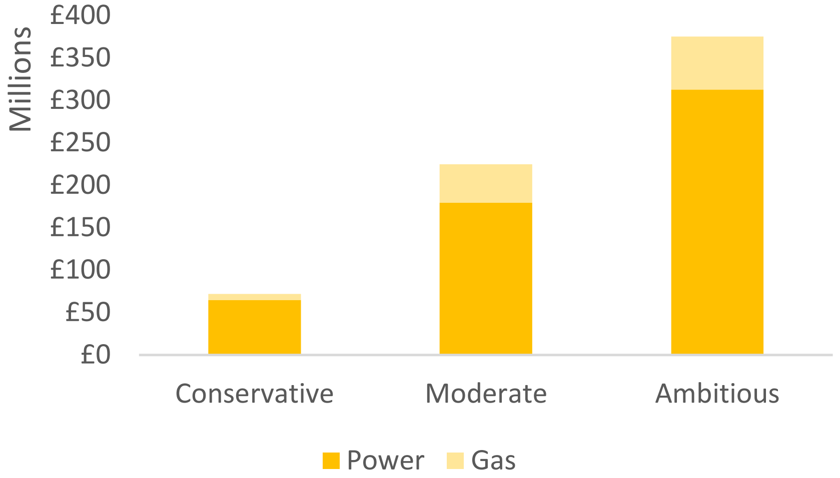


Figure 16: Total investment required by scenario

3.5 Key Takeaways

- **48** energy efficiency measures across electricity and heat were analysed against Trafford Park subsectors and load profiles
- Three scenarios were modelled with differing levels of ambition, with the moderate scenario being integrated into Trafford Park's decarbonisation roadmap
- The moderate scenario results in a **19% decrease in electricity** demand and an **11% decrease in heat demand** by 2038 resulting in a cumulative emissions reduction of 470,000 tCO_2 between 2023-2038 when compared against BAU
- Combined measures would cost businesses **£225 million** between 2023-2038
- Combined measures would save an estimated **£61 million per year** when fully implemented

4. Category 2 Measures: Low Carbon Technologies

After energy efficiency measures are taken into account, low carbon generation technologies are modelled. These measures are undertaken to replace demand from the electric and gas grids with low or zero carbon alternatives. These are on-site generation technologies for individual businesses, centralised solutions across the Park, or technologies centred around industry clusters within and outside the Park area. In addition to generation technologies, a plan for a district heating network is outlined which would allow Trafford Park to capture and utilise modelled heat sources to best effect.

4.1 Solar PV

Solar PV panels convert sunlight into electrical energy and are widely used throughout the UK and globally as part of the energy transition. Rapidly declining technology costs make solar an attractive investment opportunity for small- and large-scale system owners, supplying zero emission electricity to offset on-site consumption, and decarbonising the wider grid.

Scope and Methodology

The overall maximum generation potential for Trafford Park has been modelled at approximately 147GWh per annum with capacity of 175MW[12] for rooftop solar. In addition, 20% of available carparking space identified could be utilised for carport solar generation results in approximately 14 GWh per annum with 16 MW installed capacity. Combined, this would provide a total of 191 MW installed PV capacity if fully developed by landlords, tenants or developers. This level of output would translate into cumulative emissions savings of 69,000 tCO_2 between 2023-2038 when compared against BAU.

Electric outputs from PV are derived from local irradiance[13] data. For Trafford Park, modelling accounted for roof location, slope and type, as well as PV efficiency and transformer losses. Car port locations were modelled utilising the solar insolation map. Visualisations of the solar mapping can be seen in Figure 17, Figure 18, and Figure 19. As shown in Figures 19 and 20, a large portion of potential PV capacity can be developed with the participation of several large stakeholders at Trafford Park (highlighted in red and orange). Direct outreach and support for these major stakeholders can be supplemented by individual participation of smaller businesses through community solar programmes as discussed in Chapter 6. Due to the strong payback associated with PV projects in the UK, particularly in the context of recent increases in electricity costs, appetite for such projects is strong throughout the country, and was noted during Trafford stakeholder engagement activities (Appendix D).

[12] MW, or MW peak, defines peak output potential for a solar PV system. PV output per MW is principally determined by the amount of sunlight at a given area throughout the year, panel orientation, operating temperature, and system efficiency

[13] A measure of the amount of sunlight at a given area throughout the year

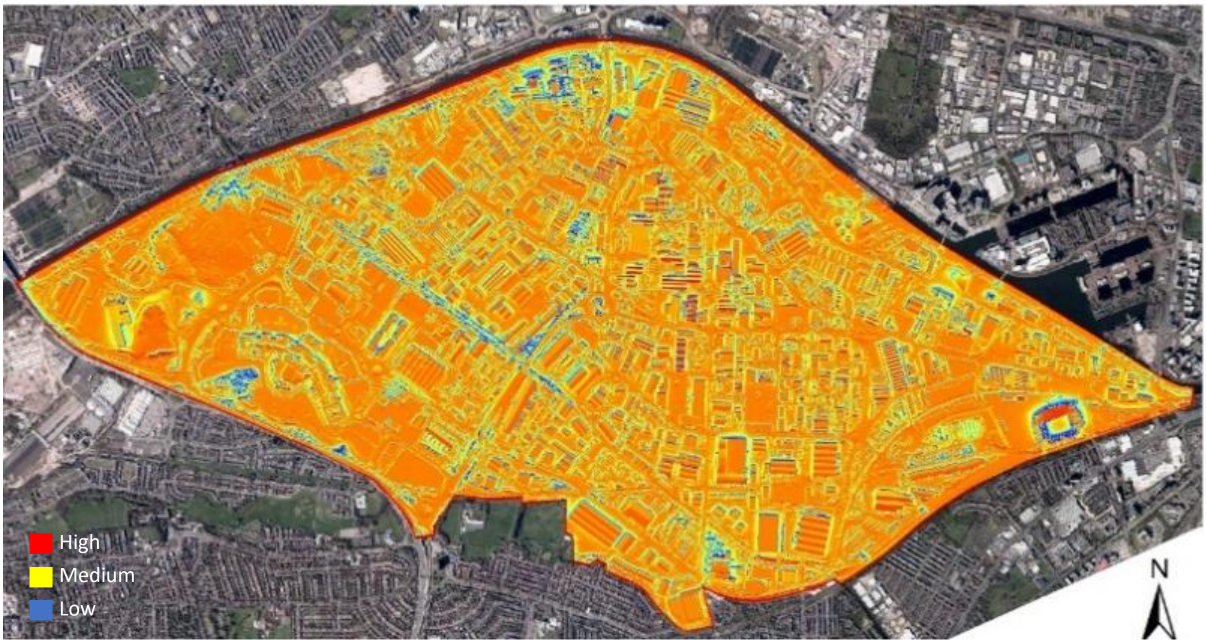


Figure 17: Solar Insolation[14] Map - Annual

Figure 18: Solar Generation Potential rooftop (MWh / year)

[14] The amount of solar radiation reaching a given area

Figure 19: Solar Generation Car Port potential (MWh / year)

Capital Expenditure has been estimated based on internal supplier databases and previous project experience. For solar PV, this equates to a capital cost of ~£1,050 per kW for rooftop systems, and ~£1,500 per kW for carport systems. Operating costs are estimated at 1% and maintenance is estimated at 10% of capital costs over 20 years, covering items such as inverters and other equipment. Sensitivities are modelled around the site-specific consumed energy as well as the grid. Savings and revenue from solar generation are estimated at between £16 and 38 million per year after implementation. These prices are subject to variance to give a range of payback periods to reflect volatility in the markets. Detailed techno-economic modelling should follow to refine this strategic assessment.

A steady build out of rooftop and carport PV systems across Trafford Park is expected to provide short-term job opportunities for about 55 installation professionals based on FTE required to install 191 MW (ca. 3.5 MW per full-time installer annually), with around 20 long-term jobs equivalent for conducting intermittent electrical work, maintenance, physical cleaning, and the management of operational controls, monitoring and reporting.

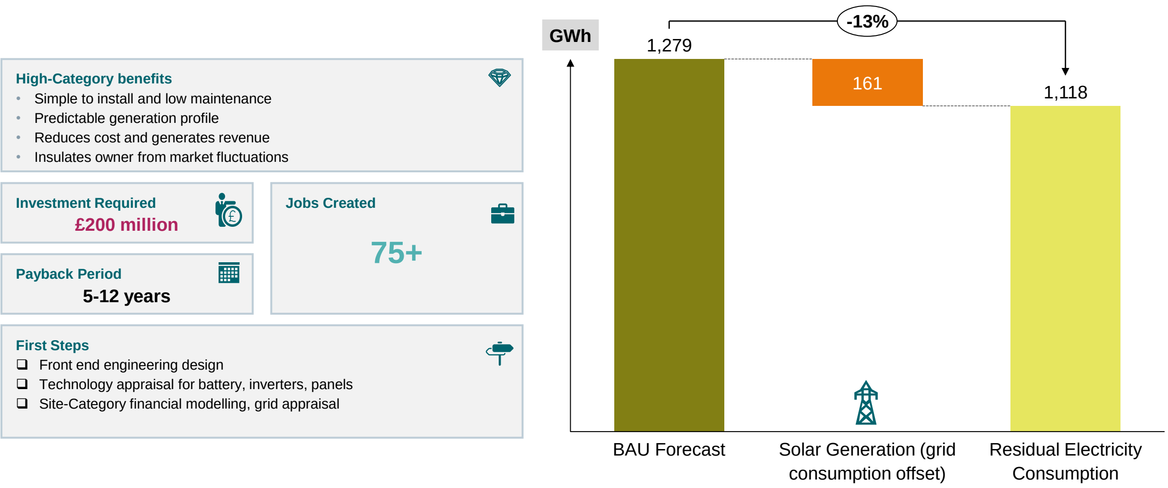


Figure 20: Key figures for rooftop and carport solar generating 161 GWh per year

4.2 Wind

Wind power is the use of wind turbines to generate electricity. Wind is a sustainable and renewable energy source with a significantly smaller impact of the environment than burning fossil fuels.

Unprecedented wind turbine rollout has occurred in the UK over the last ten years and the technology continues to develop with deployment of increasingly larger turbines. To date, large wind turbines have dominated the wind generation space, though smaller scale systems are in development and starting to be deployed in Urban areas.

Scope and Methodology

Urban wind modelling was carried out over the Trafford Park area[15], with an estimated 21 GWh of potential annual yield across three development types (large scale wind, small scale wind in carparks, small scale wind at roadsides) visualised in Figure 23. The figure below shows an example of an initial scenario output.

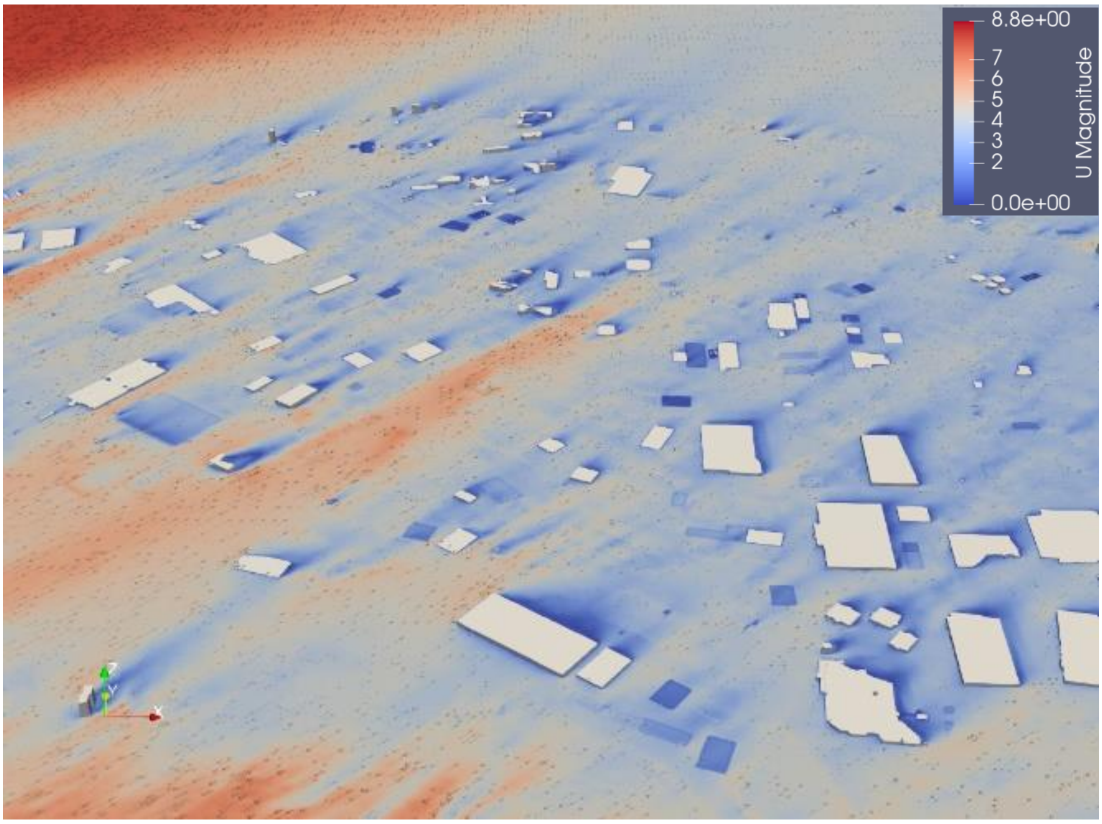


Figure 21: Trafford Park Wind Speed (10m height)

The wind scenarios have been summarised to enable power generation for different placements of wind turbines. Wind has been modelled up to 100m in height over the Trafford Park area. Figure 22 below illustrates where wind is sufficient to harness with turbines up to 20m in height.

[15] Analysis focused on multi-scenario computational fluid dynamics (CFD) modelling within the built environment using historical environmental data to determine average wind speeds

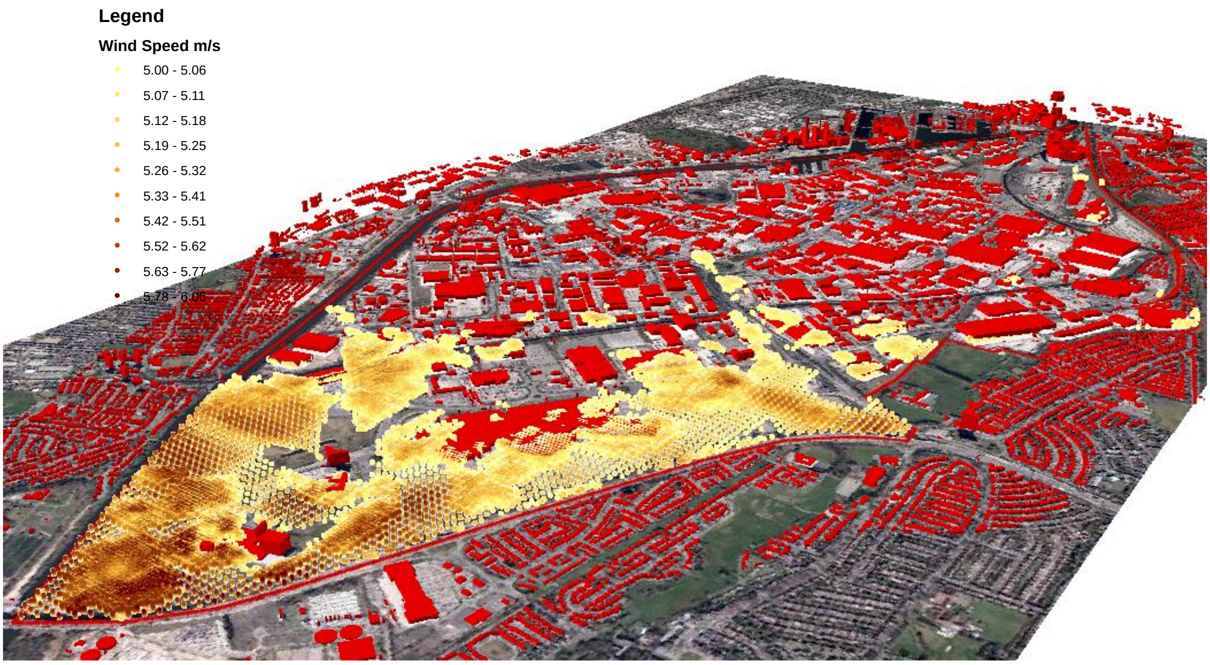


Figure 22: Modelled Average Wind Speed (20m height)

Two types of wind turbine deployment have been assessed.

1. **QR6**: A freestanding vertical axis wind turbine. These are 15m in height and have a maximum generation output of 7.5kW.
2. **DirectWind61**: A horizontal axis turbine with a rotor diameter of 40-61m, a height of 50-70m and an output of 0.5-1MW.

Three turbine placements have been simulated based on wind direction, site suitability, and estimated system space requirements. Scenarios are modelled for QR6 turbines for both car parks and roadside developments.

Carparks: a grid formation was modelled with 20m between turbines. Car parks are advantageous given operational and maintenance requirements for the turbines. Wind turbines may be collocated with solar carports for optimal use of available space and more consistent power generation.

Roadsides: turbines require 3m x 3m x 1.5m foundation, placed in the verges adjacent to roads. Roadside obstacles must be considered, and installation and maintenance is more challenging.

Figure 23 shows the simulated wind placement, with yellow overlays representing smaller turbines and pink markers showing placement of larger turbines. A 50% acceptance is assumed for the smaller scale wind turbines.

