Sustainable Infrastructure Procurement

Reducing greenhouse gas emissions (GHGE) from consumption of fossil fuels in road construction is an essential step in meeting Australia's Kyoto Protocol obligations. GHGE reduction is an important driver to change procurement processes for both road authorities and contractors.

The overarching aim of the project has been to provide both the client-side and the provider-side of infrastructure construction with a methodology and measure, based on mass-haul planning, which can be applied to an integrated GHGE reduction procurement protocol to reduce GHGE.

The haulage of mass materials (mass-haul) around, as well as to and from a road construction site, has been identified as a major producer of GHGE. High volumes of GHGE are produced during the earthworks cut and fill operations when large quantities of fuel are consumed building the road to its designed alignment.

Industry problem:

Industry needs a method to encourage reduction of GHGE arising from mass-haul operations during the construction of major roads.

Proposed solution:

An effective and practical procurement system based on an alternative method for calculating, estimating, evaluating and monitoring GHGE using the principle of calculated 'work' derived from a mass-haul plan.

A small but effective change is recommended for procurement processes related to mass-haul/ earthworks operations. This practical system for motivating GHGE minimisation is presented as a series of interventions in the procurement cycle of major road projects. Recommendations for all procurement phases are based on reducing the effort/work required for mass-haul activities. Hauls planned using a contractor's preferred methods can be used to calculate comparative GHGE reductions by using the planned effort/work involved in the physical movement of loads.

This small change to existing procurement methods has the potential to deliver a major reduction in GHGE on major road-works and other infrastructure projects.

Green public procurement

In Australia, state transport authorities are 'greening' their procurement processes to meet declared GHGE targets. For example, Main Roads Western Australia has a 2020 target of 5-15% reduction in GHGE from 2010 levels and NSW Roads and Maritime Services has committed to becoming carbon neutral by 2020.

Sustainable Built Environment National Research Centre

Proxy for GHGE

Current construction industry practice is to use fuel consumption as a proxy for GHGE. Using this proxy, measuring the GHGE produced from road construction activity is difficult for two reasons: fuel consumption can only be calculated after the project is completed, and the data is aggregated for all phases of the construction project. This retrospective approach does not assist in the development and management of pro-active fuel reduction strategies.

One significant contributor to GHGE *during* road construction is the handling and movement of mass materials (soils, aggregates, rock). Representing on average almost 30% of overall project costs, the negative environmental impact of the physical effort to move men, machines and materials during earthworks is an even higher percentage of fuel consumption for a project, leading to the consumption of millions of litres of diesel across all projects.

An alternative method of calculating GHGE

Focus on fuel reduction during project planning is a better method to proactively reduce GHGE. An alternative method has been developed as a practical and feasible solution to planning and controlling the negative environmental impact of GHGE from mass-haul/earthworks operations. This method is based on work or effort as a *relative proxy* for GHGE.

The alternative method is based on four assumptions:

