

GPP seeks to implement policy through influencing the supply and demand side of certain product markets. Within this equation, product lists can only be partially successful because they tend to target procurers rather than the market. While they provide a ready-made recipe for procurers wishing to learn GPP and bridge capacity gaps, they do little to drive private sector innovation. Companies are not incentivized to design and innovate past the minimum requirements for inclusion in the lists, and, once on the list, there is little to encourage a product's further development. Stimulating technological and product development therefore relies heavily on the continued updating of list minimum requirements, an administrative burden that suggests in reality that updates occur less frequently than is necessary.

## Concluding Thoughts

Product lists can be seen as a potential stepping stone for governments seeking to transition to GPP, offering the ability to overcome the capacity and knowledge gaps within the public sector to enable practical GPP implementation, whilst also educating and guiding the market on the design of environmentally sensitive products. To be successful however, lists and the entry requirements must be regularly and comprehensively updated to ensure correct market representation and to support innovation in product technology and design. As a stepping stone, it is important that more developed GPP practices are integrated into the list approach, including a move towards more robust price evaluation mechanisms such as life cycle costing, and capacity building across the bureaucratic levels in order to spread administrative burdens and encourage GPP take up at local levels.

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## Sustainable Road Infrastructure Procurement in Australia

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### Introduction

According to Tan et al. (2011), the establishment of a clear sustainability policy in the construction industry is paramount, if only as a statement of the commitment of the top management to protecting the environment and enhancing social responsibility. The resulting policies should then translate into proactive strategies and action plans that improve the sustainability performance of contractors and provide a competitive advantage by integrating "long-run profitability" with sustainable development efforts. The strategies should also take into account climatic protection issues through greenhouse gas emissions (GHGe) monitoring and reduction initiatives (Stocker & Luptacik, 2009).

Government procurement often represents a significant share of national GDP, accounting for up to 20 per cent for some countries (Garcia-Alonso & Levine, 2008) and approximately AUD100 billion in Australia (APCC, 2007). Therefore, in industry sectors where government entities constitute the largest client, such as in the Australian road construction sector, procurement practices can be used both as a strategic tool to promote certain behaviour and as an environmental policy instrument to further the environmental performance of products and services (Faith-Ell, 2005).

Road authorities have the opportunity to use green public procurement as a tool to promote positive environmental changes during the procurement process through green preferences and environmental selection criteria for bid evaluation. However, green procurement is also the aspirational target concerning environmental objectives that might help contractors achieve additional advantages in winning a contract (Uttam, Faith-Ell, & Balfors, 2012). Systems that encourage contractors to "go the extra mile" should therefore be employed.

According to the Australian Procurement and Construction Council (APCC) (2007), Australian Government entities such as the road authorities should encourage suppliers to adopt design and construction processes that reduce the use of resources and the overall GHGe generated by their services.

The Australian Sustainable Built Environment National Research Centre (SBEnc) endeavours to build a more in-depth understanding of the complexities involved in construction of major roads in order to assist road authorities in their GHGe management efforts. Project 1.8 (Sustainable Infrastructure Procurement) focuses on the overall procurement processes, while also investigating ways to reduce the environmental impact of micro-construction processes such as mass-haul.

The main objective of the project is to provide the industry with a tool that can be used as a proactive mechanism to plan, monitor and review the GHGe from earthworks during major road infrastructure construction projects. This tool should support the development of green procurement methodologies to achieve Australia's GHGe reduction targets by optimizing mass-haul.

## National GHGe Reduction Initiatives in Australia as They Pertain to the Built Environment

In May 2006, the APCC established a working group to develop an Australian and New Zealand Government Framework for Sustainable Procurement. This framework was released to the public in September 2007 (APCC, 2007).

During the same year, the Australian Government introduced the National Greenhouse and Energy Reporting Scheme (NGERS) (Aijun, 2007) under which all companies with annual emissions above 125 kilotonnes (kt) CO<sub>2eq</sub> (for the fiscal year 2008-09) and 50 kt CO<sub>2eq</sub> (as of 2010) or energy consumption over 500 terrajoules (TJ) (for the fiscal year 2008-09) and 200 TJ (as of 2010) must register and report their GHGe and energy consumption (Australian Government. CommLaw, 2009). This scheme forces many large corporations to at least monitor and understand their GHGe sources to avoid civil penalties.

The Australian Federal Government's ratification of the Kyoto Protocol came into force in March 2008, following the government announcement in December 2007 of a 60 per cent reduction target of the national GHGe by 2050 (refer to 2000 standard) (Aijun, 2007).

The Australian Green Infrastructure Council (AGIC)<sup>3</sup> was also formed in 2008 as a member-based association which, in 2012, made public the AGIC IS rating scheme. This scheme is Australia's only comprehensive national system for evaluating sustainability across the design, construction and operation of infrastructure (AGIC, 2012).

In 2011, the Transport Agencies Greenhouse Group (TAGG)<sup>4</sup> issued a GHGe assessment workbook for Road Projects aimed at providing the means to estimate GHGe from road construction works (Dilger, Riley, Young, Bengtsson, & Kneppers, 2011).

