Sustainability Performance Assessment by Road Agencies

A Sustainable Built Environment National Research Centre (SBEnrc) literature review by Curtin University and the Queensland University of Technology

University Research Team

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Acknowledgement

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Contents

Introduction

The early decades of the 21st Century will see a change in the focus of environmental reporting in roads agencies, from the current practice of 'environmental management' which seeks to minimises ecological disturbance, to a second generation of reporting that expands this scope to include sustainable development associated considerations, including a focus on areas such as the energy intensity raw materials, both in their extraction and transportation, and the potential for alternative 'low-carbon' options. Such a shift in focus will form an important part of a road authorities approach to issues of growing concern such as increasing energy costs and increasing impacts from climate change, such as greater weather damage to road infrastructure.

The shift in environmental reporting focus has been heralded by the emergence of an array of sustainability assessment frameworks, all with varying purposes, reporting requirements, and outcomes. In order to inform Australian road agencies this report includes a literature review of current and emerging rating tools that aim to identify the kinds of metrics and indicators that road agencies are likely to be asked to report on in the future. The report however does not make recommendations as to the adoption of a particular rating tool, but rather provides guidance to key reporting area, given the political, geographical, and regulatory differences that exist throughout Australia.

The research team has identified that much of the data that is required to fulfil the new generation of environmental reporting is already being collected across many, if not all road construction projects. However, it is clear that this data is not systematically reported on in a way that encourages use or transparency of such data. This report aims to provide road agencies with a set of 'key areas' from which their environmental/sustainability reporting can be based. The report does not provide a prescriptive list of key performance indicators or metrics, as this kind of list already exists rating tools described herein.

To identify the 'key areas' of environmental reporting, the research team considered the areas already defined by existing rating tools and international road agency frameworks. These findings were then compared to the findings of a number of stakeholder workshops held as part of the project. Particular attention was paid to the current environmental reporting situation in both Queensland and Western Australian road agencies. This knowledge has informed the compilation of six (6) key themes the research team considers to be of importance for Australian road agencies to develop/adopt systems for data collection and reporting.

Whilst the critical phases of road delivery, namely design, construction, and operation have all been considered in this report, the focus has been set primarily on the construction phase in alignment with the greater vision of the SBEnrc research agenda.

Sustainability Performance and Reporting Tools

Sustainability Performance and Reporting Tools for Road Agencies

When considering the sustainability of a road project there are two key aspects, firstly the performance assessment of the projects and secondly the rating of the performance against an industry benchmark. As shown in Figure 1 either can be self-assessed or assessed as part of a third party tool, such as those as listed in Table 1. In short, 'Assessment tools' provide a framework to collect data on the actual performance of projects across a number of selected indicators, and 'Rating tools' consider this data to provide a rating that can be used to compare with industry benchmarks and internal targets.[1]

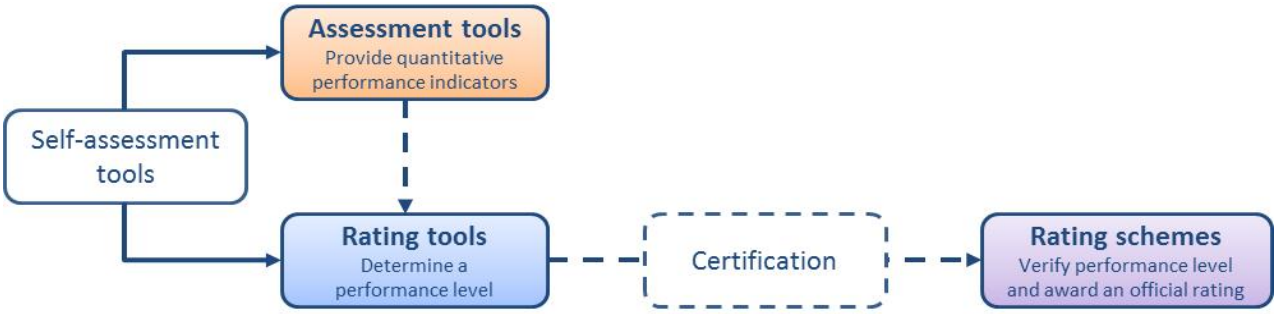

Figure 1: *Self-assessment tools and rating schemes*

Given the growing concern regarding the impact of road and transport infrastructure projects on the environment, and visa versa, a number of national and international sustainability performance and rating tools have been developed (as listed in Table 1). Such tools cover both general infrastructure and road and transport specific projects, making it increasingly challenging to determine an appropriate tool to use for a particular project or agency. The key question to ask before starting the process to identify or review such a tool is 'Will the tool deliver enough value to make it worth using?', and this can be considered by asking a number of questions, such as:

1. Does the tool provide a process that will streamline data collection?
2. Does the tool assist in identifying areas for performance improvement?
3. Will the tool require substantial changes to existing systems?
4. Will the tool require onerous data collection activities?
5. Is the tool recognised in the industry as being rigorous?
6. If not is it likely that the tool will become an industry standard in the future?
7. Does the tool meet current performance assessment and reporting requirements?

[1] Ding, G. K. C. (2008) 'Sustainable construction – the role of environmental assessment tools', *Journal of environmental management (0301-4797), 86*(3), p.451.

The key emerging tools are shown in Table 1 and summarised below.

Table 1 Existing rating tools and schemes relevant to road projects

Sustainability Performance and Rating Tools	Road specific	Assessment tool			Rating tool and/or scheme		
		D	C	O	D	C	O
Australian tools and schemes							
IS (Infrastructure Sustainability) performance and rating tool (developed and administered by the Australian Green Infrastructure Council – AGIC)							
INVEST (Integrated VicRoads Environmental Sustainability Tool) rating tool (developed by VicRoads)	✓						
Carbon Gauge® Calculator (developed by HAC and jointly funded by six road agencies across Australia and New Zealand)	✓						
Bottom Line^2 software (developed by the Dipolar Pty Limited and Integrated Sustainability Analysis – ISA, at the University of Sydney)							
eTool Life Cycle Assessment software							
International tools and schemes							
GRI							
Greenroads Rating System (developed in the US)	✓						
The Highway Sustainability Checklist (developed by Parsons Brinckerhoff)	✓						
Envision^{TM} Sustainability Rating System (developed by Zofnass Program for Sustainable Infrastructure / Institute for Sustainable Infrastructure – ISI)							
CEEQUAL (developed by the Institution of Civil Engineers – ICE)							
Changer Greenhouse Gas Calculator (developed in Switzerland by the International Road Federation – IRF)	✓						
GreenLITES (Green Leadership in Transportation Environmental Sustainability - developed by the New York State Department of Transportation – NYSDOT)	✓						

The Global Reporting Initiative

The Global Reporting Initiative (GRI) is a non-profit organisation providing guidance to organisations on their sustainability, offering both an overall process (as shown in Figure 2) and a set of comprehensive guidelines on the type of sustainability information that should be collected in four key themes – economic, environmental, social, and governance performance.[2] A number of sector specific supplements are provided to assist efforts to tailor the generic sustainability reporting elements to the sector to ensure meaningful information is captured.[3] Organisations may elect to undergo an independent third-party review of their performance against the GRI criteria to validate their data findings.[4]

