Project 3C1: Developing Local Synergies in the Gladstone Industrial Area

Final Project Report

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Contributors to this project

GAIN

The University of Queensland
Executive Summary

Regional synergies, or waste and by-product exchanges, can make a significant contribution to progressing a region along the sustainable development path. Gladstone, as one of the major heavy industry areas in Australia, has been considered, for a number of years, to be a region that could benefit from the broad implementation of regional synergy initiatives. The Gladstone Regional Synergies Project, which commenced in April 2004 and ran until June 2007, had the specific aim to assist and facilitate operations in the identification and implementation of regional synergy opportunities. This report presents the outcomes and learnings from this project.

Although several opportunities were identified over the course of the project, none of these were realised within the project timeframe. This lack of uptake raised a number of questions:

- Why were more synergies not being implemented in Gladstone?
- To what extent is synergy uptake related to physical constraints, such as industry mix, density, and location?
- To what extent do less tangible factors, such as regional community pressure, organisational networks, and regulatory issues, also play a part?

Addressing these questions became one of the key objectives of the final year of the project, and were sought from various sources including interviews with key stakeholders in the Gladstone region, comparison with the Kwinana Industrial Area (a similar heavy industrial region to Gladstone), examination of Queensland’s regulatory framework, general research in the area of industrial ecology and the experiences and knowledge accumulated throughout the course of this three-year project.

As part of the closeout of the project, key stakeholders were interviewed by Dr. Janine Lay, formerly based at Central Queensland University’s Process Engineering & Light Metals (PELM) Centre and formerly the CSRP Regional Synergies Champion. Interviewees included members of the GAIN Executive, GAIN Environment Committee, Gladstone’s key development Government contacts and some key previous project participants who had left Gladstone. The main factors cited by interviewees for lack of uptake were that:

- there were no large easily achievable untapped synergies although there were several smaller synergies opportunities;
- for these smaller synergy opportunities, there were not enough associated financial benefits, or external drivers, to the respective companies to justify implementation;
- this project was not seen as an appropriate vehicle for addressing the large opportunities on the large volume waste streams;
- implementation was not readily achievable through facilitation by an external group as the perceived responsibility for synergy implementation lies with individual companies;
- even though technology exists for the identified synergies it is the many non-technical factors that most influences regional synergy uptake.
However, several of the interviewees recognised that the project did deliver useful outcomes including collating and sharing data, enhancing the communication network between companies, comparing Gladstone practice with other regions and providing insight to the early stages of synergy development. Interestingly, at the end of the project, interviewees thought that there were several non-technical synergy opportunities, such as included regulatory and financial issues, tax, closure planning, logistics in the region, commercial negotiating, and staff retention. This illustrated a broadening of the views of the definition of regional synergies and recognition that there could be benefits for industries across the region working together.

To further investigate the reasons for the lack of synergy uptake, it was logical to compare Gladstone with the Kwinana Industrial Area, one of the most successful examples of synergy implementation worldwide (Bossilkov, van Berkel and Corder 2005). While there are some common elements between the two regions, there are sufficient variations, both in terms of physical make-up (e.g. industries, locations etc.) and less ‘tangible’ factors (e.g. networks, community reactions, etc.). In brief, the main distinguishing features of Kwinana are that:

1. it has a greater diversity of industries, a larger number of operations and a greater range of industry size, which on balance should be conducive to more synergy opportunities
2. it is located close to a major city, and thus a larger market for by-product re-use opportunities
3. most of the industrial operations are in close proximity, roughly over an area of about 16 km²
4. some of its main by-products are stored close to the local community/urban area, such as Alcoa’s bauxite residue area, which can lead to greater community pressure for industry to investigative innovative re-use approaches to reduce by-product footprint
5. it has an incorporated organisation, Kwinana Industries Council (KIC), which was instigated by the core industries to co-ordinate activities of the industries across a range of common issues, such as air and water monitoring

The first three points represent the physical differences between the regions, and support the conclusions that the conditions in Kwinana are more favourable for development of synergy opportunities than Gladstone. The last two points are less ‘tangible’ factors that can also play an important role in instigating change in synergy uptake with industry. Greater community pressure, as has been the case in Kwinana, could force industries to work together to develop and/or implement innovative solutions to re-using or recycling wastes and by-products. In addition, by having a funded secretariat like the KIC, it is easier to progress regional and community focussed projects. This is a critical difference between the two regions and one that could be instrumental in driving synergies initiatives more effectively in Gladstone, particularly if growing community expectations demand more sustainable industry outcomes.

The complexities of regional synergy development are illustrated by comparing regional objectives for adopting synergy initiatives with the practical issues associated with their implementation. From a regional perspective, it makes good sense for industries to re-use by-products. The quantity of feed stock, consumables and utilities entering the region will reduce, as will the quantity of waste and emissions for
disposal. At the practical level, however, divergent objectives and drivers may exist. Individual operations aim to generate a profit within a set of generally well-defined business constraints. In short, the usual business factors do not lend themselves to promoting regional synergy initiatives. However, global factors such as reducing greenhouse gas emissions may play an important part in the future, as they are incorporated into the conventional business models.

In some cases where synergy opportunities exist, the Queensland regulatory framework, while supportive of good waste management practices, present numerous hurdles that, although minor, appear to aggregate to discourage implementation of some opportunities. These hurdles included the legislative ‘waste’ label plus associated additional costs and licensing requirements, community perceptions, and lack of knowledge on key recycling provisions, such as beneficial resource approvals. A comparison with other jurisdictions indicated that a number of factors could assist in synergy implementation, such as landfill levies or taxes, tightening of regulatory provisions, or initiatives that promote recycling programs.

The response from the stakeholders and analysis of Kwinana plus the general learnings acquired during the project were the basis for developing an organising approach to assess the uptake potential of a synergy opportunity. This approach delivered a better understanding of the key drivers, barriers and enablers for regional synergy initiatives across a region like Gladstone, and builds on the foundations of synergy ‘awareness’ established during the project. An important component of this approach is a synergy matrix (see below) for categorising a potential synergy initiative based on its financial and SD benefits (that is, improvement of non-financial aspects, such as environment, community, social, or intellectual).

**Synergy Matrix**

<table>
<thead>
<tr>
<th>Financial Benefits</th>
<th>SD Benefits</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Will proceed</td>
<td>Will proceed</td>
<td>Will proceed</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>May or may not proceed</td>
<td>Probably not</td>
<td>Will not proceed</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>Probably not</td>
<td>Probably not</td>
<td>Will not proceed</td>
<td></td>
</tr>
</tbody>
</table>

Irrespective of their SD benefits, regional synergy initiatives with strong financial benefits (that is, those that meet the companies’ return on investment criteria) will ultimately proceed to implementation provided there are no significant risk factors. Regional synergies initiatives that have moderate or low financial benefits with low SD benefits will not proceed.

The ‘grey’ area is where a regional synergy initiative has moderate or low financial benefits (that is, those that do not meet the companies’ normal return on investment criteria) but has high or possibly moderate SD benefits. What determines whether a potential synergy that lies in the ‘grey’ area will proceed is strongly dependent on local circumstances, such as the sensitivity of the natural environment, the tolerance of the community, the quality of the regional airshed, or the availability of resources from the region. However, in some circumstances there might be higher-level corporate goals, such as reduced water or energy consumption, for companies leading the implementation of SD initiatives that might be the catalyst for developing synergies with strong SD benefits but moderate or low financial returns. Review of
the KIC suggests that their main functions and activities predominantly fall into this ‘grey’ area.

A new approach, incorporating the synergy matrix, has been developed to improve the capture of new synergy opportunities. The approach has three key steps:

- Maintaining a strong network of parties interested in exploiting the benefits of regional synergies
- Pre-screening potential synergy opportunities to determine their initial viability
- Determining the financial and sustainability benefits of opportunities and using the synergy matrix to determine their feasibility.

This approach will assist with the early identification of new prospective synergy opportunities. As the key to this is regular communication amongst all parties, the GAIN Environment Committee is the obvious vehicle for initiating discussions on the possible opportunities. Given the success of the Kwinana Industries Council, GAIN should adopt a similar-style funded secretariat.

In the future, more synergy opportunities, both in terms of by-product exchanges and less tangible organisational synergies, will emerge as the number and mix of industries increases. These opportunities would ultimately need to demonstrate a strong business case in the wider sense of the term, and could eventually result in sizeable SD benefits for the region and cost savings for the participating companies and organisations. Again, a funded secretariat would greatly assist in enhancing these opportunities.

There are still many potential opportunities in Gladstone to make it a leading example of a truly sustainable region. Industry could take control of these initiatives and manage the agenda that will drive the region down the sustainable development path. If industry chooses not to take on this role, circumstances, such as a more demanding community, water scarcity and a carbon-constrained economy could force industry to work collectively to an agenda set by non-industry organisations, such as government, community groups or NGOs.

**Key Recommendations:**

- That the findings from the stakeholder interviews on the factors influencing industry engagement with regional synergies in Gladstone are reported in the public domain as an example of the practical issues to overcome in synergy implementation.

- That the GAIN group gives serious consideration to supporting a funded secretariat, similar to the Kwinana Industries Council, that would co-ordinate non-core industry activities across the Gladstone region.

- That the GAIN group employ the developed approach Capturing New Synergy Opportunities, presented in Section 6.8, to aid the early recognition of new synergy opportunities and determine the potential of any possible synergy opportunity for realisation.
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1 INTRODUCTION
The Gladstone Regional Synergies Project commenced in April 2004. The main aim of the project was to enhance local synergies between industrial operations and associated activities in the Gladstone region, and to assist these operations to achieve greater efficiencies in energy, water and materials consumption, and reductions in waste and emission generation. To achieve this objective the project assisted and facilitated operations in the identification and implementation of regional synergy opportunities. The project built upon previous work undertaken by various organisations in the Gladstone region. It also drew upon parallel CSRP projects being undertaken at Kwinana (Project 3B1) and was linked to Project 3A1 (Enabling Tools and Technologies for Capturing Regional Synergies).

This is the final report for this project. It focuses on the main findings and learnings from the project related to the key factors affecting synergy uptake in the region and proposes possible strategies for capitalising on future synergy opportunities in the region. The recent developments of the project case studies are presented in Appendix A. Although Appendix A provides an overview of the major developments over the life of the project, the reader is encouraged to refer to the earlier reports, listed in Research Outputs Appendix B, for more detail.
2 PROJECT OBJECTIVES AND OUTPUTS

The overall project research objectives and outputs as stated in the original project agreement are presented below.

The research objectives were to:

- Provide comprehensive and up-to-date information about resource consumption, value generation and waste outputs for the Gladstone region
- Facilitate the identification, development and implementation of specific projects to improve industrial synergies in the region
- Contribute to greater understanding and acceptance of industrial ecology principles in the region.

The specific project outputs and the associated reports where these outputs were documented are presented below:

<table>
<thead>
<tr>
<th>Project Outputs</th>
<th>Relevant Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. An up-to-date input output database of resource consumption, value generation and waste outputs for the Gladstone area</td>
<td>(Corder 2005a)</td>
</tr>
<tr>
<td>2. A prioritised list of resource synergy opportunities within the Gladstone industrial area.</td>
<td>(Corder 2005a)</td>
</tr>
<tr>
<td>3. Ongoing research and project support to individual operations to facilitate improved synergies in specific identified areas.</td>
<td>(Corder 2005b; Corder 2006a; Corder 2006b; Corder 2006c)</td>
</tr>
<tr>
<td>4. Contribution to the design and evaluation of enabling tools for capturing regional and supply chain synergies (through the connection with project 3A1)</td>
<td>(Bossilkov, van Berkel and Corder 2005; van Beers, Corder, Bossilkov and van Berkel 2007a; van Beers, Corder, Bossilkov and van Berkel 2007b)</td>
</tr>
<tr>
<td>5. Case studies documenting learnings from the project</td>
<td>(Corder 2005b; Corder 2006a; Corder 2006b; Corder 2006c; Corder and Moran 2006; Corder, van Beers, Lay and van Berkel 2006; Davis 2007; Tuazon 2006)</td>
</tr>
</tbody>
</table>
3 PURPOSE OF THIS REPORT

An important task in the third year of the Gladstone Regional Synergies Project (CSRP project 3C1) was to better understand why more industrial synergies are not being pursued in the Gladstone region. Although technically feasible and environmentally sound opportunities appear to exist, there has been little uptake to date. To examine this lack of uptake, a more detailed investigation of drivers and barriers for regional synergies was conducted to address the third research objective as per the original project agreement, i.e. “to contribute to greater understanding and acceptance of industrial ecology principles in the Gladstone region”. This examination comprised:

- A series of semi-structured interviews with relevant stakeholders associated with the Gladstone Regional Synergies Project to identify their impression of the factors influencing synergy uptake (refer to Section 4)
- A comparison of the key factors between regional synergies in the Gladstone area compared with regional synergies in Kwinana Industrial Area, one of the most successful examples of synergy implementation worldwide (Bossilkov et al. 2005) (refer to Section 5)
- The development of an approach for recognising and capturing the potential synergy opportunities based on the learnings and findings from this project (refer to Section 6)

Finally an analysis was conducted to identify the potential future possible synergies initiatives based on the possible industries that could establish in the Gladstone region (refer to Section 7).
4  FACTORS INFLUENCING THE UPTAKE OF REGIONAL SYNERGIES IN GLADSTONE

The aim of this sub-project was to get a better understanding on why more industrial synergies are not being pursued in the Gladstone region. Dr Janine Lay conducted the project and prepared the report presented in this Section. At the time of the study, Janine was working for the Process Engineering and Light Metals (PELM) Centre at Central Queensland University.

4.1  Summary

The objective of this analysis was, through a series of semi-structured interviews with key project stakeholders, to assimilate an understanding of the reasons why no significant synergies had been implemented at the end of the project.

Analysis of the responses from the interviewees showed that:

- there were no large untapped synergies at this time but several smaller synergies had been identified;
- For the smaller synergies, there were not enough associated financial benefits to the companies involved, or external drivers, to justify project implementation;
- The range of synergies available was limited to small opportunities because this project was not seen as an appropriate vehicle for addressing the large opportunities (which by their nature were complex due to the particular characteristics of the Gladstone region relative to Kwinana - operations are physically distant from one another and the diversity of industries is low);
- The perceived responsibility for synergy implementation lies with individual companies which means that implementation is not readily achievable through facilitation by an external group. The use of ‘third-party’ contractors or small companies was raised as a means to implement a synergy which was not core business for a company.
- The technology exists to implement the identified synergies yet this did not happen due to the many non-technical factors influencing regional synergy uptake.
- The project did deliver many useful outcomes to interviewees including collating and sharing data, enhancing the communication network between companies, comparing Gladstone practice with other regions and providing insight to the early stages of synergy development.

