CARBON ZERO — Climate Change Appraisal Summary Report: A470 Pontybat safety scheme

Date of Appraisal: 15/12/2021 | Scheme Promotor: Welsh Government and North and Mid Wales Truck Road Agency | Stage of development: Detailed Design / WelTAG Stage 3 Study

Greenhouse Gas (Co2e) Appraisal

Quantified predicted change:

Scheme appraisal period (60 years):

408	tonnes of which...	48	% embodied carbon

Predicted change in carbon dioxide equivalent emissions (CO2e) produced during 60 year scheme lifetime

Note: not all relevant aspects have been quantified. See key and qualitative summaries below.

Milestone	Impact (tCo2e)	Timescale of quantified Impact
3rd Carbon Budget (2018-2022)	199	2018-2022
4th Carbon Budget (2023-2027)	15	2023-2027
5th Carbon Budget (2028-2032)	16	2028-2032
6th Carbon Budget (2033-2037)	17	2033-2037
Wales and UK Net Zero 2050 Target	293	2022-2050

This is equivalent to...

816		Equivalent Trees	Indicative number of trees you'd need to plant to remove this amount of carbon from the atmosphere in the same time
248,566		Equivalent Trips	This many car trips, based on an average trip length of 7.9 miles and average emissions in 2021
70		Carbon Cost Ratio	The carbon impact per £1mil of scheme cost (£5.8 million)
Low	£34,295	Carbon Value	Based on Treasury Green Data Book (Low, Central & High Estimates of Carbon Value
Central	£68,590		
High	£102,885		

Key:

Quantified | Relevant but not quantified | Not relevant

Summary of scheme impact on Greenhouse Gas emissions:

User Emissions

MS: car to walking | MS: car to cycling | MS: car to bus | MS: car to rail | Induced demand car | Traffic flow changes | Shared mode freq. | Diversion traffic change

The scheme proposes to amend the junction at the crossroads of the A470 and A438, locally known as Pontybat to form a new 4 arm roundabout. The roundabout is intended to ease a pinch-point on the A470 where queuing traffic can form, as right turning A470 southbound traffic tries to find gaps within the A470/A438 mainline traffic. As well as the new roundabout, a Differential Acceleration Lane (DAL) is proposed in the southbound direction along the A470 towards Brecon. This would provide 250 metres of formal overtaking opportunity for southbound drivers to pass slower moving vehicles safely. The works will allow general traffic to overtake slow moving vehicles safely, thus reducing the potential for accidents caused by frustrated drivers taking risks.

A quantitative assessment has been undertaken to identify the carbon impact of the vehicles that are released as a result of the DAL, as they will be able to travel at higher speeds (assumed increase of 10mph to 55mph) until they reach the next platoon. A spreadsheet based journey time savings model (based upon Calculations based on 'Uniting the Nation 1999' Appendix D) was produced to support the economic appraisal of a number of safety schemes in Mid Wales. Relevant to this assessment, the spreadsheet quantified the AADT of the A470 and the distance to the next platoon and the max number of light vehicles released per platoon. These values allowed the calculation of the number of platoons per day and therefore the number of vehicles released per day to travel at 55mph as opposed to 45mph, until the next platoon is reached. These values were profiled across the 60 year appraisal period using values from NTM March 2015 and entered into WSP's bespoke Carbon Appraisal Tool. The output of the tool indicates that there will be a slight adverse carbon impact (increase of 209 tCO2e), due to lower fuel economy at 55mph compared to 45mph. This, however, is an estimate of speed difference created from the DAL and could potentially have the effect of enabling vehicles to travel at a speed that is more beneficial to fuel economy e.g. if average speeds changed from 40mph to 50mph (RAC guidance states that, typically, cars are most efficient at 45-50mph).

The easing of a traffic pinch point is additionally expected to reduce stop-start movements associated with congestion. This would enable vehicles to operate more efficiently and thereby reduce emissions. While this impact has not been quantified it is expected that there would be a slight benefit in regard to emission reduction.

Given the remote location of the junction there are minimal pedestrian movements at this location; however, the scheme does include the replacement of the two existing bus stops and the construction of new footway linking them. These improvements to public transport infrastructure are minor and have the potential to encourage a minor uptake in modal-shift to shared modes (bus), thereby avoiding trips that would otherwise have occurred by private vehicle; however this has not been quantified and is likely to be minimal given the remote nature of the stops. Additional factors that may potentially influence the user benefits of this infrastructure, and not accounted for in this assessment, include the potential in-combination benefits of the proposals with other planned infrastructure.

A review of the census data for the nearby settlements of Bronllys and Talgarth indicates that an average of 84% of residents travel to work by car with 87% of households having access to a car or van. This data (namely the already high car mode share) , coupled with the limited route choice in the area, means that there is limited potential for induced demand (i.e. new car trips or modal-shift from active and shared modes to private car).

