



# Sustainable Infrastructure Procurement in Australia: Standard vs. Project Practices

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## Abstract

The Australian Government and most Australian road authorities have set ambitious greenhouse gas emission (GHGe) reduction targets for the near future, many of which have translated into action plans. However, previous research has shown that the various Australian state road authorities are at different stages of implementing 'green' initiatives in construction planning and development, with considerable gaps in their monitoring, tendering, and contracting. This study illustrates the differences between procurement standards and project specific practices that aim to reduce GHGe from road construction projects in three of the largest Australian road construction clients, with a focus on the tools used, contract type and incentives for better performance.

**Keywords: procurement, greenhouse gases, road construction, sustainability, Australia.**

## 1. Introduction

This research aims to understand an important element of current procurement practices in the Australian road construction industry. It seeks to analyse incentives that could be utilised in motivating contractors to improve their greenhouse gas emissions (GHGe) performance in construction and especially from earthworks activities in major road construction projects.

Public road authorities hold key roles in driving initiatives for reducing GHGe throughout the road construction project life cycle (APCC, 2007). The GHGe reduction goals can be achieved by means of a coherent and efficient chain of procurement processes and methods to transform sustainability and climate change policies into proactive initiatives and incentives.

Green procurement policies and practices are being adopted to varying degrees in a number of governments across the world (Brammer and Walker, 2011). For example, most

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Australian state road authorities have developed advanced policies and strategies to enable reduction of GHGe through their road construction and maintenance procurement (Lehtiranta, et al., 2012).

To ensure the effectiveness of these policies and strategies it is also necessary to determine authority, communication of responsibilities, processes and resources needed to implement sustainable management systems (Tan, et al., 2011). Furthermore, well developed incentive mechanisms will aid this process by placing more emphasis on achieving a client GHGe objective than a contractual obligation alone would (Broome, 2002).

To this end, procurement practices and incentives are being developed and tested to motivate contractors to better perform with regards to their GHGe from construction activities. In fact, several Australian road authorities have responded positively both to recommendations for the inclusion of non-price criteria addressing sustainability in expressions of interest (EOI) for major contracts (Roads Australia, 2010a), as well as to the inclusion of sustainability clauses in major contracts (Roads Australia, 2010b).

However, there remains a lack of adherence to best practices, standardised procedures and guidelines for GHGe assessment and reduction in Australia’s road construction industry (Lehtiranta, et al., 2012). This results in irregular application of green initiatives throughout the state project portfolio. The question as to what extent the identified green procurement standard processes are being addressed on a project-by-project basis, remains unanswered.

A deeper understanding of the differences between standard procedures and project specific practices will help road authorities to close the existing gaps to ensure the effective translation of climate change policies into feasible project delivery actions.



**Figure 1 (a) total road expenditure by state/territory, by level of government, 2008-09 prices — all levels of government (2008-09); (b) total road length by state/territory (2010-11) (BITRE, 2012)**

This study focuses on carrying out a gap analysis by comparing standard guidelines to project specific contract documentation through case studies. The case studies take place in

three Australian state road authorities: Queensland Department of Transport and Main Roads (QTMR), New South Wales Roads and Maritime Services (NSW RMS) and Main Roads Western Australia (MRWA). These agencies are three of the four largest road construction clients in Australia, contributing to 80% of the AU\$16 billion invested by the Australian government in the roads sector in 2009 and are currently responsible for more than 60% of the roads in the country in road length (see Figure 1) (BITRE, 2012).

## **2. Methodology**

The research began with a review of international best practices literature. Based on this analysis, the authors found the most relevant categories as applicable to GHGe from earthworks in Australian road construction. These categories were used as the basis for a detailed document review. The study followed an exploratory approach and aimed to contrast the findings of an earlier study on standard green procurement policies in Australia (Lehtiranta, et al., 2012) with new findings based on project specific practices.