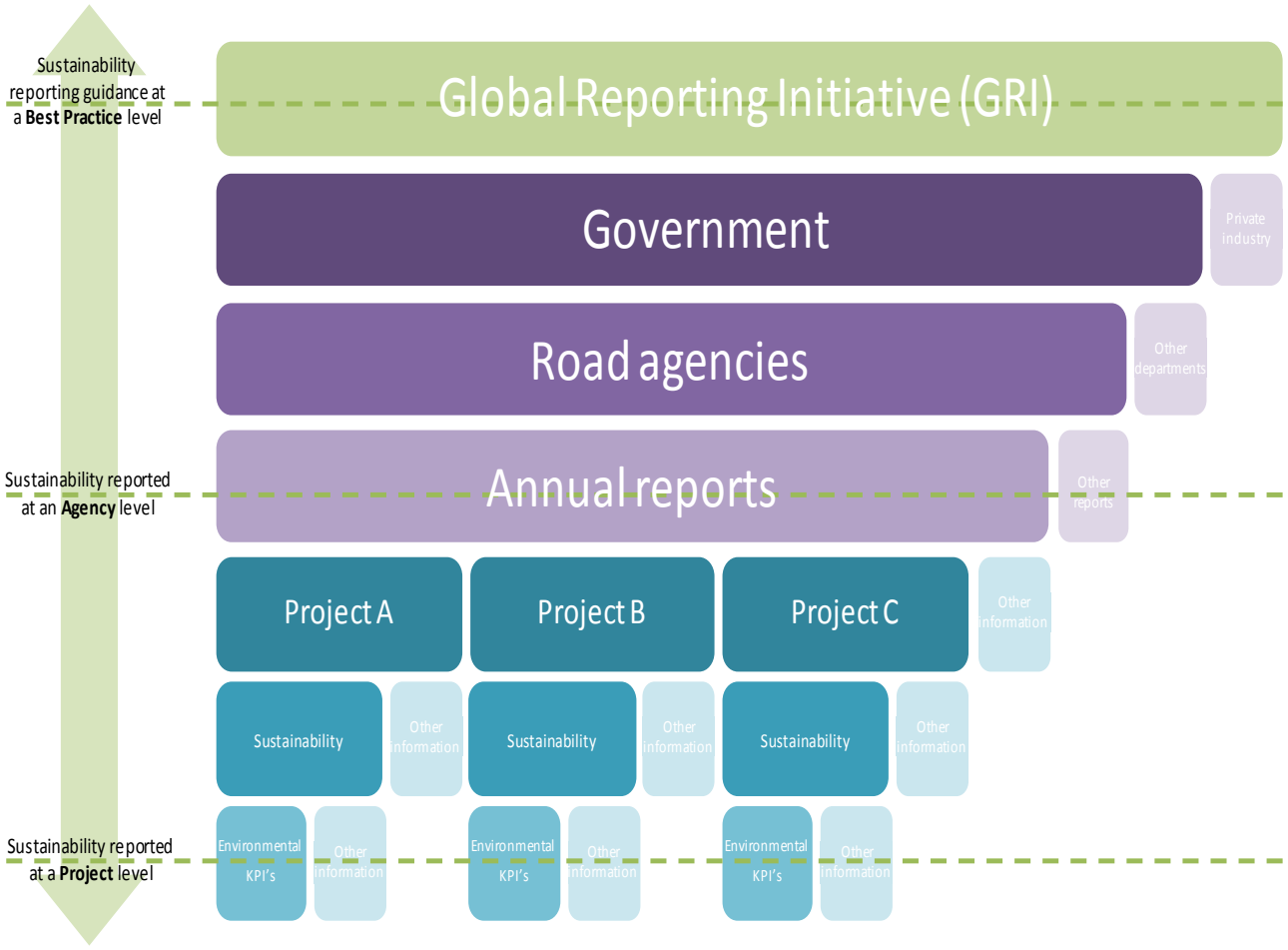

Figure 2: Global Reporting Initiative overarching framework to guide sustainability reporting

[2] Global Reporting Initiative (n.d.) "What is GRI?" [website] https://www.globalreporting.org/information/about-gri/what-is-GRI/Pages/default.aspx

[3] Global Reporting Initiative (n.d.) "Sector Guidance" [website] https://www.globalreporting.org/reporting/sector-guidance/Pages/default.aspx

[4] Global Reporting Initiative (n.d.) "Application Level Check" [website] https://www.globalreporting.org/reporting/report-services/application-levels/Pages/default.aspx

The tools offered by the GRI are used around the world by organisations of all sizes and in all sectors, including government agencies such as DTMR and MRWA.[5,6] By utilising an appropriate sustainability performance assessment process as part of the design, construction, and operational phases of road projects, data can be collected to inform performance improvement and internal and external performance reporting.

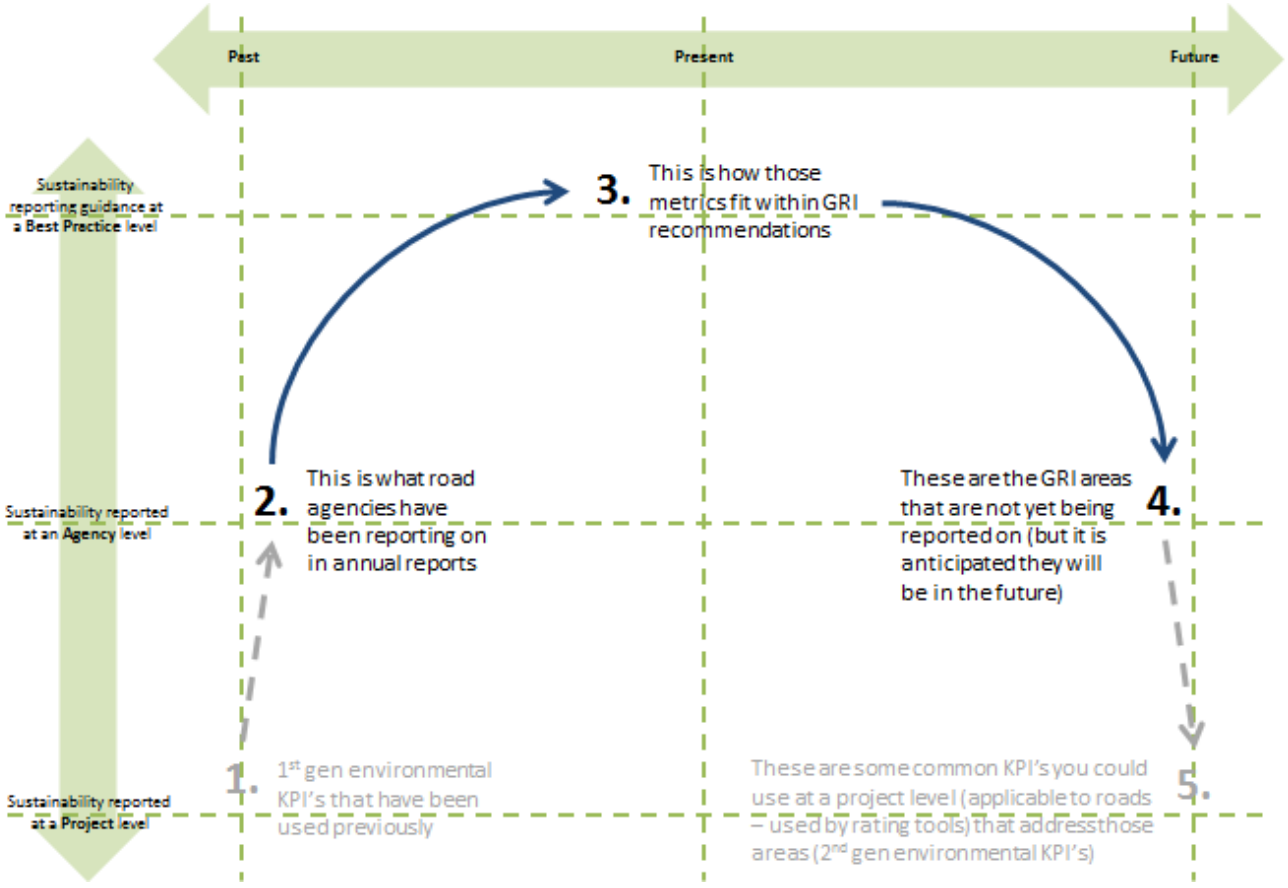

Figure 3: The relationship between project, agency and best practice level reporting

Both DTMR and MRWA have reported on a number of GRI areas in annual reports, with MRWA seeking verification from the GRI for its data collection in 2011. Across road agencies in Australia the scope of environmental performance discussed in annual reports has increased over the years, with an evident increase in proactive commitment to sustainability and associated reporting.

[5] Department of Main Roads (2007) *Annual Report 2006-2007.* Retrieved from http://www.tmr.qld.gov.au/~/media/8b0d681a-4a54-44a3-9b8a-00484802d000/mrannualreport0607.pdf

[6] Main Roads Western Australia (2011) *Main Roads Achieves International Recognition for Sustainability*. [press release]. Retrieved from http://www.mainroads.wa.gov.au/aboutmainroads/pages/news.aspx

IS Rating Tool

Developed and administered by the Infrastructure Sustainability Council of Australia (ICSA), the 'IS Tool' is designed to be used to evaluate the sustainability of infrastructure across design, construction, and operational phases. The tool can be used as part of a self-assessment as well as being able to be formally certified as 'good', 'excellent', or 'leading' performance levels. Considering specific elements within a range of social, economic and environmental sustainability categories across each project, the users of the rating tool nominate a performance level (1, 2, or 3) that they believe they have achieved for each element. Based on predetermined weightings designed into the tool, the overall rating is calculated, and compared to a possible level of achievement. For example Figure 4 shows a sample rating across the various performance areas with a score of 3 attained for 'Management Systems' out of a possible 10.5.