The Australian Parliament passed the Carbon Tax Bill in November 2011, with the tax coming into effect in mid-2012, thereby establishing a fixed carbon price regime of 23 AUD/tonne of CO<sub>2eq</sub> (Sydney Morning Herald, 2011) to affect all companies with GHGe above 25,000 tonnes of CO<sub>2eq</sub> (Crook, 2011). However, most road construction contractor emissions are under this threshold, and therefore will not be affected directly by the scheme.

Although there have been several national initiatives aiming to provide tools to the sector to encourage greener practices, there has been a lack of conviction in carrying out the action plans to materially affect practices in the road construction sector. Currently, the only national initiative which provides some level of accountability for GHGe in this sector is the NGERS. Nevertheless, there are neither mandatory reduction targets nor economic incentives to encourage attempts at reaching them.

<sup>3</sup> The predecessor organization for the SBEnc, the CRC for Construction Innovation, was a founding partner of AGIC

<sup>4</sup> Members: New Zealand Transport Agency (NZTA), New South Wales Roads and Maritime Services (NSW RMS), VicRoads, Government of South Australia Department of Transport, Energy and Infrastructure (SA DTEI), Tasmania Department of Infrastructure, Energy & Resources (DIER), and Main Roads of Western Australia (MRWA).

## Current Australian procurement practices

Lehtiranta, Hampson and Kenley (2012) mapped Australia's current GHGe reduction initiatives in the public road construction procurement sector based on the nation's five largest road authorities. These agencies are responsible for 96 per cent of the total AUD13 billion of annual national public road construction and maintenance expenditure.

Major gaps found in Australia's green procurement practices were found (Lehtiranta, Hampson, & Kenley, 2012):

1. A lack of established best practices, standardized procedures and guidelines for GHGe assessment and reduction.
2. A lack of integration between GHGe assessment and management mechanisms including platforms for interdisciplinary collaboration.
3. Scarcity of environmental criteria in designer and contractor selection.
4. Scarcity of incentives for GHGe reduction in contracts.
5. Incomplete monitoring, control, and review methods.
6. Lack of focus on mass-haul optimization as an environmental management tool.

The SBEnrc research team has continued to build on the work of Lehtiranta et al. (2012), helping to find a solution to the fact that most road authorities do not have systems in place to ensure the translation of such goals to proactive mechanisms applicable to road construction projects, despite having developed policies, strategies and action plans integrating GHGe reduction components to different degrees. However, it was found that many road authorities who are core partners to the SBEnrc are currently developing sustainable procurement guidelines and tendering requirements that will have an impact on GHGe from construction operations.

The SBEnrc research team is in close contact with influential agencies at both national and local levels, such as the Australian Green Infrastructure Council (AGIC), the Transport Authorities Greenhouse Group (TAGG), Austroads (Australian and New Zealand road transport and traffic authority association), Main Roads Western Australia, Queensland Transport and Main Roads, New South Wales Roads and Maritime Services, and Roads Corporation, Victoria (VicRoads) with an aim to maximize the relevance and impact of the research outcomes.

## Green Procurement Incentive Tools

Broome p.112 (2002) states that "intelligent use of incentives relates to designing a multi-incentive plan so that the contractor, in pursuing its business objectives, is indirectly placing the same emphasis or weighting on each of the client's project objectives as the client does." There are numerous incentive mechanisms that can be built into the procurement process in order to translate policies and strategies into proactive initiatives that ensure achievement of the overall goals and objectives. Some of the possible incentive mechanisms are explained in the following sub-sections.

### 1.1 *Pre-qualification*

Lam, Ng, Hu, and Skitmore (2000) define contractor pre-qualification as a process to evaluate the ability of candidate contractors to complete a contract satisfactorily before they are admitted into the bidding process. Austroads developed the National Pre-Qualification System for Civil (Road and Bridge) Construction Contracts, applied nationwide. However, while this system requires a certified EMS, it does not include sustainability or GHGe management (Casey & Kelley, 2010). These concepts could be included as a criterion in the EMS.

### 1.2 *Multi-Factor Tender Evaluation*

Multi-factor or multi-criteria tender evaluation is a way to achieve best value for money instead of simply the lowest price. This approach to tender evaluation has been growing in the contractor selection process over the last decade and can be carried out on a project by project basis or through a standard set of criteria (Wong, Holt, & Cooper, 2000).

To this end, numerous advanced models (such as Multiple Kernel Learning [Lam & Yu, 2011], Stochastic Decision Models [Russell, et al., 1990], etc.) and non-financial criteria have been created to compare different bids. They could be applied based on the road-building techniques and materials proposed by the contractors during tender (e.g., GHGe calculations [Zammataro, 2010], Environmental Cost Assessment [Curkovic & Sroufe, 2007], CO2 Performance Ladder and DuboCalc [Rijkswaterstaat, 2010], etc.).