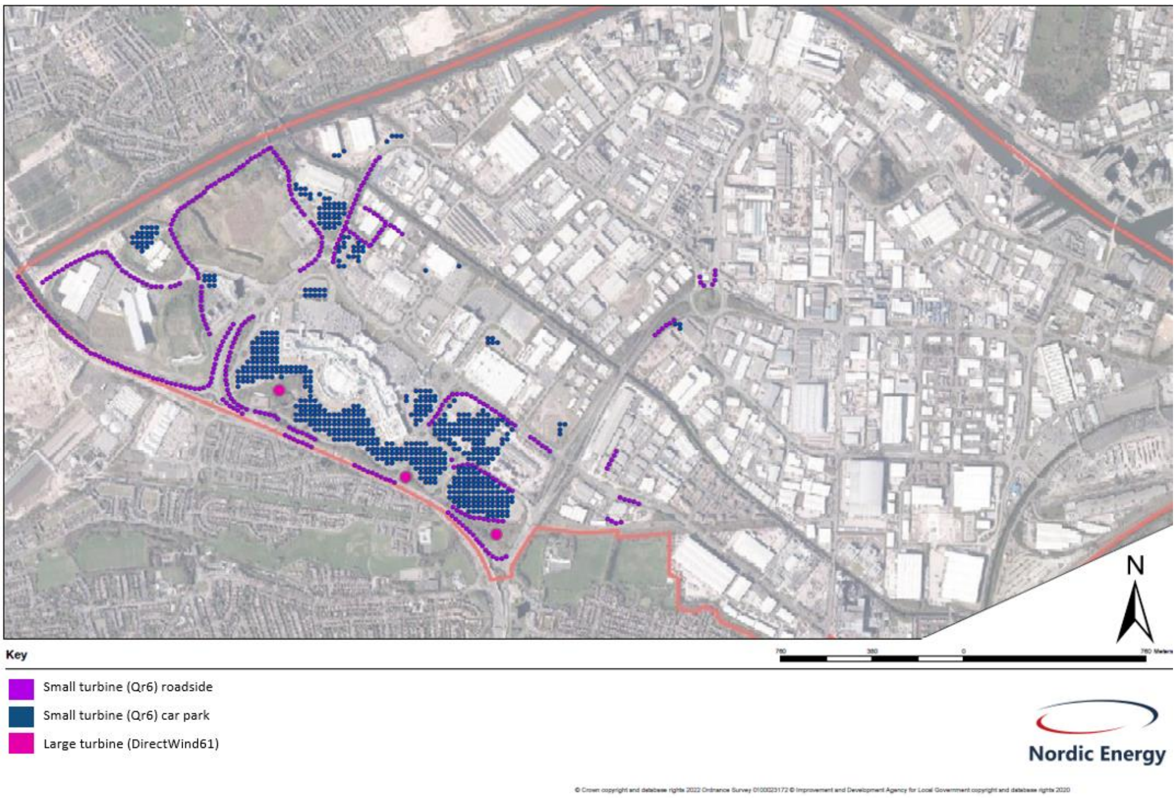


Figure 23: Potential Wind Turbine placement

Trafford Park has been identified as a Low Carbon Growth Area within Trafford's Core Strategy. This lends itself to an area suitable for the future deployment and exploration of wind turbines. Whilst large wind turbines have been modelled, overcoming planning requirements would be challenging. Issues such as noise and shadow flicker would be significant, as well as safety considerations, such as fall over distance in a densely populated working space. This has been considered for large turbines resulting in 5.5GWh/yr installed generation capacity. 15.5 GWh/yr of generation for smaller turbines would be installed on roadside or on car parks would fit within permitted development planning considerations and align with Trafford's Core Strategy. These estimations should be investigated further through a feasibility study in the areas identified in this report. The results of the modelling for each scenario are presented in Table 4. Together, this measure would result in cumulative emissions savings of 9,000 tCO_2 between 2023-2038 when compared against BAU.

Model	Annual Yield
Large scale wind	5.5 GWh
Small scale wind in car parks	9.5 GWh
Small scale wind at roadside	6.0 GWh

Table 4: Annual yield for each turbine size and placement assessment

Capital expenditure has been estimated based on internal supplier databases and previous project experience. For wind this equates to large turbines capex of ~£1.25M per turbine and smaller turbines at £50k each. Operation and maintenance costs are assumed to be ~3.5% of capital value for large wind turbines and 1% for smaller turbines. Replacement expenditure has been estimated at 20% of the capital cost to cover major overhaul such as the rotor blades and internal workings. Savings and revenue are estimated at between £2-3 million after full implementation. Export prices are modelled against market rates with large swings in sensitivity due to the uncertainty of future market prices. Detailed techno-economic modelling should follow to refine this strategic assessment.

The build out of small- and large-scale wind turbines across Trafford Park is expected to provide short-term job opportunities for about 25 installation professionals with construction and electrical skills, and around 10 permanent positions including for conducting electrical work, maintenance, and operational controls, monitoring and reporting.

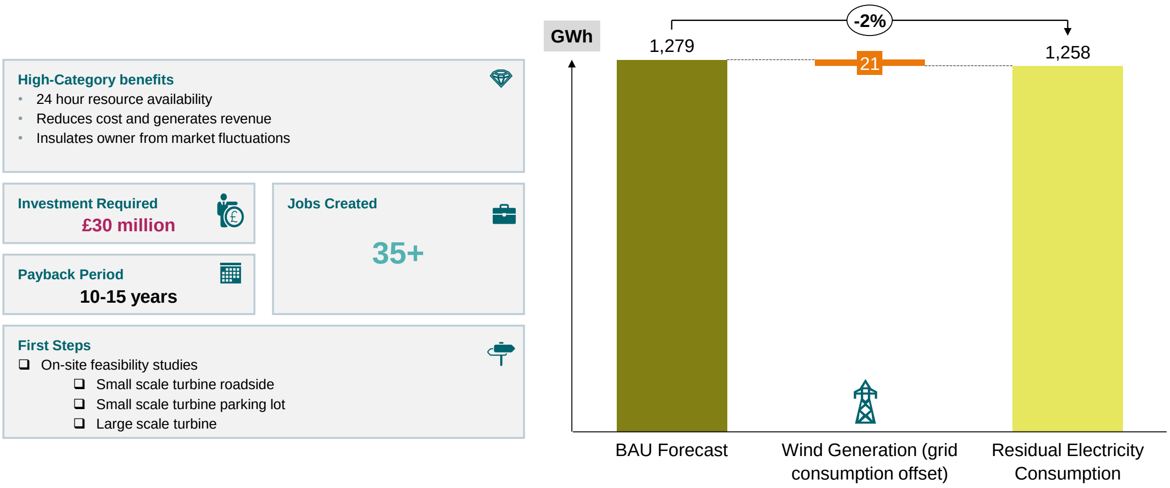


Figure 24: Key figures for small- and large-scale wind generating 21 GWh per year

4.3 Waste to Energy

Waste to energy is the process of extracting energy from waste either by direct combustion or production of synthesised gas for combustion. A range of combustion and gasification processes exist, and a high-level synthesis of these two main methods can be reviewed in Appendix B. For this analysis, conventional mass burn incineration technology is considered.

GHG related to energy from waste is determined by the composition of the waste inputs. Energy from Waste (EfW) processes via an Energy Recovery Facility (ERF) offset landfill, and when coupled with carbon capture and storage can have a negative carbon footprint. This is due to an amount of the waste in the feedstock being made from biogenic materials, which pulls in and stores carbon from the environment as it develops as part of its lifecycle – this is known as short cycle carbon having its lifecycle in the last 100 years.

Scope and Methodology

The Greater Manchester Combined Authority (GMCA) has a contract with Suez to handle, sort and transport municipal waste from 9 Greater Manchester Local Authorities, including Trafford, amounting to an estimated 980,414 tonnes per year (tpa), with residual waste of 563,331 tonnes per year, in 2028[16]. The waste management operation key parameters include Waste Collection Authority (WCA) material from kerbside collection and Household Waste & Recycling Centre (HWRC) material:

[16] Earliest break clause with Suez allowing for shift to ERF system

GMCA Waste inputs as from WCA and HWRC's		Tonnage
Source Segregated (SSR)		90,007
Comingled Recycled (CMR)		112,143
Biowaste		131,508
Recycling		46,764
Green Waste		9,058
Rubble		27,603
Residual		563,331
Total	**tonnes/a**	**980,414**

Table 5: Waste tonnage by type

- Residual Waste (potential fuel/solid recovered fuel) **563,331 tpa** by 2028-29
- 20 Household Waste and Recycling Centres
- 7 Transfer Loading Stations where council vehicles deliver household waste and recycling
- A Materials Recovery Facility where mixed recycling is sorted
- 5 Mechanical Treatment and Reception Facilities where general waste is prepared and delivered to the Energy Recovery Facility in Runcorn
- A Thermal Recovery Facility
- 3 Renew retail shops
- 1 Renew Hub

In 2018-19 there was a residual waste level of 530,000 of the 925,809 tpa input after recyclables (Plastics/Metals), compost material, and food waste was sorted and removed. This is forecast to become 980,414 tpa with a residual content of 563,331 tpa by 2028-29, when it will be possible to break existing contract conditions with Suez and obtain feedstock for ERF processes. New contract conditions will also allow for a redefining of waste supply parameters as required to optimise for its use as ERF feedstock.

325,000 tpa is contracted to be exported to INEOS Chlor near to Runcorn to a Thermal Recovery Facility (TRF). From this, an available fuel feedstock at a solid recovered fuel (SRF) specified state of 11-12MJ/kg[17] of 238,000 tpa from across all of the GMCA area could be utilised for an ERF facility.

At present GMCA is sending circa 10% of its waste to landfill – the majority is residual waste, which can be used as an ERF fuel feedstock for use by GMCA.

Whilst the identified 238,000 tonnes of residual material in 2028-29 is substantial enough to run an energy from waste facility, consideration should be given to the feedstock volumes from within Trafford and its closest other GMCA Local Authorities to minimise cross-city transport needs and maximise local energy generation. Therefore, considering localised feedstocks as plant input from Trafford, Salford and Manchester, a level of 170ktpa is possible. From present waste arising data, this feedstock is estimated to have a thermal input of 11-12MJ/kg.

[17] The thermal value of this SRF is subject to assessment and verification during the feasibility phase for this measure. ERFs can be specified to handle unsorted residual municipal solid waste streams. The ultimate blend will affect the operational cost element of the material shipment, which will be part of contract structuring.

A 170kt ERF facility could generate approximately 520GWh of thermal output at 11 MJ/kg. After plant loss of ~20% the thermal output would be ~420GWh/yr – with the ERF facility focused on heat for a district heat network (DHN) feed, the electrical generation would be up to 85GWh/yr. There are many technical considerations in the design and outputs, but when approached as a heat, cooling, and power facility it could deliver 335 GWh/yr of low carbon energy to the Trafford Park area. This would result in cumulative emissions savings of 316,000 tCO_2 between 2023-2038 when compared against BAU.

A visual assessment for placement of an energy from waste plant was undertaken factoring for technology normally required to deliver gasification with carbon capture with the typical on-site requirements for an ERF plant taken into account. These requirements are listed in Appendix B.

Three sites[18] were identified as opportunities for an ERF facility, two of which have a footprint of 3 Ha or greater[19] as shown in Figure 25. To summarise, the identified sites were:

1) **2 Hectare site**: no existing buildings, with potential for import waste across the water body
2) **5 Hectare site**: existing waste facility, would need redevelopment. Planning may be less desirable here due to new developments underway to the southwest.
3) **4 Hectare site**: currently assigned to parking, with potential to import waste across the rail system

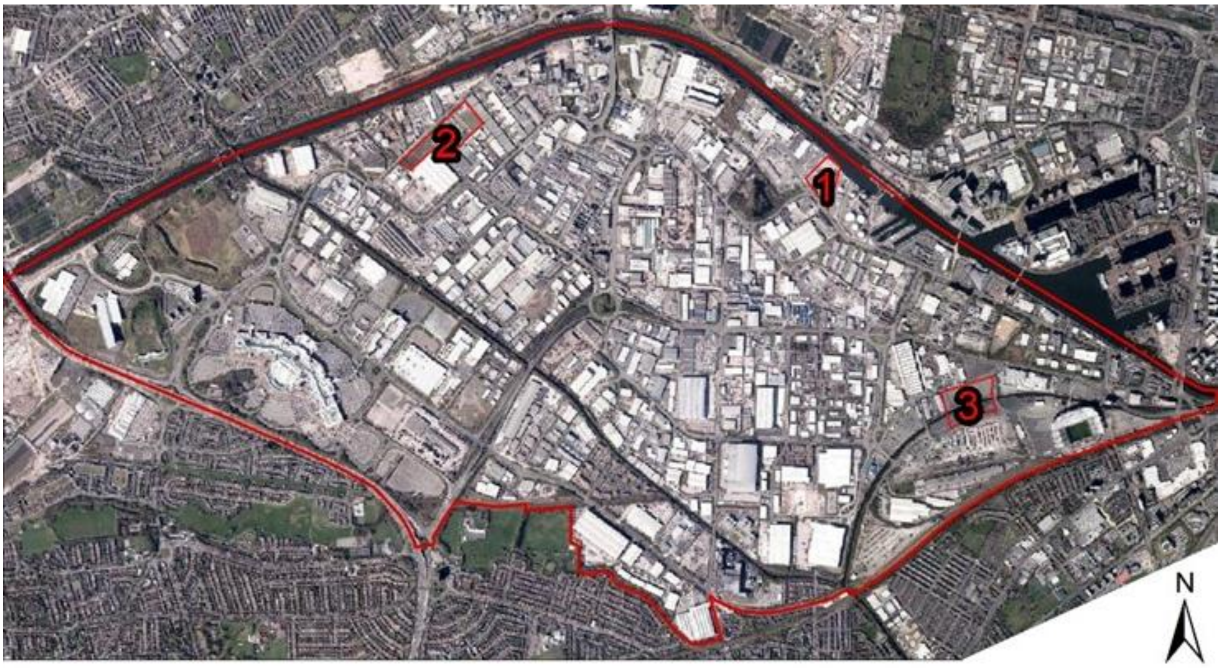


Figure 25: Potential Site for Energy from waste facility

The above three example sites' proximity to residential buildings should limit planning restrictions, likewise proximity to road infrastructure and the canal and railway eases transport of waste.

An ERF is a real opportunity within Trafford Park. This needs to be approached with a long-term outlook given the pre-existing contractual waste disposal contracts in place. It should be noted that not all waste is

[18] Identified sites will require discussion and agreement with private land owners and neighbouring businesses prior to any detailed feasibility and implementation

[19] Larger site can accommodate carbon capture and storage for enhanced CO_2 savings

contracted, approximately 10% (~100,000 tonnes) of Greater Manchester's waste is sent to landfill which would be ideal for diversion into an ERF facility. This would make an ERF deliverable in stages, where a facility is created with future capacity expansion built in to take in new waste as it became contractually available and support the growth of a heat/cooling network. Given the scope and nature of the feedstock for an EfW solution, GMCA may consider leading implementation of this measure in the context of Greater Manchester's net zero transition.

Should the ERF be focused purely on heat recovery, with distribution through a district heating network, up to 500 GWh of heat could be supplied to Trafford Park, this would account for 40% of the annual demand. ERF heat output is high grade and could be supplied as steam where necessary for industrial processes.

Capital expenditure has been estimated based on internal supplier databases and previous project experience. For design and build this equates to an overall cost of £250-£300 million. Maintenance has been estimated at 20-30% over 40 years with an overall O&M cost of approximately £12 million including consumables. Export energy prices have been modelled against market rates with significant sensitivity due to the uncertainty of future market prices. Expected revenue for the designed EFW facility is estimated at between £32.8 and £40 million per year, with an operating profit of between £26 and £32 million per year. Detailed techno-economic modelling should follow to refine this strategic assessment as part of a feasibility or FEED (front-end engineering design) study.

Job creation estimates includes a FEED study team of 30 people for design and contract development, and a deployment team of 300 on-site professionals and construction workers for the build and commissioning stage. 35 full time posts are estimated for ongoing O&M activities, plus bi-annual maintenance activities requiring around 30 professionals on a temporary (one month) basis.

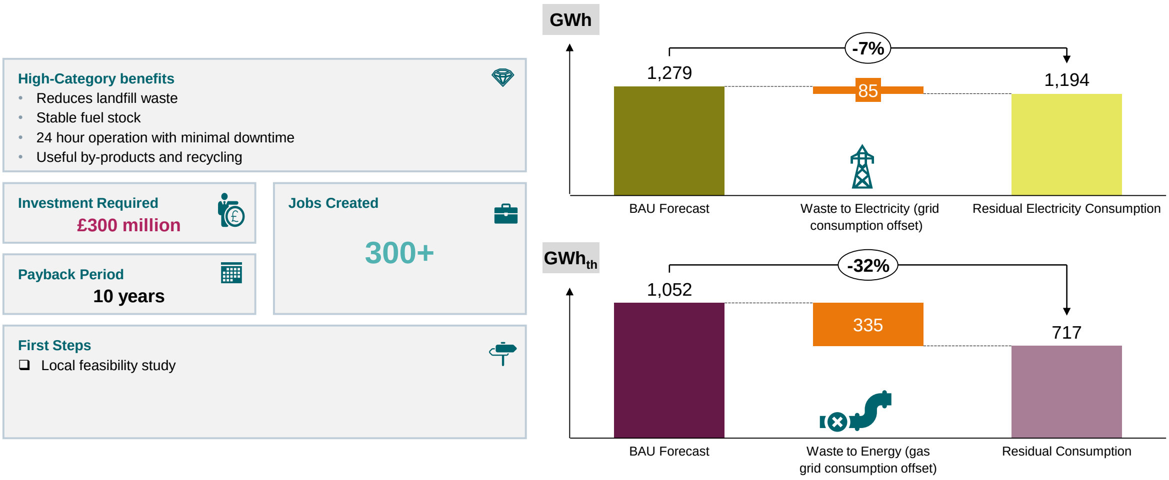


Figure 26: Key figures for a Waste to Energy facility generating 335 GWh_{th} of heat, and 85 GWh of electricity per year

4.4 Combined Heat and Power

Combined Heat and Power (CHP) or cogeneration is the highly efficient process of converting a single fuel into both electricity and heat at the point of use. A commercial CHP unit turns 60% of its input energy into heat and 30% into electricity giving an overall efficiency of up to 90%. Individual units can also modulate their outputs, typically between 50% and 100% to match the base heating load required.

Due to national decarbonisation initiatives, the carbon content of electricity[20] has plunged over the last decade and is forecast to reduce rapidly until 2035[21], while reduction in carbon intensity of the gas network over the same period will be minor[22]. This decarbonisation on the electricity grid has had a profound impact on the carbon content of heat produced by CHP, which has increased markedly, and heat pumps, which have steadily decreased.

There are significant short-term challenges with the supply of heat pumps and the skillsets required to install them. While these technologies are less suitable for industrial purposes, heat pumps are highly likely to replace gas as the dominant form of heat in the UK. This means that natural gas fails to perform against the grid longer term and becomes less competitive as a clean energy source. In the short to mid-term, however, gas CHP can provide CO_2 reductions while the electric grid remains emissions intensive, particularly when leveraging carbon capture and storage technology. Likewise, CHP is a main heat source to leverage to increase the scope of a local DHN network, and can be adapted to capture future opportunities for a potential transition to hydrogen.

In some instances where an organisation has a process requirement for CO_2, such as glasshouse growers or producers of carbonated drinks, the production of CO_2 from carbon-based fuels may continue to be an economic consideration.

Scope and Methodology

A 40MW gas fired CHP with CCS could deliver a total power requirement of 300GWh with heat output of about 400 GWh_{th}. This would result in cumulative emissions savings of 457,000 tCO_2 between 2023-2038 when compared against BAU.

Two approaches were considered for the introduction of additional gas CHP engines within Trafford Park:

1) Small scale CHP distributed to each building that currently has a gas boiler
2) Centralised solution that feeds a district heating network

The first option is less favourable as a decarbonisation pathway for Trafford Park. Grid decarbonisation forecasts mean that gas is comparatively carbon intensive when carbon capture and storage is not included. A decentralised CCS system would need to be installed in each site along with a larger plant room, bringing significant logistical challenges related to the space requirements of the total system. Additionally, the economic benefits of power generation become less favourable as gas levies increase. Therefore, this option has not been explored further as part of this study, although it should be noted that it currently has very favourable payback periods due to the current differential between gas and electrical prices.

