A significant proportion of the global energy budget is consumed in providing us with essential mineral resources. **Andrew Bloodworth** and **Fiona McEvoy** investigate ways of reducing the carbon footprint left by the construction industry.

Big feet?

Minerals are essential in maintaining our economy and lifestyle, but their extraction, processing, and transport are probably responsible for about 7 per cent of total global energy consumption. Reducing this significant carbon footprint in the face of accelerating demand for commodities and construction materials is a major challenge facing the mining industry and its regulators over the next 30 years.

Transport of primary minerals is responsible for around 40 per cent of the energy consumed by the industry. Although no figures are available, the proportion of energy consumed transporting bulk construction materials such as aggregates is likely to be even higher. Moves toward more sustainable procurement and transport of aggregate minerals are therefore likely to have a significant positive effect in reducing the overall carbon footprint of the minerals industry in the UK.

> " the extraction, processing and transport of minerals are probably responsible for about 7% of total global energy consumption "

Developments in the Thames Gateway and for the London 2012 Olympic and Paralympic Games will generate significant additional demand for primary aggregates in London and south-east England over the next 10 years. The planning process will be critical in ensuring that the primary aggregates required to build the Olympic Park in Stratford East, and 160 000 new homes in the Thames Gateway, are sourced and transported in ways which minimise carbon emissions. The BGS is working with the Leeds University Centre for Spatial Analysis and Policy to develop a mechanism that will assist the planning process. It will be based on geographical information systems and include 'location allocation' modelling and network analysis. This is a technique for evaluating the sustainability of each of the different options for supplying aggregate minerals to major infrastructure projects. It also establishes a framework within which these alternatives can be compared. The carbon footprint of each of the supply scenarios will be evaluated using a distribution network in which the point of consumption is linked to the locations of aggregate resources. Our plan is that the framework will have two components: a method for evaluating the impact of different supply choices, and a process for optimising the environmental, economic, and social factors across all the potential alternatives.

The range of aggregate supply options for London and south-east England is relatively wide. It extends from local river terrace and glaciofluvial deposits, through marine-dredged material, to crushed igneous rock from the Midlands, Scotland, or Norway. There are marked differences in the carbon emissions from road, rail, and water transport per tonne of aggregate minerals and per kilometre transported. The ultimate aim of our research is to allow regulators to simulate the carbon

Some possible aggregate supply options for the London 2012 Olympic Park, Stratford East.

footprint — and other economic, environmental, and social impacts — for different aggregate mineral supply and transport policies.

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Next steps

This research is in its early stages. We need to address a large number of economic, environmental, and social issues if the simulations are to be meaningful. These include:

- Transport network capacity — existing road and rail networks are already operating at or close to capacity.
- Trans-shipment terminals — wharfage in the Thames Gateway is limited and communities are reluctant to accept 'virtual quarries' on docksides. These factors also apply to aggregate rail terminals.
- Security of supply — onshore sand and gravel reserves in south-east England are declining rapidly. New onshore reserves are not being developed, probably due to pressure from other forms of development and environmental objections.
- Carbon emissions — the figures given in the table below are for general freight and not specific to aggregates transport. We need better data for the different modes of water transport (barge, dredger, large bulk carrier).
- Demand side issues — moves toward more sustainable construction methods will have a major impact on the quality and quantity of primary aggregates required. One likely effect is that, although the overall quantity required may be reduced, the material will be more tightly specified, more restricted in its geological occurrence, and therefore have to travel longer distances.

Mode	CO_2 (g/t/km)
Road (HGV)	160
Rail	41
Water (inland and coastal)	25

Carbon emissions for different aggregate minerals transport options.

Source: © European Communities, 1995–2007.

Resource	Location	Approximate haulage distance (km)	Transport mode	Approximate mass (in kg) of CO_2 emitted over journey per tonne of aggregate
Thames terrace onshore sand and gravel	London & Home Counties	50	Road	8.0
Thames terrace offshore sand and gravel	Offshore, East Anglia	150	Sea	3.7
Solent River terrace offshore sand and gravel	East English Channel	200	Sea	5.0
Granite	Glensanda, Highland Region	1500	Sea	37.5
Carboniferous limestone	Derbyshire, Peak District	250	Rail	10.2
Carboniferous limestone	Leicestershire	180	Rail	7.4
Larvikite	Norway	1100	Sea	27.5

Estimated carbon footprint of different aggregate supply scenarios for the London 2012 Olympic Park, Stratford East.

A first look at the evidence suggests that there is some scope to reduce the carbon footprint associated with the supply of primary aggregates. Our research aims to assist both the industry and policy makers to move towards a more sustainable, lower carbon emission supply scenario for the major developments planned for south-east England.

For further information, contact:

Andrew Bloodworth, BGS Keyworth
Tel: +44(0)115 936 3495
e-mail: ajbl@bgs.ac.uk

Transport of aggregates by barge may represent a relatively low carbon option for moving these heavy and bulky materials. This barge is being loaded with high-quality gravel from a quarry in Nottinghamshire for transport by river to West Yorkshire.