

March 2006



Recycle 202 Workshop: Construction and Demolition (C&D) Recycling, Reuse and Reduction



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What is C&D Waste?



What is C&D Waste?

- C&D - Construction and Demolition
- Refers to waste produced during:
 - Land clearing
 - Construction
 - Renovation
 - Demolition



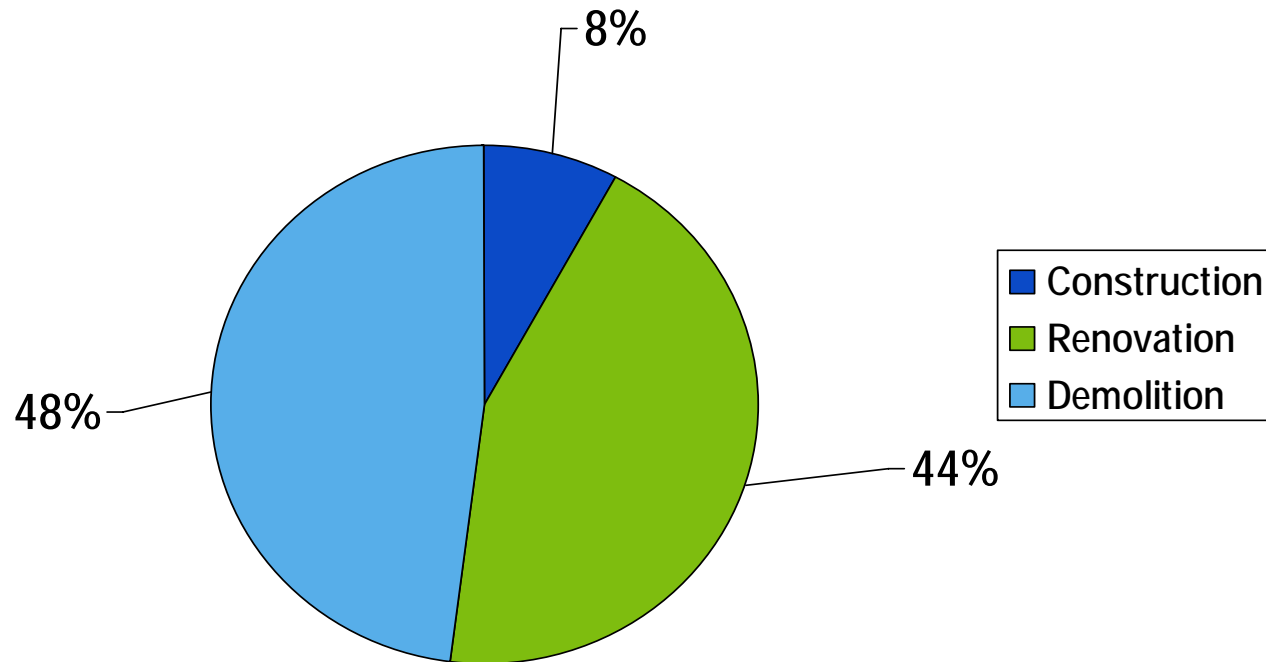
C&D Waste Includes Many Materials

- Asphalt
- Bricks
- Concrete
- Metal
- Drywall
- Roofing
- Wood
- Rock
- Insulation
- Carpet
- Paint
- Fixtures
- Glass
- Aluminum
- Steel
- Soil
- Plastic
- Vinyl Siding
- Cardboard
- Electrical Materials
- Plumbing Fixtures



Primary Sources of C&D Waste

- Majority of C&D waste comes from building demolition and renovation.



Source: U.S. Environmental Protection Agency Report



Primary Sources of C&D Waste

- Significant additional quantities are generated from:
 - New construction
 - Construction of roads and bridges
 - Land clearing
- Roughly equal percentages from residential and commercial building sectors.
 - 43% Residential
 - 57% Commercial



Why Reduce & Recycle C&D Waste?