At the end of the project, interviewees thought that there were several non-technical synergy opportunities (such as regulatory and financial issues, closure planning, or staff retention), demonstrating a broadening in their thinking about synergies during the project.

4.2  Introduction

One of the tasks in the third year of the Gladstone Regional Synergies Project was to better understand the drivers and barriers for regional synergies. Although the synergies that had been identified through the project were technically feasible and
environmentally beneficial, no operating synergies were delivered by this project, demonstrating the limited uptake by industry.

To undertake this analysis Dr. Janine Lay at Central Queensland University’s Process Engineering & Light Metals (PELM) Centre was commissioned by Gladstone Regional Synergies Project Manager to undertake a series of semi-structured interviews, with project stakeholders and analyse the responses to answer the research question: ‘Why weren’t more regional synergies implemented in Gladstone?’

This section presents the key parts of the final report prepared by Janine Lay in conducting this study.

4.3 Stakeholder Interviewees
A list of key stakeholders was chosen from several groups:

- The GAIN Executive (those who were still in Gladstone and had played a key role in the project);
- The GAIN Environment Committee (the industry contacts for the project, who were still in Gladstone and associated with the project);
- Government contacts (the CEO of the Gladstone Economic and Industry Development Board, present and previous incumbents);
- A large company ‘across-Gladstone’ representative;
- Some key previous project participants who had left Gladstone.

4.4 Responses from Interviews
In general, interviewees agreed that the right synergy opportunities had been identified at the end of the first year of the project, through the research and workshopping processes. The short term opportunities were identified as technically possible by all participants. The longer term opportunities, in particular those relating to red mud utilisation, were viewed as inherently difficult and not achievable within this project’s budget or time frame. Interviewees commented that these longer term opportunities were:

‘never going to be solved in this project’;
‘not the dollars in this project to pursue’;
‘would never have happened in a project like this - low funding, collaborative’

By default, the project had to focus on the short term opportunities, which were by their nature relatively small.

4.4.1 Lack of Synergy Uptake
Interviewees gave several explanations for why these smaller synergy opportunities were not taken up. These can be grouped into ‘Lack of Drivers’ and ‘Internal Company Impediments’, as shown in Table 1.
Table 1  List of explanations offered by interviewees for the short term synergy opportunities not being taken up.

<table>
<thead>
<tr>
<th>Lack of Drivers</th>
<th>Internal Company Impediments</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No dollars involved, or not enough dollars to justify the effort</td>
<td>• Companies didn’t sufficiently resource their contribution to this project. This meant that people who were nominated to be involved were usually tied up solving their day to day issues.</td>
</tr>
<tr>
<td>• No drought right now [for water re-use synergies]</td>
<td>• Lack of corporate support.</td>
</tr>
<tr>
<td>• No legislative changes</td>
<td>• Lack of support from site GMs (not on their list of key priorities).</td>
</tr>
<tr>
<td>• Landfill is still cheap</td>
<td>• Disconnect between Corporate and site.</td>
</tr>
<tr>
<td>• The critical mass and industrial diversity of Gladstone industry is low</td>
<td>• Disconnect between sites.</td>
</tr>
<tr>
<td>compared with other areas where regional synergies are working (such as Kwinana)</td>
<td>• Decision making within the company was complex.</td>
</tr>
<tr>
<td>• ‘Things are working as they are’</td>
<td>• Turnover of senior management meant an increase in short term, in-company focus compared with longer term, inter-company, focus.</td>
</tr>
<tr>
<td>• The ‘do-able’ synergies are not a big enough problem to do anything about</td>
<td></td>
</tr>
</tbody>
</table>

One person said that the smaller synergies identified weren’t taken up because of ‘the sum of many small things’; that is, not because of one big reason, but because of many small issues, which individually may have been overcome given other positive drivers. Yet the presence of all of these ‘small things’ without positive drivers was enough to stall progress.

Another interviewee gave a very succinct and catchy reason why these smaller synergies weren’t taken up:

‘not much carrot and no stick!’

4.4.2 Characteristics of Viable Regional Synergies

For a regional synergy to be implemented in Gladstone, interviewees said that it would need to:

• Deliver real dollar value to the company in some way, such as through cost savings or increased revenue;
• Preserve the licence to operate e.g. by responding to changes in legislation;
• Be aligned with company priorities (preferably high priorities);
• Provide competitive or strategic advantage in some way;
• Meet a company need (e.g. fulfilling obligations or commitments to external bodies).
Some agreed that non-monetary benefits, such as reducing landfill or other environmental or community benefits, would be considered but that these benefits would have to be significant for the project to proceed.

Most interviewees thought that it was up to each individual company to decide whether to pursue regional synergy opportunities and then to implement these if there was a financial case. Several mentioned that the way of bringing these synergies to life may be through a third party for whose core business focussed around waste management or re-uses.

Only a small number of interviewees said that they thought that GAIN should be leading regional synergies. The interviewees cited benefits such as enhanced corporate reputation and a competitive benefit for the region. Many interviewees stated that GAIN was not set up to drive regional synergies. GAIN was described as more a mechanism for sharing information, not for driving projects, although some suggested that GAIN would be better equipped to drive initiatives if they had a secretariat or in future years the Gladstone Engineering Alliance (smaller) companies are able to join GAIN.

4.4.3 Project Performance and Benefits

In discussing project performance, some interviewees recognised the inherent difficulty of the task and gave credit that the right things were done in the right way. The fact that there were no operating synergies at the end of the project was because they weren’t possible (for various reasons including financial value of synergies and difficulty of companies working together). For example, the project ‘did as much as it could given lack of industry buy in and the kind of synergies available’.

Other interviewees said that because the project delivered no operating synergies that it had failed their expectations, for example:

‘Wasn’t very successful- no synergies enacted as a result of it’.

The numerical ratings requested (from 1-5) reflect this split also. Those who thought the project was a failure because it had not delivered operating synergies scored it between 1 and 3. Those who thought that there just weren’t the synergies to implement evaluated it between 4 and 5, which is significant and demonstrates the importance of expectations on perception of project success.

Figure 1 is a chart of the scores that interviewees gave to the project performance (numbers at base of bars) and the number of people giving each score (vertical axis). Those who said that the project was not very successful at all or only somewhat successful, because it did not deliver any active synergies, scored the project either 1 or 3. Those who said that the project did nearly all that it could have, scored it either 4, 4.5 or 5. (There were three people who declined to score the project performance because they had not been involved with it sufficiently overall).
Figure 1  Scores given to project performance by interviewees and the number of people giving that score.

(Note 1 = not successful at all; 2 = only somewhat successful; 3 = moderately successful; 4 = successful; 5 = very successful)

Interviewees listed several perceived project benefits. These seemed to fall into distinct groupings, as shown in Table 2. How each participant valued each of these aspects of the ‘benefits’ seems to dictate how they valued the project outcomes overall.
Table 2  Perceived Project Benefits and their value to stakeholders

<table>
<thead>
<tr>
<th>Perceived Project Benefit to Stakeholder</th>
<th>Role of Benefit to Stakeholder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validation of previous work</td>
<td>Reassurance</td>
</tr>
<tr>
<td>Confirmed that there really is no ‘low-hanging fruit’ right now;</td>
<td></td>
</tr>
<tr>
<td>Developed a rigorous methodology</td>
<td>Preparing (laid the ground work for starting up synergies)</td>
</tr>
<tr>
<td>Considered global inputs and comparisons</td>
<td></td>
</tr>
<tr>
<td>Identified the need for a collaborative solution</td>
<td></td>
</tr>
<tr>
<td>Put this kind of material into the public domain</td>
<td></td>
</tr>
<tr>
<td>Collated company data and made it available to all</td>
<td></td>
</tr>
<tr>
<td>Updated data and provided more accurate data</td>
<td></td>
</tr>
<tr>
<td>Provided insight to the early stages of synergy development</td>
<td></td>
</tr>
<tr>
<td>Pinpointed the difficulties and roadblocks to getting synergies up</td>
<td></td>
</tr>
<tr>
<td>Provided a full time learned person available to do this kind of thinking (not usually possible in industry)</td>
<td></td>
</tr>
<tr>
<td>Enhanced Gladstone companies’ communication-through enhancing regularity of GAIN Environment Committee meetings</td>
<td>Enriching (assisted with current activities)</td>
</tr>
<tr>
<td>Provided a forum for industry people to discuss any environmental issues; enhanced the environment people’s networks</td>
<td></td>
</tr>
<tr>
<td>Raised awareness of synergies with industry reps;</td>
<td></td>
</tr>
<tr>
<td>Provided an opportunity for companies to demonstrate that they are good corporate citizens</td>
<td></td>
</tr>
<tr>
<td>Enhanced GEIDB and Gladstone’s reputations</td>
<td></td>
</tr>
<tr>
<td>Helped to keep the long term waste problems on the agenda (red mud and ash)</td>
<td></td>
</tr>
<tr>
<td>Provided focus to the GAIN Environment Committee</td>
<td></td>
</tr>
</tbody>
</table>

This listing of perceived benefits concurs with some interviewees’ project expectations:
A thorough job would be done, and that synergies would flow if it was possible (that is, opportunities actually existed and the necessary support was given)

The novelty of this kind of project may make it difficult to succeed

The project may not be ‘do-able’, that is not sure that such synergy opportunities actually exist.

The list differs from others’ expectations of the project, which were that:

- The project would work out how to do synergies
- The project would take ideas (opportunities) and turn them into reality (operating synergies)
- These synergies would be earning money (and perhaps topped up by Government money).

Interestingly, while all of those interviewed said that they were aware of the funding level by industry for the project, most said that they were not aware of how much the CSRP was contributing. When told of the value of the CSRP contribution, most conceded that they had received more than their money’s worth from the project. These responses demonstrated an ignorance of the ‘unseen’ contributions to the project by the CRC which resulted in the support being largely taken for granted and undervalued.

### 4.4.4 Suggestions from stakeholders for other possible synergy initiatives

Almost all interviewees replied that they thought that the right initiatives had been identified at the end of the first year of the project. When asked at the end of the project to suggest other synergies that the project could have looked at, interviewees gave a comprehensive list of (mostly) non-technical influences on regional synergies. None of those had formed part of the initial project scope:

- Physical distance between sites
- Regulatory issues
- Financial issues
- Tax
- Closure planning
- Logistics in the region
- Commercial negotiating
- Staff retention
- Liveability.

When pressed for other possible technical synergies, the suggestions seemed to be quite general and longer term:

- A solid waste energy plant
- A networked water balance for the industries
- Investigating smelter wastes
• Using waste energy from the power station;
• Reduction of greenhouse gases.

All of these had been discussed with stakeholders during the course of the project and for various reasons, such as not enough benefit in them for individual companies and not their core business, were not taken up.

4.5 Analysis of responses

The kinds of synergies currently available in Gladstone did not have sufficient financial value for the large companies who participated in this study to consider implementing them. Some interviewees expressed this as:

‘(the project) did as much as it could given lack of industry buy-in and the kind of synergies available’

‘As successful as it could ever have been, probably more so due to the project leader’s hard work and commitment to being present in Gladstone.’

‘CRC involvement was important to us. They had been involved in Kwinana and could apply the learnings from there to Gladstone. We wouldn't have done this project with just a consultant. The project leader’s commitment to the project was honourable- regular feedback to GAIN and meetings, but he couldn't create opportunities.’

This lack of suitable synergies is one answer to the research question. However, this can give a one dimensional picture of a complex set of conditions, which may nurture or prevent active regional synergies, and can change substantially both suddenly and in the longer term. Interviewees said that the following are the major influences on whether or not to uptake regional synergies:

Absence of clear and focused drivers: as long as there is no over-riding need to change the way that companies are operating their sites, it will be difficult to justify funding a synergy project.

Senior Staff Turnover: When identifying stakeholders for interviewing, it became obvious that there had been huge turnover in the project during its three years of operation. Of the GAIN Executive, only two (out of nine) members present at the start were there at the end. In the GAIN Environment group, all representatives had changed during the project except for one. One of the remaining stakeholders commented that:

‘Senior turnover in Gladstone has really complicated cross-company collaboration. It was much easier to discuss and address issues back in the nineties with the long-termers; they were more open to inter-company relations. Now, with turnover, they are more focused on the goals of the role-inter-company work is not one of their priorities. It’s much harder now.’

Industry Buy-in: By these words, interviewees meant how much industry commits funds and staff to regional synergies. The higher the priority, the more commitment and the higher the probability of a synergy project being taken up and implemented. There was a low level of industry buy-in in this project, probably because of the perception that there weren’t any large financial gains available, with the consequence that the project had even less chance of mobilising any regional synergies.
Commercial Realities: once technical and financial feasibility have been dealt with, the next hurdle is to negotiate a commercial contract between the parties. Interviewees said this can be extremely time consuming and can result in impasses. Sometimes, economic parameters and external drivers change which enable an agreement to be made. Spent Cell Linings from the Aluminium Smelter to the Cement kiln is an example of a synergy now in operation which took several years to activate.

Third Parties (small companies) as vehicles for synergy uptake: Interviewees commented that while there wasn’t enough financial benefit in the short term synergy opportunities, it may be possible to get a third party such as a waste contractor interested. What is a small, marginal business for the large companies is a core business for them. There are some examples of individual companies having approached some of their internal projects in this way. Third parties could ‘enable’ synergies by servicing several larger companies. This could be seen as ‘outsourced collaboration’ within the region.

Importance of non technical issues: The discussion of reasons why synergies have not been taken up in Gladstone focused around non-technical factors. All of the synergies identified at the end of the first 12 – 18 months were technically feasible. This means with some fine tuning they could have been achievable (e.g. optimising filter bag shredding or baling for feeding into the kiln and ensuring that chemical composition was kept to within specification limits for the kiln.) As one interviewee put it:

‘While this started out as a technology project, after 18 months or so, it became evident that it was about all the other issues- relationships, trust, legal liability, incentive, and just doing what was required from industry's side….which may have required another kind of project entirely.’

