COMMERCIALISING WASTE:

TURNING WASTE PLASTERBOARD IN CHRISTCHURCH INTO A VALUABLE RESOURCE

By Fraser Scott, True North Consulting

021 122 4167 | fraser@tnc.co.nz | www.tnc.co.nz

Introduction

Small volumes of waste plasterboard have been recycled in Christchurch for over a decade. Used primarily as agricultural fertiliser, the gypsum extracted from waste plasterboard is a low value product, with a supply that has typically far exceeded demand. The result has been that most construction and demolition waste plasterboard in Christchurch has been sent to landfill. This raises issues, not only of wasting a usable resource, but also around the potential harm that may result from the hydrogen sulphide gas that can be emitted when waste plasterboard interacts with organic matter in a landfill.

A group of industry stakeholders formed in early 2011 to consider this issue and to determine whether an economic model for the wide-scale recycling of waste plasterboard could be determined. This group, which was comprised of Winstone Wallboards, Holcim Cement, Christchurch City Council, BRANZ and 5R Solutions, was further motivated by the unprecedented volumes of waste plasterboard likely to be produced from demolition and construction activity as a result of the February 2011 earthquake. Testing undertaken by Holcim Cement had confirmed that their cement manufacturing process, in which imported natural gypsum is a key element, could support the use of recycled gypsum. This development provided an end user for recycled product with scope for high rates of usage to be achieved.

With funding from the Ministry for the Environment's Waste Minimisation Fund and direct stakeholder contributions, the Gypsum Recycling for Cement Manufacture (GR4CM) feasibility study was launched in August, 2011 with an overall objective of "reducing the amount of waste plasterboard entering the waste stream by 32% per annum through improved design and onsite management practices and increasing the amount of plasterboard being collected and recycled in the Canterbury region by 3,000-6,000 tonnes per annum".

The feasibility study recognised that several unsuccessful attempts had already been made in New Zealand (including Christchurch) to create a viable system for recycling plasterboard. With this in mind the study identified four key objectives:

- Identify (by 31 March, 2012) a financially viable waste reduction, collection and recycling scenario that can then be implemented, promoted and scaled up over time
- Achieve a 10% reduction in plasterboard waste generated on new building projects by 31 December 2012
- Achieve an additional 200% (3,000-6,000 tonnes) of plasterboard collection in the Canterbury region per annum by 31 December 2013
- Achieve an additional 200% (3,000-6,000 tonnes) of plasterboard recycling in the Canterbury region per annum by 31 December 2013

Methodology

The GR4CM group determined from the outset that the feasibility study must be grounded in commercial reality and not be too 'optimistic or aspirational' in its conclusions. There was an inherent recognition that waste minimisation service design endeavours are inclined to assume that businesses and consumers will act altruistically and with a focus on environmental impact, when this is not typically what is observed.

To this end, a business consultant (the author) was engaged to undertake the project as an evidence-based commercial feasibility study. In accordance with this model the project was split into five key milestones:

- Milestone 1: *Industry overview.* This phase of the project involved thoroughly analysing the existing industry and mechanisms for production, collection, recycling and end use of waste plasterboard in Christchurch. Interviews were undertaken with key stakeholders and service providers to build an understanding of industry activities, issues and relationships, and a model constructed illustrating the current cost structures and revenue streams in the industry at existing volumes. The history of the industry, including previous attempts at recycling, was considered in order to identify key barriers, issues and limitations to scale.

- Milestone 2: *International Industry Trends.* This phase of the project involved reviewing published research and presentations detailing successes and failures in the implementation of waste plasterboard recycling systems internationally. Technological advancements and emerging trends in the collection and recycling of waste plasterboard, and the potential impacts these could have on the collection and recycling of waste plasterboard in New Zealand, were studied.

- Milestone 3: *Potential Scenarios.* This phase of the project involved preparation of a high-level vision for an economically sustainable gypsum recycling business model, with explicit critical success factors. Based on synthesised data, several potential scenarios for implementing scaled-up systems for the collection, recycling and end use of waste plasterboard in Christchurch were created. Broad supply chain and financial models were created for these scenarios based on stated assumptions and risks, and initial feasibility analysis was undertaken.

- Milestone 4: *Stakeholder Collaboration.* This phase of the project involved working with individual stakeholders to develop detailed business cases, supply chain models and financial models around the scenarios created. Workshops were undertaken with stakeholders to test and enhance these models and ensure a base level of feasibility for pilot trials before commencing. Stakeholder feedback was integrated and synthesised into scenarios to prepare for pilot trials.

