

Upcycling ideas for Sustainable Construction and Demolition Waste Management: Challenges, Opportunities and Boundaries

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ABSTRACT: Significant effort has been seen with upcycling or repurposing old materials such as soil, wood, metal, concrete etc. The concept of upcycling relates to the process of converting waste materials or useless products into new materials or products of better quality or better environmental value than in their previous use. This paper explores the challenges, opportunities that exist with the development of a recycled and reused building material market. This paper also seeks to address how issues behind secondary material in the life cycle of C&D wastes can be resolved by reusing and recycling techniques deemed problematic by local recyclers. The paper was developed using a variety of multidisciplinary resources within the field of solid waste management. It is hoped that the policy, regulation, circular economy recommendations within this paper be adopted as potential options for the municipality to address these issues.

KEYWORDS: Construction and demolition (C&D) waste, sustainable construction practices, upcycling, downcycling 3R's concept, life-cycle assessment (LCA), repurposing, waste management, solid waste management hierarchy

I. INTRODUCTION

The built environment and the construction industry are often referred to as major consumers of natural resources and energy. Evidently, the construction industry is reported to be generating unacceptable levels of waste for many decades [1]. Waste generation in construction have created a number of concerns in term of energy use and the economic impact. This is as a result of the significant amount of construction and demolition (C&D) waste generated which as huge impact in contributing to environmental damage both locally and internationally [2]. It is important to understand the C&D waste system covering a broad range of building materials which is often categorised as: waste arising from total or partial demolition of buildings and/or civil infrastructure, waste arising from the construction of buildings and/or building civil infrastructure, civil works and/or excavations for foundations and materials arising from road construction and maintenance works [3].

The creativity in reusing many building materials often available to contractors as the idea of upcycling continues to create urgent attention. The principle of upcycling also referred to as creative reuse, is the process of transforming by-product, waste materials, useless and/or unwanted products into the materials or products of better quality for better environmental value [4]. Many industrial processes such as plastics and electronic fabrication reply on the consumption of finite resources [5]. Moreover, the waste generated may have an environmental impact and can affect human health. Within, this context, upcycling describes the use of available and future technologies to minimise waste and resource consumption by creating a product with a higher value from waste or by-product waste streams [6]. There is a need to

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find understanding to the barriers of upcycling concept to sustainable C&D waste management. The idea of sustainable development seemed to be the best practice and solution to C&D waste management and to the entire construction industry. This idea is to improve the durability and use of recycled materials as well as eliminating the development of C&D waste throughout the construction life cycle [7] [8].

This paper explores the challenges, opportunities that exist with the development of a recycled and reused building material market. This paper also seeks to address how issues behind the secondary material and carbon footprint trends in the life cycle of C&D wastes can be resolved by reusing and recycling techniques deemed problematic by local recyclers. The paper was developed using a variety of multidisciplinary resources within the field of solid waste management. Scholarly references (i.e. peer-review journal, professional articles, textbooks, case study and literature reviews) were combined with government documentation to provide a background of the life cycle of building material and related issues behind the development of secondary material. It is hoped that the policy, regulation, circular economy recommendations within this paper be adopted as potential options for the municipality to address these issues. This paper focused mainly on construction and demolition (C&D) wastes.

II. PROBLEMS WITH MANAGING C&D WASTE

Waste materials resulting construction and demolition of buildings and infrastructure constitute a significant amount (10-15%) of the total municipal social waste stream. The term “waste” has become quite common in many municipalities and can be referred to as any materials by-product of human and industrial activity that has no residential value [9]. Arguably, waste poses a threat to the environment to human health if it is not effectively managed, recovered and considerably disposed of. In 2011, study by WARP estimated that over 100 million tonnes of inert construction, demolition and excavation (CD&E) waste was being generated each year in England [10] Also an estimated 20 million tonnes of unused waste has been diverted to landfill as CD&E waste remains a major component of fly-tipped waste and is estimated by the Environment Agency to be responsible for around one third all fly-tipping incidents [11]. A few studies suggest that about 10 to 30% of C&D waste materials that end up as waste on construction site have been unused which accounted for true cost of construction waste that can be up to 15 times more than the waste disposal costs when labour and material costs are considered [12], [13], [14].

