

Construction and Demolition Waste Management Plan to Support Required Recycling Rates in Florida

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In 2008, the "*Energy, Climate Change and Economic Security Act of 2008"* was passed by the State of Florida, United States (US) legislature. The act established a new statewide recycling goal of achieving 75% recycling rate of municipal solid waste (MSW) by the year 2020. Currently, C&D waste comprises approximately 28% of total MSW in Florida, a significant portion. The first set of recycling goals passed by the legislature in 1988 aimed at achieving 30% recycling rate for MSW. Today, after more than two decades, Florida recycles only 28% of its overall MSW and only 27% of C&D waste is recycled or recovered. Data is provided about where Florida currently stands in term of C&D waste recycling as a whole, and a rationale is provided for an integrated market-based waste management plan to support recycling efforts. The identification of conditions, such as transportation costs, that limit diversion and provision of realistic diversion rates based on market conditions are discussed. The proposed waste management approach has the potential to explain gap between legislative goals and current market rates and provide insight as to increasing waste diversion rates.

Key Words: Construction and Demolition, Waste, Diversion

Introduction

In the late 1980s, the state of Florida set its first recycling goal aimed at achieving a 30% recycling rate for total municipal solid waste (MSW) by the end of year 1996. However, as per reported data in 2007 from a study conducted by Cochran and Townsend "Estimation of regional building-related C&D debris generation and composition: Case study for Florida, US", 11 years after the goal year, showed Florida generated 32 million tons of MSW, of which only 8.96 million tons (28%) was recycled. In the same year, Florida generated 8.03 million tons of construction and demolition (C&D) waste, of which only 2.22 million tons (27%) was recycled (Cochran 2007). Despite these facts, in 2008 the Florida legislature passed another act, "*Energy, Climate Change and Economic Security Act of 2008*" with a goal of recycling 75 percent of total MSW waste by the end of 2020 (FDEP, 2008).

This study looks to establish a better understanding of county self-reporting recycle and diverted material trends from 1996 to 2010 as well as determine hindrances to achieving the new 2020 goal. As a result, this study additionally provides an outline for a more feasible business minded approach for policy makers that take into account market demands, transportation, education, and processing in a more integrated business plan.

A comparison between recent recycling or diversion rates and the legislation being passed illustrated a gap between legislative goals and local market execution. Current practices were examined to determine whether the current legislative goal is achievable and to what extent C&D waste may be diverted on a county by county basis. A construction and demolition (C&D) waste survey was conducted to analyze trends in county self reported recycling rate data. Recycling data is self reported annually by county officials throughout the state. The survey was sent to those noted as the county official or operators responsible for reporting data to the Florida Department of Environmental Protection (FDEP) that oversees waste collection and diversion data. Analysis of survey data revealed that a platform for communicating outcome goals and key market drivers was needed to better link policy makers to C&D efforts. A business model focused approach to increase the C&D waste recycling rate in the state of Florida evolved from this research.

Recycled construction and demolition materials are defined by the EPA as debris generated during the construction, renovation, and demolition of buildings, roads, and bridges. C&D materials often contain bulky, heavy materials, such as concrete, wood, metals, glass, and salvaged building components (EPA, 2008). According to the latest data from 2008, Florida recycles around 28% of total C&D-generated waste (FDEP, 2000). Traditionally in the United States construction site-generated C&D can be handled in the following ways:

1. Recycle on-site.
2. Transfer to recycling or product recovery plant directly from site.
3. Divert to C&D debris facility (i.e., landfill) for recycling or disposal.

If material is recycled or reused on-site, for example crushed concrete as sub-base, there are no associated offsite transportation costs for the product. Both transfer to recycling plants and diverted to landfills require transportation costs from the jobsite to the facility. Once C&D waste is diverted from a site, there are a limited number of methods by which it can be managed. It can be disposed of at a landfill facility permitted to accept C&D waste or processed at (a) a material recovery facility (MRF) or (b) a transfer station where recyclable materials are separated from the C&D stream.

