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Enhance resilience of micro businesses and create sustainable livelihood opportunities in the Gaza Strip

SAWA PROJECT

Mapping Study of Green and Circular Economy Challenges and Opportunities within the Industrial Sector in The Gaza Strip

Prepared by Integrated Visions for Developmental Solutions

DECEMBER 2020

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List of Abbreviations

BMOs	Business Membership Organisations
EQA	Environmental Quality Authority
EU-LAC Foundation	The European Union - Latin America and the Caribbean Foundation
FGD	Focus Group Discussion
GCE	Green/Circular Economy
GHG	Green House Gas
HSA	Hot Spot Analysis
IVDS	Integrated Vision for Developmental Solutions
KIIs	Key Informant Interviews
LCA	Life Cycle Analysis
PAC	Project Advisory Committee
PFI	Palestinian Federation of Industries
OECD	The Organization for Economic Co-operation and Development
SCP/RAC	Regional Activity Centre for Sustainable Consumption and Production
ToRs	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNITAR	United Nations Institute for Training & Research
VC	Value Chain

Executive summary

"Enable" implements 'SAWA' project that aims to contribute to economic resilience in the Gaza Strip through enhancing the resilience and sustainability of micro businesses in the Gaza Strip and initiating sustainable and innovative green/circular economy initiatives. According to the project design, the second result is Empowerment of youth through initiating sustainable and innovative green/ circular economies initiatives. Under this result, the project will facilitate new economic growth opportunities in the field of circular/green economy by providing green solutions to problems and challenges identified by the industrial sectors and create new innovative green entrepreneurs. To identify major challenges that can be solved by applying Green/Circular Economy (GCE) concept through the development of small business ideas, Enable has contracted Integrated Visions for Developmental Solutions (IVDS) to conduct a study mapping the green and circular economic challenges and opportunities in the industrial sector in the Gaza Strip.

The study was conducted in three phases. The first phase focused on literature review to prioritize industrial sectors that have significant environmental challenges and potential GCE solutions. Inception phases involved intensive literature review to reach nationally applicable definition for GCE, describe the industrial sectors in Gaza and update the methodological approach. The results of the inception phase indicated six prioritized industrial sectors to be further assessed using Hot Spot method. This was based on assessing the 11 sectors against set of economic, environmental and social criteria.

The second phase focused on primary data collection, Hot Spot assessment to reach long list of challenges, further filtration of the long listed challenges to short list them; and to analyze the shortlisted challenges to describe the context and potential solutions. Primary data collection covered all prioritized sectors and integrated field visits, KIIs and FGDs with all stakeholders. Hot Spot Analyses (HSA) have utilized the primary data as well as the intensive literature review achieved during the inception phase. Hot spot analyses identified challenges considering seven potential environmental hazards including high consumption of materials, high wastes, high energy consumption and high GHG emissions, air pollution and high water consumption. A long list of 60 challenges was obtained as a result of HSA. Further filtration using set of criteria resulted in shorten the list into 30 challenges. The criteria are relevancy, applicability, impact, scale, economic viability and sustainability. The shortlisted challenges were further analyzed to describe the context, potentials and possible applicable solutions.

The third phase of the study was the validation of study results and analyses through set of workshops with stakeholders. Three workshops were conducted with project advisory committee, PFI and industrial sectors. The validation has provided good opportunity to obtain further information on the targeted sectors and the results were integrated in the final version of the report.

The study has provided several recommendations to serve optimal design of the project activities related to entrepreneurship component. The study has identified set of challenges that have significant potential to be solved through small and medium scale enterprises. The study has recommended conducting further studies on the prioritized sectors to explore technical and economic feasibility of the suggested solutions considering the local context. It was obvious that local context and associated complications and scale has important implications on the potential of the suggest solutions. Therefore, tailored incubation program need to be designed to successfully utilize the suggested solutions as economic opportunities for youth.

1. Introduction

Belgian Development Agency "Enable" implements 'SAWA' (Arabic word for 'Together"), Enhance Resilience for Microbusinesses and Create Sustainable Livelihood Opportunities in the Gaza Strip. The project aims to contribute to economic resilience in the Gaza Strip through enhancing the resilience and sustainability of micro businesses in the Gaza Strip and initiating sustainable and innovative green/circular economy initiatives. According to the project design, the second result is Empowerment of youth through initiating sustainable and innovative green/ circular economies initiatives. Under this result, the project will facilitate new economic growth opportunities in the field of circular/green economy by providing green solutions to problems and challenges identified by the industrial sectors and create new innovative green entrepreneurs.

The project will implement a new model of green/circular economy in Gaza strip. This model will find and offer new innovative green solutions and initiatives for the economic sectors' challenges and problems and create new opportunities for innovative green entrepreneurs in the Gaza strip.

To identify major challenges that can be solved by applying Green/Circular Economy (GCE) concept through the development of small business ideas, Enable has contracted Integrated Visions for Developmental Solutions (IVDS) to conduct a study mapping the green and circular economic challenges and opportunities in the industrial sector in the Gaza Strip. The study aims to target the industrial sectors in the Gaza strip (only 11 are active in the Gaza strip).

2. Objectives of the study

The mapping study aims at:

- Reviewing relevant documents and studies in the field of GCE challenges and opportunities within the industrial sectors relevant for the Gaza context.
- Developing a clear definition and framework for the GCE within the context of the Gaza Strip.
- Conducting an in-depth analysis for each industrial sector in terms of challenges related to GCE and identifying the potentials and opportunities related to these challenges.
- Defining a set of criteria on which the industrial sector challenges can be ranked in order to make a selection.
- Identifying the top-ranked 30 challenges in all industrial sectors according to the pre-defined criteria.
- Developing a matrix of the challenges regarding the GCE that tabulates the prioritized challenges.

3. Study Approach

The study adopted a unique approach to prioritizing the most relevant GCE challenges by following a number of sequential steps as shown in the chart below.

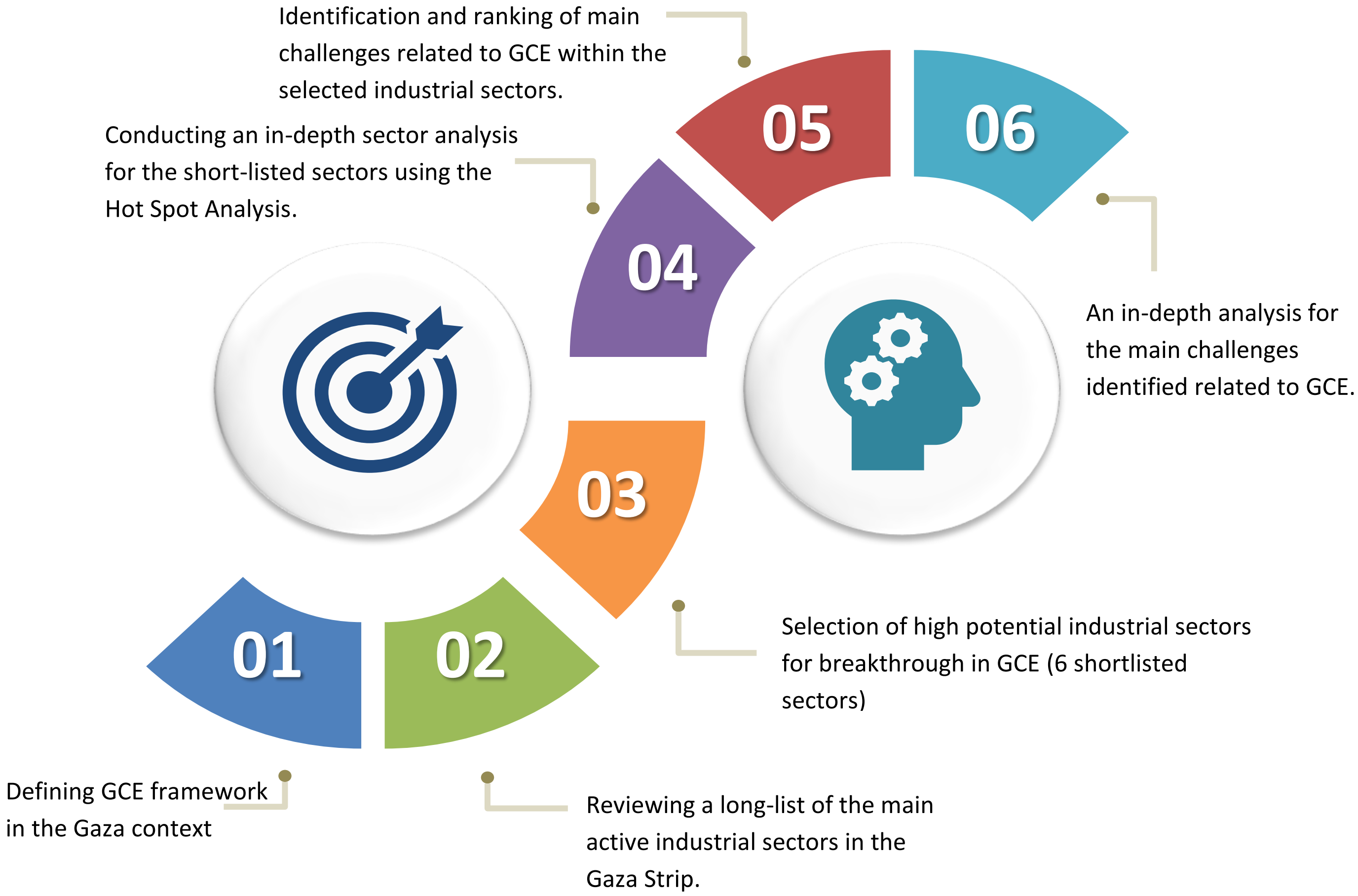

Figure 1: Methodological Approach

3.1 Defining GCE framework in the Gaza context

In order to gain a better understanding of the concept of a GCE in a context like the Gaza Strip. Consultants began researching literature on GCE, including but not limited to articles, books, journals, websites, UN reports, etc. The consultants also organized rigorous group discussions and consultations with experts in other contexts where possible to gain more knowledge about the concept of GCE and its applications in similar contexts. In addition, the consultants looked for local and regional projects that had implemented GCE, particularly for the industrial sectors. Nonetheless, the consultants were able to find a few projects, which helped to understand the dynamics and draw many lessons learned.

As a result of the literature/desk research process, a well-thought-out concept of green/circular economy has been identified. This step was necessary to understand the boundaries of this consultancy service, and to help focus efforts in areas where the SAWA project could achieve better outcomes within target industrial sectors. (More details can be found in the annex 7.2 – Literature Review Analysis Report). The following documents, among others, helped to conceptualize the definition of GCE.

Table 1: List of reviewed documents to develop a localized GCE framework

#	Document	Author	Publishing year
1	Introduction to a Green Economy: Concepts and Applications	United Nations Institute for Training & Research (UNITAR) *"All rights are reserved"*	2013
2	Towards the circular economy	The Ellen MacArthur Foundation	2013
3	Overcoming the main barriers of circular economy implementation through a new visualization tool for circular business models	Augusto Bianchini , Jessica Rossi and Marco Pellegrini	2019
4	A guidebook to the Green Economy	UNDESA	2012
5	Roadmap for Scaling Up Green Entrepreneurship Palestine	Regional Activity Centre for Sustainable Consumption and Production (SCP/RAC)	2018

3.2 Reviewing a long-list of the main active industrial sectors in the Gaza Strip.

A long list of articles, reports and research documents were used to review the current status of the active industrial sectors in the Gaza Strip. The list includes documents provided by the SAWA project and other documents sought by consultants. The list is presented in the annex 7.1. The literature review has provided in-depth analyses of the 11 targeted sectors in the Gaza strip. An overview of each including its volume, employability, factors affected the performance and trend in the market. The analyses also provided detailed description of major challenges that affected the sector in general and focused on major environmental issues related to product life-cycle stages. Barriers that limit the application of GCE solutions were also presented in for all sectors. Furthermore; the literature review has presented potential green solutions that can be applied in each sector. Examples from all over the world were presented to reflect the potential GCE solutions.

3.3 Selection of high potential industrial sectors for breakthrough in GCE

The consultants developed a matrix to select the most potential sectors, including criteria for economic growth opportunities, opportunities to apply green economy concepts and achieve breakthroughs, opportunities to engage marginalized groups, including women and youth, and the extent to which there is an enabling environment and policies supportive of the sector.

The different sectors were ranked on each selection criteria from high to low considering the literature/desk research. Table 2 provides the highlights of indicators used in the selection process of the sectors and their weightings.

It is worth noting that the criteria selected are based on criteria used for Value Chain (VC)/sector selection process. For that, almost all VC guidelines including such criteria, however, it may differ from one guideline to another depends on the context. As for example some guidelines don't include the environmental aspects, others do. Another aspect that may differ is the weight of ranking. In our case, the consultants built this weight according to their understanding to the project (based on the documents shared by the project team) and based on the review of other documents.

Table 2 Prioritization matrix with indicators and weightings.

Potential Criteria		Sector		
		High	Med	Low
Economic (30%)	Employment Opportunities			
	Sector growth potential			
	Competitiveness (quality)			
	Profitability			
	Scalability			
				0
Environment (40%)	Environmental impact (resource use (land, water) and air pollution (GHG emissions)			
	Contributing to a green economy (adaptation)			
	Potential for products and/ or services that compensate for greenhouse gas (GHG) emissions			
	Potential for products and/ or services which are conducive to a green economy.			
				0
Social (20%)	Inclusiveness: potential to include women and youth			
	Potential products for the poor			
				0
INISTITUTIONAL (10%)	Stakeholders' readiness for change and innovation			
	Enabling policy and regulatory environment			
				0

3.4 Conducting an in-depth sector analysis for the short-listed sectors using the Hot Spot Analysis.

Consultants applied Hot Spot Analysis (HAS) when conducting an in-depth analysis for each industrial sector. The HSA is a qualitative tool which aims at identifying ways to improve resource efficiency and reduce negative environmental impacts. HSA rely mainly on stakeholder involvement, and the identification of environmental 'hot spots' along the sector under study. Hot spots indicate critical problems related to inefficient resource use, high Green House Gas (GHG) emissions and further environmental problems at the various stages (or 'life cycle phases') of the target sector.

The analysis starts by **(1)** Defining the Value Chain (VC) stages (life-cycle phases) and environmental and resource categories: This step builds on **(a)** A value chain mapping, that comprises a full range of activities that are required to bring a product or service from conception, through the intermediary phases of production and delivery to final consumers, and final disposal after use. This includes activities such as raw material procurement, production, processing, marketing, and distribution, up to the final consumer, and waste disposal. **(b)** The environmental & resource categories were defined too, including material consumption, energy, GHG, water consumption, land, air & water pollution, waste, etc.

In summary: for each sector the value chain stages, and environmental and resource categories need to be defined.

(2) Scaling the level of relevancy of each resource category at every stage of the value chain: To compare the different resource categories and classify the resource intensities according to the following scale: 'not relevant' (0), 'low' (1), 'medium' (2) and 'high' (3). The aim is to judge the consumption of and impact on the resource categories (material, energy and/or water), including GHG emissions and/or environmental degradation. For example, in textile sector, material consumption could be ranked high in production stage; indicating that the material consumption is highly relevant to this stage of the VC, while were ranked low in distribution stage.

(3) Scaling the relative importance of the value chain stages: The stages of the value chain are classified according to a similar scale of 0 to 3 according to their relative weight in the total resource consumption of the value chain. In the same example, in textile sector, production stage could have a weight of 3 related to material consumption, indicating that this stage is very important to this resource category (material consumption) among others.

(4) Multiplying the points assigned to resource categories by the points assigned to the stages. This process results in a value between 0 and 9. Conventionally, categories with a result between 6 and 9 are considered to be 'hot spots'.

Table 3 below can be used to identify and rate the relative significance of hot spots along the value chain.

Table 3 Hot Spot matrix

Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption				
Energy				
Greenhouse Gas Emissions				
Water consumption				
Air pollution				
Water pollution				
Waste				

Categories with a result between 6 and 9 are considered to be 'hot spots'

3.5 Identification and ranking of main challenges related to GCE within the selected industrial sectors.

As a result of the HSA, a long list of challenges for the industrial sectors were identified. In order to narrow down the list and rank the key challenges, a set of criteria were used as shown in the following ranking matrix (Table 4)

It should be noted that the weight assessment depends on the consultants' understanding of the level of importance of each dimension for the project objectives and the type of challenges that the project aims to address. In addition, this is reflected in consultations with various stakeholders during the data collection process, the results of the review of the literature, and the lessons learned from others.

Table 4 Challenges Ranking Matrix

Dimension/Key criteria		Definition	Weight of Criteria	Challenge 1	Challenge 2
1	Relevancy	To what extent the challenge relevant to the concepts of green/circular economy.	20		
2	Applicability	To what extent the challenge can be addressed within the capacity of local actors.	10		
3	Impact	Severity and likelihood of impact on the sector (Economic, Social and Environmental)	25		
4	Scale	To what extent the challenge affect the wider sector (supply chain, enabling environment)	15		
5	Economic Viability	To what extent the challenge can be addressed within an economic viable business model (economic return versus investment cost)	20		
6	Sustainability	To what extent the challenge can be addressed using a sustainable business models.	10		
			100		

3.6 An in-depth analysis for the main challenges identified related to GCE.

By the end of the ranking process, the top-ranked 30 challenges were further analyzed using the following matrix in table 5. The shortlisted challenges were further described illustrating potentialities to turn them into investment ideas following the GCE. As explained in the annexed literature review report (the annex 7.2), the suggested solutions need to fulfill several preconditions to be scaled up and be accepted and adopted by the Private sector. The matrix in table 6 shows such analyses.

Table 5 analyses of the potential of the shortlisted challenges

Challenge	Underlying causes	Impact	Technical and financial feasibility	Potential technical and financial added-value	Potentials
Challenge (1)					
Challenge (2)					
Challenge (3)					

4. Methodology

To achieve the objectives of the study, the consultants used a combination of primary and secondary data collection tools as follows:

4.1 Primary data collection

Since consultants used HSA as a qualitative tool to analyse selected sectors and identify main GCE challenges, a combination of primary data collection tools were selected to serve this purpose. Therefore, consultants rely mainly on qualitative tools such as KIIs, FGDs and on-site observations. The tools used are qualitative, based on stakeholder involvement, to identify environmental 'hot spots' alongside the sector under study. Hot spots indicate critical problems related to inefficient resource use, high GHG emissions and further environmental problems at the various stages (or 'life cycle phases') of the value chain (sector). It should be noted that the outbreak of COVID 19 in the Gaza Strip and the consequent restrictions imposed by local authorities delayed field work, sometimes on-site observations, and KIIs were conducted via phone interviews and Live Recording of factory processes. The following tables illustrates the data collection tools conducted and the list of stakeholders consulted.

Table 6 Data collection plan

#	Data Collection Tools	No
1	FGDs	6
2	KIIs	24
3	On-Site Observations	6

Table 7 List of stakeholders interviewed

No	Sector	Stakeholder
1	Textile	Coral Co.
2		Al Ostaz Co.
3		Odeh Garment Factory
4	Wood & furniture	The Palestinian Wood & Furniture Industries Union (WIU)
5		Al Faneya for Furniture Co.
6		Fesal Yoniess Co.
7		Al Sousy for furniture Co.
8		Bsaiso for Furniture Co.
9	Construction	The Palestinian Construction industries Union(PCIU)
10		Hussein Abu Ghalyoun Factory for Marble and Granite
11		Abu Kmeil Factory for Block
12		Al-Taawun for ready Concrete Co.
13		El-Khaesie Co. For Industry, General Trade & contracting
14		Al Jinob for Interlock
15		Palestine for Building Materials Co.
16	Food	The Palestinian Food Industries Union (PFIU)
17		Alai Brothers Group for Food Industries and General Trade
18		Al-Salam mills co.
19		Al Madena Company for soft drinks
20		Abu Eita Dairy Factory
21	Plastic	The Palestinian Plastic Industries Union (PPIU)
22		AL Ahmaady Co.
23		Al hkadary Co.
24		Al-Radisi Company for Industry and Trade
25		Ramlawi Plastic Company

26	Chemical	Bio Clean Co.
27		Sami Helles Co.
28		Sharaf Co.
29	All Sector	The Palestine Trade Center (Paltrade)
30		Gaza Chamber Of Commerce & Industry
31		Dr.Mahmoud Shatat

The data collection activities were coordinated with PFI. Detailed documentation of the data collection is annexed in the annex 7.4.