A four-phase evaluation framework for mapping the findings across the road construction project delivery lifecycle was adapted from Lehtiranta et al. (2012) following Matar, et al. (2008). The original lifecycle was modified to include four phases that determine the GHGe from road construction, maintenance and operation. The first phase refers to decisions made before tender at a strategic planning level. The second phase is composed of initiatives, tools and elements that affect project development decisions. The third phase is shaped by processes related to contract formation. Finally, the fourth phase refers to project implementation and entails client-side activities for achieving green procurement targets, documenting the results and learning from the project.

### **2.1 Data**

A further revision of all available standard procurement documents was carried out to include recently released information. Documents studied in the initial review included tender standard documents, manuals, guidelines and templates. Project specific green procurement processes and tools were evaluated through a detailed document review of 12 exemplary projects provided by the three road agencies in Queensland, New South Wales and Western Australia. These case studies were chosen based on project complexity, size (large mass-haul components and over 5 km of road length) and contract type. Specific project details will not be released due to confidentiality agreements. A total of 161 documents were analysed for this study.

### **2.2 Research Questions**

The present study has a particular focus on the GHGe assessment tools used, including considerations of the contract type and incentives for better performance, with an aim to address the following research questions:

- Have the gaps found by Lehtiranta et al. (2012) been bridged by project managers or other leadership roles during the course of specific projects?

- Are the road agencies carrying out GHGe monitoring or benchmarking efforts?
- Does the chosen contract type have an effect on effectiveness of GHGe reduction incentives and requirements?

### **3. Results**

Table 1 shows that there have been initiatives on all levels of the project delivery lifecycle that depend on the experience of the client-side project manager. The case studies demonstrated that individual project managers occasionally place significant weight and effort on reducing GHGe emissions from road construction. It was also found that some road authorities are including clauses that require addressing GHGe reduction at a tender stage. However, this practice has not been integrated into the standard tender documents, nor has it translated into the production of best practice guidelines, thus jeopardising the longevity and industry wide implementation of such practices.

As shown in Table 1, the current standard tender guidelines do not include GHGe calculations, GHGe reduction or earthworks optimisation components applied to all projects. This could represent an opportunity for the road authorities to better balance tender competition by including recommendations for the project managers regarding pre-qualification requirements, non-financial selection criteria and contract clauses related to GHGe and earthworks optimisation applicable to all projects.

#### **3.1 GHGe calculations and benchmarking**

Most Australian road authorities have in-house GHGe calculators and many have stated their intentions to create benchmarks for GHGe and long-term goals of raising sustainability benchmarks across road construction project and enable non-price attributes to be assessed as part of tender evaluation processes.

NSW RMS for example has planned action to support the development of nationally agreed methods for measuring and benchmarking road construction GHGe and has set goals of establishing GHGe benchmarks for infrastructure construction (NSW RMS, 2011, p. 68). In fact, NSW RMS has already begun using their in-house GHGe calculator to estimate and analyse past projects (Lambous, 2011).

MRWA has recently begun collecting data from individual projects, having in prior years lacked sufficient data and appropriate systems to monitor emissions from networks and operators. To improve this information gap, some actions under consideration are the comparison of a benchmark to the tender documents with subsequent comparison to the actual GHGe from projects, measurement of GHGe from all contracts or at least a sample (MRWA, 2011, p. 7).

**Table 1: Procurement processes implemented by QTMR, NSW RMS and MRWA on a project by project basis vs. standard guidelines.**

