

Chapter 18

Circular Economy in Construction from Waste to Green Recycled Products in Israel: A Case Study



Zvi Weinstein

Abstract The chapter describes a policy of the State of Israel with the aim to cope with construction and demolition waste (CDW) through recycling, to be further used as green products. It is aimed at supporting the national economy and the recovery of the open public spaces that became places for illegal landfills, impacting the natural environment. Two major tools are used to achieve these aims: the first is the circular economy (CE), instrumentally led by the Ministry of Economy, and the second is the regulatory framework led by the Ministry of Environmental Protection. Both have the capacities to cope with, and support, the national economy and the environment. We argue that the way to achieve the full integration between the circular economy and the legal framework has still a wide gap, although big changes and advancements have been made towards reaching a comprehensive policy. Both Ministries are aware that it is a long process to achieve real changes after many years of environmental neglect due mainly to conflictual politics, economic interests, lack of budget and other government priorities. The means to achieve that goal include the use of the circular economy principles for recycling CDW into green and reusable products, on the one hand, and empowering the responsibility and accountability of local municipalities through regulation, on the other.

Keywords Construction waste · Illegal placement · Recycling · Green materials · Environmental regulation

18.1 Introduction

The chapter examines and analyses two key aspects of construction and demolition waste (CDW): the economic and the environmental. The introduction defines the two terms to enable establishing a framework for the following sections, including

Z. Weinstein (✉)
Israel Smart Cities Institute, Tel Aviv, Israel
e-mail: zviw@nonstop.net.il

the economics of CDW and considering that Israel needs to supply new housing for the growing population.

In 2020, Israel celebrates its 72 years of existence with 9.2 million residents, while it is expected to double its population, in 2048, to 15.8 million. Hence, construction needs in Israel indicate that by 2030 more than 400,000 additional housing units will be built; and by 2035 approximately 1,120,000 new housing units will be added (Hasson, Kutok, Drukman, & Roter, 2016).

During the expected construction momentum, joined by many urban renewal operations, huge amounts of CDW will be produced, of which 95% could be recycled and returned to the construction and infrastructure sectors. Moreover, 2020 data from the Israel Planning Administration on Master Plan 14b in Mining and Quarrying signal a critical and expected shortage of clay, limestone, cement, basalt and sand (Ministry of Interior, 2012).

The present case study focuses on two faces of the same coin, i.e., economic and environmental. The coin represents the issue of construction and demolition waste. To achieve the goal of minimizing waste, both the economy and the environment should be taken into account in a building policy aimed at providing the best answers to all relevant stakeholders. This requires establishing a targeted and efficient mechanism able to take into consideration policy, operating functions, supervision, regulation and legal aspects.

The economic side regarding CDW involves the central government's ministries, i.e., the Ministry of Environmental Protection (MoEP), The Economic Ministry, the National Infrastructures & Energy (MoE), the Ministry of Interior (MoI) and the Ministry of Housing & Construction (MoCH). The direct responsibility for CDW treatment is in the hands of the MoEP. The objective of this paper is to support cooperation of different ministries for a common interest, thus bringing success in one of the most complicated issues the State of Israel is currently faced with.

The building and construction domain in Israel plays a major role in the economic activity of the country and it is one of the fastest growing economic sectors in Israel. The total investment amount in the year 2017 reached 45 million Euros, which equals to 10.7% of Israeli Gross Domestic Product (GDP). The building sector employs 260,000 workers (Israel Builders Association, 2017).

The scope and size of these activities witness the huge amount of materials and resources consumed in the domain. Figure 18.1 presents data by the MoE regarding the forecasted demand of raw materials from 2016 to 2040.

“Business as usual” activities of the building and construction sector will cause extensive use of raw material mining, which are already scarce. The goal is consequently to size the benefits of implementing a circular economy model with the aim to decrease, at first, the scope of mining.

The environment aspects became a very significant factor in Israel in the last decade, raising the general awareness of citizens and of many organizations, such as NGOs or civic organizations, who adopted the vision of “quality of life” and sustainable environment, thus supporting a deep change in government policy and attitude towards open spaces, natural sites, climate change, renewable energy and nuisance caused by CDW.

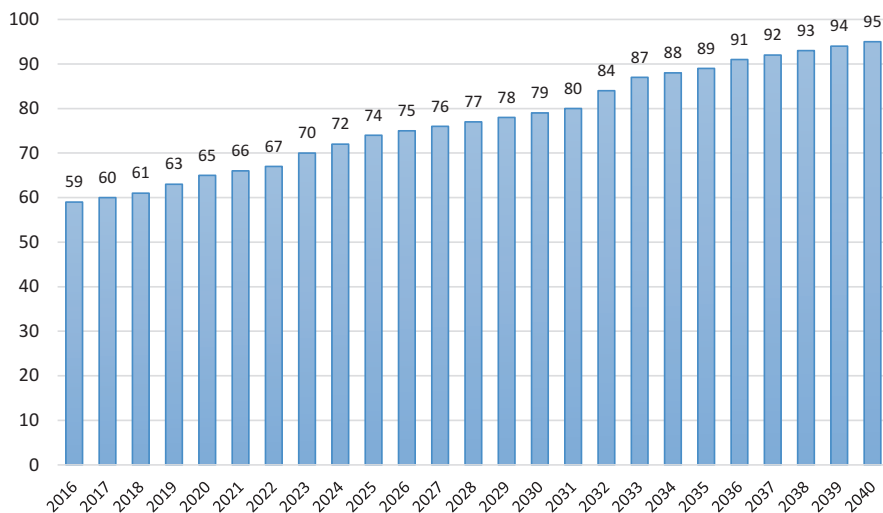


Fig. 18.1 Demand for raw materials 2016-2040e (million tonnes). (Source: Israel Ministry of National Infrastructures and Energy, 2017)