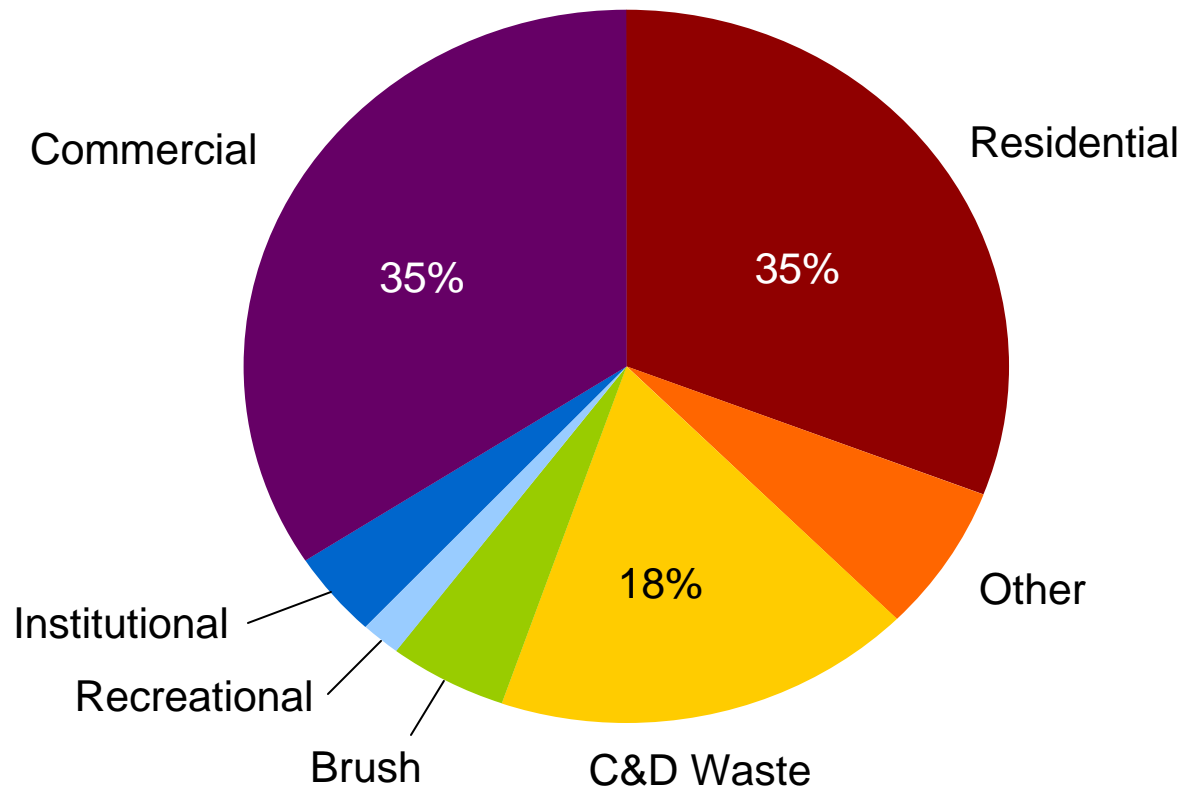
C&D Minimization & Recycling Increases Diversion

- Implementation of an effective C&D waste minimization strategy can substantially increase diversion.
- Option for communities wanting to improve waste diversion rates beyond what can be diverted through residential and commercial recycling programs.



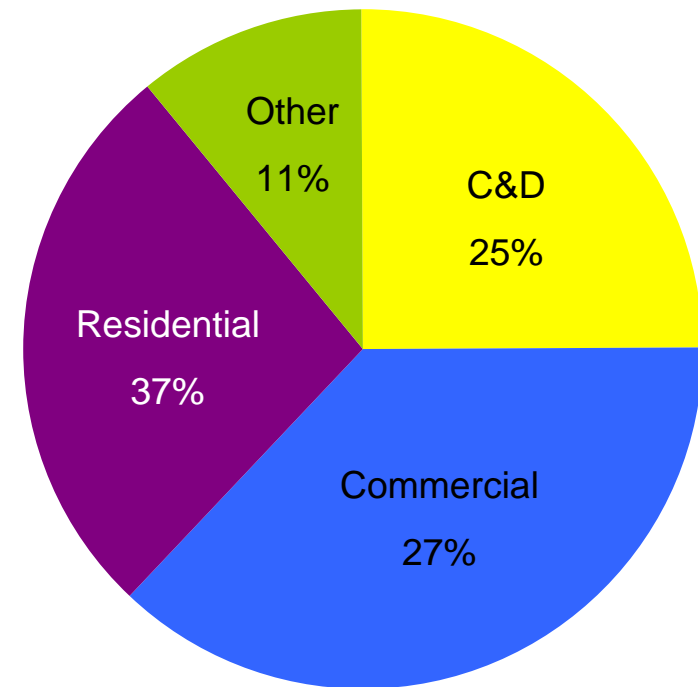
C&D Materials Represent a Significant Percentage of the Waste Stream

Character of the Texas Waste Stream
Source: TCEQ Annual MSW Facility Report, 2004



C&D Waste Generation in the H-GAC Region

- In 2004, landfills in the region disposed of:
 - 6 million tons of waste
 - 1.5 million tons of C&D waste
- C&D represented 25% of all waste disposed of in the region.



Source: TCEQ Annual MSW Facility Report, 2004



C&D Waste Can be Recycled Into New Products

- Majority of C&D waste currently disposed in landfills.
- However, estimates indicate that up to 90% of the C&D waste stream is potentially reusable or recyclable.
- C&D materials have a net economic value if they can be recovered and reused less expensively than the cost of disposal in a landfill.



C&D Waste Can be Recycled Into New Products

Used C&D Material	New Product	New Use
Wood	Mulch	Landscaping / Erosion control Engineered woods Industrial fuel source Compost additive
Wallboard	Gypsum	Soil amendment Recycled into new drywall
Concrete	Aggregate	Base for road building Drainage applications



C&D Waste Can be Recycled Into New Products



Other Benefits of C&D Waste Minimization and Recycling

- Avoid trash collection and disposal fees.
- Reduce illegal disposal costs of C&D materials.
- Help your community meet local and state waste reduction goals.
- Marketing tool for the building industry.