Knowledge Capture and Transmission: some interviewees mentioned the importance of capturing the outcomes of this project in a form that could be taken up again by industry participants in the next few years when they re-examine regional synergies.

The number and nature of these issues indicates that synergies are multi-variable and are inherently complex. While the synergies identified in this project are not regarded as financially attractive now, variables may well change so that next year what was once marginal may become viable. Spent cell linings is an example of this - it could be said that this particular synergy was waiting for fuel costs to rise sufficiently and spent cell linings to accumulate to such an extent that, overall, the synergy became feasible.

Also important is how community opinion can change over time and become a key parameter in the viability equation. This is relevant to Gladstone right now, given recent concerns about ambient dust levels and the impact of industry emissions on local residents’ health. Companies may soon find that they can differentiate themselves in the market place by demonstrating their commitment to Sustainability by actually implementing and publicising some near neutral NPV regional synergy opportunities that impact positively on the local community.

In discussing the overall worth of the project, it is useful to consider interviewees’ degrees of satisfaction with the project. They tended to rate the project highly if they got what they expected from it, and they rated it lowly if they didn’t get what they
expected. In conversation with the interviewees, it was apparent that all would agree that the outcomes and benefits listed were actually delivered, yet they rated the project differently. It seems that people expected different things from the project. One group expected the CRC to deliver operating synergies and the other group expected that the CRC would investigate the possibilities and assist with their implementation.

In looking at the cause of these different expectations, it is useful to examine the Project Agreement (initial agreement (12th March 2004) and the Amendment to the Project Agreement (2nd October, 2006)). Selected relevant excerpts are given below, referring to the commitments made by the CRC to outcomes, (key words have been italicised):

The Project Plan gives the project objectives as:

‘to enhance local synergies between industrial operations’ and
‘to assist these operations to achieve greater efficiencies in energy, water and materials consumption and reductions in waste and emission generation’
‘to facilitate the identification, development and implementation of specific projects to improve industrial synergies in the region’

The Performance Indicators listed include:

‘The project identifies substantial and achievable synergy opportunities in the Gladstone region and contributes to their implementation’

Among the Project Outputs listed are:

‘Ongoing research and project support to individual operations to facilitate improved synergies in specific identified areas’

In the Performance Indicators, the agreement said that the project would ‘identify substantial and achievable synergy opportunities’ and then contribute to their implementation. The project did identify several substantial synergy opportunities and several minor ones- these were agreed on at a workshop involving industry participants. The agreement did not state that the CSRP would undertake sole accountability for delivering operating synergies but that the project would enhance, assist, facilitate, contribute and support this process. The documented expectation was that the CSRP and industry would collaborate to make synergies happen. The only possible point for discussion then, and perhaps differing expectations, is to what extent each of the parties would contribute.

A learning point from this project, therefore, is that defining the boundaries of project obligations is important. Perhaps each party’s obligations to the project could have been discussed in detail, maybe even workshopped and agreement reached.

It is also interesting to note the change of viewpoint by participants at the end of the project compared to at its beginning. The project was scoped with a focus on the technology required to implement synergies. Yet, in these interviews, people identified mainly non-technical aspects of regional synergies that could be investigated. Arguably, their involvement in this project has broadened their thinking about regional synergies and this could also be listed as a project benefit in the ‘Preparing’ category.
4.6 Conclusions

- From the perspective of the interviewees, the project confirmed that no synergies with potentially large financial value to participating companies exist at this time in Gladstone.

- More regional synergies in Gladstone were not taken up because there were not enough financial benefit or external drivers to justify project implementation.

- The range of synergies available was limited to small opportunities because this project was not seen as an appropriate vehicle for addressing the large opportunities. These, by their nature, were complex due to the particular characteristics of the Gladstone region - operations are physically distant from one another and the diversity of industries is low).

- Factors influencing regional synergies and their uptake are complex: sorting out any technical issues is only the first step in implementation. It is the non-technical issues which are impacting uptake of the synergies identified.

- Implementing regional synergies cannot be achieved through facilitation by an external group, as perceived responsibility for implementation lies with each company at this time.

- The project achieved several important outcomes for industry and for the Australian public in enhancing the understanding of the factors affecting regional synergies. Putting this information into the public domain, will enable smaller companies and individual contractors to also benefit from it.

- At the end of the project interviewees thought that there were several non-technical synergy opportunities, demonstrating a broadening in their thinking about synergies during the project.

- Further defining the boundaries of obligations is important and may have led to increased alignment of project expectations.
5 COMPARISON WITH KWINANA

5.1 Introduction

The Kwinana Industrial Area is another heavy industrial region where regional synergy initiatives have been realised to a greater extent than compared with Gladstone. The question that arose during the course of this project is: ‘Why is there greater synergy activity in Kwinana compared with Gladstone and what are the key differences between the two regions?’ To answer this question a comparison was conducted on the two regions and their respective regional synergy initiatives.

During the course of the Gladstone Regional Synergies Project, a similar project was being run through CSRP in the Kwinana Industrial Area. It was the information collated in this project that provided the basis for comparison of the two regions. The Kwinana project, which commenced at a similar time to the Gladstone project and will continue until June 2008, had similar objectives, namely, to identify and facilitate the implementation of regional synergy opportunities. A recent status report on this project (van Beers 2007) is available from www.csrp.com.au/_media/pdf/3B12007StatusReportJuly-07.pdf.

The text presented in this section draws on the earlier work presented in Corder et al. (2006).

5.2 Kwinana Industrial Area

The Kwinana Industrial Area (KIA) is located 40 kilometres south of the capital city of Perth on the shores of the Cockburn Sound. It was established in the 1950s through a special Act of Parliament to secure an area of about 120 square km for the development of major resource processing industries in Western Australia. Like Gladstone, it has a deep-water port and this makes it well placed for export markets in Asia. The KIA generates a total economic output that exceeds A$4.3 billion annually (SKM 2002).

Heavy process industries dominate the Kwinana Industrial Area and include (SKM 2002):

- 2 Mtpa Alcoa alumina refinery,
- 70 kt/yr Kwinana Nickel Refinery,
- 105 kt/yr Tiwest titanium dioxide pigment plant,
- 850 kt/yr Cockburn Cement lime and cement kilns,
- 135,000 barrels/day BP oil refinery,
- 800 kt/yr HIs melt pig iron plant.

A variety of chemical producers complements these resource processing companies, including: CSBP’s ammonia, ammonia nitrate, cyanide, chlor-alkali and fertiliser plants, Coogee Chemicals (inorganic chemicals), Nufarm (herbicides and other agricultural chemicals), Nufarm Coogee (chlor-alkali plant), Bayer (agricultural chemicals), Chemeq (veterinary products), Ciba and Nalco (water treatment and process chemicals). In addition there are several utility providers: two power stations (900 MW coal, oil and gas fired, and 240 MW combined cycle gas) both owned and operated by Verve Energy, two cogeneration plants (respectively 116 MW (Kwinana
Cogeneration Plant) and 40 MW (Verve Energy)), two air separation plants (Air Liquide and BOC Gases), a grain handling and export terminal (CBH), Port facilities (Fremantle Port Authority), water and wastewater treatment plants (Water Corporation). Figure 2 gives the location of these industries in the Kwinana Industrial Area. For comparison the location of the Gladstone industries is given in Figure 3.

Figure 2 Location of Companies in Kwinana Industrial Area (the grey coloured area represents the Kwinana Industrial Area) – source (Corder et al. 2006).
The Kwinana Industries Council (KIC) was established in 1991 at the instigation of the core industries, with the aim of collectively organising the necessary air and water monitoring for the industries in the area. This was in response to government and community pressure to manage the air and watersheds, and protect the sensitive marine environment in the adjacent Cockburn Sound. The aims of the KIC now extend to co-ordinating activities of the industries across a range of common issues, as well as fostering positive interactions between member companies, government, and the broader community.

It is important to note that the KIC is an incorporated business association with membership drawn from the Kwinana Industrial Area and an annual income of around $1 million, largely sourced from members’ fees (KIC 2006). Current membership is 12 full members, who include all the major industries, and 28 associate members covering the support and service sectors and it these members fees. KIC has an Executive that manages the day-to-day running of KIC activities as well developing, in junction, with industry longer term initiatives (KIC 2005).

5.3 Comparison of Regions

5.3.1 Location of industries

Compared with Kwinana, industry development in the Gladstone region is more spread out (compare Figure 2 with Figure 3). The closest two major industries, the Rio Tinto Aluminium Yarwun Refinery and Orica, are over one kilometre apart while the furthest distance between the major industries, Boyne Aluminium Smelters to Cement Australia, is approximately 40 kilometres.
From a practical point-of-view, significant distances between operations can pose a challenge to the development of regional synergies. In terms of capital and operational costs, a waste heat or steam utility synergy is less likely to be economically feasible if the two involved sites are not closely located to one another. From an administrative perspective, the transfer of a by-product from one site to another over more than one local government authority area may require multiple licences or permits from different levels of government. Although, in general, more densely concentrated industrial areas are more suitable for the development of regional synergies, the determining factors regarding distance are dependent on the nature of the synergy and the by-product’s value. For example, it is difficult to justify process heat recovery and re-use beyond about a kilometre while other synergies (such as fly ash re-use as a cement additive) are feasible over longer distances. This is because the by-product has a significant value and the costs associated with loading and unloading the by-product outweigh the actual transportation costs. While distance is a critical issue, the successful synergies in Gladstone show that longer distances do not necessarily preclude synergistic transfers.

5.3.2 Types of industries
Both regions generate significant and comparable export earnings for Australia. There is a diverse range of industries in the Kwinana region (e.g. various refineries, chemical plants, manufacturing operations, power and water utility operations). By contrast, the Gladstone region is dominated by the alumina/aluminium industry, although other major industries (such as Cement Australia and the Orica Chemicals plant) are significant in their own right. Products from both regions are produced primarily for international markets with limited local competition between the companies operating in the area.

5.3.3 Environment
Environmentally, Gladstone and Kwinana are similar. Both regions are located on the edge of marine sensitive environments and have access to deep water channels. In addition, Port Curtis in Gladstone and Cockburn Sound in Kwinana are major recreational areas. There are also large areas of land used for the disposal of inorganic by-products, such as bauxite residue (red mud) and fly ash. Air emissions are monitored closely given the intensity of industrial activity in both regions.

5.3.4 Community
The two regions differ greatly in community related issues. The Gladstone region not only has a much lower population than the Kwinana region but it is also located over 500 kilometres from the nearest major metropolitan centres (Brisbane and south-east Queensland). In contrast, Kwinana is situated only 40 kilometres from Perth, and the Kwinana community is situated considerably closer to industry and its by-product stockpile areas (e.g. bauxite residue area). The close proximity of Kwinana industries to urban areas and the ongoing urban encroachment as a result of the development of the southern corridor from Perth to Mandurah, can be and has been, in some cases, a significant catalyst for community issues and concerns. On the other hand, in Gladstone there is a large buffer between residential and industry land, with the exceptions of QAL and, to a degree, the power station.

5.3.5 Industry Organisations
Differences between the industry organisations in both regions could be one of the key reasons why important regional projects proceed in Kwinana compared with
Gladstone. By having a funded secretariat as KIC does, regional and community focussed projects, which one company alone would not pursue, can be much more easily progressed than through essentially voluntary committees made of busy company representatives, such as GAIN. It is too much to expect company representatives to drive projects with good regional benefits, yet marginal benefits to their company, in addition to their other work activities. As a result, projects that in general are considered worthwhile from a regional perspective, do not progress beyond the concept stage.

5.3.6 Summary Table
Table 3 presents a summary of the comparative review of Gladstone and Kwinana.

Table 3 Comparative Review of Gladstone and Kwinana

<table>
<thead>
<tr>
<th></th>
<th>GLADSTONE</th>
<th>KWINANA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of major industries*</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Key sectors</td>
<td>Alumina and aluminium, cement, chemicals, power generation, oil shale, major port and water supply and treatment</td>
<td>Alumina, nickel, iron and oil refineries, pigment, cement, chemicals, fertilisers, power generation, water supply and treatment</td>
</tr>
<tr>
<td>Location</td>
<td>~ 550 km north of Brisbane</td>
<td>~ 40 km south of Perth</td>
</tr>
<tr>
<td>Area</td>
<td>Regional centre with radius of ~ 20 km</td>
<td>Coastal strip of ~ 8 by 2 km</td>
</tr>
<tr>
<td>Industry organisation</td>
<td>Gladstone Area Industry Network, 10 members</td>
<td>Kwinana Industries Council (KIC), established in 1991, currently 37 paying members</td>
</tr>
<tr>
<td><strong>CURRENT SYNERGIES:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total regional synergies</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>Existing by-product synergies</td>
<td>4</td>
<td>32</td>
</tr>
<tr>
<td>Existing utility synergies</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Number of local companies involved in synergies (located in industrial region)</td>
<td>6</td>
<td>22</td>
</tr>
<tr>
<td>Number of ‘external’ companies involved in synergies (located outside industrial region)</td>
<td>1</td>
<td>13</td>
</tr>
</tbody>
</table>

5.4 Comparison of Similar Regional Synergies
In this section a comparison is made between similar regional synergies in the Gladstone and Kwinana regions to determine the main drivers for these synergies. The objective of this section is to identify the key differences and similarities between similar regional synergies in the Gladstone and Kwinana regions.
5.4.1 Water Synergies

5.4.1.1 Queensland Alumina Ltd Effluent Re-use - Gladstone

The QAL effluent re-use synergy had been documented in the earlier project report (Corder 2005a). A brief description of this synergy is presented here.

In 2002, Gladstone suffered one of the worst droughts ever experienced in the region. The seriousness of the water shortage resulted in the Gladstone Area Water Board initially imposing 10% water restrictions, in April 2002, which were then increased to 25% water restrictions in October 2002. As a large consumer of water (approximately 38 ML per day in 2001), Queensland Alumina Ltd was faced with a significant loss of revenue if forced to operate with 25% less water than usual. As a consequence, Queensland Alumina Ltd decided to fund a project to build an 8.5 km pipeline so that secondary treated effluent from the Calliope River Sewage Treatment Plant could be used at Queensland Alumina Ltd as process water in the final mud washing process. Extensive investigation concluded that there would be no process impacts from using the treated effluent (Stegink, Lane, Barker and Pei 2003).