Table 18.1 Estimated construction waste for 100 m² per building type

Sources of construction type	Waste quantity per 100 m ²
Dwelling, public, offices	20 tons
Commercial, industrial	6 tons
Basements	3 tons
Demolitions	150 tons

Source: Edri (2010)

The chapter relates to both economic and environmental aspects of a circular economy and its benefits, as well as to the difficulties in implementation of a dedicated policy, highlighting both pros and cons.

The Israeli Ministry of Environmental Protection is in charge of all regulations and laws regarding waste. Collection of construction and demolition waste in Israel, unlike the collection of domestic waste, is not regulated by the local authorities. This makes it more difficult to ensure CDW is legally disposed of. CDW is collected only upon request – either by local authorities, or private companies. As a result, much of this type of waste is illegally thrown into open spaces causing environmental damages. As a consequence, a large part of the MoEP’s efforts related to CDW are focused on its reduction by means of recycling, creation of authorized waste disposal sites and enforcement of laws to ensure legal behaviours.

Each year, the amount of construction waste reaches circa 7.5 million tons, of which 4.5 million tons are CDW and 3.0 million tons are excavating ground containing a major part of CDW (Tal, 2016). Table 18.1 shows the estimated amount of waste created as a result of a 100 m² building.

Construction waste is defined by the Maintenance of Cleanness Law (1984) and the Clean-up Law (1984) which include all types of waste and debris left over from construction and demolition activities. These materials (soil, rubbles, blocks, concrete, asphalt, tar and tar sub-products, bricks, tiles, ceramic, glass, insulation panels, wood, etc.) are mostly inert, though there are some that are dangerous, toxic, or flammable.

This case study follows the development goals of two Israeli Ministries – the Economy and the Environment – regarding CDW policies and investigate whether a joint resolution could succeed in achieving a comprehensive framework to be implemented in Israel. A second issue regards the hindered factors that prevent the realization of a sound policy able to satisfy all engaged stakeholders with respect to CDW.

The following sections describe the relevant policies developed in the period from the mid-1980s until today; the objectives and goals of the most recent regulations, as well as the possible alternatives leading to the choice made by the MoEP.

18.2 Method

A case study is developed focusing on the issue of CDW and discussing how the central and local governments deal with it from two angles: the economical and the environmental. An analysis of the present state of CDW from the point of view of these two main aspects is presented and future directions to achieve the most effective outcomes with respect to this issue are introduced.

The available documents collected from the central government are analysed under these two perspectives. Relevant documentation includes planning laws, regulations and guidelines from both Ministries as well as other data. Sources and data have been categorized into sub-titles. In addition, two study tours have been made, visiting companies that successfully reuse CDW in the building sector, thanks to a recycling process in a circular economy approach.

Several interviews have been conducted with experts in the domain of CDW, at the Ministry of Economy and at the Ministry of Environmental Protection, as well as with owners of recycling enterprises. The case study used the qualitative approach and was performed during the period of January to June 2020.

18.2.1 Approaching the Circular Economy

In this section, we present a short description about the circular economy (CE), i.e., its meaning, principles and benefits with respect to construction and demolition waste (CDW). CE is seen as a tool to explain how to cope with scarce materials, and a system employed in many projects. It is an economic model aiming at growing the

effectiveness of resources and raw materials in the manufacturing process of products and systems along the supply chain (Tal, 2016).

A CE assumes that the linear economic model – based on production, consumption and growing amount of waste – is not able to exist anymore, due to the limited size of the resources our planet can offer, and in consideration of the destructive impacts on the environment. A CE is characterized by increasing exploitation and reusing/recycling of raw materials, and it acts according to a holistic process that integrates them through their life cycle (Eco-Finance, 2020).

The reuse of recycled materials derived from CDW is growing mainly in urban areas that have to satisfy the demand for housing and other constructions for the local population. In some densely populated areas with limited supply of natural materials, economics can play a key role in increasing the use of alternative raw materials (Hendriks & Pietersen, 2005).

The concept of CE goes from restorative to regenerative to create a life-long sustainability. Our environment has a limited amount of resources, and not always what we spend we return back to keep the equilibrium. Buildings, and the manner in which we design, construct and maintain them, have been significant contributors to the climate crisis the global population is witnessing, including Israel. Consequently, to keep a sustained environment we are committed “to do more good than less bad” (Brown et al., 2016: 47).

Building waste is a mixture of different quality materials that have been originally used to build various elements in construction, open space development or infrastructure. The position of the Israeli Ministry of Economy is that almost 95% of the building waste has the potential and possibility to be recycled and reused (Benita, 2018).

The environmental impacts of throwing waste in unauthorized sites cause damages in open sites and natural values, i.e., soil and water pollution due to infiltration of contaminants; creation of attractive places for multiple pests; air pollution with smoke and unpleasant odours due to illegal burning. There are several reasons why we need to recycle: to save significant amount of capital; to prevent damage to mining and quarrying areas spoiling the landscape; to decrease open spaces pollution; to reuse building waste, which is qualitatively equal to other building materials (Katz & Baum, 2011).

