Zero Carbon Analysis – Junction 3, M54

DATE:	28 April 2020	**CONFIDENTIALITY:**	Confidential
SUBJECT:	Zero Carbon Analysis		
PROJECT:	Junction 3 M54, Shropshire	**AUTHOR:**	Yanis Savvopoulos
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Executive Summary

This report sets out the upcoming changes to the regulatory framework, emerging definitions of zero carbon and potential pathways for Junction 3 M54 development to achieve zero carbon.

The UKGBC Net Zero Carbon Buildings Framework sets out definitions and principles around the approaches to net zero carbon. The ambition of Bradford Estates is that Junction 3 can achieve a net zero-carbon status for the operational energy and transport emissions generated from the new development.

As most of the development is expected to be delivered post-2025, the Future Homes Standard (FHS) is likely to apply to this scheme. Therefore, it has been assumed that the development will be designed according to the proposed standards of Option 2 of the FHS which is the government's preferred option, (see Appendix C). On this basis, modelling has been undertaken in order to quantify the expected energy consumption. Modelling included three domestic and three non-domestic typologies which are considered representative from a planning use class perspective. The development has been assumed to be all-electric.

The CO_2 emissions factor for electricity used to quantify the carbon emissions are 41 g CO_2e / kWh for the 2040 scenario and 28 g CO_2e / kWh for the 2050 scenario. These are the updated figures (March 2019) that are considered to reflect accurately the average grid intensity for the years 2040 and 2050 according to the Treasury Green Book supplementary appraisal guidance on valuing energy use and greenhouse gas (GHG) emissions.

Scenarios

Two future scenarios were explored for the purposes of the emission calculations. Scenario 1 assumes 60% build out of the development by 2040 and Scenario 2 assumes 100% build out of the development by 2050.

Buildings Emissions

After reasonable energy efficiency standards are applied, the overall energy consumption for the proposed development buildings was calculated to be:

- **Scenario 1 (2040): 17,860 MWh/year** equating to **732 tCO_2 per annum.**
- **Scenario 2 (2050): 29,767 MWh/year** equating to **833 tCO_2 per annum**

This will have to be offset with renewable energy generation to allow the development to be net zero.

For the purposes of this analysis, only solar photovoltaic technology has been modelled as a significant option to generate renewable power. The available roof area of the site has been calculated and the possible energy generation on-site has been calculated to be:

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- **Scenario 1 (2040): 8,076 MWh** which accounts for 45% of the energy generation required for a net zero-carbon scheme. This is entirely based on rooftop solar availability. This would cost up to £8.1m. Assuming this is achieved, that would leave **9,784 MWh / 401 tCO_2** per annum to be accounted for. To deliver this remaining net energy generation / CO_2 emission reduction would require an off-site solar farm of approximately **9.7 MWp**, across 21.5 Ha. This would cost around £6m.
- **Scenario 2 (2050): 13,459 MWh** which accounts for 45% of the energy generation required for a net zero-carbon scheme. This is entirely based on rooftop solar availability. This would cost up to £13.5m. Assuming this is achieved, that would leave **16,307 MWh / 457 tCO_2** per annum to be accounted for. To deliver this remaining net energy generation / CO_2 emission reduction would require an off-site solar farm of approximately 16.3 MWp, across 36 Ha. This would cost around £10m.

One option for this would be to deploy solar on the wider Bradford Estate. A review of the map of the estate indicates there is suitable space. It has been normal to deploy solar only on agricultural land of classification 3b or higher. It appears a lot of the state is Grade 3, and could be used for deployment, although further work is required to identify an ideal location.

If any of these methods cannot be delivered or are not favoured, then an offset payment to an accredited provider or an entirely off-site solar farm would be the final options.

Table 1 - Energy & CO_2 Emissions Analysis – J3 Buildings Operation (2040 Scenario)

Element	MWh (demand / supply	Net tCO_2 annum	Est. Additional cost
After Energy Efficiency	17,860	732	N/A – Effectively mandatory*
Rooftop solar generation on-site	-8,076	-331	£8.1
Off-site solar	-9,784	-401	£5.9
Total	-	-	**£13.9m**

*Confirmation will be required with potential developers that this is priced in to their analysis.

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Table 2 - Energy & CO_2 Emissions Analysis – J3 Buildings Operation (2050 Scenario)

Element	MWh (demand / supply	Net tCO_2 annum	Est. Additional cost
After Energy Efficiency	29,767	833	N/A – Effectively mandatory*
Rooftop solar generation on-site	-13,459	-377	£13.5m
Off-site solar	-16,307	-457	£9.8m
Total	-	-	**£23.2m**

*Confirmation will be required with potential developers that this is priced in to their analysis.

Some of the additional costs of the renewable generation assumed here may be recouped through sale of rooftop solar power to tenants or on through power purchase agreements for the solar farm. It may be possible to use third party investors.

Transport Emissions

Sustainable transport will be proposed to be at the heart of the development through the provision of a mixed-use community. The proposals include both a strategic employment area and residential dwellings. Within the residential element of the development, local centres will be provided that will supply a greater level of everyday facilities such as employment, education, retail and recreation all within the site. The provision of a mixed-use development will encourage internal self-sufficiency which in turn helps to reduce the need to travel as well as encouraging sustainable and active travel within the site.

Given the scale of the strategic employment area and the other proposed land uses generating employment opportunities, we have aspirations to achieve 35% of residential to employment trips remaining internal within the proposed site. However, in order to be robust, as part of our analysis we have assumed that 30% of residential to employment trips during the peak periods will be internal within the site.

In addition to employment trips, education trips represent approximately 30-40% of trips in the morning peak. The proposals include both primary and secondary education facilities. Whilst it is acknowledged that

the secondary school may attract some pupils from off-site, the majority of education trips will be contained within the site.

Creating choice is also a fundamental feature in encouraging people to make use of sustainable modes of transport. The proposed development will be designed to provide a vibrant, active and healthy community which is built around green routes, footways and cycleways to encourage sustainable travel. The proposed pedestrian and cycle routes will permeate out into the surrounding area with connections to existing routes linking the site to nearby destinations. In addition, the proposed development will be well served by the improvement/creation of strategic bus routes linking the site to Telford, Cosford Station and Wolverhampton. As technology continues to progress, the provision of electric shuttle pods, connected and automated vehicles and the rise of e-scooter and e-bike is transforming the way we travel. The proposed development will ensure these modes of travel are available to provide an alternative to single occupancy vehicle movements. In light of these proposals, a 20% mode shift from car driver to sustainable modes of travel (based on 2011 Method of Travel to Work Census Data) has been assumed within our analysis.

Both the 2040 and 2050 build out scenarios have been assumed to be all-electric.

Scenario 1: 2040 – 60% Build Out

The Total Carbon Emissions for the 2040 scenario has been established to be **555 tCO_2e**.

Scenario 2: 2050 – 100% Build Out

The Total Carbon Emissions for the 2050 scenario has been established to be **457 tCO_2e**.

Energy production off-site will have to match that the equivalent energy figure is exported to the national grid in an annual basis in order to demonstrate that a net zero-carbon (transport) development is feasible with off-site electricity generation. The table below illustrates the required size of array to achieve that:

Table 3 - Cost and Land Requirements for transport emissions offset

	Scenario 1 (2040)	Scenario 2 (2050)
Output MegaWatt peak	14 MWp	16 MWp
Land area required	30 Ha	36 Ha
Total Cost	£8.1 m	£9.8 m