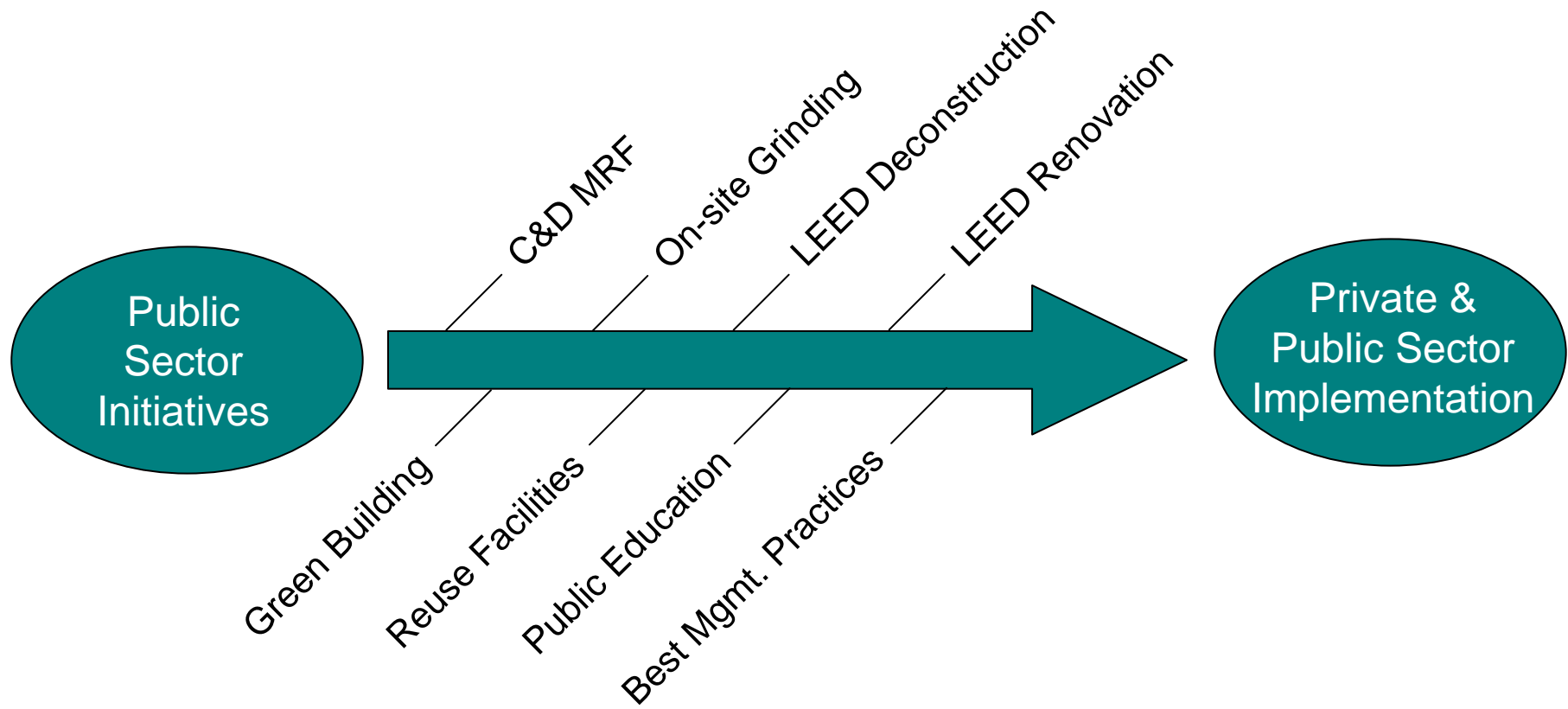


Part of a Comprehensive Waste Management Plan

- Successful C&D waste minimization programs require comprehensive effort on the part of public and private sectors.
 - Each sector will have different but critical roles.
- San Diego, CA case study



C&D Waste Minimization Efforts



Must be Economically Viable



Types of C&D Waste Minimization Programs



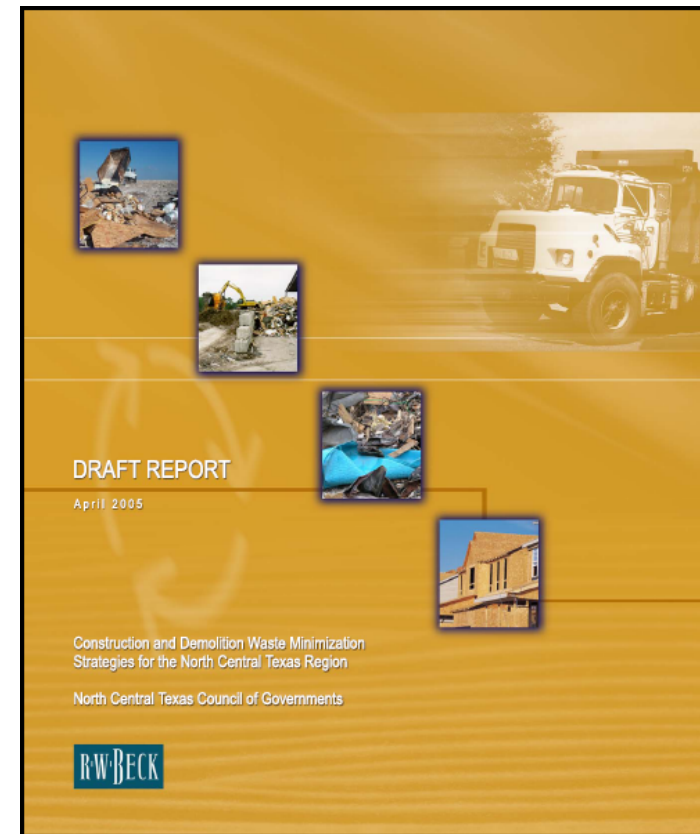
There are a Variety of Ways to Approach C&D Reuse and Recycling

- C&D Materials Recovery Facility (MRF)
- Green Building Program
- On-Site Grinding
- LEED Deconstruction & Renovation
- Reuse Facilities
- Best Management Practices
- Public Education Efforts



NCTCOG C&D Waste Minimization Study

- In 2005, R. W. Beck conducted a study for NCTCOG that examined the feasibility of each of these C&D waste minimization methods.
- Study is the basis for much of the material in this presentation.