The second option assesses a 40-80MW CHP system. The footprint required for this kind of infrastructure would be challenging given the land constraints within the Trafford Park area. The only sites identified are those proposed for the ERF in Figure 25. This would be likely limited to a 50MW boiler site with 90% CCS.

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[20] The amount of CO_2 required to produce a unit of electricity

[21] Gov.uk Build Back Greener

[22] BEIS conversion factors

During operation of the facility, land use and development changes would need to be considered for expansion to facilitate additional CCS if the transition to hydrogen does not develop as envisaged.

A 40MW gas fired CHP could deliver a total power requirement of 300GWh/r, with a larger system delivering up to 600GWh/yr. It is anticipated that the heat offtake would be around 400 GWh/yr. A heat network and private wire system would be the most economical way to deliver the two energy vectors to businesses within Trafford Park.

Carrington power station operates a combined cycle gas turbine engine with a total capacity of 844MW. While outside of Trafford Park, this facility could provide the complete thermal requirements for Trafford Park if in continuous operation. Land availability is more prevalent on the site's location for additional carbon reducing measures. The potential for this site is being explored as part of the Heat Network Zoning Pilot and should be investigated alongside this study, aiming to deliver a district heating pipe towards the centre of Manchester and passing through Trafford Park. To explore these opportunities related to Carrington power station, Trafford Borough Council could open discussions with the North West Hydrogen Alliance and the plant operator (Electricity Supply Board[23]).

The overall view regarding gas powered CHP remains uncertain due to current geopolitical factors, making gas significantly more expensive in the wholesale market[24]. At 220p/thm the kWh price is around 7.5p/kWh. Historically the price has hovered around 50p/thm, which equates to a wholesale price of 1.7p/kWh. The industry outlook for future price direction is divided, but the expectation is that it will take time to return to lower levels. The wider geopolitical direction to divest from Russian gas introduces inherent risks to the overall business case, in part due to price volatility.

References to CCS utilisation in tandem with CHP is in alignment with regional and national developments on carbon capture. In the North West and the North East there are targeted programmes and infrastructure in development which will enable CCS. An example of these programmes is the Hynet partnership's development of CCS infrastructure for capture and transport of carbon alongside its rollout of hydrogen, which will be brought to the Carrington Power station as part of Hynet 2, and within 10km of Trafford Park linked to Hynet 3. Likewise, in the North-East, Suez have outlined plans for CCS on their existing Tees Valley (EfW) plant as part of the wider Northern Endurance Partnership (NEP). Associated costs for CCS in the context of Trafford Park have been incorporated in capex estimates below, pending a focused feasibility study.

Capex is estimated based on 20 gas CHP internal combustion engines of 2 MW capacity each, with CCS train and heat interface with DHN supply, costed at £2 million per engine. For complete design and build, this results in an overall cost of £60 million. Maintenance has been estimated at 5% over 25 years, accounting for downtime services every 8-9 years. Operation and maintenance cost is estimated at 2% of capital expenditure, not including fuel costs. Revenue from heat and generation sales are estimated at £6 to £8 million per year, noting that operational periods would relate to peaking load requirements and high sale

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[23] ESB Group is an Irish electricity company with expanding operations in the UK including Carrington Power Station
[24] UK Natural Gas Wholesale (Trading Economics)

values rather than continuous operation. An estimated 180 short term jobs for design, construction and commissioning are expected for the scale of CHP outlined, with an additional 20 permanent roles for plant operations and maintenance.

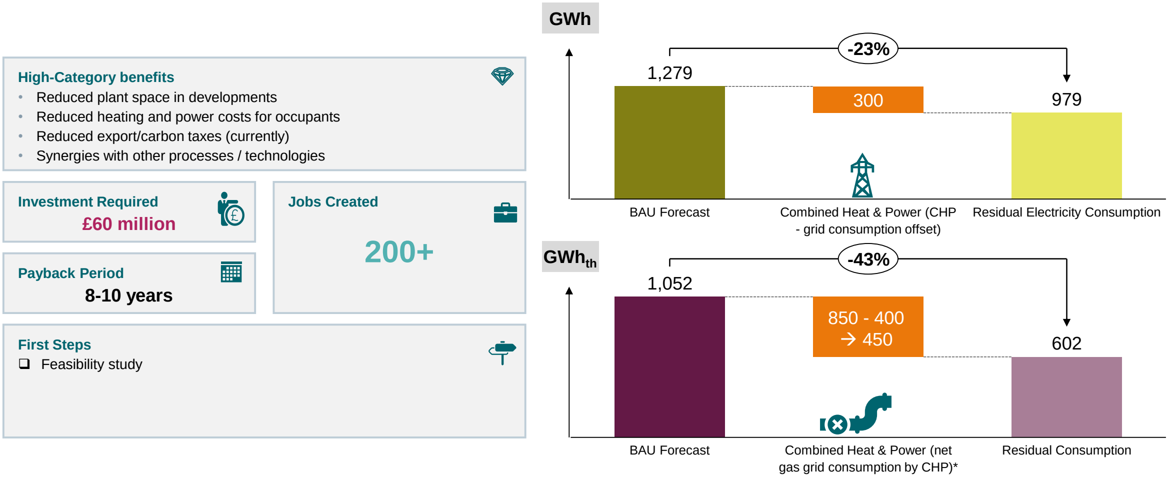

Figure 27: Key figures for CHP developments generating 400 GWh_{th} of heat, and 300 GWh of electricity per year

4.5 Waste Heat Recovery

Waste heat is the energy generated in industrial processes which is not put into any practical use and is lost. Waste heat recovery is the collection of this heat for use. This can be conducted through various recovery technologies to provide valuable energy sources and reduce overall energy consumption.

By considering the heat recovery opportunities for energy optimisation in the steel and iron, food, and ceramic industries, a revision of the current practices and procedures is assessed. The research is conducted on the operation and performance of the commonly used technologies such as recuperators, regenerators, including furnace regenerators and rotary regenerators or heat wheels, passive air preheaters, regenerative and recuperative burners, plate heat exchangers and economisers and units such as waste heat boilers and run around coil (RAC) around the exhaust stack.

Waste heat recouping methods range from the simple to the complex with a range of techniques now available “off the shelf” such as:

- direct contact condensation recovery
- indirect contact condensation recovery
- transport membrane condensation

Each of these approaches can have a particular heat range target or operational requirements for an optimal energy recovery efficiency by way of:

- as heat pumps, heat recovery steam generators (HRSGs)
- heat pipe systems
- Organic Rankine cycles (ORCs), that exploit the Stirling Cycle and the Kalina cycle, that recover and exchange waste heat with potential energy content

Modern combined cycle gas turbines (CCGT) represent heat capture optimisation as the primary gas turbine operation heat is used to raise steam for a 2nd stage steam turbine application, and there is opportunity for a 3rd stage to utilise the medium to low temperature outfeed from the 2nd stage to be used in an ORC system for an additional 3-4% gain. There is still the opportunity for post ORC heat to be exported into a DHN.

Where CCGT are not the waste heat source, heat recuperators on exhaust stacks from ovens, cookers, baking, plants, furnaces, and kilns would capture waste heat from furnaces, mills, and heating processes at the site entities, which via heat exchanger systems feed into the space heating normally fed from standalone natural gas boilers (as in office/warehousing spaces) or for export into a DHN.

Scope and Methodology

An estimated 196 GWh/year of waste heat could be captured at Trafford Park based on an analysis of waste heat hotspots shown in Figure 28 and Table 6. This would result in cumulative emissions savings of 180,000 tCO_2 between 2023-2038 when compared against BAU.

The waste heat opportunity for the top leading natural gas users can be mapped as a range of cluster "hotspots" for further analysis and consideration for heat export options as shown. There is an opportunity to capture waste heat from energy intensive operations in Trafford Park, including Cargill, SCA/Essity, Kellogg's, Procter and Gamble, and others.

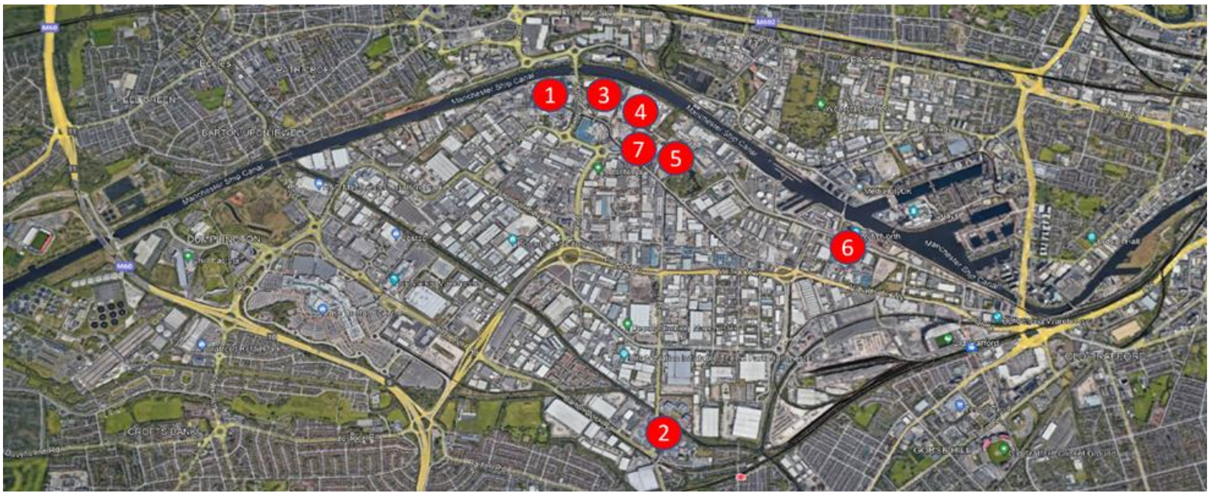

Figure 28: Waste Heat Hotspots that represent 38.2% of the overall Natural Gas consumption

No	Site Name	Post Code	Thermal NG Input GWh	Pot. % Heat Offtake	Pot. Waste Process Heat GWh	Comment
1	Cargill	M17 1NX	274.1	45%	123.3	Milling plant/flour drying – CHP Gas Turbine
2	Kellogg's	M32 0YQ	24.4	40%	9.8	Milling & Cooking
3	SCA/Essity	M17 1EQ	113.5	35%	39.7	Paper & Pulp processing
4	Procter & Gamble	M17 1NX	18.4	35%	6.4	Process Heat
5	CEMEX	M17 1NH	17.4	35%	6.1	Asphalt plant
6	Whitworth Bro's	M17 1FT	17.4	30%	5.2	Milling plant/process – Bakery
7	Unilever	M17 1NH	17.5	30%	5.2	Food Prep/cooking
Total – Park Thermal Input 1,263 GWh			482.6	41%	195.7	This is 38.2% of the Park Thermal input and sees a 15.4% recovery level

Table 6: energy intensive emitter profiles for waste heat offtake

Using waste heat on site or for export will result in carbon reductions from avoided fossil fuels. Export also provides additional revenue streams, which can provide additional security to plant operations and local jobs.

Businesses benefit from using high temperature heat in medium to low temperature processes down or upstream of the principal operation. This avoids fossil fuel use, both reducing fuel costs and carbon emissions. Low temperature opportunities will normally lie on site for office and warehouse space heating and hot water supply, supplementing individual boiler sets. If the initial temperature is high enough there is also the potential for electrical power generation via ORCs.

Once internal utilisation opportunities have been realised, excess heat may be used as a saleable commodity for neighbouring processes or space heating. If the waste heat is of sufficient volume and of a DHN temperature level it could be used via WHR for supply into local thermal heat accumulators and DHN infrastructure which would be of great interest to Trafford Park.

Every MWh of heat that can be captured and utilised can give a saving of 0.203 t CO_2e/MWh when replacing natural gas. If 1GWh of heat can be captured and utilised it will mitigate 203 t CO_2e as a carbon reduction from that operation within the local authority. This may reduce future costs stemming from carbon tax as in a UK/EU ETS system with the UK moving to a £80/tonne CO_2e carbon price by 2035[25].

With the increasing cost of fuel, the capture and reuse of waste process heat can have a direct effect on a business's operational costs. Given present price fluctuations and differing supply contract criteria, a specific cost saving for internal reuse is difficult, but for every MWh of heat reused a saving of £46.20 can be expected based on UK Government fuel price statistics as for Jan-Mar 2022 at 4.62p/kWh. For a large natural gas consumer on the park using around 275 GWh of natural gas pa with a cost £12.66 million pa, a 10% re-use of waste heat equates to a £1.27 million pa saving before potential heat exports to a third party.

[25] Gov.uk Future Carbon Pricing

The overall natural gas consumption at Trafford Park is estimated at 1,300 GWh/yr, within which around 55%, or 695 GWh of the consumption is attributable to the largest process-based businesses. Considering the largest natural gas energy users, including Cargill, Essity, Kellogg's and P&G's operations, the level of natural gas thermal input is at around 38% of the park's consumption at 483 GWh/yr. Given virtually all this is related to process heat or the running of site-based CHP systems, the level of waste heat has been evaluated to be considerable, comprising three main clusters over the park, aiding supply into DHN developments (see DHN chapter 4.8).

Capex is estimated based on 20 waste heat recovery nodes, installed within the clusters identified in Figure 28 generating $10GWh_{th}$ each at 95% uptime, costed at £2 million per node. For design and build this equates to an overall cost of £40 million. Maintenance has been estimated at 2% over 30 years, accounting for the exchange of fluting and vanes every 10 years. Opex is estimated at 1% of capital expenditure, including annual cleaning and scaling procedures. Revenue is estimated at between £5.5 and £7.6 million per year for the combined system. An estimated 40 temporary job during design, construction and commissioning are anticipated for the scope of system outlined in this analysis. An additional 10 permanent roles for operation and maintenance will likely be accommodated by existing engineering maintenance operations of the as identified sites.

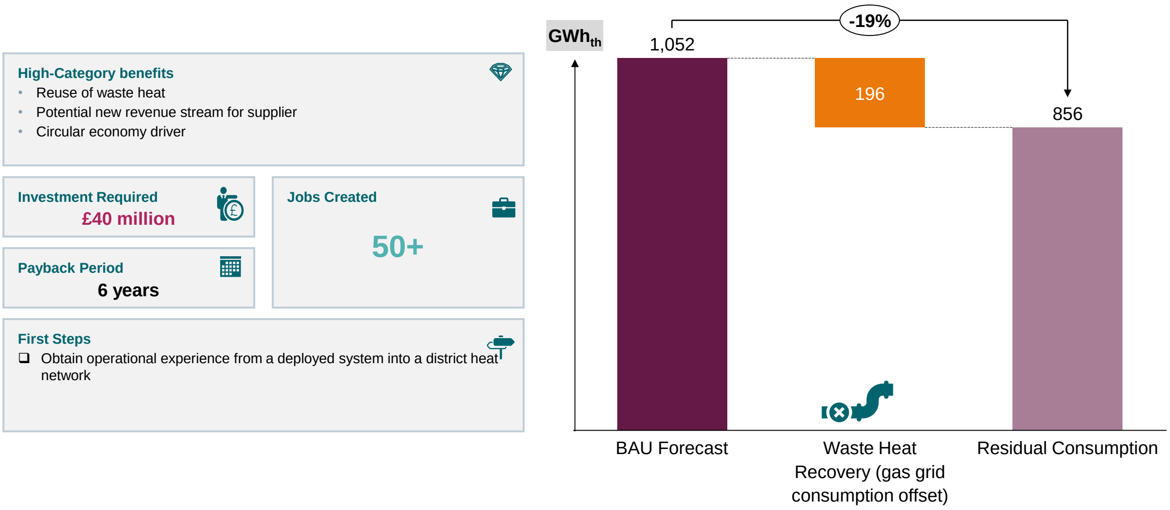

Figure 29: Key figures for Waste Heat Recovery developments generating 196 GWh_{th} per year

4.6 Geothermal Heat

Geothermal energy is heat that is derived within the subsurface of the earth. The heat is naturally renewable and is generated from the radioactive decay of materials in the earth's core. The estimated temperature of the earth's core is 6,000°C. This energy has been harnessed for centuries and the typical temperature gradient increased by 25-35 degrees per km drilled in the UK.

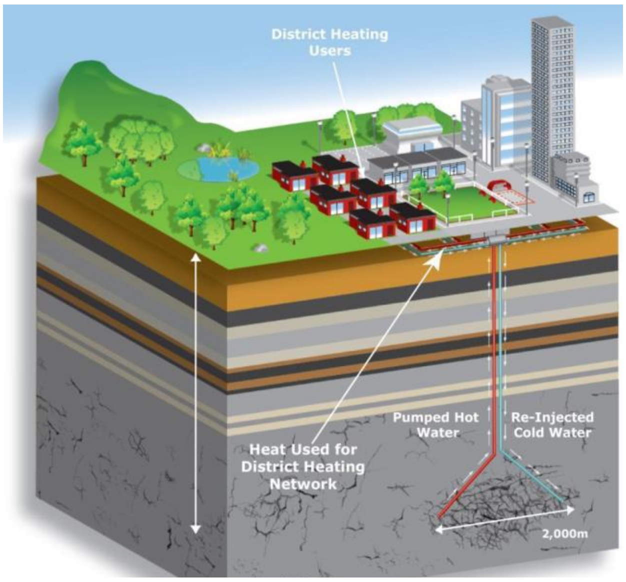

Figure 30: Visualisation of Geothermal Heat system (Source: GT Energy/ IGAS)

Dependent upon temperature, geothermal can be used for electrical production, heating and cooling. Geothermal energy is harness by drilling a well into a deep aquifer and pumping hot water to the surface. The hot water is then pumped through a heat exchanger which can provide heat for a district heating network. The cooled geothermal fluid is then recycled back down into the aquifer via a second re-injection well.

While deep geothermal energy is widely recognised as a source of low carbon heat, there are few specific assessments of the carbon intensity of low-enthalpy deep geothermal, studies have mainly focused on geothermal power or higher enthalpy heat. As such there is little information regarding the downstream process, this is also in part due to the long nature of the resource (100+ years). Deep geothermal has been slow to develop in the UK despite the technology being well proven in other European countries. It was only in 2021 that the first deep geothermal site signed a power purchase agreement, including heat produced at the plant.

