South West of England Regional Development Agency

Use of the REEIO Model to Assess Environmental Implications of Freight Efficiency

Paper 1: Freight Efficiency Scenarios

The South West SCPnet Technical Group discussed the testing of a number of scenarios put forward by the Policy User Group using the REEIO model in order for the group to gain a better understanding of the model and insight into potential policy uses of the model by regional partners in the future.

The scenarios proposed, prompted by the current work on developing an energy efficiency strategy for the region, were:

(i) Domestic energy use, looking at the effect of a 50% reduction in pupil transport miles;

(ii) Business energy efficiency, assessing what means might be required in different sectors to achieve a 20% reduction in CO_2;

(iii) Sustainable construction, assessing ways in which zero CO_2 emissions from sustainable construction might be achieved.

Further discussions with the Technical Group identified that further work, including possibly additional data collection, outside REEIO would be required in order to develop Scenario 1 into a meaningful REEIO run.

Looking at business energy efficiency, bearing in mind the heavy dependence on freight transportation in the region, it was decided to look at the freight assumptions within REEIO and assesses the impact that changes to freight patterns might have.

1. Baseline Scenario

1.1 Economic Assumptions

The economic module of the REEIO model is based on the Cambridge Econometrics Local Economy Forecasting Model (LEFM), assuming an average growth of 2.5% per annum in GVA but 0.75% growth per annum in population. However it was agreed this should be amended to reflect the projected growth scenarios outlined in the recently reviewed Regional Economic Strategy. These are:

- 2.8% per annum increase in GVA, 2006-2015, maintaining the sector distribution predicted by the LEFM
- 0.65% increase in population per annum, 2006-2015, maintaining the age distribution predicted by the LEFM

This growth scenario is considered by HM Treasury and others in central government to be a realistic outcome for the South West region and therefore has been adopted as the Baseline Economic Scenario.

1.2 Baseline Freight Assumptions

For the baseline transport assumptions, it was agreed to use the transport parameters in the environmental part of the REEIO model which are:

(i) The majority of SW freight is transported by road, with the share of freight transport (in total freight kilometres) remaining constant to 2015, as shown by mode in Table T1 below.

Table T1: Share of Total Freight Kilometres by Transport Mode

Transport Mode	% Freight km
Road	93.2
Rail	1.0
Air	0.1
Water	5.7

(ii) The amount of freight transported per vehicle / craft / vessel by mode remains constant to 2015, as shown in Table T2 below.

Table T2: Quantity of Freight per Vehicle

Transport Mode	Freight tonnes per vehicle
Road	3.93
Rail	40.9
Air	0.643
Water	8,296

(iii) The tonnage of freight is directly related to GVA and this relationship is constant over time and freight mode, at 0.4662 tonne kilometres per unit of GVA;

(iv) The share of fuel used by each type of transport remains constant over time, as indicated in Table T3 below. The model currently does not account for any current or projected use of alternative fuels.

Table T3: Tonnes of Oil Equivalent per Thousand Tonne Kilometres

	Motor spirit	Derv	Gas oil	Fuel oil
Road	0.0116	0.152	0	0
Rail	0	0	11.3	0
Air	0	0	0	0.211
Water	0	0	57.4	62.2

These assumptions, together with the baseline economic assumptions above, are referred to from this point forward as the “Baseline Scenario”.

2.0 Projected Future Scenarios

The possible future transport scenarios assume the following changes in (ii) and (iii) above, i.e. the amount of freight per vehicle and the amount of freight per unit GVA.

2.1 Scenario #1: Variations in the Amount of freight per vehicle

It is likely that, with improved logistics, efficiency savings can be made in transportation of freight. It is possible that better use could be made of transport in and out of the region, with potentially empty vehicles carrying a return load for a different customer. In order to provide some insight into the effect of possible policy interventions aimed at increasing efficiency in the freight sector could have on energy consumption and emissions over the next ten years, the effects of a 5%, 10% and 20% increase in the amount of freight carried per vehicle were analysed.