Figure 18.2 presents the components of construction materials participating in the process of circular economy model.

18.2.2 Implementing the Circular Economy in Building and Construction

There are several reasons why we need to adopt the model of circular economy in the building industry in Israel:

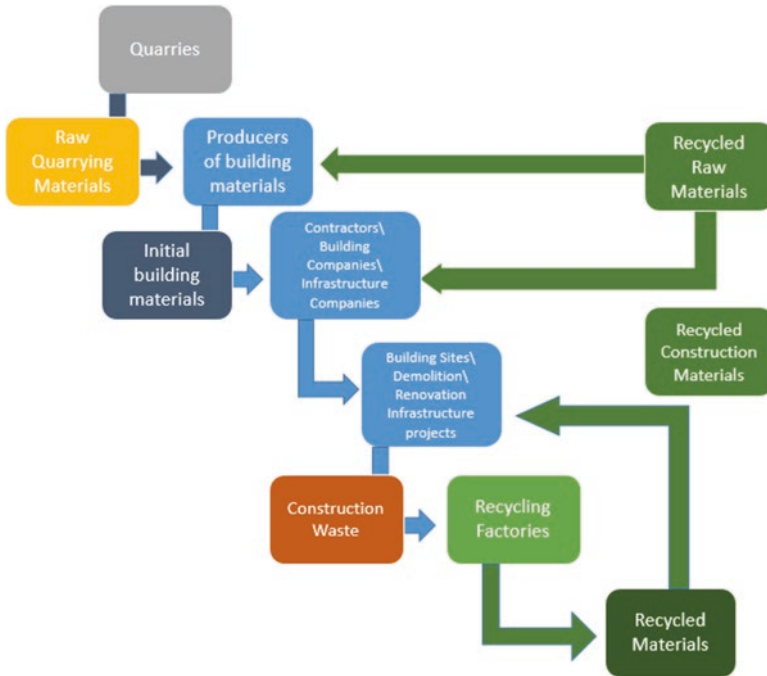


Fig. 18.2 The model of circular economy, from mining & quarrying, to recycled construction waste. (Source: Eco-Finance, 2020: 5)

- The amount of materials used in the building sector is very large (65 million tons per year, as shown in Fig. 18.1).
- Demand for building materials is growing annually due to urbanization processes and population growth (Ministry of Energy, 2017).
- The size of environmental impacts is huge. The industrial construction factories (mining & quarrying, asphalt and cement productions), are responsible for one fourth of the national greenhouse gases (GHG) emissions (Ministry of Environmental Protection, 2018b).
- Resources become limited and price fluctuations are significant (mainly metals and natural minerals).
- Present construction systems are using resources which are not recycled.

Implementing circular economy in construction waste has to take a different point of view through a detailed analysis of the building process, the choice of the construction materials and the ways the products are used. The building, whether renovated or demolished, can supply materials for recycling. When examining the construction materials, there is a need to consider their composition features, their exposure and life length scale for different uses. Table 18.2 shows an example of transferring a construction waste material into new products and their uses. This is an example provided to the author during an interview with the Greenmix co-founder, Mr. A. David, on January 26th, David, 2020.

Table 18.2 From waste materials to green products

Tier	Module	Output/Product	Used for
1.0	Sorting, crushing, sieving	Base	Sub layers.
		Subbase	
		Backfilling A 2–4	Roads reinforcement.
2.0	Sorting, crushing, sieving, rinsing	Rinsed sand	Sand for flooring. Raw material for construction products.
		Recycled aggregate (“sesame”)	Sub-flooring filling. Raw material for construction products.
3.0	Concrete production line based solely on recycled raw materials	Non-constructive concrete	Plasters.
			Light concrete.
			Self-leveling underlayment concrete.
			Controlled low strength material (CLSM).
4.0	Sorting packaging waste	Paper/cartons, metals	Send to specialized treatment facility.
		Wood	Tier 6.0.
		Polymers	Tier 5.0.
	Extraction of locked minerals	Minerals	Raw material for tier 1.0 and tier 2.0.
5.0	RDF & Gasification	Energy	The recycle process.
			Cement production.
6.0	Wood treatment system	Woodchips	Poultry farming.
		Wood pellets	Energy substitutes.
7.0	Purified sand by redundant health (from tier 5&6)	Fine sand	Plasters and adhesives.

Source: Author, with data from Greenmix, Benny & Zvika Group

18.2.3 Quantifying the Benefits of CE in the Building Sector

The main step to implement CE in the building sector is an effective management of the construction waste array. It is necessary when utilizing recycled materials instead of quarrying mining. The Eco-Finance consulting company, at the request of the Ministry of Economy has prepared three scenarios in that respect (Eco-Finance, 2020).

- Business as usual – Basic status, where only 40% of construction waste is recycled in comparison to an average of 89% as in the OECD (European Union, 2019)
- Scenario A – Partial implementation of CE at a rate of 75% of construction waste
- Scenario B – Full implementation of recycling up to 100% of the construction waste.

Landfills of construction waste without recycling and no operation for reuse, on the one hand, cause high costs for the economy, and for the landfill itself and, on the other hand, reduce the need for mining and quarrying. The resulting equation is: Landfill costs + recycling costs – saving costs of recycled materials = the cost to the economy.