Report can be found online at:

http://www.nctcog.org/envir/SEELT/documents/NCTCOG_C_D_Final_Report.pdf



C&D Material Recovery Facility

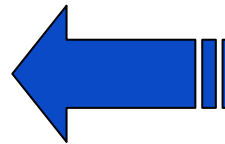
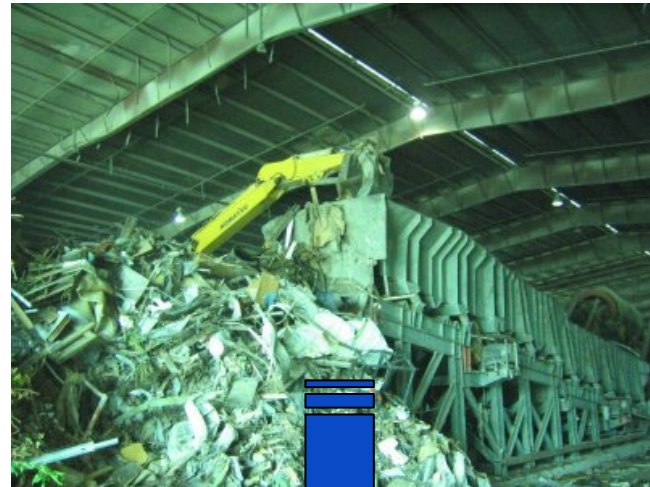
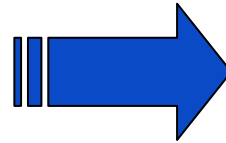


C&D Materials Recovery Facility (MRF)

- A C&D MRF is a processing center that accepts mixed C&D waste, and then sorts it by material type.
- MRF operator can then sell materials that have economic value.
- Similar in concept to MRFs that process recyclables from the municipal solid waste stream.
- There are currently no C&D MRFs in Texas.



MRF Operations Overview



C&D Materials Recovery Facility (MRF)

- The more valuable products of a C&D MRF include:
 - Wood
 - Metal
 - Concrete
 - Cardboard
- Remaining materials with little or no value are typically landfilled.
- *Alternative:* Identify customers that are willing to take material at no cost.



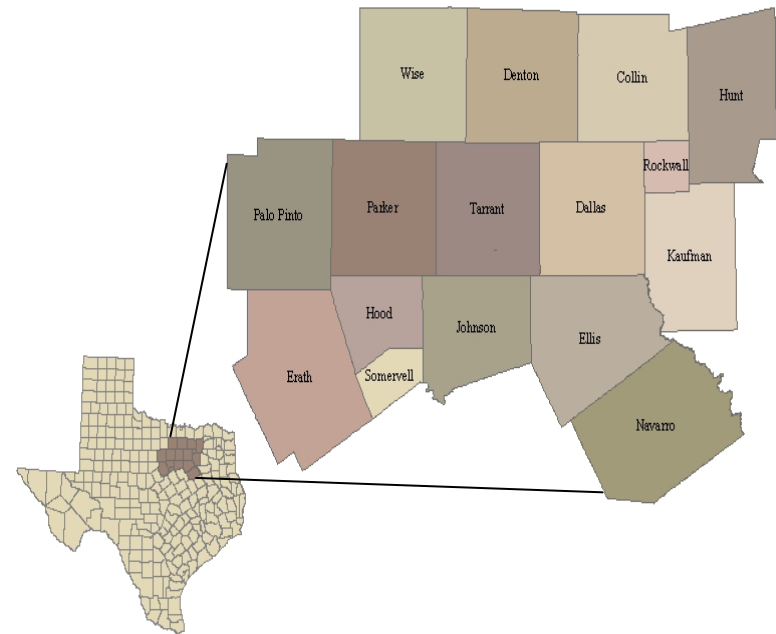
Public Awareness is Key to a Successful C&D MRF

- Goal of C&D MRF:
 - To be completely self-sustaining (i.e. generate enough revenue from operations to cover expenses).
- To accomplish this goal:
 - Must convince private haulers to dispose of C&D material at MRF rather than landfill.
 - Cost of using the MRF must be less than other alternatives.



C&D MRF Feasibility Study - NCTCOG

- Study Components:
 - Description of typical C&D MRF facility and a process overview
 - Discussion of current C&D disposal in NCTCOG region
 - Description of materials processed and sold at a C&D MRF
 - Overview of capital investment and operating expenses
 - Discussion of revenue sources and tipping fees



C&D MRF Feasibility Study - NCTCOG

- Methodology:
 - Interviews with current and potential C&D MRF operators.
 - Research of C&D recycling industry and equipment.
 - Cost estimates based on research and internal engineering resources.
- Key Assumptions:
 - Constructed in North Central Texas region.
 - MRF to process an average of 550-600 tons per day of material.
 - Characterization of waste stream based on North Carolina Department of Environmental and Natural Resources study.
 - All material not recovered is landfilled.
 - Costs per ton assume the MRF operates on a break-even basis.