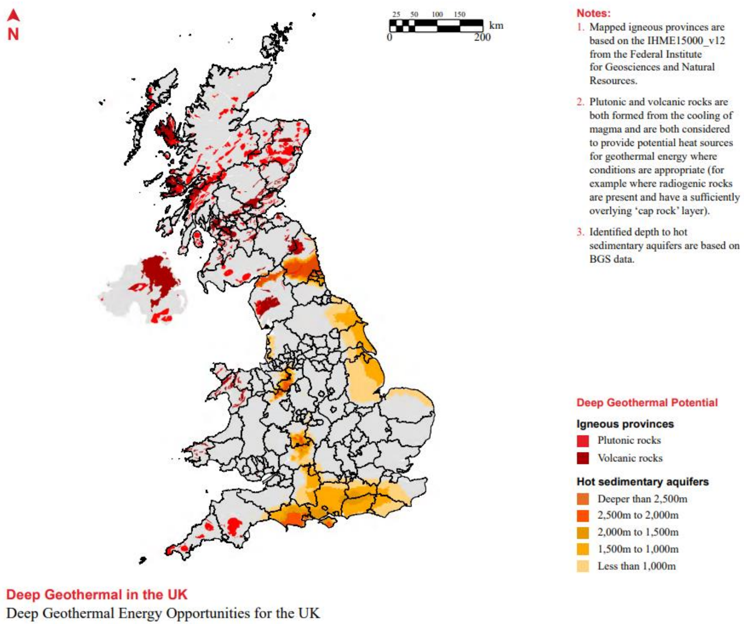

Figure 31: Deep Geothermal in the UK (Source: REA & ARUP)

Geothermal is very much in its infancy within the UK but is in a favourable position to be a staple technology option within the UK's transition to low carbon energy.

Scope and Methodology

Trafford Park could potentially produce upwards of 45 GWh/year of geothermal heat based on its subsurface geology should a deep geothermal project prove successful. This would result in cumulative emissions savings of 63,000 tCO_2 between 2023-2038 when compared against BAU.

Previous studies highlight a lack of opportunity for geothermal energy. While this is true for shallow geothermal options linked to heat pumps, deep geothermal potential around Manchester may provide an opportunity for Trafford Park, subject to a detailed feasibility assessment.

Available information from the Open Geophysical Library[26] provides insight into previous work that has been undertaken on the geology of Trafford Park.

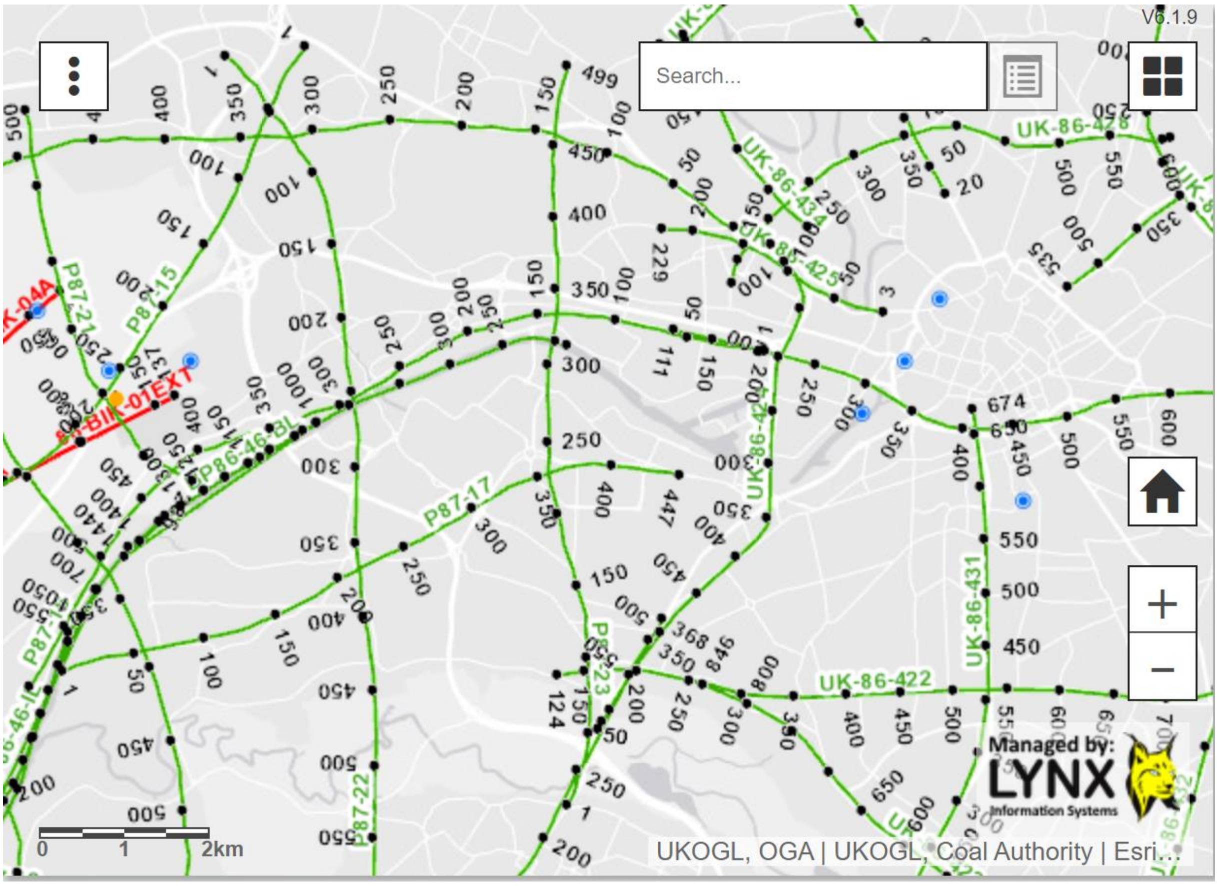

Figure 32: Trafford Park shallow borehole sites[27]

Further engagement with markets holding private information regarding the geology was conducted. IGAS/GTENERGY provided data from their modelling for Manchester, which is pertinent to Trafford. After appraisal of subsurface potential, the surface requirement was investigated. Delivery of the geothermal requires up to 8,000 square meters during construction and 500 square meters subsurface for operation of the geothermal plant. It also requires access for maintenance as and when required. Car parks are a credible delivery option for geothermal as indicated in the following figure.

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[26] Open Geophysical Library
[27] Open Geophysical Library

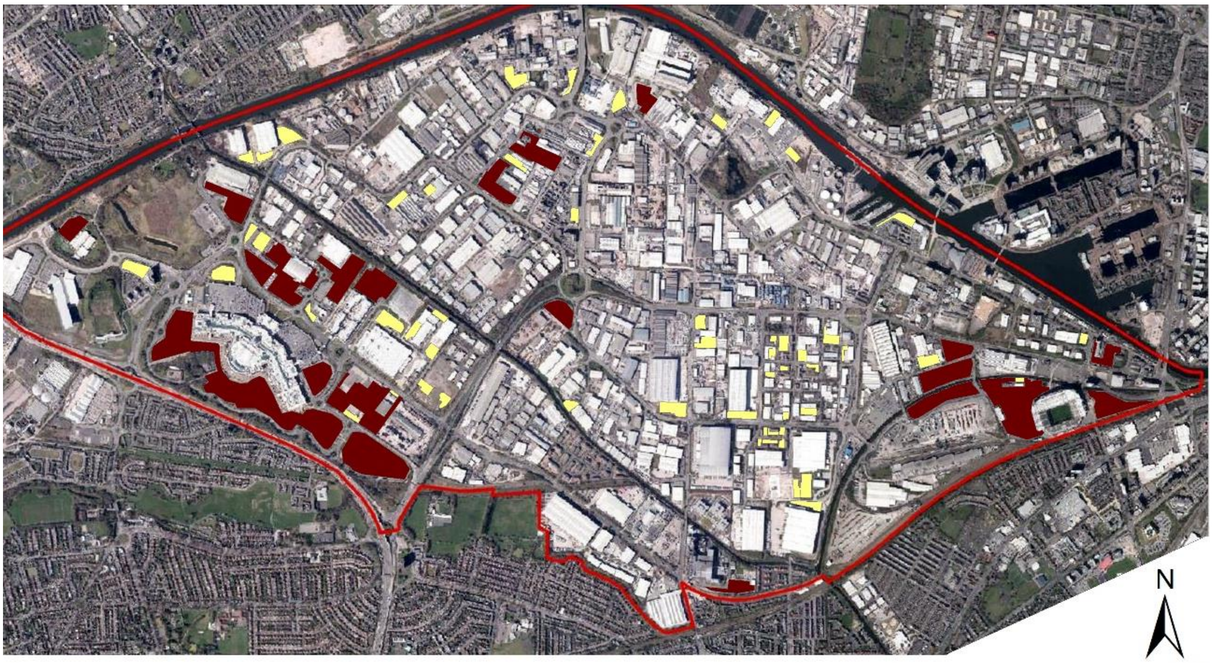


Figure 33: Car Park Area Trafford Park

Results suggest that a limestone layer with a depth of 2.5 – 3.5km could be targeted. The further west a site is positioned from Manchester, the shallower the aquifer. IGAS/GTEnergy has previously encountered temperatures of circa 70 degrees at 2.1km depth in an exploration well west of Trafford which indicates a good temperature gradient (~35°C per km).

This provides confidence to deliver temperatures of 90-95 degrees. There is potential for up to 3 well doublets, these could be individual plants located in different areas, or six wells from a single pad. This would equate to over 30MW of heat capacity.

GTEnergy are currently looking for projects of this type and would need at least 40GWh/yr of heat demand to justify the first doublet. An initial project plan at Trafford would align with this scope, pending further feasibility. Dependent upon load the offtake price is expected to be in the region of £35-70 MWh.

Deep geothermal is a more innovative technology but there is very limited experience in delivery of these schemes in the UK. Capital expenditure has been estimated from supplier engagement and exploratory work undertaken in different regions of the UK, and sense checked against international knowledge of deep urban geothermal systems. It is estimated that the capital expenditure would be in about £15M-£20M per doublet (a pair of boreholes), of which three could be feasible within the Trafford Park Area. O&M costs have been estimated at 0.015% -0.03% of capital expenditure. Profit has been modelled, with sensitivities, to be between £1.2 to 3 million per year. Detailed techno-economic modelling should follow to refine this strategic assessment.

The geothermal plant is expected to require 5-7 full time operational staff, plus around 50 short-term workers to undertake initial construction activities. Skills requirements during pre-feasibility, development, surface and subsurface preparation, and operation and maintenance will require personnel including geologists, geochemists, drillers, reservoir engineers, and hydraulic engineers.

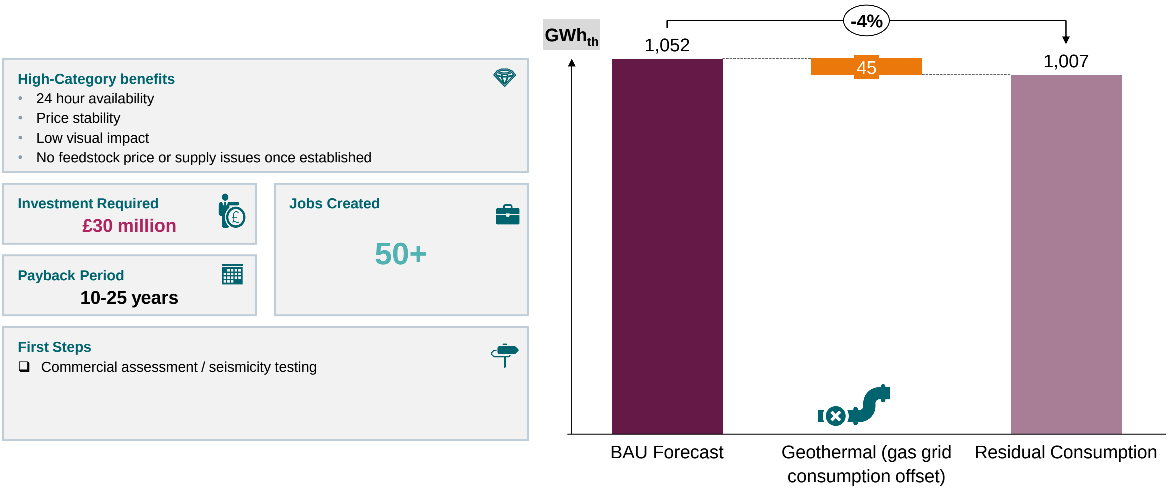


Figure 34: Key figures for a Geothermal Heat facility generating 45 GWh_{th} per year

4.7 Hydrogen

Hydrogen is widely regarded as an energy-dense, low-carbon alternative to fossil fuels as when burnt it releases only water and minimal NOx[28]. However, there are uncertainties around its application and availability at scale as supply chains are limited, and it is expensive and energy-intensive to produce. Hydrogen is processed from a feedstock with various methods of extraction that are categorised using ‘colour’ terminology (see Table 7).

Colour terminology	Process	Feedstock or electricity source	High-level emissions contribution
Green	Electrolysis	Renewable energy	Zero / low
Purple / pink		Nuclear	Low
Yellow		Mixed – grid electricity	Medium
Blue	Natural gas reforming with carbon capture and storage/gasification with carbon capture and storage	Natural gas or coal	Low[29]
Turquoise	Pyrolysis	Natural gas	Solid carbon by-product
Grey	Natural gas reforming		Medium
Brown	Gasification	Brown coal	High
Black		Black coal	

Table 7: Hydrogen colour terminology associated with feedstock, process, and emissions

The market for hydrogen is in its nascent stages and despite there being significant political and industry interest, future availability is largely unknown. Figure 35 illustrates best- and worst-case availability scenarios.

[28] Nitrogen oxides: a type of air pollutants produced by the combustion of fossil fuels. NOx emissions are associated with respiratory issues and the formation of smog in industrial areas and transport hubs
[29] Additional emissions likely from distribution pipe leakage and extraction processes

Of note, as a best-case, despite 15 TWh of hydrogen fueled residential and space heating available by 2050, this still only represents about 3% of total space heating demand[30]. Most experts believe hydrogen fuels will be prioritised for difficult-to-decarbonise sectors such as aviation, shipping and heavy industry.

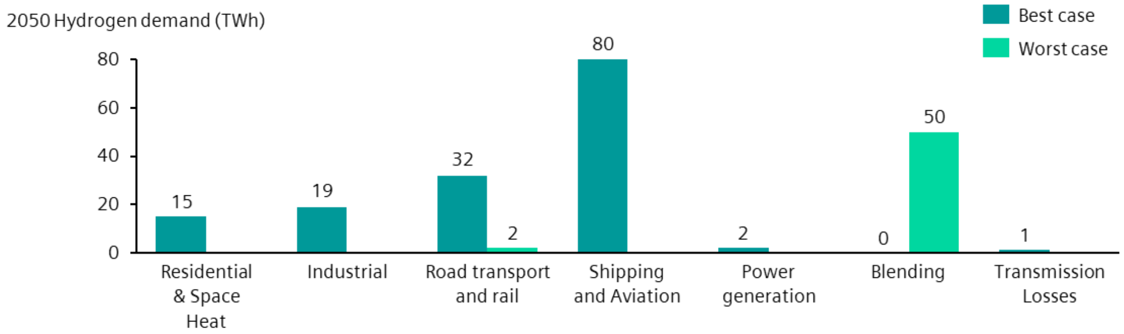


Figure 35: Scenarios for Hydrogen availability in 2050 – Best and Worst case. Reference: National Grid – Future Energy Scenarios 2021

Scope and Methodology

Trafford Park has been identified as a 'hydrogen from heat' and 'non-domestic' opportunity area as part of Greater Manchester's Local Energy Plan for long-term deployment[31]. As a result, this report will focus on the potential consumption of Green and **Blue** Hydrogen as a source of zero-low emissions fuel for industrial processes at the site.

The future of hydrogen for heating is uncertain despite there being many infrastructure projects aiming to develop hydrogen supply and distribution. There is no guaranteed commitment that hydrogen will be available at volume for Trafford Park tenants, however, based on current planning applications and proposals in the North West up to 29 GWh/year of industrial process heating could be supplied by 2038. There will likely be increased fuel costs when compared with an equivalent natural gas supply, and tenants will need to invest in plant refurbishment or replacement as well as hydrogen storage assets in the short term.

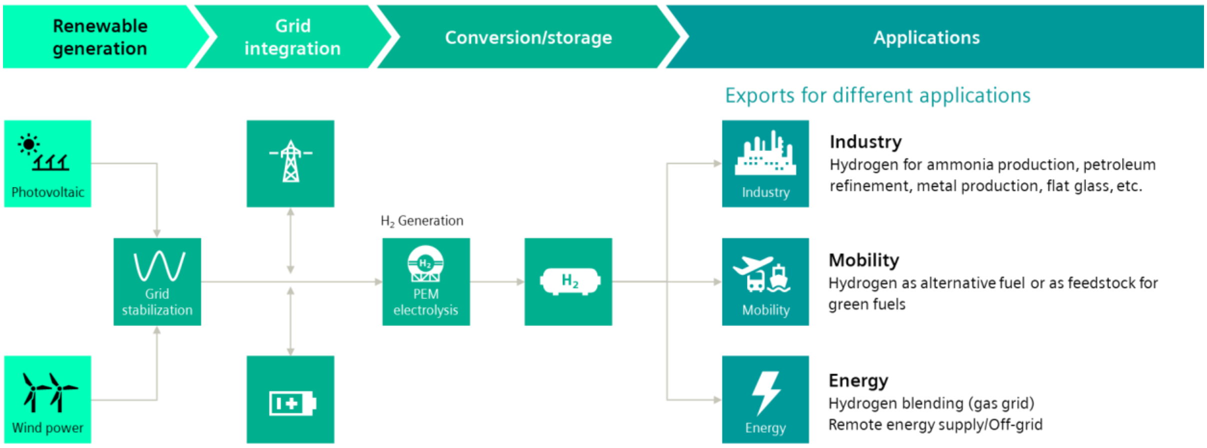


Figure 36: Green Hydrogen production system overview

[30] Based on a total 434 TWh demand. Source: UK regulator – ofgem
[31] Greater Manchester Local Energy Market (GMLEM)

Hydrogen is stored and transported either at high pressure (350-700 bar) or liquefied (-253 °C); or it can be stored within materials using absorption. Due to limited supply and issues around storage and transport, it is expected to be used at larger industrial sites or clusters that enable scale efficiencies. There are two notable projects that could supply Trafford Park.

1. *Via road tanker from Trafford Low Energy Park*[32]

Trafford Green Hydrogen Ltd is developing a renewable energy supplied production facility on a brownfield site near Carrington Power station – around 5km from Trafford Park. The project aims to supply green hydrogen to customers in the Greater Manchester area as early as 2024, with initial phases focusing on providing fuel to difficult-to-decarbonise industries in the area.

Trafford Green Hydrogen could be an ideal supplier in the initial stages of hydrogenification of the site from around 2027 as they are first-to-market and can distribute fuels locally via road tanker.

2. *Via pipeline as part of HyNET North West*[33]

HyNET North West is a hydrogen production, distribution and carbon capture project providing infrastructure across Liverpool, Manchester and Cheshire with the aim of supporting the Government's Clean Growth Strategy (CGS). Hydrogen would be produced from natural gas and distributed by pipeline to industrial sites, with the associated carbon dioxide being captured and stored offshore at the Liverpool Bay gas fields.

The Greater Manchester LAEP assumes that HyNET ('Phase 3') can provide hydrogen to Trafford Park by 2030 along the Manchester Shipping Canal. With an understanding that the quantity of hydrogen available would not be sufficient to satisfy space heating demand, and therefore should initially be prioritised for targeted industries.