Project delivery lifecycle		Procurement Processes	Project Specific			Standard Tender Documents		
			Queensland	New South Wales	Western Australia	Queensland	New South Wales	Western Australia
STRATEGIC PLANNING PHASE	Prequalification Requirements	GHGe/carbon calculations						
		GHGe reduction plan			√			
		Mass-haul optimisation						
		Sustainability Rating						
PROJECT DEVELOPMENT PHASE	Tender and contract requirements and incentives	Carbon calculation (road construction)		√	√			
		Scope comparisons based on calculations						
		Mass-haul optimisation plan required/encouraged		√				
		Project plan revision based on GHGe opportunities	√					
		GHGe reduction plan required		√	√			
	GHGe reduction as qualification criteria							
	Non-cost criteria for contractor selection	GHGe/carbon calculations						
		GHGe reduction plan			√			
		Mass-haul optimisation						
		AGIC Sustainability Rating						
PROJECT CONTRACT FORMATION	Contract requirements and/or incentives	Mass-haul optimisation		√				
		Environmental audit	√	√	√	√*	√*	√*
		Fuel consumption monitoring			√			
		Shared costs of emission reduction or offset		√				
		GHGe reduction plan			√			
		GHGe/carbon calculations						
		Sustainability Rating						
PROJECT IMPLEMENTATION PHASE	Project monitoring and control	Database of carbon calculations (BENCHMARKING)						
		Fuel consumption monitoring			√			
		Other GHGe reporting						

\* Part of Environmental Management System requested by National Pre-Qualification System for Civil (Road and Bridge) Construction Contracts (PQS) (Austroads, 2004).

Although QTMR has not specifically stated its intention to carry out benchmarking efforts for GHGe from road construction projects, according to the Queensland Government Chief Procurement Office (QGCPO) *Procurement Guidelines* professionals should identify the key sustainability issues, risks and opportunities, as well as the associated 'good and best practice' benchmark, which will assist in defining the desired level of sustainability performance (QGCPO, 2009).

At a national level, the Transport Authorities Greenhouse Group (TAGG) issued the Greenhouse Gas Workbook in 2011. This workbook outlines indicators to be monitored, default factors for missing data, and a step-by-step checklist for calculating GHGe from road construction projects (Dilger, et al., 2011).

The TAGG workbook encourages monitoring of fuel (type and volume consumed by construction vehicles), material type and quantity hauled, haulage distances and other indicators that can be monitored during road construction (Dilger, et al., 2011).

NSW RMS is currently using the TAGG workbook in the pre-tender environmental impact assessment stage to estimate the project GHGe and to propose mitigation initiatives to reduce emissions (Sanchez and Hampson, 2012a). However, this has not been introduced into the standard procurement guidelines as yet.

Some TAGG members are in the process of adopting Carbon Gauge, a GHGe calculator developed by VicRoads (Victoria state road authority) and based on the TAGG workbook (Sanchez and Hampson, 2012a).

### **3.2 Non-financial criteria and contract type**

The more traditional contract types studied, namely construct only, and design & construct (D&C), presented very few examples of non-financial criteria related to: GHGe; mass-haul/earthworks; and fuel usage/planning used for contractor selection.

Although these types of projects require an *Earthworks Plan* (EP) to varying levels of detail, this is usually requested as a post-contract award requirement (all except for one project). Furthermore, GHGe reduction initiatives seem to be requested on a project-by-project basis, based on the experience of the project manager, and are to be addressed through the *Contractor Environmental Management Plan* (CEMP), generally delivered before the start of the works but following the contract award.

It was found that documents of the construct only projects studied from NSW RMS contain more detailed clauses with GHGe and fuel consumption impact than D&C projects. The D&Cs from MRWA require initiatives to reduce GHGe and fuel consumption as standard practice through the request for proposal (RFP).

It was also determined that, although most projects did not present any specific requirements of GHGe reduction considerations for the design, in many cases the mass haulage was a key consideration during pre-tender design selection.

Under alliance projects, some RFPs mentioned minimisation of environmental impact and superior environmental and sustainability performance. However, these documents were rather general and gave little guidance to the contractors on how to address such issues.