Although it can not be fully quantified at this stage, it is considered likely that overall carbon impact from user emissions during the operation stage will be neutral, based on the potential for a slight increase in emissions from vehicle speed changes (i.e. overtaking) being offset by operational improvements with the introduction of a roundabout. However, the quantified overtaking impact described above has been included within the quantified net-impact to present a precautionary estimate in the absence of evidence of the scale of traffic efficiency benefits.

During construction, traffic management and diversions required may cause an increase in journey lengths and congestion. This may cause some increase in emissions associated with increased stop-start traffic and reduced fuel efficiency resulting from congestion. Appropriate traffic management through the development and use of a robust construction management plan however will reduce this impact, and only a minor adverse impact on emissions is anticipated.

Embodied Carbon

Pre-construct | Raw material supply | Product transport | Product manufacture | Transport to site | Construction process | Construction waste | Maintenance | End of life

The manufacture and transport of materials required for construction of the scheme (i.e. embodied carbon) will cause an increase in carbon emissions. This impact has been quantified using the Highways England carbon tool and material estimates produced as part of the cost estimation process.

A total embodied carbon impact of 166.8 tCO2e from the construction stage has been calculated. This accounts for raw material supply, transport, manufacture and transport to works site. The largest carbon impacts are associated with bulk materials (80 tCO2e, of which 12tCO2e from transport), relating to asphalt, aggregates and concrete for construction of new kerbs. It has not been possible to quantify the carbon impact of all construction impacts, such as waste and site activities. As such, a precautionary 20% uplift has been added to account for these unquantified impacts. This gives a total estimated construction stage embodied carbon impact of 198.8 tCO2e.

It has not been possible to quantify the carbon impact of all construction impacts, such as waste and site activities, however this assessment also adopts the precautionary approach in some aspects of quantification where there is an absence of available evidence. For example, it is assumed that materials are transported 300km from depot to site (in line with RICS guidance) whereas there may be opportunities identified at later stages to source materials more locally. The subsequent detailed design process will also look to reduce these embodied impacts through material selection and the procurement process employed to appoint a contractor.

Once operational, maintenance and repair processes will result in additional carbon emissions, however this is an impact that will occur in a do-nothing scenario (i.e. repair of the existing carriageway). Where the highway asset has been renewed or maintained as part of the scheme proposal, this would actually have a positive impact on embodied carbon, due to the reduced maintenance need compared to the do-nothing scenario. At this stage, reduced ongoing maintenance requirements have not been defined and are therefore not accounted for in the calculation.

Additional Impacts

Tree loss | Tree Planting | Other carbon stores | Electric vehicles | Operational energy use | Other (describe below)

The number and species of trees to be removed is estimated to be around 5 to 15 small trees within the existing hedgerow. Landscape / planting has been proposed to mitigate loss of hedgerows and provide enhancement, which will sequester a negligible amount of carbon. As such, the scheme may result in a minor loss of carbon storage and future carbon sequestration but this will have a negligible carbon impact given the likely number of trees to be lost.

Summary of predicted net-impact

Adverse (in isolation under business as usual)	The reported quantitative net carbon disbenefit of 408 tCO2e (49% embodied carbon) over 60 years is driven by the scheme's embodied carbon impact and increased vehicular speeds (with potential for lower fuel economy). During operation it is likely that carbon savings from traffic efficiencies will offset quantified emission increases from higher speeds when vehicles overtake, however a quantified operational increase in emissions is reported as a precautionary approach has been taken in the absence of modelling data showing traffic efficiency benefits. However, when considering construction stage embodied impact an overall net-increase in greenhouse gas emissions is expected. This however is minor in scale and could be mitigated through compensatory measures and low carbon construction methods. The reported scale of impact will not have a significant impact on Wales' ability to meet carbon budgets or Net Zero targets.