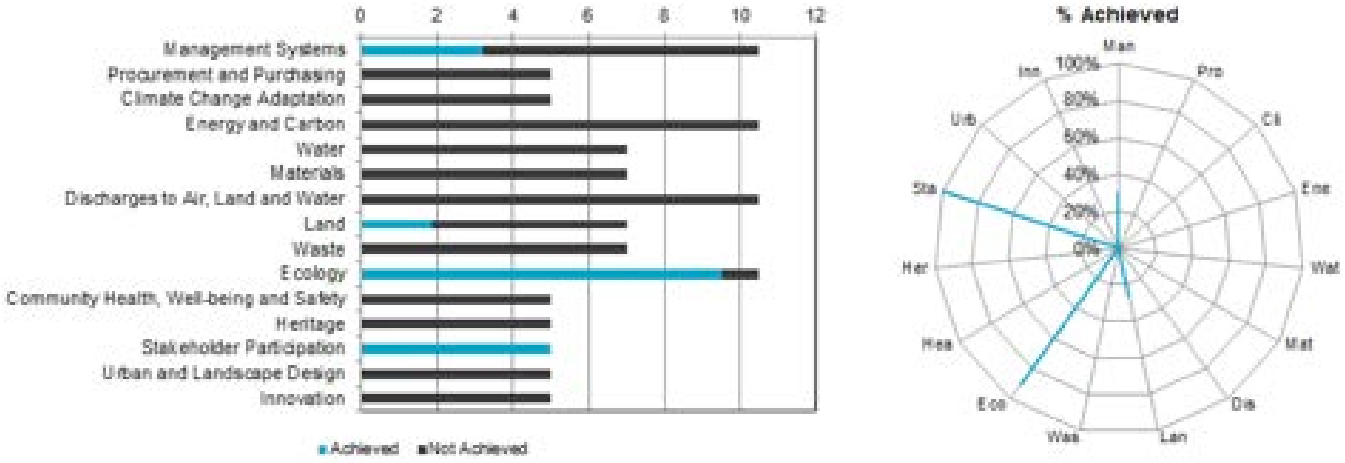

Figure 4: *An example of IS Rating Tool outputs*[7]

INVEST (Integrated VicRoads Environmental Sustainability Tool)

Tailored to road projects, VicRoads has developed a self-assessment rating tool to evaluate the social, economic, and environmental sustainability elements pre-construction, during construction and post-construction. In response to descriptions of best practice in each category, users complete the spreadsheet indicating which practices they have engaged in, and receive points accordingly.

The tool includes 11 categories of sustainability indicators, namely:

1. Air Quality,
2. Behaviour change and capacity building,
3. Biodiversity,

[7] IS Rating Tool (downloaded from http://www.agic.net.au/ISratingscheme1.htm#779338)

4. Cultural heritage,
5. Community engagement,
6. Energy management,
7. Design,
8. Noise management,
9. Resource management,
10. Urban design, and
11. Water management.

Provided the mandatory sustainability requirements (including complying with policy and legislation) have been met, and supporting evidence has been provided for verification by an appointed assessor, projects may be awarded a 1, 2, 3, 4 or 5 start 'INVEST' rating.

Carbon Gauge® Calculator

Developed by HAC and jointly funded by six road agencies across Australia and New Zealand, the 'Carbon Gauge' calculator is a carbon assessment tool that estimates greenhouse gas emissions on road projects. The tool may be used to assess the emissions from planned construction, operation, and maintenance activities including drainage, material transport, earthworks, street lighting and traffic signals. Users are required to select the activities that are applicable to the project, and entering project inputs into the spreadsheet. As a result, the project summary report includes tables and pie graphs with a breakdown of Scope 1, 2 and 3 (direct, indirect, other) greenhouse gas emissions overall and by activity (as shown below in Figure 5).

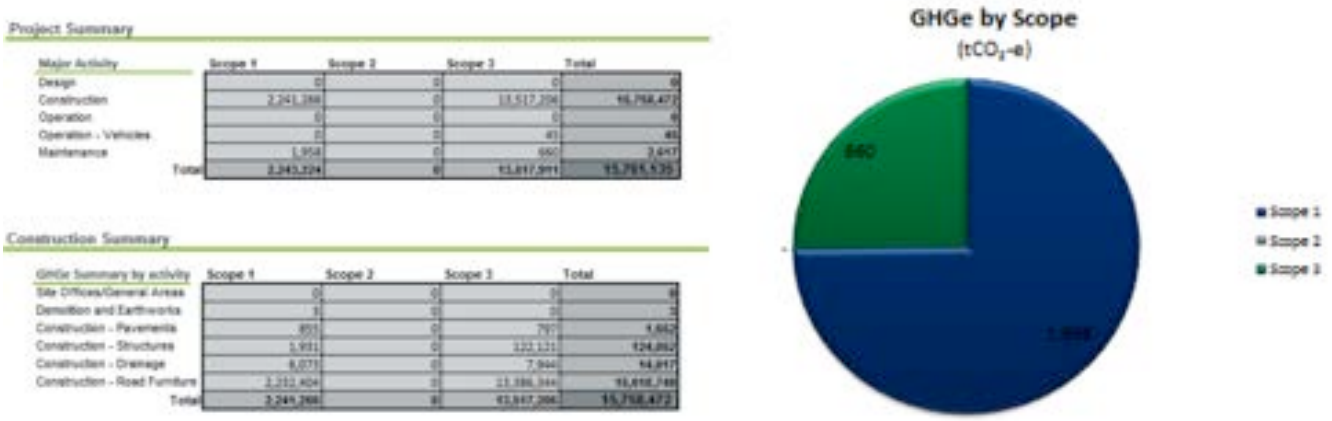

Figure 5: *An example of Carbon Gauge® calculator outputs*

Bottom Line[3] Software

Launched in the UK, Australia and Japan, 'Bottom Line[3]' is a software program developed by the Dipolar Pty Limited and Integrated Sustainability Analysis (ISA – at the University of Sydney) that utilises organisational financial data to report across a wide range of social, economic, and environmental sustainability indicators. Using existing internal records collected from revenue and expenditure accounts and balance sheets, the direct and indirect impact of an organisation's activities is estimated based on purchases and supply chain information. The software produces a triple bottom line sustainability report across a wide range of indicators including detailed breakdowns, diagrams and tables (as shown below in Figure 6).[8]

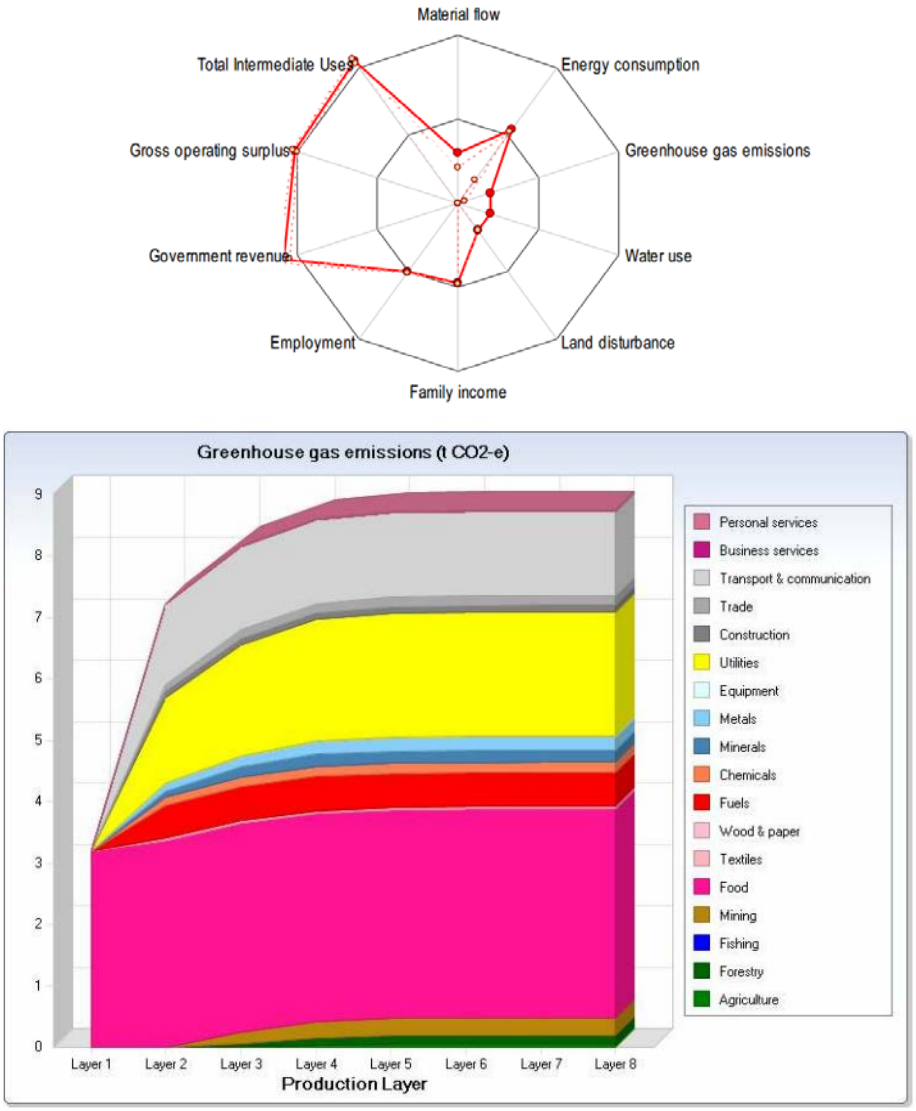

Figure 6: *An example of Bottom Line[3] outputs*

8 University of Sydney (n.d.) 'About BottomLine[3]', *Integrated Sustainability Analysis research team* [website], http://www.isa.org.usyd.edu.au/consulting/BL3.shtml, accessed 20 June 2012.

eTool Life Cycle Assessment Software

Applicable to a range of industries including residential, commercial, development and infrastructure projects, 'eTool' is a software program enabling the analysis and comparison of several design concepts in terms of energy and carbon output. In self-assessing each proposal, users enter information regarding materials, assembly, operational, transport and recurring sustainability considerations so as to obtain an indication of the sustainability across the life of the project.[9] eTool may be used as an assessment tool to aid in decision-making or in retrospect as a measurement tool supporting future improvements. The software generates reports, graphs and charts showing the "Embodied Energy" and the "Operational Energy" over the total life of the project (as shown below in Figure 7).