The construction industry, therefore, is increasingly coming under pressure to enhance resource efficiency and reduce waste. These problems will become even more complex in the case of lack of management on larger construction projects. There are numerous research works carried out on C&D waste and the findings show several negative impacts to the environment, social and economy of a nation [14], [15], [16]. These impacts somewhat contribute to a reduction in work productivity and thus reduce the overall performance of many construction projects [17]. The need for a sustainable approach to managing C&D waste continues to attract many contractors, local recyclers and researchers in recent times.

A. SUSTAINABLE APPROACH TO C&D WASTE MANAGEMENT

With the pursuit of sustainability across the world, there has been a huge focus on C&D waste management. The UK construction industry has focused on “green initiatives” to meet all sustainability requirements. Since 2012, the construction industry has shown significant efforts in fulfilling the sustainability requirements to effective management of C&D waste by investing on “*Halving C&D Waste to Landfill*” as implemented by the UK Sustainable Construction Strategy [18]. This initiative sets a national target to “*Zero C&D waste*” to landfill by 2020 as UK Government continue to embark on a long-term ambition to end the disposal of C&D waste in a landfill as far as practicable.

To meet the target set for 2020 national policy on waste management has been strengthened by preparing for a more sustainable approach to reuse, recycle and other material recovery practices [19]. Following the pursuit of sustainability, some of fiscal and regulatory measures such as landfill taxes, aggregate levy, Site Waste Management Plan, BREEAM standard (offering credit for diversion of C&D from the landfill 75% by weight and 65% by volume) are already

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driving resource efficiency [20].

B. DESIGN OUT WASTE

The ultimate goal of a sustainable approach to managing C&D waste is to strategically design to reduce the amount of waste produced. The site waste management practices worldwide have been able to fulfil this vision by “*design-out waste*” at various stages of construction [21]. Arguably, however, the best opportunities for enhancing materials resource efficiency in construction projects occur during the design stage [15]. Implementing these possible opportunities can further provide huge reductions in cost, waste and carbon emissions. Designers often use five key principles (design for reuse and recovery, design for off-site construction, design for materials optimisation, design for waste efficient procurement and finally design for deconstruction and flexibility) these five principles are mostly guided by an extensive consultation, research and work carried regulatory bodies [22].

It is quite important to understand the design for reuse of material components and/or entire building has substantial potential to reduce the environmental weights from construction. With reuse, the effective life of materials is extended and thus annualised weights are spread over the years. Reuse, on the other hand in the waste hierarchy is preferable to recycling, where additional processes are involved [22]. The advantage of designing for off-site construction are well discussed in modern times as this process has potential in reducing C&D waste.

C. IMPLEMENTING 3R'S PRINCIPLE

C&D waste management is required various stages within the solid waste management hierarchy model (SWMH). Figure 1 shows the various stages required for waste management as suggested by Peng et al. [23]. These authors recommend that C&D waste management should be executed by techniques such as: reducing, reducing, reusing and recycling. However, certain events such as avoidance and minimisation, which further depicts the reduction, process alongside the recycling operations, which are considered to be desirable. Waste management concept is guided by the level of hierarchy known as the ‘*3R's principle*’, and this is explained by El-Haggar in 2007 [24].

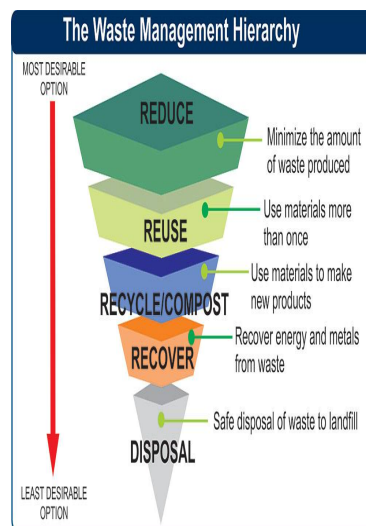


Figure 1: Solid waste management hierarchy model

The SWMH model produces an integrated approach in which options of waste management can be considered and thus serves as a systematic tool for those who generate and manage waste [24]. El-Haggar [24] argued that when waste is being managed effectively, it could generate various benefits through the whole life cycle of the waste from its generation to its end disposal.

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D. Life Cycle Assessment (LCA)

The environmental concern all C&D waste materials have grown for many decades. LCA is an important tool used to support decision-making in the field of waste management and also helps to determine environmental viability. The LCA is a popular tool used to investigate the potential environment impact, throughout a product's life [25].