The available water from the secondary treated effluent of 6.5 ML/day (some of the effluent was already being used by the Gladstone Power Station for ash conditioning) matched the decrease in available water when 25% water restrictions were introduced. An additional benefit was the reduction in raw water usage from Awoonga Dam of 6.5 ML/day. Not only was QAL receiving effluent water that was suitable for use in the plant, but the secondary treated effluent was no longer being discharged into the Calliope River. As a result, there will be no need to construct tertiary treatment facilities avoiding major costs for the Gladstone City Council and ratepayers (Australian Aluminium Council 2005).

5.4.1.2 Kwinana Water Reclamation Plant – Kwinana

The Kwinana Water Reclamation Plant (KWRP) is a joint initiative of the Water Corporation and the Kwinana industries to achieve the double benefit of greater overall water efficiency and redirection of process water discharges out of the Cockburn Sound. A micro filtration/reverse osmosis unit has been built (at a cost of approximately A$30 million), which takes secondary treated effluent from the nearby Woodman Point wastewater treatment facility to produce a low TDS (Total Dissolved Solids) water supply, which is used (or will be in the near future) by CSBP, Tiwest, Kwinana Cogeneration Plant, BP and HIs melt to replace ‘scheme water’ (from the public water supply authority)

One of the principal benefits of this project is that some of the scheme water previously used by industry is now available to other users, with the additional capacity of 6 GL/year amounting to about 2-3% of the total scheme water use in the drought-affected Perth metropolitan area. In addition, the low TDS will enable the process plants to reduce the use of chemical in cooling towers and other process applications, thereby reducing metal loads in their effluents. In exchange for taking water from the KWRP, most industries are able to discharge their treated process effluents into the deep ocean outfall through the Water Corporation pipeline, thereby redirecting their current discharges of treated process water from the sensitive Cockburn Sound into the deep ocean (Water Corporation 2003).
5.4.1.3 Comparison of Water Synergies

The common element and benefit that both these utility synergies deliver is increased water source security. Although these utility synergies are significantly different (in Gladstone the synergy uses chlorinated treated effluent in a less critical process application while in Kwinana the synergy produces high quality water for critical process applications), the basic principle for implementing these synergies is one of securing an alternative water source and reutilising a water stream that would otherwise be discharged into the environment.

The circumstances for developing both synergies were again different. In Gladstone there was a water crisis threatening to worsen while in Kwinana investment in the water reclamation plant (KWRP) was triggered by HIsmelt, which required large quantities of water that could not be obtained from scheme or ground water sources. In both cases, however, there was an appreciation that the responsible approach was to implement water efficiency measures to reduce consumption of potable water resources.

The real threat of a restricted water supply emphasised the critical importance of this utility, which had traditionally been available at low cost for plant production. Even though significant reductions in water supply might be unlikely, the consequence of such reductions is immense, namely greatly reduced production or even plant shutdowns. Therefore, the major benefit of these water utility synergies and the basis of their attractiveness to industry, is that water re-use can significantly reduce the industry vulnerability with regard to water shortages and droughts.

5.4.2 Energy Synergies

5.4.2.1 Alternative Fuels at Cement Australia

The alternative fuels and raw materials program at Cement Australia in Gladstone has been documented in the earlier project report (Corder 2005a). A brief description of this synergy is presented here.

Cement Australia has an internal and voluntary policy to use non-traditional, alternative, raw materials and fuels for clinker production. The policy aims to provide environmental, economic and social benefits by reducing greenhouse gas emissions and using wastes and by-products as a fuel source which not only reduces costs but replaces coal which would otherwise fuel the kiln. Cement kilns can be used to destroy wastes and by-products while extracting the calorific heating value due to the high temperatures (1500 to 1800 degrees Celsius) and the relatively long residence times (> 4 to 6 seconds).

Alternative fuels that have been used or trialled at the Cement Australia plant in Gladstone include: domestic tyres (which have typically been disposed to landfill), solvent-based fuels (prepared from hazardous and combustible wastes) and spent cell linings (a waste generated by Boyne Aluminium Smelters in the reduction of alumina to aluminium that has calorific value and materials that benefit cement production).

5.4.2.2 Tiwest Co-generation Facility

Built in 1999, a cogeneration facility (40 MW), owned by Verve Energy, provides superheated steam and electricity for the process needs of the Tiwest pigment plant. Tiwest can now operate in island mode, independently from the state grid. For the majority of the time, however, the cogeneration plant feeds the grid with Tiwest drawing power from the grid. The cogeneration plant sources its demineralised water...
and compressed air from the pigment plant, and the facility discharges its wastewater into the Tiwest wastewater treatment plant.

5.4.2.3 Comparison of Energy Synergies

The energy synergies discussed above are mainly driven by three factors: reduction in energy operating costs, enhanced energy security and efficiency, and environmental benefits.

In Gladstone the alternative fuel program with the cement kiln provides a better environmental solution than disposing wastes to landfill. In addition, energy costs are reduced by using wastes as alternative fuel compared with using the traditional fuel source, coal. In Kwinana, the ability for Tiwest to be self-sufficient in terms of electricity and superheated steam provides energy security while the increased efficiency of the co-generation facility results in reduced greenhouse gas emissions.

The obstacle for re-using waste as an energy source or improving energy efficiency is typically the associated equipment capital costs. Even in Gladstone, there are significant capital costs to install dedicated equipment for transporting and injecting the alternative fuels in the cement kiln. Low cost energy sources may result in unattractive investment returns, meaning that it might essentially be more cost-effective to use energy in inefficient processes rather than installing more advanced energy efficient equipment. With the possibility of a future carbon tax or carbon trading scheme, there could be strategic advantages in implementing energy efficiency measures.

5.4.3 Inorganic By-Products Synergies

5.4.3.1 Gladstone Power Station Fly Ash Re-use

The fly ash re-use synergy at the Gladstone Power Station had been documented in the earlier project report (Corder 2005a). A brief description of this synergy is presented here.

Pozzolanic Enterprises, a subsidiary of Cement Australia, collects fly ash from the Gladstone Power Station for use as cement additive in Cement Australia operations. Fly ash has chemical and physical properties, in particular its sphericity and fine size that are beneficial in both the plastic and hardened states of concrete. Pozzolanic Enterprises selects fly ash that meets the required specifications and the remaining fly ash is discharged to local storage bunds. The collection of fly ash from power stations for use as a cement additive is not only common practice but a by-product synergy where both parties benefit. The power stations dispose of less fly ash to local bunds and the cement operations have an improved product, as well as using less limestone, a non-renewal resource.

5.4.3.2 CSBP Stockpiled Gypsum Re-use

CSBP previously produced gypsum (calcium sulfate) as a by-product of the manufacture of phosphoric acid. This material was stockpiled at one of the CSBP’s sites during the 1980s. Even though this practice has ended, there remains a stockpile of at least one million tonnes of gypsum. CSBP has extensively reviewed reuse options for this material including the use in plasterboard, sale to farmers, and use in soil amendment. Interactions between CSBP and Alcoa staff at KIC meetings identified the potential for the by-product gypsum to replace virgin gypsum for assisting plant growth in the bauxite residue area. Alcoa now takes approximately 10,000 tonnes of this material each year.
5.4.3.3 Comparison of Inorganic By-Product Synergies

The driver for implementing these two inorganic by-product synergies is that the reuse reduces the costs of storing and managing large inorganic by-products and the long-term liabilities these pose. The difference between these synergies is that it is necessary to use a processing plant to separate the fly ash that will be suitable as a cement additive, while no re-processing of the CSBP gypsum is necessary to enable it to assist plant growth in the Alcoa bauxite residue area.

This illustrates that by-products ‘as generated’ can be used for less critical applications, but some re-processing is usually required for more critical applications. The more a by-product needs re-processing, the greater the cost and therefore the less attractive it becomes compared with the raw material it is replacing. If the by-product improves the quality of the final product, as fly ash does for concrete, this can warrant the additional costs for re-processing.

5.5 Summary

This section has presented the main differences and similarities between two of Australia’s major industrial regions. While there are some common elements between the two regions, there are sufficient variations that help explain the ‘order of magnitude’ differences in the number of regional synergies between Gladstone and Kwinana.

The main different features of Kwinana are that:

- It has a greater diversity of industries, a larger number of operations and a greater range of industry size.
- It is located close to a major city
- Most of industrial operations are in close proximity, roughly over an area of about 16 km²
- It has some of its main by-products stored close to the local community/urban area, such as Alcoa’s bauxite residue area, which can lead to greater community pressure for industry to investigative innovative re-use approaches to reduce by-product footprint.
- It has an incorporated funded organisation which was instigated by the core industries in 1991 to co-ordinate activities of the industries across a range of common issues, such as air and water monitoring
- The examples of the similar synergies illustrated the different drivers between the two regions:
  - The water synergies were brought on by water scarcity concerns; the Gladstone example was reacting to water scarcity in the immediate future whereas the Kwinana example was in response to the longer-term security of water
  - The energy synergies had different drivers; the Gladstone example was aimed at fuel replacement whereas the Kwinana example was focussed on energy efficiency
  - The in-organic by-product synergies aimed at reducing the managing of large inorganic by-product stockpiles and their associated long-term...
liabilities; the difference between these synergies is that it is necessary to use a processing plant in the Gladstone example, while no re-processing is required for the Kwinana example.
6 SYNERGY UPTAKE ASSESSMENT

6.1 Introduction

The analysis of the factors influencing synergy uptake, presented in Section 4, and the conclusions from the comparison of Gladstone with Kwinana, presented in Section 5, illustrated that there is a range of issues that will affect the uptake of synergies in an industrial region. These findings contribute to the better understanding of the key drivers, barriers and enablers for regional synergy uptake across the region which has emerged through this project. As a result this has satisfied one of the three main research objectives of this project:

"to contribute to greater understanding and acceptance of industrial ecology principles in the region."\(^1\)

To extend further this understanding from the associated learnings and findings of the project, a systematic approach for synergy uptake was developed and is proposed here. This aim of this approach is to assess if a particular synergy opportunity has the likely characteristics for success. By employing such an approach it will be possible to build on the foundations of synergy awareness established during the course of the project.

6.2 Characteristics for Synergy Development

For a synergy to be realised, all involved parties must benefit in one way or another. In fact, it is unlikely that a synergy would be implemented unless all involved parties at least perceive some business benefit (direct or indirect). For all synergy examples presented in Section 5.4 there are both tangible operating benefits as well as less tangible benefits, such as reputation, environment or community. The realisation of successful synergies is dependent on three main aspects: proven technology, convincing business case, and licence to operate (van Berkel 2006). Discussion on the success factors for regional synergies was given in some detail in Corder et al. (2006) and briefly summarised here:

- Proven and viable process technology and equipment is essential to develop a regional synergy.
- There must be a viable business case, that is that the financial and other business benefits outweigh the project costs and risks.
- Even if a company is satisfying its environmental licences, its ‘licence to operate’ could be jeopardised unless it employs smarter waste disposal or re-use initiatives such as regional synergies.

While the above are important factors in the development of successful synergies there are also other considerations such as those highlighted from the study on synergy uptake in Gladstone region presented in Section 4 and specifically summarised in Section 4.6.

Based on this and other observations made during the course of the project, a model for synergy uptake in the Gladstone region is proposed here.

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\(^1\) CSRP Developing Local Synergies in the Gladstone Industrial Area Project Agreement.
6.3 Regional Resource Efficiency

From a theoretical viewpoint, it makes good sense for industries in a geographically similar region to re-use waste and by-products. From a regional perspective, this will reduce the quantity of material (feed stock, consumables and utilities) entering the region and reduces the quantity of waste and emissions for disposal while still maintaining desired rates of production. In simple terms, the aim of regional synergies is to produce the same (or more) product with less use of resources, and thus the overall industrial regional efficiency increases. This is schematically illustrated in Figure 4.

![Figure 4: Theoretical Aim of Regional Synergies](image)

(a) Without synergy initiatives – Regional efficiency = Product/Resources = X

(b) With synergy initiatives – Regional efficiency = Product/Resources = Y

\[ Y > X \quad \text{Better regional efficiency with synergies} \]

6.4 Operational Business Drivers

While this makes sense theoretically (the basic motive being ‘use resources as efficiency as possible’), at the practical level (namely an operation within an industrial region) divergent objectives and drivers exist. The main objective of an operation is to generate a profit, typically through one of two avenues of increasing production or reducing costs, with a set of generally well-defined constraints, such as acting within the law, producing product to specification, maintaining high safety and health standards, operating within licence limits, maintaining good relationships with local neighbours etc. None of these core business objectives will necessarily improve the regional resource efficiency, which is the main aim for adopting regional synergies within an industrial area.

Occasionally, the business drivers for such an initiative generate the same outcome as the drivers for regional resource efficiency. An example of this in Gladstone is the re-use of spent cell linings from Boyne Smelters at Cement Australia plant. For Boyne Smelters, the main driver for implementing this synergy was to reduce their growing stockpile of spent cell linings, while for Cement Australia the main driver was to use an alternative fuel (with an associated ‘gate fee’) instead of coal. In general terms, there were strong conventional business cases for both parties; for Boyne Smelters it
was in reducing the risk of a growing liability and for Cement Australia it was in reducing costs. From a regional resource efficiency perspective, re-using a waste generated within the region as a fuel source is a better outcome than storing the waste and using more coal (a non-renewable resource from outside the region) to fuel the cement kiln.

For operations situated in an industrial region like Gladstone, the business activities can be shown schematically, as illustrated in Figure 5. Overwhelmingly, the main reason for the industries being situated in Gladstone is access to a well protected deep water port, although secure and cost competitive supply of energy and water are other important considerations. Besides a few supply-chain synergies such as QAL supplying Boyne Smelter’s alumina feed, activity on a conventional business basis between industries is limited. Typically, an operation’s business activities is with other entities situated outside the region, such as suppliers, customers, head office or government, with local authorities being the main exception. Unless there is some compelling conventional business reason to interact with a neighbouring operation, as is the case with QAL and Boyne Smelters (alumina) or Boyne Smelters and Cement Australia (spent cell linings), operations will continue to view their neighbouring sites as just that, neighbours.
Figure 5  Typical Structure of Business Activities in an Industrial Region
6.5 Queensland’s Regulatory Framework Impact on Regional Synergies

A common observation from the Gladstone industry representatives and other stakeholders associated with the project was that while, in theory, waste and byproduct exchanges between companies made good sense there was, in practice, too many perceived hurdles or barriers to implement possible synergy opportunities. Anecdotal evidence suggested that government regulations and liability concerns were one of the reasons for lack of action in developing synergy initiatives.