Impact Area:	Total CO2e / Year (kg CO2e)	% Saved Against Benchmark	eTool Medal
Materials	346	77%	
Assembly, Transport and Recurring Impact	234	72%	
Operational Impact	-1,000	118%	
Total Impact:	-420	105%	

Figure 7: An example of eTool outputs

If users elect to become certified, eTool assessors rate performance in each impact area and award 'bronze', 'silver', 'gold', or 'platinum' certification according to the level of performance against their industry benchmark (as shown below in Figure 8).

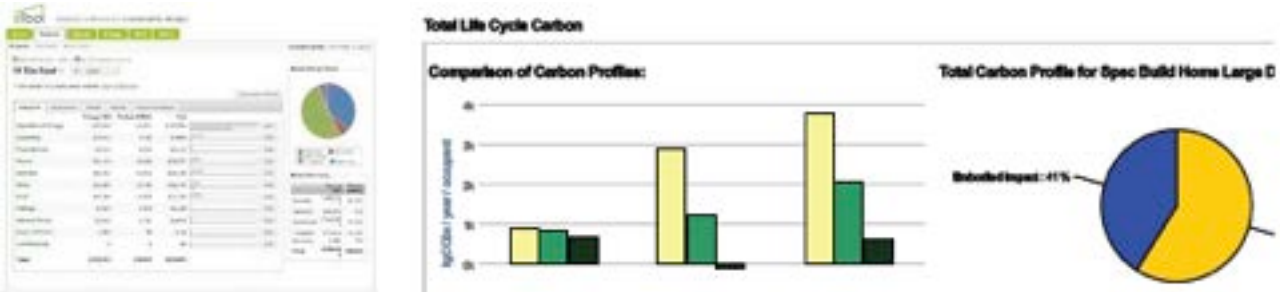

Figure 8:1 An example of eTool certification across several impact areas

[9] eTool (n.d.) 'Innovation in sustainable building', *eTool Life Cycle Assessment* [website], http://etool.net.au/, accessed 4 July 2012.

Greenroads Rating System

Developed in the US, the Greenroads rating system is suitable for evaluating the social, economic and environmental sustainability of roadway and transportation infrastructure projects during design and construction phases. Users must first meet eleven mandatory project requirements and then using the rating tool, must list the project details where relevant under a broad range of categories and provide supporting evidence in order to obtain a score. A summary of the category scores and total possible credits is provided (as shown below in Figure 9)

Figure 9: An example of Greenroads summary

Certification is available through the rating scheme after a formal review of supporting evidence, and 'bronze', 'silver', 'gold' or 'Evergreen' rating is awarded.

The Highway Sustainability Checklist

Developed by Parsons Brinckerhoff, the Highway Sustainability Checklist is a spreadsheet listing key environmental considerations across various phases of highway projects - from planning to design, through construction, operations, and maintenance (as shown below in Figure 10)

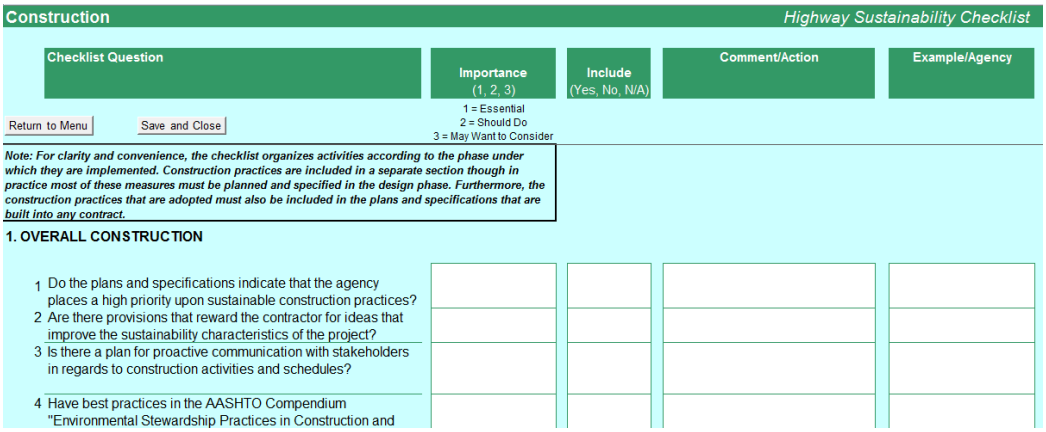

Figure 10: One of the Highway Sustainability Checklists

It is designed to be used as a planning tool and can be customised by the user who determines which elements to include and how important they are ('essential', 'should do', 'may want to consider'). The checklists may be printed after completion.

EnvisionTM Sustainability Rating System

A joint collaboration between the Zofnass Program for Sustainable Infrastructure at the Harvard University Graduate School of Design and the Institute for Sustainable Infrastructure (ISI), Envision^{TM} evaluates the economic, social and environmental sustainability aspects of infrastructure projects of all types, sizes, complexities and locations. A self-assessment checklist functions as a tool to aid in decision making, highlighting the range of sustainability considerations including ecology and biodiversity, energy and carbon, and access and mobility. An optional stage two verification process is available whereby a rating is established based on stage one scoring and then verified by an independent third party for public recognition.

CEEQUAL

Suitable for infrastructure, landscaping and other public realm projects, CEEQUAL is an initiative of the Institution of Civil Engineers (ICE). Focusing on a range of economic, social and environmental sustainability criteria, the rating tool is most useful when applied as early as possible in the project as a planning aid for design and construction, but may also be used in retrospect as an assessment tool. Using an online rating tool, the organisation is required to input information about their project and provide supporting evidence in order for a CEEQUAL appointed verifier to assess the completeness of the submission. Projects may be reviewed in their entirety or on a single aspect of the project such as design or construction only. Recognising the varied cultural influences and differences in physical environmental conditions around the world, CEEQUAL has developed an additional version of the tool that is suitable for international projects beyond the UK and Ireland. Upon review, and provided the project extends beyond the legal minimum of environmental and social performance in the industry, the project is presented with a CEEQUAL Award that specifies the level of award (from 'pass', 'good', 'very good' to 'excellent').[10]

Changer Greenhouse Gas Calculator

Changer is a greenhouse gas calculator developed by the International Road Federation (IRF) in Switzerland specifically designed for use in road infrastructure projects as an assessment tool. It requires the input information on the construction techniques and materials in order to calculate overall emissions. Currently with two main modules, pre-construction and pavement, the emissions from activities such as clearing and piling,

[10] http://www.ceequal.com/

materials transport and construction machines are able to be estimated.[11] Assessing construction and operation activities (as shown below in Figure 11) it is best applied in the pre-project phase to estimate greenhouse gas emissions, but may also be used at the end of the project as an assessment tool. Reports are generated as a result, and may be exported to Excel, Word and HTML.[12]