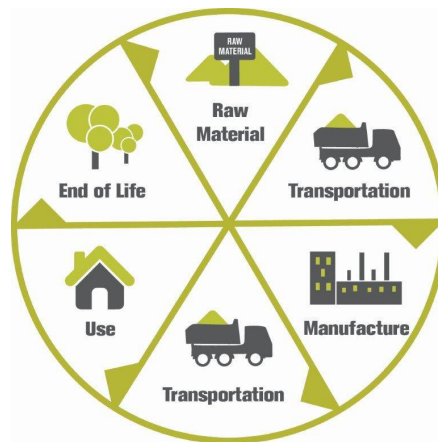


Figure 2: Life Cycle Assessment (LCA)

International Organisation for Standardization (ISO) first developed the LCA methodology and framework by considering four unique phases: goal and scope definition, inventory analysis, (input/output), impact categories and interpretations.

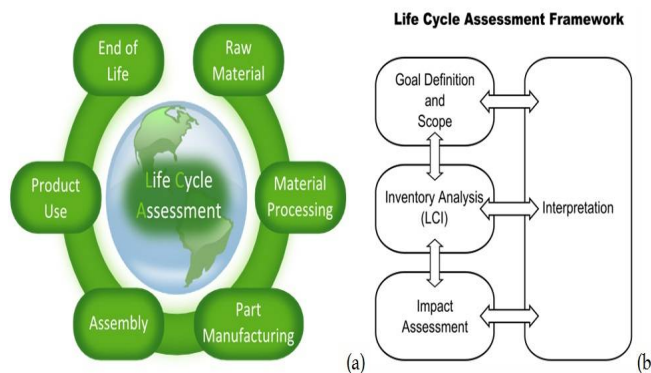


Figure 3: Life Cycle Assessment Framework

By analysing the positive and negative environmental effects of all kinds of projects or products, LCA tool, is a reliable tool considered for several areas to analyse and to evaluate different policy alternatives [26]. Huang et al. [26] use LCA tool to evaluate environmental impacts of using recycled materials in asphalt pavements. The authors evaluated and concluded that relevant LCA model could be used a decision support tool for sustainable construction in the road industry. Cherubini et al. [27] discouraged the diversion of construction and demolition waste to landfill due to the significant environmental and economic impacts. Thus, the integration of LCA model in the construction sector has two unique perspectives 1) building material and 2) construction processes.

Understanding the underlying principle of C&D waste management can be explained through this process as various phases' involved play a vital role in the application of LCA model [27]. Key LCA phase include: pre-construction phase, construction, and renovation. Each stage of the construction project life cycle considers Solid Waste

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Management Hierarchy (SWMH) using the 3Rs (reduce, reuse and recycle) principle as a guide. Thus, the LCA inventory process covers the “input and output”, and that impact outcomes are derived from the inventory data processed. The life cycle map is developed to explain the waste material flow from the system start to finish.

III. RECYCLING vs. UPCYCLING

Recycling is a concept most of the construction, and demolition professionals understand and refer to the process of converting used construction materials waste into reusable material [4]. Recycling is by all means great for the environment, but is it always the best option? After all, recycling requires energy in the form of transportation, as well as in the recycling processes itself. The 1995 UK Government White Paper ‘*Making Waste Work*’ [25] had targets for increasing the use of waste and recycled materials as aggregates to 30 million tonnes per year by 2006. The UK Consultation Paper on sustainable construction ‘*Opportunities for Change*’ [26] highlights the need for incentives to encourage the use of recycled material and acknowledges the importance of economic considerations.

Repurposing (upcycling), on the other hand, refer to taking a product that some may consider being at the end of its lifecycle, and restore it to a functional condition of finding an alternate use for it. Repurposing requires minimal energy, and by giving a product a second chance at life, and in turn saving a significant amount of waste being diverted to landfill [26]. Repurposing old and used objects is a great way to help clean up the environment. Martin and Parsapour [5] claim that repurposing is the process by which an object with one use value is transformed or redeployed as an object with an alternative use value. Interestingly, repurposing is the use of a tool being re-channelled into being another tool, usually for a purpose unintended by the original toolmaker.