C&D MRF Feasibility Study - NCTCOG

Cost/Benefit Analysis:

- Estimated Facility Capital Expenses
 - Total Cost
 - \$6.9 million - \$9.6 million
 - Annual Funding Cost
 - \$1.0 million - \$1.3 million
- Estimated Facility Operating & Maintenance Expenses
 - Annual Cost
 - \$2.5 million - \$3.4 million



C&D MRF Feasibility Study - NCTCOG

- Findings:
 - Total cost per ton is within the range of landfill tipping fees in the North Central Texas region.

Facility	Cost per Ton
C&D MRF	\$18.45 - \$24.23
Weighted Average Landfill Disposal	\$19.83

- A C&D MRF has the potential to be competitive with landfills in the NCTCOG region.



Keys to Successful C&D MRF

- Locate C&D MRF close to sources of C&D debris.
- Control in-bound contamination to improve efficiency and reduce expenses.
- Co-location with an existing MSW facility provides benefits.
- Operational efficiency will improve competitiveness.
- Effective communication with consumers and private haulers.
- Support policies that increase requirements for C&D recycling and promote other C&D waste minimization efforts.



C&D Materials Recovery Facility (MRF)

- Discuss relevance to H-GAC Region





Green Building



Green Building Programs



- Green Building is a an environmentally responsible approach to land development and housing construction in an effort to conserve natural resources.
- Can involve virtually every aspect of design and construction.
- Waste minimization is one of the key components of green building.



Common Approaches Used in Green Building Programs

- Waste minimization during construction and throughout life of the home.
- Selection of materials based on recyclability, durability, and energy used to create the material.
- Sustainable site planning.
- Water conservation.
- Energy efficiency.
- Indoor environmental quality.



Common Program Characteristics



- Typically administered by local/regional government, local utilities and/or a home builders' association.
- Communities establish evaluation criteria and certify whether building meets criteria.
- Most programs are voluntary and designed to encourage use of green building practices in the construction industry.
- 20-30 established programs across the country.



Green Building Case Studies



- Methodology
 - Literature review of green building resource materials
 - Interviews with Green Building Program staff in Austin and Frisco



Case Study – City of Austin, TX



- Program operated through City's electric utility - Austin Energy.
- Program Requirements
 - Five-level certification system, ranging from one to five stars.
 - Uses comprehensive, weighted checklist to determine level of certification.
 - Primarily voluntary, but required in the downtown district and for affordable housing projects.



Case Study – City of Austin, TX

Solid Waste Management Component

- Builders have option to:
 - Use at least 50 percent recycled-content material.
 - Recycle or use lumber longer than two feet.
 - Recycle jobsite garbage according to the COA Solid Waste Services guidelines including: paper, plastic bottles, glass bottles and jars, and metal cans.
 - Separate and re-use or recycle construction waste including:
 - Stone, concrete and masonry rubble
 - Metal scraps
 - Corrugated cardboard



Case Study – City of Austin, TX

Public Awareness

- City focuses awareness efforts on building industry and consumers through:
 - Internet site
 - Articles for newspapers, industry and real estate publications
 - Advertisements via television and radio
 - Public speaking at industry and community events
 - Phone calls to answer questions from builders and consumers
 - Multiple training and technical assistance opportunities for builders and members





Case Study – City of Frisco, TX

- Program established through City ordinance
- Program Requirements
 - Mandatory program for all single-family residential buildings platted after May 2001.
 - All new single-family construction must meet minimum standards for:
 - Energy efficiency
 - Water conservation
 - Indoor air quality
 - Waste recycling



Case Study – City of Frisco, TX

Solid Waste Management Component

- Minimum standards for waste recycling:
 - Construction waste (brick and wood) hauled from building site by the builder must be taken to a facility that will accept it for recycling.
 - Requires construction waste minimization / reuse plan written and followed by builder.
 - Unwanted building materials must be donated to a non-profit building organization.
 - Must provide built-in recycling center option with two or more 5-gallon bins for homebuyers.
 - Must provide a composting system option installed in yard for homebuyer.



Case Study – City of Frisco, TX

Public Awareness

- Efforts are in developmental stages and currently relatively informal.
 - Builder's Task Force organized to discuss important green building issues and conduct workshops.
 - City website provides information on the program.
 - Have developed a green building video, with financial assistance from the U. S. EPA regional office.
 - City does not currently offer specific training or technical assistance programs.



Green Building Program Costs



- Costs associated with green building programs vary widely.
 - City of Frisco ~ \$30,000 annual budget
 - Austin Energy ~ \$1 million annual budget
 - Average first year budget for developing green building program ~ \$45,000-98,000

Source: *Guide to Developing Green Building Programs*, National Association of Builders, 1999.



Green Building Program Case Studies

- Key Findings
 - Traditional focus on energy, but solid waste can be an important focus.
 - When implemented during preliminary stages of construction, green building results in minimal or no cost increase.
 - Giving builders multiple options to implement waste minimization efforts provides best opportunity for success.
 - Supporting infrastructure such as on-site grinders and C&D MRFs need to be in place in order to recycle significant quantities of material.