4.2 Secondary data collection

Consultants conducted literature/desk review process, which was based on reviewing relevant studies, reports, press releases, public statistics, reports of United Nations agencies, industry reports, and regional and international initiatives related to GCE. Documents shared by the SAWA team, were reviewed too. List of reviewed documents are presented in the annex 7.1. The desk review process covered the main active industrial sectors in the Gaza Strip, according to reports of the Palestinian Federation Industries, including: Textile, Furniture, Metal, Construction, Plastics, Papers, Food, Chemicals, Aluminum, Leather, and Handicrafts. The desk research process has helped achieving the following objectives.

1. Formulating a localized definition and framework of GCE which can be adopted in the Gaza context.

2. Mapping of green/circular economy industrial sectors' challenges and the green opportunities for 11 industrial sectors. The literature/desk review report highlighted detailed information on each industry, key market system challenges, environmental challenges, barriers faced by actors to apply GCE in the context of Gaza, and finally green opportunities for the industry.

3. Mapping of interventions that supported the implementation of GCE concepts in Palestine. The literature/desk review report highlighted main target sectors, key activities implemented, and some successful green case studies at the country, regional and international levels.

4. Mapping of interventions that supported the implementation of GCE concepts in the region (other contexts similar to Palestine). The literature/desk review report highlighted main target sectors, key activities implemented, and some successful green case studies.

5. Define the conditions needed to scale up and disseminate green/circular solutions.

4.3 Data analyses

The study made use of both secondary and primary data to identify major environmental challenges and filter them to reach a shorter list that fulfill certain conditions that suites the project concept. The process of challenges identification starts with hotspot analyses where major environmental hazards are assessed against the value chain of the six selected sectors. Hotspot analyses define a long list of environmental challenges. The long list is assessed against six criteria to be shortened to fulfill the objectives of the study. The final short list of challenges is further analyzed to reflect the context and potentials.

5. Results and discussion

The results will be presented in ninth sections.

- The first section presents the definition of green/circular economy within the current context of the Gaza Strip.
- The second section summaries the main barriers to closing the loop in the majority of industrial sectors, and the potential areas to support the transformation of the industrial sectors towards GCE.
- The third section illustrates the experiences reviewed for others conducting projects in Palestine, Egypt, Jordan and Lebanon.
- The fourth section clarifies the attractiveness of the GCE and the potential scalability for the private sector.
- The fifth section explains the results of the sector prioritization process.
- The sixth section presents sectors analyses and the identified hotspot challenges in the six selected sectors. The analyses in the first section will explain the logic behind defining the hotspot challenges.
- The seventh section presents the results of the filtration process to identify the high priority challenges.
- The eighth section describes the context analyses of the selected 30 challenges. Analyses revealed that Gaza context may affect the process of selecting environmental challenges.
- The ninth section of the results explains how the national context has affected the selection of challenges.

5.1 Localized definition and framework of Circular Green Economy

Based on the findings of the literature review of the industrial sectors and initiatives on the green/circular economy, the consultants came up with a comprehensive definition of the green circular economy, which is in line with the current context of the Gaza Strip: ***"A green circular economy describes an economic system based on business models that replace the concept of 'Take-Make-Dispose' with reducing, reusing, recycling and recovering materials throughout the product life cycle "production, distribution and consumption processes". The shift towards GCE need to be executed at the micro-level (level of products, companies, consumers), and at the macro-level (city, region, nation) with the aim of achieving sustainable development, which implies creating environmental quality, economic prosperity and social equity (including for women and youth), for the benefit of present and future generations.".***

In terms of the differentiation between green and circular economy, the consultants see the importance of keeping the definition simple and straightforward. Having said that, there is a difference indeed between green and circular economy, however, it is inconsiderable and most of the time the two concepts are used exchangeable. It worth noting that in principal, all circular economy modalities are green. However, not all green is circular. Circular economy integrates modalities that focus on resources use/reuse, processes efficiency, and waste treatment and use. On the other hand, green is more general concept. Some modalities focus on changing the consumption behaviors through promoting the ecological added value of the products through promoting awareness among consumers. This may involve circular economy practices or may not. Still several theories do not differentiate between the two concepts. In our context, the project focuses rather on green circular economy. Therefore, there is no need to dig deeper on the differences between the two concepts which is rather theoretical with limited practical implications

Detailed description of the definition of GCE and the suggested definition that can apply locally is presented in the annexed literature review report in the annex 7.2.

5.2 Industrial sector review

Sectors review has revealed the presence of major challenges that affect the performance of all sectors. The impacts of geopolitical situation in Gaza affect the economic performance not only of the industrial sector but on all other economic sectors as well. Deteriorated purchasing power in the local markets; restriction on the input and raw material supply; the lack of innovative production technology; and the limited products markets are the major reported challenges. Such general challenges have negative impact on the efficiency of resources use, and limits the ability of the factories to invest in innovative solutions. Thus, it may lead to deepening the negative impact of environment related challenges. Still additional environmental challenges that are related to product life-cycle stages were found to be relevant in the targeted sectors.
Based on the literature review, several barriers to closing the loop in the majority of industrial sectors:

- Lack of financial resources available to implement GCE.
- Lack of design, process, and supply chain expertise, technology, and/or technical support.
- Lack of information about the available technologies and best practices.
- Organizational culture hinders the adoption of GCE.
- Lack of management commitment, and inadequate management capacity.
- Resistance to change.
- Uncertainty about the potential environmental and economic benefits of GCE.
- Implementing GCE practices requires replacement of current technologies that are still profitable.
- High cost of implementing GCE and the possible adverse effect on scale economy.
- Weak environmental regulations and enforcement to support GCE implementation
- Lack of market preference and pressure from both customers and consumers.
- Supply chain actors are reluctant to collaborate/support GCE initiatives

The following potential areas to support the transformation of the sector towards a GCE were defined based on the literature review:

- Efficient use of energy.
- Efficient use of resources
- Recycling.
- Resource Recovery
- Maintain and reuse.
- Closed water systems.
- Etc.

The sectors however, differed in the potential to apply green solutions. Therefore, the consultants recommend selecting some of the sectors that have higher potential to apply green solutions. Detailed sector review is presented in the annex 7.2 (Literature Review Analysis Report).

5.3 Learning from others

Consultants have also reviewed experiences of others conducting projects in Palestine, Egypt, Jordan and Lebanon. In Palestine, briefing on similar projects and description of their intervention strategies and success in creating green businesses were presented. It is worth noting that one of the most significant programs focused on promoting the concepts of a green circular economy in Palestine and the Middle East in general including Morocco, Algeria, Tunisia, Jordan, Lebanon, Egypt, and Israel is the SwitchMed Programme. This programme has been a major focus of the literature review process because it is closely linked to the scope of work to be carried out by the SAWA project in the industrial sectors. The SwitchMed Programme was launched in 2013 by the European Union to speed up the shift to sustainable consumption and production patterns in the Southern Mediterranean, notably through the promotion of circular economy approaches. The Programme aims at achieving productive, circular and sharing economies in the Mediterranean by changing the way goods and services are consumed and produced so that human development is decoupled from environmental degradation. SwitchMed supports and connects stakeholders to scale ups eco and social innovations. The Programme supports policy makers, eco-innovative small and medium sized enterprises, industries, start-ups and entrepreneurs in the Southern Mediterranean countries.

One of the good examples of how SwitchMed has contributed to transforming local industries into a circular economy is the case of **Siniora Food Processing Company**, a Palestinian company that has been supported by identifying several areas for improving energy efficiency, water and raw materials consumption. Another example is **Sinokrot Chocolate and Confectioneries Company**, which has applied several energy efficiency measures led to a reduction of the total gas consumption in boilers and oven by about 60%. At industry level, the 10 target industries will reduce their annual water consumption with 244,850 m^3, their energy consumption with 5.3 GWh per year. Waste will also be reduced by 261 t per year and CO2 emissions 4,197 t per year. All in all, the identified saving measures require investments worth 2.5 million euros, at an average payback period of one year, and will enable the companies to annually save 2.4 million euros in annual production costs.

The project also achieved good results in promoting the green circular models among start-ups and entrepreneurs. To this end, 330 green entrepreneurs were selected and trained on green circular economy business modeling. In the aftermath of the trainings, 21 entrepreneurs were selected and received a 10 hours individual coaching to improve their green business models. As a result, 13 green businesses have been successfully launched. Ideas ranging from recycling e-waste, waste water treatment, and upcycling scraps of fabric and leather. (for more details, see the annex 7.2).

Similarly, the experiences from Egypt and Jordan were presented (see annex 2). 22 green businesses have been established in Egypt, in addition to 12 green businesses in Jordan as part of the SwitchMed project. The businesses have been supported to introduce a wide range of green products that address key market challenges. The products introduced including, composing, plastic recycling, paper recycling, food recycling (producing orange peel powder), e-waste recycling, and green buildings & rooftops, etc.

Another example is from Egypt, a project implemented in 2018 as part of the World Bank's Finance Competitiveness & Innovation Global Practice, funded by the Department for International Development (DFID). The project aims to support clean Tech entrepreneurs in Egypt through partnerships and a focus on market development. The project has intervened in the off-grid solar sector in agriculture markets in Egypt (which was cited as having significant potential). The project used sector analysis and stakeholder mapping to identify key players in the market (those directly connected to the market as well as those who could have an innovation role). One key findings was that mobile payments and financing were a key barrier to clean-technology uptake in agriculture, accordingly, a team of startups were brought together to visit three farms in Aswan, with the objective of: i) developing a share experience and understanding of the challenges and practices in the agri-sector, ii) to expose these startups to each other's' knowledge, iii) convene relevant intermediaries who can help support the innovation process with strong links to farmers and local institutions. As a result, several start-ups have succeeded in turning them into real businesses. One of them is **SUNUTIONS;** a start-up company that works on the production and development of solar systems to provide green energy solutions using the sun. The University graduates of electrical and mechanical engineering worked on their graduation project together and wanted to turn it into a real business. They are currently developing a lighting solution: the "DayLight Collector". It is a fundamental system that uses a rooftop collector to gather sunlight and with the help of fiber optic cable bundle and unique mirrored bulbs, it carries sun light into the building. Another one is **KarmSolar**, a solar technology and integration company that delivers innovative solar solutions to the agricultural, industrial, tourism and business sectors. KarmSolar is now Egypt's largest private off-grid solar energy integrator.

These examples from Palestine and others in the region help to find realistic applications on the ground for green circular economy concepts, and enable consultants and the SAWA team to find other economically viable opportunities applicable to the context of the Gaza Strip.

The reviewed cases were also beneficial improving knowledge defining GCE challenges and exploring potential solutions through integration of GCE solutions and creating green enterprises. The analyses have shown that trends of applying green solutions are more or less similar in different context. However, adopting solution to fit certain circumstances (market system, socioeconomic settings, consumers' culture and investment environment) is necessary. Details of the analyses are presented in the annexed literature review report (the annex 7.2).

5.4 Scalability and attractiveness of GCE for the private sector

One of the major challenging questions is how to disseminate the concept of GCE to be practiced at different scales. In countries where the weak economy is dominant, most of environmental programs applying shallow intervention strategies. Strategies are designed to disseminate awareness of the damage caused by applying the linear economy model in production and trying to disseminate innovative environmental practices. However, such an approach in several cases lacks proper analyses to ensure the economic feasibility of applying the introduced environmentally-friendly innovation. Some of these innovations create added cost on the production while no added market value is recognized. Others need financial resources and skills that are not available in private sectors or not possible in risky investment environment. In such cases, the promotion of environmentally friendly practices needs proper analyses to explore the potential of scalability and making them attractive to the private sector. The GCE concept is based on this concept as the introduced solutions must be green and must be economically feasible.

The suggested GCE solution should fulfill the following conditions to be scalable and attractive to the private sector:

1- It should follow the GCE concept either by reducing the use of resources, increasing efficiency of resources use, reusing of resources, increasing the life of products, reuse of products, or any of similar practices.

2- It should create added market value that exceeds or at least equal to the added production costs.

3- It requires skills and knowledge that are available in the targeted sector or at least easy to transfer to the private sector. Possibly it can be disseminated by services providers but considering the above mentioned first condition.

4- Ensuring that the enabling environment would allow for the application and dissemination of the suggested solutions. Enabling environmental factors are such as market dynamics, policies, regulations, and consumer culture.

Based on the above precondition, not all GCE solutions can be applied in all contexts. Thus, solutions need to be tested for local context and if possible, to customize it to certain market conditions. The above-mentioned preconditions are necessary to convince the private sector to apply the suggested solutions or buy the services from startups. Therefore, these will be considered when prioritizing the challenges of industrial sector under Gaza strip conditions.

5.5 Prioritization of sectors

Following an in-depth review of studies and reports, and in view of the analysis of the various industrial sectors, particularly with regard to economic growth opportunities, challenges and barriers related to the green economy and opportunities for the application of green business models, consultants have concluded that there are real opportunities available in a number of industrial sectors while these opportunities are declining in other sectors, especially given the realities of the Gaza Strip. For example, in the textile sector, there are real opportunities for this sector to shift towards a green economy by: 1) **Digitization of** products, their design, manufacturing, distribution and retail processes, consumer/end-user interaction, factories, workplaces and supply chains; 2) **Sustainability, circularity and resource efficiency of** materials, processes and overall business operations; 3) **New business and consumption models** based on the sharing of productive resources and final products, pay-per-use or subscription models, all moving people towards collaborative or sharing economy. This can happen with the potential for rewarding economic returns for companies and entrepreneurs who adopt green business models, especially those that address challenges related to the green economy. As for a sector such as Aluminum, opportunities are almost non-existent at present, and the cost of their application and economic returns are worthless for companies and entrepreneurs.

The consultants therefore recommend focusing on a number of potential industrial sectors in which unique breakthroughs can be made and include real opportunities for entrepreneurs to develop green business models. Instead of distracting effort in sectors that are incomparable to the return value of their investment. The results of prioritization matrix I presented in Table 8.

Table 8 Results of the prioritization matrix

NO	SECTOR	ECONOMIC	ENVIRONMENT	SOCIAL	INISTITUTIONAL	Total	Rank
1	TEXTILE	24	8	15	10	57	1
2	FURNITURE	18	12	10	3.5	43.5	5
3	CONSTRUCTION	19	17	11	3.5	50.5	2
4	METAL	7	8	2	2	19	8
5	PLASTIC	13	21	10	3.5	47.5	3
6	FOOD	18	16	6	7.5	47.5	3
7	PAPER	9	4	2	2	17	10
8	LEATHER	11	4	2	2	19	8
9	CHEMICAL	14	16	6	3.5	39.5	6
10	ALUMINIUM	7	4	2	2	15	11
11	HANDICRAFTS	11	4	10	2	27	7

The analysis confirms that the Textile & garment, Construction, Plastic, Food, Wood & Furniture, Chemicals sectors have high potential (ranking high in the majority of the fields). The full analysis is annexed in the annex 7.3.

5.6 Results of hotspot analyses

The results of hot spot analyses are presented for the selected six sectors. First, the sector value chain map is described. The value chain map reflects how the sector is operating in the Gaza strip. The environmental "hot spots" challenges are then illustrated. Challenges in each sector are categorized based on the type of environmental hazard including material consumption, energy, greenhouse emission effect, water consumption, water pollution and waste. The full hotspot analyses matrix is presented at the end for each sector. The Excel analyses file is in annex 5.

5.6.1 Textile value chain

The primary input for textile and garment is yarn (weather natural or man-made fibers) for weaving, knitting, crocheting, embroidery, or use as thread. While other ancillary components are needed such as buttons, zippers, snaps and other forms of trim; dyes; pigments; and finishes. Chemical inputs are also included such as soaps and detergents, in addition to the machinery suppliers. The textile is the process of using the raw yarn to produce the fabrics/cloths used in the garment by means of weaving, and sometimes knitting or crocheting. The garment industry passed through different stages including: 1) design, 2) cutting, 3) sewing, 4) pre-washing, 5) ironing, 6) packaging, 7) marketing, and 8) distribution.

Figure 2 illustrates the general flow of the textile and garment value chain

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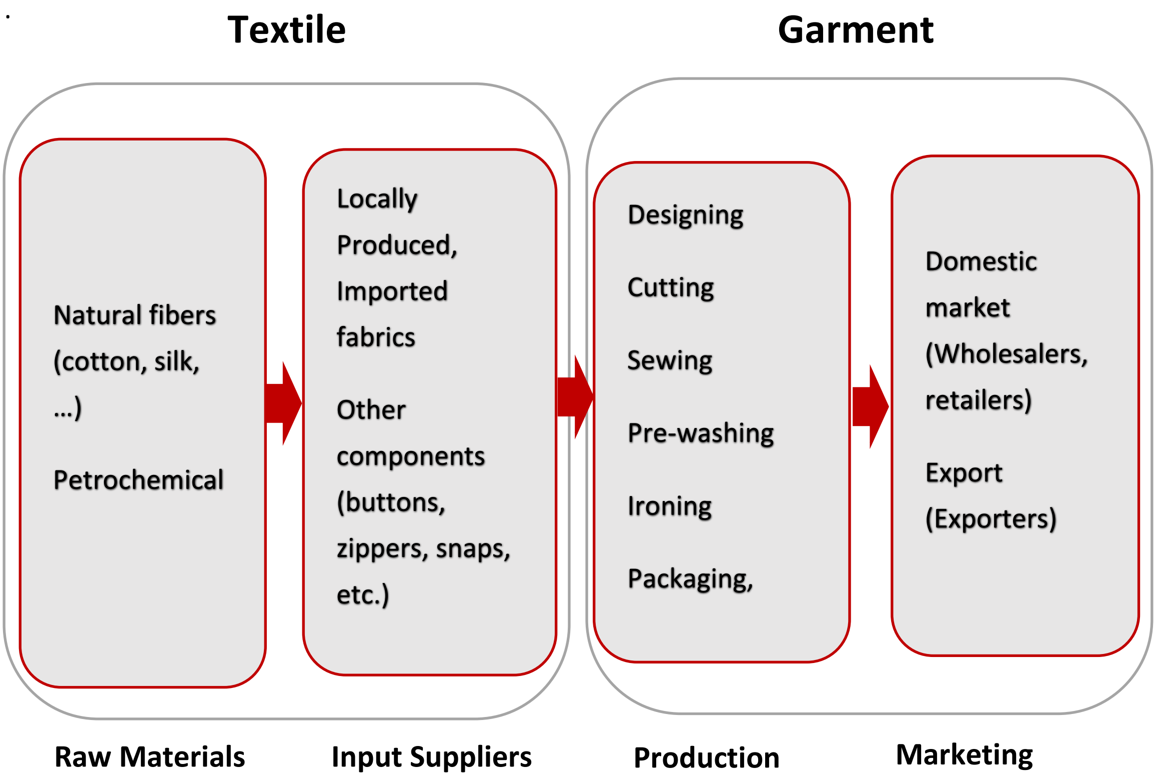


5.6.1.1 *MAJOR ENVIRONMENTAL ISSUES RELATED TO TEXTILE VALUE CHAIN STAGES*

1. Material consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal

Material consumption	2	**9**	2	**9**

In the Gaza Strip, there is one fabric firm, however it is not working as the machines need some spare parts which are not allowed to enter (dual use). Additionally, due to the shortage in the electricity and the dependence in the generators as energy alternative, the production cost is very high. Overall, there are three types of fibers used in cloths, **(1) Cotton**, which accounts for more than 25 % of all fibers used for clothes, is considered problematic because it requires huge quantities of land, water, fertilizers and pesticides. **(2) Polyester**, which is made of fossil fuels and is non-biodegradable, accounted for 66 % of fibers used in clothes. Its main advantages are that, unlike cotton, it has a lower water-footprint, has to be washed at lower temperatures, dries quickly and hardly needs ironing, and it can be recycled into new fibers. **(3) Manmade cellulosic (MMCs)**, derived from cellulose made from dissolved wood pulp of trees, make around 9 % of fibers used in clothes. Most commonly used is viscose, also known as rayon. They are made from renewable plants and are biodegradable, but the main challenge is also the sustainable sourcing of cellulose. It is worth noting that none of the fibers sourced locally and are all imported from China and Turkey. Furthermore, the textile material traders and factory owners tend to import large quantities of low-cost clothing materials/fabrics without taking into consideration the quality or the market requirements of fabrics; this has ultimately led to the long-term overstocking of large quantities of fabrics in the warehouses. A sizable part of stocks has been subject to spoilage due to extended periods of storage in non-favorable temperature and atmospheric conditions.