However, the New Perth Bunbury Highway (NPBH) project from MRWA carried out under an alliance model does not present any GHGe criteria expressed in the RFP, although the selected contractor did produce a GHGe analysis based on a client request which was publicly available (GHD, 2008). This project was also used as a case study for infrastructure planning and delivery best practices, where the Australian Department of Infrastructure and Transport (ADIT) highlighted that the early involvement of contractors was key to enhancing the chance of success of the project (ADIT, 2012a). In another alliance project studied, the project team was considering climate change impact and GHGe as a core part of the project delivery planning which led to the production of a climate change assessment during the planning stage. This included detailed activities and recommendations to address GHGe from construction activities.

## **4. Discussion**

The need for standard monitoring techniques and requirements that assure accurate GHGe measurement for construction operations, serving for later benchmarking and definition of specific Key Performance Indicators (KPIs) has been noted in previous studies (Sanchez and Hampson, 2012b). Lehtiranta, et al. (2012) also highlighted the need for requirements for detailed earthworks and emissions plans that can be used to measure performance through on-site monitoring of KPIs.

Broom (2002) suggests that performance indicators that can be used as incentives must be realistic and relevant to the project, reflect the state of the technical definition and be easily administered. We propose the integration of requirements for contractors to estimate and subsequently monitor their total fuel consumption and weighted haulage distance (haulage distance per unit volume of material transported) into the procurement process. These two components have a direct impact on GHGe from earthworks in road construction (Hughes, et al., 2011), can be monitored and recorded on-site without the need of costly new infrastructure, and the client could use this information to establish benchmarking systems or weighted non-financial criteria to be used for bid comparison, evaluation and conditional financial incentives.

Alternatively, the use of GHGe calculators could facilitate the comparative analysis of road-building materials and techniques proposed by the contractors on their tenders with respect to the climate change targets of the issuing road authorities (Zammataro, 2010). While the use of benchmark data in negotiation and performance management would be of significant benefit in evaluation and negotiation (ADIT, 2012b).

The inclusion of GHGe estimation as part of the standard tender documentation requirements, using either in-house or internationally available GHGe calculators, would provide a quantifiable parameter that can be directly compared between bids and industry benchmarks. If the implementation of such criteria were enforced, road agencies would also



need to include clauses in their standard contracts that would allow them to monitor and benchmark GHGe from earthworks, particularly in projects with large haulage components.

Additionally, practitioners interviewed by the ADIT (both clients and contracting parties) were reluctant to the idea of nationally standardised contractual arrangements. However, *“tenderers and clients across all jurisdictions agreed that better design definition in the planning and procurement phases would offer significant benefits to traditional contracting; particularly in construct only projects”* (ADIT, 2012b). More detailed requirements for the mass-haul/earthworks plan and best practice guidelines with sustainability and GHGe components could therefore promote minimum levels of project planning and a common language that can be used by both clients and tenderers in tender documentation.

The former recommendation could be integrated into the procurement practices by using the existing TAGG Workbook to combine the benchmarking and best practices development efforts already considered by several road agencies.

Another noteworthy finding was that non traditional contract types that stipulate the involvement of contractors during the earlier stages of the project planning, design and funding, namely alliance and early contractor involvement (ECI), seem to be more likely to serve as useful procurement models for promoting improved environmental outcomes and potentially, GHGe reduction.

The fact that mass haulage was a key point for the pre-tender design selection in many of the case studies analysed reinforces the idea that contract models that allow for more flexibility in the design can in itself be an incentive for the integration of earthworks planning in the design phase due to lower cost with GHGe reduction consequences.

Existing examples in Australia of successful ECI contracts include the MRWA Great Northern Highway Kimberley ECI Project (AU\$116 m value, 2007-2009), where the delivery model allowed the maximisation of synergies with the contractors in a complex geographical area (Earth Mover & Civil Contractor Magazine, 2010).