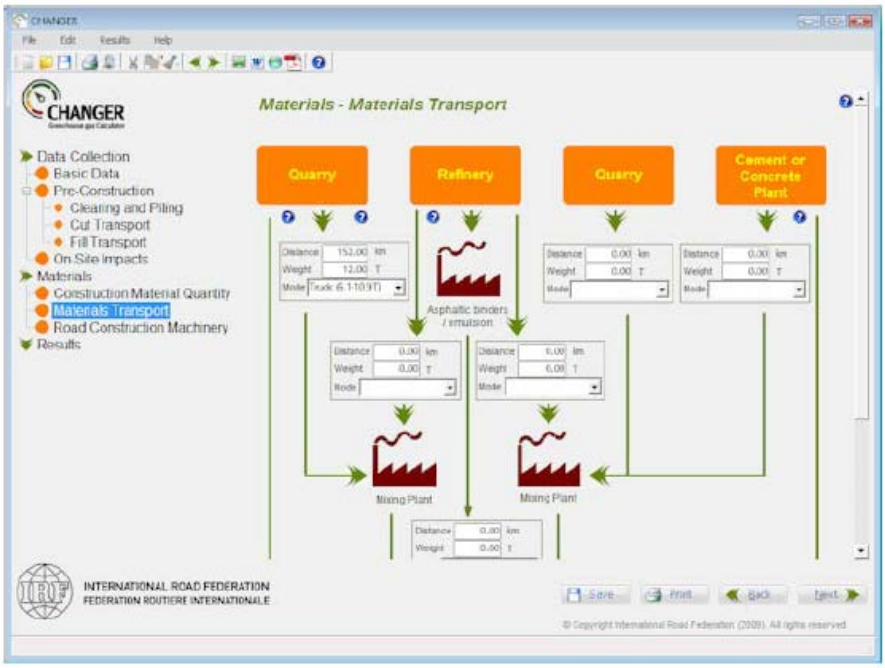

Figure 11: Changer greenhouse gas calculator

GreenLITES (Green Leadership In Transportation Environmental Sustainability)

Developed by the New York State Department of Transportation (NYSDOT), GreenLITES is a self-assessment tool that may be used in transportation projects to review the economic, social and environmental sustainability practices undertaken in design, operations and maintenance phases. Modelled on the building industry's LEED system, and initially developed to assess environmental issues, GreenLITES now takes a triple bottom line approach highlighting areas for improvement across each project. In response to a series of best practice statements, the user rates their internal level of performance in each category (as shown below in Figure 12).

11 International Road Federation (IRF) (2012) "Changer – IRF Greenhouse gas calculator" [website] http://www.irfnet.org/activities.php?id=32&title=CHANGER

12 Zammataro, S. (May 2010) "Monitoring and assessing greenhouse gas emissions from road construction activities: the IRF GHG calculator". International Road Federation (IRF) http://www.irfnet.org/files-upload/pdf-files/CHANGER_Article_May2010.pdf, accessed 18 July 2012

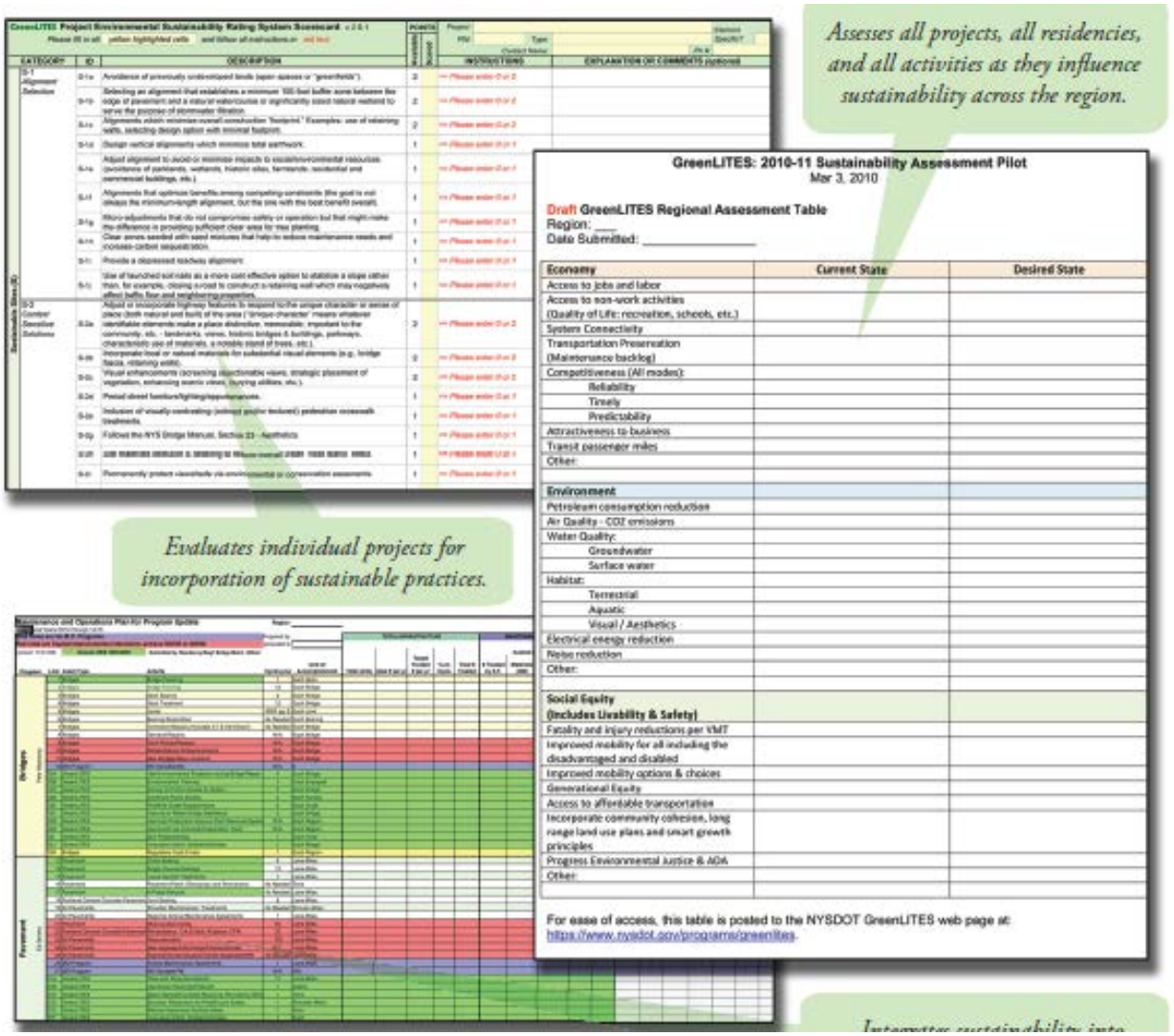

Figure 12: GreenLITES requirements

A level of achievement is ascertained based on the total credits received through the assessment, and a formal certification process may be undertaken to receive a 'Certified', 'Silver' and 'Gold', or 'Evergreen' award.

Other

According to a review by the Engineering and Physical Sciences Research Council in the UK in 2004, there are over 600 tools evaluating the social, environmental and economic dimensions of sustainability.[13] As highlighted by Cooperative Research Centre for Infrastructure and Engineering Asset Management (CIEAM), additional tools relevant to infrastructure and road building projects include:

13 Reed, Bilos, Wilkinson, and Schulte, 2009

- Energy Conservation in Road Pavement Design (Ireland)
- HalSTAR internal Sustainability Wheel toolkit for Halcrow (UK)
- GAIA Environmental Assessment Tool (Austria/France)
- SUSOP – sustainability framework for resources industry. risk and opportunity analysis. No rating
- SUSAIP – sustainability appraisal in infrastructure projects
- SPeAR (developed by Arup) - design tool that aims to inform decision making and aid delivery of sustainable developments
- SusStations – rail station sustainability assessment tool (primarily buildings)
- SB Method Tool – framework for rating the sustainable performance of buildings
- FIDIC - Project Sustainability Management Guidelines (international)
- Enduring Value – sustainability framework for Australian minerals industry
- Water Aid Sustainability Framework - framework for sustainable water supply and sanitation services in low-income countries
- ASPIRE - integrated planning, monitoring and evaluation tool for appraising the sustainability and poverty reduction performance of infrastructure projects[14]

[14] State of Affairs: infrastructure Sustainability rating schemes used by industry (CIEAM report)

Best Practice in Road Construction

IS Rating Tool and the Eastern Busway

The Eastern Busway in Brisbane, Queensland is a major infrastructure project that provides rapid bus transit between the eastern suburbs of Brisbane, the central business district and the University of Queensland. In 2009, the design and construction of the 1.05km Buranda to Main Avenue section of the Eastern Busway was awarded to the Alliance team, consisting of the Department of Transport and Main Roads Queensland (TMR), Leighton Contractors, SKM and AECOM. The Alliance delivered the project at a cost of $45.81 million and successfully provided the community with a significant number of environmental, financial and social benefits.[15]

The use of the ISCA IS Rating Tool directly and indirectly lifted the sustainability performance of the Eastern Busway project in a number of significant ways. It also led to the beginnings of a significant body of knowledge in ways to encourage and embed sustainability into large infrastructure projects.[16]

Tangible changes resulting from the ISCA trial and the inclusion of sustainability as a key performance area included a reduction in busway grades to save fuel, the lifting of bus stations to prevent flooding, the incorporation of water sensitive urban design, the removal of houses prior to demolition, and significant reduction in lighting and operation costs due to improved design.