The design is the first and the most important step for the apparel production process, because design is a key influencing factor in the amount of textile waste, as 10-12% of textile used during textile manufacturing are wasted in the making-up stages which includes a garment pattern creating and the raw material cutting process. There is a considerable consensus among industry professionals that relying on traditional methods of pattern design and cutting and not using newer technologies has been the main source of high rates of waste. On average, factories can have losses of $2,000 - $2,500 per month.

The "consumption" phase is the most critical phase in terms of material consumption, especially since a large number of washing machines are used by households in Gaza. Besides, there are a large number of chemicals, especially detergents used in washing. It is estimated that Gazans consume between 700 and 1,000 tons of detergent for washing clothes each year.

2. Energy.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Energy	2	**6**	2	**6**

Basically, Apparel is a less energy-intensive industry than, for example, cement, steel, chemical, etc. The production process uses a significant amount of energy for sewing and seam taping equipment. Denim washing process as well has a high consumption of energy as largely relies on boilers. The machines used in the production process are old and operate with an average energy consumption, and the electricity problem in the Gaza Strip increases the energy consumed for production through the use of the diesel generators as an alternative source of power. It is estimated that the apparel industry consumes up to 0.26 kWh/Kg of electricity, while up to 0.04 L/Kg of diesel are consumed when using diesel generators. The main sources of energy consumption are: air conditioning, lightening, sewing machines, pumps, fans, blowers, compressors, and other equipment.

The often-random distribution process from storage to the retailers and showrooms result of increasing the amount of energy used by vehicles. It is estimated that the average monthly vehicle fuel consumption per factory is 150 - 200 liters at a total cost of $216 – $288.

At consumption level, the calculation of the electricity for clothes washing by washing machine requests information about laundry washing habits and practices, like the number of wash cycles run per year, the chosen wash temperature, and the average load size. The average electricity consumption for laundry washing is estimated at 1.03 kWh per wash cycle, this leads to the annual electricity consumption of 206 kWh and 200 wash cycles per household. In terms of ironing, the average electricity consumption is estimated at 1.1 kWh. For that, annual electricity consumption is about 220 kWh per household. This clearly indicates the high energy consumption in households, bearing in mind that the vast majority of households in Gaza have a washing machine and an iron.

3. GHG Emissions.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
GHG Emissions	2	**6**	**6**	1

GHG Emissions resulting from the use of generators during the grid electricity power cut, and the Transport vehicle fuel combustion. Burning diesel or other fuels creates exhaust gasses. Diesel generators produce carbon dioxide (CO2), nitrogen oxide (NOx), and particulate matter. These generators release this into the atmosphere and substantially reduce air quality in the nearby regions. Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel. This means that each kilogram of apparel production releases about 0.03 Kg of pure carbon, and 0.1 Kg of carbon dioxide. On average, each factory consumes 350 – 400 liters of fuel to run the generator on a monthly basis, which costs $504 – $576. In addition, the factory releases 910 – 1,040 kilograms of carbon dioxide on a monthly basis.

Transport is another source of GHG emissions, including transportation from the factory to retailers widely distributed throughout the Gaza Strip. To give an example of the amount of GHG emissions from a trip from a factory located in the center of Gaza City (Nasser area) for retailers in the Nusseirat area (one of the largest retail markets for clothing) using a truck, the total distance is 16 km, consumes 2.67 liters of diesel fuel. So this trip will release 1.95 kg of pure carbon and 6.94 kg of carbon dioxide. It is estimated that the average monthly vehicle fuel consumption per factory is 150 - 200 liters, at a total cost of $216 - $288. That's mean a total release of 390 – 520 kilograms of carbon dioxide on a monthly basis.

Gaza is a small area (365 km2) with a high population density. Unlike other countries, transport in Gaza is limited in distance, so land can be crossed within an hour. However, there is still traffic for trucks through the territory, particularly for the import of raw materials and the distribution of finished products within the provinces. In the textile sector, there are too many retailers, so traffic is relatively high, which means that GHG emissions are also relatively high.

Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.

4. Water consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water consumption	1	**6**	1	**6**

With regard to raw materials, although not cultivated in Gaza, cotton continues to contribute excessively to water scarcity. The average water footprint for 1 Kilogram of cotton is 15,000 Liters. However, the global industry is testing less commonly used natural fibers, such as hemp, flax, linen and nettle, which require less water, fertilizers and pesticides.

The textile and apparel industry and especially textile wet-processing is one of the largest consumers of water in manufacturing. On average, an estimated 100 -150 liters of water is needed to process 1 Kilogram of textile material. Denim washing process has also a very high consumption of water. In addition, the apparel production industry is labor intensive meaning that an average size factory will consume large quantity of water for cleaning and hygiene purposes.

The consumption phase is the largest water footprint in the life cycle of clothing, especially given the Palestinians' heavy reliance on washing machines. The average water consumption per wash cycle mainly depends on the washing machine technology. Vertical axis machines consume about twice as much as horizontal machines per wash cycle. However, modern washing machines with horizontal axis technology often have an automatic load sensing function in order to reduce water and electricity consumption in response to consumer loads that are smaller than the rated capacity. Most vertical axis machines also have automatic water level settings or the water level can be set manually by the user. Irrespective of load size and water setting level, the average water consumption per wash cycle is estimated at 60 Liters, and this leads to the annual water consumption of 12,000 Liters per household.

5. Air pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Air pollution	3	**6**	1	1

Air pollution caused by the textile industry is majorly caused by the use of boilers, and diesel generators produce pollutants released into the air. The heavy use of diesel operated power generators is resorted to operate boilers in denim washing factories and as well as the usual clothing and textile production process. The pollutants generated include Suspended Particulate Matter (SPM), sulphur di oxide gas, oxide of nitrogen gas, etc. The nearby areas with human population get affected adversely owing to the release of toxic gas into the atmosphere.

6. Water pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water pollution	0	**6**	0	**6**

The textile and apparel industry is one of the main producers of industrial wastewater. Since various chemicals are used in different textile processes such as pretreatment, dyeing, printing, and finishing, the textile wastewater contains many toxic chemicals which if not treated properly before discharging to the environment, can cause serious environmental damage. Cleaning and hygiene processes are another sources of water pollution using detergents and personal hygiene materials. The denim washing process on the other hand has a large amount of wastewater discharge.

Laundry and chemicals used in washing (detergents) are one of the main sources of water pollutants. Having said that, several studies have recently shown that one load of laundry of polyester clothes (also nylon and acrylic) can discharge 700,000 micro plastic fibers, which release toxins into the environment and can end up in human food chain.

7. Waste.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Waste	3	**9**	**9**	**9**

In the textile and apparel industry, there are different types of processes like cutting, bundling & shorting, sewing, printing, embroidery, finishing. The cutting activity is the main activity to produce waste in a clothing factory. wastage generated in the sewing section is usually due to rejection of faulty pieces. In the printing section if any print doesn't match with the standard printing shape/color/pattern, the garment piece will be a waste and disposed of. In the embroidery section, if the embroidery is not done in the proper place, the garment will be treated as wastage. In the finishing section if there is any measurement or trims defect this will generate wastage.

Each piece produced by the factories is packaged by nylon cover and certain number of pieces are packaged into a carton box; a set of complementary products are put into the box when necessary. All these packaging materials will turn into waste that is disposed of in landfill or incinerated.

The average lifetime of a garment product is approximately 3 years. The average person buys 50% more items of clothing every year and keeps them for about half a year and as long as 15 years, a process that generates a huge amount of consumer waste. In contrast to plastic, aluminum or steel, there is no credible recycling concept, the used or unused clothing items as well as waste cloth fragments are disposed with other solid waste and sent to the landfill site or incineration plants. There is no collection or sorting of disposed textiles according to their condition and/or the types of fibers used.

Recycling faces a number of issues, even globally, as only less than one percent of all materials that are used in clothing is recycled back into clothing. This reflects a lack of technologies for sorting the collected clothing, separating blended fibers, separating fibers from chemicals including color during recycling, and establishing which chemicals were used in the production in the first place (which is one reason why it is easier to recycle factory waste such as cut-outs). In addition, technologies that would enable clothes to be recycled into virgin fibers are absent. Therefore, none of the cut-outs or waste are used to manufacture new clothes or even down-cycled into insulation material, wiping cloths, mattress stuffing, or any other materials.

OVERALL TEXTILE SECTOR HOT SPOT RANKING

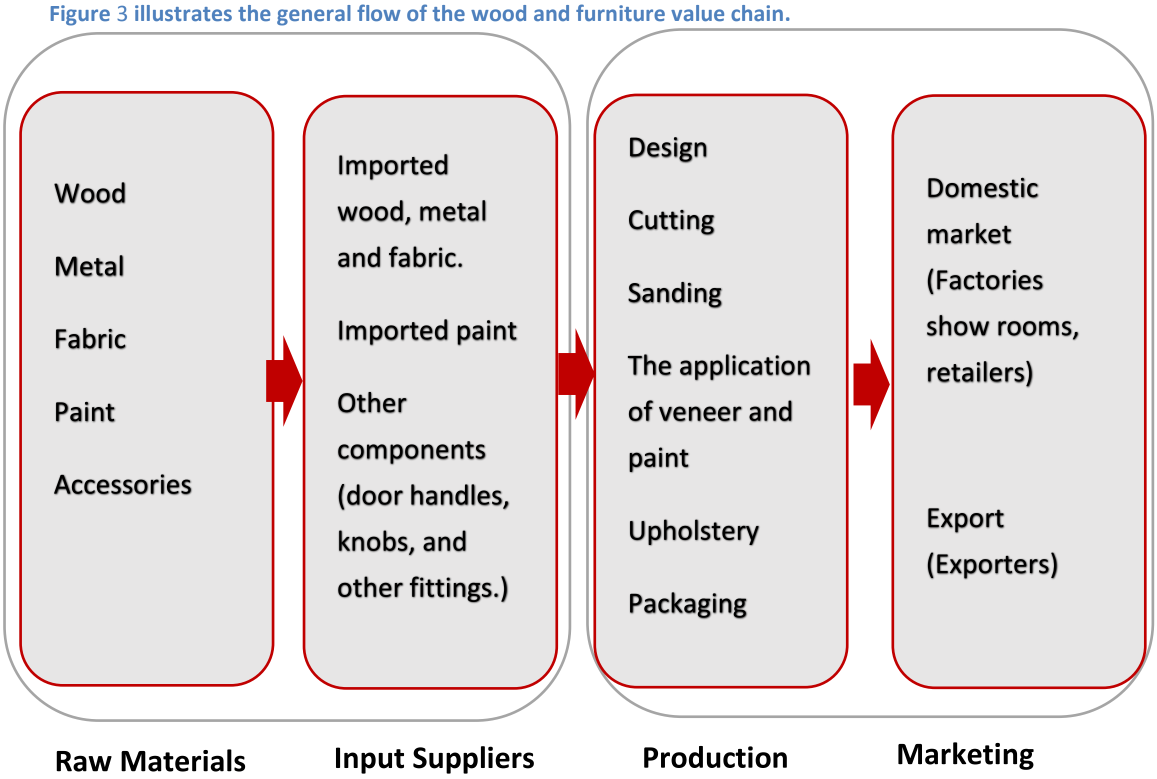
Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption	2	**9**	2	**9**
Energy	2	**6**	2	**6**
GHG Emissions	2	**6**	**6**	1
Water consumption	1	**6**	1	**6**
Air pollution	3	**6**	1	1
Water pollution	0	**6**	0	**6**
Waste	3	**9**	**9**	**9**

Categories with a result between 6 and 9 are considered to be 'hot spots'

5.6.2 Furniture value chain

The furniture industry in oPt is a transformative, labour intensive industry which imports most of it inputs, converts them into a value-added product, and sells it into both domestic and foreign markets. The types of furniture being produced include office, kitchen, and household furniture. Production begins with sourcing raw materials, including wood, metal, fabric, paint, and accessories. Once these are obtained, the typical production process involves design, cutting, sanding, the application of veneer and paint, upholstery, packaging, and retail. Production of all types of furniture is carried out both in small household workshops as well as larger, more sophisticated factories.

Figure 3 illustrates the general flow of the wood and furniture value chain.



5.6.2.1 MAJOR ENVIRONMENTAL ISSUES RELATED TO FURNITURE VALUE CHAIN STAGES

1. Material consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Material consumption	1	**9**	2	4

The wood traders import two types of wood including the natural wood and the artificial one, natural wood is stored under regular conditions, but artificial wood needs warehouses where humidity is low, small amount of artificial wood is damaged from humidity and in addition to that there is some reported damage/spoilage of some artificial wood that aren't utilized in production process early enough before rapid change of models or material usage occur. In the wood warehouses owned by big traders, a small amount of wood is destroyed because of Wood Boring weevil specially if infested with fungus.

Local furniture factories are mostly considered as workshops, by size of production and assets, rather than mass-production factories. Therefore, the amount of waste is relatively negatively proportional to the size of production. This consequently means that small workshops, that work based on small scale non-mass production, produce coarse residues, sawdust and shavings wastes resulting from the traditional cutting process used by craftsmen. Both mass production and using high tech design software and cutting technologies and machine can significantly reduce the high parentage of waste. The solid waste generation is directly related to the conversion efficiency of round-wood to sawn lumber or other final products. Conversion efficiencies from round-wood to sawn lumber are often below 40 percent. The use of modern equipment and trained staff may increase efficiencies to 70 percent. As an example of material consumption, the 2-meter sofa uses about 35 board feet of wood, 0.35 cubic meters of foam with a total weight of 20 Kg, and 70 meters of fabric.

While few factories are utilizing sophisticated and expensive machinery, they do have issues which reduce their operational efficiency. Very few factories invested in introducing process automation, standardization, and efficiency. Even the more sophisticated factories are still run as family-owned businesses. As a result, factory floor setups are not structured to allow for optimal utilization of raw material and resources. Some producers are also utilizing inefficient equipment; such as paint sprayers that apply heavier coats than they should. On average, small factories can have losses of $2,000-$3,000 per month.

Each piece produced by the factories is packaged in several types of material such bubble wrap, plastic stretch wrap, Sealable plastic bags, and/or corrugated cardboard sheets carton box.

2. Energy.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Energy	1	**6**	2	1

Compared to other industries the furniture industry is considered a relatively energy intensive. If we take the example of sofa mentioned earlier, the total embodied energy consumed per sofa is about **1,400** kWh. (see the table below).

Materials used	Quantity	Embodied energy in kWh
WOOD	35 board feet of wood	**80**
FOAM	0.35 cubic meters of foam with a total weight of 20 Kg.	**550**
FABRIC	70 meters of fabric	**770**
Total		**1,400**

It should be noted that most of the energy consumed prior to the production of furniture, which means beyond the control of manufacturers in Gaza. In fact, the production phase taking place in Gaza is the lowest energy consumption. However, the machines used in Gaza are mostly old and considered high energy consumption machines relative to newer ones as in other industrial sectors. The continuous electricity shortage in the Gaza Strip increases the direct cost of energy consumed for production through the use of the diesel generators as an alternative source of power. It is estimated that each factory consumes 200 - 250 kWh/ton of electricity, and 45 - 80 L/ton of diesel on a monthly basis.

The transportation of raw materials, semi-finished products, and finished products within the factory, consume significant amounts of fuel through commonly used material handling equipment such as forklifts and overhead conveyors. The often-random distribution process from storage to the retailers and showrooms result of increasing the amount of energy used by vehicles.

3. GHG emissions.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
GHG emissions	2	**6**	3	0

GHG Emissions is present and detectable resulting from the use of generators during the grid electricity power cut, and as a result of the transport vehicle fuel combustion. Burning diesel or other fuels creates exhaust gasses. Diesel generators produce carbon dioxide (CO_2), nitrogen oxide (NO_x), and particulate matter. These generators release this into the atmosphere and substantially reduce air quality in the nearby regions. Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel. It is estimated that 1 cubic meter of wood products release about 51 Kg of pure carbon, and 182 Kg of carbon dioxide, majority of which are resulted from processes prior to the production (sawmill operations).

Transport is another source of greenhouse gas emissions, including from factory/workshop to widely distributed customers throughout the Gaza Strip. Greenhouse gas emissions depend on the type of vehicle, engine age and distance from the plant to the destination. Suppose the distance is 10 km, diesel fuel consumption is 1.67 liters, emissions will be 1.22 kg of pure carbon and 4.43 kg of CO_2. In general, furniture distances are much lower than those in the textile, food or other sectors.

4. Water consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water consumption	0	1	1	1

A large amount of water consumed in forests and during sawmill operations, while a small amount is consumed in manufactures and workshops. Therefore, water consumption is not recorded as an environmental challenge in Gaza's furniture sector.

5. Air pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Air pollution	1	**6**	1	4

Air emissions from sawmill operations are generated from a number of sources. Combustion products emitted by boilers may include carbon monoxide (CO), nitrogen oxides (NOX), sulfur oxides (SOx) particulate matter (PM), and volatile organic compounds (VOCs) from bark and wood depending upon fuel selection. VOCs may also be emitted during kiln drying of wood and application of solvents, coatings, and lacquers. Wood dust and larger particulates are generated during sawing, machining and sanding operations. Sawmill operations may use controlled incineration to dispose of wood waste, which may result in emissions of carbon monoxide (CO), nitrogen oxides (NOX), particulate matter (PM), and volatile organic compounds (VOCs) from bark and wood. All these operations do not occur in Gaza so they are not recorded as environmental challenges.

The only challenge to air pollution in Gaza's wood furniture industries is the fine dust that originates in large quantities and is very harmful to the surrounding areas. Other sources of toxic emissions include adhesives used in gluing, paint sprays, varnishes, glue and other materials used during the coating and finishing process, which can also cause air pollution.

6. Water pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water pollution	0	**6**	0	0

Wastewater effluent from sawmills is generated from runoff from irrigated storage areas known as log yards and log ponds. Wastewater is also generated from chemical coating of wood. Toxic wood preservation chemicals may include poly-nuclear aromatic hydrocarbons, pentachlorophenol, other pesticides, and compounds of chrome, copper and arsenic. Process wastewater containing chemical preservatives should be contained as part of a closed loop application system. The runoff from log yards and log ponds may contain toxic chemicals (such as tannins, phenols, resins, and fatty acids) leached from the timber, and soil and other materials washed out of the bark. The leachate typically has a high BOD (150 - 5000 mg/l) and COD (750 – 7500 mg/l). These operations do not occur in Gaza so they are not recorded as environmental challenges.