### 1.3 *Performance Selection Incentive*

Kenley, et al. (2000) described a performance incentive scheme based on voluntary assessments, which could work as a reward scheme by assigning tender price reductions depending on the rating attained by the bidding contractors. This system could be used in the road construction industry through the adoption of sustainability rating tools (e.g. INVEST [Murphy, 2011b], AGIC IS [AGIC, 2012], CEEQUAL International [CEEQUAL Ltd., 2012a], etc.).

### 1.4 *Tax Incentives*

Tax incentives can motivate stakeholders to perform more sustainably in the construction industry (Feige, Wallbaum, & Krank, 2011). An example of such taxes is the carbon tax, an excise tax imposed according to the carbon content of fossil fuels (Zhanga & Baranzinic, 2004). The Australian Parliament passed the Carbon Tax Bill in November 2011, with the tax coming into effect in mid-2012 and thereby establishing a carbon price regime of AUD23/tonne of CO2 (Sydney Morning Herald, 2011). Such a tax could be an incentive to reduce fuel consumption during road works and therefore improve contractor GHGe performance.

### 1.5 *Incentive Contracts*

Contract clauses can be used for sustainability purposes to address issues that pertain to the execution of the contract. Performance-based incentives can be used through the establishment of minimum levels of performance at project completion ("gatepost" incentives) or at milestones ("graduate" incentives) (Broome, 2002, Ch. 5). Conditional and banked awards, as well as value enhancement incentives can also be integrated into the contract to promote higher performance (Broome, 2002). GHGe calculators such as Carbon Gauge designed by VicRoads (Murphy, Sustainable Procurement Practices, 2011a) and CHANGER designed by the International Road Federation (IRF, 2010) could be used to such an end.

### 1.6 *Delivery Models*

There are many delivery models available to the road construction industry, and the project will excel only if the right delivery model is chosen for the appropriate context (Song, Mohamed, & AbouRizk, 2009). The delivery method selection is therefore one of the most critical steps in ensuring project success (CEIID, 2010).

In the construction industry, traditional design-bid-build approaches have historically created adversaries among project team members, whose individual profitability frequently is only attainable at the expense of another party to the contract (Hauck, Walker, Hampson, & Peters, 2004). Currently, there is a trend in Australia towards Alliance and PPP contracts for delivering some of Australia's most complex and significant public sector infrastructure projects (CEIID, 2010). However, PPP is not as common as Alliance in the Australian road construction industry.

Because Alliance contracts are based on best value primacy (Walker & Hampson, 2003), this model has the potential for promoting innovation and achievement of positive outcomes in relation to GHGe and other sustainability issues (Gollagher & Young, 2009).

## Conclusions & Recommendations

In a world concerned about climate change, government procurement can be a very powerful tool to create incentives for industry to adopt less GHGe-intensive practices and technologies.

To this end, there are several incentive mechanisms for performance improvement that could be applied to the road construction industry. These are been currently studied by SBEnc in order to find the most suitable option. These incentives vary depending on the project phase where they are considered; road authorities, for example, can employ project management incentives, which can include access to contracts through pre-qualification requirements, performance-rating-based tender evaluation, contract specific incentives and early contractor involvement delivery methods.

In the opinion of the authors, the steps towards achieving the GHGe reduction goals that Australia has committed to on behalf of all government entities by signing the Kyoto Protocol should include the implementation of a combination of project specific and cross-project incentives by road authorities.

Based on the research conducted for the present study, it has been concluded that incentives are most effective when applied at the earliest project phases. Furthermore, a benchmarking system of project emissions and GHGe reduction initiatives would facilitate the objective comparison of bids, including their impact on the GHGe reduction goals. To achieve this, such a system should allow the implementation of pre-qualification requirements based on maximum GHGe per kilometre of road work, on environmental cost of carbon pollution, or on a combination of both into the cost/benefit analysis of the tender evaluation.

For incentives to be effective, systems for accurate and objective monitoring and reporting of contractor performance must be instituted. The above strategies should therefore be combined with the use of specific key performance indicators (e.g., on-site fuel monitoring device requirements) that ensure accurate and objective performance monitoring to ensure these contract incentives are as effective as possible.

The delivery method can have considerable influence on achieving the project GHGe goals. By including the contractor at an earlier stage and with the use of proper incentives (e.g. conditional contract renewal), Alliance, Early Contractor Involvement and Public/Private Partnership models could allow for the utilisation of technologies and techniques that, while not necessarily representing the lowest cost, have preferable GHGe impact levels. Furthermore, incentives such as extra-cost sharing for carbon offsetting or 'greener' technologies can be used as an alternative solution.

The Australian Sustainable Built Environment National Research Centre (SBEnc) will continue to work with the various road authorities and influential groups to develop a set of tailored solutions for the Australian road construction context.

## Clusters as Catalysts for Developing “Smart Cities” Through Intelligent Public Demand

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### Background

With the ambition to become carbon neutral in 2025, the City of Copenhagen has embarked on a journey to become a “smart city,” where, among other things, energy is used intelligently, transportation flows smoothly, and waste is utilized as a resource in order to increase the quality of life for its citizens. A broad variety of initiatives need to be developed and implemented to realize this goal, and the City Hall plays an important role, not only as a policy developer, but also as a procurer of new infrastructure, technologies and services. However, cities and other