A CARBON LED APPROACH TO ASSESSING THE IMPACT OF A RESIDENTIAL DEVELOPMENT

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Introduction

Recently WSP was involved in the development of a carbon neutral site in the Middle East, where the main constraint on transport trips to, from and within the development was the carbon emissions these trips produced. This led to us developing a carbon calculator specifically for this project that took account of many modes of travel including walking, cycling, bus, private cars, Light Rapid Transport and Personal Rapid Transport.

As the project was nearing completion, we took time to reflect on the implications that the carbon calculator tool that had been developed could have on other developments within the same geographic area, i.e. those that were within the “near carbon zero” development area. It was during this process that the team considered other possibilities for this tool, including work within Scotland.

It is acknowledged that there has already been a significant amount of work undertaken in this field of developing carbon calculators and emissions. However, we believe this tool provides a pragmatic approach to assessing the carbon implications of major new developments in a clear and consistent way.

Transport Assessments (TA) should allow the transport implications (including carbon emissions) of proposed major developments to be properly considered and, where appropriate, will help identify suitable measures to achieve a more sustainable and environmentally sound outcome (Scottish Executive, 2005a). Clearly a tool that calculates the carbon emissions from a proposed development will have a role to play in assessing a development’s environmental impact and could also assess the impact of any mitigating measures that may be developed.

There has recently been a significant shift in national policy with a far greater emphasis being placed on carbon emissions from transport and more importantly the introduction of steps to control these emissions. This is being reinforced through emerging Scottish Government legislation on the statutory duty for sustainable development and climate change.

The forecast potential economic impacts of global warming (or not tackling the issue effectively, Stern Review) will undoubtedly mean that carbon emissions and their control will play a more significant role in almost all walks of life. This will be particularly evident in situations where the government can have a direct influence (such as through the planning process).
There is no serious scientific doubt regarding the existence or seriousness of human induced climate change. An overwhelming body of evidence demonstrates that our climate is being rapidly changed by an increase in greenhouse gases resulting from the actions of humans. If left unchecked, greenhouse gas emission levels are expected to reach double that of pre-industrial levels between 2030 and 2060 leading to a rise in temperatures of between 2 and 5 degrees centigrade (HM Treasury, 2006).

The Stern Review (HM Treasury, 2006) estimated that the economic consequences of unabated climate change over the long run could cost between 5 and 20% of global GDP – described as the equivalent of the combined effect of the Great Depression and the two world wars of the twentieth century (HM Treasury, 2006).

Transport globally accounts for 14% of all greenhouse gas emissions. In the UK, it accounts for a higher share of national emissions and has grown in recent years to become the largest ‘end user’ creator of emissions. Transport is expected to deliver the second largest share of emissions reduction in the Climate Change Programme (CCP) by 2020, with Energy Supply delivering the largest potential for emissions reduction.

A series of reports (the Commision for Integrated Transport, 2007; Bannister & Hickam 2006; Fergusson, Kroger & Skinner, 2003; Sustainable Development Commission, 2005) all came to the same conclusion that a cut in transport emissions can be achieved through a mixture of technological and behavioural change (changes to Vehicle Excise Duty, biofuels, adjusting speed limits, road pricing and acceleration of smarter choices). The reports concluded that:

The major contribution of technological innovation was not likely to occur until after 2020;

Travel behaviour change was seen as having a significant effect in the short term;

Without behavioural change, a 60% reduction in emissions was not possible.

Overall CO2 emissions in the UK have reduced since the beginning of the 1980’s. Emissions in the industry sector are decreasing and residential emissions have been largely constant. However the road transport sector has been increasing significantly. Overall road transport contributes around 38 million tonnes of carbon equivalent annually, a doubling since 1970. The Transport Sector currently contributes around one quarter of all UK carbon emissions and this proportion is set to rise in the coming years.

Passenger car CO2 emissions have doubled from 12 million tonnes of carbon equivalent in 1970 (cars currently make up 13% of the UK total carbon emissions hence the quantity of emissions from this mode is of particular significance). There has been little change in bus emissions over this time at 5 million tonnes of carbon equivalent.
The base level of greenhouse gas is set at 1990 levels (being 280 parts per million CO2). The UK government has set out a target of at least a 26 to 32% reduction in greenhouse gas emissions by 2020 from 1990 levels and an 80% reduction by 2050 (recently announced revision of the previous 60% target – accepting advice provided by the Commision for Integrated Transport [2007]).

The current draft Climate Change Bill (Scottish Government, 2008) will enshrine these targets in law. The draft Bill:

- Makes targets legally binding;
- Introduces a system of ‘carbon budgeting’; and
- Allows the purchase of emission reductions from overseas to count towards the UK’s targets; and
- Creates a new independent body to advise on the setting of carbon budgets and to report on progress (the Committee on Climate Change).

Emissions Targets- Proposal to set mandatory targets on vehicle manufacturers to reduce tailpipe CO2 emissions. Target of 130g CO2/km to be delivered by 2012.

Fuel efficiency labels- deliver information to car buyers on how they can save money and help the environment

Biofuels - 5% of all UK fuel sold on UK forecourts to come from a renewable source by 2010.