In Gaza, 70% of the pollutants resulting from the furniture coating process is collected by using water curtains in the painting process. However, this process causes a degree of contamination to large quantities of water that is disposed of in the sewage network system.

7. Waste.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Waste	1	**6**	**6**	4

In the current situation, about 20% to 25% and about 15% to 10% of waste[1] is generated from the use of natural and artificial wood during the production respectively. The waste takes different forms such as Coarse waste include slabs, timber edges, and veneer cores that are suitable for chipping. Fine wastes include by-products that are not suitable for clippings, such as sawdust and fine dust that generated during drilling and milling operations, in addition to low-quality wood rejected by the manufacturing process.

Recycling of used wood furniture is theoretically possible to some extent, but in practice, there are factors that limit recycling practices. These include limited waste collection and transportation, but the furniture usually considered a durable product with product lifetime extending from 7 to 30 years or more depending on wood type and on second hand reselling.

As mentioned earlier, each piece produced by the factories is packaged in several types of material such bubble wrap, plastic stretch wrap, Sealable plastic bags, and/or corrugated cardboard sheets carton box. All these materials turned into waste that is often thrown away to be transferred to landfills or incinerators.

OVERALL FURNITURE SECTOR HOT SPOT RANKING

Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption	1	**9**	2	4
Energy	1	**6**	2	1
GHG Emissions	2	**6**	3	0
Water consumption	0	1	1	1
Air pollution	1	**6**	1	4
Water pollution	0	**6**	0	0
Waste	1	**6**	**6**	4

Categories with a result between 6 and 9 are considered to be 'hot spots'

5.6.3 Construction value chain

The construction industry is mostly composed of several major fields and hence product types. These are ready mix concrete, bricks, stone crushers, asphalt products, cement precast manholes, cement pipes, carpe stone and cement tiles. The following is a brief description of each of the major fields of construction industry:

A) Concrete.

Concrete is a hardened building material created by combining a chemically inert mineral aggregate (usually sand, gravel, or crushed stone), a binder (natural or synthetic cement), chemical additives, and water. Although people commonly use the word "cement" as a synonym for concrete, the terms in fact denote different substances: cement, which encompasses a wide variety of fine-ground powders that harden when mixed with water, represents only one of several components in modern concrete. As concrete dries, it

[1] Of total wood used in production process

acquires a stone-like consistency that renders it ideal for constructing roads, bridges, water supply and sewage systems, factories, airports, railroads, waterways, mass transit systems, and other structures.

B) Bricks.

In modern construction practices, common bricks are categorized according to their component materials and method of manufacture. Under this classification, there are five common types:

1. Burnt clay bricks
2. Sand lime bricks (calcium silicate bricks)
3. Concrete bricks
4. Fly ash clay bricks
5. Firebrick

Concrete bricks are the most common bricks in the Gaza Strip. The concrete commonly used to make concrete blocks is a mixture of powdered portland cement, water, sand, and gravel. This produces a light gray block with a fine surface texture and a high compressive strength. A typical concrete block weighs 38-43 lb (17.2-19.5 kg). In general, the concrete mixture used for blocks has a higher percentage of sand and a lower percentage of gravel and water than the concrete mixtures used for general construction purposes. This produces a very dry, stiff mixture that holds its shape when it is removed from the block mold. The production of concrete blocks consists of four basic processes: mixing, molding, curing, and cubing.

C) Stone Crusher.

Stone Crushing Industry is an important industrial sector in the country engaged in producing crushed stone of various sizes depending upon the requirement which acts as raw material for various construction activities such as construction of Roads, Highways, Buildings, etc. The sector comprises various activities such as mining, crushing plant, transportation of mined stones and crushed products, etc.

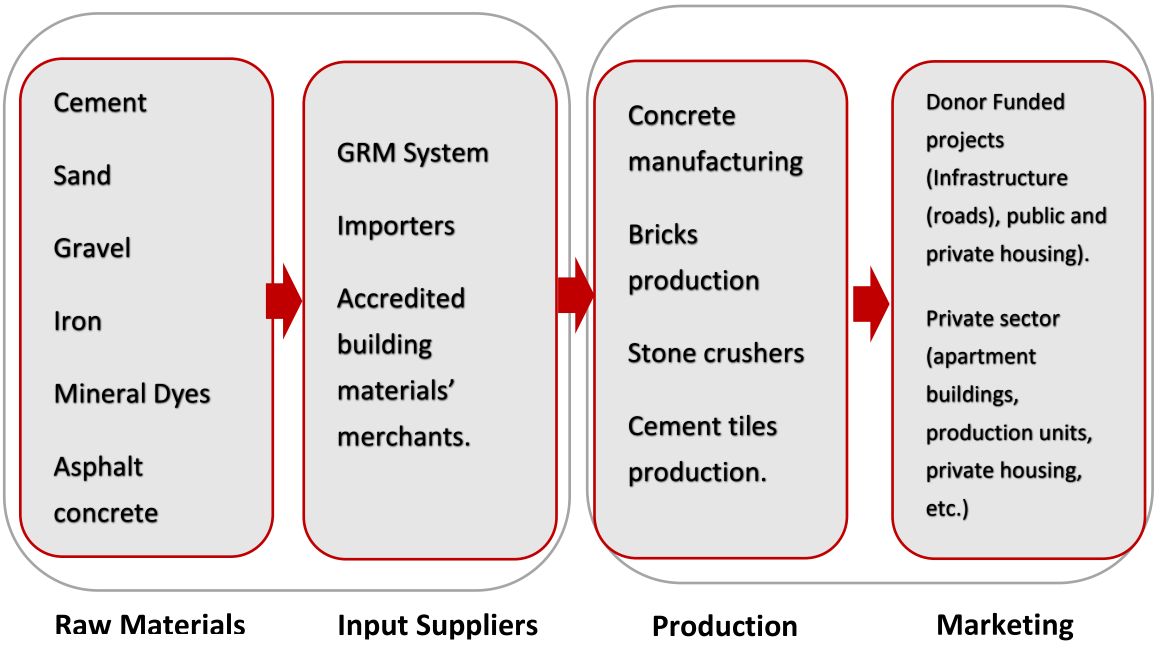
D) Cement Tiles.

Cement tile is a mixture of cement, hydraulic lime, colorants (dyes), sand, marble or stony components, and water. The mineral sources of these materials existed in different areas in the Gaza Strip.

A good cement tile is compact, waterproof and very durable. During the production, only the best natural materials are used. These are mechanically compressed with high pressure. The different patterns are made by manually applying the different colours one by one in a hand-copper mould, which is also hand-made. It is a very careful and skilled process, and that can only be performed by highly trained professionals. The manufacturer of the tiles is decisive for the final quality of the tile.

The build-up Cement tiles are made up of two different layers. First layer: The wear layer/colour layer or the view. This is a fine mixture of white cement, crushed white marble (natural) pigments. The quality of this layer provides the abrasion resistance, and the colour and brightness of the tile. Second layer: This layer, which consists of a mortar of cement and fine sand, is the basis of the product and strengthens the first layer. The second layer ensures that the entire tile can withstand high pressure. Both layers are compressed in a special cement tile, press into one single tile.

Figure 4 illustrates the general flow of the construction value chain



5.6.3.1MAJOR ENVIRONMENTAL ISSUES RELATED TO CONSTRUCTION VALUE CHAIN STAGES

1. Material consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Material consumption	2	**6**	4	**9**

The construction industry is one of the largest exploiters of renewable and nonrenewable natural resources. It relies heavily on the natural environment for the supply of raw materials such as timber, sand and aggregates for the building process. This extraction of natural resources causes irreversible changes to the natural environment of the source countries.

Except for sand, all raw materials used in the construction industry are imported from Israel and abroad, because of the land limitation and urban and agricultural expansion, it is expected that after ten years sand sources will diminish to almost zero supply and there will be no source of sand in the Gaza Strip.

The marble pallets are imported in different dimensions, depending on the type of marble and the country of origin, this leads to an increase in the percentage of waste during production processes.

Because of the situation of Gaza, and the unstable process of importing material, the factories receive 16 different brands of cement and 15 types of aggregate resulting in producing variable quality products some of which are rejected and defected.

The process of truck loading and unloading of raw materials on the borders causes a loss of about 5% of the imported construction raw material. Old transportation equipment used to move the products from the factory to the construction sites results in damages to and losses of products.

In marble production, the machines used in the production process are old and locally produced in Gaza, this results in around 8-15% losses in volume/quantity of raw materials in the production processes. On average, factories can have losses of $2,300 – $2,500 per month. In other subsectors losses in raw materials during production and manufacturing process accounts for less than 1%.

Since Gaza is plagued by frequent conflicts, the destruction process often occurs, causing more material to be consumed. For example, 600,000 tons of concrete debris were reportedly generated in the 2008 war as a result of large-scale destruction of homes and public buildings. However, the vast majority of them have been recycled in the construction of new buildings. Industry in Gaza still does not apply the concept of green buildings so that there are many records of the irrational use of large materials and waste generated, not to mention poor health and safety conditions for construction workers. Building design, construction, rehabilitation, and destruction processes cause the use of materials significantly.

2. Energy.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Energy	2	**6**	**6**	4

Building material production consumes energy, the construction phase consumes energy, and operating a completed building consumes energy for heating, lighting, power and ventilation. Therefore, the construction industries are considered one of the most energy consuming among industries. It is worth noting that the embodied energy associated with construction materials during extraction, processing and manufacture represents the largest portion of total embodied energy in buildings.

The industry largely depends – in its operations- on a wide range of heavy machinery both in production and transportation. In addition to that the machines and equipment used in the production process are relatively old with some operational inefficiency that increases energy consumption. Adding to that persistent electricity problem in the Gaza Strip increases the direct cost of energy consumed for production through the use of the diesel generators as an alternative source of power.

The following table illustrates energy consumption, for a partition wall constructed using Hollow concrete block[2] with a dimension of 200*200*400 mm, for each stage of the value chain:

Phase	Embodied Energy
Manufacture	26 kWh/m^2
Transportation (using diesel fuel truck 20 ton)	6 MJ[3]/m^2
Onsite construction	0

[2] Standard weight hollow concrete block. Every third vertical core is grouted and reinforced with one steel bar.

[3] MJ stands for Megajoule.

Demolition	2 MJ/m^2

The construction and erection of building assemblies requires the use of a range of manual and power operated tools and equipment such as saws, compressors, drills, welders and etc. The values of embodied energy of related equipment is estimated to be marginal.

Another example is asphalt which consumes considerable energy, with one ton of asphalt mixture consuming up to 680 MJ (190 kWh) throughout the life cycle from raw material production to construction.

The following table illustrates the energy consumption per subsector:

Subsector	Electricity consumption (kWh)/ton	Fuel consumption (Liter)/ton
Ready concrete	4	1.43
Tile	3.3	2.2
Marble	14	1.2
Block and interlock	5.7	1.14

3. GHG Emissions.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
GHG emissions	2	**6**	**6**	2

The majority of emissions are produced at the asphalt facilities resulting from the combustion of fuel, that is used to heat the aggregate and the bitumen mixture to keep the temperature of the asphalt hot. GHG Emissions are also produced resulting from using the generators during the electricity supply cuts, and the transport vehicle fuel combustion and emissions.

Building on the previous example of the construction of a partition wall (200*200*400 mm), each m^2 releases the following GHG emissions (see table below).

Phase	GHG emissions (Kg CO_2 Eq. per m^2)
Manufacture	11
Transportation (using diesel fuel truck 20 ton)	0.6
Onsite construction	0
Demolition	0.5

In terms of the concrete tiles, 1 m^2 may release up to 12 Kg CO_2. throughout the life cycle from raw material production to construction. Asphalt for instance releases up to 600 kg of CO_2 per ton.

The following table illustrates the average consumption of fuel & greenhouse gas emissions per factory on monthly basis:

Subsector	Fuel consumption (Liters)	Greenhouse gas emissions (Kilogram)
Ready concrete	10,000	26,000
Tile	1,000	2,600
Marble	300	780
Block and interlock	4,000	10,400

4. Water consumption.

Resource Categories	Raw	Production/	Marketing	Consumption

	material	processing		and waste disposal
Water consumption	1	**9**	1	**6**

Water represents 10% to 20% of the construction industry mixtures that are made within the production process to produce mixtures for blocks, interlocks, tiles, and ready mixed concrete. Equipment, production lines, and trucks are washed in daily manner a frequent process that consumes a huge amount of water.

In the tile, Block and interlock factories the water is used on the concrete mixtures at several stages of production process. The casted finished or semi-finished products are treated by water to increase the hardness and the quality of the finished products, such processes also consume a big amount of water.

It is estimated that the average water consumption in the factory which produces daily 2,000 pieces of hollow blocks of size 400*200*75 is 13 – 17 cubic liters. Overall, the amount of water used to produce a concrete tile is 20 - 25 Liters, whereas for a brick is 12 - 15 Liters.

At the consumption stage, a relatively large amount of water is needed during on-site construction, especially immediately after concrete casting. Water needed to clean tiles is also another source of water consumption.

5. Air pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Air pollution	2	**9**	4	4

Construction industries generate large amounts of dust because the primary raw materials used in the production process are very dry and dusty materials such as cement and aggregate, dust result from the production process itself and the poor aggregate transfer practices that generate dust as the aggregate and other raw materials are transferred from area to another. Most of the raw materials used at ready mix plants are dry and dusty. Bulk materials are not kept in covered or closed area to protect them from wind, vehicle traffic, and other factors that can cause them to be released into the air. The factories wash their equipment, trucks, and vehicles regularly. The water used in washing forms areas of muddy surfaces and soil. During transportation and movement of trucks, their wheels pick up the mud, where its carried and transferred out of the plant and deposited onto nearby roads. The mud dries out and then becomes airborne when other vehicles drive over it.

6. Water pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water pollution	1	**9**	0	2

Rejected ready-made concrete is treated by pouring massive amount of water to separate the aggregate and sand form the Cement in order to reuse the aggregate again. Wastewater output from this process as well as the water resulting from the washing of equipment and trucks, ends up contaminating the soil and possibly causes contamination to deeper layers.

In the construction industries massive amount of water are used for cooling, cutting, and polishing machines. It's worth noting that some manufactures collect production wastewater to be used for further applications.

7. Waste.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Waste	2	4	2	**6**

The construction industry produces an enormous amount of waste. A large volume results from the production, transportation and use of materials.

Almost 100% of the waste of construction materials are recycled but the recycling process itself results in air, water and soil pollution as well huge water consumption. Plastic and wood are minor waste types produced from construction industries, which are used as complementary materials such as holders or wrapping packing materials.

Using recycled materials is considered one of the ways to create sustainable or green buildings, as utilizing such materials ensures reduction of embodied energy and consumption of natural resources, which consequently reduces negative environmental impacts. Furthermore, a vast amount of recyclable rubble has been generated in Gaza as a result of buildings destroyed in numerous past conflicts. Therefore, considerable attention has been given in recent years by international and local organizations in the Gaza strip to recycle and reuse rubble in the construction sector. Recycling activities increased especially after the Israeli disengagement from the settlements in the Gaza strip in 2005, where about 400,000 tons of concrete rubble was collected from destroyed buildings of Israeli settlers. In addition to this, the Israeli war on Gaza in late 2008 generated about 600,000 tons of concrete rubble as a result of the extensive destructions of houses and public buildings.

OVERALL CONSTRUCTION SECTOR HOT SPOT RANKING

Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption	2	**6**	4	**9**
Energy	2	**6**	**6**	4
GHG Emissions	2	**6**	**6**	2
Water consumption	1	**9**	1	**6**
Air pollution	2	**9**	4	4
Water pollution	1	**9**	0	2
Waste	2	4	2	**6**

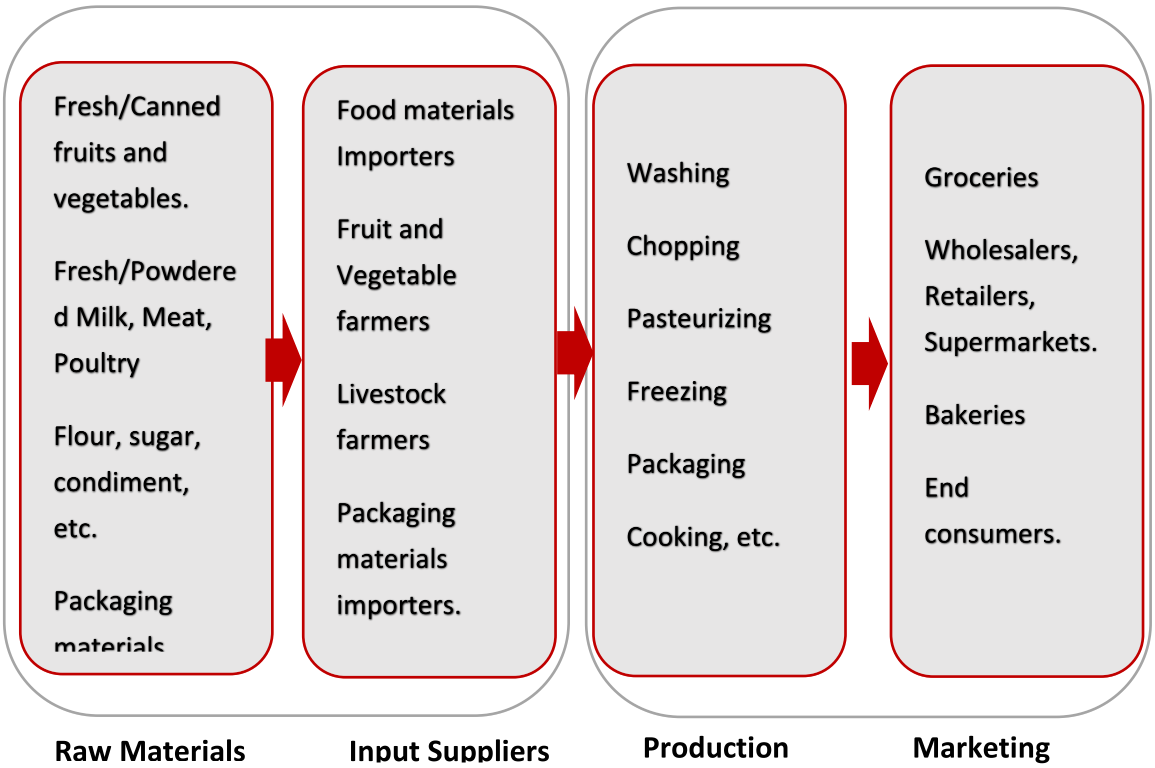
Categories with a result between 6 and 9 are considered to be 'hot spots'

5.6.4 Food value chain

Food processing is the process of turning fresh foods into food products. This involve a combination of various processes including washing, chopping, pasteurizing, freezing, fermenting, packaging, cooking, etc. Food processing also includes adding ingredients to food, for example to extend shelf life. Food processing includes traditional (heat treatment, fermentation, pickling, smoking, drying, curing) and modern methods (pasteurization, ultra-heat treatment, high pressure processing, or modified atmosphere packaging). The food sector in Gaza covers several subsectors, including but not limited to: olive mills, beverage and mineral water factories, confectionery and corn chips factories, grain/wheat mills, dairy factories, among others. The following is a brief description of each industry:

- **Beverage & mineral water industry** involves: treating water, receiving raw materials, concentrate manufacturing, concentrate and additives filling, and shipping finished products.
- **Olive milling industry** involves: (1) Cleaning the olives and removing the stems, leaves, twigs, and other debris left with the olives; (2) Grinding the olives into a paste; (3) Malaxing (mixing) the paste for 20 to 45 minutes allows small oil droplets to combine into bigger ones; (4) Separating the oil from the rest of the olive components by centrifugation; (5) Storing, filling and packaging.
- **Confectionery industry** involves: Preparing raw materials (weighing and dosing), Creating a smooth butter & cream, Baking (turning batter into treats), Cooling the wafer sheets, Conditioning the wafer sheets, building filled wafer blocks, Cooling the wafer blocks, Cutting the wafer blocks, Separating the wafer fingers, Enrobe the wafer with chocolate, Finalizing the product.
- **Grain/wheat milling industry** involves**:** Cleaning and conditioning – ridding the grain of all impurities and readying it for milling, Crushing or breaking – breaking down the grain in successive stages to release its component parts, Reduction – progressive rollings and siftings to refine the flour and separate it into various categories, called streams.
- **Dairy (cheese) industry** involves**:** Standardize milk, Pasteurize/heat treat milk, Cool milk, Inoculate with starter & non-starter bacteria and ripen, Add rennet and form curd, Cut curd and heat, Drain whey, Texture curd, Dry salt or brine, Form cheese into blocks, Store, and package.
- **Baking industry** involves: Mixing, Fermentation, Makeup (dividing, rounding, intermediate proofing, sheeting and molding), Baking.