To determine if this was an accurate reflection of government regulations and policies, a study was undertaken by a summer vacation student from December 2006 to February 2007 to investigate the regulatory and legal factors that can affect the uptake of regional synergies. The student, Megan Davis, was a fourth year dual environmental science and law degree undergraduate. This section presents a summary of the findings from the study, and a more detailed account of this study is presented in Appendix C.

This study comprised:

- A review of Queensland’s waste management regulatory framework and the potential criminal and civil liability that could arise when implementing waste recycling in synergy projects
- Interviews with relevant industry and government people in Gladstone and Brisbane
- Analysis of the findings from reviews and interviews, including recommendations for change to Queensland’s environmental regulatory framework

A review of the key waste management legislation, consisting of the Environmental Protection (Waste Management) Policy 2000 (Qld) and the Environmental Protection (Waste Management) Regulation 2000 (Qld), indicated that the regulatory framework was theoretically supportive of by-product and waste re-use in Queensland through such concepts as the waste management hierarchy.

However, despite the theoretical support for recycling in this legislation, when reviewed practically, various hurdles to implementation were found that, although minor, could aggregate to discourage implementation of synergy opportunities. These hurdles included the legislative ‘waste’ label and associated additional costs and licensing requirements, community perceptions, as well as more far-reaching hurdles such as fear of potential liability, low waste quantity, core business focus, and poor knowledge or information of key recycling provisions in the legislation, such as beneficial resource approvals. Another concern is that the waste management policy allows for deviation from the waste management hierarchy, providing suggestions rather than legal requirements and offers no penalties or consequences for the breach of its provisions.

A comparison with other jurisdictions indicated that financial penalties, such as landfill levies or taxes, the strengthening of regulatory provisions by the inclusion of penalties for breaches, or initiatives such as increased education and promotion of recycling programs, could assist in driving regional synergy initiatives.

6.6 Synergy Matrix

Based on the observations and learnings from this project, a synergy matrix for categorising possible initiatives was developed. Broadly speaking the chance of a
regional synergy initiative progressing is dependent on its financial and SD benefits as illustrated in Table 4. The purpose of this table is to categorise the likelihood of whether a given synergy initiative will proceed. SD benefits in this table refer to the improvement of some or all non-financial aspects, such as environment, community, social, intellectual (essentially anything that cannot be directly measured in monetary units), as a result of implementing a given synergy initiative. Examples of SD benefits include saving potable water as in the QAL effluent re-use synergy, or use of less non-renewable fuel as in the re-sue of spent cell lings at Cement Australia.

<table>
<thead>
<tr>
<th>SD Benefits</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Benefits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>Will proceed</td>
<td>Will proceed</td>
<td>Will proceed</td>
</tr>
<tr>
<td>Moderate</td>
<td>May or may not proceed</td>
<td>Probably not</td>
<td>Will not proceed</td>
</tr>
<tr>
<td>Low</td>
<td>May or may not proceed</td>
<td>Probably not</td>
<td>Will not proceed</td>
</tr>
</tbody>
</table>

Irrespective of their SD benefits, regional synergy initiatives with strong financial benefits (that is, they meet the companies’ return on investment criteria) should ultimately proceed to implementation provided there are no significant risk factors. Regional synergies initiatives that have moderate or low financial benefits with low SD benefits should not proceed. The ‘grey’ area is when a regional synergy initiative has moderate or low financial benefits (that is, does not meet the companies’ normal return on investment criteria) but has high or possibly moderate SD benefits.

The question here is: ‘how much will the SD benefits contribute to a sound business strategy even though the financial case may not be satisfied?’ For instance, do the SD benefits of re-using water from a neighbouring wastewater treatment facility (saving water, improving reputation, increasing water security) warrant the less than ‘ideal’ financial case if the cost of water is relatively cheap? The answer partly depends on the local circumstances: if abundant fresh water is available then probably not, but if there is an impending drought then the investment might be well warranted. If under drought conditions there is a perception that industry is ‘taking’ fresh water from the community then this could affect an operation’s ‘licence to operate’, and hence a water recycling synergy would be well justified.

6.7 Determining Factors for Synergy Development - Government and Community

In many cases, particularly from a research perspective, regional synergy initiatives will fall into the grey areas (that is, moderate to low financial benefits) in Table 4. Outside this area, initiatives will or will not be implemented purely based on their financial credentials. What determines whether a potential synergy that lies in the ‘grey’ area will proceed or not is strongly dependent on the local circumstances, such as the sensitivity of the natural environment, the tolerance of the community, the quality of the regional airshed, or the availability of resources from the region.
The environmental authority can require that an operation or operations reduce their environmental impact and one possible way to do this is through a regional synergy initiative. For example, if a steelworks were to be established in the Gladstone State Development Area, a requirement of that development could be the installation of a flue gas desulphurisation unit (FGD) to significantly reduce sulphur dioxide emissions. The flue gas desulphurisation unit could produce gypsum which could then be used as part of the feedstock to the cement plant. Essentially, a synergy initiative of this nature is well-defined early in the project life and is thus a compliance instigated initiative. So, regardless of the commercial value of selling the gypsum by-product to the cement plant, the project will not proceed unless a FGD unit is part of the plant.

Where the benefits of synergy initiatives become more difficult to understand and predict is when there is a likelihood that the local community could react adversely to particular operational practices, even if the operation is satisfying all their legal and regulatory requirements and has been doing so for many years. For instance, as a result of land sales close to a bauxite residue area, the community might apply pressure on the alumina refinery to investigate and implement re-uses measures for the residue. If the alumina operation does not foresee this concern of the community, or worse still initially ignores their concerns, then the community, if well organised, could severely affect the operation’s licence to operate. If, however, the alumina operation began early action of investigating and subsequently implementing re-use initiatives for bauxite residue, the initial up-front investment in undertaking this work would most likely pay for itself in mitigating any future community disquiet.

Typically, in the minerals industry, a case like this would be analysed using a risk-consequence approach – essentially the chance of the risk and the magnitude of the consequence would determine what action the operation would take. The risk-consequence approach by its nature requires a good deal of judgement to envisage the likelihood of future events. This can be reasonably well achieved for impending changes in legislation or regulation but is much more difficult if an ‘unpredictable’ community suddenly takes issue with an operation’s practices.

In an industrial region the community tend to group all operations into a single entity termed ‘industry’, rather than distinguishing individual operations or industries. This means that the perceived or actual poor practices of one site in an industrial region might tarnish the rest of the industrial operations, and therefore collective and unified industry action is required to appease the community concerns. An example of this is the Kwinana Industries Council which was an industry lead response to government and community pressure to manage local air and watersheds and protect the sensitive marine environment in the adjacent Cockburn Sound (van Beers 2007).

Once the community becomes mobilised as an entity itself, then the operations within an industrial region can be forced to work together. Under these circumstances, industries require a collective response to satisfy community concerns. A significant part of the solution could be through the adoption or implementation or regional synergy initiatives, as this could reduce the overall emissions from an industrial region (satisfying the community) through re-use or recycling (finding a “home” for unwanted by-products). Thus, with strong enough community concern synergies that fall into the grey area in Table 4 on first inspection might in fact move up to the top row (high financial benefits) on the basis that without such an initiative the
operation’s or operations’ ‘licence to operate’ in the region might be severely impaired.

An example of this in the Gladstone region was the way industries and government worked together during the drought of 2002. Being a large water user, industry was required to make significant cuts in their water usage and also investigate new and novel approaches of re-using or saving water. Although there were strong conventional business drivers to do so (the distinct possibility of no or reduced revenue due to lack of available water), the industry could not have continued to employ their previous water practices while the local community had to severely reduce their water consumption. Even though these were extraordinary circumstances, this illustrates that the industry can work together to deliver sustainable outcomes that will both benefit the community and appease their concerns with industry practices.

Recognition that industry needs a collective response is a critical step in satisfying the concerns, whether real or perceived, of a discontented community. Such responses can take a number of forms, but industry pursuing collaborative initiatives that have environmental and community benefits through regional synergies, such as recycling and re-using water, can deliver outcomes that demonstrate to the region that industry as whole wants to make a positive and significant contribution to local sustainable development.

6.8 Approach for Capturing New Synergy Opportunities

This project has raised the awareness of potential synergy opportunities in the Gladstone region. It is important that any future synergy opportunities within the region are identified and evaluated as early as possible so that any benefits can be realised. This is particularly true for greenfield projects where the potential synergy can be included in the design process.

To build on the groundwork established during the project, an approach has been designed to assist with the early identification of new prospective synergy opportunities. The most important part of this approach is regular communication amongst all parties that may be interested in potential synergy opportunities. By continuing to maintain strong and open lines of communication amongst the network of interested parties, the chances of discovering new potential synergy opportunities will be significantly enhanced. The GAIN Environment Committee is the obvious vehicle for initiating discussions on the possible opportunities. To strengthen its role in this process, inclusion of other non-industry parties, not necessarily on a permanent basis, is recommended. These groups could include:

- Gladstone Economic and Industry Development Board (GEIDB)
- Local shire councils,
- Gladstone Engineering Alliance (GEA),
- EPA,
- Local waste management companies
- Relevant community groups.
Awareness of both the possible waste and by-products from local organisations and any impending or latent concerns with current waste or by-product storage or disposal can be important and critical triggers for initiating synergy opportunities.

Once a potential synergy has been identified, there are some relatively straightforward steps to determine its initial viability:

1. Can the by-product be used ‘as is’ or is some re-processing required?
2. If re-processing is required, is the technology proven and currently available?
3. Does generation rate (both volume and frequency) of the by-product match the re-use requirements?
4. Are there any potential sensitive issues in relation to re-using this by-product – for example, minor elements, hazards, contractual or liability issues?
5. Are there any regulatory issues with re-using this by-product? For instance, is it a regulated waste?

Answers to the above questions will help in pre-screening the identified synergy opportunity. If after analysing the answers to the above questions, the synergy appears to have potential, both the financial and sustainability benefits should be estimated. The synergy matrix can then be used to determine the feasibility on the proposed synergy initiative. Who leads this process is an important consideration and will depend on the nature of the opportunity and the interested parties.

The toolkit currently under development (and nearing completion) in CSRP ‘Enabling Tools and Technology’ project could be used to assist in answering the questions above and estimating the financial and sustainability benefits.

Once this process is completed the synergy opportunity will either progress as a standard project through the conventional company or organisation project development system or will be discarded as being not viable at the present time. Discarded potential synergies could in the future, however, become viable synergies as conditions, such as regulations, community pressure, or by-product quality or quantity, change with time. Thus, a register of unsuccessful as well as successful synergies should be maintained and reviewed on a regular basis.

The above approach has been summarised in a flowchart, presented in Figure 6.
Figure 6  Approach for Capturing New Synergy Opportunities

6.9 Summary
In the main, regional factors will predominantly drive the development and implementation of regional synergy initiatives. Often regional synergy initiatives have moderate or low financial benefits (that is, they do not meet the companies’ normal return on investment criteria) but have high or possibly moderate SD benefits,
(that is, non-financial benefits, such as environment, community, social, and intellectual). As part of this mix of SD benefits are external drivers such community expectations and demands for industry to adopt practices that are more environmentally or socially acceptable even if the conventional financial case is only marginal. The key consideration for whether these opportunities are feasible greatly depends on the value of the SD benefits (for all stakeholders) to compensate for the, at best, moderate financial case. This value will depend on the regional circumstances such as government regulation and more importantly community sentiment towards industry either as a whole or particular operations within a region. Understanding the community concerns and how this could affect an operations ‘licence to operate’ is a critical factor in deciding whether to proceed with the implementation of a synergy initiative. Having a structured networked strategy for capturing and assessing potential regional synergies will assist in delivering a streamlined process for developing the viable opportunities.

6.10 Recommendations

- Maintain a strong network of interested parties to improve the chances of discovering new potential synergy opportunities through an organised body such as the GAIN Environment Committee.

- For any prospective synergy opportunity, ensure that the value of the SD benefits are fully appreciated within the relevant companies and organisations and that there is recognition that even if the conventional financial case may be marginal, the synergy might contribute to an overall sound business strategy.

- Appreciate the need for industries to have a collective response to satisfy community concerns and that a significant part of the solution could be through the adoption or implementation of regional synergy initiatives.
7 POSSIBLE FUTURE SYNERGY SCENARIOS

One final task in the project was to postulate the possible synergy opportunities with the existing industries and potential future industries. For these initiatives to be successful they should ultimately demonstrate a strong business case in the wider sense of the term, that is they should have at least a positive or neutral financial return plus environmental and community benefits. Section 6 discusses the important characteristics in delivering a successful synergy initiative. Details on these opportunities have been described in the earlier project reports and the appropriate references are supplied in the following sections.

7.1 Current Industries

Using the data and information collected during the course of the project, a synergy map illustrating existing and potential synergies is presented in Figure 7. The potential synergies are based on the identified opportunities from the workshop in the first year of the project – refer to Sections 6 and 7 of Corder (2005a). To date none of these synergies have been fully implemented.
Figure 7  Existing and Possible Synergies with Current Industries
7.2 Possible Future Industries

Based on the latest information supplied by the GEIDB (GEIDB 2007), possible future synergy opportunities were identified.