Transport and carbon emissions trading - possible inclusion of surface transport into the EU Emissions Trading Scheme or as a UK self-standing measure.

Rail – targets to be set for reducing CO2 emissions per passenger-kilometre and per tonne-kilometre by increasing rail capacity (so that it can accommodate the demand and growth forecast as people and firms factor carbon-costs into their travel and transport decisions).

Travel Plans – the government has put in place a substantial programme to promote change of travel behaviour using a range of measures called ‘Smarter Choices’. These include workplace, school and personalised travel planning, travel awareness campaigns and marketing.

The target to reduce Scotland’s emissions by at least 80% by 2050 from the 1990 baseline set in the Kyoto Protocol, which the Scottish Government committed to in June 2007, is one of the most ambitious in the world. It will form the keystone of the Bill.
The Scottish Government is clear that emissions reductions should be achieved in the most cost effective way possible in support of its commitment to increasing sustainable economic growth in Scotland.

The Stern review of the economics of climate change (HM Treasury, 2006) reported that if the world does nothing to mitigate climate change, the impacts could cost the world the equivalent of 5 - 20% of global GDP each year.

The Committee on Climate Change (2008), in its interim advice to the UK Government, advised that the 2050 emissions reduction target for the UK Climate Change Bill should be increased from 60% to 80%, and that it should be extended to cover all greenhouse gases. This expert, independent Committee advises that this is challenging but achievable with the right policies and could cost between 1-2% of UK GDP in 2050.

Scottish Ministers agree that strong action is needed to avoid dangerous climate change. They therefore commit Scotland to playing its part in addressing the global challenge presented by climate change and to Scotland leading the way by bringing forward a Scottish Climate Change Bill with a target to reduce emissions of the basket of six greenhouse gases by at least 80% by 2050.

Taking all this background work, targets and pressure placed on governments to reduce carbon emissions, how can we achieve this through practical and realistically viable measures? We believe that sustainable living begins with the planning process and that by targeting new developments, and ensuring their transport-related carbon emissions are the lowest they can be, it will provide a significant step towards achieving the targets imposed by Kyoto and Stern.

A global problem tackled at a local level

There is no denying that climate change (or “global warming” in old speak) is truly a global problem, however one single global remedy is unachievable. The solution has to be the sum of a host of small measures ranging from work practices to development layouts and power generation. Independent tasks working towards the greater goal. A global problem tackled at a local level.

Part of this change could be alteration to the planning process. Alteration that ensures carbon emissions can be controlled for all new major developments within the country. Alterations that ensure Scotland can realistically attempt to achieve its carbon reduction targets set for them.

This, we believe, can be done in four stages within the planning process, which has already supported sustainable transport objectives through policy such as SPP17: Planning for Transport (Scottish Executive 2005b). These stages are:

Site selection stage;
Site Selection Stage

At site selection stage, as part of the strategic and local development plans, carbon implications of the site identification should be considered. Access to public transport and proximity to major employment areas should be considered to reduce the carbon footprint of the site, in terms of transport related emissions. Software such as Accession can be a powerful tool to aid this process but a full carbon assessment could be carried out using WSPs Tool for Assessing Transport Emissions (TATE). The TATE process used to calculate carbon emissions for new developments is based on the 3 key factors of:

- **Number of trips;**
- **Trip length;** and
- **Emissions rates of vehicles used to undertake journeys.**

For example, we can look at the hypothetical site selection for a new 1000 unit housing development in East Lothian. Three potential locations were initially selected: Wallyford, Prestonpans and Tranent.

Using standard walking isochrones shown in the figure below, it is easy to identify which of the three sites (shown in blue) have easier access to rail with the station being greater than 20 minutes walk time from the site at Tranent, 20 minute walk time from the site in Prestonpans and just 10 minutes walk time from the site in Wallyford.

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1 Site selection is undertaken as part of the development planning process – refer to Circular 1 Development Planning (2009) published by The Scottish Government.
Assessment of the anticipated trip distribution for each of the sites, undertaken by a traditional gravity model, could be supplemented by more up-to-date local data, shows that 70% of the trips would be to Edinburgh. Again, using standard drive time isochrones it is easy to see which site would have easier access, along with quicker and shorter journey times, as seen below.

Again, Wallyford appears to score better in this assessment with a journey time of around 17 minutes, with Prestonpans having a journey time of 20 minutes and Tranent around 22 minutes.
Combining these three assessments (PT access, trip distribution and trip length) gives a good indication of which site should be selected. However, TATE takes all these elements and produces a carbon emissions value for each of the sites, allowing the lowest scoring site to be selected.

Masterplanning Stage

At masterplanning stage, as part of the development of the site and its proposed use, carbon implications of site make up should be considered. This mix of residential, retail, employment and education on a development site is vital to reducing the carbon emissions associated with the site traffic.

By ensuring a mixed use development, internal trips, either home to work or home to leisure, encourage short distance trips and if the development is properly designed these trips can be made by sustainable modes. To aid this process, several elements can be addressed and implemented such as:

Permeability;

Safety;

Public transport penetration;

Street design; and

Travel behaviour.