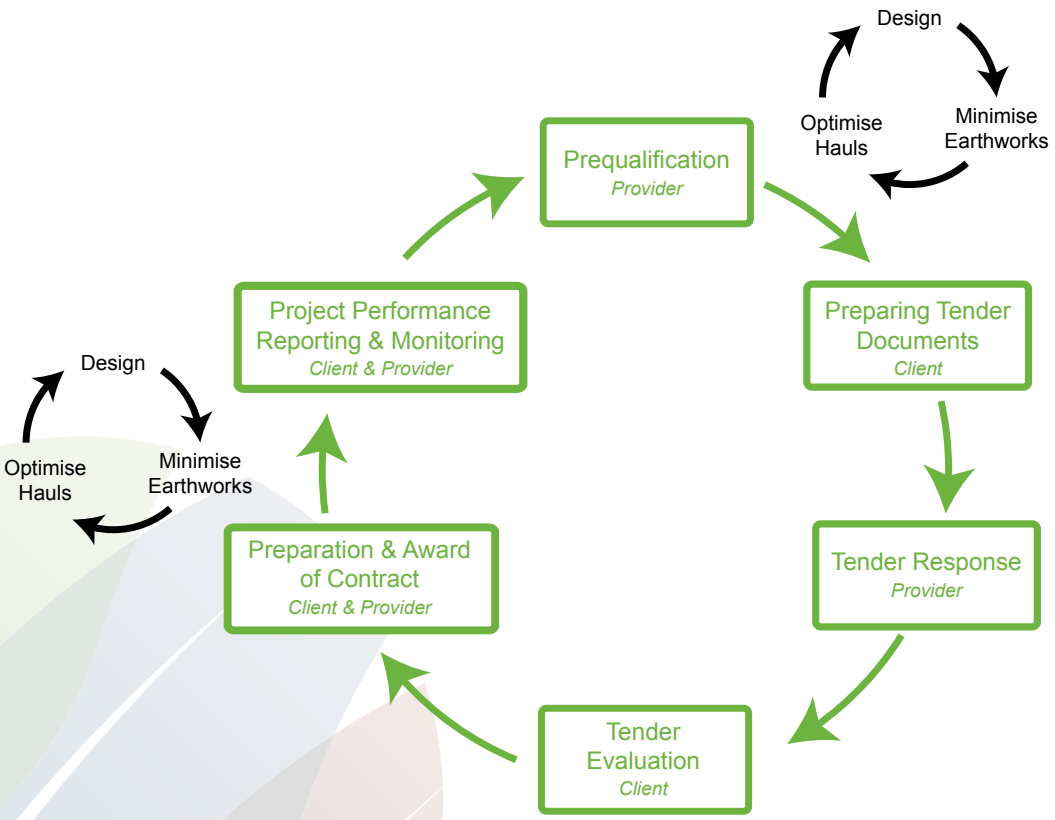
1. Fuel consumption from the fleet engaged in mass-haul operations is an indicator of GHGE.
2. The effort required to move mass is an indicator of fuel consumption.
3. Effort can be reduced if the amount of material moved, the distance travelled or the height lifted can be reduced.
4. GHGE can be reduced if the amount of mass-haul effort can be reduced.

The three advantages of using the work/effort principle are:

1. Calculations are simple
2. Requires only tables of hauls
3. Takes quantity, distance and gradient into account.

Using physics principles, the amount of work can be used as a tool when comparing different mass-haul plans for relative fuel consumption and relative cost. The summation of the amount of work for individual hauls becomes the total amount of work for the table of hauls. This amount is **a unique figure for non-price comparison**. This **unique figure** can be used as an indication of the amount of fuel used and GHGE, and can serve as a tool for comparing different mass-haul plans.

Figure 1 GHGE reduction opportunities in the procurement of major road-works



A model for greening road construction procurement

There are six primary functions in the road construction procurement cycle (Figure1). This closed-loop includes the National Austroads Prequalification Ranking System, now an important addition to traditional major works procurement.

Each procurement phase provides an opportunity to change process and influence changes to industry practice. The GHGE reduction intervention points collectively provide an effective and alternative method for calculating, estimating, evaluating and monitoring GHGE using the principle of 'work' calculated from a mass haul plan. Further, there are two opportunity points for design intervention to minimise earthworks and haulage. The first opportunity is before the tender documents have been developed. The second opportunity is once the contractor has been selected.

1. Contractor pre-qualification scheme

Contractor pre-qualification is the outcome of a process that evaluates the ability of organisations to complete a contract satisfactorily before they are admitted into the tender bidding process. This motivates contractors to improve their performance.

Two recommendations for clients to consider as pre-qualification criteria.

- Require contractors to have management systems with the capacity to create, monitor, report and adapt constrained and unconstrained optimal mass-haul plans.
- Require sustainability credentials, such as AGIC membership.

Four capability recommendations for providers.

- Have the means and methods for preparing unconstrained and constrained optimal mass-haul plans.
- Have systems in place for monitoring, controlling and reporting against a constrained mass-haul plan.
- Have expertise in calculating, monitoring and reporting GHGE.
- Have sustainability credentials.

2. Preparing tender documents

There are two opportunities to maximise 'value for money' during the preparation of tender documentation.

- Early contractor involvement in design.
- Requiring tender submissions to include mass-haul method statements and plans (constrained and unconstrained) as tables of hauls.