2.2 Scenario #2: Variations in the Amount of freight per unit GVA

The second scenario examined looks at decreasing the amount of freight per unit of GVA, which might be achieved by increasing local sourcing and decreasing the consumption of goods and services from outside the region. Scenario #2 analyses a 5%, 10% and 20% decrease in the amount of freight per unit of GVA

2.3 Scenario #3: Scenarios #1 &#2 Combined

Scenario #3 combined Scenario #1 and Scenario #2 pair-wise, pairing a 5% increase in the amount of freight carried per vehicle with a 5% decrease in the amount of freight per unit GVA, etc.

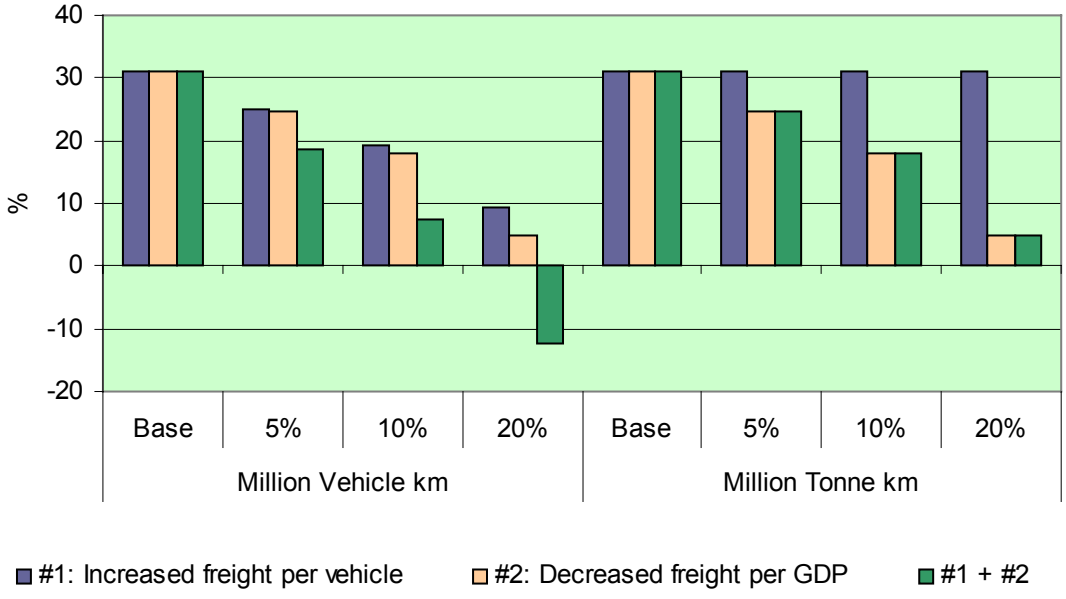
The scenarios are considered below against the different output variables produced by the model.

3.0 Environmental Outputs

3.1 Changes in Vehicle and Freight Kilometres

Figure T1 shows the effect of each set of scenarios on levels of freight, both vehicle kilometres and freight tonne kilometres.

Figure T1: Change in Freight Movement, 2005-2015



The baseline scenario, where no changes to transport assumptions were made, indicates that freight transportation, both in terms of total freight movements and vehicle movements is likely to increase by the order of 30% between 2005 and 2015.

The key findings are:

(i) Scenario #1 increases the amount of freight carried per vehicle, whilst the total freight moved remains unchanged, the number of vehicle kms travelled reduces as the level of freight carried per vehicle increases by 5%, 10% and 20%, as indicated in Figure T1.