Table 18.3 presents the costs of waste treatment and their division for cycling, landfill, external negative costs caused to the environment, and the cost of landfill in open spaces. The costs are calculated according to bids of the Ministry of Construction & Housing for waste disposal, targeted at developing new neighbourhoods. There are additional costs related to mining and quarrying of natural aggregates, and other external costs (difficult to quantify) caused by the operation of mining and quarrying, such as dust emission and air pollution, negative impacts on the landscape, lost ecological values and image of the region.

According to the calculation of the Ministry of Economy the results are: Basic scenario – 45,788,000 Euros; Scenario A – 19,578,000 Euros; and scenario B – 14,437,000 Euros.

Based on the calculations of Eco-Finance (2020), full implementation of CE in construction (Scenario B where 100% of CDW is recycled) compared to business as usual is expected to save (i.e., “economic efficiency”) a yearly sum of about 32 M Euros. While a partial implementation will save a sum of approximately 26 M Euros on a yearly basis.

The conclusion appears to state that as long as the CE ratio of implementation is higher, thus is the scope of saving both mining and quarrying expenditures and

Table 18.3 Costs quantified under different scenarios (in ‘000 Euros) (converted from NIS at 1:4 Euros)

		Basic Scenario	Scenario A	Scenario B
		Business as usual	75% recycling in 2030	100% recycling in 2030
Variables	Cost per ton	Cost	Cost	Cost
Landfill	4	10,112	9657	3937
External landfill	1.25	3370	3172	1312
Recycling	8.1	24,666	45,937	61,250
Cleaning open spaces	15	28,606	–	–
Waste treatment total cost		66,754	59,387	66,499
Mining & Quarrying saving costs	(6.67)	(14,978)	(27,890)	(37187)
External mining & quarrying costs	(2.5)	(5991)	(11,156)	(14,875)
Mining & Quarrying total saving		(20,969)	(39,047)	(52,062)
Total cost for local economy		45,788	19,578	14,437

Source: Eco-Finance (2020)

economic efficiency. The major part of efficiency stems from saving as a result of decreasing scope of raw materials and the increased amount of recycled materials which causes much less CDW.

The following section is the complementary part of the economic aspects dealing with the construction waste activity. It presents the law regulations changes and the level of responsibility supposed to enforce the law to those who are involved in the construction waste processes under a “new deal” scenario. Both are aiming at changing and improving the problematic issue of construction waste in Israel.

18.2.4 Policy Development of Construction Waste Treatment

This section describes the policy development of laws and regulations passed by the Israeli Parliament (the Knesset) since the mid-1980s until these days in order to cope with the illegal disposal and the related environmental nuisances and economic losses throughout the country. These actions have been executed in several steps that are explained and summarized below.

The existing regulations consist of a number of laws and standards enforced in 1970, after the Planning and Building Regulations, accepted in 1965 (Planning Administration of Israel, 1965), ruling the applications for construction permits, as well as terms and fees to comply with all administrative norms. It was followed by the Cleanness Law, in 1984. The law introduced fines for dumping waste in the public domain, and called for establishing a limited number of properly managed landfills. A second step, called National Outlines Plan for Solid Waste (NOP 16), was approved in 1989. It was the first comprehensive attempt to regulate the locations of operational criteria for waste treatment and disposal sites, and in particular municipal waste. In 1993, the Government decided to close all unregulated waste dumps, which numbered some 500 at that time, including about 75 large landfills. These dumps were associated with a variety of environmental nuisances: risk of groundwater and soil contamination, air pollution, aesthetic blight, safety threats in extensive tracts of land. Additional steps began in the early twenty-first century and are being continued to date.

The treatment of CDW came up in the Israeli national agenda in 2003, following government decision number 2927 (Government of Israel, 2003). The Government decision initiated a clear policy of CDW and of the usage of recycled materials by public companies. The decision aimed at preventing redundant mining and quarrying, and securing expensive natural resources. The entrepreneurial building domain is mainly in private hands and, therefore, the economic interest represents a priority for its existence. On the other hand, the economic activity must be conducted according to the law and the CDW has to be delivered to the MoEP-authorized landfill sites. The Government decision left to the MoEP the responsibility to take the needed steps to implement the decision. As a result, the central local authority was asked to prepare a plan aimed at approving authorized legal sites, where the waste had to be delivered from the local municipality and, in addition, to set up sites

for waste recycling up to 50% of its capacity. In 2007, a landfill levy went into effect in Israel – Amendment 9 of the Maintenance of Cleanliness Law, The Clean-up Law (Knesset of Israel, 2007, 2010). The introduction of a levy is aimed at reducing the amount of waste sent to landfills by internalizing the external costs of landfilling in order to reflect the true price of burying waste. The funds collected from the landfill levy are deposited into a Maintenance of Cleanliness Fund to be used for the development and establishment of alternative waste treatment methods, such as recycling and energy recovery.

An important step was taken in 2009, when the MoEP began to lead a “recycling revolution”, which includes a separation of waste at-source, funding of recycling and recovery facilities, and an awareness-raising campaign. The goal is to increase recycling rates and to significantly reduce the amount of waste sent to landfills from 80% to 26% by 2030.

In 2018, a 2030 Strategic Plan for the Treatment of Waste was approved, allocating a budget of one billion Euros (MoEP, 2018). The plan is expected to result in making the waste market more efficient, reducing the landfilling of waste, increasing the rate of recycling, and reducing pollution and overall environmental risks.