Green Building Program Case Studies

Key Findings (cont.):

- End markets for materials and sources of affordable recycled building materials should be established.
- Regional/sub-regional training efforts can be effective in developing awareness.
- Need for acceptance of green building practices in building industry.
- Can be used as a marketing tool for the building industry.



Benefits of Green Building Programs

- Higher property values
- More desirable places to live
- Delay future capital costs
- Avoided environmental costs



Green Building Programs

- Discuss relevance to H-GAC Region



On-Site Grinding



On-Site Grinding



- On-site grinding is the practice of grinding and crushing building materials and depositing them onsite as a soil amendment or for use in erosion control.
- Home builder may either own and operate the grinder or subcontract on-site grinding services.
- Can divert up to 85% of C&D waste generated from new home construction.



How Does On-Site Grinding Work?

- C&D waste is separated by material, stored on-site and then processed into smaller chips or dust using an on-site grinder at various stages throughout the construction process.
- Materials that can be processed and reused on-site include:
 - Wood, stone/masonry, drywall, corrugated cardboard and asphalt shingles
- Residual materials can have a variety of productive uses on the construction site and may be used in place of materials that would otherwise have to be purchased.



On-Site Grinding Process



Economic Feasibility of On-Site Grinding

- Economic feasibility of on-site grinding will vary depending on:
 - How the on-site grinding service is operated
 - Number of homes being built in the area
 - Whether homes are production or custom built



On-Site Grinding Case Study

- Case Study Structure
 - Operational analysis of on-site grinder
 - Two Operational Scenarios
 - Own/Operate
 - Subcontract Services
 - Evaluation for two types of homebuilders
 - Custom
 - Production



On-Site Grinding Case Study

Operational Analysis Results

- Subcontracting is generally more cost effective than own/operate.
- Custom Homes
 - Potential additional cost of \$1,200 - \$1,800 per home to implement on-site grinding.
 - Not currently cost effective, but may be used as marketing strategy or upon client request.
- Production Homes
 - Subcontracting for on-site grinding may result in up to a \$180 cost savings per home.
 - On-site grinding appears to be a cost-effective option.



Indirect Benefits of On-Site Grinding

- Reduce illegal use of disposal containers
- Risk mitigation and better aesthetics as a result of a cleaner jobsite
- Operate in accordance with local ordinance restrictions
- Reduce downtime due to inclement weather
- Use as a marketing strategy
- May be used to comply with green building principles or requirements.



On-Site Grinding Case Study

- Key Findings
 - Subcontracting on-site grinding services cost effective for production homebuilders
 - Can reduce overall cost of construction by avoiding costs of soil amendments and erosion control
 - Indirect benefits can have substantial impact on likelihood that homebuilders will make use of on-site grinding.



Keys to Successful On-Site Grinding

- Establish good communication between all parties.
- Institute regularly scheduled grinding times.
- Provide homebuilders with informational resources explaining uses of reduced material, scheduling process and benefits.
- Establish and maintain locations for source separated and reduced materials throughout project.



On-Site Grinding

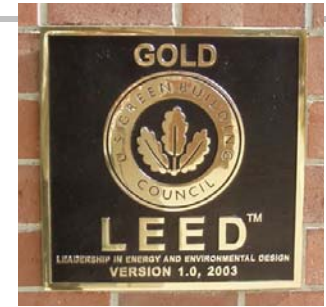
- Discuss relevance to H-GAC Region



LEED Deconstruction



LEED Deconstruction



- Deconstruction is the selective dismantling or removal of materials from buildings for reuse or recycling.
- Deconstruction is also one of the activities used under the Leadership in Energy and Environmental Design (LEED) system.
- LEED is a rating system that sets standards and evaluation criteria for construction and deconstruction of commercial and institutional buildings in an environmentally friendly manner.



Impacts of LEED Deconstruction

- Larger commercial structures have greater potential impact on waste stream.
- Instituting program such as LEED can encourage C&D waste minimization activities in commercial building.



LEED Deconstruction Case Study



- Case Study Structure
 - Implementation of deconstruction at Hensley Field (Phase I)
 - Materials handling and diversion rate review
 - Cost/Benefit comparison of deconstruction to demolition
- Methodology
 - Site visits to Hensley Field
 - Interviews and follow-up discussions with construction management firm, contractor, and City of Dallas staff
 - Analyzed all cost data related to deconstruction



LEED Deconstruction Case Study

- City of Dallas passed ordinance requiring that all demolition or construction of public buildings (10,000 sq. ft. or larger) must attain a certain minimum LEED rating.
- Hensley Field was the first LEED rated deconstruction project for the City.



LEED Deconstruction Case Study

- Prior to project initiation, City required contractors to submit:
 - Waste Management Goals
 - Construction Plan
 - Communications Plan
 - Quantity Verification Procedures
 - Indoor Air Quality Plan
 - Definitions



LEED Deconstruction Case Study

Cost Benefit Analysis:

- Deconstruction process costs for Hensley Field were approximately the same as demolition costs would have been.

	Demolition	Deconstruction
Approximate Cost	\$200,000 - \$280,000	\$220,000 - \$235,000

- Deconstruction will generally result in reduced landfill disposal costs and increased labor and material processing costs.