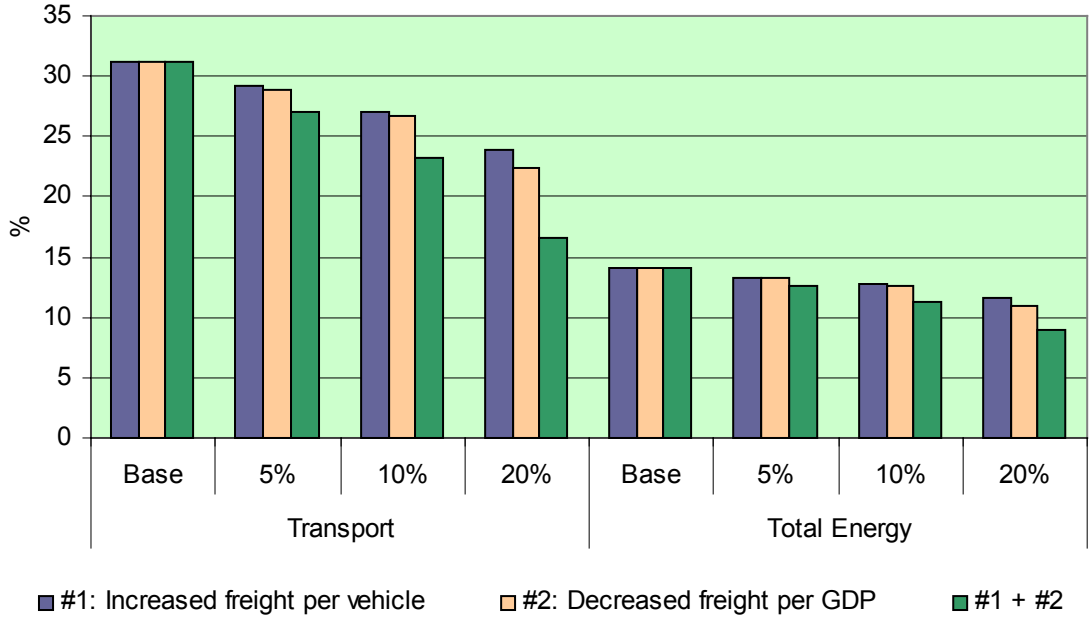
(ii) In Scenario #2 the amount of freight carried per unit of economic output is decreased. As a result there is a corresponding decrease in both total freight and vehicle kms. At the 20% level, the effect of Scenario #2 is markedly greater than for Scenario #1, with a projected increase in freight (by both measures) between 2005 and 2015 of around only 5%.

(iii) Combining scenarios #1 and #2 does not affect the total amount of freight transported beyond the changes observed for Scenario #2. Vehicle kms, however, decrease further, with only a 5% change in freight movements (both freight per vehicle and freight per unit of GVA) reducing the projected increase in the baseline scenario by almost half (18.6% vs. 31.1%). Increases at the 20% level actually result in a projected decline in freight movements by 2015 compared to the 2005 level.

3.2 Changes in Energy Use

The baseline scenario indicates that total energy use in the South West will increase by 14% between 2005 and 2015, as shown in Figure T2. By comparison, transport energy consumption is projected to increase by 31%, with transport's share of total energy consumption increasing from around 35% to 40%.