Starting 1998, the directives of the Planning and Building Law (1970) instructed that local authorities must include in the building permits they issue to contractors an assurance that CDW will be disposed legally. In addition, residents must provide proof to the local authorities that the waste has been legally disposed, in order to obtain “Form 4”, a document that citizens must receive before they can move into a new or renovated home. In practice, though, these directives are not fully executed. Reports by the Israeli State Comptroller, in 2007 and 2013, found out that the Local Planning Committees have not been able to fulfil their functions (Israel State Comptroller, 2013), thus revealing a failure. In 2015, the Standards Institute of Israel issued a regulation that allows using recycled aggregates for infrastructures in accordance with the European Standardization (Standards Institute of Israel, 2015).

As a consequence, those who produce the waste, either tenants who renovate their homes or developers, normally get in contact with contractors, and deliver the waste to landfills or recycling sites (“gate fee”).

According to the MoEP, about 0.9 million tons annually, which is 25% of the total quantity of construction waste in Israel, are not transferred to legal sites, but are thrown in open public spaces. That practice is an illegal alternative to landfill and recycling, and its direct costs are relatively low.

The results of these illegal actions cause direct and indirect impacts, as described below.

Direct nuisances:

- Damage to open spaces and landscape values – both functional and visual
- Cost of handling cleaning of building waste from open spaces
- Government offices, local authorities and other public agencies invest a great deal of money in treating or preparing sites for construction. During the years 2010–2016, as part of the “Equal Environment” project, the MoEP has transferred to the local authorities a sum of 35 million Euros for cleaning hazardous

construction waste, as ranked according to four socio-economic classes (Central Bureau of Statistics, 2017). Building waste treatment refers to waste-on-site collection operations, recycling and transport of the materials to landfill site. The cost of treatment per ton ranges from 7.2 to 9 Euros (Eco-Finance, 2020).

- Loss of revenues from landfill levies – Calculating the loss of revenue is based on the fact that approximately 900,000 tons are generated each year. Since July 2007, a fee is imposed on construction waste in legal landfill sites. The levy estimation is calculated in accordance to reports sent to the MoEP by the recycling sites. The total sum is about ten million Euros.
- Fires outbreaks – Flammable construction materials in building waste, such as rubber, wood and tires. These events cause air pollution and nuisance due to smoke, odours and other toxic emissions that can cause cancer (Tal-Spiro, 2016).

Indirect nuisances:

- Risk of soil, run-off and ground water pollution – Construction waste might include dangerous materials liable to cause soil and drinking water contamination, or even seep into groundwater (Shenkar & Chen, 2011).
- Falling prices in the real estate market, and lower economic value of open spaces used for leisure and tourism.
- Loss of tax revenue – In the present state, disposal services of construction waste are managed as free market which features in cash payments. As a result, reports about transactions are lacking and taxes are not paid.
- Loss of raw materials available for reuse – Potentially, construction waste could be recycled at a “gate fee”, and reused in the building market. Due to illegal discharge, large amounts of raw material waste are lost, which could conversely be saved.
- Nuisance to health as a result of pests, invasive plants and animals, which could cause damage to biodiversity.

18.2.5 Objectives and Goals

The main reason for the need of a regulatory framework is due to the economic market failure in eradicating the illegal disposal of construction waste in open spaces, together with its economic, social, health and environmental damages. It became a top priority also thanks to the rising awareness towards keeping the environment safe in a bottom-up approach, with the wide support from civic organizations and the Ministry of Environmental Protection.

The MoEP has added new goals in regulating the building waste, as part of its annual programme. These goals are part of the Israel National Strategy (2010) on natural resources. Israel is short of natural resources like iron, coal, streams of rivers and more. Therefore, recycling has a high importance among different national strategies of all ministries. These goals are:

- Achieving 80% waste recycling
- Defining an inter-office policy of controlling the life cycle of raw materials embodied in building waste, as a recurring resource for long term sustainability of the construction and paving industry, resulting in reduced mining activities
- Extending the demand for recycling materials instead of mining new raw materials
- Establishing an information database for building waste production volumes
- Enforcing the use of recycled materials for firms and companies relying on public budget
- Reinforcing the social values related to the protection of the public quality of life, while protecting the environment through the intervention.

Similar to the economic part discussed above, the MoEP examined three alternatives with respect to the regulatory tool, its requirements and the mechanism it aims to achieve. The choice of the best alternative process was based on the existing knowledge, and the experiences gained using regulatory tools to deal with waste management.

The alternatives were reviewed and described considering their main principles, and the chosen one was discussed in detail. The analysis used the following list of variables and criteria for each alternative: benefits; regulatory burden; direct financial costs; implementation costs for the regulator; and public interests (Tal, 2018).

18.2.5.1 First Alternative – The Zero Alternative – The Current Situation

The existing situation consists of two main provisions: firstly, the Clean-up Law (1984) that prohibits that a person who builds or renovates from throwing waste in the open space. This is the general rule that applies to all producers of waste, and that enforces the disposal of waste to approved landfills and/or the recycling of it. Accordingly, the MoEP is adopting a number of enforcement strategies to avoid disposal of unauthorized building waste, including penalties, legal proceedings and forfeiture of trucks. In addition, as part of the current policy, the planning and construction regulations require that the Local Planning and Building Committees supervise that the construction waste is transferred to legal disposal sites. This regulation applies only to new construction or demolition of buildings for which a building permit has been granted.