Figure 5 illustrates the general flow of the food value chain.



5.6.4.1 MAJOR ENVIRONMENTAL ISSUES RELATED TO FOOD PRODUCT VALUE CHAIN STAGES

1. Material consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Material consumption	2	9	6	6

In Gaza, a small percentage of raw materials are obtained from domestic production, while the majority of raw materials are imported from Israel, Turkey, China and/or Egypt. Therefore, the consumption of materials in this sector is relatively low if raw materials obtained from the Gaza Strip are considered. However, as a general fact, the food industry is one of the high-consumption sectors of materials. The sector is heavily dependent on materials from agricultural crops and livestock products, and therefore consumes large quantities of water, fertilizers and pesticides, while causing many environmental risks. Besides, most raw materials of food industries have short shelf life (validity duration/expiry date), needing special storing and inventory conditions/system such as the control of temperature and humidity. Given the persistent shortage of electricity, absence atmosphere control and few adequate inventory management systems, most factories encounter spoilage of massive amount of raw materials. Adding to that and due to poor storage conditions significant amount of raw materials are eaten by insects, rodents or birds.

The startup and calibration of the machines and production lines generate sizable amount of wasted raw and packing materials. In cases of sudden electricity shutdowns factories are susceptible to losing full batch of products especially in dairy and bakery products.

The food sector also consumes large quantities of non-food items, especially for packaging such as glass and metals (aluminum, foils and laminates, tinplate, and tin-free steel), paper and paperboards, and plastics. For example, each ton of olives needs 10 plastic tins of a size of 20 liters. Thus, every year thousands of plastic tins are purchased in the olive season to fill the olive oil. In addition, hundreds of thousands of disposable plastic bottles are consumed for one-time use of drinking water, soda and juice.

Due to the economic situation, the majority of food companies started to fill food products in very small packages for sale for 1 Shekels. This has doubled the use of packaging materials and causes a huge waste of plastic packaging.

2. Energy.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Energy	6	9	6	6

The energy consumed by the food and drink industry is a significant proportion of the total energy used in manufacturing industries. Energy is consumed by the food industry to keep food fresh and safe for consumption. This is achieved by different processing operations (boiling, evaporation, pasteurization, cooking, baking, frying, etc.), safe and convenient packaging (aseptic packaging) and storage (freezing, chilling).

In addition to that the machines and equipment used in the production process are relatively old with some operational inefficiency that increases energy consumption. Adding to that persistent electricity problem in the Gaza Strip increases the direct cost of energy consumed for production through the use of the diesel generators as an alternative source of power.

It is estimated that 1 ton of olives consumes 35 - 50 kWh during olive oil extraction. While each ton of flour consumes only about 0.7 - 1 kWh. On the other hand, each piece of bread consumes up to 0.4 – 0.7 kWh of electricity and 0.13 – 0.2 kWh of natural gas. In terms of dairy products, the following table illustrates the energy consumption of some of the dairy products.

Product	Energy consumption per ton (kWh)
Fluid milk	200 – 250
Yoghurt	300 – 400
Cheese/Labnah/Feta	500– 700
Ice cream	800 – 900

While, the table below shows the energy consumption per subsector:

Subsector	Electricity consumption (kWh)/ton	Fuel consumption (Liter)/ton
Dairy	250-280	30-40
Beverages and mineral water	500	4
Grain/wheat mills	90-100	5
Olive mills	50	5

The often random distribution process of storage to retailers, supermarkets and grocery stores leads to an increase in the amount of energy used by vehicles. Since food grocery stores and supermarkets are widely distributed throughout the Gaza Strip, the movement of trucks distributing food is very high. For this purpose, thousands of diesel fuel is consumed daily, resulting in higher energy consumption. It is estimated that the average monthly vehicle fuel consumption per factory (including in different subsectors) is 6000 – 9000 liters, at a total cost of $8,640 - $12,960.

At consumption level, the main source of energy consumption is the refrigeration used by households. The vast majority of households in Gaza have a refrigerator of different size, year of production, and operating system, and thus different energy consumption patterns. The average daily operating hours per refrigerator is 15 hours, which leads to an average daily consumption of 4 - 5 kWh of electricity, and annual electricity consumption of 1,460 – 1,835 kWh per household.

3. GHG Emissions.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
GHG Emissions	3	**6**	**6**	1

The food production mainly depends on boilers that are powered by diesel fuel which generate/emit high amounts of GHG Emissions. GHG Emissions resulting from using the generators during the electricity supply turn off, and the Transport vehicle fuel combustion.

Like other sectors, burning diesel or other fuels creates exhaust gasses. Diesel generators produce carbon dioxide (CO2), nitrogen oxide (NOx), and particulate matter. These generators release this into the atmosphere and substantially reduce air quality in the nearby regions. Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel.

In general, each ton of processed olives emits 158.2 kg of CO_2. While each ton of flour grinding releases 1.25 kg CO_2. On the other hand, each kilogram of bread releases 0.8-2.3 kg of CO_2. For dairy products, the average release of greenhouse gas emissions per ton is 300 to 400 kilograms of carbon dioxide.

As mentioned earlier, grocery stores and supermarkets are widely distributed throughout the Gaza Strip, with very high movement of trucks distributing food. Therefore, thousands of diesel fuel is consumed daily, resulting in high fuel combustion. It is worth noting that the truck crossed a distance of 16 km, consumes 2.67 liters of diesel fuel. So the trip releases 1.95 kg of pure carbon and 6.94 kg of carbon dioxide.

4. Water consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water consumption	0	**6**	1	0

The food industry is one of the largest users of desalinated water representing about 85% 0f the beverages products. Most of the food processing companies have water desalination plants water recovery ration depends on the salinity of input water and desired salinity of output water and may range from 45% to 70%.

Olive milling and dairy industry are the highest water consumption compared to other food sub-sectors. For instance, each ton of processed olives consumes 0.7-2 m^3 of water, which means that a medium-sized olive mill receives 20 tons of olives per day and consumes 14-40 m^3 of water. In terms of dairy industry, the following table illustrates the water consumption of some of the dairy products.

Product	Water consumption per ton (m^3)
Fluid milk	2 – 4
Yoghurt	2 – 4
Cheese	2 – 4
Ice cream	4-6.5

5. Air pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Air pollution	0	4	1	0

Boilers, ovens, and heating facilities in food processing factories are potential sources of air pollutants. The use of diesel generators produces pollutants that are released into the air.

6. Water pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water pollution	0	4	0	1

The cleaning and sanitizing of food processing equipment results in massive amounts of wastewater which is usually disposed in the sewage networks.

The waste products from food processing facilities include bulky solids, wastewater and airborne pollutants. All of these cause potentially severe pollution problems. Generally, wastewater is most common, because food processing operations involve a number of unit operations, such as washing, evaporation, extraction and filtration. The wastewaters resulting from these operations normally contain high concentrations of suspended solids and soluble organics, such as carbohydrates, proteins and lipids, which cause disposal problems.

As an example, a medium-sized olives mill receives 20 tons of olives per day and produces 0.7 m^3 olive mill wastewater per ton of olives. That means that the daily production of liquid waste in a mill reaches approximately 14 m^3 of olive mill wastewater. The mean production of olive mill wastewater is between 0.7 and 2 m^3 per ton of olives.

For dairy sector, the following table illustrates the waste water volumes in some dairy products.

Products	Wastewater (kg ww/kg milk)
Milk	0.5 - 5
Cheese	1.7 - 5
Ice cream	2 - 6
Condensed milk	1 -4
Butter	2- 4

7. Waste.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Waste	4	**6**	4	**9**

The quality and quantity of wastes produced depend on the type of food being processed. There are big differences from sector to sector, and even site to site: generalization is not only difficult, but could also be misleading. Food wastages levels are often inferred from mass balances. It is estimated that about 10-12% of food product at the farm gate is lost, much due to spoilage, and only about 5-10%, on an average, is lost during processing. It can be inferred that, although the percentage loss during food processing is low, wastage mass or volumes are very high. Food processing operations produce many varied types of wastes that can be categorized into solid, liquid and gaseous wastes.

Human error is the main cause of waste in the food industry. Errors are a result of wrong planning/ordering, storage, inventory, and/or lack of training and standardization among staff and managerial practices.

By-products are common in the food industry, for example in the milling industry producing one ton of flour, produces about 270 kilograms of wheat bran, which is used in the animal fodder production. Most of the organic waste that results from food production is used in the manufacturing of feeder or agricultural fertilizers.

As a result of olive milling, a large amount of olive cake waste produced, unless treated causes a lot of environmental risks. There are a number of businesses that have introduced olive cake treated as an energy source for industrial or domestic heating purposes.

For instance, the flour industry generates up to 15% of wheat processing as wastes. Bread waste is amounted to 25 kg per capita per year, of which 17 kg is wasted within households, 8 kg in bakeries and retail.

Despite the advantages of packaging, the environmental impact of packaging wastes is considerably high and, in many cases, outweighs their benefits. The key environmental issues related to packaging are: the use of packaging materials like plastics and steel which are either non-recyclable or uneconomic to recycle (a large amount of such wastes invariably end up in landfills); the use of material intensive packaging, which requires an energy-intensive process to manufacture; the use of substances in the packages having high chemical and biological oxygen demand (some even hazardous and toxic to the environment) which cannot be discharged safely into natural water streams.

The packaging is crucial to protect the quality of food products. It is used to provide important information, and offers food and beverages in a safe convenient way to consumers, the using of disposal one-use bottles, plastic bottles, and containers are responsible for much of the solid waste. For example, the beverage and dairy industry

Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption	2	**9**	**6**	**6**
Energy	**6**	**9**	**6**	**6**
GHG Emissions	3	**6**	**6**	1
Water consumption	0	**6**	1	0
Air pollution	0	4	1	0
Water pollution	0	4	0	1
Waste	4	**6**	4	**9**

together accounts for over 50% of the total packaging waste produced.

OVERALL FOOD SECTOR HOT SPOT RANKING

Categories with a result between 6 and 9 are considered to be 'hot spots'

5.6.5 Plastic value chain

The Plastic products in Gaza are produced in different ways including injection molding, rotational (roto) molding, extrusion blow molding, and injection blow molding. The following is a brief description about each production way:

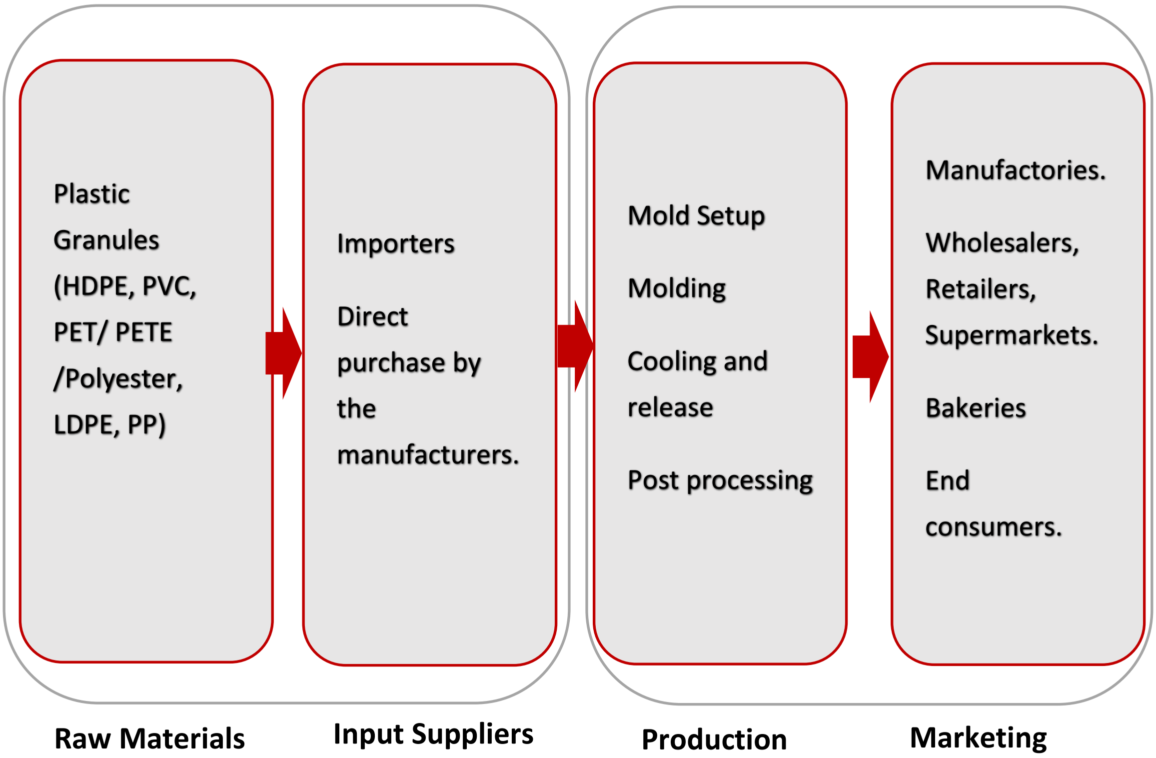
(1) **Injection molding**, involves: Mold setup, Plastic extrusion (Small plastic pellets are melted and extruded through a heated chamber by a screw), Molding (The molten plastic is injected into the mold), Cooling and release (The part cools in the mold until it is solid enough to be ejected, either mechanically or by compressed air), Post-processing (Sprues, runners and any flash is removed from the part).

(2) **Rotational molding**, involves: Charging (Plastic powder is loaded into the mold cavity, and then the remaining parts of the mold are installed, closing the cavity for heating), Heating (The mold is heated until the plastic powder melts and adheres to the mold's walls, while the mold is rotated along two perpendicular axes to ensure a uniform plastic coating), Cooling (The mold is slowly cooled while the mold remains in motion to ensure that the skin of the part does not sag or collapse before fully solidifying), Part removal (The part is separated from the mold, any flashing is trimmed away).

(3) **Extrusion blow molding**, involves: Plastic extrusion (Plastic is heated and pushed through a heated chamber by a screw), Molding (Plastic is forced through a die that creates the final shape of the part), Cooling (The extruded plastic is cooled), Cut or spool (The continuous shape is spooled or cut into lengths).

(4) **Injection blow molding**, involves: Mold setup (Small plastic pellets are melted and formed into a hollow tube, called the parison or preform (depending on the blow molding subtype), Molding: (The parison is clamped into a mold and gets inflated by pressurized air until it takes the shape of the inside of the mold), Cooling and release: (The part cools in the mold until it is solid enough to be ejected).

Figure 6 illustrates the general flow of the Plastic value chain.



5.6.5.1 MAJOR ENVIRONMENTAL ISSUES RELATED TO PLASTIC VALUE CHAIN STAGES

1. **Material consumption.**

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Material consumption	0	**6**	1	**9**

Material consummation in the industry is around 20,000 tons of which 12,000 tons is of new raw material and 8,000 of recycled material.

The plastic production mainly depends on input martial imported from outside Gaza strip. The primary input material is Plastic Granules of several types such as Polyethylene Terephthalate (PET or PETE or Polyester), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE) and Polypropylene (PP), these martials imported both by traders and/or by the plastic factories directly. Imports come from different countries with diverse quality which consequently affects the equality of the production process and of the end products.

The Mould which is a hollowed-out block is considered the essential component of the production process, since 2006 Israel imposes severe restrictions on importing molds. Therefore, the majority of the available molds are old, outdated and obsolete. The molds that are manufactured in Gaza are of low quality and can't sustain production for lengthened time.

Losses of raw material during production and processing of plastic is generally low, this is attributed to the fact that each factory has a crushing machine used to crush the defected parts and pieces resulting from the production as well as the waste resulting from the production process setup. On average, factories consume 20,000 tons of plastic materials on annual basis.

At the level of consumption, the use of plastic is very wide among Palestinian households, particularly in packaging. The vast majority of food and non-food products are packaged using plastic, not to mention disposable plastic shopping bags that are widely used by groceries, bakeries, supermarkets, etc. It is estimated that households in Gaza consume about 300 tons of plastic per day. On the other hand, only a small percentage of plastic waste is recycled, which increases the consumption of plastic raw materials.

2. **Energy.**

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Energy	1	**9**	**6**	0

Plastic production depends on melting the raw material of plastic so the process itself is characterized by high consumption of energy, adding to this is the increased energy consumption due the progressing inefficient of ageing machines.

The primary form of energy used for plastics production is electricity. Electricity is used to provide heat to extruder barrels and to energize extruder drives. Electricity is also used as a power source for hydraulics, chilling, heating and compressed air, and for providing ventilation, air conditioning and lighting for the building. The embodied energy of plastic indicates a typical embodied energy of 22 -25 kWh per kilogram of plastic. This includes the energy embodied in the raw materials themselves as well as the process energy required to make plastic. It is estimated that the plastic manufactories in Gaza consumes up to 0.9 kWh/Kg of electricity, while up to 1.67 L/Kg of diesel are consumed when using diesel generators.

The often random distribution process of storage to manufactories, retailers, supermarkets and grocery stores leads to an increase in the amount of energy used by vehicles. Since manufactories, wholesalers and retailers are widely distributed throughout the Gaza Strip, the movement of trucks distributing plastic is very high. For this purpose, thousands of diesel fuel is consumed daily, resulting in higher energy consumption. It is estimated that the average monthly vehicle fuel consumption per factory is 600 – 800 liters, at a total cost of $864 - $1,152.

The process of drying crushed plastic within the plastic recycling process requires a large amount of energy.

3. **GHG Emissions.**

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal

GHG Emissions	1	**6**	**6**	1

GHG Emissions are generated primarily as a result of energy consumption in the plastics production processes. GHG Emissions resulting from using the generators during the electricity supply turn off, and the Transport vehicle fuel combustion.

Like other sectors, burning diesel or other fuels creates exhaust gasses. Diesel generators produce carbon dioxide (CO_2), nitrogen oxide (NO_x), and particulate matter. These generators release this into the atmosphere and substantially reduce air quality in the nearby regions. Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel. It is estimated that each kilogram of plastic releases 2.4 – 2.6 Kilogram of carbon dioxide. On average, each factory consumes 100K – 250K liters of fuel to run the generator on a monthly basis, which costs $144K – $360K. In addition, the factory releases 260K – 650K kilograms of carbon dioxide on a monthly basis.

As mentioned earlier, manufactories, wholesalers and retailers are widely distributed throughout the Gaza Strip, with very high movement of trucks distributing plastic. Therefore, thousands of diesel fuel is consumed daily, resulting in high fuel combustion. It is worth noting that the truck crossed a distance of 16 km, consumes 2.67 liters of diesel fuel. So the trip releases 1.95 kg of pure carbon and 6.94 kg of carbon dioxide. It is estimated that the average monthly vehicle fuel consumption per factory is 600 – 800 liters, at a total cost of $864 - $1,152. That's mean a total release of 1,560 – 2.080 kilograms of carbon dioxide on a monthly basis.

4. Water consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water consumption	0	1	0	0

There is no record of notable water consumption at any stage of the plastic industry.