Figure T2: Change in Energy Use, 2005-2015



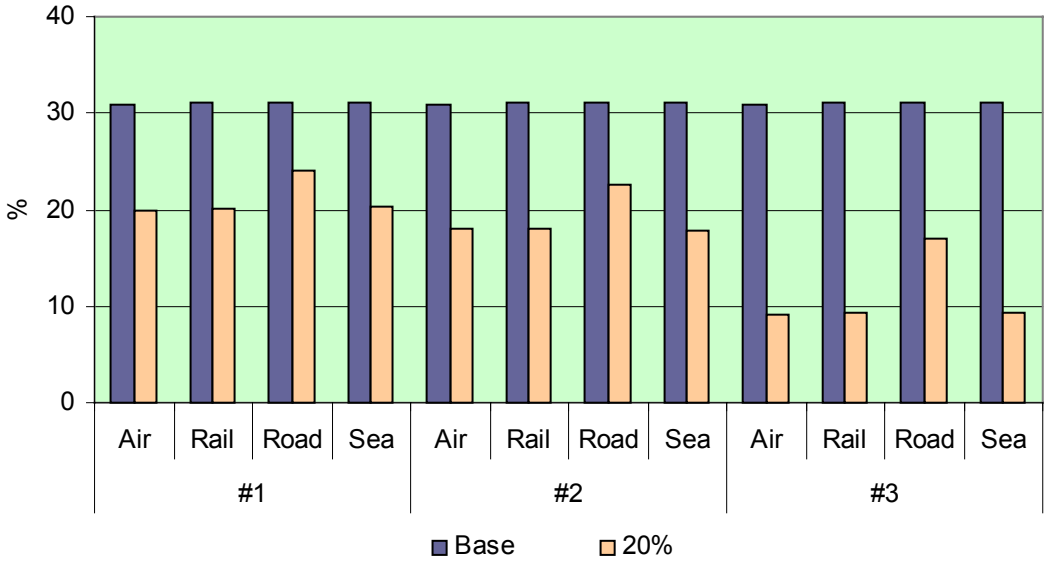
The key findings in terms of are:

(i) *Total Energy Consumption:* As Figure T2 shows, individually both scenarios result in a similar decrease in energy consumption for the transport sector. Combining the scenarios has a marked effect especially at the 20% level, where the increase in energy consumption between 2005 and 2015 is almost halved from 31% to 17%. The effect on total energy consumption is also noticeable – 14% to 9%, cutting the overall increase by a third.

(ii) *Transport Energy Consumption:* The effect on transport energy is less noticeable than the freight values presented above (which fall in the combined scenarios from a 31% increase to a 12% *decrease* relative to 2005) as transport energy consumption includes domestic transport. Energy consumption for domestic transport accounts for about 45% of total transport energy use – thus the freight assumptions do not affect a large proportion of transport fuel use.

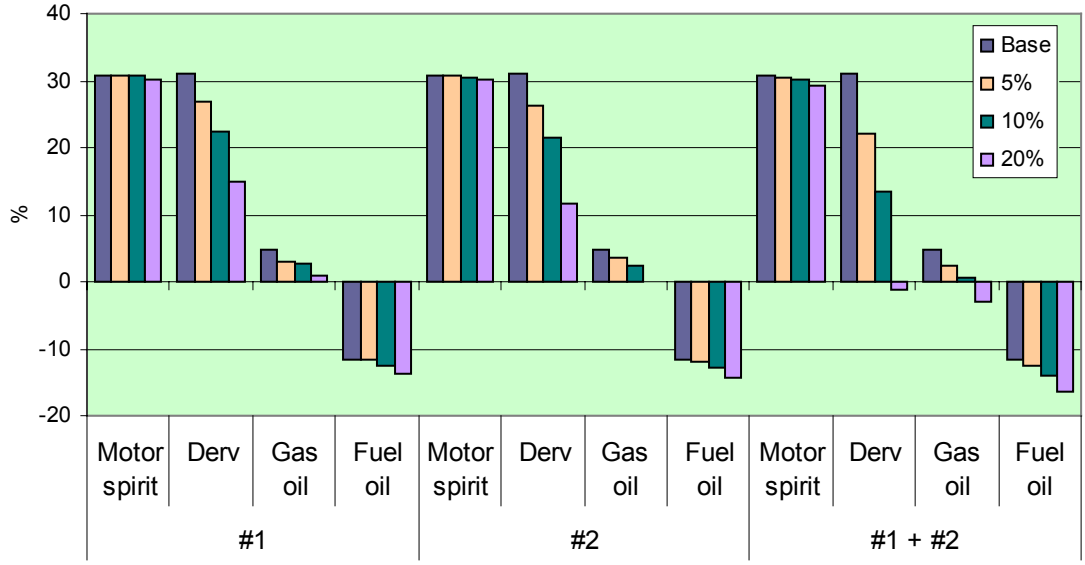
(iii) *Energy Use by Mode:* Figure T3 below shows the change in energy consumption across the four transport sectors – road, rail, air and sea. For clarity, only the 20% scenarios are shown, to illustrate the point that road transport fuel consumption does not vary in the same way as the other three transport types overall. Road transport does not decrease to the same extent as the other transport types, because the domestic sector comprises such a significant proportion of road transport.