Factors Affecting C&D Waste Generation

There are various factors affecting C&D waste generation, these include: volume of construction, demographic and economic economic factors. In addition, there are other barriers affecting the C&D recycling, these include: tipping fee and site location. The volume of construction can greatly affect the generation of C&D waste. For example, more volume of construction will lead to more C&D waste generation. More construction activity can also cause more demolition, which will increase the generation of C&D waste in the future.

Demographic factors also affect C&D generation (Franklin, 2003). Increased population places greater demands on residential, commercial and institutional construction, resulting in more demand for houses, schools, offices, parking and other supporting structures. Conversely, areas with smaller populations will have less wear and tear on roads and building structures, thus reducing C&D generation.

More construction accompanies any region that is economically strong or growing. Economic development will result in construction of new offices for growing business and homes for new workers. Jobs per capita and income per capita are elements that indicate economic development in a particular region. One of the main factors that affect C&D recycling is the ease of buying or selling recycled products. For C&D material to be recovered, a market for their reuse is essential.

A *tipping fee* is the flat cost of a truck disposing of (or tipping) material into a landfill or facility. Tipping fees and recycling rates are proportional to each other. Campman (2001) found that as tipping fees increase with disposal costs, people are more likely to recycle more waste to keep their own costs down (Campman, 2001).

In another C&D diversion study, Brooks (2005) found a similar trend: an increase in tipping fee resulted in increased recycling rate. The result of that research and other research conducted in the northeastern US indicated a direct relationship between increased tipping fees and increased recycling and diversion rates. The average cost of disposal for C&D in Florida is $42.69 per ton, and it ranges from $25.00 per ton in Bay County, which is located in north Florida, to $92.00 per ton in Monroe County, which is at the very tip of southern Florida.

Method

The main source of information used in Florida to obtain C&D waste generation data is the final report submitted by each county to Florida Department of Environmental Protection (FDEP, 2000). Each C&D waste facility throughout Florida is required to complete and submit a waste estimate form to its respective county. The estimate form contains information about the amount of waste accepted and recycled by that county in a particular year. Each county then submits a combined final report to FDEP.

The methodology of this research was divided into two sections: (1) a survey conducted throughout Florida and a comparison of survey results with existing self reported data from counties to FDEP, and (2) propose a waste management plan based on business strategies. Responding counties were then grouped based on geographic, population, and self-reported recycling rate variance.

In the first section, the process was based on the following factors:

Population: Population was considered the main factor for analyzing C&D waste. The larger the population, the more waste it generates.
Higher recycling rate: The second factor used for the selection process was the recycling rate of a particular county in the last few years. It is important to know why a particular county had an impressive recycling rate and why its neighboring county might not be doing as well. The waste management practices adopted by these counties can be applied to other counties as well to get a good result.
Fluctuating recycling rate: Another factor to consider in the county grouping process is high fluctuating, year-to-year recycling rates. There was a question as to if the fluctuating rates were reporting errors to the state or actual fluctuations in material processed at the sites.

All counties in the state of Florida are required to report their C&D waste recycling rates to the FDEP. Recycling rates for each county vary by a wide margin. The survey questionnaire was comprised of 10 questions and emailed to 200 entities listed on the FDEP website as county officials or private entities working in the C&D processes in the state. Further information was solicited by follow up emails and phone calls. Of the 34 entities that responded to the survey, most belonged to the following three types of agencies:

County-owned waste facilities (n=20)
County administration (n=6)
Private waste recyclers (n=1)

The survey questionnaire focused on current diversion rates and reasons for the lack of diversion.

1. Which category of ownership does your site fall under (i.e., private, county)?
2. Are you aware of the 75% diversion goal?
3. How much C&D waste is being recycled at your facility?
4. Which of the following C&D materials would you like to recycle/divert but cannot?
5. Check the reasons for the lack of diversion?
6. From 1998 to 2007 there was a sharp reduction in reported diversion rates. In your opinion what was the cause of this fluctuation?
7. If your facility/counties recycling rate varies by year; in your opinion why does this happen?
8. At what level would you set the recycling goal for C&D waste that can be achieved by 2020 and what amount of investment will it require to reach the respective goal?
9. Rate the following based on their potential to improve the C&D recycling rates in your county (e.g., Buy new equipment, improves sorting process).
10. I believe the current economic recessions will increase/decrease/no change to recycling rates.