5. Air pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Air pollution	1	**6**	1	3

Air pollution caused by the plastic industry is also caused by operation diesel generators that emit pollutants that are released into the air. Plastic's slow decomposition rates is a major obstacle for the rapidly filling landfills with tons of plastic materials. Burning plastic releases hazardous, noxious and harmful substances such as toxic chemicals into the air and persist in ash waste residues.

Just like producing brand new plastics, recycling plastics share the same threshold for emitting noxious gases into the atmosphere.

6. Water pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water pollution	0	**6**	0	0

The plastics industry discharges relatively small amounts of polluted water. The bulk of the effluent is water cooling, but a small amount of polluted effluent contains certain amounts of intermediate products, by-products, and end-products, which are present in the solution either as suspended solids or as emulsions.

7. **Waste.**

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Waste	1	1	**9**	**9**

Losses of raw material during production and processing of plastic is generally low, this is attributed to the fact that each factory has a crushing machine used to crush the defected parts and pieces resulting from the production as well as the waste resulting from the production process setup.

One of the main hurdles for plastic recycling is that it is a complicated process that requires extensive experience and sophisticated technology particularly is the process of separation and granulation. There are multiple types of plastics and they must all be separated and recycled in different ways and at different recycling centers. Furthermore, not all plastic types can be recycled because some plastic may contain other foreign materials that cannot easily separated.

OVERALL PLASTIC SECTOR HOT SPOT RANKING

Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption	0	**6**	1	**9**
Energy	1	**9**	**6**	0
GHG Emissions	1	**6**	**6**	1
Water consumption	0	1	0	0
Air pollution	1	**6**	1	3
Water pollution	0	**6**	0	0
Waste	1	1	**9**	**9**

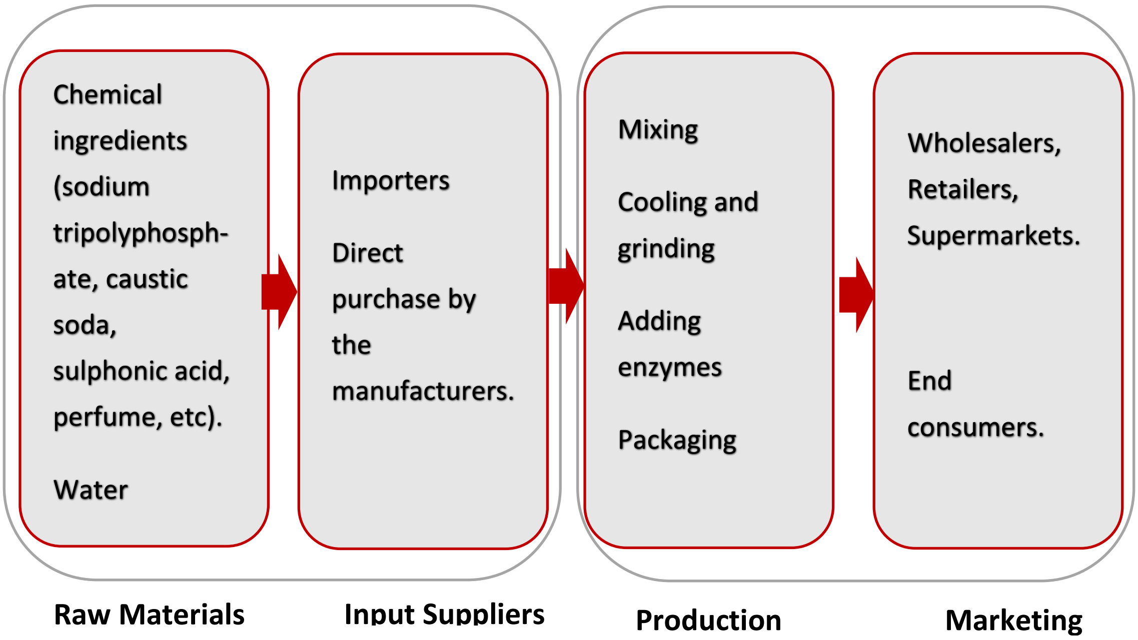
Categories with a result between 6 and 9 are considered to be 'hot spots'

5.6.6 Chemical value chain

The chemical sector represents different industries such as: detergents, cosmetics, paint, and battery industries. There is currently no battery production where raw materials (such as sulphuric acid, etc.) are not allowed into Gaza from the Israeli side.

The chemical industry in Gaza is limited to a few industrial processes, including: mixing imported ingredients at high temperature, cooling and grinding the resulting mixture, adding enzymes in powder form to the mixture, and finally, pouring the mixture into different size packages.

Figure 7 illustrates the general flow of the Chemical value chain



5.6.6.1 MAJOR ENVIRONMENTAL ISSUES RELATED TO CHEMICAL VALUE CHAIN STAGES

1. Material consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Material consumption	1	**6**	0	**9**

All the material enters the process of detergent, cosmetic and paint products are imported from Israel and abroad, this material is imported in tanks and containers. All Chemical materials used in production are inorganic materials, that aren't spoiled with long term storage yet its effectiveness may decrease over time. The ingredients used in the manufacturing of liquid detergents are usually sodium tri-polyphosphate, caustic soda, sulphonic acid, perfume and water. While, the ingredients used in manufacturing of paint are pigments (titanium dioxide, zinc oxide etc.), solvents (mineral turpentine) and resins and additives.

There are a number of varieties of chemicals having different densities. The manufacturing process is uncomplicated and almost only requires mixing of ingredients in right quantities and sequence. The very simple production process doesn't produce any kind of waste of material during production process.

Packing materials for detergents and cosmetics represent about 65% of the cost of the product, 90% of these materials are plastic. Therefore, the chemicals sector consumes large quantities of plastic packaging materials. Thus, hundreds of thousands of disposable plastic bottles are consumed by end consumers on an annual basis.

The consumption phase is the most critical stage in terms of material consumption, especially since a large amounts of detergents are used by Gazan households. Besides, a large amount of chemicals, particularly detergents used in washing. It is estimated that Gazans consume between 8,000 and 10,000 cubic meter of fluid detergent each year.

2. Energy.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Energy	1	3	**6**	1

The production process generally depends on mixing raw materials with electric powered mixers, as well as automatic or semi-automatic packaging machines, all of which consume average degree of electrical power. By definition, the production process is a chemical reaction, the reaction must be acquired at a certain temperature, that is attained and controlled by cooling systems which in turn consumes some energy.

The often random distribution process of storage to wholesalers, retailers, and supermarkets leads to an increase in the amount of energy used by vehicles. Since wholesalers and retailers are widely distributed throughout the Gaza Strip, the movement of trucks distributing detergents, cosmetics and paint is very high. For this purpose, thousands of diesel fuel is consumed daily, resulting in higher energy consumption. It is estimated that the average monthly vehicle fuel consumption per factory is 1,800 – 2,500 liters, at a total cost of $2,592 – $3,600.

3. GHG Emissions.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
GHG Emissions	1	2	**6**	0

GHG Emissions are generated primarily as a result of energy consumption in the chemical production processes. GHG Emissions resulting from using the generators during the electricity supply turn off, and the Transport vehicle fuel combustion.

Like other sectors, burning diesel or other fuels creates exhaust gasses. Diesel generators produce carbon dioxide (CO_2), nitrogen oxide (NO_x), and particulate matter. These generators release this into the atmosphere and substantially reduce air quality in the nearby regions. Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel.

As mentioned earlier, wholesalers and retailers are widely distributed throughout the Gaza Strip, with very high movement of trucks distributing detergent, cosmetics, and paint. Therefore, thousands of diesel fuel is consumed daily, resulting in high fuel combustion. It is worth noting that the truck crossed a distance of 16 km, consumes 2.67 liters of diesel fuel. So the trip releases 1.95 kg of pure carbon and 6.94 kg of carbon dioxide. It is estimated that the average monthly vehicle fuel consumption per factory is 1,800 – 2,500 liters, at a total cost of $2,592 – $3,600. That's mean a total release of 4,680 – 6,500 kilograms of carbon dioxide on a monthly basis.

4. Water consumption.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal

Water consumption	0	**9**	1	4

Chemical industries consume considerable volume of water for various manufacturing processes of detergent and painting production, in many of these products water represent from 50% to 75% of its volume.

5. Air pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Air pollution	1	4	1	1

Dust is created in large amount, and it is very harmful to the surrounding areas and creatures during production transferring, and packing of the powdered paint products.

6. Water pollution.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Water pollution	0	4	1	**6**

Water is usually polluted through the wastewater resulting from production and /or use of detergents and paints. Because detergent and paint products are water-soluble and are usually mixed with water when used and disposed in sewage afterwards particularly in the case of detergents, their waste water are major contributor to polluting soil, groundwater, and sea water.

7. Waste.

Resource Categories	Raw material	Production/ processing	Marketing	Consumption and waste disposal
Waste	1	1	1	4

The sulphonic acid and nonionic detergents that are used in producing liquid detergents, soaps and shampoos are highly biodegradable.

OVERALL CHEMICAL SECTOR HOT SPOT RANKING

Sector	Value chain stages			
Resource Categories	**Raw material Procurement**	**Industrial production / processing**	**Distribution, wholesale and retail trade**	**Consumption and waste disposal**
Material consumption	1	**6**	0	**9**
Energy	1	3	**6**	1
GHG Emissions	1	2	**6**	0
Water consumption	0	**9**	1	4
Air pollution	1	4	1	1
Water pollution	0	4	1	**6**
Waste	1	1	1	4

Categories with a result between 6 and 9 are considered to be 'hot spots'

5.7 Short listed challenges

Based on the hot spot analyses, 60 challenges were defined. These were assessed against six criteria as explained in the methodology. Table 9 presents the results of the analyses highlighting the short listed challenged in green color. The filtration process results in shortlisting 30 challenges which obtained total score of 70 and above.

Table 9 Assessment of hotspot challenges against filtration criteria

No.	The Challenge	Resource Category	Sector	Total Score
1	High consumption of fabrics, trims, and accessories during apparel production.	Material Consumption	Textile	71
2	High consumption of chemicals/cloths by end users during the clothes washing.	Material Consumption	Textile	38
3	High energy consumption during apparel production, and denim washing.	Energy	Textile	79
4	High energy consumption during apparel distribution process.	Energy	Textile	78
5	High energy consumption during end-user clothes washing.	Energy	Textile	41
6	GHG emissions resulted from the use of generators for apparel production during the grid electricity power cut.	GHG emissions	Textile	79
7	GHG emissions resulted from transport vehicle fuel combustion.	GHG emissions	Textile	70
8	High consumption of water during the denim washing process.	Water consumption	Textile	59
9	High water consumption by end users while washing clothes.	Water consumption	Textile	42
10	Heavy use of diesel operated power generators to operate boilers in denim washing and during the textile production process.	Air pollution	Textile	64
11	A large amount of waste water and chemical discharge caused by the process of washing denim.	Water pollution	Textile	57

No.	The Challenge	Resource Category	Sector	Total Score
12	A large amount of wastewater & chemical discharge caused by washing clothes for end-users.	Water pollution	Textile	47
13	High waste generated by processing and garment production	Waste	Textile	77
14	High waste generated by distribution & retail (packaging, tagging, hangers, bags, etc.)	Waste	Textile	64
15	High waste generated by end-users (used and un-used clothes).	Waste	Textile	59
16	High consumption of wood, foam, fabric, and chemicals during the furniture production process.	Material Consumption	Furniture	73
17	Energy consumption during the furniture production process.	Energy	Furniture	79
18	GHG emissions resulted from the use of generators for furniture production during the grid electricity power cut.	GHG emissions	Furniture	79
19	large amount of fine dust created during the furniture production process, in addition to toxic emissions include adhesives used for gluing, paint thinners, lacquers, glues and other materials used during coating and finishing process	Air pollution	Furniture	57
20	A large amount of waste water and chemical discharge caused by the furniture coating process.	Water pollution	Furniture	47
21	High waste generated by furniture production.	Waste	Furniture	96
22	High waste generated by distribution & retail (bubble wrap, plastic stretch wrap, Sealable plastic bags, and/or corrugated cardboard sheets carton box)	Waste	Furniture	85

No.	The Challenge	Resource Category	Sector	Total Score
23	High consumption of plastic granules (such as Polyethylene Terephthalate (PET or PETE or Polyester), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE) and Polypropylene (PP)	Material Consumption	Plastic	78
24	Very high consumption of plastic by end consumers (cans, plastic bags, plastic utensils, etc.)	Material Consumption	Plastic	49
25	High energy consumption during plastic production	Energy	Plastic	78
26	High energy consumption during plastic distribution process.	Energy	Plastic	78
27	GHG emissions resulted from the use of generators for plastic production during the grid electricity power cut.	GHG emissions	Plastic	78
28	GHG emissions resulted from plastic transport vehicle fuel combustion.	GHG emissions	Plastic	78
29	Heavy use of diesel operated power generators in plastic production process.	Air pollution	Plastic	64
30	A large amount of contaminated waste water caused by the plastic production.	Water pollution	Plastic	49
31	Very high plastic waste generated by distribution & retail.	Waste	Plastic	78
32	Very high plastic waste generated by end-consumers.	Waste	Plastic	78
33	High consumption of chemical materials (especially packaging) during detergent, cosmetic and paint production.	Material Consumption	Chemical	65
34	Very high consumption of detergent, cosmetic and paint by end consumers.	Material Consumption	Chemical	38
35	High energy consumption during detergent, cosmetic and paint distribution process.	Energy	Chemical	77
36	GHG emissions resulted from detergent, cosmetic and paint transport vehicle fuel	GHG emissions	Chemical	77

No.	The Challenge	Resource Category	Sector	Total Score
	combustion.			
37	Very high consumption of water during detergent, cosmetic and paint production.	Water consumption	Chemical	59
38	A large amount of wastewater & chemical discharge caused by using detergent by end-consumers.	Water pollution	Chemical	56
39	High consumption of construction materials (cement, marble pallets) in the production process.	Material Consumption	Construction	70
40	High consumption of construction materials by end-users.	Material Consumption	Construction	62
41	High energy consumption during the construction materials production.	Energy	Construction	75
42	Energy consumption during construction materials distribution process.	Energy	Construction	67
43	GHG emissions during the manufacturing.	GHG emissions	Construction	74
44	GHG emissions resulted from construction materials transport vehicle fuel combustion.	GHG emissions	Construction	65
45	Very high consumption of water during the construction materials production.	Water consumption	Construction	62
46	High water consumption by end users during the construction process.	Water consumption	Construction	59
47	large amount of dust created during the construction materials production and transport.	Air pollution	Construction	59
48	A large amount of contaminated waste water caused by the construction materials production.	Water pollution	Construction	59
49	High construction waste generated by end-consumers.	Waste	Construction	75
50	Very high consumption of food raw materials during food processing.	Material Consumption	Food	76

No.	The Challenge	Resource Category	Sector	Total Score
51	High consumption of food products and packaging materials during transport process.	Material Consumption	Food	66
52	High consumption of food products by end consumers.	Material Consumption	Food	47
53	High energy consumption during food raw materials importation and transport within the province	Energy	Food	54
54	High energy consumption during the food processing.	Energy	Food	79
55	High energy consumption during food products transport.	Energy	Food	76
56	High energy consumption of food storage and cooking by end consumers	Energy	Food	49
57	GHG emissions resulted from the use of boilers and generators for food production during the grid electricity power cut.	GHG emissions	Food	73
58	GHG emissions resulted from food products transport vehicle fuel combustion.	GHG emissions	Food	73
59	High consumption of water during the food processing.	Water consumption	Food	67
60	High waste generated by food processing.	Waste	Food	79
61	High waste generated by the consumption of food products (by end consumers)	Waste	Food	50

5.8 Context analyses of shortlisted challenges

Based on the filtration of the long listed analyses, 30 challenges were short listed. This section describes context analyses for each challenge. Underlying causes, impact, technical and financial feasibility, potential financial and technical added value of solutions and the possible solution for each challenge is presented. Potentialities were also evaluated based on the primary and secondary data to assess the strength of the impact and potential. This is to wide extent affected by the local context in Gaza strip.

It should be noted that the figures in the context analyses are estimates derived from interviews with key stakeholders and were validated by a number of key informants in each industrial sector. The figures used to give an indication of the size of the challenge, and do not necessarily reflect the exact situation of all factories, especially since there are high differences in the capacity between different factories in each industrial sector.

CHALLENGE (1)

TEXTILE/MATERIAL CONSUMPTION	High Consumption Of Fabrics, Trims, And Accessories During Apparel Production.
UNDERLYING CAUSES	• The textile material traders and factory owners tend to import large quantities of low-cost clothing materials/fabrics without taking into consideration the quality or the market requirements of fabrics; this has ultimately led to the long-term overstocking of large quantities of fabrics in the warehouses. A sizable part of stocks has been subject to spoilage due to extended periods of storage in non-favorable temperature and atmospheric conditions. • The design is a key influencing factor in the amount of textile waste, as 10-12% of textile used during textile manufacturing are wasted in the making-up stages which includes a garment pattern creating and the raw material cutting process. • Relying on traditional methods of pattern design and cutting and not using newer technologies has been the main source of high rates of material consumption and waste.
IMPACT	**HIGH** • High percentage of losses and waste during the manufacturing process (10-12% of textile used are wasted). • Increased per unit cost of production (6-10% of unit cost). On average, factories can have losses of $2,000-$2,500 per month. • Increased demand for raw materials thus increasing the consumption of chemicals, water, energy and greenhouse gas emissions during the production of fabrics and yarn manufacturing.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of material consumed in the production process, thus reducing unit cost by 6-10%, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** Controlling the amount of losses and waste saves up to 6-10% of the cost of production (on average $2,000 – 2,500 on a monthly basis per factory), reducing the amount of raw materials imported and used in production, thereby reducing emissions of chemicals, water, energy and greenhouse gases during the production of fabrics and the spinning industry.
POTENTIALS	**HIGH** • Integral knitting, where a whole garment is produced in one piece without the need for cutting and sewing. • Computer controlled tools for pattern making to use

	more of the fabric with fewer cut-offs, garments with no or fewer seams, bonding or gluing instead of sewing. • Combining creative pattern-making with a process of generating new garments from the surplus fabrics. • Smart fashion that may use smart technology to instantly adjust to the wishes of the consumer, by changing colors. Instant fashion could enable on-demand production at point of sale, with the help of future and improved 3D printing. Consumers would be able to get what they want produced locally with no overproduction.

CHALLENGE (2)

TEXTILE/ENERGY	Energy Consumption During Apparel Production, And Denim Washing.
UNDERLYING CAUSES	• The production process uses a relatively significant amount of energy for sewing, and seam taping equipment. • Denim washing process as well has a high consumption of energy as largely relies on boilers. • The machines used in the production process are old and operate with an average energy consumption, and the electricity problem in the Gaza Strip increases the energy consumed for production through the use of the diesel generators as an alternative source of power. • It is estimated that the apparel industry consumes up to 0.26 kWh/Kg of electricity, while up to 0.04 L/Kg of diesel are consumed when using diesel generators. • The main sources of energy consumption are: air conditioning, lightening, sewing machines, pumps, fans, blowers, compressors, and other equipment.
IMPACT	**LOW** • Increased per unit cost of production (up to 3.5 – 5 % of unit cost). • Increased greenhouse gas emissions as a result of the use of the electricity grid (the central power plant operated by fuels), and the use of fuel generators operated during the grid power outage.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities and it seems technically and financially feasible as they can solve the challenge by reducing the amount of energy consumed in the production process, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**LOW** There is an opportunity to reduce the amount of energy consumed in production from 0.26 kWh/kg of electricity, 0.04 L/Kg of diesel to 0.02 kWh/Kg of electricity, 0.008 L/Kg of diesel respectively with unit cost reduced by up to 3.5 – 5 %. This will result in a decrease in greenhouse gas emissions per Kilogram of apparel to about 0.006 Kg of pure carbon, and 0.1 Kg of carbon dioxide.