Figure T3: Change in Transport Energy Use by Type, 2005-15



(iv) *Variations in Fuel Use:* Figure T4 shows the change in fuel-use of for the transport sector. Very little change is seen in the increase in use of motor spirit (petrol), which is primarily used for domestic transport. Indeed, petrol accounts for 20% of *total* energy use, potentially rising to 23% by 2015. Alternative scenarios/policies are likely to be required to address petrol consumption.

Figure T4: Change in Fuel Use, 2005-2015



As road transport predominates in the freight sector, the major fuel used is diesel or derv (diesel engine road vehicle). Diesel accounts for 13% of *total* fuel consumption, potentially rising to above 15% by 2015, which equates to a 31% increase above that predicted in the baseline scenario.

Each of the scenario combinations contributes to a decline in diesel consumption in step-wise fashion. Interestingly, the combination of Scenarios #1 and #2 results in complete mitigation of the model's projected baseline increase.

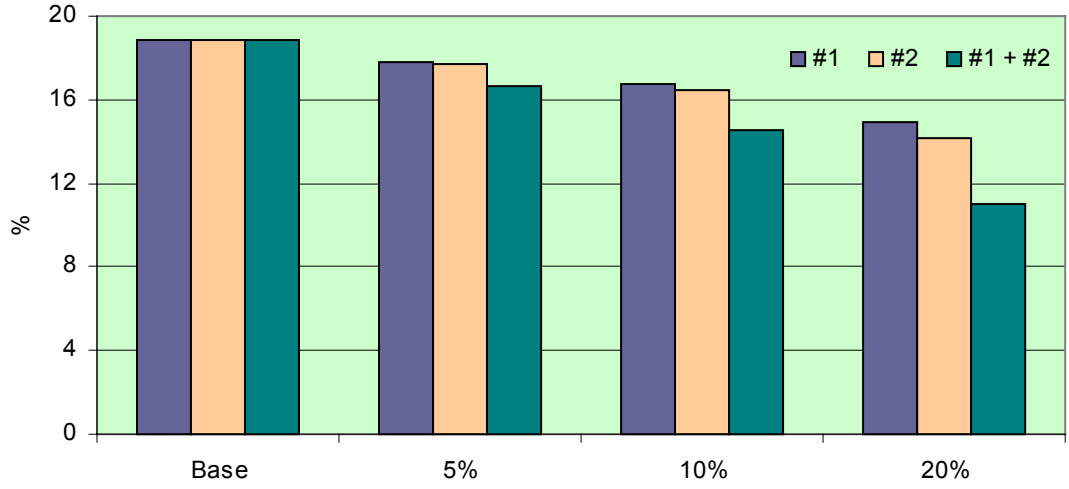
Little change is shown in the consumption of fuel and gas oil used in air and water transport. This may be related to decline in manufacturing and/or SW share of exports for specific sectors.

3.3 Carbon dioxide emissions

Transport is a significant contributor to CO_2 emissions, comprising 53% of total emissions for the region in 2005, excluding emissions from electricity generation outside of the region or from air transport), rising to 59% in 2015.