FoR1 Academic Report, SBEnrc 'Future of Roads' Project, 2012

Main Roads Western Australia have also expressed their support for the ISCA Rating Tool.

Main Roads WA support ISCA

> *"Main Roads WA views ISCA, with its innovation focus, as providing us an important framework for consideration within our forward 2K12 Strategy… .to move the organization's culture from a 'business-as-usual' approach to a commitment to go 'beyond best practice' in highway delivery and maintenance towards 'achieving excellence'. This focus has already resulted in a number of projects, especially our recent major freeway extension being completed ahead of schedule and below budget with on-going recognition of its sustainability initiatives."*
>
> *Tony Missikos - Director, Strategic Relationships - Office of the Commissioner Main Roads WA*

15 Losee, S. (2011) 'Sustainability Rating Tool for Infrastructure Undergoes Pilot Testing', Australian Green Infrastructure Council, Australia, www.aprs.com.au/australian-environment-news/sustainability-rating-tool-for-infrastructure-undergoes-pilot-testing, accessed 16 April 2011.

16 White, G. (2011) 'Eastern Busway – Buranda to Main Avenue', AGIC Conference 2011, Australian Green Infrastructure Council, Australia.

Case studies (UK)

Local Highway Authorities responsible for managing the local road network, such as Hampshire County Council (HCC) (UK), are striving to embed sustainability in their decision-making processes, policy development and operational activities. Responsible for delivering local highway infrastructure (98% of the country's network – in excess of 380,000km), 152 local highway authorities collectively spend over £4.6 billion of which £2,309 million is in maintenance and £2,355 million on improvements. Local highway authorities design, construct and operate a range of local infrastructure - HCC's highway assets, in particular, include 8,500km of carriageways, 8,000-10,000km of footways, 190,000 drains and 118,000 street lights.

HCC is committed to developing a low carbon economy by embracing climate change considerations in all undertakings, and declaring the following vision:

> *"Within a decade Hampshire will prosper without risking our environment"*[17]

With sustainability aspirations "above and beyond minimum compliance"[18] and a proven performance history, HCC engaged Amey as the supplier of their Term Highways Contract (THC) "...*to deliver a range of planned and reactive highway maintenance works including emergency response, routine repairs, resurfacing, environmental maintenance on County Council-maintained roads and footways*" over a 7 to 10 year contract.[19] An expanded range of sustainability contractual performance indicators and associated targets have been adopted by HCC in regards to waste and emissions within this contract. With an emphasis on increased performance (including sustainability), HCC assert that "*additional work and contract extension is dependent on meeting stretching targets against PI's [Performance Indicators]*".

Testament to the impact of measuring performance, the following examples demonstrate that a broader and greater emphasis on reporting in key sustainability areas (through incentivising best practice), can promote change and achieve significant performance improvement. In measuring "Construction Waste to Landfill", HCC sought to achieve a "*percentage increase, compared to the baseline year, in the weight of construction waste produced in the delivery of the service that is disposed of at Landfill or sent for incineration, per thousand pound of works delivered through the contract*". As a minimum, the supplier was required to meet a 2.5% reduction in waste, with a target of 5% and a best practice "stretching" target of 5.8% was encouraged beyond that. As shown below in Figure 5, a significant reduction in waste was, in

[17] Steve Spender PPT

[18] http://www.amey.co.uk/Sustainability.aspx

[19] http://www3.hants.gov.uk/d9f75c86.pdf

fact, achieved from 0.28 tonnes per £1000 works in the baseline year to 0.03 tonnes per £1000 works in year three.

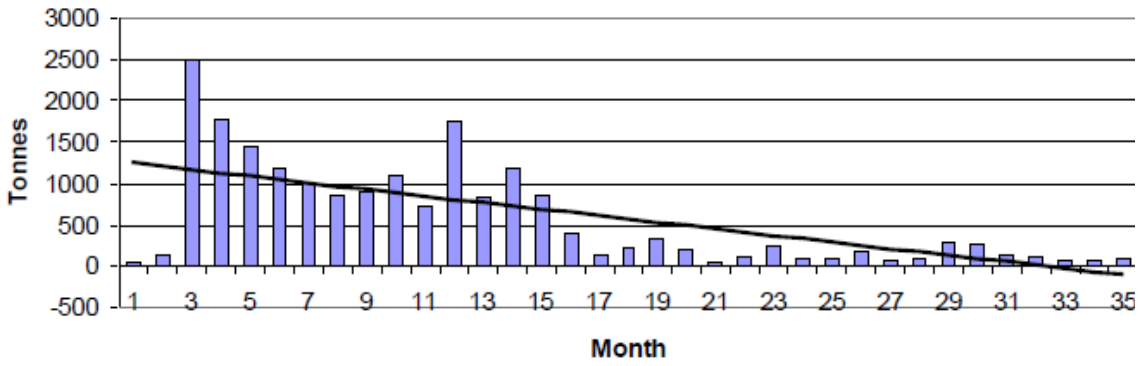

Figure 13: Construction Waste to Landfill in Hampshire City Council's Term Highways Contract

In evaluating "Construction Waste Recycling Rate", HCC measured the "change in the percentage of construction materials (by value) used to deliver the service that are from either secondary or recycled sources, compared to the baseline year". With a minimum requirement of 2.5%, target of 4.97% and stretching aim of 5.8%; the value of materials recycled in the THC has increased since day one and had already surpassed the baseline year value four months into the second year. The greatest contributor of this significant improvement is said to be as a result of using foam mix.

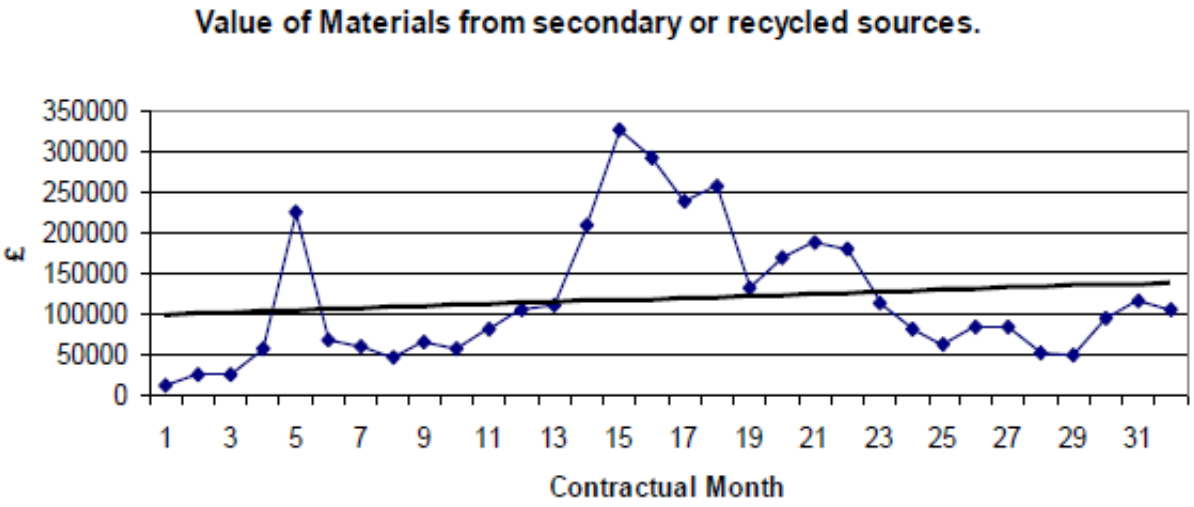

Figure 14: Construction Waste Recycling Rate in Hampshire City Council's Term Highways Contract

"Fleet CO_2 Emissions" were measured as a "*percentage reduction of the total mass of CO_2 produced by the Contractor's vehicle fleet in delivery of the service per thousand pounds of the Contract compared to the baseline year*". A minimum of an 8% reduction was required, a target of 14% was set, while a stretching aim of 19% was desired. A consistent reduction in

fleet CO_2 emissions has been achieved from the baseline 0.08 t/£1000 since day one of the contract, as shown below in Figure 15.