Results

As reflected in Table 1, the majority of the 34 facilities recycle between 0% - 20% of the C&D waste (n=21) diverted to their facility/counties. Survey responses indicated that gypsum or gypsum board, roofing material, and carpet were the most difficult to recycle. Survey responders were asked to choose between the following options as a reason for low recycling rates in their facilities/counties:

1. Unavailable equipment for recycling.
2. No recycling facility available.
3. Recycling facility present but too far away to transport material.
4. No local market for recycled products.

5. Uneconomical to recycle or it is cheaper to landfill.

Respondents were allowed to select more than one reason for each material type. The result of this section is shown in Table 2. The results indicate the limitations that C&D facilities have in effectively handling common debris. The highest rated category is listed as "5. Uneconomical to recycle or it is cheaper to landfill." This indicates that profit based diversion plans need to be developed more fully to increase rates.

How to Reach Mandated Goal

Survey responders were asked to rate the best way to reach the 75% legislated goal on a scale of 1 (low impact) to 5 (high impact). As shown in Table 3, a majority of responders believed the best way to reach 75% recycling rate was by improving the C&D waste sorting process at their facilities/counties.

Integrated Waste Management Plan

An integrated waste business plan is formulated in order to increase the diversion of waste as well as generate revenue and increase profitability from diverted waste streams. The goal is to develop a systematic strategy based on processes that view the waste stream holistically with an emphasis on social and financial tradeoffs. The Integrated Solid Waste Management (ISWM) model concept was introduced in the late 1990s (EPA, 2002) ISWM works towards pushing reliance away from the landfill towards a wider range of waste management techniques, including environmental, economical and social aspects. In order for the ISWM model to run effectively, a strategic system should be set into place. The system should consider: awareness, preparation, implementation and follow up as well as fundamental business strategies in order to support higher mandated recycling rates.

Achieving a recycling goal is a four-step process that emphasizes awareness, preparation, implementation, and follow-up. Cross-disciplinary goals are dependent on players from design preparation through deconstruction collection. This study suggests that Florida policy makers consider the following:

1. Awareness: spread the idea of the 75% goal. Conducting more surveys, emails, phone calls and meetings can accelerate this process.
2. Preparation: generate a financially feasible and practical business model. The business model should be set up according the criteria and strategies listed below (this step will be discussed in detail in the next section).
3. Implementation: states and counties throughout Florida should make sure all facilities are following the waste recycling model. Introduce incentives and workshops in order to educate recycling entities about waste management plan.
4. Follow Up: for example, every county may set yearly recycling goals of 5% or more than the previous year.

This research focuses on second and third steps above to promote a financially viable alternative to land filling construction waste. The main criteria for which policy makers and public and private operators base the business model are listed below:

Identify waste that is economically feasible to recycle on-site or waste currently being recycled.
Waste that can be recycled locally.
Waste that can be recycled but currently not being recycled due to economic reasons or locally unavailable recycling facility.
Advance recycling equipment that can improve recycling.
Available market for recycled products.

Based on these criteria, business model concepts or strategies are noted as the following:

Create local marketing for reusable material.

Increase tipping fee.
Improve sorting process.
Create special groups or organizations.
Recognize and fund future investments.
Provide incentives from the state.
Seek collaborative effort for waste management.

As mentioned above, part of the four-step process is preparation. Preparation is the most important step in preparing the Integrated Waste Management Plan, as it gives an estimate on the amount of additional investment required to reach a stated goal. A layout of a business plan should include a list of all the materials from a construction and demolition site. Each material will have the following:

Volume of material received by facilities.
Recovery rate of that material.
Landfilling cost.
Transportation cost.
Selling cost.
Equipment used until now.
Equipment required in future.
Place where material is diverted.

In order to a make a profit from C&D waste diversion, recycling needs to become more economical and be balanced with current demands and tipping fee schedules. Below are two case studies based on actual process costs detailing these possible outcomes:

Case 1: Assume a landfill facility accepts construction waste comprised of gypsum board and they charge the contractor a disposal cost of $200 per load. Additionally assume the facility can either (A) landfill this accepted waste at an internal cost of $150 per load or (B) divert it to a recycling plant at a transportation cost of $200 per load. In this instance the landfill option (A) is a net profit of $50 per load and the diversion option (B) is a breakeven alternative. In this case there is no incentive to divert the material from the operator standpoint. This is a concern for those counties without equipment or long distances from demand markets.