HyNET should be considered a suitable hydrogen supplier in the 2030s as its pipeline infrastructure could achieve economies of scale and distribution efficiencies. Further investigation and review of HyNET's progress would be recommended given the current geo-political changes and uncertainties around natural gas costs and supplies.

Hydrogen could be supplied to tenanted sites with a high-temperature industrial heating requirement, such as:

- Cargills – food production
- Kellogg's – food production
- Automet – recycling centre
- Lanxess / Chemtura Manufacturing UK Limited – chemical plant
- Essity – paper manufacturing

As part of the HyNET project, Cargill, Kellogg's and Essity have been identified[34] as potential initial adopters of hydrogen for industrial heating, with uptake in other suitable industries possible by 2038.

[32] Trafford Green Hydrogen
[33] HyNET North West
[34] North-West Hydrogen Alliance

At Trafford Park industrial processes heat produced using natural gas account for around 591 GWh/yr, it is assumed that 5% can be replaced with hydrogen (29 GWh/yr) by 2038, if:

- Green Hydrogen can be delivered by tanker from Trafford Low Energy Park starting in 2027
- Blue Hydrogen can be delivered via 'HyNET' Phase 3 pipeline from 2030

Total hydrogen costs to the Park's tenants will be significantly higher than comparable volumes of natural gas despite the hydrogen price falling from £89/MWh in 2022 to £67/MWh in 2038 (see Figure 37).

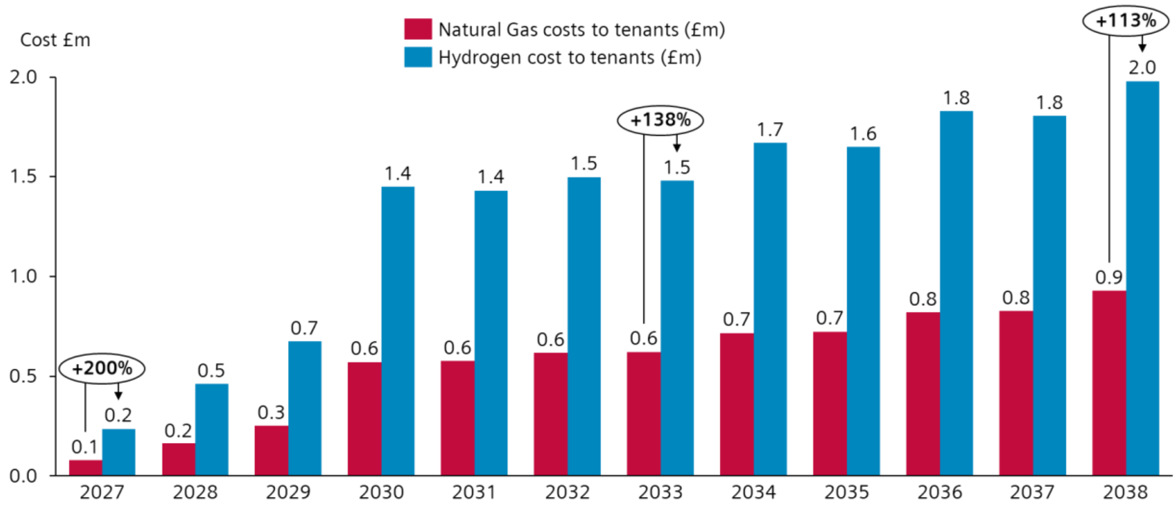
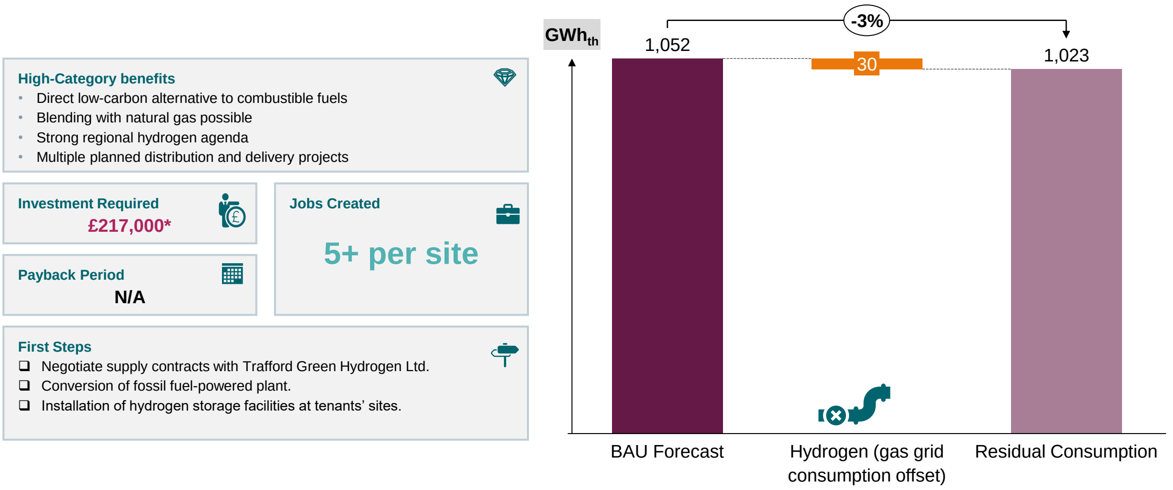


Figure 37: Cost of Hydrogen vs cost of Natural Gas assuming a phased uptake up to 5% of total industrial process heat at Trafford Park

Although third parties will invest in infrastructure to supply hydrogen to the site, tenants will need to invest capital to refurbish or replace combustion plants to become hydrogen ready. Additionally, 100,000 litres of storage facilities will be needed for tanker supply (2027-2030). Storage can be used as an operating reserve when supply pipework is connected in 2030. Compression, storage, and dispensation facilities costs are estimated at £2.17/kg of hydrogen.

The CO_2 savings of 47,000 tCO_2 between 2023-2038 are based on a mix of green (28%) and blue (72%) hydrogen. Green hydrogen is supplied from the Trafford Low Energy Park project, and blue hydrogen is supplied from the HyNET project. The assumed carbon intensity is 0 t/GWh for green hydrogen, and 146 t/GWh for blue hydrogen.



**Capex includes compression, storage, and dispensation facilities on site; capital costs for hydrogen facilities are incurred by third parties outside the Trafford Park boundary*

Figure 38: Key figures for hydrogen facilities generating 29 GWh_{th} per year

4.8 District Heating

District heating is a means for distributing heat generated in a centralised location through a system of insulated pipes for industrial, commercial, and residential uses such as space heating and hot water. Within Trafford Park, a heat network will be a vital enabler to the buildout of the low carbon heat technologies proposed throughout Chapter 4, capturing and transporting heat from different sources across the Park.

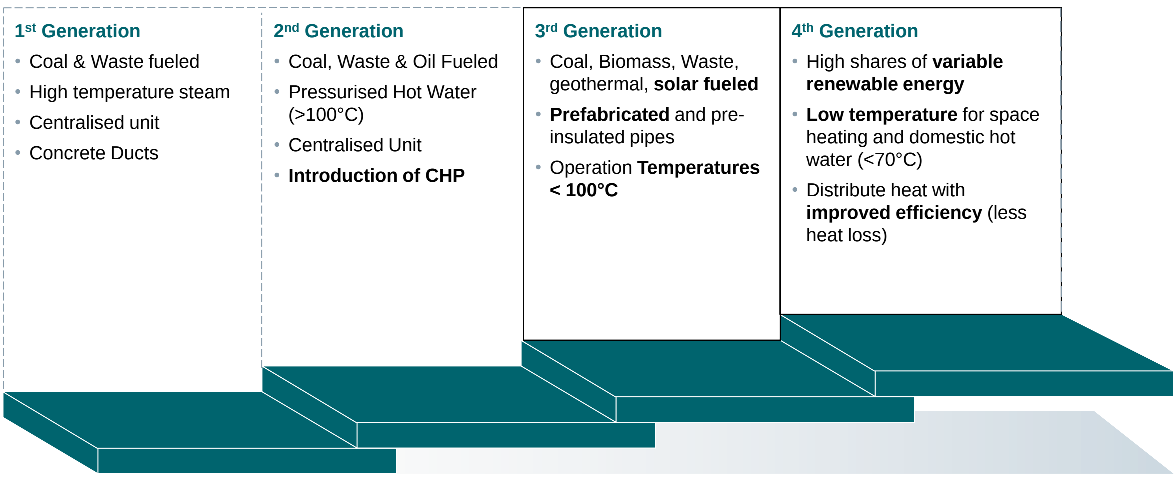


Figure 39: Configurations of heating inputs for district heating networks

District heating is technology agnostic, it can take energy from multiple sources[35] as shown in Figure 39 and therefore, dependent upon its source, it has a wide variance in its carbon factors. This is one of the biggest strengths for heat networks, implementation of new low carbon technologies is done centrally and easily. In this instance, district heating is a facilitation technology for the Category 2 measures Waste to Energy, Waste Heat Recovery, Geothermal, and CHP, which aligns 2nd and 3rd generation systems in Figure 39.

[35] UK Heat Networks Planning Database

Scope and Methodology

The national context for district heating is moving towards supporting larger networks. These policy initiatives, including local projects such as the Manchester's Civic Quarter heat network, are driving at more dense heat networks through the potential implementation of zones. Trafford Park could form one of these zones given its high heat requirements and waste heat potential[36].

A fully integrated heat network has been modelled at a high level for Trafford Park. This network has the potential to move 1TWh of heat per annum through 65km of underground pipework shown in Figure 40. This would mark a significant upscale in the size of heat networks in the UK. The largest single scheme is in Nottingham, which has ~350GWh/yr of input from its waste incinerator with approximately 125GWh/yr of heat distributed through 80km of pipework. The expected sources[37] would be a mixture of the following:

- Waste heat from industry
- Energy from Waste
- Imported Heat from outside of Trafford, e.g., Carrington Power Station
- Ground Source Heat
- CHP / Gas Boilers

Heat demands have been applied across Trafford Park for the purpose of developing an indicative network size and demand profile for a strategic assessment of the district heating opportunity.

Figure 40: District Heating Potential Trafford Park

[36] UK Heat Networks Zoning Pilot

[37] Sewer heat and air supplied heat pumps have not been included due to the scale and non-residential nature of the park, and higher temperature assumptions in this commercial/industrial context.

Pipework capital installation cost has been modelled using benchmarks and historical project data. The modelled capital requirement for the pipework and connection requirements to the entire Trafford Park is approximately ~£160M-£200M. With a heat purchase price of £20MWh and resale price of £40MWh the network has a good IRR of 9-15% over 40 years and includes full replacement expenditure. This assumes that the buildout connections steadily grow and achieve full capacity after 10 years when policy measures such as the potential heat networking zoning policy have been implemented for several years driving consumers to the network. Alternatively, with only 70% of the heat demand signed up within Trafford Park, an IRR of 4-8% could be achieved. At current prices heat sales could achieve £100MWh, if this energy were isolated from the market volatility such as an ERF then IRRs of 50% could be achieved, although these prices are not expected to be sustained for the long-term. The expectation is for it to fall somewhere in between. This assumes heat requirements will be similar for the next 40 years.

The introduction of energy efficiency measures as highlighted in Chapter 3 naturally reduce the heat requirement of buildings. These measures affect the revenue of a potential district heating network. The moderate scenario reduces the heat demand circa 12% by 2038, in addition to the waste heat capture potential. With a full network rollout, the IRR would reduce to around 5-11% assuming full up-take. With 70% of heat demand allocated to the DH network the IRR would be around 0%.

Capital expenditure has been estimated based on internal supplier databases and previous project experience. The network has been sized using diversity factors and heat transportation through steel pipework. This sized pipework has been cost modelled against benchmarks to define a cost for the installation of the network. These costs can be found in Appendix C.

An additional cost has been included for heat losses, uplifts, and energy centre, which would likely be modifications or expansion to one of the aforementioned technologies in the report. Full replacement of the pipework has been costed over 40 years. Export prices are modelled against market rates with large swings in sensitivity due to the uncertainty of future market prices. Detailed techno-economic modelling should follow to refine this strategic assessment.

4.9 Key Takeaways

- **7 low carbon technologies and 1 district heat network** are modelled to provide electricity and heat to replace grid sourced energy demand by 2038, combined annual electric generation outputs of **567 GWh electric** and **1,192 GWh_{th}** heat are possible at Trafford Park
- A built-out district heating network is a key prerequisite for the successful application of the outlined low carbon heat technologies, which enables the capture and distribution of heat across Trafford Park
- Combined measures would cost **£898 million between 2023-2038**

5. Category 3 Measures and Low Carbon Roadmap

In this chapter, Category 1 and 2 measures are consolidated into a roadmap to 2038. The order and timeline of implementation is outlined, as well as the year-on-year and total impacts of all measures on CO_2 emissions. Remaining annual CO_2 emissions by 2038 are highlighted, and Category 3 measures are explored to mitigate and offset these impacts.

5.1 Impact of All Measures

All measures from Chapters 3 and 4 have been consolidated, based on their implementation start year and ramp up rate, to calculate total combined impact on energy and emissions on a cumulative, end year, and year on year basis. Implementation year and ramp up rate is based on a technically feasible installation timeline required for individual measures. Depending on the actual implementation timeline and scale for combined measures, cumulative emissions may be higher.

Measure	Max Annual Output Electricity (GWh)	Max Annual Output Heat (GWh_{th})	Implementation Start Year	Cumulative Emissions Reduction 2022-2038 (tCO_2)
Energy Efficiency Measures	(247)	(115)	1	470,047
Solar PV	161		1	68,729
Wind	21		1	8,965
Hydrogen		30	5	46,524
Waste to Energy with CCS*	85	335	6	316,481
Combined Heat and Power with CCS*	300	400	6	456,898
Geothermal Heat*		45	8	62,591
Waste Heat Recovery*		196	8	179,653
Total	814	1,121	-	1,609,888

**District Heat Network required for scaled rollout. DHN itself does not contribute to emissions reductions.*

Table 8: Itemised Measures Category 1 and 2

After all measures, net grid electricity can be reduced from 1.3 TWh per year to 0.549 TWh per year. Gas consumption can be reduced from 1 TWh_{th} in 2019 to 0.781 TWh_{th} per year as shown below in Figure 41 and Figure 42.

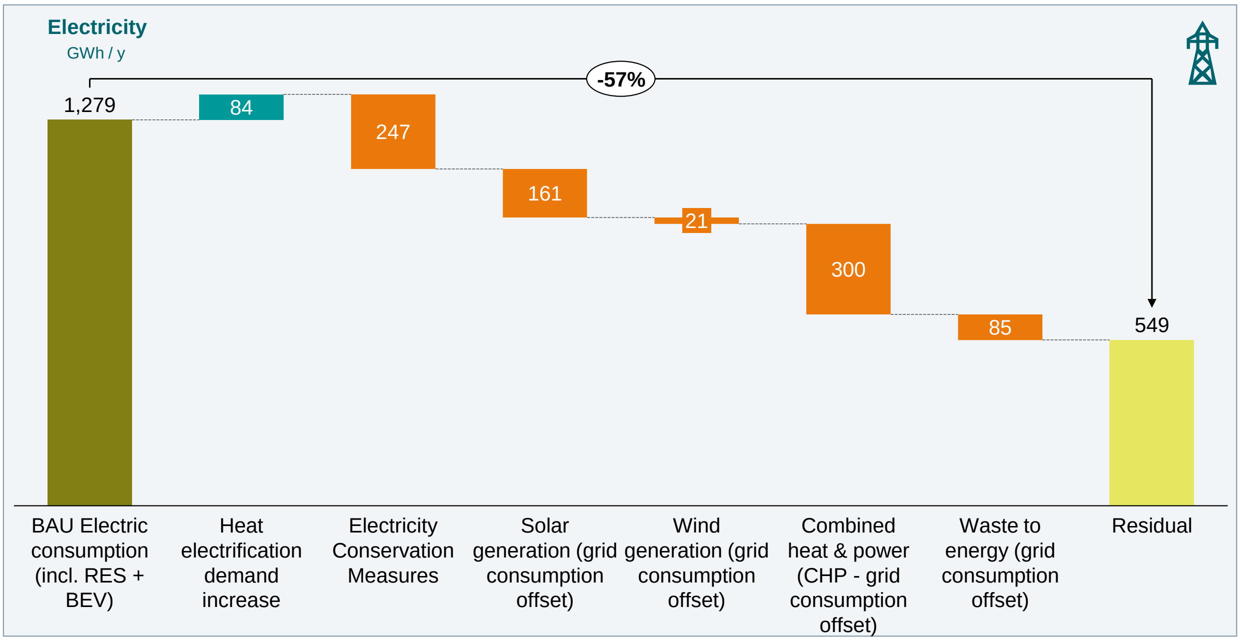


Figure 41: Impact of electric measures in year 2038 from BAU

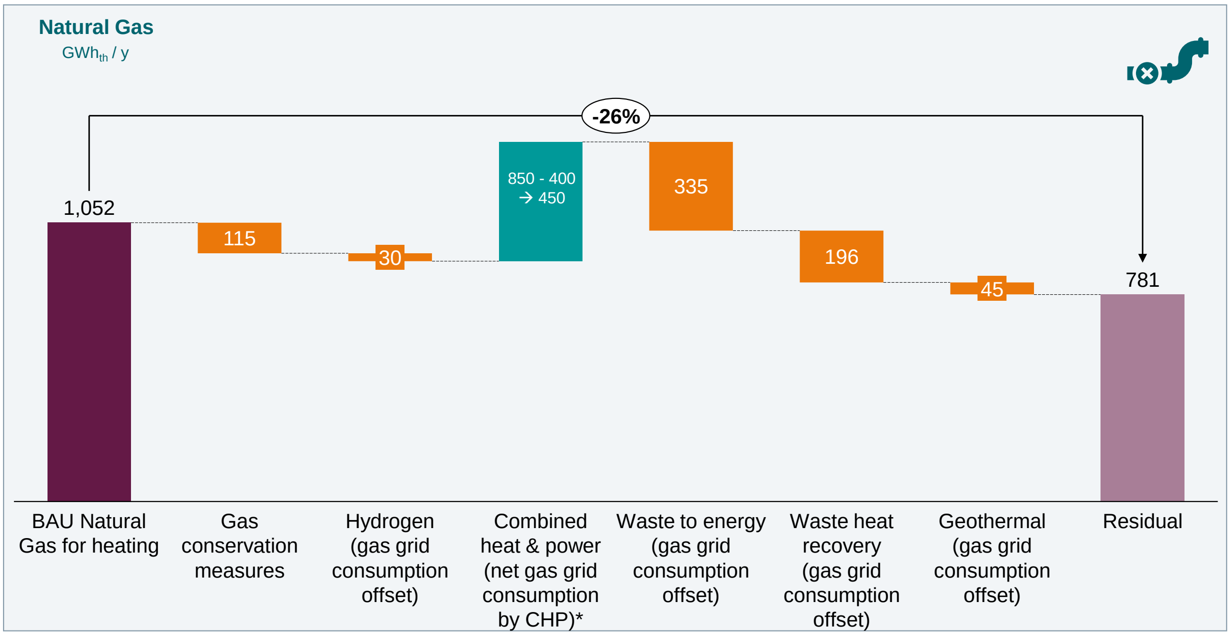


Figure 42: Impact of heat measures in year 2038 from BAU

By 2038, the UK government has committed to a zero-emission electricity grid, reducing the net carbon benefit of low carbon electric technologies year on year along Trafford Park's net zero trajectory. Emphasis is therefore placed on the early implementation of low carbon electricity measures while carbon intensity remains high.