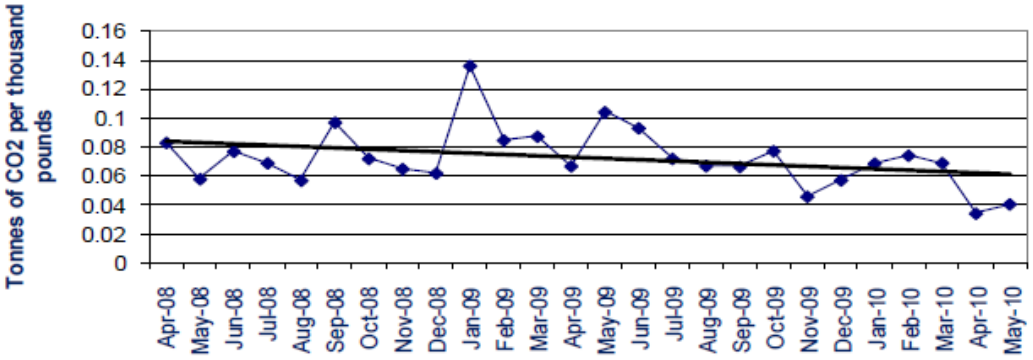

Figure 15: Fleet CO_2 Emissions in Hampshire City Council's Term Highways Contract

Potential Future Pressures on Road Agencies

Key Environmental Reporting Areas

The research team held workshops in winter 2011 in both Perth and Brisbane to gain stakeholder input into the early project deliverables. These workshops were attended by road and transport agency staff from various departments, ranging from project directors and officers to engineers and strategic advisors. The workshops also attracted a number of external participants, from organizations such as Seymour Whyte, SMEC, Cement Concretes and Aggregates Australia, Logan City Council, QUT and in-kind project partner ISCA. The broad and varied background of the participants led to interesting findings. Whilst the workshops generally followed a structured format the research team worked closely with participants to capture valuable side conversations throughout the day.

The workshops involved a session to discuss potential future global changes facing road agencies. To guide the discussion, the purpose of this stage of the workshop was to seek insight into possible future indicators for successful road projects. Whilst this exercise was successful in gathering an extensive list of these indicators, a secondary outcome was the chance to gain some interesting insights into the perception and current state of environmental reporting within main roads agencies. The full list of potential key indicators identified by workshop participants is vast. However when analysed the indicators established in the workshop began to follow certain themes and notably align closely with the existing ISCA categories. The indicator themes established by the workshop are:

- Energy/Emissions
- Materials
- Water
- Community
- Environment
- Economics
- Legacy
- Innovation
- Maintenance

Every road construction project varies considerably in terms of size, cost and environmental impact. It is not practical to implement or recommend an environmental reporting procedure that will be beneficial and efficient for every project. Ideally, a rating tool would be applied consistently across all projects, however many projects will not (yet) have the time or the budget to undertake this somewhat onerous reporting and data collection. At this point, the recommendation is that all projects that have budget and time capacity should undertake environmental reporting through the use of a rating tool, such as the IS from ISCA. This will allow a more systematic reporting of 1st generation environmental issues, such a biodiversity and ecological footprint considerations, and help to encourage more thought and design in 2nd generation issues, such as life cycle analysis and material recycling.

For projects that are not able to employ a rating tool, the next option is to use a project manager who has a significant understanding of the benefits of environmental reporting and is able to use the areas recommended in Section 5 of this report to ensure that the most important environmental reporting areas are covered. Regardless of the methods and tools selected, it is clear that the requirement for data collection and reporting on key environmental performance areas is an ever-increasing task within road agencies. The challenge to road agencies will be to select and regulate the use of one or many reporting tools so as to effectively improve environmental performance whilst limiting the onerous data collection and reporting task.

The future of environmental reporting for road agencies lies in optimizing the onerous task of data collection and compilation whilst still covering a broad and detailed range of issues. Such an approach will encourage a measureable and quantifiable shift to a more sustainable road agency. The research for this report has shown that the there will be an increased focus on GRI by road agencies, which will assist in the progression towards best practice and to adapt to increasing environmental and societal pressure on the transportation network. The remainder of this report aims to guide road agencies towards a simple, implementable plan to with which to begin their environmental reporting. Examining the current environmental reporting process in road agencies, it is clear that some, but not all of the recommended environmental GRI metrics are being reported on in annual reports. It is also apparent, that in many instances, the data is being collected but not systematically reported on.

The key environmental reporting areas that we have identified as important and not yet fully adopted are:

1. Waste
2. Materials
3. Water

Beyond the construction phase (the primary focus of this report), the design and operations phases are acknowledged as being integral to the overall sustainability of a road. Upon brief preliminary investigation, the key environmental reporting areas that have been identified as important and not yet fully adopted in the design and operational phases of a road project are:

4. Road Design
5. Community/Stakeholders
6. Lighting

In ascertaining the above key environmental reporting areas, the research team considered the areas already defined by existing rating tools and international road agency frameworks, examined the outputs of a number of stakeholder workshops and investigated the current environmental reporting situation in both Queensland and Western Australian road agencies. This knowledge has informed the recommendation of the key areas for road agencies to

consolidate existing data collection, commence new data collection if needed, and report on across all road projects. Below is a summary of the global context for each key environmental reporting area and the justification for their inclusion as a key environmental reporting area.

Waste

Reducing waste production, promoting the use of recycled aggregates and improving the process of repurposing waste brings substantial environmental gains in the form of reductions in resource consumption, diversion of waste materials from landfill, reduced quarrying and reduced GHG emissions (because recycled aggregates can have lower embodied energy in addition to the reduced transport emissions where recycled materials are reused close to their original location). AGIC's IS rating tool and scheme devotes an entire category and a substantial proportion of 'credits' to 'Waste'. Within the category are a number of key performance indicators, such as 'Was-1: Waste Management', which aims to reward sustainable waste management plans and practices. Other credits are awarded through the rating tool for diverting (non-hazardous) waste from landfill and the design and planning for deconstruction, disassembly and adaptability of infrastructure in the future.

A significant reduction in waste going to landfill was evident during construction within the aforementioned Hampshire City Council (HCC) Term Highways Contract (THC) as a result of striving for a 5.8% (stretching target) reduction in tonnes of waste from the baseline year. As demonstrated in this particular project, the inclusion of ambitious performance targets regarding waste were a key factor in driving significant waste reductions. Through literature review and stakeholder engagement in 'Stage 1' of the Future of Roads project; waste was indirectly discussed in the strategic areas of Road Construction Aggregates, Asphalt, and Alternative Cements highlighting opportunities to minimise waste through repurposing, reclaiming and recycling materials. These strategic areas, in particular, were identified as key components within road construction projects in which the greatest potential for waste reduction is evident, and thus a greater focus on data collection and reporting in these strategic areas should occur.

Although DTMR and MRWA have recently been reporting on waste to some degree in their annual reports (as shown earlier in Table 2), numerous environmental GRI metrics in this category do not appear to be currently reported on. As highlighted earlier in Table 3, several recommended environmental GRI metrics related to waste could complement existing reporting efforts in road projects for a more thorough and progressive environmental reporting. The prominence of waste as a category with several credits in the IS rating tool (AGIC), the demonstrated link between waste related performance targets and significant waste reductions in a best practice case study, the opportunity for waste reduction in road construction processes as informed by literature and stakeholders, and gaps between current road agency environmental reporting and recommended GRI environmental metrics supports the inclusion of waste as a key environmental reporting area. As a result of synthesising such factors relevant to the new generation of environmental reporting, we believe some of the

most pivotal waste related metrics for road agencies to immediately begin measuring, managing and reporting on are as follows:

- Total weight of waste
- Total weight of hazardous waste transported, imported, exported, or treated
- Percentage of transported waste shipped internationally
- Percentage of packaging materials that are reclaimed

Materials

Studies exploring extractive resource availability in Australia estimate that current resources approved for extraction (including rock, sand, gravel, loam and other materials from a pit or quarry) may be depleted in the near future. Comparing demand estimates from 2005 to 2026 with extractive material currently available in SEQ, a GHD report predicts that current resources that are approved for extraction will be depleted by the year 2015, and that there will be a shortfall of 509 million tonnes of resources available for extraction by 2026.[20] The methodology for mitigating the risks associated with resource scarcity focuses on building a business case for alternative materials in road construction. Resource scarcity will be combated by both more efficient use of virgin resources and the use of innovative materials and products. In order to advance the market acceptance of recycled aggregates in the construction sector, future data collection needs to quantify offsite environmental impacts of quarrying, recycling and landfill operations. Consistent reporting of these quantities across all projects will enable tracking and reduction of the use of limited road construction materials.

The IS rating tool and scheme (AGIC) features a 'Materials' category, with an equally as substantial proportion of 'credits' to that of 'Waste'. A credit called 'Mat-1 - Materials lifecycle impact, measurement and reduction' aims to reward design and practice that reduces the lifecycle environmental impacts of materials. This is achieved by allocating points to projects that use a lifecycle calculator to measure their materials use, and award further point to projects that demonstrate considerable reductions when compared to baseline material use. It is anticipated that many large and small road construction projects will soon be using a rating tool such as IS, and therefore, by commencing a transparent and directed process of reporting within the key environmental reporting area of 'Materials', road agencies will be simultaneously preparing for the possible advent of the mandated use of rating tools whilst reporting to reduce risk of material shortages to construct new roads.