Case 2: Assume same constraints as Case 1 but add an additional option (C) for a recycling plant buying the gypsum board from landfill facility at a cost of $70 per load. In this option (C), the facility will make a profit of $70, more than the $50 profit (option A) and additionally saving the landfill space which could be sold at a later date.

The price between the diversion cost and landfill cost can be minimized by operating a gypsum recycling plant *close to the facility*. This will decrease the transportation cost, resulting in more profit. It will also generate more local economic activity, thus increasing the desire and incentive to recycle as opposed to landfilling.

Discussion

Over eight million tons of C&D waste was generated in Florida in 2007. Of that waste, only 2.2 million tons or 28% was recycled. To get back on track by year 2020, the Florida legislature passed an aggressive goal of recycling 75% of its MSW waste. The goal might look almost impossible unless one considers a four-step process: awareness, preparation, implementation, and follow-up. If these steps are followed, the goal is potentially achievable..

This study addresses the concern for those in the waste diversion arena that similar to the 1996 goal the 2020 goal will not be met due to a lack of business considerations and a comprehensive integrated plan for the diversion of C&D materials across the state. The survey data suggest that transportation costs and process resources are factors that should be considered in order for the goal to be met.

It is the responsibility of each county, and the independent operators within each county, to respond to the state requirements and guidelines. However, this study demonstrated a need to address feasibility and costs associated with diversion and recycling of C&D material specifically for those less dense and rural markets.

A business model should be created to support growth for all major C&D facilities throughout the counties Florida. After analyzing the business model approach, findings revealed that diversion costs to recycling plants needs to be less than or equal to land filling costs in order to provide an incentive to the C&D facilities. Additionally, there needs to be an increase in the available markets for recyclable materials. Without these markets, there is little to no incentive to recycle materials as opposed to land filling them.

While the goals of increased diversion are laudable, this study demonstrates that for those in the market place attempting to achieve them there are constraints to overcome. While there are greater opportunities to divert materials in dense areas with readily available secondary markets for diverted materials more rural areas with limited access to markets and transportation barriers will find it difficult to increase rates. The state should reconsider requiring state wide goals but rather look at regional and material differences to establish local goals and material specific regulation.

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Table 1

C&D Currently Recycled

Percent Recycled	Response	Response Percent
0-20%	21	66%
20-40%	4	13%
40-60%	2	6%
60-80%	3	9%
80-100%	2	6%
Total	32	100%

Table 2

Reasons for low recycling*

Material	1	2	3	4	5	Others	Response Count
Brick	23.1%	30.8%	15.4%	0.0%	53.8%	15.4%	13
Asphalt	23.1%	23.1%	15.4%	0.0%	38.5%	30.8%	13
Roofing material	52.4%	28.6%	33.3%	9.5%	38.1%	9.5%	21
Carpet	63.6%	27.3%	22.7%	4.5%	31.8%	4.5%	22
Cardboard	0.0%	30.0%	10.0%	0.0%	40.0%	50.0%	10
Concrete	8.3%	33.3%	25.0%	8.3%	41.7%	25.0%	12
Wood	47.1%	11.8%	17.6%	11.8%	41.2%	11.8%	17
Gypsum	68.4%	26.3%	21.1%	5.3%	31.6%	10.5%	19

*Note: Respondents were allowed to select more than one reason for each material.

1 = Unavailable equipment for recycling

2 = No recycling facility available

3 = Recycling facility present but too far away to transport material

4 = No local market for recycled material

5 = Uneconomical to recycle or it is cheaper to landfill

Table 3

How to Reach 75% Goal*

Options	Avg. Rating (Scale 1-5)	Response
Buy new equipments	2.63	19
Transport recyclable material to far away recycling facilities	2.47	17
Improve sorting process	3.5	20

*Note: Respondents were allowed to select more than one option.