LEED Deconstruction Case Study

- Key Findings and Recommendations
 - Deconstruction of Site diverted 2,202 tons of waste or 97% of total weight
 - Waste management planning is essential to success of project
 - Cost of deconstruction is comparable to partial demolition
 - Many indirect benefits of deconstruction and renovation: risk mitigation, site cleanliness, waste reduction



LEED Deconstruction

- Discuss relevance to H-GAC Region



LEED Renovation



LEED Renovation



- Renovation is another of the many activities under the LEED system.
- Renovation refers to the modification or rehabilitation of the interior and/or exterior of an existing structure.
- Green building practices may be applied to renovation activities through the recovery of various building materials.



Impacts of LEED Renovation

- Process can serve as effective way to reduce amount of C&D debris entering the waste stream.
- As with deconstruction, implementing LEED renovation practices can:
 - Have significant impact on the waste stream.
 - Encourage C&D waste minimization activities in commercial building.



LEED Renovation Case Study

- Case Study Structure
 - Implementation of renovation at Hensley Field (Phase II)
 - Materials handling and diversion rate review
 - Cost/Benefit comparison between traditional and alternative disposal method
- Methodology
 - Site visits to Hensley Field
 - Interviews and follow-up discussions with construction management firm, contractor, and City of Dallas staff
 - Analyzed all cost data related to renovation



LEED Renovation Case Study

Cost Benefit Analysis:

- LEED renovation costs for Hensley Field were estimated to be approximately \$2,500 greater than they would have been using traditional renovation methods.

	LEED Renovation	Traditional Renovation
Approximate Cost	\$79 per ton	\$65 per ton

- LEED Renovation will generally result in reduced landfill disposal costs, but increased labor and material processing costs.



LEED Renovation Case Study

- Key Findings and Recommendations
 - Cost of C&D waste minimization strategies in renovation projects is slightly higher than traditional methods
 - Can divert up to 75% of waste (by volume) from landfill
 - Communication with subcontracts is imperative for compliance
 - C&D waste minimization, overall, did not significantly affect the project timing



LEED Renovation

- Discuss relevance to H-GAC Region



Reuse Facilities



Reuse Facilities



- A C&D material reuse facility is a location where businesses and individuals may bring building material for reuse in the community.
- Reduces burden on the solid waste stream by diverting new and used building materials from landfills to be used in other construction.
- Facilities commonly accept:
 - Construction wood, drywall, paint, carpet, metals, light fixtures, doors, windows and plumbing



Reuse Facilities Case Study



- City of Huntsville, TX
 - Established reuse facility in 2002
 - Facility is co-located with the City's transfer station
 - Operated under the City's Solid Waste Department
 - Accepts various building materials from the public and from businesses.
 - Open only on weekends
 - Staffed by one FTE
 - City has seen a significant amount of participation from the public and will continue to operate the facility



Reuse Facilities Case Study



- Habitat For Humanity ReStores
 - Habitat for Humanity operates a number of Habitat Home Improvement Outlet Stores within the H-GAC region
 - Facilitate reuse of building materials and gently used appliances
 - Accept donated building materials and sells them to residents and businesses
 - Provide market for building materials that would otherwise be disposed of in the landfill
 - Accept materials at the store and also provide on-site pick-up and deconstruction service

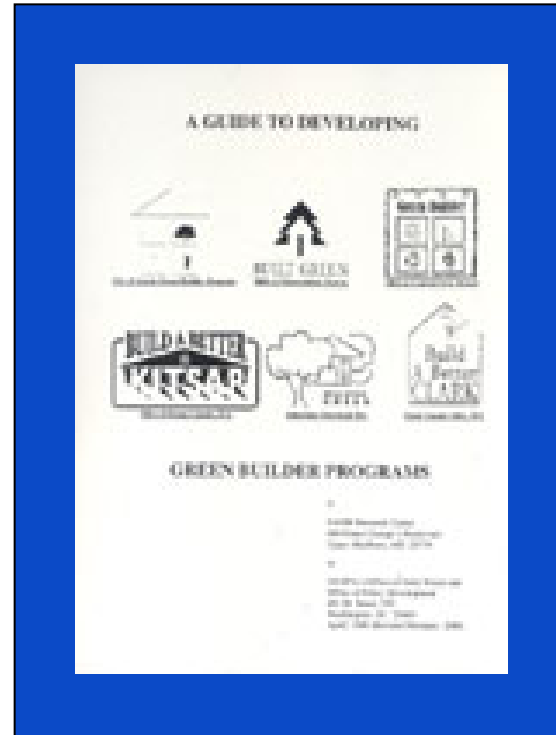


Practical Applications for The Public Sector



A Guide to Developing Green Building Programs

- Key Steps:
 - Determining Interest
 - Establishing a committee
 - Setting objectives
 - Determining partners
 - Determining program coverage
 - Setting up a budget
 - Considering existing programs
 - Est. certification process
 - Choosing program resources
 - Est. program structure
 - Creating program checklist



Available online at:

www.nahbrc.org



LEED Rating Program

- Establish LEED rating ordinances requiring new construction, demolition or renovation of commercial buildings to be rated under the system.
- May apply only to public buildings or may be applied Citywide.
- Advantages
 - Yields energy efficient and environmentally friendly buildings.
 - Sets a high community standard.
- Disadvantages
 - Higher construction costs
 - Impact is somewhat limited
 - May have significant administrative costs if implemented on Citywide level.