Permeability, or ensuring ease of access for all modes, is an important factor in redistributing the model split of the site, and therefore impacting on the
carbon emissions. By designing a road network that caters for vulnerable road users then travel by these modes is encouraged. As part of the carbon assessment of the site, the permeability is assessed and ranked against benchmark figures (level of service). This ranking then allows the internal trips to be reassessed in terms of mode share, which in turn allows a recalculation of carbon emissions.

The element of safety always comes into consideration when walking is considered as a viable mode from one place to another. Providing routes that are perceived as safe to the users allows a change from the baseline modal shift pattern, and again this is ranked on a level of service style scale. This then informs TATE as to the new modal split and the anticipated number of walking trips, allowing a recalculation of emission figures.

Public transport accessibility can have a major impact on carbon emissions from a development site on many levels. In TATE public transport is assessed on several criteria including penetration to the site/catchment, frequency, routing and journey times. Each of these criteria has a benchmark for the site to be measured against (again coming back to level of service) and these values are transferred to the carbon emission calculations.

The emerging Designing Streets manual (which WSP are currently leading for the Scottish Government) places more emphasis on good street design. Providing mixed use, high density frontage development along with more permeable, legible and less car dominated street layouts can help to encourage more sustainable travel and influence travel behaviour.

Travel behaviour is the final heading of carbon assessment at this stage of the development. Examination of local travel patterns will be assessed in addition to trip type and final destination for the development trips. Parking at the destination (city, industrial, out-of-town) will influence public transport use as will existing travel patterns for the area (depending on what the development is). The use of personalised travel plans can provide an affective tool to influence travel behaviour and mode choice for new developments at a microlevel.

**During the Transport Assessment process**

During the TA process there is scope to influence transport related carbon emissions by engaging with public transport operators. Encouraging bus operators to increase the frequency or route of their service or even introducing a new service, where possible, through good street design can have a profound impact on the attractiveness of public transport and therefore carbon emissions.

WSP recently completed a TA for a large mixed development in Scotland where engagement with the bus operators during the masterplanning process was key. WSP, after many meetings, managed to convince a commercial bus operator to reroute their service through the development. The design of the
development required to be changed, and now includes a bus-gate, but this was seen as a positive change as it increased public transport penetration.

**Once the Transport Assessment is completed**

On completion of the transport assessment document, it is proposed that the output from TATE forms a chapter of the report. This will inform the Local Authority of the carbon emissions assessment that has been carried out and the baseline values for the development. It will also assess the measures put in place throughout the evolution of the site selection and masterplanning and therefore give an anticipated carbon emissions total. This new total shows the change from the baseline and how it was achieved. This is a measurable target, taking the travel planning section of a TA one step further.

In addition to just being “information in a document”, the carbon emissions calculated can be offset to ensure the development is carbon neutral. The purchasing of “Carbon Credits” is becoming more widespread and should be considered to ensure Scotland is leading the way with carbon neutral developments. While we have a target of reducing our “actual” carbon emissions by 80% can we not offset the remaining 20% for new developments?

For example, during a standard TA for a small 180 unit development on the outskirts of Glasgow produces 313 two-way trips across the AM and PM periods. Using a standard gravity model to inform trip distribution and trip length, this amounts to 2,770 vehicle kilometers per day or over 1,000,000 vehicle kilometers per annum. Using TATE to calculate the carbon associated with the trips, gives an answer of 206 tonnes of carbon. By implementing different measures such as new bus services and reducing the car trips by 20% carbon emissions can be reduced by 15% to 175 tonnes. This remaining carbon can be offset annually by the developer for a set number of years, to ensure the development is carbon neutral.

Carbon offsetting can be purchased easily at around £10 per tonne and while offsetting does not replace carbon reduction, by offsetting the remaining carbon from the development we can ensure that the new developments within Scotland achieve a carbon neutral standard.

**Standardising and consistency**

To ensure consistency of the carbon emissions calculations, we are developing a set of standardised tables for many of the elements that influence the carbon emissions and detailed above. These tables are based on level of service and allow for easy use and consistency. Looking at public transport catchment as an example, the percentage of the development within 5 minutes walk of the site is split into six bands ranging from 0% – 100% and next to each band is a standard value for altering the modal split (reducing car trips and increasing bus trips). This process is automated so the user just selects the band that corresponds with the catchment of the site.
Using this process ensures consistency of the assessment. Consistency between:

*Users* – each staff member may have a different view on how much modal shift can be achieved by increasing bus service penetration. By using the level of service technique removes individual perception and keeps results standardised.

*Consultants* – any consultancy that could use this tool would have guidelines on how to use it and a fixed list of interventions. So if two consultants undertook the same analysis it should produce the same results.

*Consultants and Local Authorities* – by having a clear set of standardised tables, Local Authorities have a clear trail to follow when auditing the TA.

**So what now?**

The bold carbon emission reduction targets set by the Scottish Government call for greater innovation in the way transportation and land use planning interact. The development of this process provides a natural step forward for transport planning in Scotland to contribute effectively towards significant reductions in carbon emissions and meeting the objectives of sustainability.
References