From (GEIDB 2007), several projects have been committed and significant number of projects are under study:

Committed projects

- **Bauxite**
  - Rio Tinto Aluminium Limited - Yarwun Alumina Refinery – Stage 2
- **Cement**
  - Cement Australia - new cement mill (720 ktpa)
- **Gas**
  - Origin Energy- gas supply for Rio Tinto Aluminium Refinery
  - Alinta Limited - compression and looping for the existing Qld Gas Pipeline
- **Industrial minerals**
  - Goondicum Industrial Minerals Project (Monto Minerals Ltd) - Production and marketing of ilmenite, feldspar and apatite and titanomagnetite
- **Ports**
  - Central Queensland Ports Authority (CQPA) – R G Tanna Coal Terminal expansion

Projects under study

- **Gas**
  - Arrow Energy - Boyne River Coal Seam Gas Exploration and Appraisal Project
  - LNG Ltd with Arrow Energy NL - LNG production facility to consume coal seam gas
  - Santos Ltd - LNG production facility to consume coal seam gas
- **Bauxite**
  - Aurukun Project - development and refining of the Aurukun bauxite and kaolin mineral resources
- **Nickel**
  - Gladstone Pacific Nickel Limited (GPNL) - laterite nickel and cobalt ore processing plant
- **Shale oil**
  - Queensland Energy Resources Limited - commercial scale plant to process Stuart Oil Shale resource
- **Ports**
- Central Queensland Ports Authority (CQPA) – Fisherman’s Landing Wharf Expansion
- Central Queensland Ports Authority (CQPA) and Queensland Rail – Proposed Wiggins Island Coal Terminal

- Rail
  - Australian Inland Rail Expressway - inland railway to link Melbourne and Darwin via NSW and Queensland including the Dawson Valley Railway

- Power
  - Ergon Energy Infrastructure Upgrades
  - Powerlink Queensland Infrastructure upgrades and New Large Network Assets Proposal

- Waste management
  - Transpacific Industries Group Limited - Regional Waste Management Facility

In relation to the **committed projects**, there are no obvious new opportunities. The major new operation is the Goondicum Industrial Minerals Project situated at Monto which is over 200 kms from Gladstone. Such a distance means that it is unlikely there are opportunities for regional synergy initiatives with Gladstone operations.

There are, however, some possibilities with the expansion of the Rio Tinto Aluminium Refinery, a larger operation might be able to justify some of the already identified opportunities. Similarly the installation of new cement mill at Cement Australia, with commensurate increase in milling capacity, might generate more demand for alternative fuel and raw materials.

In relation to the **projects under study**, there are several possible synergy opportunities:

- Gladstone Pacific Nickel Limited – as discussed in Corder (2006c), there is the opportunity for co-disposal of the acidic tailings from laterite nickel operation with alkali red mud (before neutralisation) to produce a neutral mixture - thereby reducing waste and saving costs. This opportunity is currently being investigated by GPNL.

- Queensland Energy Resources – As described in Corder (2005a), there are several potential opportunities if a full-scale oil shale plant was in operation, although the opportunities would depend on the chosen processing technology:
  - recovery of ammonia from the sour gas, which is a mixture of hydrogen sulphide and ammonia, for use as a chemical feedstock
  - use of red mud as a backfill for the mine
  - use of waste heat (temperatures of 500 degrees Celsius) to pre-heat shale, generate steam and, if possible, use excess steam to generate electricity that could be sold back to grid
  - feed old tyres to the process to extract their oils and in doing so reduce consumption of non-renewable oil shale
- use processed shale, which could have similar properties to fly ash, as a cement additive.

- Aurukun project – there is likely to be limited synergy opportunities with a third alumina refiner in the region, apart from the opportunity to share collective expertise or organise collective purchasing.

- Transpacific Industries Group Limited – there could be opportunities for Transpacific to re-process some of wastes and by-products to a form that makes them suitable to replace inputs to the exiting operations.

- Gas production facilities – although there might not be any direct synergies, the introduction of major gas facilities might lead to a broader range of industries in the region which would ultimately create greater synergy opportunities.

A schematic representation of the possible future synergies if Gladstone Pacific Nickel and Queensland Energy resources established operations in Gladstone is presented in Figure 8.
Figure 8 Possible Future Synergies
7.3 Summary

While there are several synergy opportunities currently in the Gladstone region, more are likely to emerge as the number and mix of industries increases. The region is currently dominated by the alumina and aluminium industries which limits the number of synergy opportunities between major operations. Most of the identified opportunities would rely on non-GAIN organisations, some of which lie outside the Gladstone region, as avenues for waste or by-product re-use (e.g. biomass from sawmills). The introduction of major operations not related to the alumina/aluminium industry will enhance the prospect of greater regional synergy development, which could ultimately result in sizeable SD benefits for the region and cost savings for the participating companies and organisations.
8 KEY CONCLUSIONS AND RECOMMENDATIONS

This final report on the Gladstone Regional Synergies Project drew together the major findings and learnings from the project with particular emphasis on the factors that affect synergy uptake in a region like Gladstone. Even though no identified synergy opportunities were realised during the lifetime of the project, the research and analysis conducted in this project have highlighted a number of important conclusions and recommendations that enhance the understanding of the synergy uptake factors:

Factors Influencing the Uptake of Regional Synergies in Gladstone: Factors influencing regional synergies and their uptake are complex, a fact recognised by the key stakeholders in the Gladstone Regional Synergies Project. Sorting out any technical issues is only the first step in implementation, and it is the non-technical (e.g. legal, contractual, regulatory) issues which significantly impact the uptake of the identified synergy opportunities. In the project, this was illustrated by the fact that even though there were several smaller synergies opportunities, there were not enough incentives or external drivers for the companies involved to justify their implementation. The project achieved several important outcomes for industry and for the Australian public in enhancing the understanding of the factors affecting regional synergies. Much of this information has been published into the public domain to enhance the general understanding of regional synergy uptake. Towards the end of the project some industry participants thought that several non-technical opportunities (e.g. regulatory issues, closure planning, staff retention) were possible.

Recommendation: That these findings on the factors influencing industry engagement with regional synergies in Gladstone are reported in the public domain as an example of the practical issues to overcome in synergy implementation.

Comparison with Kwinana: While there are some common elements between the Gladstone and Kwinana regions, there are significant differences that help explain the larger number of regional synergies in the Kwinana region. Kwinana has a greater diversity of industries, a larger number of operations and a greater range of industry size, all located in close proximity, roughly over an area of about 16 km². In addition it is located close to a major city, Perth, and has some of its main by-products stored close to local community/urban area, such as Alcoa’s bauxite residue area. Another critical feature is the Kwinana Industries Council, an incorporated organisation which was instigated by the core industries in 1991 to co-ordinate activities of the industries across a range of common issues, such as air and water monitoring. This is an important difference between the two regions and one that could be instrumental in driving synergies initiatives much more efficiently, particularly as growing community pressure due to changes in the regional demography demands more sustainable outcomes from industry.

Recommendation: That the GAIN group give serious consideration to supporting a funded secretariat, similar to the Kwinana Industries Council, that would co-ordinate non-core industry activities across the Gladstone region

Synergy Uptake Assessment: Regional factors will predominantly drive the development and implementation of regional synergy initiatives. The few opportunities with a strong financial case will proceed almost regardless of any SD
benefits. Many of the opportunities within a region will typically have a moderate financial case but will deliver sound or even strong SD benefits. The key consideration for whether these opportunities should be implemented essentially depends on weighing up SD benefits (for all stakeholders) against the moderate financial case to determine if the opportunity will deliver an overall sound business strategy for the prospective organisations. The regulatory and legal framework of a state needs to have suitable drivers and enablers to encourage re-use and recycling, otherwise the various hurdles to implementing synergy opportunities, even if they are minor, could aggregate to discourage their implementation. An approach has been developed based on the learnings and findings in this project for recognising the potential of new synergy opportunities. With a change in the demographics of the region there will be mounting pressure on industry as a whole to improve its environmental and sustainability performance; part of the solution to this may lie with regional synergy initiatives.

**Recommendation:** That the GAIN group employ the developed approach, presented in Section 6.8, to aid the early recognition of new synergy opportunities and determine the potential of any possible synergy opportunity for realisation.

**Future Synergy Scenarios:** While there are several synergy opportunities currently in the Gladstone region, more will emerge as the number and mix of industries increases. The introduction of major operations not related to the alumina/aluminium industry (such as Gladstone Pacific Nickel or LNG production facilities) will enhance the prospect of greater regional synergy development, both in terms of waste and by-product exchanges and less tangible, but valuable, synergies. Ultimately significant SD benefits and cost savings could result from greater regional synergy development once more major operations become established in the Gladstone region.
9 REFERENCES


Stegink, H. D. J., Lane, J., Barker, D. J., and Pei, B. "Water Usage Reductions at Queensland Alumina." Water in Mining Conference, Brisbane, Australia, 293-299.


10 APPENDICES
APPENDIX A

PROJECT CASE STUDIES

This appendix provides an update on the project case studies and relative initiatives along with brief background details on Gladstone, current synergies and the regional synergies project. As stated in Section 1, for more detail on the development of the project, the reader is encouraged to refer to the earlier project reports (Corder 2005a; Corder 2005b; Corder 2006a; Corder 2006b; Corder 2006c).

Background

Gladstone Industrial Area Overview

Gladstone, situated on the central Queensland coast some 540 kilometres north of Brisbane, has a population of about 50,000 in the region which extends from Tannum Sands in the south to Yarwun in the north.

Major industrial operations have been part of the Gladstone region since Queensland Alumina Limited (QAL) commenced operation in 1967. Today there are several major industries operating in the region and they form an association called the Gladstone Area Industry Network or GAIN. GAIN comprises:

- Queensland Alumina Limited (QAL), the world largest alumina refinery producing 3.9 million tonnes of alumina annually
- NRG - Gladstone Power Station, the largest coal–fired power station in Queensland with a total generating capacity of 1680 MW
- Cement Australia, with the largest cement kiln in Australia and a quick lime kiln producing 1.5 million tonnes per annum and 300, 000 tonnes per annum respectively
- Boyne Smelters Limited, the largest aluminium smelter in Australia producing over 500,000 tonnes of aluminium annually
- Orica Chemicals, which produces ammonium nitrate (600,000 tones per annum), sodium cyanide (60,000 tonnes per annum) and chlorine (15,000 tonnes per annum)
- Rio Tinto Aluminium Yarwun Refinery, the first alumina refinery constructed in Australia since 1985 producing 1.2 million tonnes of alumina annually
- Central Queensland Port Authority, the largest multi-cargo port in Queensland
- Gladstone Area Water Board, the operator of the Awoonga Dam
- Queensland Energy Resources Limited (QERL) - Stuart Shale Oil Project, currently on hold
- Transpacific Industries, operators of the resource recovery and management facility on the former Ticor site.

Rio Tinto Alcan have a major presence in Gladstone. They own all of Rio Tinto Aluminium Yarwun Refinery, are major shareholders in Boyne Smelters Limited (59.39%) and QAL (80%) and own part (41.125%) of the Gladstone Power Station.

For a more detailed description of the Gladstone Industrial Area refer to Section 2 of (Corder 2005a).
**Existing Industrial Synergies**

Prior to the commencement of this project there were already several examples of waste or by-product re-use synergies among the GAIN industries. These are:

- an alternative fuels strategy at Cement Australia using tyres, solvent-based fuels and spent cell linings from the Boyne Aluminium smelter
- re-use of secondary treated effluent from the Calliope River Sewage Treatment plant at QAL
- a waste transfer facility at QAL that sorts site waste for reusing, recycling or reselling
- re-use of power station flyash as a cement additive at Cement Australia
- re-use of caustic soda from Boyne Smelters at QAL and previously at QERL.

A schematic diagram illustrating these regional synergies is presented in Figure 9.

A detailed description of the existing synergies was presented in Section 4 of Corder (2005a).

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**Figure 9   Existing Regional Synergies**

**Approach for Identification of Synergy Opportunities (April 2004 – April 2005)**

The CSRP research in Gladstone aimed to assist operations to achieve greater efficiencies in energy, water and materials consumption, and reductions in waste and emission generation. Over the first year of the project, April 2004 to April 2005, the project researcher identified a prioritised set of synergy opportunities and prepared proposals for these opportunities. The process that was applied to identify these opportunities is presented below.

Initially, a database of material, energy and water inputs and by-product generation from the principal companies was established (Corder 2005a). Additional interviews with the GAIN industries and independent research resulted in a list of both short- and long-term opportunities. All these opportunities were reviewed at a workshop with industry and state/local governments, with the aim of selecting synergy projects with the perceived best business and sustainability case for the involved companies and the region as a whole.
The identified short-term projects were:

- consolidation of wastes for use as an alternative fuel source for cement clinker manufacturing – this would required a central facility to collect and blend all low volume wastes so that a sizeable and consistent alternative fuel source would be available for cement manufacturing, thus diverting wastes from landfill, while also providing Cement Australia (and potentially other industries) with alternative fuel

- re-use of ‘fit-for-purpose’ water - several possibilities for water re-use were identified, for example, re-use of treated effluent from sewage treatment plants and trade wastewater as process water in nearby industries.

The identified long-term projects centred on opportunities:

- to recover and re-use of large volume waste streams (bauxite residue and fly ash)
- to capture and recover gaseous emissions (carbon dioxide and sulphur dioxide).
- to improve process energy utilisation (e.g. waste heat) in the Gladstone industrial area.

It was determined that the synergy projects would initially focus on facilitating the implementation of the short-term synergy opportunities, while continuing to monitor the technological developments related to the selected long-term synergies.

For a more detailed description of the research approach, outcomes and synergy proposals refer to Sections 5 to 8 of Corder (2005a).


This section briefly describes the development of each of the identified opportunities over the course of the project. Further details are available in (Corder 2006b; Corder 2006c).

**Consolidation of Waste for Alternative Fuel Initiative**

The aim of this initiative was to re-use a central facility for collecting and blending low volume wastes so that a sizeable alternative fuel source would be available for operations such as Cement Australia. The benefit from this initiative was to provide a more efficient disposal method of wastes, which in many cases are treated and sent to landfill. Moreover, there would also be an opportunity for Cement Australia, or other appropriate industries, to utilise alternative fuels instead of burning non-renewal fuels such as coal.

To get this initiative underway, a pilot study was proposed that would involve using old filter bags from the two alumina refineries, the aluminium smelter and the power station as an alternative fuel source. Although potentially feasible from a technical viewpoint, there were a number of issues that made it difficult to progress this opportunity.

The major barrier was not having a suitable material handling and feed system to deliver the filter bags to Cement Australia’s clinker kiln. The initial estimate of about 200 tonnes of solid filter bags per year did not replace enough of the conventional fuel - coal - to warrant the expense of re-commissioning the existing conveyor and installing additional feed preparation equipment.

The progression of this initiative over the second and third years of the project was well documented in the earlier reports (Corder 2006b; Corder 2006c). By the end of
the project, Transpacific Industries were pursuing the options with Cement Australia about the potential for using filter bags as alternative fuel source at the cement kiln.