Under this model, the team was able to simultaneously consider social, environmental and economic factors to ensure project works were consistent with sustainability principles. This focus on sustainability led to the inclusion of sustainability incentives in the consequent D&C contract (Earth Mover & Civil Contractor Magazine, 2010), where MRWA included sustainability performance bonus clauses, translated into KPIs such as quantity of concrete wasted and fuel consumption (MRWA, 2007). The project was successfully delivered on schedule in December 2009 and within budget (Earth Mover & Civil Contractor Magazine, 2010)

QTMR also provided an exemplary ECI where the private sector was involved at a stage where the potential to influence the design was limited. However, even minor changes to the geometry and methods of works led to estimated savings of over AU\$7 million from avoided mass-haul (600,000 m<sup>3</sup> avoided at AU\$12/m<sup>3</sup>) and approximately AU\$100 million due to the cost reduction per cubic metre based on conservative estimates (5.6 million cubic metres

earthworks with a saving of AU\$18/m<sup>3</sup>) (QTMR, 2012). The collaborative model used also provided benefits in terms of time, risk allocation and conflict avoidance.

Other countries such as The Netherlands have already opted to involve contractors before the route is defined and Environmental Impact Assessments (EIAs) have been carried out (van Valkenburg, et al., 2008). Through this approach, the Rijkswaterstaat (Dutch road authority) has stopped placing tenders with “ready-made” designs focusing on price and has now shifted to open and functional questions during the planning consent. At this stage the contractor still has sufficient freedom in their design and choice of construction method (van Valkenburg, et al., 2008).

Alternatively, because Alliance contracts are based on best value primacy (Walker and Hampson, 2003), this model has the potential for promoting innovation and achievement of more positive outcomes in relation to GHGe and other sustainability issues (Gollagher and Young, 2009). However, it is not clear if the GHGe targets of the clients are included in the partner selection criteria, jeopardising the achievement of the client goals in this area.

Furthermore, because reward and risk allocation mechanisms are determined after alliance partners have been selected (Walker and Hampson, 2003), it is possible that the specific contractual clauses and project objectives regarding earthworks optimisation, GHGe and fuel consumption are determined after the alliance is formed and therefore are not shown on the RFPs. Furthermore, any contractual incentive should also be accompanied by sound monitoring and control systems in order to ensure success relative to quality performance in construction (Chua, et al., 1999).

## **5. Conclusions**

The findings of this research confirm the following gaps found by Lehtiranta et al. (2012) on Australia’s current green procurement practices:

- 1) lack of established widely used best practices, standardised procedures and guidelines for GHGe assessment and reduction
- 2) lack of integration between GHGe assessment and management mechanisms including platforms for inter-disciplinary collaboration
- 3) scarcity of incentives for GHGe reduction in contracts
- 4) incomplete monitoring, control, and review methods
- 5) lack of focus on mass-haul optimisation as an environmental management area.

However, the study also shows that project managers are closing these gaps on a project-by-project basis and there is a need to translate these isolated efforts into best practice guidelines and standard procurement documentation for industry wide adoption and improvement.

An area of opportunity found was the *Contractor Environmental Management Plan (CEMP)*, which is required in all three states. The CEMP could be used as a tool to motivate better GHGe performance by including carbon emissions in the *air* or *atmospheric* pollution categories and integrating these clauses throughout the procurement process.

Another area of opportunity is monitoring standard techniques and requirements that assure the accurate GHGe measurement of road construction operations that could later be used for benchmarking and KPI definition. There is also a lack of requirements for detailed earthworks and emissions plan. These documents could be used to assess contractor performance through on-site monitoring of KPIs.

It was also concluded that procurement models that stipulate the involvement of contractors in earlier phases of a project can potentially help to better integrate decisions made during the planning phase with the construction activities, and improve sustainability outcomes while achieving other project benefits.

Further research is needed to deepen the understanding of common project practices including contractor perspectives. Therefore, future research should analyse a larger set of case studies from different localities to evaluate the internal contractor processes, drivers and barriers for GHGe reduction initiatives in the road construction industry. Moreover, a comparison of Australian and international best practices would illustrate further possibilities for bridging the current green procurement gaps.

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