Early-stage decarbonisation along Trafford Park's low carbon pathway initiates with energy efficiency measures for both electricity and gas. Likewise, solar and wind systems begin to offset grid electricity in the early phase of the trajectory, benefitting the Park early on while grid carbon intensity remains a significant emissions factor. As Figure 43 shows, heat electrification results in a slight increase in overall electricity consumption in the earlier years – a phenomenon paralleled by the corresponding decline in gas consumption as evident in Figure 43 and Figure 44. Green hydrogen from the Trafford Low Energy Park begins to displace natural gas in 2027, and by 2030 this is mixed with blue hydrogen from HyNET Phase 3. By 2030, heat measures including waste to energy, CHP, and waste heat recovery begin to ramp up, displacing natural gas heating. Geothermal and waste heat recovery are added to the heat mix starting in 2032.

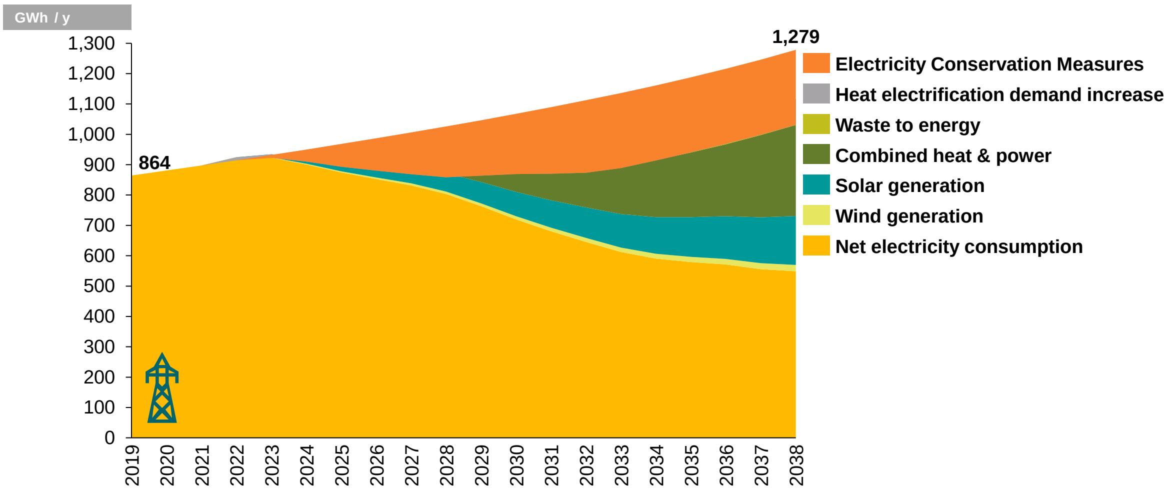


Figure 43: GWh electric consumption after all measures 2019-2038

Heat measures including H_2, waste heat recovery, waste to energy, and gas conservation and waste prevention measures together contribute to the general overall trend of decreasing gas consumption. However, implementation of combined heat and power is expected to increase Trafford Park's gas consumption in stages as regular modular extensions to a centralised plant are made until 2038 (as referenced in Section 4.4).

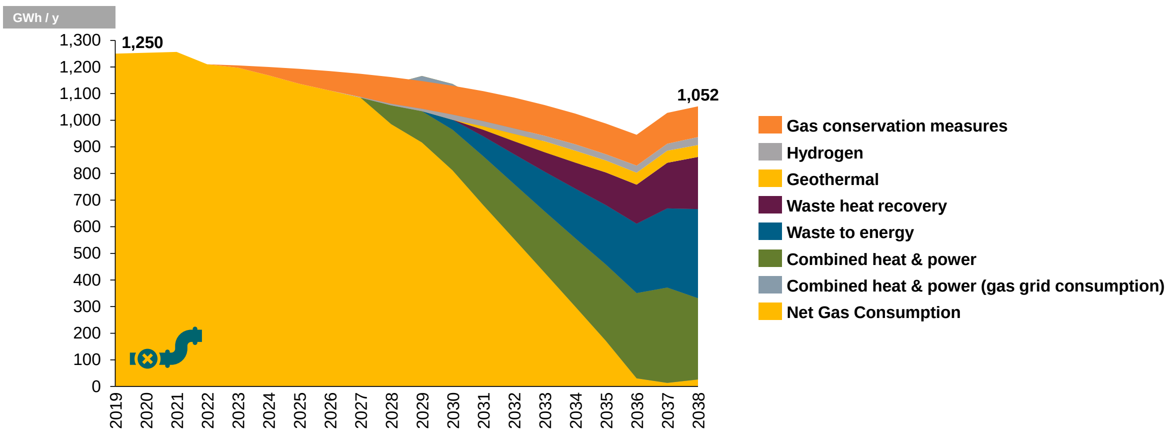


Figure 44: GWh_{th} heat consumption after all measures 2019-2038

By 2035 electricity from grid supply in Trafford is expected to be fully carbon-free in line with national grid emissions projections, which will contribute to a strong decrease in carbon emissions in the BAU scenario[38], leaving the gas consumption as the key contributor to the overall carbon footprint by 2038.

[38] Forecasted decreases in national electric grid emissions are not impacted by measures undertaken at Trafford Park and so are built into the BAU scenario

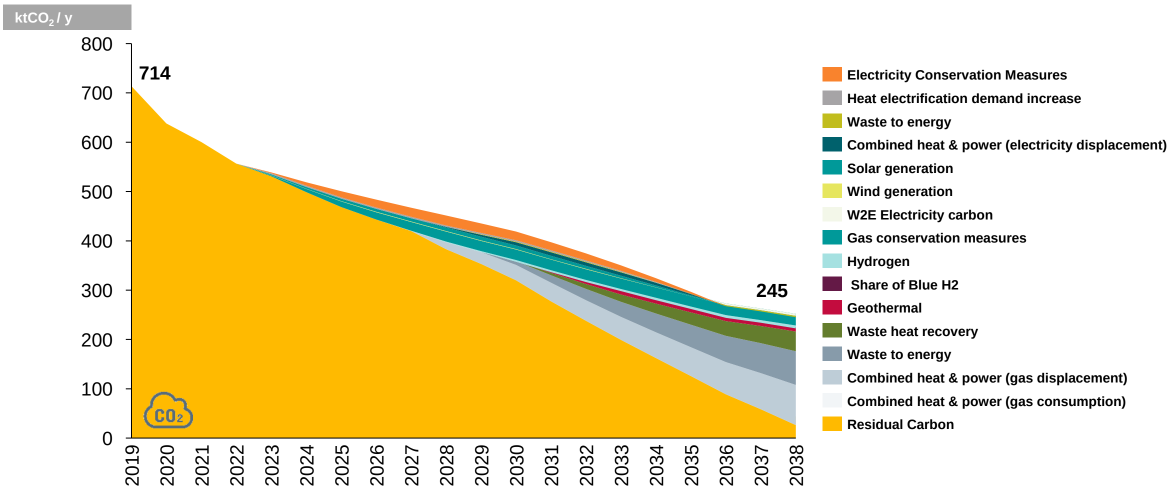


Figure 45: Annual carbon emissions after all measures 2019-2038

In year 2038, Trafford Park will emit 43,656 tonnes of CO_2 after implementing all measures to the scope outlined in Chapters 3 and 4. By this stage, heat is the primary contributor to Trafford Park's carbon footprint. In order to meet net zero targets, this remaining carbon would need to be offset or further reduced by more aggressive measures, described in the following section.

Category 3 Measures:

Trafford can consider more aggressive measures in the following areas to further reduce annual CO_2 emissions in 2038:

- **Ambitious scenarios for energy efficiency measures**: the current low carbon pathway for Trafford Park takes a moderate view of energy efficiency savings in terms of measures taken and the speed of their rollout. Adopting the ambitious scenario for energy conservation measures would lead to an additional reduction of 91 GWh per year for electricity and 40 GWh per year for heat, reducing residual CO_2 emissions by more than 8,200 tCO_2e in 2038. However, targeting more ambitious measures will involve deploying more complex and expensive technology solutions which would increase the overall capex requirements for energy efficiency investments by around 74%.
- **Expanded scope for hydrogen**: The combined H_2 infeed from green and blue hydrogen amounts to 29 GWh which makes up around ~ 2-3% of the natural gas load of the park. This is a conservative measure based on current stages of development for HyNET and the Trafford Low Energy Park. A more ambitious deployment trajectory may indeed offset an even higher share of gas grid consumption.

  The North West Hydrogen Alliance outlined that testing of hydrogen as a replacement process fuel is about to start at Kellogg's, Cargill and Essity. This will be facilitated with tank-to-site hydrogen supply. If the testing shows conversion is 'process-acceptable', development entities as part of the NWHA will begin planning and project design work for an extension of HyNET 2 from the Carrington Power station as (HyNET 3) to come to the present high natural gas users on the Park area – supplying a dedicated hydrogen supply to enable a conversion away from natural gas. A HyNET 3 supply would give the top gas users the ability to transfer onto hydrogen and so further reduce their carbon footprint.

This would result in at least 35% of the Park's overall natural gas demand being replaced with hydrogen (475GWh$_{th}$) – and still potentially give a "waste" heat feed option to a district heating network, reducing residual CO_2 emissions by a further 23,000 tonnes per year in 2038 with a corresponding increase in capex amounting to £3.3 million.

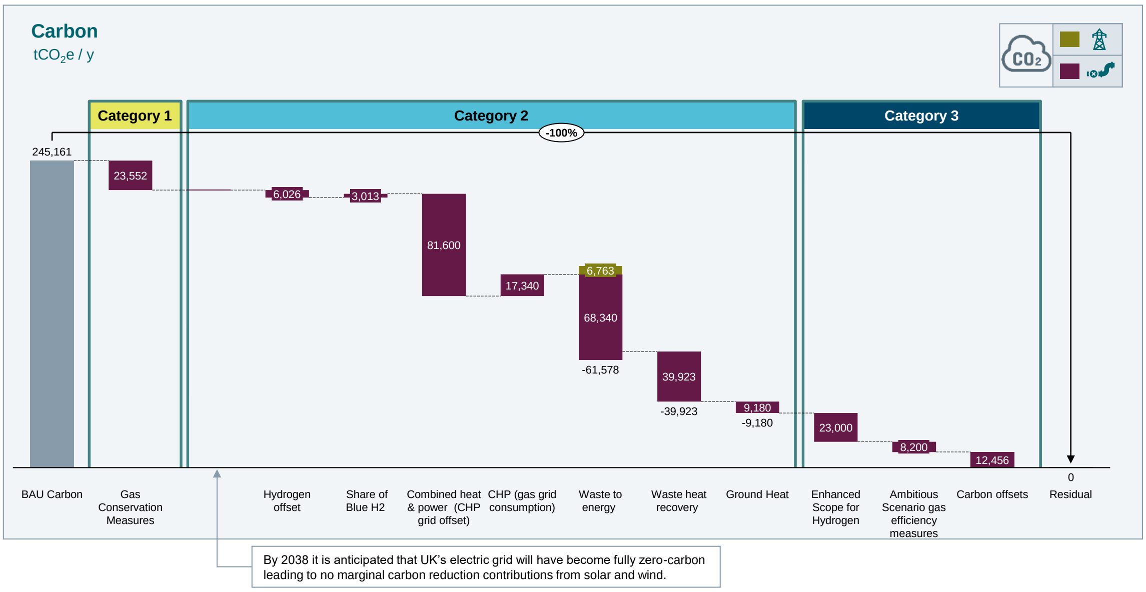


Figure 46: Carbon impact of measures in 2038

Figure 47 displays the established timeline for all energy decarbonisation measures between 2023-2038[39]. The start year indicates the year at which the measure will begin to impact Trafford Park's carbon emissions. Category 3 measures may begin earlier, should the enhanced roadmap be adopted. Full implementation of waste to energy, waste heat recovery, geothermal and CHP is contingent upon development of a district heat network.

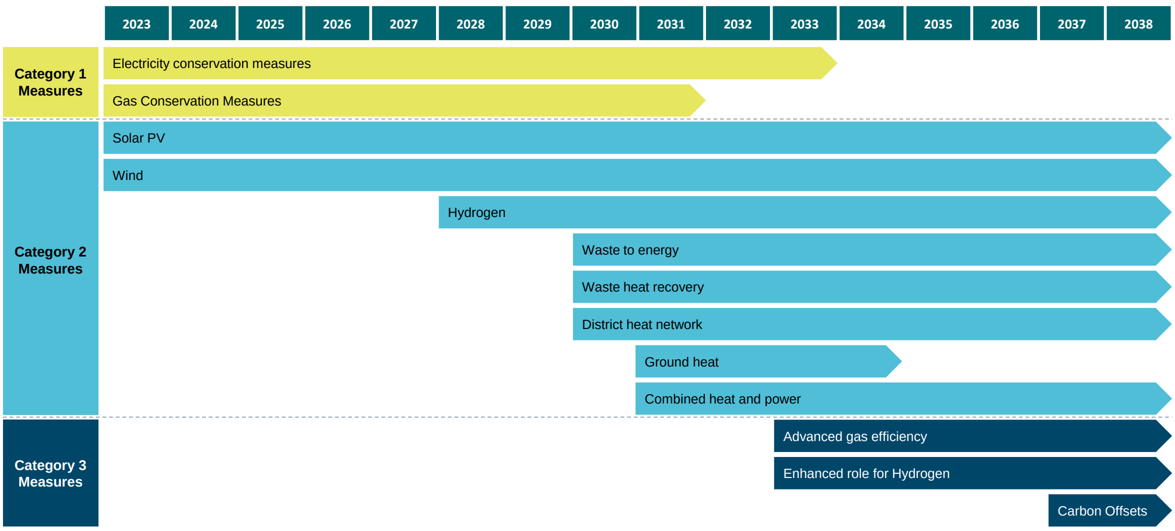


Figure 47: Impact Timeline 2023-2038

[39] Timeline is an estimate based on the technical and planning requirements for each measure, and may vary when projects are individually or jointly progressed to planning and implementation

<u>Carbon Certificates / Offsets</u>:

Certified carbon offsets[40] can currently be purchased by a verified partner for an average price of £15 / tonne CO_2[41] for a total of £187,000 per annum for Trafford's volume of residual emissions, or £655,000 without enhanced energy efficiency and hydrogen measures. In addition to current pricing variations by project, demand for voluntary carbon offset credits (credits not used to comply with legal reporting requirements) is anticipated to increase by as much as 100 times through to 2050[42], which will drive costs considerably higher. In the UK this ceiling is anticipated to be as high as £80 / tonne by 2040[43]. If voluntary offset prices follow in line with this, costs of offsetting residual carbon at Trafford Park could reach £996,000 per year, or £3.5 million per year without enhanced energy efficiency and hydrogen measures. The breadth of these potential price fluctuations is a source of longer-term risk in the absence of further decarbonisation measures.

5.2 Transportation Electrification

The UK intends to ban the sale of new petrol and diesel passenger vehicles and vans in 2030[44], and plans to expand the ban to heavy goods vehicles (HGVs) in 2040[45]. This applies natural pressure for the decarbonisation of the transport sector, which benefits from downward forecasts on grid emission intensities over the timeline of Trafford Council's net zero programme.

As a result of natural EV penetration in new year on year vehicle sales, and the expected government bans on internal combustion engines, as high as 2/3 of vehicles in Trafford Park are estimated be electric by 2038. Emissions from transportation is reduced by more than 80% in line with the penetration of EVs, grid decarbonisation, and total vehicle count through to 2038. While most passenger vehicle commuter miles will be met through home charging, businesses seeking to electrify their fleet and freight operations must be proactive to avoid bottlenecks in their operations relying on vans and HGVs at the end of each of the next two decades. By 2038 electric vans and HGVs will account for an estimated 9% of electric vehicles at Trafford Park[46], with a charging requirement of 12.3 GWh per year.

Freight and commercial fleets require a mix of slower overnight charging, and faster day charging along travel corridors and hubs. Long-dwell infrastructure composed of level 2 charging stations (7.4-22 KW_{Ac}) are recommended in most instances for fleets, with exceptions for larger HGVs, which will require lower-level rapid charging overnight (100-150 kW_{DC}).

The table below indicates the total number of charging stations required within the boundary of Trafford Park to transition existing fleets and HGVs in Trafford Park away from internal combustion engines in line with UK

[40] Credits should be verified to a standard recognised by an organisation's chosen reporting body, standards may include the Verified Carbon Standard (Verra), Voluntary Gold Standard, or the Quality Assurance Standard (QAS) among others.
[41] Savills Carbon Markets; Gold Standard Product Marketplace
[42] McKinsey 2021
[43] Gov.uk Carbon Valuation
[44] 2030 ICE passenger vehicles and vans
[45] 2040 ICE ban HGVs
[46] Based on DNW transport electrification forecasts in its FES and Trafford LAEP, adjusted for Trafford Park area and commuting base. Total vehicle count is forecasted by DNW to remain largely constant between 2022-2038, with a small decline in the final stages of the 2030s. A small proportion of HGV freight mileage may in future be served by increased use of Trafford Park's canal area, though the extent of impact on scoped emissions within Trafford Park itself cannot be predicted with a reasonable degree of confidence using available data.

regulations. This assumes one plug per commercial fleet vehicle (vans/pickups and HGVs) for overnight charging, and one plug per ten vehicles providing daytime rapid charging.

Type	Total (2023-2038)	Equipment Cost (£ millions)	Use Case
22 kW AC	2,177	6.4	Overnight charging fleet (van)
100 kW DC	190	11.5	Overnight charging HGV
150 kW DC	218	7.9	Daytime charging fleet (van)
350 kW DC	19	1.8	Daytime charging HGV

Table 9: required charging infrastructure for fleets and freight 2022-2038

Charging equipment itself represents only a part of the total cost of installation for EV charging facilities, which must also account for required capacity upgrades, trenching and wiring, signage, and safety measures on top of labour costs for the installation. The cost for such installations can vary considerably depending on available grid capacity, total additional charging capacity, and ability to charge flexibly. In many cases, bundled costs for upgrades and installations can represent about 4/5 the total installation price. It is recommended that fleet operators and businesses operating heavy goods vehicles conduct site level studies to determine potential upfront costs.

As described in Chapter 6, grant schemes and ownership and rental models do exist to reduce costs and enhance the business case for EV charging installations based on business needs. Additional measures to reduce transportation emissions require an increased emphasis on non-motorised or community mobility options.