A. Methods of C&D Waste Recycling

On-site source separation, recycling, storage, and reuse are commonly found on many construction sites. This highly effective method of recycling can also be very cost-effective when available site condition allows [25]. Cases where contractors can store, recycle and reuse C&D wastes on-site, this represents one of the most efficient methods of recycling, saving transportation, storage, and some processing costs. For construction sites that can coordinate on-site material processing and storage process, however, financial benefits can be significant. This process is most applicable for inert materials such as concrete, asphalt paving, stone, soil, and brick as well as useful for green waste. Some of machineries are used for recycling rocks and concrete into new products. Figures 4 and 5 shows typical examples of machinery such as conveyors and VSI crushers, used for means of transporting materials between feeders, crushers, and screens as well as recycling glass to produce sand.



Figure 4: Conveyors for transporting crushed rock waste material (Source: Living-lifestyle, 2014)

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Figure 5: VSI Crusher used for glass recycling into sand product (Source: Living-lifestyle, 2014)

There is a growing market for glass recycling into the sand product in Australia and Europe [29]. Some of recyclers and waste management companies in the UK have developed a business-driven solution for the recycling and recovery of all non-hazardous construction and demolition waste [25]. The UK recycling rate of 'non-hazardous C&D waste' reached 87% in 2014 [26]. There is EU Waste Framework Directive (WFD) target for the UK to recycle or recover CD&E waste at least 70% of this type of waste by 2020. The UK generated 400 million tonnes of total waste in 2014. Half of this was generated by the construction sector. Commercial and industrial activities generated almost 24%, with households responsible for a further 14% [27], [28]. Growing evidence suggests that previous studies considerably underestimated that amount of C&D waste being recycled or reclaimed. Regarding recycling, the landfill tax has contributed to a big increase in the number of fixed and mobile crushing and recycling sites [29].

B. Methods of C&D Waste Upcycling (Repurposing)

In theory, upcycling materials should be a straightforward process; however, creating a market for recycled materials as important for stimulating the repurposing of recyclable material in the construction industry [6]. Repurposed materials remind construction and demolition professionals of the 3R's (reduce, reuse and recycle) principle where 'reduce' simply means the reduction in consumption of new materials and the reduction of waste. The term 'reuse' under the 3R's concept refers to the act of using the waste material again and again for its original function while 'recycle' simply refers to breaking down waste into raw materials, which are then later used to make new materials, where additional energy inputs are required [6].

With the desire to incorporate an eco-friendly approach to buildings at its height, design, construction, and demolition professionals are looking for creative ways to reuse old building waste materials in new construction. C&D waste such as wood and metals make ideal repurposed items for constructing large frames such that frames can be covered with clear sheets of repurposed plastics acting as weather protective material. Hard rock and soil are often sent to impact crushers used in quarrying and construction works. Depending on the waste material, once it's broken down, it can very often be repurposed to have another construction uses (i.e. the conversion of concrete into gravel as shown in Figure 6).

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Figure 6: HIS Impact Crushers (Source: Living-lifestyle, 2014)

IV. CHALLENGES AND OPPORTUNITIES

Despite the importance of repurposing C&D waste material considering the fore coming scarcity of raw materials and the anthropogenic impact on the environment, the concept of repurposing waste material faces many challenges. Most developed countries do not support the idea of repurposing C&D waste materials and would rather prefer the use of new building materials, which are not readily available around the world. Consequently, a number of people upcycle waste materials as a matter of survivability. Other key challenges relate to the development of problematic and unaesthetic structures that are not mechanically stable [28]. Special focus should be placed o producing simple structures while preserving the ability to aesthetically embrace repurpose material. The social acceptance for repurposing C&D waste material in new developments continue to become the greatest challenge. However, the opportunities for recycling and repurposing C&D waste continue to attract a number of local contractors and recyclers.

Opportunities with C&D Waste Recycling

Construction and demolition waste materials recovery facilities and general waste management practices have promoted the idea sustainability within the construction industry for many decades [30]. Reducing the amount of C&D waste has lots of cost saving through lower disposal and labour costs through handling and process [31]. When site space allows, on-site source separation of C&D materials can yield reduced or even eliminated tipping fees. Building waste materials account for about half of all materials used and about half the global solid waste generated. They have an environmental impact at every phase of the building process (i.e. extraction of raw material, processing, manufacturing, transportation, construction and disposal at the end of a building's useful life.