**Water synergies**

The aim of this initiative was to re-use various wastewater streams on a fit-for-purpose basis at the two alumina refineries, thus reducing usage of raw water from Awoonga Dam.

These water re-use synergies did not require further research as the next step in their development was a straightforward engineering design. Some facilitation support was offered, however these synergies were not actively pursued by the relevant companies during the course of this project.

**Large waste streams**

Earlier documents provided accounts of the potential opportunities for re-using the larger waste streams; however no significant progress was made during the final stages of the project. A report entitled “Interim Report on Long-Term Initiatives for Large Waste Streams in the Gladstone Region” (Corder 2006a) outlined the feasible opportunities for re-using the large waste streams from the Gladstone region. Other possible opportunities were also presented in the second year progress report (Corder 2006c). Reasons for the not pursuing initiatives on the large waste streams are discussed in Section 4.

**Major project**

Another aim was initiate the development of a major project of regional significance for the Gladstone area, to utilise the synergistic advantage of having a number of major operations within a geographically compact region to improve energy or water efficiency. There are strong motivating factors such as water scarcity and future carbon trading/tax schemes for the Gladstone region to implement short to medium term initiatives that reduce fresh water consumption (such as a large-scale water recycling facility for industry) or measures to improve energy consumption and thus reduce the region’s greenhouse footprint. Although these initiatives did not commence over the duration of the project, it is possible that with greater industrial expansion likely to occur in the region in the near future such initiatives, could be justified.

As part of this report, the potential for future synergy initiatives based on the likely and possible expansions or new operations is analysed in Section 7.

**Related Initiatives**

**Life Cycle Assessment of Red Mud for Acid Mine Drainage Remediation**

A student research spin-off project was conducted over the summer vacation of 2005-2006. In this project, a desk top life cycle assessment (LCA) was conducted comparing the use of red mud (bauxite residue) with lime for acid mine drainage treatment at the Mount Morgan mine site in Central Queensland. The aim of the study was to evaluate the environmental merits of each neutralant by comparing the carbon dioxide emissions and the net energy use over their respective life cycles. The results of this study indicated that about 80% less carbon dioxide is generated and about 60% less electricity is used over the red mud life cycle compared with the lime life cycle. However, the results also indicated over seven times more fuel is necessary
for red mud, due to the fact that significantly more red mud was required to neutralise
the acid mine water compared with lime. As LCA does not take into consideration
the financial aspects for using a material, product or service, no financial calculations
were included in this study.

Full details on the study are available in (Tuazon 2006).

**QAL Putrescibles Initiative**

The aim of this initiative was to produce compost from putrescible wastes resulting in
better sustainable fertiliser solutions for the local agriculture industry. By re-using
putrescibles wastes, there would also be reduced disposal costs, improved
rehabilitation of local industrial sites and a potential revenue source from on-selling
the product to the local agriculture industry. The plan was to establish the procedures
and processes by initially trialling it on a QAL rehabilitation site, with the intention to
include other industries, local councils and organisations to develop a broader
regional composting initiative. Funding was sought through the Fitzroy Basin
Association (FBA) Innovations Fund in November 2006. The application was
unsuccessful as the FBA Board did not believe there was a business case for such an
activity.

Further background on this initiative is presented in the earlier research reports
(Corder 2006b; Corder 2006c).
**APPENDIX B  RESEARCH OUTPUTS**

During the course of this project there have been a number of conventional research outputs. These outputs are listed in Table 5 and Table 6.

**Table 5  Research Outputs – Papers and Reports**

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Table 6  Research Outputs - Presentations

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APPENDIX C QUEENSLAND’S REGULATORY WASTE MANAGEMENT FRAMEWORK AND ITS IMPACT ON THE UPTAKE OF REGIONAL SYNERGIES

This appendix summarises the main findings from the sub-project that had the specific aim of identifying and investigating the legal, contractual and regulatory aspects that could inhibit or promote the implementation of regional synergies in the Gladstone region. This sub-project was conducted by a fourth year dual environmental science and law degree student, Megan Davis, from November 2006 to February 2007.

Summary

The regulatory framework of a state is an important facilitating mechanism that can either impede or impel sustainable waste management practices. As regional resource synergies involve the exchange of wastes and by-products for reuse and recycling in an intense industrial but geographically small area, their implementation is governed by this framework.

This research was aimed at evaluating Queensland’s regulatory framework for waste management, and specifically at whether the framework offered barriers or drivers for the implementation of regional resource synergies.

A review of the key waste management legislation, consisting of the Environmental Protection (Waste Management) Policy 2000 (Qld) and the Environmental Protection (Waste Management) Regulation 2000 (Qld), indicated that the regulatory framework was theoretically supportive of by-product and waste re-use in Queensland through such concepts as the waste management hierarchy.

However, despite the theoretical support for recycling in this legislation, when reviewed practically, various hurdles to implementation were found that, although minor, could aggregate to discourage implementation of synergy opportunities. These hurdles included the legislative ‘waste’ label and associated additional costs and licensing requirements, community perceptions, as well as more far-reaching hurdles such as fear of potential liability, low waste quantity, core business focus, and poor knowledge or information of key recycling provisions in the legislation, such as beneficial resource approvals.

Another concern is that the waste management policy allows for deviation from the waste management hierarchy, providing suggestions rather than legal requirements and offers no penalties or consequences for the breach of its provisions.

A comparison with other jurisdictions indicated that financial penalties, such as landfill levies or taxes, the strengthening of regulatory provisions by the inclusion of penalties for breaches, or initiatives such as increased education and promotion of recycling programs, could assist in driving regional synergy initiatives.

Background and Objective

A common observation from the Gladstone industry representatives and other stakeholders associated with the project was that while, in theory, waste and by-product exchanges between companies made good sense there was, in practice, too many perceived hurdles or barriers to implement possible synergy opportunities.
Anecdotal evidence suggested that government regulations and liability concerns were one of the reasons for lack of action in developing synergy initiatives.

To determine if this was an accurate reflection of government regulations and policies, a study was undertaken by a summer vacation student from December 2006 to February 2007 to investigate the regulatory and legal factors that can affect the uptake of regional synergies. The student, Megan Davis, was a fourth year dual environmental science and law degree undergraduate. This section presents a summary of the findings from the study.

This study comprised:

- A review of Queensland’s waste management regulatory framework and the potential criminal and civil liability that could arise when implementing waste recycling in synergy projects
- Interviews with relevant industry and government people in Gladstone and Brisbane
- Analysis of the findings from reviews and interviews, including recommendations for change to Queensland’s environmental regulatory framework.

Queensland’s Waste Management Regulatory Framework

Background

Waste management legislation was introduced by the Queensland Government on 1 July 2000 under the *Environmental Protection Act* 1994 (Qld) (2.1). This regulation, which was developed in collaboration with local government and industry, comprises the *Environmental Protection (Waste Management) Policy* 2000 (2.2), and the *Environmental Protection (Waste Management) Regulation* 2000 (2.3).² The combination of these three pieces of legislation provides the regulatory backbone for waste management in Queensland. Its objective is to promote the re-use of waste in a way that is ecologically sustainable. Along with this legislation, other regulations such as the *Coastal Management Protection Act* 1995 (Qld), the *Environmental Protection Regulation* 2000 (Qld) and the *Integrated Planning Act* 1997 (Qld) are part of the regulatory system that administers Queensland’s waste management.

Prior to the introduction of the *Environmental Protection (Waste Management) Policy* and *Regulation*, the Environmental Protection Agency developed a Waste Management Strategy. The strategy aimed at achieving a framework that minimised or avoided adverse impacts on the environment, while at the same time allowing for economic development and improvement in the quality of life for all Queenslanders.³ The strategy provided the basis for introducing a legal framework for Queensland’s waste management, however, the strategy was never assessed or revised. The strategy is technically still applicable to the waste management regime, it is currently out-of-date and not effective in delivering the desired goals of the regime.

Figure 10 illustrates the interrelationship between the various aspects of the Environmental Protection Act and the related Regulation and Policy.

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Waste managing restricted to council

Approval for others to manage waste under s369A

Waste considered in EMP approval

Environmental Protection Act 1994
Defines waste, delegates authority to policy and regulations

Legal Framework for Queensland’s Waste Management

Waste Management Strategy 1996
- Hierarchy
- Principles (outdated)

Environmental Protection (Waste Management) Policy 2000 (Qld)
Hierarchy & Principles must be considered in:

Environmental Protection Regulation 1988 (Qld)

Environmental Protection (Waste Management) Regulation 2000 (Qld)

Integrated Planning Act 1997

IDAS process approves ERAs

Not legally binding

Legally enforceable

Waste management solutions

Problems

Legend

Figure 10  Regulation Applying to By-Products and Waste Re-Use in Queensland
Environmental Protection Act 1994 (Qld)
The Environmental Protection Act 1994 (Qld) (the EP Act) is the principal legislation enacted to ensure the protection of Queensland’s natural environment. The object of the Act is to protect Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).4

Two aspects of this Act that are applicable to synergy opportunities are:

- ‘Best Practice Environmental Management’ (BPEM) which considers the waste prevention, treatment and disposal of certain activities.5 Environmental Management Programs (EMPs) that address waste prevention, treatment and disposal through BPEM can be required as a condition of approval of an environmental authority or development approval.6

- Waste management works which remove, collect, transport, store, treat or dispose of waste. These are restricted to the local council unless a third party has a development approval or have environmentally relevant activity (ERA) approval, or the works are for, or by, the local government.7

Examples of some of the problems associated with the above practices are:

- Changing current waste management practices require a new EMP which could affect the overall development approval (DA), thus resulting in a disincentive for implementing new recycling initiatives.

- If a company does not want to endanger its DA by applying to re-use its waste and by-products, it can employ private companies to perform the relevant waste management works. Private companies can apply for permission to the local council under s 369A of the EP Act to obtain the necessary approval. This is only viable for operations that produce significant amounts of waste.

A possible solution to this problem is to allow the administering agency to approve EMPs with built-in specified targets, rather than approving individual practices as a condition of the DA. Strategies that aim to reduce waste within certain operating boundaries would be then receive preferential treatment, as these would allow for procedural change while still protecting individuals and the environment from harm.

Environmental Protection (Waste Management) Policy 2000
While the EP Act does its part in managing waste through the provisions mentioned above, the majority of waste management regulation is devolved to the Environmental Protection (Waste Management) Policy 2000 (Qld) and the Environmental Protection (Waste Management) Regulation 2000 (Qld) which were enacted to “enhance or protect Queensland’s environment in the area of waste management”8.

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4 Environmental Protection Act 1994 (Qld) s 3
5 Environmental Protection Act 1994 (Qld) s21 2 (e)
6 Environmental Protection Act 1994 (Qld) s 332 (1)
7 Environmental Protection Act 1994 (Qld) s 369
8 See Chapter 2 Environmental Protection Act 1994 (Qld).
The WM Policy provides a strategic framework for managing wastes in Queensland and roughly identifies the ‘triple bottom line’ values (society, environment and economy) as ‘environmental values’ to be enhanced or developed through the policy. These ‘environmental values’ are ‘life, health and wellbeing of people’ (society), the ‘diversity of ecological processes and associated ecosystems’ (environment) and the ‘land use capability, having regard to economic consideration’ (economy). To achieve its objectives, the policy:

- Identifies environmental values to be enhanced or protected through the Waste Management Hierarchy and Principles (Part 3)
- Provides a framework for the administering authority to make consistent and fair decisions through Environmental Management and Decisions Concerning Waste (Part 4)
- Provides for the preparation of Waste management programs (Part 5)
- Provides for the preparation of Industry waste reduction programs (Part 6)
- Provides for Government planning for waste management (Part 7)

Although the overall intent of the WM policy is commendable, the policy is more a set of guidelines than legally binding policy. The WM Policy’s hierarchy and principles accord agreeably with potential synergy projects at the conceptual level. However, practically, the policy is not effective as there is no assistance for local governments to implement the required strategy. This allows for deviation from the waste management hierarchy. There is also no incentive for companies to adhere to the voluntary industry program. Consequently, the WM Policy has had limited success in implementing the hierarchy and principles and thus fallen short of its target of achieving sustainable waste management.

In Gladstone region, the non-compulsory nature of the WM policy has been illustrated by the fact that none of the local governments in the Central Queensland Region has implemented a strategic waste management plan. This is in part due to resources constraints, particularly in rural regions, where resources are limited and the strategy implementation required is very involved and must consider a number of relevant issues. In addition, no penalties are imposed if a strategic waste management plan is not implemented by the specified date. This is another possible reason for no plans having been put into operation.

The Central Queensland Local Government Association (CQLGA) was formed to combat this lack of resources, and enable regional councils to work towards mutually beneficial solutions. The CQLGA consists of 14 member councils from the Central Queensland Region and is currently working on the required waste management plan.

While the Queensland State Government was not involved in the formation of this group, by comparison, the New South Wales (NSW) government actively promotes such initiatives by running a Local Council Partnership Program. The Department of Environment and Conservation in NSW works with a range of councils to support the planning and delivery of community education projects and to integrate these programs with other household services supplied by councils.

**Environmental Protection (Waste Management) Regulation 2000**

The Environmental Protection (Waste Management) Regulation 2000 (WM Regulation) focuses on minimising the impact of waste on the environment including,
in particular, the impact of waste so far as it directly affects human health; and by establishing an integrated framework for minimising and managing waste under the principles of ESD.9

The regulation stipulates offences for littering, waste dumping, unlawful disposal of hypodermic needles and unlawful activities at waste facilities, a procedure for approval of wastes for beneficial reuse and a waste tracking system that collects data on waste generation, transportation and disposal within Queensland and interstate.10

**Trackable Wastes**

The transportation of certain regulated waste requires waste tracking to reduce the risk of environmental harm. This is an important aspect for synergy initiatives where wastes are typically transported between sites and often on public roads. Even though some trackable wastes do not have any environmentally significant characteristics, they are treated as a regulated waste which means that all appropriate approvals and licences must still be in place to transport, receive, recycle, reprocess, treat or store regulated wastes.

One of the Gladstone industries produces filter cakes which are listed as a trackable waste. However, these filter cakes are believed to have no potential to cause environmental harm. Currently these cakes need to be transported to an appropriate facility in Brisbane, approximately 600 kms away, for disposal. Before this regulation, the cakes were disposed of in landfill, costing significantly less than the present arrangement. An exemption is currently being sought for this waste because of its inert properties. This waste can be used for land reclamation as it is believed to present no harm to the environment. However, even if this approval is given, the waste will still be regulated and the necessary approval and licences will thus be required to be in place. If the waste is produced in low volumes, these requirements may make it economically unfeasible to reuse the waste.