Waste Management Planning & Reporting

- Adopt policies encouraging waste management planning and reporting prior to construction or deconstruction of commercial and residential buildings.
- Provide contractors with a framework for waste diversion goals and strategies during projects.
- May be used as component of green building or LEED rating program.
- Establish reporting requirements such as:
 - Disposal and recycling tonnage data
 - Recycler or salvage yard contact information
 - Copies of all load and disposal tickets



Reuse Facility Program

- Establish a construction and deconstruction material reuse facility where businesses and individuals may bring building material for reuse in the community.
- May be established at city, county or sub-regional level and be located near an existing landfill or transfer station.
- Common facility characteristics:
 - Operate on a limited basis
 - Staffed by one or two FTEs
- Consider working with non-profit organizations such as Habitat for Humanity.



Best Management Practices



Best Management Practices

- Many in the construction industry are unfamiliar with C&D waste minimization strategies.
- Best management practices should focus on providing the private sector with tools, resources and information.
- Achieving “buy-in” from the industry is very important for increasing waste minimization efforts.



Best Management Practices

- Focus on practices for construction and recycling industry.
 - Grinding and Crushing Methods
 - Material Collection Methods
 - Deconstruction
 - Renovation
 - Materials Recovery Facility
 - Alternative Erosion Control Methods



Best Management Practices

- Establish some combination of:
 - C&D waste diversion program
 - Green building
 - LEED certification
 - Reuse facility
 - Waste management planning and reporting
 - Ordinances or voluntary incentives to promote C&D waste management.



Best Management Practices

- Ordinances:
 - Deposit Requirements
 - Franchise Fees for C&D waste disposal at landfills
 - Fines and Penalties for Non-compliance
- Incentives for Increasing Participation:
 - Contractor Rebates
 - Government Grants
 - Contractor Education Programs
 - Fast Track Permitting
 - First Choice Programs



Incentives for Increasing Participation

▪ Contractor Rebates

- Rebates to contractors for delivering C&D material to recycling facilities.
 - Levels of recyclables delivered to recycling facilities are documented and communicated to a governmental authority which issues the rebates.
 - Program is typically voluntary.
 - Requires the establishment and operation of a C&D MRF.

▪ Government Grants

- Appropriation of funds for grants to private businesses or non-profit organizations for C&D recycling programs.
 - May include development of actual building or housing-start, development of recycling infrastructure or administration of pilot C&D recycling project.



Incentives for Increasing Participation

- Contractor Education Programs
 - Aim to illustrate value of C&D recycling to contractors, thereby changing their beliefs and motivating them to participate in recycling programs.
- Fast Track Permitting
 - Gives preferential treatment during the permitting process to contractors or home-builders who participate in waste minimization programs.
- First Choice Programs
 - Aim to create a market for C&D materials by mandating that government agencies buy these products as their first choice in purchasing supplies.



Best Management Practices

- C&D waste diversion goals will be easier to achieve if local governments take initiative to develop the necessary infrastructure prior to implementing any requirements.
 - Example: San Diego C&D ordinance article
- Select the combination of waste diversion options that are best suited to your community.



Best Management Practices

- Develop a Regional Strategic Plan for C&D Waste Minimization Efforts
 - Based on recognition that there is a need to develop programs and infrastructure
 - Participation of the various stakeholders in the strategic plan is key
 - Regional Government (H-GAC)
 - Local Governments (Cities, Counties)
 - Construction and Recycling Industry
 - Develop specific tactics for C&D waste reduction



Technical Resources & Funding Mechanisms



Technical Assistance Resources

- TCEQ Sponsored Programs
 - Recycle Texas Online
 - <http://www.tnrcc.state.tx.us/exec/sbea/rtol/>
 - RENEW
 - <http://www.tnrcc.state.tx.us/exec/oppr/renew/renew.html>
 - Technical Assistance Hotline
 - 1-800-447-2827
- Internet Resources
 - C&D Recycler Online
 - <http://www.cdrecycler.com/>
 - U.S. EPA Website
 - <http://www.epa.gov/epaoswer/non-hw/debris/about.htm>
 - <http://www.epa.gov/greenbuilding/>
 - California Integrated Waste Management Board
 - <http://www.ciwmb.ca.gov/ConDemo/>



Technical Assistance Resources

- Associations and Organizations
 - National Association of Home Builders
 - <http://www.nahb.org/>
 - The Kresge Foundation
 - <http://www.kresge.org/initiatives/index.htm>
 - U.S. Green Building Council
 - <http://www.usgbc.org/>
 - WasteWise
 - <http://www.epa.gov/epaoswer/non-hw/reduce/wstewise/>
 - Construction Materials Recycling Association
 - <http://www.cdrecycling.org>
 - Toolbase Services
 - <http://www.toolbase.org>
 - National Association of Home Builders Research Center
 - <http://www.nahbrc.com>



Funding Mechanisms

▪ C&D Waste Minimization

- U.S. Department of Agriculture
- U.S. Environmental Protection Agency
- U.S. Department of Commerce
- Houston-Galveston Area Council
- Amy Shelton McNutt Charitable Trust
- The Meadows Foundation
- The Home Depot Foundation

▪ Green Building

- The Home Depot Foundation
- StEPP Foundation
- U.S. Department of Energy
- Green Communities Program
- U.S. Department of Housing and Urban Development
- U.S. Department of Agriculture
- Texas General Land Office



Questions or Comments?

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