3. Tender response

Recommendations for inclusion in the contractor's detailed analysis of the project requirements.

- Creation of a mass-haul method statement.
  The method statement is the opportunity for the contractor to demonstrate understanding the specific nature of the project as well as the project constraints.
- Development of mass-haul plan (unconstrained) as table of hauls as the ideal solution without time-related impacts.
- Development of mass-haul plan (constrained) as table of hauls that includes resource issues, task sequencing and project priorities.

4. Tender evaluation

Tender evaluation, including non-price criteria, aims to achieve 'best value for money'. Reducing GHGE is one non-price criterion currently required by a number of state road authorities.

It is recommended that clients use work/effort as a *relative proxy* for GHGE as a non-price criterion to facilitate tender evaluation.

- To compare different haul solutions presented in tables of hauls.
- To assess the practicality of mass-haul plan methodology statements.

5. Preparation and award of contract

Contractor selection using the non-price criterion of work/effort provides the opportunity for design changes to be made to minimise effort/work in mass haul to reduce GHGE.

6. Project performance monitoring and reporting

It is critical for the contractor to monitor the movement of earthworks and compare and report actual hauls against planned hauls. Deviations can be identified and corrective action taken.

Recommendations for accurate monitoring and reporting: client requirements and capacity.

- Require contractors to monitor hauls and report against the constrained mass-haul plan.
- Require contractors to report using a table of actual hauls.
- Client capability to calculate the **unique figure of work** calculated from the table of actual hauls and compare performance with the constrained plan.
- Client capacity to assess performance data that can feed back into the contractor's pre-selection profile.

Benefits to industry

The benefits of this project are that it provides infrastructure clients and construction service providers with a a practical procurement system based on mass-haul planning and associated work/effort that can be applied to an integrated GHGE reduction procurement protocol to reduce GHGE on road projects. SBEnrc 1.8 is just one of a number of Australian initiatives focused on ensuring a sustainable built environment. These include the AGIC Infrastructure Sustainability Rating Tool, VicRoads INVEST (Integrated VicRoads Sustainability Tool) and TAGG Greenhouse Gas Assessment Workbook & Carbon Gauge for Road Projects. These GHGE reduction tools focus on the total road construction or the life-cycle of the road. However, such tools are not intended to examine in depth high levels of GHGE produced by mass-haul.

The study proposes a new procurement system that can deliver additional value to these existing tools. As such, it may be readily implemented practical with only minor change to existing construction practices and delivery strategies. An effective and practical method for calculating, estimating, evaluating and monitoring GHGE using the principle of work calculated from a mass haul plan is provided. The alternative method introduces GHGE reduction procurement process changes for all phases of road procurement.

This will provide an alternative to the current reliance on post-hoc measuring of fuel consumed, by instead motivating contractors to target fuel reduction through better planning of and control of mass haul. The use of non-price criteria in a structured procurement system has the capacity to significantly reduce one of the major contributors to GHGE in road construction and practical, thereby reducing the environmental impact of infrastructure construction.

The application of the complete alternative method summarised in this brochure is explained in the industry report titled *Mass-Haul Environmental Impact Minimisation: A Practical Method for Greening Road Procurement.*

Available online: www.sbenrc.com.au

The *Practical Method for Greening Road Procurement* developed during the study will make a significant contribution toward Kyoto Protocol obligations to reduce GHGE by 2020.

The Sustainable Built Environment National Research Centre (SBEnrc) is the successor to Australia's CRC for Construction Innovation. The SBEnrc is a key research broker between industry, government and research organisations servicing the built environment.

The SBEnrc is continuing to build an enduring value-adding national research and development centre in sustainable infrastructure and building with significant support from public and private partners around Australia and internationally.

Benefits from SBEnrc activities are realised through national, industry and firm-level competitive advantages; market premiums through engagement in the collaborative research and development process; and early adoption of Centre outputs. The Centre integrates research across the economic, social and environmental sustainability areas in programs respectively titled: Driving Productivity through Innovation; People, Processes and Performance; and Greening the Built Environment.

This research wouldn't be possible without the ongoing support of our industry, government and research partners:

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