An example of a traceable waste that has been granted exemption is fly ash. The transportation of power station fly ash to a place for use as a raw material in the production of cement or concrete, or in the construction of a road, or to a farm for use as a soil conditioner or fertilisers is not a trackable waste. This is occurring at the Gladstone where fly ash from the power station is being transported for use in the production of cement.

**Resource for Beneficial Use**

As regulatory requirements for waste may restrict reuse options, the EP Act makes provision for beneficial resource approval which allows some wastes to be recovered and reused safely without giving rise to adverse environmental or health impacts. Before approval can be granted, it is is necessary to ensure that potential risks have been examined thoroughly.

The examination and administration of beneficial resource approvals is left to the WM Regulation. The regulation restricts applications for the approval of beneficial resources to those who possess the resource at the time the application is made.11

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9 Environmental Protection (Waste Management) Regulation 2000 (Qld) s 4

10 Environmental Protection Agency Queensland (2006c)

11 Environmental Protection (Waste Management) Regulation 2000 s 66B (1) (a)
Alternatively, consent can be given by the person possessing the resource to make an application on their behalf.\(^{12}\)

While theoretically this sounds like an ideal way to gain approval for synergy opportunities, in practice only eight beneficial resource applications have been approved in the last seven years of operation. All of these have been approved as a specific resource with a specific producer and consumer rather than a ‘type’ of beneficial resource. Getting the resource approved as a specific type is similar to getting the resource use approved through a condition of a development approval.

Only one company in the Gladstone region indicated that it has Beneficial Resource Approval. This was for waste pitch to be reused by a clay pigeon target manufacturer. As the manufacturer had previously used pitch and had the necessary safety precautions in place, the approval was granted after inspection. However, during negotiations a condition was proposed that would have meant reporting measures similar to those required for trackable wastes. This was rejected by the applicant because the reason for seeking this approval was to avoid such reporting requirements. This demonstrates the need for regulators to use this provision wisely by not over-regulating and not diminish the incentive for recycling.

A possible solution is to create a database that lists the approved resources and their approved use to date, which could reside on the EPA website for access to potential recyclers. Companies that wish to pursue the reuse option should then apply to the EPA to use the approved resource in the same or similar manner to that currently approved, demonstrating that their individual use would be substantially similar and thus have no, or minimal, environmental risks. The EPA would still have full control over licensing but this approach could stimulate potential recyclers into action.

**Other Legislation**

Other legislation relevant to specific operations in the Gladstone region that has the potential to affect recycling initiatives includes the *Coastal Management and Protection Act 1995 (Qld)* and the *Integrated Planning Act 1997 (Qld)*.

**Coastal Act**

A potential synergy opportunity for the Gladstone Region is to dredge sand locally for re-use as commercial grade sand, provided it meets the necessary end use requirements. Currently, the sand is either dumped at sea or used in land reclamation, both of which are authorised under the Coastal Act. Re-using the sand would risk reassessment of the development approval and incur a royalty fee of $1.45 per m\(^3\). Therefore, the Coastal Act, through its royalty fee, appears to directly oppose the WP Policy’s waste management hierarchy and encouraging disposal of waste sand rather than the re-use of it.

**Integrated Planning Act**

In 1997, the Queensland Government introduced the *Integrated Planning Act 1997 (IPA)* for assessing and placing conditions on development applications in Queensland. This new system, which is known as IDAS (Integrated Development Assessment System), aims to co-ordinate and integrate the assessment and

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\(^{12}\) *Environmental Protection (Waste Management) Regulation 2000 s 66B (1) (b)*
conditioning powers of government agencies responsible for administering a range of legislation dealing with development approvals

A development approval outlines the conditions that bind the holder to protecting the environment and conducting their operations in an acceptable environmental manner. While this has the benefit of providing for certainty, it can make it more difficult to change practices, even if more sustainable solutions become available.

**Licensing**

All partners involved in the Gladstone synergies project currently have the relevant licences to produce their waste; however, if they wish to sell this waste to a receiver, this receiver must also obtain the necessary approvals or licence to deal with that particular waste. This can be a significant hurdle, particularly for sites that extract calorific value from wastes as an alternative fuels source; for instance, the clinker kiln at the cement plant. The necessary licences and approvals are required, even if the waste volume is small or sporadic. This can often mean that a high fee will be charged for taking specific types of waste to recover costs for the relevant approvals. The higher fees discourage companies from selling and recycling their waste, instead encouraging them to find cheaper alternatives for the waste, which usually results in disposal to landfill.

**Waste Management Strategy**

The EPA released the Waste Management Strategy for Queensland (the Strategy) in 1996, after comprehensive consultation and review. Whilst it is not a legislative document unlike the other Policy, Acts and Regulations above, strategies like this one can be vital to the appropriate implementation of an effective waste management framework.

The essential elements of the Strategy comprise the waste hierarchy and principles. These were incorporated into the *Environmental Protection (Waste Management) Policy 2000* (above, WM Policy) and the *Environmental Protection (Waste Management) Regulation 1998* (above, WM Regulation) thus achieving its main aim. In addition, there were a number of objectives that aimed at overcoming barriers to recycling and promoting reuse as a viable option by establishing the necessary infrastructure and education in the market. However, these aims were never achieved nor were they revised or updated which resulted in the Strategy becoming redundant. Although substantially defunct, there have been no replacements so technically the strategy is still applicable to Queensland’s waste management regime and synergy projects.

**Potential Civil and Criminal Liability for Reusing Waste**

Fear of possible litigation due to liability may also present a hurdle to the implementation of synergy projects. However, this risk can be managed appropriately though a number of initiatives. These are examined below, starting with defences to criminal liability and then examining the use of exclusion clauses and product labelling. Figure 11 schematically represents the relationships between potential civil and criminal liabilities.
Figure 11  Potential Civil and Criminal Liability due to By-Product and Waste Re-Use
Criminal Liability from Re-Use of Waste or By-products

Individuals or companies may be liable for criminal liability if, a) harm occurs to the environment; or b), harm occurs to individuals. Criminal liability for environmental harm predominately arises from the Environmental Protection Act 1994 (Qld). Criminal liability for individual harm can potentially arise from health and safety regulations such as the Health Act 1937 (Qld) or the Workplace Health and Safety Act 1995 (Qld).

Criminal Liability for Environmental Harm

There is one basic defence to a charge of unlawfully causing environmental harm and that is proof that ‘the harm happened while an activity (that is lawful apart from the Act) was being carried out and the defendant complied with the general environmental duty’. However, the case of Environmental Protection Authority v Ampol demonstrates that complying with the relevant standards and codes was not enough if the general obligation to avoid or minimise environmental harm has been breached. (Ampol should have had measures in place, as general obligation to avoid or minimise environmental harm, to prevent the escape of 2000 litres of diesel even though it was not required by the applicable code.)

In synergy projects, to protect corporations and individuals who participate in reusing waste from the possibility of criminal liability, it is important to ensure compliance with the relevant regulations (or policies) and to ensure fulfilment of the general environmental duty that applies to all Queenslanders. Applying risk management principles, namely identifying risks, implementing controls, checking controls, and addressing incidents, is another mechanism for avoiding liability. ISO14001 can also provide the mechanism for avoiding liability.

Criminal Liability for Individual Harm

The Health Act 1937 (Qld) (HA) and the Workplace Health and Safety Act 1995 (Qld) (WHS Act) both protect individuals from harm. The WHS Acts aim is to prevent a person’s death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace and to achieve this object, a framework is established for preventing or minimising exposure to risk. The WHS Act aims to do this by obliging employers to ensure and maintain a safe working environment that is without health risks to individuals and their co-workers. While there is a possibility of criminal liability for individual harm under the Health Act it is probably no more likely for the reuse of waste than for the use of any other product. If successfully managed, this should not present a hurdle to the implementation of synergy projects.

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13 Environmental Protection Act 1994 (Qld) s 436(2).
14 Environmental Protection Authority v Ampol (1994) 82 LGRA 247.
15 Workplace Health and Safety Act 1995 (Qld) s 7
16 Workplace Health and Safety Act 1995 (Qld) s 29
Civil liability for Harm due to By-Product and Waste Re-Use
The law of tort raises two forms of liability that may arise during the supply of products such as those involved in the synergies initiatives. These are private nuisance and negligence.

Private nuisance is relevant to synergy initiatives if there is a potential that re-using waste product could have harm to the neighbours’ use and enjoyment of land. Negligence involves a duty of care, a breach of that duty and damage resulting from that breach as well as sufficient proximity and foreseeability. The possibility of negligence occurring is remote and is unlikely to prevent the implementation of synergy opportunities, if properly managed.

Limiting Liability through Exclusion Clauses and Labels
The criminal and civil liability of using wastes and by-products, and the liability involved with representing the ‘fitness of purpose’ during the buying/selling of waste and by-products could be managed and limited through exclusion or limitation clauses or by labelling waste products prudently. The concept behind the use of exclusion clauses is that if nothing is mentioned on the subject matter then the prevailing statute will apply, however, if there is an express agreement between two parties at arms length (without any unconscionable conduct) then this agreement will override statute as it is more specific.

For labelling, the idea is to inform the other party about the potential danger or risks involved with the by-product or waste so as to fulfil one’s duty of care and thus limit liability or nuisance claims. Clear and concise labelling that does not mislead or deceive can effectively manage potential liability.

Contractual Issues for Synergy Initiatives
As noted, most of the short term and long term synergy opportunities identified in the 2005 Regional Synergies Report have not been implemented. Issues such as contractual arrangements or existing agreements limited the scope to realise some synergy opportunities. An example was the use of biomass fuel from vegetative wastes from local companies or sawmills at the Gladstone power station. Not only would reusing renewable energy result in capability for the company to purchase renewable energy certificates, as required by the Renewable Energy (Electricity) Act 2000 (Qld), but buying this waste could also help support the smaller communities in the district and could possibly translate into an enhanced local reputation. Despite these significant benefits, this opportunity has not been taken up because of a contractual prohibition.

The South East Queensland Forestry Agreement prevents the purchase of wood waste from mills that log native vegetation, while also outlawing the harvesting of so-called 'forest residues' from native forests (e.g. for 'green energy'). This not only prevents

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18 Townsend, M (2000) pp 33
19 Corder, GD (2005) Potential Synergy Opportunities in the Gladstone Industrial Region’ Centre for Sustainable Resource Processing
the use of the biomass waste and thus prohibits the potential synergy opportunity, it may also present disposal problems and potential fire hazards for those mills that stockpile this type of waste wood. The agreement made by the logging industry, the government and conservationists, states that native logging is to be phased out by 2024. However, by not considering or allowing waste wood to be used in the meantime, 17 years of waste wood could accumulate at Queensland mills rather than be used for ‘green energy’. This issue highlights the importance of including all stakeholders when making significant agreements.

Commercial agreements can also prevent synergy opportunities from being realised as long-term waste management relationships may already commit companies to use certain waste providers or transporters. These agreements are typically lengthy and do not promote changing the pattern of waste use or disposal. This reason was given on numerous occasions by representatives of the industries in the Gladstone region for not implementing synergy opportunities.

**Recommendations and Conclusions**

The literature states that it is often a number of small disincentives or barriers that hinder industrial symbiosis rather than one specific barrier. This has also proven to be the case for regional synergies in Queensland. However, rather than focusing on fixing these small problems individually, perhaps the most sensible way to counteract these problems is by improving incentives and drivers for recycling and reusing waste as a whole.

Below are a number of recommendations that can improve Queensland’s regulatory waste management framework by inducing industries into action through the promotion of uptake of synergy projects and industrial symbiosis.

Perhaps the most significant problem with Queensland’s regulatory waste management framework is the lack of an effective waste management strategy. This is a result of the failure to review the 1996 Strategy which caused it to become redundant. Initiatives should be put in place to rectify this situation. Such initiatives could include better data collection, providing education on the meaning of ‘beneficial resource’, instigating financial incentives for recycling, encouraging the reduction of waste management service contracts, and promoting regional council programs and workshops on collaboration schemes for recycling.

Perhaps the most significant recommendation in this list is for the introduction of financial incentives. Queensland is currently one of the lowest overall recycling rates in the country (31.5% in 2002/03). The improvement of recycling rates after the introduction of landfill levies has been seen in New South Wales, Victoria, the ACT and South Australia.

The NSW levy funds a substantial range of environmental programs to reward waste reduction and help deliver improved waste service performance standards. In some states, rebates can be claimed for waste that will be re-used as it leaves a facility, in addition to waste that has been recycled or reprocessed at the facility. Different wastes can also be targeted with prescribed industrial waste incurring a higher fee.

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than non-hazardous municipal waste. The rates can also be increased annually and predictably to promote change in operations over time.

Based on examination on landfill levies in other states, Queensland’s recycling rate could be raised significantly if a financial driver for recycling and reusing wastes and by-products was introduced - for instance, reinvesting the money from a landfill tax to support recycling initiatives.

While improving aspects of the current system would not have such a significant impact on the uptake of synergy projects as the implementation of financial drivers, changing the administration of beneficial resource approvals may be easier and quicker to implement as the necessary provisions already exist.

Beneficial resource approval has many attractions for those wishing to get approval for recycling wastes and by-products, because once approved all other waste regulations are no longer applicable. Despite this advantage, only 8 approvals have been granted.

Another improvement could be to stimulate the increased use of wastes as beneficial resources by approving resources only as types of resource, rather than specific resources. Types of resources, once approved, would allow all members in that industry that produce the same waste to use it in the manner approved. As many facilities identify additional licensing requirements as a hurdle for implementation of synergy opportunities, approval as a beneficial resource could result in waste management companies specialising in the recycling of the particular beneficial resource.

While the Gladstone region and indeed Queensland shows significant potential for the implementation of regional synergy opportunities, currently the necessary supportive regulatory regime is not present. This is an important enabling mechanism that can help to realise synergies by overcoming the current regulatory barriers that are combining to prevent synergy implementation. Improvement of the Waste Management Strategy is one such mechanism through which the necessary drivers, crucial for improving recycling rates, can be put into operation.