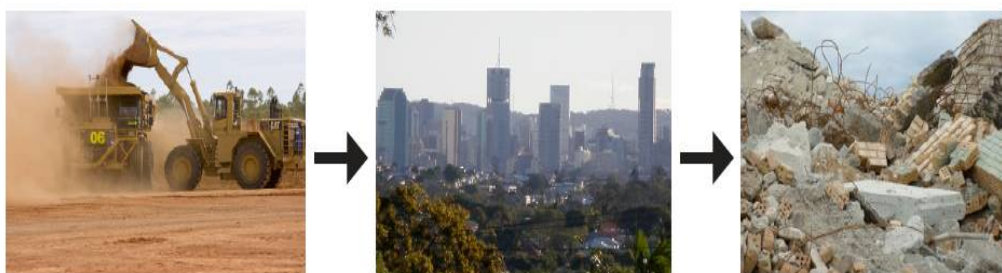


Figure 7: Perspective for building supply chain

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Across the global, governments have responded to the urgent need to reduce waste with regulation and legislation that have controlled a market for building materials and products derived from the C&D waste stream. There are clear opportunities for business and industry to invest in activities that will create profit and improve environmental outcomes by extracting valuable resources from the C&D waste stream. Recycling can be used to decrease the environmental impacts of waste management and, by displacing extraction and processing of primary materials, of other lifecycle stages as well.

Opportunities with C&D waste Upcycling

The principle of upcycling and recycling C&D waste has many opportunities for waste producers and many local recyclers. Upcycling provides a huge resource bank of materials that have already been produced. Huygen [30] claim that the term '*repurposing*' is a possible strategy for sustainability in managing C&D waste. Repurposing C&D waste is the process of using waste in a totally different way than its initial functions. This new use conserves all of the embodied energy required to extract, transport, and process the raw materials [35].

Interestingly, Tate [31] reports that there are huge opportunities with C&D waste particularly concrete and excavated soil. The author claims that broken up pieces of concrete otherwise known, as '*urbanite*' is such material that can be reused in a variety of ways for new construction works. Urbanite can be used to create a patio or walkway that looks similar to flagstone. For many decades, recycled concrete used for patios, walkways, and planters. While using urbanite for a project requires extra human effort, it keeps waste concrete from filling up landfills and requires little or no energy consumption.



Figure 8: An urbanite patio stained with iron sulphate (Source: Terra Nova Ecological Landscaping, 2013)

V. LONDON 2012 OLYMPIC PARK: A CASE STUDY FOR RECYCLING AND UPCYCLING

The case study of London 2012 Olympic park reflects the importance of reuse, recycling, and repurposing building waste materials. Queen Elizabeth II Olympic Park is at 560 acres, and as large as London's frame Hyde Park, falls within four East London Borough and is the largest urban regenerated park redeveloped in Europe in more than 150 years. The case study identifies redevelopment project at demolition and construction stage, recycling and upcycling activities and the benefits of embarking on sustainable construction by investing in waste reduction and the recovery on a construction and demolition project.

The Olympic Park has many buildings and structures built with bricks that were easy to reclaim especially Yellow Stock, Red Rubber and Staffordshire Blue bricks. The construction of the Olympic Park is built on principles of social and environmental sustainability. One of the innovative sustainable initiatives is to reuse and repurpose the materials from the demolition area to build the new Olympic Park. During the construction of the Olympic Park for the London 2012 Games, 90% of all construction demolition waste was recycled. Also, approximately 25% of all aggregates used on the Olympic project were from recycled materials [36].

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Figure 9: London 2012 Olympic Park recycling onsite location (Source: BioRegional Development Group 2009).

The challenge of reducing global greenhouse gas emissions has been a top priority for Olympic Park Team. The strategy used for the construction of the Olympic Park covers key areas such as contractual relationship, specialist subcontractors, decision-making process, working with designers and materials storage, demolition and reclamation audits, monitoring and data collection. About 90% of the material by weight arising through demolition works to be reused, repurposed or recycled following the Olympic Development Agency's waste 3R's principle (i.e. reduce, reuse, recycle, recover and disposal).

Specialist reclamation subcontractors have the knowledge and technique to achieve higher levels of reclamation than most generalist demolition firms. Using specialist contractors is beneficial to the entire redevelopment of the Olympic Park as they are experienced in finding markets and end users, ensuring materials are reused, repurposed or recycled [36]. In order to effectively manage the construction and demolition activities at the Olympic Park redevelopment, the Decision Making Process was used to manage subcontractors carrying out material reclamation during demolition works as well as working in partnership with Building Research Establishment (BRE).