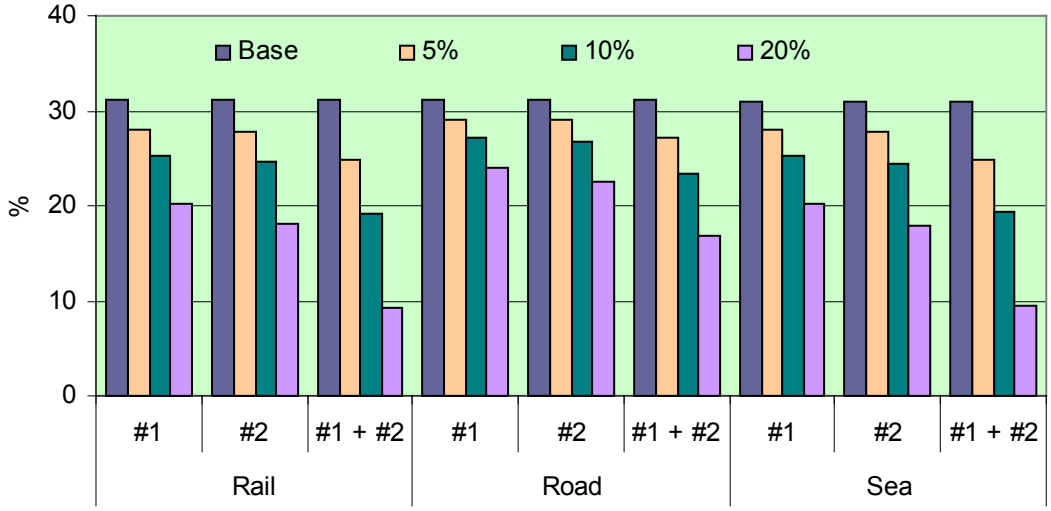
(i) Total Emissions: Figure T5 below shows the predicted change in total direct carbon dioxide emissions in the region under the different scenarios. The combined scenario at the 20% level reduces the predicted change in total emissions in the baseline scenario from a 19% increase to between an 11% and a 15% increase.

Figure T5: Change in Total CO_2 Emissions, 2005-2015



(ii) Transport Emissions: Figure T6 below shows the same chart for the transport sector. As before, all three scenario combinations result in a decline in emissions, although the effect of the assumptions on road transport emissions is not as great as for the other sectors (due to the substantial share of domestic road transport).

Figure T6: Change in Transport CO_2 Emissions, 2005-2015



4.0 Economic Outputs

Both assumptions were considered in the absence of any other changes, including exports and GVA, which are clearly linked to freight. As such, the assumptions used for the above freight scenarios have no effect on any of the "economic" outputs (GVA, population, expenditure and income). In effect, the freight assumptions considered are "neutral" in terms of the economy.

This is a rather simplistic view. It is likely that increasing the efficiency of freight transport would have a positive effect on GVA and productivity (GVA per head). A more complicated scenario could also be constructed that factors in changes to exports and GVA.

The assumptions investigated here broadly look at means of mitigating future environmental impact. There are regional aspirations, however, to increase the South West's share of UK exports, which is currently very low, in order to improve the region's competitiveness – these aspirations and any consequent policy intervention may act counter to the assumption around reducing freight per unit GVA.

If the South West were to increase its export share, potentially very different scenarios could be created. Indeed it is in investigating the different tensions between driving up economic growth and protecting the environment, and in determining how and where economic growth and environmental impact can indeed be decoupled, that the REEIO model's usefulness lies.

5. Conclusion

Transport is a significant contributor to CO_2 emissions, comprising 53% of total emissions for the region in 2005.

The combined scenario of a:

- 20% increase in the amount of freight carried per vehicle with
- 20% reduction in the amount of freight generated per unit of GVA

reduced the predicted change in total emissions in the baseline scenario from a 19% increase to between an 11% and a 15% increase. This could be achieved through measures to reduce the number of empty return trips and encouraging local sourcing.

This combined scenario also produced a noticeable reduction in overall energy consumption, almost halving the increase of 31% predicted in the baseline scenario.

It is hoped that these preliminary results will stimulate some discussion around how the REEIO model can be used to inform the development transport and other policies and add value to debates in future in this area.

Allison McCaig
South West RDA
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