Demonstrative of the influence ambitious performance targets had on Hampshire City Council's (HCC) Term Highways Contract (THC), the value of materials recycled has increased since commencement. Driven to increase the proportion of materials from

20 GHD (2007) 'Cement Concrete and Aggregates Australia: Report for Availability of Extractive Resources in Southeast Queensland Summary Report', www.ccaa.com.au/industry/documents/CCAA%20Final%20Report%202007.pdf, accessed 20 July 2011

secondary or recycled sources, the contractor actively sought to use innovative materials from secondary or recycled sources such as foam mix. In a series of 2011 Future of Roads stakeholder workshops, participants identified a range of future global changes that they predict will affect road construction projects, of which the likelihood of 'resource shortages' emerged as a strong possibility. Perth workshop participants identified resource shortages as a key global change while Brisbane participants listed the shortage of resources as an accessibility issue. Additional to the workshops, various road construction materials made up three of the six strategic areas initially identified as critical in the Future of Roads project.

With a materials category comprised of significant credits in the IS rating tool (AGIC), an increase in recycled materials within a best practice case study as a result of ambitious performance targets and expected resource shortages on the horizon, it is clear that materials is a key environmental reporting area. Some basic information that should commence or continue to be measured, managed and reported on by road agencies is:

- Materials used
- Percentage of recycled materials

Water

Whilst water and storm-water quality is an integral part of most modern road construction projects, the idea of water as a road building material is often overlooked. Water is mainly used for dust control on road construction sites, but is also a necessary component of concrete and asphalt mixes. With increasing water shortages across Australia, the efficient use of water is an important part of sustainable construction. The vision for the use of a rating scheme with a significant water element is to encourage a greater level of water efficiency across a project's lifecycle. This requires that measurement, monitoring and reporting of water use becomes the norm instead of the exception. In turn, this practice will establish the typical water usage footprint, against which other projects can be compared. This would minimize the volume of water used and encourage locally appropriate alternative water sources as substitutes for potable water. Generally, the focus would be on additional water use, not on the use of storm (or waste) water or the embodied water in road construction materials. As more and more projects are analysed and the reporting of water becomes more common, road construction agencies will be encouraged to use water more efficiently and innovatively.

The IS rating tool and scheme (AGIC) has a category for 'Water' which is weighted equally to 'Waste' and 'Materials'. Contributing the highest amount of credits is the 'Water Use, Monitoring and Reduction' (Wat-1) key performance indicator, which aims to reward monitoring and minimising water use as much as possible across the infrastructure lifecycle. Other indicators encourage the identification and implementation of innovations that reduce water use, and the degree to which a project replaces potable water. Some basic water related information has been captured in DTMR annual reporting over the years (as shown earlier in Table 2); however additional environmental GRI metrics in this category may

complement existing efforts by both DTMR and MRWA going forward. As the water category represents a significant aspect within AGIC's IS rating tool, and gaps exist between current road agency environmental reporting and recommended GRI environmental metrics, it is suggested that water be viewed as a key environmental reporting area going forward. Specific information that should continue to be considered, measured, managed and reported on by road agencies are:

- The effects on water sources by withdrawal of water
- Percentage and total volume
- Water discharge
- Size, protected status, and biodiversity value of water bodies and related habitats affected discharges of water and runoff

Road design

Decisions made in the design phase of a road construction project can have an enormous effect on the overall environmental impact of a road. Small adjustments to horizontal alignments can avoid sensitive ecological areas and minimize the amount of raw materials required to complete the project. The vertical alignment of a road has huge implications for vehicle efficiency and small changes made during the design phase can result in enormous energy savings over the life of a roadway. Additionally, recent research is increasingly confirming the role of pavement smoothness in reducing the emissions and fuel consumption of the vehicles that use the road. The AGIC IS rating tool features a category called Man-8 'Decision Making'. This category aims to reward incorporating sustainability aspects into decision making. According to AGIC, best practice decision making is characterized by the inclusion of an option that specifically aims to address sustainability aspects. AGIC also rewards decisions that are made y considering environmental, social and economic aspects through incorporating their value into a cost benefit analysis or other quantified means.

The relevance of this category to road agencies mean that each decision made will soon be examined not only on economic grounds but also on documented and quantified social and environmental aspects as well. By commencing reporting on this process, road agencies can begin to prepare for the advent of compulsory use of rating tools. As a subsidiary, reporting on the decision-making process will also ultimately ensure that better and more sustainable decisions are made. The design stage of a road construction project impacts heavily on many of the indicator theme areas identified in the FoR1 workshops. These include community, environment, economics, legacy and innovation. This provides further support for an immediate increase in the reporting on the design phase of a road construction project to support and improve the level of sustainable decisions made. Providing guidance to report on the design stage of a project is difficult, as road construction projects can vary enormously in size, cost and environmental impacts. Without performing extensive research into this phase

of road construction, detailed categories have not been listed, however this does not discount the importance of reporting for improvement in this area.

Community/stakeholders

Community and stakeholder collaboration has become an increasingly pivotal part of road construction and delivery. Innovative and best practice road construction projects are now not only incorporating a significant community consultation process into the design and delivery of a road, but also using this process to make significant improvements to a project. AGIC in particular has a number of sections regarding stakeholders and community engagement. This indicates that road agencies will need to not only increase the amount of public engagement that they undertake, but also provide significantly more reporting to demonstrate that the needs and ideas of the community have been responded to. In particular, AGIC has the following categories:

- Sta-1: Stakeholder engagement strategy
- Sta-2: Level of engagement
- Sta-3: Effective communication
- Sta-4: Addressing community concerns

By commencing structured and transparent reporting on the ever-increasing task of public engagement, road agencies will be able to continually improve and update the process. In essence, the engagement process creates a better road for its users, and a structured reporting process will help to facilitate this.

Lighting

Street lighting and traffic signal lighting result in a large amount of indirect greenhouse emissions due to the consumption of electricity. This electricity is often, particularly in urban areas, produced offsite and beyond the control of the road agency. Road agencies can however, reduce their consumption of electricity and their greenhouse gas emissions through their lighting choices. When considering the greenhouse gas emissions from lighting, the amount (or number) of lights, the type of lights used, the wattage of the lamps (bulbs) used and the operating hours of the lights all need to be considered. To reduce consumption of electricity and greenhouse gas emissions many road authorities worldwide are exploring and implementing changes to their lighting and traffic signal provision. These changes include switching light bulbs to lower wattage bulbs, installing Light Emitting Diode (LED) lights, dimming lights or switching off lights in certain areas.

Reporting on the amount of power used by lighting on a road and communicating this in both a dollar value and also as an amount of greenhouse gas produced over the life of the road. Bringing awareness to these quantities through systematic reporting will enable tracking and targeted reduction in this hugely significant area of emissions. AGIC puts heavy focus on

reduction to energy use and carbon emissions, and road agencies that demonstrate improvements in this area will be well rewarded in the rating tool. The AGIC categories that support this include Ene-1; energy and carbon monitoring and reduction, Ene-2; energy and carbon reduction opportunities and Ene-3; renewable energies. Given the significant amount of carbon emissions and energy used by lighting and signals through the life of a road, it is imperative that road agencies begin reporting on these areas in order to create the incentive for change in this area.

Table 2: *Justification of Key Environmental Reporting Areas*

Key Environmental Reporting Areas	Justification for inclusion	Possible metrics applicable
Waste	- A prominent category with several credits in the IS rating tool (AGIC) - A demonstrated link between waste related performance targets and significant waste reductions in a best practice case study - The opportunity for waste reduction in road construction processes as informed by literature and stakeholders - Gaps between current road agency environmental reporting and recommended GRI environmental metrics.	- Total weight of waste - Total weight of hazardous waste transported, imported, exported, or treated - Percentage of transported waste shipped internationally - Percentage of packaging materials that are reclaimed
Materials	- A prominent category comprised of significant credits in the IS rating tool (AGIC) - An increase in recycled materials within a best practice case study as a result of ambitious performance targets - Expected resource shortages on the horizon	- Materials used - Percentage of recycled materials
Water	- A prominent category representing a significant aspect within AGIC's IS rating tool - Gaps exist between current road agency environmental reporting and recommended GRI environmental metrics	- The effects on water sources by withdrawal of water - Percentage and total volume - Water discharge - Size, protected status, and biodiversity value of water bodies and related habitats affected discharges of water and runoff

The complexity and of modern road construction, maintenance and rehabilitation projects requires a similarly flexible and detailed reporting guidelines. Currently, the GRI guidelines provide a broad and overarching strategy for road and transport agencies. However there exists a significant need for further detailed sustainability reporting guidance. GRI have developed a number of sector specific supplements which target critical sustainability issues within various industries, including mining, construction, financial services, event organizers, food processing and media. However a specific road construction supplement is not currently available and future project directions aim to connect with GRI to discuss and encourage the development of this specific guide.