POTENTIALS	**HIGH** • Renewable and alternative energy sources (such as solar panel systems). • Introduce and adopt more efficient Heating, Ventilation, and Air Conditioning (HVAC) systems. • Energy Saving Techniques and Services. • Upgrade old, and high energy consumption equipment with new more efficient ones (or replace certain parts of machines with new more energy efficient parts).

CHALLENGE (3)

TEXTILE/ ENERGY	High Energy Consumption During Apparel Distribution Process.
UNDERLYING CAUSES	• Transport from the clothing factories to retailers widely distributed throughout the Gaza Strip. • There is a traffic for trucks throughout the Gaza Strip, particularly for the import of raw materials and the distribution of finished products within the provinces. There are too many retailers in the apparel sector so traffic is relatively high, which means that the consumption of energy is high too. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	**LOW** • The average distance per direct route between a factory and a retailer is 16 kilometers, and the truck crossing this distance consumes 2.67 liters of diesel fuel. • Fuel use is costly as 1 liter of fuel costs around $1.44, which means the abovementioned trip costs $3.8. It is estimated that the average monthly vehicle fuel consumption per factory is 150 – 200 liters at a total cost of $216 – $288.
TECHNICAL AND FINANCIAL FEASIBILITY	**LOW** After the investigation, it was concluded that the financial feasibility is very low and therefore there is no real opportunity for new businesses.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**LOW** There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 10 - 15% per factory (saving up to 30 liters per month, with a total cost of $43).
POTENTIALS	**HIGH** • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles.

CHALLENGE (4)

TEXTILE/GHG EMISSIONS	GHG Emissions Resulted From The Use Of Generators For Apparel Production During The Grid Electricity Power Cut.
UNDERLYING CAUSES	Greenhouse gas emissions from the use of generators during grid outages during the apparel production process.
IMPACT	LOW • Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel[4]. This means that each kilogram of apparel production releases about 0.03 Kg of pure carbon, and 0.1 Kg of carbon dioxide. • Fuel use is costly as 1 liter of fuel costs around $1.44. On average, each factory consumes 350 – 400 liters of fuel to run the generator on a monthly basis, which costs $504 – $576. In addition, the factory releases 910 – 1,040 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	MED There is an opportunity available and it seems technically and financially feasible as it can solve the challenge by offering a reduction of up to 80% in greenhouse emissions, as well as saving a total of $403 – $461 per factory each month. The opportunity could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	LOW • There is an opportunity to operate the plant using renewable and alternative energy sources, particularly solar panel systems. This could offer a cost reduction of about 2% per kilogram of apparel. • There is an opportunity to reduce greenhouse gas emissions to 0.008 Kg of carbon dioxide per Kilogram of apparel (a reduction of up to 80% in greenhouse emissions).
POTENTIALS	MED Renewable and alternative energy sources (such as solar panel systems).

CHALLENGE (5)

TEXTILE/ GHG EMISSIONS	GHG Emissions Resulted From Transport Vehicle Fuel Combustion.
UNDERLYING CAUSES	• Transport from the clothing factories to retailers widely distributed throughout the Gaza Strip. • There is a traffic for trucks throughout the Gaza Strip, particularly for the import of raw materials and the distribution of finished products within the provinces. There are too many retailers in the apparel sector so traffic is relatively high, which means that GHG emissions are also

[4] https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/pdf/transportation/fuel-efficient-technologies/autosmart_factsheet_6_e.pdf

	relatively high. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	LOW • The average distance per direct route between a factory and a retailer is 16 kilometers, and the truck crossing this distance consumes 2.67 liters of diesel fuel. So this trip releases 1.95 kg of pure carbon and 6.94 kg of carbon dioxide. • Fuel use is costly as 1 liter of fuel costs around $1.44, which means the abovementioned trip costs $3.8. It is estimated that the average monthly vehicle fuel consumption per factory is 150– 200 liters, at a total cost of $216 – $288. That's mean a total release of 390 - 520 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	LOW After the investigation, it was concluded that the financial feasibility is very low and therefore there is no real opportunity for new businesses.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	LOW • There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 10 -15% per factory (saving up to 30 liters per month, with a total cost of $43). • There is an opportunity to reduce 312 – 416 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	HIGH • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles.

CHALLENGE (6)

TEXTILE/ WASTE	High Waste Generated By Processing And Garment Production
UNDERLYING CAUSES	• In the textile and apparel industry, there are different types of processes like cutting, bundling & shorting, sewing, printing, embroidery, finishing. The cutting activity is the main activity to produce waste in a clothing factory. wastage generated in the sewing section is usually due to rejection of faulty pieces. In the printing section if any print doesn't match with the standard printing shape/color/pattern, the garment piece will be a waste and disposed of. In the embroidery section, if the embroidery is not done in the proper place, the garment will be treated as wastage. In the finishing section if there is any measurement or trims defect this will generate wastage. • The textile material traders and factory owners tend to import large quantities of low-cost clothing materials/fabrics without taking into consideration the quality or the market requirements of fabrics; this has ultimately led to the long-

	term overstocking of large quantities of fabrics in the warehouses. A sizable part of stocks has been subject to spoilage due to extended periods of storage in non-favorable temperature and atmospheric conditions. • Relying on traditional methods of pattern design and cutting and not using newer technologies has been the main source of high rates of material consumption and waste. • Each piece produced by the factories is packaged by nylon cover and certain number of pieces are packaged into a carton box; a set of complementary products are put into the box when necessary. All these packaging materials will turn into waste that is disposed of in landfill or incinerated.
IMPACT	**HIGH** • High percentage of losses and waste during the manufacturing process (10-12% of textile used are wasted). • Increased per unit cost of production (6-10% of unit cost). On average, factories can have losses of $2,000-$2,500 per month. • There is no credible recycling concept, the used or unused clothing items as well as waste cloth fragments are disposed with other solid waste and sent to the landfill site or incineration plants. There is no collection or sorting of disposed textiles according to their condition and/or the types of fibers used.
TECHNICAL AND FINANCIAL FEASIBILITY	**MED** Recycling faces a number of issues, even globally, as only less than one percent of all materials that are used in clothing is recycled back into clothing. This reflects a lack of technologies for sorting the collected clothing, separating blended fibers, separating fibers from chemicals including color during recycling, and establishing which chemicals were used in the production in the first place (which is one reason why it is easier to recycle factory waste such as cut-outs). In addition, technologies that would enable clothes to be recycled into virgin fibers are absent. Therefore, none of the cut-outs or waste are used to manufacture new clothes or even down-cycled into insulation material, wiping cloths, mattress stuffing, or any other materials. However, there are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of waste produced in the production process, thus reducing unit cost by 4-6%, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**MED** Controlling the amount of losses and waste saves up to 4-6% of the cost of production (on average $2,350 – $3,500 on a monthly basis per factory), reducing the amount of raw materials imported and used in production, thereby reducing emissions of chemicals, water, energy and greenhouse gases during the production of fabrics and the spinning industry.
POTENTIALS	**HIGH** • Integral knitting, where a whole garment is produced in one piece without the need for cutting and sewing.

	• Computer controlled tools for pattern making to use more of the fabric with fewer cut-offs, garments with no or fewer seams, bonding or gluing instead of sewing. • Combining creative pattern-making with a process of generating new garments from the surplus fabrics. • Smart fashion that may use smart technology to instantly adjust to the wishes of the consumer, by changing colors. Instant fashion could enable on-demand production at point of sale, with the help of future and improved 3D printing. Consumers would be able to get what they want produced locally with no overproduction. • PETbottle waste can be turned into synthetic fibers to produce garments and accessories. • Design for durability, long lasting and modularity; repairing and upgrading; and reselling. • Repairing and upgrading, in which a product's original function is restored through corrective maintenance or the repair of broken parts, or an out-of-date product is given new, more desirable features. In the fashion industry, garment defects such as rips, missing buttons, or other broken parts can be mended and replaced, while unwanted clothing can be restyled or tailored into something new. • Clothing rentals for special occasions is already relatively popular in Gaza, so this business model can be expanded to all type of cloths.

CHALLENGE (7)

FURNITURE/ MATERIAL CONSUMPTION	High Consumption of Wood, Foam, Fabric, And Chemicals During the Furniture Production Process.
UNDERLYING CAUSES	• There is some reported damage/spoilage of some artificial wood that aren't utilized in production process early enough before rapid change of models or material usage occur. • In the wood warehouses owned by big traders, a small amount of wood is destroyed because of Wood Boring weevil specially if infested with fungus. • Small workshops, that work based on small scale non-mass production, produce coarse residues, sawdust and shavings wastes resulting from the traditional cutting process used by craftsmen. • Conversion efficiencies from round-wood to sawn lumber are often below 40 percent especially in small workshops that use old equipment and less trained staff. • Most factory floor setups are not structured to allow for optimal utilization of raw material and resources. • Some producers are also utilizing inefficient equipment; such as paint sprayers that apply heavier coats than they should. • Each piece produced by the factories is packaged in several

	types of material such bubble wrap, plastic stretch wrap, Sealable plastic bags, and/or corrugated cardboard sheets carton box.
IMPACT	**HIGH** • High percentage of losses and waste during the manufacturing process (from 10 - 25% of waste produced). • Increased per unit cost of production (15-20% of unit cost). On average, small factories can have losses of $2,000-$3,000 per month. • Increased demand for raw materials thus increasing the consumption of wood, chemicals, water, energy and greenhouse gas emissions during the processing of wood.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of material consumed in the production process, thus reducing unit cost by 10-15%, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** Controlling the amount of losses and waste saves up to 10-15% of the cost of production (on average $1,600 – 2,500 on a monthly basis per factory), reducing the amount of raw materials imported and used in production, thereby reducing emissions of chemicals, water, energy and greenhouse gases during the processing of wood.
POTENTIALS	**HIGH** • Designing a set of furniture with modular structure that provides space for reuse, transformation, customization and imagination. • Introducing new furniture models that are lighter in terms of total resource consumption. • Use wood from old floors, furniture, cut offs from carpenters to make new products. • Introducing International certificates such as ISO 9001 and ISO 14001, that ensure the application of environmentally friendly measurements and ensure the optimal use of resources. • Upholstery furniture.

CHALLENGE (8)

FURNITURE/ ENERGY	Energy Consumption During The Furniture Production Process.
UNDERLYING CAUSES	• The machines used are mostly old and considered high energy consumption machines relative to newer ones. • The electricity problem in the Gaza Strip increases the energy consumed for production through the use of the diesel generators as an alternative source of power.
IMPACT	**LOW** • The continuous electricity shortage in the Gaza Strip increases

	the direct cost of energy consumed for production through the use of the diesel generators as an alternative source of power. • Increased per unit cost of production (up to 8 – 15% of unit cost). • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of energy consumed in the production process, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**LOW** There is an opportunity to reduce the amount of energy consumed in production from 200 - 250 kWh/ton of electricity, 45 - 80 L/ton of diesel to 70 - 100 kWh/ton of electricity, 9 - 16 L/ton of diesel respectively with unit cost reduced by up to 8 - 15 %. This will result in a decrease in greenhouse gas emissions per ton of furniture to about 6.75 – 11.68 Kilogram of pure carbon, and 23.4 – 41.6 Kilogram of carbon dioxide.
POTENTIALS	**HIGH** • Renewable and alternative energy sources (such as solar panel systems). • Introduce and adopt more efficient Heating, Ventilation, and Air Conditioning (HVAC) systems. • Energy Saving Techniques and Services. • Upgrade old, and high energy consumption equipment with new more efficient ones (or replace certain parts of machines with new more energy efficient parts).

CHALLENGE (9)

FURNITURE/ GHG EMISSIONS	GHG Emissions Resulted From The Use Of Generators For Furniture Production During The Grid Electricity Power Cut.
UNDERLYING CAUSES	Greenhouse gas emissions from the use of generators during grid outages during the furniture production process.
IMPACT	**MED** • Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel. This means that each ton of furniture production releases about 32.85 – 58.4 Kilogram of pure carbon, and 117 – 208 Kilogram of carbon dioxide. • Fuel use is costly as 1 liter of fuel costs around $1.44, which means an additional $64.8 – 115.2 per ton of furniture.
TECHNICAL AND FINANCIAL FEASIBILITY	**MED** There is an opportunity available and it seems technically and financially feasible as it can solve the challenge by offering a reduction of up to 80% in greenhouse emissions, as well as saving a

	total of $64 -$120 per ton of furniture. The opportunity could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**MED** • There is an opportunity to operate the factory using renewable and alternative energy sources, particularly solar panel systems. This could offer a reduction of $64 -$120 per ton of furniture. • There is an opportunity to reduce greenhouse gas emissions to 23.4 – 41.6 Kilogram of carbon dioxide per ton of furniture (a reduction of up to 80% in greenhouse emissions).
POTENTIALS	**MED** Renewable and alternative energy sources (such as solar panel systems).

CHALLENGE (10)

FURNITURE/ WASTE	High Waste Generated by Furniture Production.
UNDERLYING CAUSES	• About 20% to 25% and about 15% to 10% of waste is generated from the use of natural and artificial wood during the production respectively. The waste takes different forms such as Coarse waste include slabs, timber edges, and veneer cores that are suitable for chipping. Fine wastes include by-products that are not suitable for clippings, such as sawdust and fine dust that generated during drilling and milling operations, in addition to low-quality wood rejected by the manufacturing process. • Paints residues such as cans of glue, paints, thinners and accessories. • Each piece produced by the factories is packaged in several types of material such bubble wrap, plastic stretch wrap, Sealable plastic bags, and/or corrugated cardboard sheets carton box. All these materials turned into waste that is often thrown away to be transferred to landfills or incinerators. • In the wood warehouses owned by big traders, a small amount of wood is destroyed because of Wood Boring weevil specially if infested with fungus.
IMPACT	**MED** • High percentage of losses and waste during the manufacturing process (from 10 - 25% of waste produced). • Increased per unit cost of production (15-20% of unit cost). On average, small factories can have losses of $2,000-$3,000 per month. • Increased demand for raw materials thus increasing the consumption of wood, chemicals, water, energy and greenhouse gas emissions during the processing of wood.
TECHNICAL AND FINANCIAL FEASIBILITY	**MED** Recycling of used wood furniture is theoretically possible to some extent, but in practice, there are factors that limit recycling practices.

	These include limited waste collection and transportation, but the furniture usually considered a durable product with product lifetime extending from 7 to 30 years or more depending on wood type and on second hand reselling. However, there are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of material consumed in the production process, thus reducing unit cost by 10-15%, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**MED** Controlling the amount of losses and waste saves up to 10-15% of the cost of production (on average $1,600 – 2,500 on a monthly basis per factory), reducing the amount of raw materials imported and used in production, thereby reducing emissions of chemicals, water, energy and greenhouse gases during the processing of wood.
POTENTIALS	**HIGH** • Designing a set of furniture with modular structure that provides space for reuse, transformation, customization and imagination. • Introducing new furniture models that are lighter in terms of total resource consumption. • Use wood from old floors, furniture, cut offs from carpenters to make new products. • Introducing International certificates such as ISO 9001 and ISO 14001, that ensure the application of environmentally friendly measurements and ensure the optimal use of resources. • Producing, and selling furniture made from recycled materials and disused objects. • Upholstery furniture.

CHALLENGE (11)

FURNITURE/ WASTE	**High Waste Generated By Distribution & Retail (Bubble Wrap, Plastic Stretch Wrap, Sealable Plastic Bags, And/or Corrugated Cardboard Sheets Carton Box)**
UNDERLYING CAUSES	Each piece produced by the furniture factories/workshops is packaged in several types of material such bubble wrap, plastic stretch wrap, Sealable plastic bags, and/or corrugated cardboard sheets carton box. All these materials turned into waste that is often thrown away to be transferred to landfills or incinerators.
IMPACT	**LOW** • High percentage of waste during the transport process (Almost 100% of materials used are turned into waste). • Increased per unit cost of production (2 -3% of unit cost). • Increased demand for raw materials thus increasing the consumption of packaging materials, chemicals, water, energy and greenhouse gas emissions during the raw material extraction and processing.
TECHNICAL AND FINANCIAL	**LOW** In theory, these materials can be recycled and/or upcycled to some

FEASIBILITY	extent, but in practice there are factors that limit recycling practices, including limited waste collection and transport. There are a number of opportunities, although it is necessary to further investigate them to test their technical and financial feasibility. Opportunities focus mainly on recycling and upcycling of these materials, reducing unit cost by 2-3%, as well as introducing new recyclable packaging materials.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**LOW** Controlling the amount of waste saves up to 2-3% of the cost of production, reducing the amount of raw materials imported and used in transport and packaging, thereby reducing emissions of chemicals, water, energy and greenhouse gases during the processing of raw materials.
POTENTIALS	**MED** • Introducing new packaging materials (such as leather packaging) that can be used several times and can withstand defects resulting from transport, loading and unloading. • Introducing logistics support services that can offer safe transportation using best handling and transport practices. • Recycling and upcycling of used materials.

CHALLENGE (12)

PLASTIC/ MATERIAL CONSUMPTION	High Consumption Of Plastic Granules (Such As Polyethylene Terephthalate (PET Or PETE Or Polyester), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE) And Polypropylene (PP)
UNDERLYING CAUSES	• Reliance on old and locally manufactured molds increases the use of raw materials and increases the production of materials that do not meet the specifications and therefore need to be processed again. • The Mould which is a hollowed-out block is considered the essential component of the production process, since 2006 Israel imposes severe restrictions on importing molds. Therefore, the majority of the available molds are old, outdated and obsolete. The molds that are manufactured in Gaza are of low quality and can't sustain production for lengthened time. • Losses of raw material during production and processing of plastic is generally low, this is attributed to the fact that each factory has a crushing machine used to crush the defected parts and pieces resulting from the production as well as the waste resulting from the production process setup. • The use of plastic is very wide among Palestinian households, particularly in packaging. The vast majority of food and non-food products are packaged using plastic, not to mention disposable plastic shopping bags that are widely used by groceries, bakeries, supermarkets, etc. It is estimated that households in Gaza consume about 100 tons

	of plastic per day. On the other hand, only a small percentage of plastic waste is recycled, which increases the consumption of plastic raw materials. • Plastic recycling is a complicated process that requires extensive experience and sophisticated technology particularly is the process of separation and granulation. There are multiple types of plastics and they must all be separated and recycled in different ways and at different recycling centers. Furthermore, not all plastic types can be recycled because some plastic may contain other materials that cannot easily separated.
IMPACT	High reliance on imported plastic granules such as Polyethylene Terephthalate (PET or PETE or Polyester), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE) and Polypropylene (PP). On average, factories consume 20,000 tons of plastic materials on annual basis.
TECHNICAL AND FINANCIAL FEASIBILITY	There are apparently a number of opportunities available and need to be investigated technically and financially to ensure that they are applicable. These opportunities if found to be feasible, would minimize the need for imported plastic granules, and would be replaced by recycled materials.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	Reducing the amount of imported plastic granules, would save the cost of production depending on the type of recycled materials used. It would also reduce the environmental risks associated with the production of plastic granules (such as energy, water, and chemical consumption, as well as greenhouse emissions).
POTENTIALS	**NEED MORE INVESTIGATION** • Collected, sorted, washed and **mechanically** processed and recycled to displace resins that would be sourced from raw materials. • Collected, sorted, washed and **chemically** processed and recycled, to displace raw materials. • Introducing new products/solutions to replace single use plastics with new ones that can be compostable and recyclable. • Recycling more types of plastics by the introduction of new technologies such as **Polywaste Technology** instead of the traditional plastic melting technology.