18.2.5.2 Second Alternative – Transfer of Building Waste Responsibility to Local Municipality

The second alternative regulates the building waste treatment system by giving responsibility for waste disposal to the local authorities. As part of the proposed mechanism, developers and contractors are required to contact the local authority to

obtain the collection, evacuation and waste disposal services and are charged a fee for those services. The local authority performs the duty either by itself or through the publication of tenders for the employment of construction waste removal contractors to work on its behalf. The local municipality is charged for annual registration and reporting to the MoEP about waste quantities, the sites where the disposal is sent to for landfill or recycling. This reporting activity allows monitoring and control on the domestic and national markets (Ryvkin, 2020).

18.2.5.3 Third Alternative – Extended Manufacturer Warranty

This alternative seeks to regulate the treatment of building waste through an extended manufacturer's warranty mechanism, as it is customary in Israel in relation to packaging waste, electronic and used tyres. According to this alternative, manufacturers and importers of construction materials are responsible to finance the collection and treatment of building waste, through recycling companies whose activities are funded in accordance with the type of construction materials they sell in Israel.

Local municipalities are required to set up a mechanism of CDW collection from building renovation sites as well as from newly built buildings and deliver the waste to a recycling company. Building companies, contractors and developers of the new construction have to finance the costs of collecting and transporting the waste up to the recycling site, while the recycling company has to finance the waste's onsite treatment. This alternative takes into consideration a decrease of illegal landfilling volumes. The MoEP would be able to establish more recycling companies that will be responsible for executing the law to contact various stakeholders and to fund the whole mechanism (Tal & Zagman, 2018).

18.2.6 The Chosen Alternative

The MoEP was due to examine the three alternatives for the regulator to cope with the issue of illegal construction waste disposal in open spaces and, through this tool, to establish a statutory framework where one entity is responsible for supervising the disposal of building waste.

The alternatives' analysis focused mainly on the major benefits resulting from each of them with respect to the problem described, and the purpose of the regulation. In addition, the analysis explains the regulative imposition and the direct financial consequence of that burden, as well as the costs imposed on the regulator itself.

Among the benefits, the MoEP has chosen the second alternative of building waste treatment, empowering responsibility to the local municipality. The key feature of this alternative is the creation of a national mechanism aimed at dealing equally with building waste generated both from renovation and new construction requiring a permit.

The main benefit expected from the implementation of this alternative is the prevention of the infraction of throwing building waste in the public domain, with an estimated benefit of 17 million Euros per year. In addition, today there are local authorities investing to enforce and supervise the illegal phenomenon of throwing waste in open public spaces. This alternative is supposed to supply the municipalities with financial resources for supervision.

In terms of regularity burdens, the alternative imposes to the waste producers whose building, demolition or renovation, is in a specific territory to contact the local authority, and be charged a fee for the service obtained from this call. For this alternative, there is no difference between the amounts of waste, be it a significant or a small volume. A bureaucratic cost is created due to the local authority obligation to establish a mechanism for that purpose. These loads are taken into account in the alternative and are embodied in a fee to be paid by the one responsible for the waste to the local municipality.

As far as direct financial costs are concerned, the producers of waste from renovation or demolition actions have to pay additional fees to cover different items, such as the supply of a container, its transfer to the gate site, the entrance to the site and the management and supervision performed by the local authority.

There will be no additional implementation costs for both the regulator and the local authority, since the above mentioned fees paid by the waste producer cover them all.

Regarding public interest, it is expected that this alternative has a positive impact on the environmental landscape value, since the abuse of throwing waste in open spaces is drastically reduced. As a result, all environmental nuisances are limited.

In terms of Impact on free occupation, it has been estimated that there are about 200 legal waste operators. In addition, there are several hundred operators working illegally. This alternative changes the whole free market structure. A possible solution for that problem is that the local government launches tenders to legally contract the operators.

18.2.7 Discussion and Conclusion

Two research questions are at the basis of the conducted study: (a) Can economic and environmental aspects be successfully combined through a comprehensive framework for construction and demolition waste policy in Israel? And (b) What are the hindered factors that prevent the policy's full implementation?

A variety of environmental aspects, whether direct or indirect, undoubtedly cause impacts on human quality of life. We can mention, for example, the lack of green open spaces, all kinds of pollution, diseases, landfill nuisances and climate change among the most relevant factors that influence our life. To overcome these problems, it is necessary to find out resources, including appropriate financing, which in most cases are in the hands of the central government and partnering stakeholders. Mutual interests, when facing national issues, must be effectively combined and integrated.

Based on the conducted analysis of the CDW situation in Israel, after years of laws and regulations to limit illegal disposal of waste, illegal landfills and “black markets” still exist, causing loss of revenues to both central and local governments. Moreover, considering the direct and indirect nuisances, as well as all the other negative impacts, the evidence confirmed a very difficult social situation, impacting a large part of the population. An urgent paradigm shift is needed, under two possible approaches: bottom-up and top-down.

The bottom-up approach can be seen as the result of local “green movements” in Israel, who put pressure on the national ministries – especially the Ministry of Environmental Protection and the Ministry of Economy – forcing them to take the necessary steps to reduce the negative impacts of CDW, and enforce control. The top-down line can be interpreted as the result of the collaboration between two leading ministries – the Ministry of Environmental Protection and the Ministry of Economy. Their decision to take real steps and change priorities comes as: an answer to the emerging housing demand of the growing population and especially of young couples; the need to preserve the “status” of the construction and building domains; and the objective to preserve the government’s long term budget.