A strategic tool such as SMARTwaste was employed with BRE's contribution as other issues with contractors were monitored during work progress [37]. Challenges such as lack of non-contractual terms among contractors and waste transfer station were identified as well as it provides lesson learned on monitoring process. Material tracking systems are a useful tool for managing and monitoring waste arising onsite. Monitoring process also helped the group to educate designers on how a material can be reused and repurposed. Material storage poses other key challenges during the decision-making process. Suitable storage secured from the very beginning of demolition is vital for maximising rates of reclamation and reuse by providing a holding place for materials/items until such time as they are required or purchased.



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Figure 10: Material storage for reclaimed granite, concrete and yellow stock bricks on the Olympic Park

Used concrete is also stored and later repurposed for floor paving and pedestrian walkways.



Figure 11: Repurposed concrete for floor paving at Construction Zone A

Concrete is inherently difficult to dispose of because it's heavy and a pain to transport. While it's a good idea to keep any material out of the landfill, concrete's durability and high-embodied energy makes it an especially viable candidate for reuse and repurpose [9].



Figure 12: Repurposed concrete for walkway pavement

Site investigation identifies brick buildings around the Olympic Park with the potential for reclamation and provided a list of reclamation work [37]. Crushed recycled concrete can also be used as the dry aggregate for brand new concrete if it is free of contaminants. At the Olympic Park, Yellow stock and Staffordshire blue bricks were reclaimed and stored as well as reused. Yellow stocks are reused directly onsite and some are sold to specialist demolition contractors whilst others are sent to recycling base station [38].

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Figure 13: Reclaimed yellow stock bricks used to create seating areas on the Greenway and red and blue being reclaimed at Construction Zone B.

The case study suggests that contractors and designers need to embark on designing out waste, develop a quality Site Waste Management Plan (SWMP) as well as materials logistics plan in order to achieve a better outcome for C&D waste recycling and upcycling activities.

VI. KEY RECOMMENDATIONS

The following key recommendations were established to provide potential solutions that could address the challenges that exist surrounding the creation of a recycled building material market. The recommendations were established to address the challenges shown in the key research findings and are based on both UK and international waste management best practice examples from case studies, policies, regulation and circular economy perspectives.

A. Waste Policy and Regulation

EU vision for waste reduction in member states set up waste management directive target recovery rate of at least 70% of C&D waste by 2020 [39]. This ultimate target motivates the C&D recycling and reuse activities in the UK.

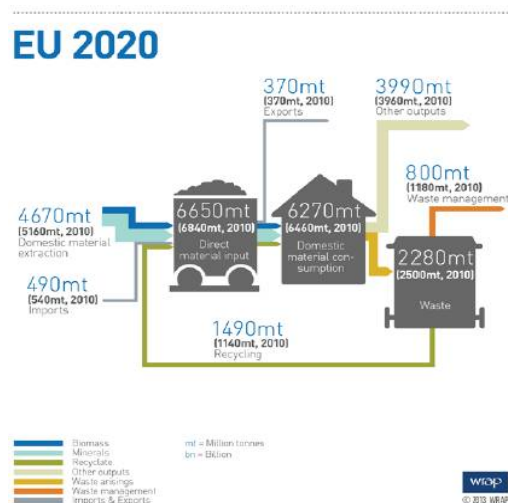


Figure 14: EU vision 2020

The waste policy and regulation recommend that:

- *Waste hierarchy*: This is incorporated in all C&D waste management activities across the country.

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- *Diversion of waste from landfill*: based on the waste hierarchy the UK government policy is to reduce the amount of waste being diverted to landfill, which is part of the UK Sustainable Construction Strategy to meet the national target by “*Halving C&D waste to Landfill*”. Also, the Environmental Permitting (England and Wales) Regulations 2010 and Landfill Allowance Scheme (Wales) impose a restriction on the type and amount of waste that can be disposed of in landfills in England and Wales.
- *Increase recycling*: UK government’s objective is to create awareness on reuse, repurposing and recycling among many citizens and organisations. This motivation helps to meet the EU waste directive target of achieving 70% waste reduction.
- *Reduction of waste from the economy*: The amount of C&D waste produced by construction sites around the UK is significantly high. Producer Responsibility Obligations (Packaging Waste) Regulations 2007 place responsibility on the producers of packaging waste to recover and recycle a certain amount of packaging.
- *Controlling Hazardous Waste*: Laws impact the way that hazardous can be disposed of in England and Wales.
- *Shared Responsibility*: The UK waste management policies operate on the basis of “shared responsibility” Almost everyone including all construction and demolition waste users have responsibilities in preventing waste growth. As part of the society also have a responsibility to reuse, repurpose, recycle and dispose waste properly.