5.3 Cost Breakdown All Measures

Table 10 shows the overall capex requirements for Trafford Park's Low Carbon Roadmap to be around £1.2 billion[47]. In the enhanced capex option, switching to an ambitious energy efficiency scenario and an extended scope for hydrogen utilisation will increase the costs to £1.4 billion.

The enhanced capex scenario will reduce the annual carbon offsetting expenditure from up to £3.5 million / year to £1.0 million / year. Expected variation in costs is based on best practices and prior project experience for UK-based implementation.

[47] This is assuming implementation to the full scope described in this report. capex is not fully paid by Trafford Council, but will be attributable to Council, stakeholders and third-party suppliers. Likewise, Trafford Council may choose to implement the roadmap at a reduced scope or amended timeline. Note that this will increase cumulative and operational emissions beyond current estimations.

Measure	CAPEX (£ millions)	CAPEX Enhanced (£ millions)	Expected Variation (+/- £ millions)
Energy Efficiency Measures	225	**392**	45
Solar PV	200	200	50
Wind	30	30	8
EV Charging Equipment	28	28	6
EV Charging connection / installation*	110	110	33
Hydrogen	0.217	**3.5**	0.043
Waste to Energy	300	300	100
Combined Heat and Power	60	60	20
District Heat Network	200	200	40
Geothermal Heat	30	30	6
Waste Heat Recovery	40	40	8
Total	1,223	1,394	305
Carbon Offset £/year	0.655-3.5	0.187-0.996	

*Connection costs may be lower as they are dependent on local conditions and can vary widely

Table 10: Total Capex for All Measures

5.4 Social and Economic Benefits

Beyond direct benefits to businesses in Trafford Park through cost savings and new revenue generation, the implementation of low carbon technologies provides ample opportunity for local job creation, both for short-term construction, and longer-term operations.

Initial deployment of low carbon technologies between 2022-2038 is expected to require up to 700 workers at full project scope, while longer-term operations of new facilities are expected to require around 100 (equivalent) employees.

Low carbon measures for an industrial estate like Trafford Park needs to ensure continued focus on socio-economic wellbeing of the hinterland economy by following circular economic principles. Creating and consuming value within the Park and its surround areas will not only create the smallest possible ecological footprint for all economic activity in the Park, it will also serve as an engine for local job growth and gross value add (GVA).

The sheer diversity of the low carbon measures at Trafford Park requires a wide range of talents and skillsets – from engineers, analysis, and data scientists to finance / insurance executives and technicians and installers. The economic opportunities unlocked by the Low Carbon Trafford Park plan and creation of green jobs will catalyse the upskilling of the local talent pool. Existing employees at energy intensive businesses, or organisations with early-stage sustainability plans, have extensive opportunities to take on new skills and broaden their careers by obtaining specialised certifications in energy management, building sustainability audit, IT and data synthesis, and project finance. Upskilling Trafford Park's existing workforce, particularly through the development of data-centric skills, is essential to creating nurturing local value and future-proofing local workers in a transitioning economy. The positioning of Trafford Park as a leader in the energy transition will also attract short- and long-term services from energy professionals. Transferrable skills energy professionals currently residing in high-emission sectors include health and safety and IT roles, electrical installation credentials, and project-related financial acumen for business case appraisals and feasibility studies.

The electrification of transport and the parallel ramp-up of e-freight, e-trucking, e-buses and trains, as well as private EVs will open up opportunities to enable multi-modal integration and business innovation. New market entrants will create new and advanced offers, pool their resources, and deliver efficiency gains across the transport value chain.

In the same vein, Trafford Park tenants' focus on energy efficiency measures, deployment of solar PV, and on-site micro wind resources will nurture an innovative start-up eco-system of small-to-medium firms. These firms can offer specialist expertise in shared savings through energy performance contracts (EPCs), load aggregation for virtual power plants (VPPs), and creation of private wires between adjacent tenants for balancing loads and generation assets through Microgrids, or for offering ancillary services to the grid or to each other (e.g., for reactive power compensation). Likewise, community-based solutions can be leveraged to enhance collective bargaining and optimise local value capture through collaborative investment in distributed technologies such as solar PV. Programmes such as Trafford Community Solar initiatives can be used as a blueprint for other technologies, from distributed micro-wind systems to collectively sourced EV charging facilities.

5.5 Key Takeaways

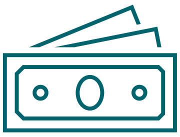
- A low carbon roadmap scenario implementing Category 1 and 2 measures decreases forecasted annual emissions from **245,161 tCO_2** to **42,656 tCO_2** at a **cost of £1.2 billion**
- Implementation of proposed Category 2 measures are expected to create ~**800 temporary jobs between 2023-2038**, with **~100 longer-term positions** created for operation, maintenance and monitoring functions
- Carbon offsetting of **42,656 tCO_2** is estimated to cost between **£0.655-3.5 million per year** if no technological Category 3 measures are implemented
- Category 3 measures may further decrease CO_2 emissions associated with the realistic pathway, at an additional **cost of £171 million**. Residual annual carbon would reduce **to 12,456 tCO_2**, at an offset cost of **£0.187-0.996 million per year**.

6. Low Carbon Business Toolkit

This Chapter outlines key measures businesses can take to define, implement, and monitor low carbon solutions in a structured, comparable, and financially viable way. First, core concepts for low carbon businesses are defined, along with key action items. Second, the role of Trafford Borough Council in facilitating business transition within the Park is explored. Finally, available incentive schemes are highlighted as an aid to businesses as they seek to implement technological solutions.

Tenant businesses play an essential role in the decarbonisation pathway of Trafford Park, and the Park's successful transition to net zero requires businesses to create and implement their own low carbon plans through to 2038. The low carbon transition provides businesses with the opportunity to capture value by reducing costs, accessing new revenue streams, and mitigating financial and regulatory risks. These are accompanied by a checklist of actions for businesses as they identify, plan, and implement low carbon projects and improvements relevant to their operations.

Cost Reduction: Reducing the cost of operations has a direct impact on profits. All businesses, and particularly energy intensive industrial stakeholders within Trafford Park, can significantly decrease their operating costs through energy efficiency measures, as well as through on-site energy offsetting measures. Measuring, reducing, and replacing on-site electricity and heat consumption on site should form the basis for all future low carbon investments.



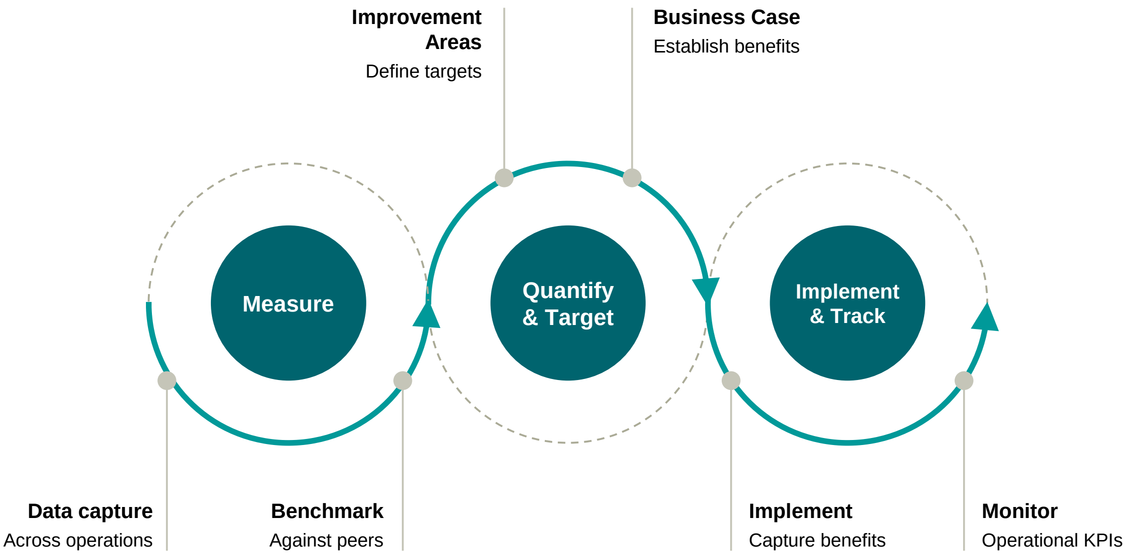
New Revenue Streams: In addition to direct cost savings through energy efficiency and on-site low carbon solutions, stakeholder collaboration and the implementation of new on-site or community technologies can be used to generate new revenue for businesses. Leveraging excess electricity or heat generation for market access or export (e.g., through virtual power plants or microgrids) or through export to produce income increases the value proposition for individual businesses and opens the opportunity for community-level value creation and exploitation of cluster synergies.

Mitigate Risk: Detailed measurement, decreased demand, and proactive investment in self-generation at the individual and community level will decrease risks related to energy price fluctuations and pre-empt climate related regulatory expenses.

This value can be captured through individual action and investment in many cases, but businesses can benefit greatly by leveraging a community of stakeholders, establishing mutually beneficial relationships, and pooling resources.

6.1 Core Concepts for Low Carbon Businesses

Planning and implementing low carbon solutions should be data driven, financially sound, impactful, and measurable. Core themes to consider when developing transition plans within a company should follow the following steps: **measure**, **quantify**, **target**, **implement**, **track**.



1. **Measure:** Data measurement and reporting is often viewed as an unwelcome burden on businesses with tight schedules and overheads, however the effective measurement, monitoring and reporting of key operational data is a core feature of every sustainable business operation and cannot be overlooked. Effective data capture is a means to identify key risks and opportunities for sustainability initiatives and provides the essential inputs for developing a meaningful and tailored business case for new improvements or technologies. For example, standardised measurement and verification protocols (e.g., IPMVP from Efficiency Valuation Organisation) that are followed by certified energy auditors are a pre-requisite for shared savings contracts between energy consuming tenants and energy service companies (ESCOs). Similarly, monitoring materials, resource use and by-products of a given operation also opens up opportunities to collaborate with other local stakeholders, who may have the capacity to provide or offtake resources or materials which would otherwise be wasted, with potential cost savings and revenue generation. Not to be overlooked, regular measurement and monitoring increases the ability of businesses to adapt to future reporting requirements, which may mitigate future costs and administrative burdens as climate regulations become stricter.

ACTIONS:

a) **Understand energy usage compared to peer group**: benchmarking against a peer group is a simple way to identify at a high level whether a business is performing as it should in regard to energy, and through this, emissions and cost efficiency. The Carbon Trust provides a UK benchmarking tool for several sectors.

b) **Measure detailed energy usage**: install smart meters, sub-meters, or other monitoring equipment to identify operational resource use across different business processes and segments.

c) **Identify key improvement areas**: this can be achieved through a gap analysis, using high level peer benchmarking, and real data from your business. Identify areas where processes are exceeding peer group benchmarks or best practices.

2. **Quantify & Target:** Identifying a business case is an essential step for all businesses who wish to decrease their carbon footprint. Every sector, company and facility must take actions which are in its best interest by reducing costs, creating additional revenue streams, or increasing the quality of core

operations. Quantifying opportunity for low carbon measures with real data will ensure any business case and target measures are realistic and achievable. Accuracy in quantification of baselines and target values will enable businesses to appraise sustainability projects as tangible investments with forecastable returns.

ACTIONS:

a) **Map processes**: track resource consuming processes from start to finish to classify process steps into broad categories of 'value', 'non-value add', and 'business value add' steps, and associated resource requirements.

   i. **Value Add**: the conversion or processing of raw materials via manual labour, expenditure of fuel/power to achieve paid for activity
   ii. **Non-Value Add**: actions that should be eliminated, such as waiting, stocking, wasting resource such as leaving heating or combusting process on in extended non process activities, extended size changes
   iii. **Business Value Add:** actions that are wasteful but necessary under current operating procedures in the business

b) **Identify and quantify opportunities**: use measured values to quantify scope of potential resource optimisation procedures. Identify impact scope in terms of energy, emissions, and operational savings.

c) **Set targets**: set real targets against a performance baseline. Example targets may include:

   i. % Reduction electricity usage for a specific process
   ii. % Overall reduction across a resource type or source
   iii. £ Investment goal in a low carbon technology
   iv. % Reduction in overall emissions for a specific process or site
   v. Commitment to culture and behavioural change in management and across the employee base

d) **Build out a business case**: identify cost savings, revenue generation, payback and returns on investments related to specified targets. Retain and refer to the business case throughout feasibility, implementation, and post-project monitoring.

3. **Implement & Track**: Continued business justification requires project results to be measured against estimated outcomes. Businesses should continuously measure and report on materials, resource use and by-products relevant to operations, and analyse the impacts of implemented projects towards stated targets, and financial and non-financial goals. This tracking provides insight into the continued business justification for a partially implemented project or, a phased / piloted project stage. Lessons learned from monitoring during and after project completion will shape the business case and implementation process for future initiatives. Businesses may also share insights with their wider stakeholder community and establish local best practices.

ACTIONS:

a) **Conduct a feasibility study**: seek a professional quote to affirm the practicality of your project scope and business case and build a preliminary implementation plan.

b) **Identify funding sources**: confirm how the project will be funded, either privately, through external funding, or a combination of both. Section 6.3 highlights a number of potential incentives available to businesses engaging in low carbon projects.

c) **Implement**: execute project implementation plan.

d) **Monitor / check**: through implementation and ongoing operation, continue to monitor against the stated aims of the project, particularly in terms of energy, emissions, and energy savings or revenue goals.

e) **Review targets**: regularly compare project performance against established targets. Maintain, reduce, or increase targets as necessary, and pursue corrective actions.

f) **Pursue continuous improvement**: return to assess baseline performance at regular intervals, compare to peers, and establish new targets

Businesses at Trafford Park are not operating in isolation, and so there are various opportunities to collaborate with other stakeholders and leverage local and national support schemes, as well as national bodies such as the Climate Change Committee, when developing low carbon projects.

Collaborate: Trafford Park has an engaged community of stakeholders, providing a unique opportunity to establish working groups, operational synergies, and pooling of finances for low carbon projects. Collaboration with adjacent businesses is aimed at facilitating best practices in knowledge acquisition, monitoring, and compliance, as well as providing the opportunity to identify process synergies and partnerships to jointly achieve low carbon goals.

Leverage support schemes: There are a host of opportunities to enhance the benefits and reduce the upfront costs of low carbon technologies for businesses through governmental support schemes and funding programmes. Relevant schemes are described in section 6.3 of this chapter. In addition to these schemes, local organisations in the Trafford area such as Groundwork, the sustainability team and economic regeneration service of the GMCA, and the Business Growth Hub can help businesses to access grants, collaborate with the community, and sharpen strategies.

6.2 The Role of Trafford Borough Council

The Council is the main facilitator and cultivator of net zero engagement in Trafford Park. The Council has the ability to bring stakeholders at the park together, stimulate collaboration, provide a framework for action, and where possible provide targeted financial support for local businesses. This would be developed in collaboration with the GMCA, who have existing skillsets to assist Trafford Borough Council from within its net zero sustaibanity team, and can provide contacts, funding routes and programme support within the region. This interaction would lead to greater alignment between Trafford Borough Council and GMCA in achieving a net zero emission position by 2038 for the city region.

There are **7 specific actions** recommended for Trafford Borough Council:

1. **Cultivate an active low carbon community:** Trafford Council is well placed at the centre of the Trafford Park community, and should leverage its position to coordinate its varied stakeholders and facilitate working groups to catalyse low carbon projects. To meet its ambitious decarbonisation goals, the Council's role as facilitator is important to ensure businesses maintain a level of comparability in their low carbon journeys, as well as standardisation in metrics and reporting. Early working groups and regular collaboration will help to align stakeholders at every stage of implementation.
2. **Engage with domestic and international municipalities:** the Council may wish to leverage learnings from other UK and international authorities with similar industries, sector mixes, and operational carbon dynamics. A particularly crucial relationship to be leveraged is the ongoing collaboration between Trafford Council and the GMCA environment team. The council can also showcase international case studies of municipalities implementing ambitious decarbonisation plans**.** The following cities are examples of such international leaders:

   ***Stoke-on-Trent City Council*:** Stoke is developing an aligned Energy system across its city with an 18km core spine DHN, and a deep geothermal heat source and new waste to energy plant to feed its heat into the network. Community solar both on its social housing stock and also in city solar farms on council land assets. This is also to be headed by a Council owned "Stoke Energy Co" and delivered through strategic partnerships with the private sector.

   ***Bristol City Council*:** Bristol has developed a LEAP programme pathway to decarbonise the City by 2030, with opportunities for engagement and knowledge transfer.

   ***Helsingborg Municpal Authority*:** Helsingborg, a city of 250,000 inhabitants, is 50 years into its decarbonisation activities and owns a municpal untilities company Oresund Kraft. Oresund is responsible for the heat, electrical and cooling demands of 95% of the city's inhabitants – operaitng a c500km heat network, +200ktpa waste to energy facility and a major waste heat recovery facility sourcing from city-based industries. Oresund provides a revenue of about €50 million to the Municpal Authority annually. Helsingborg Municpality and Oresund are open to dialogue and knowledge transfer with other Local Authority bodies, and is currently engaging with with Stoke-on-Trent City Council.

   Munich: Munich City Authority is developing a major deep geothermal heat extraction system to heat a mix of residential and public space buildings. This provides an opportunity for knowledge transfer should Trafford pursue geothermal solutions after geotechnical analysis.

   Rotterdam: Rotterdam, Linden and the Hague are developing Europe's largest DHN system utilising waste industrial heat from Rotterdam and combined with Smart Grid infrasturucutre. This is a major step towards achieving decarbonisation of a highly populated part of Holland by 2030. The public side of the project is open to dialogue and knowledge transfer with other Local Authority bodies.

3. **Provide incentives for low carbon businesses:** Based on the outcomes of ongoing workgroup facilitation, the Council may determine the applicability of targeted use of funds that can be identified and won working with the GMCA that stimulate the uptake of technological solutions by businesses at Trafford Park. This may include setting up a Smart Solar Fund or other pooled resource for low carbon initiatives. The Council may also consider such incentives as decreased business rates for organisations that implement solutions from a list of agreed low carbon technologies, determined in part through stakeholder workshops and technical working groups.

   Trafford could consider utilising Groundwork or establishing a "Trafford Business Envrionmental Network (TBEN)" that can bid for funding from Central Government as per the prosperity funding that is to replace the European Regional Development Fund (ERDF) and European Structural and Investment Funds (ESIF) funding routes. An example of this type of network is the Staffordshire Business Environmental Network (SBEN[48]), which operates from the County Authority and gives direct support from ERDF/Prosperity funding to businesses for efficency audits, and part-funding capex spend on energy and carbon reduction projects.

   Given the local stakeholder interest in on-site solar solutions at Trafford Park (see Appendix D), the Council may facilitate a business or community solar programme, mirroring the Solar Together[49] or Your Home, Better[50] scheme for residents of the Greater Manchester area. The scheme leverages collective bargaining for technology procurement, providing lower cost and pre-screened systems through a streamlined application and scoping process. By reducing costs and eliminating process and quality uncertainties, Trafford Council can eliminate barriers to entry and facilitate proactive low carbon measures for the businesses of Trafford Park.