This contribution has described relevant issues concerning construction waste and how Israel is coping with its environmental impacts using two lenses: economic and environmental goals. Two possible approaches have been discussed: the input of circular economy principles into the building sector, and new regulatory aspects adopted by law.

In both Israel and the Western world, attention is given to acting according to the circular economy principles for recycling high percentages of construction waste. The State of Israel is eager to adopt the European Union guidelines and implement the circular economy as in other countries in the EU (European Union, 2019).

The discussion above shows that the way to reach the point of satisfaction has to go a greater distance due to factors that hinder the goals to be achieved. These factors include rivalry and competition interests, too many actors, lack of budget, environmental civic organizations, government ministries, local municipalities, recycling firms, transportation companies in charge of delivering waste, owners of landfills and quarrying sites. Above all are obstructions, such as conservatism in the building sector and the anxiety of using imported recycled materials, a policy of a centralized economy and a vertical ownership of mining and quarrying, construction producers and building companies, developers and the citizen themselves. In other words, the current situation portrays a very complex state, which is not easy to solve.

Enforcement of waste regulations are not executed by all involved entities dealing with building waste. It seems that the race to saving costs and achieving as much economic gains as possible dictates the behaviour of many stakeholders engaged in the construction and industrial building sectors.

In spite of the above, most organizations support the tools of circular economy and the necessary regulations aiming at reducing damages for the society, the economy and the environment.

Taking into consideration the lack of important raw materials in Israel, which are necessary for the building and infrastructure sectors, and the benefits and cost

savings of the proposed steps in coping with the issues of waste, it seems that the change in attitude among policy decision-makers might be the last obstacle to integrate the circular economy and the regulatory frameworks to plan and build a cleaner and more environmentally conscious country.

One of the steps in progress is the establishment of an inter-organizational network platform that will serve as an inter-disciplinary knowledge centre of best practices in the field of construction waste to serve local producers and importers of construction materials and landfill sites, as well as a source for updated information about new recycled materials, new systems and guidelines.

Another important step is the Israeli Standard 118 regarding the “concrete, functioning and manufacturing requirements” for the cement amount and its degree of exposure (Standards Institute of Israel, 1962).

As of today, there are only 38 recycling sites in Israel. They recycle CDW up to 40% of the amount that reaches the site. This data is still insufficient, and it means that 60% of CWD is landfilled with the many environmental impacts and consequences this implies. By imposing new regulations, the Ministry of Environmental Protection can try to extend the enforcement through the empowerment of the local municipalities in charge of construction waste treatment in their territory.

The scenarios chosen by both the Ministry of Economy and the Ministry of Environmental Protection focus on aspects of costs-benefits, the contribution to the local economy, changing illegal landfills into leisure open spaces and future real estate areas to accommodate the population growth expected in 2030 and beyond.

In other words, the two ministries are trying to act according to world standards, paying great attention to the human aspects coping with environmental issues and strengthening the local economy.

To conclude, the necessary steps are pointing at ambitious economic and environmental sustainability goals, such as the entrance in the market of additional recycling entrepreneurs, a better local supervision on construction sites, the delivery of clearer and better information to stakeholders dealing with construction and demolition waste, the improvement of innovative technology, a higher consumption of recycled construction materials and the implementation of the ISO 14001 and 14004 standards aimed at environmental management systems (Standards Institute of Israel, 2004). These steps give us the answer to the question whether the combination between the two ministries – environment and economy – succeeded in the effort to bring positive changes. The lessons learnt from the examination and analysis of the case study are aiming far away. In other words, recognition, awareness, collaboration, integration of all relevant players starting from regulators, academia, research institutions, public companies such as entrepreneurs and consumers, private initiators, various industries, developers and builders, can help in achieving the full adoption of a circular economy in construction and demolition waste and the production of recycled green products. A significant employment of recycled CDW will certainly leverage the green building growth in Israel.

This ambitious goal seems possible if the above considerations succeed in encouraging and acting according to the following lines: a policy that aims at

innovation, quality goals, standardization, less bureaucracy, controlling and enforcement for planning and safety; appropriate financing that supports technological developments, investment in innovations and partnerships; levies concessions; assistance for physical infrastructures; access to government support in technological innovations; and, most of all, the creation of a Human Capital rich in vocational skills, and willing to invest in appropriate technologies.