- Milestone 5: *Scenario Pilot Trials.* This phase of the project involved building detailed evaluation criteria and mechanisms for pilot trials, and gaining endorsement from stakeholders. Small-scale, iterative business model pilot trials were implemented and evaluated to determine whether a feasible model could be identified. At the conclusion of the pilot trials, the preferred business model scenario was presented and endorsed by the stakeholder group. At this point responsibility passed to the commercial stakeholders involved to implement the business model based on the learnings from the project.

Results

The initial analysis of the Christchurch industry suggested that many of the conditions required for a successful waste plasterboard recycling business model were in place. A motivated end user in Holcim Cement was present and a processor with access to current technology was also available. The key barrier to success was quickly identified to be the cost and effort in sorting waste plasterboard, particularly given the low prevailing perception of marginal savings in sorting waste plasterboard.

Conclusions from the in-depth analysis of international models (mainly from the UK, Scandinavia and the US) included:

- *None of the markets considered thrived without high landfill costs or a ban on landfilling waste plasterboard*. Where landfilling is relatively inexpensive, and it may be argued in New Zealand that it is, it was apparent that creating a thriving plasterboard recycling business would prove extremely challenging. Landfill costs internationally are driven by the almost universal acceptance of the risks of combining waste plasterboard with organic waste and the resulting creation of hydrogen sulphide. This concern has not yet been formally addressed in New Zealand.

- *There are basic economic requirements in a successful model that appear to be virtually absolute*. The first of these is that the cost of disposing of segregated waste plasterboard must be materially lower than the costs of dumping mixed waste. The second is that the costs for an end user of obtaining recycled gypsum must be materially lower than the cost of obtaining new gypsum. All evidence suggests these decisions are made on a pure price basis.

- *Successful operations rely on on-site segregation*. It was concluded that a successful model must work hard to understand the needs of the building or demolition contractor to make this process as easy and convenient as possible. Consideration of these needs extended to collection processes which needed to align closely with the 'rhythms' of operation on the building or demolition site. Developing strong and

positive working relationships between collection contractors and building or demolition contractors was seen as vital.

- *Transportation costs can be a significant barrier to success, and transportation processes must be optimised*. Minimising transportation movements and making use of back hauling where possible was clearly important in keeping costs down.

- *Pricing strategies are important.* Pricing for waste disposal based on weight alone did not appear to be sufficient, and the quality and contamination level of the waste needed to be considered.

- *Processing technology should allow for demolition waste*. The volumes required in New Zealand suggested that demolition waste must be considered but, as in most areas of the world, this provides significant challenges. A higher price for receiving demolition waste appeared to be justified.

Four key 'new sources' of waste plasterboard for recycling (in addition to manufacturing waste which was already recycled through 5R Solutions) were identified:

- Residential construction waste
- Commercial construction waste
- Residential demolition waste (primarily earthquake-related)
- Commercial demolition waste (primarily earthquake-related)

Each of these was considered as a separate 'track' through the research as, while the processing and end use considerations were consistent, the economics of extraction, sorting and collection for recycling were clearly unique for each different source.

Residential Construction Waste

Consideration of a sustainable business model for the recycling of waste plasterboard from residential construction was given considerable attention due to the expected sharp increase in building activity in Christchurch post-earthquake, and because this supply would continue indefinitely, albeit at lower volumes, unlike demolition-related sources. The participation of Transpacific and Mastagard in trialling different collection options allowed two distinct on-site collection systems for waste plasterboard to be tested.

Mastagard offered a multiple bin system with a skip for general waste, a skip for plasterboard, timber and steel and four smaller bins for other recyclable waste such as polystyrene and cardboard.

Transpacific provided a 'Flexibin' system, consisting of a proprietary polypropylene bag. This was provided to installers as a small handheld folded bag that could then be assembled into a two or three cubic metre unit for receiving waste plasterboard. A customised gantry truck was employed by Transpacific to facilitate pick up of these units.

The two systems were trialled by three Christchurch builders with the Flexibin system proving to be the most acceptable and cost-effective solution. The skip-based system was seen to take up too much space and resulted in too high levels of waste contamination.

Overall the pilot involved:

- 18 homes, with on-site sorting and collection of waste plasterboard
- An average of just under 700kg (3 m^3)of waste per home
- Minimal levels of waste contamination, with no dampness from weather which can negatively impact processing
- An average waste figure (percentage of plasterboard ordered by building companies that was wasted) of 13%
- An expressed satisfaction with the service model from three out of four installers and two out of three building companies

The pilot for residential construction plasterboard waste recycling demonstrated that it was feasible, but that uptake would depend on the effective engagement of building companies.

The greatest argument for the feasibility of this service was the simple fact that two out of the three building companies that participated in the pilot continued to recycle plasterboard using the Flexibin service offered by Transpacific after the project concluded.