B. Circular Economy

A circular economy is an alternative to a traditional linear economy (i.e. make, use, dispose of) in which resources is kept in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life [38]. The recommendations of the circular economy are important as it creates new opportunities for growth. The circular economy will boost the EU's competitiveness by protecting businesses against scarcity of resources and volatile prices, helping to create new business opportunities and innovative, more efficient ways of producing and consuming.

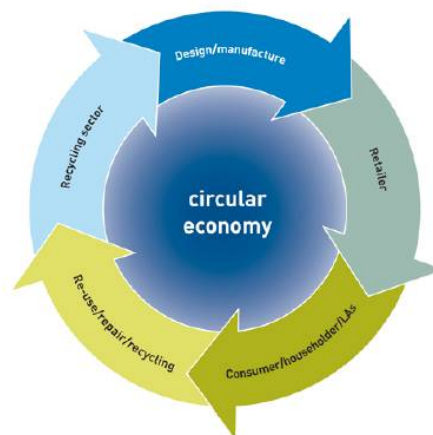


Figure 15: Circular economy recommendations

Circular economy helps to reduce waste, it drives greater resource productivity, delivers a more competitive UK economy, position the UK to better address emerging resource security/scarcity issues in the future and help reduce the environmental impacts of managing C&D waste. The use of a circular economy offers considerable economic benefits by recycling and upcycling C&D waste. UK vision meets the EU target for 2020 and urges that many municipalities across the country can address the current C&D waste practices and meet the circular economy requirement by following the recommendations:

- UK’s economy assumes to have achieved 70% of waste reduction

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- Ensure full implementation and enforcement of existing EU and the UK waste management laws
- 30 million tonnes material inputs into the UK economy
- Set realistic and achievable packaging recycling targets
- 20% less waste produced (i.e. about 50 million tonnes less waste)
- There are four key ways (i.e. lean production, reducing waste, goods-to-services) to achieve cost and energy savings.
- Promote diversion of packaging materials from the landfill for reuse, repurpose (upcycle) or recycle.

VII. CONCLUSION

With the significance of C&D upcycling and recycling, need to meet the EU target for 2020 to cut down waste by 70%, and if nothing else, the paper shows that the success of any type of used C&D waste material market depends on the strategic approach, extent of waste generated and stakeholders involved. As with any waste management model, there is not one simple response to reducing waste than applying best practice across all regions. The idea of “upcycling” for C&D waste management requires minimal energy, and by giving a product a second chance at life, and in turn saving a significant amount of waste sent to landfill. The paper found out that there are some challenges facing recycling and upcycling output. Many developed countries do not support the idea of C&D waste upcycling and would rather prefer new building materials, which are not readily available. Among other challenges are survivability and the use of problematic and unaesthetic structures that are not mechanically stable. Despite the challenges in upcycling, the paper suggests that the opportunities found with C&D waste upcycling and recycling is far more than its challenges. The case study review in this paper provides evidence for recycling and repurposing C&D waste with special focus concrete, soil and bricks.

The paper acknowledges that there are clear differences between “upcycling, recycling and downcycling”. Upcycling is more desirable out of the three as it involved the conversion of low-value materials into high-value products, whilst downcycling remains the opposite of upcycling in context. Recycling, on the other hand, is the first step in reaching a more comprehensive and sustainable solutions for C&D waste management that can eventually limit the amount of new, virgin materials that need to be produced. However, the boundaries within these concepts lie within the actual waste system under study. The London Olympic 2012 case study on reuse of concrete and bricks shows the benefits of both recycling and upcycling concepts with unique opportunities to capitalise on the need to meet circular economy requirements. The United Kingdom has become stewards of a more sustainable built environment for many years and gradually working effortlessly to meet EU 2020 vision. This paper hoped that the recommendations herein on waste policy and regulation and that on the *circular economy* could be used as potential options for the municipality to address current C&D waste issues.

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