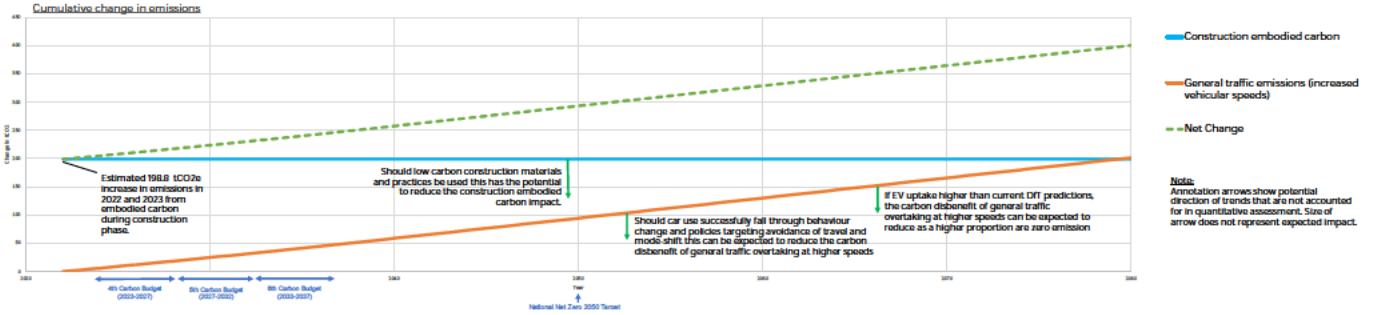
Influence of likely scenarios

Fleet composition	Given decarbonisation commitments at national and regional levels it is realistic to expect more accelerated uptake of low and zero emission vehicles than presented in TAG Unit A1.3.9 (July 2021), upon which the business as usual assessment above is based. The DfT's Transport Decarbonisation Plan defines commitments towards the decarbonisation of the vehicle fleet by 2050. This is additionally supported by the Welsh Government within the Prosperity for All: A Low Carbon Wales strategy, Wales Transport Strategy and Electric Vehicle Charging Strategy for which the former states the Welsh Government believe 60% of new sales for cars and vans must be electric vehicles by 2030. This likely accelerated uptake of ZEV and ULEVs would reduce predicted adverse impacts from traffic disbenefits; however, the carbon savings derived from modal shift will also be reduced. TAG (Unit A1.3.9) data currently predicts that in 2040 electric vehicles will comprise only 33% of the vehicle fleet (44% by 2050). It is therefore realistic to expect reduced carbon impacts of road traffic, notably from the mid-2030s onwards.
Behaviour change	Changes in travel behaviour and associated mode shares are also expected to change in future in response decarbonisation commitments. The DfT's Transport Decarbonisation Plan sets the acceleration of modal-shift to public and active transport as its first strategic priority, with an expectation that the future will see reduced car use. Welsh Government policy supports this. A fall in car use is understood to be required to achieve Net Zero targets and must be achieved through behaviour change towards growing demand for active and shared modes and avoidance of vehicle trips (e.g. home working). Should these changes be realised through policy and other interventions to realise a reduction in car use the volume of traffic flows using infrastructure and causing emissions would reduce. As such, modal-shift emission reductions could be more significant in future years.
Adverse (in isolation under likely future scenarios)	The carbon impact of the scheme under future scenarios of fleet composition and travel demand / mode-share has not been quantified. However, the assumed accelerated electrification of the vehicle fleet would result in the predicted carbon disbenefit from the use of the overtaking lane to be reduced. Under a scenario that a reduction in car use is realised the carbon disbenefits would further reduce as traffic flows performing overtaking manoeuvres reduces so less vehicles operate at higher speeds. Embodied carbon impacts from construction however would remain and a high proportion of the vehicle fleet is still expected to remain as petrol or diesel powered in the 2020s and beyond, so the scheme would still overall cause an increase in emissions.

Opportunities for further mitigation

Inherent Carbon Mitigation	Construction Practice Mitigation	Additional Mitigation
Development of landscaping and including selection of number and species of tree planting to maximise carbon sequestration.	Engagement with contractors on sustainable construction practices throughout the detailed design stage by incorporating emissions standards into contracts with suppliers. Techniques to reduce the use of carbon-intensive equipment during road renewal work such as refining material choice, procurement processes to mitigate forecast impacts and the use of sustainable materials (e.g. ready mix concrete & aggregates) and methods (low-temperature asphalt for the carriageway, on-site re-use of materials etc). For example, cement free concrete can reduce CO2 emissions by 30-80% compared to traditional methods such as ready-mix concrete used for this site. ULTILOW warm mix asphalts can also be used as a low-carbon substitute for general asphalt. These are a type of asphalts installed in the UK for road surfacing which are manufactured and supplied at far less temperatures than the usual asphalts and are hence known to reduce CO2 emissions by 15%.	Explore options for additional tree planting or woodland creation. It would take planting approximately 816 trees to mitigate the 408 tCO2e disbenefit over 60 years

Cumulative change in emissions



Climate Resilience and Adaption Appraisal

	RAG Rating	Comments
Understanding of climate risks to the scheme	Amber	Climate risks partly understood through completion of the steps above in liaison with the design team. Risks such as flooding identified as potentially relevant, due to the scheme being in proximity to an area of flood risk.
Resilience of Proposed Scheme to risks	Amber	Scheme is partly resilient to future climate conditions. Incorporation of planting and landscaping to help reduce surface run-off and a proposed attenuation basin within the vicinity. Upgrades to drainage and materials will also improve resilience to flooding and extremes of heat in comparison to a do-nothing scenario.
Impact of the scheme in-combination with changing climate	Amber	Scheme is unlikely to have any significant effects. Further assessment required to identify potential in-combination impacts; however, given the nature of the proposed scheme, climate change is not anticipated to worsen any potential environmental impacts associated with the scheme.

Opportunities to improve resilience through further action

Incorporation of further sustainable drainage measures and choice of species within the landscaping design that are more resilient to future conditions