One of the participants, Stonewood Homes, has subsequently transformed its entire waste management system to the use of source separation via Flexibins as a result of the data generated from the trials.

Informal research with two additional building companies following the conclusion of the pilot suggested a willingness to trial the service and a general acceptance of the need to both minimise and recycle waste. It appears likely that, so long as the service is not more expensive than the incumbent waste management system, a wide uptake is possible.

Commercial Construction Waste

The economics of managing large-scale building projects prompts most building contractors to sort waste on-site, including plasterboard waste. While it is anticipated that this will be the case for commercial construction projects as part of the Christchurch rebuild, the absence of any such activity during the project timeframes did not allow further consideration of methods for improving collection rates.

Discussions with key personnel from a number of major building contractors did suggest, however, that no fundamental barriers existed to recycling plasterboard and that such activity was intended for future projects.

Residential Demolition Waste

A delay in residential construction activity (initially slated to begin in October 2011) until February 2012 limited the engagement of contractors in trial activities. Once activity did begin, determining who in 'the system' had the decision-making power to alter demolition processes was extremely difficult. After protracted discussions and negotiations with demolition contractors, it was determined that no baseline feasibility existed for recycling of waste from residential demolition. This was particularly disappointing as as much as 80,000 tonnes of waste plasterboard are believed to be contained within homes set for demolition.

The key information that determined the absence of feasibility came from a Christchurch-based salvage company that had extensive experience in removing plasterboard from residential dwellings for recycling and application to agricultural purposes. The company advised that, in their experience, removal of plasterboard by three experienced labourers

took two days, with an additional day required for removal of ceiling plasterboard. They concluded that this was not possible for earthquake-related demolition for three reasons:

- The cost in time far exceeds the savings made by avoiding landfill dumping fees
- The economic returns from other resources in the home such as framing or wiring were minimal, and did not meet the cost savings shortfall
- The Project Management Offices (PMOs) allowed two days *in total* for the demolition of a home. Increasing this to four or five days for removal of plasterboard would not be permitted

Commercial Demolition Waste

The GR4CM project coincided with the bulk of the Christchurch earthquake commercial demolition activity and so the availability of a recycling service was heavily promoted, with the assistance of CERA, to demolition contractors. Contractors paid a rate of approximately $40 + GST per tonne to dispose of sorted plasterboard waste, as opposed to an average of $120 + GST per tome for mixed waste to landfill.

Several large demolition contractors participated and waste from buildings including the Grand Chancellor, BNZ and Westpac buildings was recycled. Contractors were frank about being driven primarily by price and speed; environmental or resource recycling concerns were almost completely absent.

Given this fact, ongoing participation beyond the project by engaged contractors was a strong indication that diverting plasterboard to a recycling facility offered compelling economic benefits. It was concluded that the feasibility of waste plasterboard recycling from commercial demolition was likely to be limited to those applications where the time taken to recycle is not significantly greater than existing processes and where there is a marginal cost saving versus landfill disposal of plasterboard. Multi-storey commercial buildings that are being deconstructed are the obvious candidates for this process.

Conclusions

The goal of tripling the volume of waste plasterboard recycling in Christchurch has likely been met based on increased commercial demolition and residential construction waste recycling, although, as the goal centres on sustainability, only sustained volumes over time will satisfy the project's objectives.

Fundamental in achieving these results has been working with industry to understand the realities of their processes to ensure the business model and service delivery methods align as closely as possible with existing practices. In both the construction and demolition sectors, change appears to come very slowly and both economics and convenience are primary drivers for the people actually tasked with handling waste.

The importance of a competent waste processor cannot be underestimated, especially when only one such processor exists in the marketplace as is the case with plasterboard. While there are a number of different sources and collection methods for waste plasterboard, everything depends on the processor having the capacity and capability to consistently and reliably receive and process the waste, which is often challenging for a small business.

Systems to viably capture waste from residential and commercial building sites clearly exist. While the marginal economic benefits on the former are low at best, a reasonable proportion of the residential building industry are likely to adopt these mechanisms, particularly with the backing and reliable service of the largest waste transportation operator in Christchurch behind them. Transpacific's vested interest in the service, and their desire to increase the value of the benefit delivered by offering compelling complementary services to handle other waste, bodes well for the future of this waste stream.

Beyond Christchurch, it is considered probable that potential exists for rollout of residential and commercial waste plasterboard collection systems, particularly those main centres that can supply the needs of Golden Bay cement in the Far North.

One final note, as advised by Holcim, is that increasing publicity around the use of recycled gypsum in cement manufacture has led to a number of enquiries and a low level of concern from customers as to its potential impact on product quality. There has been no impact on quality, but it is clear that customer perceptions must be managed in such an endeavour.