   The Council can obtain seed funding through entities such as a Trafford Business Environment Network concept and Groundwork, as well as from Central Government funding programmes given that priority options align with national policy and funded programme support.

4. **Provide procedural guidance:** A key barrier to entry for businesses of all sizes in developing a business case and implementation plan for low carbon technologies can be attributed to procedural uncertainties and the risk of unexpected planning or capacity costs. Trafford Council can use its position to provide stakeholders with detailed procedural guides for the installation of on-site generation local energy scheme applications. These procedures may be produced through collaboration with local stakeholder working groups, coordination with other UK Authorities, and interactions between the Council and relevant network and planning entities. The Business Growth Hub can be a key facilitator partner for this undertaking.

   Procedural guides may include:

   - Step by step actions for businesses
   - Entities and contact points
   - Estimated process times and cost bands
   - Relevant incentive schemes

[48] SBEN
[49] Solar Together scheme
[50] Your Home, Better

5. **Encourage collective action:** the Council may use its position to facilitate stakeholder groups with alligned projects in order to collectively minimise cost and duplicative efforts. Focus areas may include self generation through Solar PV, process drivers for energy efficiency, practices for pivoting away from fossil fuel use in different industry contexts, and business case and best pracice for sourcing and installation of EV charging services, amongst others identified by the Business Association, Chamber of Commerce, and individual contributors. GMCA's Bee Net Zero[51] programme is a useful example of this collaborative approach in practice. This activity should be a priority to motivate the large SME base on the Park area.

   Synchronisation of capacity upgrades for on-site generation or electric charging can distribute costs amongst stakeholders and further encourage participation in the low carbon transition. Trafford Council is well placed to enhance these and simliar collaborative efforts.

6. **Develop strategic partnerships:** the Council may initiate strategic partnerships for scoping, design, delivery and operation of low carbon solutions at the municipal level. Strategic partnerships unlock financing, delivery and operations to enable Trafford Borough Council to proactively realise its low carbon targets.

   Examples of UK Local Authority Strategic Partnerships are:

   Stoke-on-Trent City Council and SSE are developing a working partnership which was agreed in 2021 to co-develop Energy infrastructure across the City area. This will allow SSE and its partners to bring its skillsets to deploy projects with aligned investment.

   Bristol City Council has selected Ameresco Limited as its strategic partner to form the City Leap partnership.

   Ameresco Limited, a leading cleantech integrator and renewable energy asset developer, owner, and operator, will work in collaboration with Vattenfall Heat UK, Sweden's nationally owned energy company, who specialise in low and zero-carbon heat networks.

   The City Leap partnership is aimed at delivering low carbon energy infrastructure, such as solar PV, heat networks, heat pumps and energy efficiency measures at scale, all which will help Bristol meet its carbon reduction targets of becoming carbon neutral by 2030. The partners will invest in the council's estate to deliver low carbon energy infrastructure and support others, such as residents, community energy groups and businesses, to deliver local carbon reducing projects.

7. **Be an exemplar in the region**: Trafford has the opportunity to cultivate its early mover image, community building and public commitments to attract public funding and commercial interest for major low carbon investments. By undertaking the above-described engagement, incentivisation and guidance actions in collaboration with local stakeholders and like-minded authorities, the Council can showcase Trafford Park as a proof of concept for large-scale, multi-stakeholder technological transitions towards net zero. This would also align with numerous North-West regional programmes underway with GMCA and Net Zero North West partnerships.

[51] Bee Net Zero

6.3 Direct support schemes for businesses

There are several incentive structures which can help support businesses to reduce their carbon footprint, decrease costs, and produce additional revenue streams.

On-Site Generation

Smart Export Guarantee[52] (SEG): The SEG requires licensed energy providers to offer an export rate to small scale generators (up to 5MW). Rates offered by energy providers may vary, though typically track with wholesale rates for electricity. This guarantee provides additional revenue to on-site generation facilities when electricity outputs exceed on-site demands, enhancing returns.

EV Charging

Workplace Charging Scheme[53]: The Workplace Charging Scheme (WCS) helps to support businesses with the upfront capex required for the installation of authorised EV charging stations for staff use and fleet operations. The scheme offers up to £350 per charging socket for up to 40 sockets per applicant site.

Business Tax Credit[54]: First introduced in 2016 and since extended through to 2023, first year allowances incurred on EV charging equipment can be claimed against corporate taxes in the first year of installation.

Ownership / Rental Models for EV Charging: Different ownership and rental models are available to EV charging site hosts. Depending on use case and available financing, different models may be more accessible than others.

- *Own and operate*: EV site owners cover the hardware and installation costs at the property and have full control over operations of the charging equipment.
- *Charger rental*: EV site owners cover costs up to the charger and rent the charging equipment. This reduces upfront installation costs and provides future flexibility to change charger types to respond to a quickly developing market.
- *Site leasing*: EV site owners provide access to property for a third-party installer, who covers costs for installation and equipment, and operates stations independently of site host. This reduces upfront costs but relinquishes pricing control and revenue.

Low carbon heat

Climate Change Levy Exemptions[55]: supplies to CHP Quality Assurance scheme registered systems are exempt from the Climate Change Levy (between £0.005-£0.008 in 2022).

Green Heat Network Fund[56]: Open to public and private entities for the planning and construction of low carbon heat networks, the Green Heat Network Fund (GHNF) can cover up to 50% of total costs for

52 Ofgem
53 UK Workplace Charging Scheme
54 Gov.uk first year allowance EVSE
55 Environmental taxes, reliefs and schemes for businesses
56 GHNF BEIS 2022

commercialisation and construction. Potential projects must meet core criteria on rate of return, carbon intensity, price of heat and minimum demand.

Heat Networks Delivery Unit (HNDU) Support[57]: The HNDU provides grant funding for eligible organisations, including local authorities, within England and Wales to support in feasibility and project development during heat network project initiation. Successful projects can receive grants of up to 67% of eligible consultancy costs, and up to 100% of project management costs[58] during feasibility and design project stages.

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[57] HNDU

[58] Public sector and social landlord applicants only

7. Conclusion

The aim of this report is to identify, cost and measure the impacts of low carbon technologies and strategies to realise Trafford Council's low carbon ambitions. Achieving net zero by 2038 requires a strategic approach which leverages a suite of energy conservation measures and technologies targeting electric, heat, and transport consumption.

Development of Trafford's decarbonisation pathway highlighted opportunities to lower energy demand, replace grid consumption with low carbon alternatives, and offset residual emissions. National trends toward decarbonisation of the electricity grid and broad scale electrification of the transport sector are highly beneficial to Trafford Park's decarbonisation goals. This puts emphasis on capturing early carbon savings with mature low carbon electricity technologies and measures, while at the same time implementing mid and long-term solutions to reduce emissions from heat and responding to increasing demands for electric transport in commercial and freight contexts.

A realistic low carbon roadmap scenario decreases forecasted emissions to 42,656 tCO_2 at a cost of £1.2 billion. **Category 1** energy conservation measures, comprising an array of energy efficiency upgrades, result in a 19% decrease in electricity demand and an 11% decrease in heat demand by 2038, with a combined cost to businesses of £225 million. These measures would save an estimated £61 million per year when fully implemented. The eight low carbon technologies comprising **Category 2** measures provide electricity and heat to replace grid sourced energy demand. By 2038, combined annual electric generation outputs of 567 GWh electric and 1,192 GWh heat are possible at Trafford Park, at a cost of £898 million. Carbon offsetting of the remaining 42,656 tCO_2 is estimated to cost between £0.655-3.5 million per year if no further measures are pursued. **Category 3** measures, which expand the scope of heat efficiency measures and the hydrogen economy at Trafford Park, may further decrease CO_2 emissions associated with the realistic pathway, at an additional cost of £171 million. Residual carbon would reduce to 12,456 tCO_2, at an offset cost of £0.187-0.996 million per year.

Trafford Park's engaged stakeholders, and the Council itself, are well positioned to leverage collective action to meet low carbon goals, while accessing cost savings, process improvements, and new revenue streams. Trafford Council has a core role to play in facilitating working groups to align stakeholders based on shared goals and should capture knowledge from these engagements to develop best practice guidance and further enable community actors to seize opportunities along their sustainability journeys. The solutions presented cannot be singly implemented or funded by the council or an individual solution provider. Rather, the presented roadmap outlines short, mid-, and long-term measures to be undertaken by local government, third party solution providers, and most importantly the range of large and small businesses and industries operating within Trafford Park in a proactive and coordinated manner. Likewise, various private and public funding must be leveraged to account for upfront planning and installation costs. A long-term view to this cross-park coordination is key to the successful transition to net zero and provides the opportunity to demonstrate Trafford Park as an example of global best practice in a multi-stakeholder environment.

8. Appendix A – Energy Efficiency Interventions

8.1 Electric Intervention Measures

Measures	**Load Category**								
Load-specific: Motors and Drivers	**Motors**	**Pumps and Fans**	**Conveyors and rollers**	**Com-pressed Air**	**Lighting**	**HVAC**	**Cooling**	**Hot Water**	**Other**
Energy Efficient Motors (IE2, IE3, IE4)	X	x	x						
Variable Speed Drives (VSDs)	x	x	x						
Correct Sizing	x	x	x						
Load-specific: Compressed Air Systems									
Leak Detection and Rectification				x					
Compressor control optimisation				x					
Reduce pressure setpoint to match end use pressure				x					
Reduce intake air temperature to compressor				x					
Load-specific: HVAC									
Increase Setpoint						x			
VSDs for HVAC Fans and Compressors						x			
Chiller Control Optimisation						x	x		
General									
Preventive Maintenance Strategy	x	x	x	x	x	x	x	x	x
Pipework insulation for chilled processes (incl. storage tanks)						x	x		
Energy Monitoring and Evaluation (Submetering, dashboarding, process analytics)	x	x	x	x	x	x	x		x
Optimised Process Controls	x	x	x	x	x	x	x		x
Correct sizing of equipment	x	x	x	x	x	x	x		x
Behavioural Change and Awareness	x	x	x	x	x	x	x		x
Efficient Lighting Technology					x				
Daylight Harvesting					x				
Wall insulation						x			
Glazing						x			
Demand oriented lighting					x				
Building Efficiency Monitoring (BEM)					x	x		x	x
Building Performance Optimization (BPO)					x	x		x	x
Building Automation, BACS B					x	x		x	x
Building Remote Monitoring (BRM)					x	x		x	x
Building envelope									x
Demand control ventilation (DCV)						x			
Room automation HVAC (BL20)						x			
Room automation HVAC+Lighting					x	x			
Room automation HVAC+Lighting+Blinds					x	x			
Building Automation, BACS A					x	x		x	
Building Automation, BACS C					x	x		x	
Insulated doors						x			
Improve airtightness						x			
Adjust room setpoint based on regional requirements (e.g. 18 C instead of 22 C)						x			

8.2 Heat Intervention Measures

	Load Category		
General	**Space Heating**	**Water Heating**	**Industrial Heating**
Behavioural change and awareness	x	x	x
Wall insulation	x		
Glazing	x		
Building performance optimisation (BPO)	x	x	
Building automation, BACS B	x	x	
Building Remote Monitoring (BRM)	x	x	
Building envelope	x		
Insulated doors			x
Improve airtightness			x
Minimise ambient air intake			x
Dynamic control of air fuel mix			x
Waste heat recovery and reuse			x
Insulation of steam piping, valves, fittings, vessels			x

9. Appendix B – Waste to Energy

9.1 Waste to Energy Processes

Primary Waste to Energy Processes	
Combustion	Heat is produced by burning waste, which drives a turbine to generate electricity. This indirect approach to generation currently has an efficiency of around 15-33%. If district heating is incorporated, the efficiency can be as high as 80%.
Gasification	This process produces gas from waste. Everyday waste, consisting of product packaging, grass clippings, furniture, clothing, bottles, appliances, and other products is the feed for chemical conversion at high temperature (without combustion). Waste is combined with oxygen and/or steam to produce 'syngas' – synthesised gas which can then be used to make numerous useful products, from transport fuels (including hydrogen fuel cells) to fertilisers or turned into electricity. This syngas is often burned in the same manner as direct combustion.

9.2 Technology requirements for ERF

On-site technology requirements for an ERF plant
33kV Sub Station
Service and El Annex Building
Energy power generating Area
Step-up Transformer Building
Tipping Hall
Fuel Bunker
Ammonia unloading Area
Ammonia Tank Area
Residues Storage Area
Ash & Slag Storage Area
Effluent Area
Boiler Building
Stack Area
Steam Turbine Hall
Energy/Heat Centre
ACC Area
Fire Equipment Area
Administration Building
Weighbridge Area
Flue Gas Treatment
Gate House
Attenuation Pond
CCS train (Capture & Storage – injection to pipeline or tanking infrastructure)

10. Appendix C – District Heat Network

10.1 District Heat Network Modelled Cost Assumptions

Dimension(internal)	Length	Modelled Cost	
20mm	5,439m	£	6,278,372
32mm	11,277m	£	13,718,159
50mm	7,914m	£	10,267,287
100mm	18,996m	£	27,410,978
200mm	10,532m	£	18,237,915
250mm	177m	£	408,645
300mm	697m	£	1,809,215
400mm	1,799m	£	5,968,635
500mm	2,375m	£	9,589,483
600mm	645m	£	3,161,994
700mm	1,492m	£	8,391,199
800mm	1,299m	£	8,052,097
900mm	521m	£	3,458,590
1,000mm	379m	£	2,961,319

11. Appendix D – Community Engagement

Visioning Workshops

June 2022

Four visioning workshops were conducted in June, three were onsite at the Groundworks Trafford Park Ecology site on the 20th and one was held virtually/online on the 21st June.

The sessions were held in parallel with the Greening Trafford Park project carried out by Arup, with Siemens presenting an outline of the future options for a Low Carbon Trafford Park and routes to meet the Trafford Borough Council and GMCA's wider target to be net zero by 2038.

A range of stakeholders were present at the physical and virtual workshops: council members and officers, local businesses from on the Park, trade/commercial organisations and interested parties developing energy supply and generation options in the North West region, including the North West Hydrogen Alliance and North West Energy Hub.

Each of the sessions consisted of an introduction and overview by officers from Trafford Council, a session on Greening Trafford Park by Arup and a session on Low Carbon Trafford Park by Siemens. This was followed by an interactive discussion with attendees, who provided perspectives and insight to their ongoing low carbon activities. Sessions were aided by an interactive online survey amongst the present stakeholders.

An outline of the low carbon Trafford roadmap was detailed. This was then supported with examples of solar and wind mapping and modelling. The range potential technological interventions that could be deployed across the Trafford Park area which would be aligned to its core activities were then outlined. The context and regional drivers were outlined as from the Net Zero North West Pathway to become zero carbon.

In parallel to the stakeholder discussion, a survey was administered to highlight key areas of stakeholder concern in the emerging pathway and the main areas of development interest. The survey highlighted a strong inclination toward on-site generation and storage technologies, community-based initiatives for their installation, as well as interest in electric vehicle charging.

Additional Engagement

May-June 2022

Further to the workshop sessions, other engagements were undertaken with interested parties around both specific entity developments and the promotion of the Low Carbon Trafford roadmap to the wider business community via the Trafford Chamber of Commerce.

Discussions were held with representatives from Peel NRE and the North West Hydrogen Alliance.
With Peel NRE Siemens discussed their future Park developments and their interest to engage on a potential industrial waste heat feed into a DHN build that could feed to the Peel Trafford Waterfront development. This is of considerable interest to them, to be followed up on concerning their current project development stage.

The North West Hydrogen Alliance outlined testing and trailing activities of Hydrogen with large natural gas users on the Park. This trailing if successful would see an extension application of the HyNET 2 from the Carrington Power station as HyNET 3 to bring large supply volumes of industrial scale hydrogen to the top tier users on the Park. This could reduce the natural gas demand and so associated carbon emission footprint on the Park. This would be a first step to a broader transition, as the hydrogen use by large users would result in a “waste” heat opportunity secured for the long term, feeding heat into a Park heat network to the smaller and medium sized businesses and retail areas for space heating. The HyNET 3 development is seen as a high strategic development need for Trafford Borough Council’s collaboration with the NWHA by promoting the project in its public authority capacity. This is in its interest to drive security of employment with all levels of commercial activity on the Park. It is seen as a high priority that dialogue with NWHA and key gas users is commenced and aligned with a future heat network development, as from the heat zoning studies also underway in the Borough.

Case Studies

Case studies have been collated through stakeholder engagement activities. Such cases serve to feature a subset of active projects and interest areas of those with ongoing local operations and highlight common planning and implementation challenges in low carbon activities that can be remedied by local initiatives.

Company	Business Activity	Project Area / Interest	Challenges & Opportunities
Esprit Ltd	Warehousing and Logistics, and Ship Canal docking facilities	All low carbon technologies	Operations are within leased buildings. It is unclear whether there is a case for investment in low carbon measures as a tenant, until long term habitation is fixed or landlord is a driver for take-up. A good exemplar of a common problem of retrofit/system deployment. Leased properties made investments difficult as the length of stay in a premises was time limited by contract. Esprit Ltd showed interest in the business opportunities for diversification into decentralised energy options to be developed on the Park as could be aligned to its logistics specialisms.
APC	Courier / Parcel Logistics	Current solar PV investment and open to further investments	No challenges communicated at this time. Interest in further retrofit / efficiency measures that could be concerned for their operation. Interested in business diversification opportunities from decentralised energy developments.

Lindab	Metal Fabrication Provider / Supplier	Solar PV	Finalising 330 kWp PV system with future installations considered on a 2nd Park operation/facility. At this stage of development, no issues on DNO capacity have been raised. Third party supplier of the PV system to Lindab has outlined the 330kW PV system would met 50% of their demand. Unclear if this has been explained / detailed to show seasonality effects on this 50% supply envelope. Considering other energy saving options in addition to solar.
Speedy Services	Plant and Equipment Hire	Green buildings and park operations	General direction required to identify high impact solutions. Speedy are open to follow-up on options that they should consider to greening their operation and buildings. Speedy are very keen to better understand business diversification opportunities from decentralised energy developments that their supply model could support.
Hardwood Dimensions Ltd	Timber Products Import / Export	Solar PV	Hardwood had developed a plan for a 50 kWp system with financing secured, but secured investment was cancelled when the local DNO informed them that an expensive network capacity upgrade was required – with that cost falling onto them, this would make such a PV project unfeasible. This is viewed as a likely common issue on the Park area – that ageing electrical network infrastructure will need major upgrading to accept large scale individual business PV deployment – to the extent it will stall as the costs will deter individual business to move forward. A more balanced approach for network needs regarding upgrade funding is required to spread the costs – this is something the Council can take up with GMCA as a regional into national policy discussion with Central Government with the electrical supply industry.