References

- Benita, R. (2018). *Coping with illegal waste projection*. www.knesset.gov.il/mmm. Accessed on 16 March 2020.
- Brown, M., Haselsteiner, E., Apro, D., Koperva, D., Luca, E., Pulkinen, K. L., et al. (Eds.). (2016). *Sustainability, restorative to regenerative*. Bolzano, Italy: EU-COST ACTION 16114 and EURAC Research.
- Central Bureau of Statistics (CBS) in Israel. (2017). https://www.gov.il/en/departments/central_bureau_of_statistics. Accessed on 16 March 2020.
- David, A. (2020). *Co-owner of Zvika & Benny Recycling Company*. Herzliya, Personal communication, 26 January 2020.
- Eco-Finance. (2020). *Implementing circular economy in the building sector*. Report submitted to the Ministry of Economy, Department of Industrial Administration. 16 January 2020.
- Edri, V. (2010). *Environmental planning central district planner. Annex to waste construction and detailed plan*. Tel Aviv, Israel: MoEP.
- European Union. (2019). *Construction and demolition waste*. <https://ec.europa.eu/eurosta/documents/29995521/962924/8-04032019-BP-EN/pdf/295e2302-4ed-45b9-af86-96d1bbb7acb1>. Accessed on 4 Feb 2020.
- Government of Israel. (2003). *Decision No. 2972 Regulation of Construction Waste Treatment*. Accepted on 9 Feb 2003.
- Hasson, S., Kutok, O., Drukman, D., & Roter, D. (Eds.) (2016). *Israel 2048 spatial development and planning*. The Planning Administration, The Hebrew University in Jerusalem, and The Shasha Center for Strategic Research.
- Hendriks, C. F., & Pietersen, H. S. (Eds.) (2005). *Report rep022: Sustainable raw materials – Construction and Demolition Waste - State-of-the-Art Report of RILEM TC 165-SRM Overview regarding construction and demolition waste*. <https://www.rilem.net/publication/publication/86>. Accessed on 16 Mar 2020.
- Israel Builders Association. (2017). *Survey of the building and infrastructure developments in 2017 and forecasts for 2018*. www.acb.org.il. Accessed on 10 Mar 2020.
- Israel Ministry of Environmental Protection. (2018a). *Israel's preparations for adaptation to climate change: Recommendations for National strategy and action plan*. <http://www.sviva.gov.il/English/ResourcesandServices/Publications/ResearchReportsPublications/Pages/default.aspx>. Accessed on 16 Mar 2020.
- Israel Ministry of Environmental Protection. (2018b). *Israel's Preparations for Adaptation to Climate Change: Recommendations for National Strategy and Action Plan*. <http://www.sviva.gov.il/infoservices/reservoirinfo/doclib2/publications/p0801-p0900/p0869-eng.pdf>. Accessed on 17 Mar 2020.
- Israel State Comptroller. (2013). *Report on controlling local authority treatment of construction waste*. No. 58B. https://www.mevaker.gov.il/he/Reports/Report_554/08a04796-1b27-43d7-ba1d-c891ddf71c97/108-project.pdf. Accessed on 25 March 2020.
- Katz, A., & Baum, H. (2011). A novel methodology to estimate the evolution of construction waste in construction sites. *Journal of Waste Management*, 32(2), 353–358.

- Knesset of Israel. (2007). *Clean Up Law (Amendment No. 9)*. In The 17th Knesset, Law Book 2079, 88. 23 January 2007. <https://www.knesset.gov.il/review/ReviewPage3.aspx?kns=17&lng=3>. Accessed on 16 Mar 2020.
- Knesset of Israel. (2010). *Israel National Report Eighteenth session of the commission on sustainability development*. Jerusalem, Israel: Knesset of Israel.
- Ministry of Environmental Protection of Israel. (2018). *Strategic plan for the treatment of waste by 2030*. Jerusalem, Israel: Ministry of Environmental Protection of Israel.
- Ministry of Interior of Israel. (2012). *Master plan 14b: National mining plan for the construction and paving*. Jerusalem, Israel: Ministry of Interior of Israel, Planning Department.
- Ministry of National Infrastructures and Energy. (2017). *Report on mining and quarrying*. www.gov.il/BlobbFolder/Reports/Quarries_2040/he/Quarries2040.Pdf. Accessed on 11 May 2020.
- Planning Administration of Israel. (1965). *Planning Building Law 1965 of Israel*. Published 12 August 1965. <https://mfa.gov.il/mfa/pressroom/1998/pages/planning%20and%20building%20law-%201965.aspx>. Accessed on 15 Mar 2020.
- Ryvkin, A. (2020). *An interview with the Head of Industrial Administration*, Ministry of Economy of Israel. 1 June 2020.
- Shenkar, M., & Chen, Y. (2011). *Construction and demolition waste leachates, their composition and interactions with the unsaturated sub-layers and testing methods evaluation*. Jerusalem, Israel: Faculty of Agriculture, The Hebrew University in Jerusalem.
- Standards Institute of Israel (SII) (1962). *Standard No. 118*. <https://www.sii.org.il/en/standards-search>. Accessed on 14 Mar 2020.
- Standards Institute of Israel (SII) (2004). *Environmental Management Systems ISO 14001 and ISO 14004*. <https://www.sii.org.il/en/standards-search>. Accessed on 14 Mar 2020.
- Standards Institute of Israel (SII) (2015). *Standard No. 5003 applies to use recycled aggregates for infrastructure projects*. <https://www.sii.org.il/en/standards-search>. Accessed on 14 Mar 2020.
- Tal, U. (2016). *Construction waste in Israel*. Jerusalem, Israel: Ministry of Environmental Protection of Israel.
- Tal, U. (2018). *Memorandum of cleanliness for building waste*. Jerusalem, Israel: Ministry of Environmental Protection of Israel.
- Tal, U., & Zagman, D. (2018). *Report on evaluation of regulation impacts – RIA. Managing treatment for construction and demolition waste*. Jerusalem, Israel: Ministry of Environmental Protection of Israel.
- Tal-Spiro, O. (2016). *Waste fires*. Jerusalem, Israel: Center for Research and Information, Knesset. <https://knesset.gov.il/mmm/data/pdf/m027>. Accessed on 14 May 2020.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