CHALLENGE (13)

PLASTIC/ ENERGY	High Energy Consumption During Plastic Production
UNDERLYING CAUSES	• Plastic production depends on melting the raw material of plastic so the process itself is characterized by high consumption of energy, adding to this is the increased energy consumption due the progressing inefficient of ageing machines. • The primary form of energy used for plastics production is electricity. Electricity is used to provide heat to extruder barrels and to energize extruder drives. Electricity is also used

	as a power source for hydraulics, chilling, heating and compressed air, and for providing ventilation, air conditioning and lighting for the building. • The electricity problem in the Gaza Strip increases the energy consumed for production through the use of the diesel generators as an alternative source of power. • The process of drying crushed plastic within the plastic recycling process requires a large amount of energy.
IMPACT	**HIGH** • The embodied energy of plastic indicates a typical embodied energy of 22 -25 kWh per kilogram of plastic. This includes the energy embodied in the raw materials themselves as well as the process energy required to make plastic. • It is estimated that the plastic manufactories in Gaza consumes up to 0.9 kWh/Kg of electricity, while up to 1.67 L/Kg of diesel are consumed when using diesel generators. • High per unit cost of production (up to 35 – 45% of unit cost). • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities and it seems technically and financially feasible as they can solve the challenge by reducing the amount of energy consumed in the production process, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** There is an opportunity to reduce the amount of energy consumed in production from 0.9 kWh/kg of electricity, 1.67 L/Kg of diesel to 0.75 kWh/Kg of electricity, 1.17 L/Kg of diesel respectively with unit cost reduced by up to 10 - 15%. This will result in a decrease in greenhouse gas emissions per Kilogram of plastic to about 0.85 Kg of pure carbon, and 3 Kg of carbon dioxide.
POTENTIALS	**MED** • Renewable and alternative energy sources (such as solar panel systems). • Introduce and adopt more efficient Heating, Ventilation, and Air Conditioning (HVAC) systems. • Energy Saving Techniques and Services. • Upgrade old, and high energy consumption equipment with new more efficient ones.

CHALLENGE (14)

PLASTIC/ ENERGY	High Energy Consumption During Plastic Distribution Process.
UNDERLYING CAUSES	• Transport from the plastic factories to retailers widely distributed throughout the Gaza Strip. • There is a traffic for trucks throughout the Gaza Strip, particularly for the import of raw materials and the distribution of finished products within the provinces. There

	are too many retailers in the plastic sector so traffic is relatively high, which means that GHG emissions are also relatively high. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	LOW • It is estimated that the average monthly vehicle fuel consumption per factory is 600 – 800 liters, at a total cost of \$864 - \$1,152. That's mean a total release of 1,560 – 2.080 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	LOW There are a number of opportunities available and it seems technically and financially feasible as it can solve the challenge by offering a monthly saving of \$130- \$173 per factory.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	LOW • There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 15% per factory (saving up to 120 liters per month, with a total cost of 173\$). • There is an opportunity to reduce 234 – 312 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	MED • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles. • Online marketing.

CHALLENGE (15)

PLASTIC/ GHG EMISSIONS	GHG Emissions Resulted From The Use Of Generators For Plastic Production During The Grid Electricity Power Cut.
UNDERLYING CAUSES	Greenhouse gas emissions from the use of generators during grid outages during the plastic production process.
IMPACT	HIGH • Every liter of fuel has 0.73 kg of pure carbon, 2.6 kg of carbon dioxide released per liter of diesel fuel. This means that each kilogram of plastic production releases about 0.85 Kg of pure carbon, and 3 Kg of carbon dioxide. • Fuel use is costly as 1 liter of fuel costs around \$1.44. On average, each factory consumes 100K – 250K liters of fuel to run the generator on a monthly basis, which costs \$144K – \$360K. In addition, the factory releases 260K – 650K kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	HIGH There is an opportunity available (as described in the potentials section below) and it seems technically and financially feasible as it can solve the challenge by offering a reduction of up to 30% in greenhouse emissions, as well as saving a total of \$80K – 100K per

	factory each month. The opportunity could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** There is an opportunity to reduce the amount of energy consumed in production from 0.9 kWh/kg of electricity, 1.67 L/Kg of diesel to 0.75 kWh/Kg of electricity, 1.17 L/Kg of diesel respectively with unit cost reduced by up to 10 - 15%. This will result in a decrease in greenhouse gas emissions per Kilogram of plastic to about 0.85 Kg of pure carbon, and 3 Kg of carbon dioxide.
POTENTIALS	**LOW** • Renewable and alternative energy sources. • Upgrade machines which in turn can reduce electricity consumption and also make it possible to operate machines on solar systems (PLC and inverter control).

CHALLENGE (16)

PLASTIC/ GHG EMISSIONS	GHG Emissions Resulted From Plastic Transport Vehicle Fuel Combustion.
UNDERLYING CAUSES	• Transport from the plastic factories to retailers widely distributed throughout the Gaza Strip. • There is a traffic for trucks throughout the Gaza Strip, particularly for the import of raw materials and the distribution of finished products within the provinces. There are too many retailers in the plastic sector so traffic is relatively high, which means that GHG emissions are also relatively high. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	**LOW** It is estimated that the average monthly vehicle fuel consumption per factory is 600 – 800 liters, at a total cost of $864 - $1,152. That's mean a total release of 1,560 – 2.080 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	**LOW** There are a number of opportunities available and it seems technically and financially feasible as it can solve the challenge by offering a monthly saving of $130- $173 per factory. The opportunities could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**LOW** • There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 15% per factory (saving up to 120 liters per month, with a total cost of 173$). • There is an opportunity to reduce 234 – 312 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	**MED**

	• Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles. • Online marketing.

CHALLENGE (17)

PLASTIC/ WASTE	Very High Plastic Waste Generated By Distribution & Retail.
UNDERLYING CAUSES	The use of plastic is very wide among Gazan. The vast majority of food and non-food products are packaged using plastic, not to mention disposable plastic shopping bags that are widely used by groceries, bakeries, supermarkets, etc. It is estimated that households in Gaza consume about 300 tons of plastic per day. On the other hand, only a small percentage of plastic waste is recycled.
IMPACT	HIGH • The use of packaging materials like plastics which are either non-recyclable or uneconomic to recycle resulted in a large amount of plastic waste dumped in landfills, and sea. This causes many environmental risks to humans, animals, and marine life. • The use of material intensive packaging requires an energy-intensive process to manufacture. • The use of substances in the packages having high chemical and biological oxygen demand (some even hazardous and toxic to the environment) which cannot be discharged safely into natural water streams.
TECHNICAL AND FINANCIAL FEASIBILITY	There are apparently a number of opportunities available and need to be investigated technically and financially to ensure that they are applicable. These opportunities if found to be feasible, would minimize the plastic waste.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	Reducing the amount of plastic waste would also reduce the environmental risks associated with the production of plastic (such as energy, water, and chemical consumption, as well as greenhouse emissions). It would save the marine life too.
POTENTIALS	MED • Innovations in plastic manufacturing, and recycling technology. • Packaging Materials Recycling: With a view to make packaging from sustainable materials, a number of biodegradable alternatives can be introduced. First generation materials consist of synthetic polymers and 5–20% starch fillers. These materials do not biodegrade after use, but will bio-fragment, i.e. they break into smaller molecules. Second generation materials consist of a mixture of synthetic polymers and 40–75% starch. Some of these materials are fully bio-based and biodegradable. • There are hundreds of ideas to upcycle and re-purpose plastic products including bags, bottles, covers, etc.

CHALLENGE (18)

PLASTIC/ WASTE	Very High Plastic Waste Generated by End-Consumers.
UNDERLYING CAUSES	• The use of plastic is very wide among Palestinian households, particularly in packaging. The vast majority of food and non-food products are packaged using plastic, not to mention disposable plastic shopping bags that are widely used by groceries, bakeries, supermarkets, etc. It is estimated that households in Gaza consume about 300 tons of plastic per day. On the other hand, only a small percentage of plastic waste is recycled. • The food sector consumes large quantities of plastic for packaging. For example, each ton of olives needs 10 plastic tins of a size of 20 liters. Thus, every year thousands of plastic tins are purchased in the olive season to fill the olive oil. In addition, hundreds of thousands of disposable plastic bottles are consumed for one-time use of drinking water, soda and juice. • The majority of food companies started to fill food products in very small packages for sale for 1 Shekels. This has doubled the use of plastic packaging materials and causes a huge waste of plastic packaging.
IMPACT	**HIGH** • The use of packaging materials like plastics which are either non-recyclable or uneconomic to recycle resulted in a large amount of plastic waste dumped in landfills, and sea. This causes many environmental risks to humans, animals, and marine life. • The use of material intensive packaging requires an energy-intensive process to manufacture. • The use of substances in the packages having high chemical and biological oxygen demand (some even hazardous and toxic to the environment) which cannot be discharged safely into natural water streams. • Using of disposal one-use bottles, plastic bottles, and containers are responsible for much of the solid waste.
TECHNICAL AND FINANCIAL FEASIBILITY	There are apparently a number of opportunities available and need to be investigated technically and financially to ensure that they are applicable. These opportunities if found to be feasible, would minimize the plastic waste.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	Reducing the amount of plastic waste would also reduce the environmental risks associated with the production of plastic (such as energy, water, and chemical consumption, as well as greenhouse emissions). It would save the marine life too.
POTENTIALS	**MED** • Innovations in plastic manufacturing, and recycling technology. • Packaging Materials Recycling: With a view to make packaging from sustainable materials, a number of biodegradable alternatives can be introduced. First generation materials consist of synthetic polymers and 5–20% starch fillers. These

	materials do not biodegrade after use, but will bio-fragment, i.e. they break into smaller molecules. Second generation materials consist of a mixture of synthetic polymers and 40–75% starch. Some of these materials are fully bio-based and biodegradable. • There are hundreds of ideas to upcycle and re-purpose plastic products including bags, bottles, covers, etc.

CHALLENGE (19)

CHEMICAL/ ENERGY	High Energy Consumption During Detergent, Cosmetic And Paint Distribution Process.
UNDERLYING CAUSES	• The often random distribution process to wholesalers, retailers, and supermarkets leads to an increase in the amount of energy used by vehicles. Since wholesalers and retailers are widely distributed throughout the Gaza Strip, the movement of trucks distributing detergents, cosmetics and paint is very high. For this purpose, thousands of diesel fuel is consumed daily, resulting in higher energy consumption. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	**MED** It is estimated that the average monthly vehicle fuel consumption per factory is 1,800 – 2,500 liters, at a total cost of $2,592 – $3,600. That's mean a total release of 4,680 – 6,500 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities and it seems technically and financially feasible as it can solve the challenge by offering a monthly saving of $1,166 – 1,620 per factory. The opportunities could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**MED** • There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 45% per factory (saving up to 1,125 liters per month, with a total cost of 1,620$). • There is an opportunity to reduce 2,106 – 2,925 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	**MED** • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles.

CHALLENGE (20)

CHEMICAL/ GHG EMISSIONS	GHG Emissions Resulted From Detergent, Cosmetic And Paint Transport Vehicle Fuel Combustion.
UNDERLYING CAUSES	• The often random distribution process to wholesalers, retailers, and supermarkets leads to an increase in the amount of energy used by vehicles. Since wholesalers and retailers are widely distributed throughout the Gaza Strip, the movement of trucks distributing detergents, cosmetics and paint is very high. For this purpose, thousands of diesel fuel is consumed daily, resulting in higher energy consumption. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	MED It is estimated that the average monthly vehicle fuel consumption per factory is 1,800 – 2,500 liters, at a total cost of $2,592 – $3,600. That's mean a total release of 4,680 – 6,500 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	HIGH There are a number of opportunities available and it seems technically and financially feasible as it can solve the challenge by offering a monthly saving of $1,166 – 1,620 per factory. The opportunities could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	MED • There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 45% per factory (saving up to 1,125 liters per month, with a total cost of 1,620$). • There is an opportunity to reduce 2,106 – 2,925 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	MED • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles.

CHALLENGE (21)

CONSTRUCTION/ MATERIAL CONSUMPTION	High Consumption of Construction Materials (Cement, Marble Pallets) In The Production Process.
UNDERLYING CAUSES	READY CONCRETE • Because of the situation of Gaza, and the unstable process of importing material, the factories receive 16 different brands of cement and 15 types of aggregate resulting in producing variable quality products some of which are rejected and defected. • The process of truck loading and unloading of raw materials

	on the borders causes a loss of about 5% of the imported construction raw material. • Old transportation equipment used to move the products from the factory to the construction sites results in damages and losses of products. **MARBLE** • The machines used in the production process are old and locally produced in Gaza, this results in around 8-15% losses in volume/quantity of raw materials in the production processes. **TILE / BLOCK AND INTERLOCK** • losses in raw materials during production and manufacturing process accounts for less than 1%.
IMPACT	**READY CONCRETE** • Material losses during the manufacturing process (around 5-8% losses volume/quantity of raw materials). • Increased per unit cost of production (2- 4% of unit cost). On average, factories can have losses of $1,000-$1,200 per month. • Increased demand for raw materials thus increasing the consumption of cement, marble pallets, and sand, as well as water and energy. **MARBLE** • Material losses during the manufacturing process (around 8-15% losses volume/quantity of raw materials). • Increased per unit cost of production (5- 8% of unit cost). On average, factories can have losses of $2,300-$2,700 per month. • Increased demand for raw materials thus increasing the consumption of cement, marble pallets, and sand, as well as water and energy. **TILE / BLOCK AND INTERLOCK** Insignificant
TECHNICAL AND FINANCIAL FEASIBILITY	**READY CONCRETE** There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of material consumed in the production process, thus reducing unit cost by 1-3%, while still achieving a good economic return for manufactures as well as business developers. **MARBLE** There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of material consumed in the production process, thus reducing unit cost by 2-4%, while still achieving a good economic return for manufactures as well as business. **TILE / BLOCK AND INTERLOCK** N/A
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**READY CONCRETE** Controlling the amount of losses saves up to 1-3% of the production cost (on average $500 - $900 on a monthly basis per factory), reducing the amount of raw materials imported and used in

	production. Thus, emissions of chemicals and greenhouse gases are reduced, as well as water and energy consumption during the extraction and processing of raw materials. **MARBLE** Controlling the amount of losses saves up to 2-4% of the production cost (on average $1,000 - $1,350 on a monthly basis per factory), reducing the amount of raw materials imported and used in production. Thus, emissions of chemicals and greenhouse gases are reduced, as well as water and energy consumption during the extraction and processing of raw materials. **TILE / BLOCK AND INTERLOCK** N/A
POTENTIALS	Introducing Technical Product-Service Systems (PSS), including the following services: ○ Technical services (maintenance). ○ Qualifying services. ○ Process-oriented services. ○ Logistical, information services. The overall aim is to enhance the efficiency of the old machines, and introducing a more economic and ecological usage of the machines. • Introducing innovative solutions to improve resource efficiency of machines. • SMART industry solutions to reduce the material consumption in construction materials manufacturing, and transportation. • Using recycled materials. • Introducing Computerized systems to run the manufactory.

CHALLENGE (22)

CONSTRUCTION/ ENERGY	High Energy Consumption During The Construction Materials Production.
UNDERLYING CAUSES	• The industry largely depends – in its operations- on a wide range of heavy machinery in production. • The machines and equipment used in the production process are relatively old with some operational inefficiency that increases energy consumption. • Persistent electricity problem in the Gaza Strip increases the direct cost of energy consumed for production through the use of the diesel generators as an alternative source of power.
IMPACT	**READY CONCRETE** • It is estimated that the ready concrete manufactories in Gaza consume up to 4 kWh/ton of electricity while up to 1.43 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (4– 5% of unit cost) • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage.

	TILE • It is estimated that the tile manufactories in Gaza consume up to 3.3 kWh/ton of electricity while up to 2.2 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (3– 5% of unit cost) • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage. **MARBLE** • It is estimated that the marble manufactories in Gaza consume up to 14 kWh/ton of electricity while up to 1.2 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (3– 5% of unit cost) • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage. **BLOCK AND INTERLOCK** • It is estimated that the marble manufactories in Gaza consume up to 5.7 kWh/ton of electricity while up to 1.14 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (3– 5% of unit cost) • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage.
TECHNICAL AND FINANCIAL FEASIBILITY	Overall, there are a number of opportunities available (especially in marble, block and interlock sub-sectors) and it seems technically and financially feasible as they can solve the challenge by reducing the amount of energy consumed in the production process, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**MARBLE** There is an opportunity to reduce the amount of energy consumed in production from 14 kWh/ton of electricity, 1.2 L/ton of diesel to 6 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 2 - 3 %. This will result in a decrease in greenhouse gas emissions per ton of marble produced to almost zero of carbon dioxide. **BLOCK AND INTERLOCK** There is an opportunity to reduce the amount of energy consumed in production from 5.7 kWh/ton of electricity, 1.14 L/ton of diesel to 2 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 2 - 3 %. This will result in a decrease in greenhouse gas emissions per ton of block and interlock produced to almost zero of carbon dioxide.
POTENTIALS	**HIGH (for all subsectors)** • Renewable and alternative energy sources (such as solar panel systems). • Introduce and adopt more efficient Heating, Ventilation,

	and Air Conditioning (HVAC) systems. • Energy Saving Techniques and Services. • Upgrade old, and high energy consumption equipment with new more efficient ones.

CHALLENGE (23)

CONSTRUCTION/ GHG EMISSIONS	**GHG Emissions During the Manufacturing.**
UNDERLYING CAUSES	GHG Emissions resulting from using the generators during the electricity supply turn off.
IMPACT	**READY CONCRETE** On average, each factory consumes 10,000 liters of fuel to run the generator on a monthly basis, which costs $14,400. In addition, the factory releases 26,000 kilograms of carbon dioxide per month. **TILE** On average, each factory consumes 1,000 liters of fuel to run the generator on a monthly basis, which costs $1,440. In addition, the factory releases 2,600 kilograms of carbon dioxide per month. **MARBLE** On average, each factory consumes 300 liters of fuel to run the generator on a monthly basis, which costs $432. In addition, the factory releases 780 kilograms of carbon dioxide per month. **BLOCK AND INTERLOCK** On average, each factory consumes 4,000 liters of fuel to run the generator on a monthly basis, which costs $5,760. In addition, the factory releases 10,400 kilograms of carbon dioxide per month.
TECHNICAL AND FINANCIAL FEASIBILITY	Overall, there is an opportunity available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of energy consumed in the production process, as well as the greenhouse gas emissions, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**MARBLE** There is an opportunity to reduce the amount of energy consumed in production from 14 kWh/ton of electricity, 1.2 L/ton of diesel to 6 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 2 - 3 %. This will result in a decrease in greenhouse gas emissions per ton of marble produced to almost zero of carbon dioxide. **BLOCK AND INTERLOCK** There is an opportunity to reduce the amount of energy consumed in production from 5.7 kWh/ton of electricity, 1.14 L/ton of diesel to 2 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 2 - 3 %. This will result in a decrease in greenhouse gas emissions per ton of block and interlock produced to almost zero of carbon dioxide.

POTENTIALS	Renewable and alternative energy sources

CHALLENGE (24)

CONSTRUCTION/ WASTE	**High Construction Waste Generated by End-Consumers.**
UNDERLYING CAUSES	Conventional construction process causes high waste of energy, water and materials during construction. Construction industry in Gaza still does not apply the concept of green buildings so that there are many records of the irrational use of large materials and waste generated. Building design, construction, rehabilitation, and destruction processes cause huge amount of material consumption and waste.
IMPACT	• High amount of construction wastes are going to landfills. • High consumption of construction materials, thus increasing consumption of water and energy as well as greenhouse gas emissions.
TECHNICAL AND FINANCIAL FEASIBILITY	There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of construction materials used and the waste produced, while achieving a good economic return for business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	Reducing the amount of construction waste would reduce the environmental risks associated with the production of construction materials (such as energy, water, and fossil oil consumption, as well as greenhouse emissions). It would save money for households.
POTENTIALS	• Introducing the green building/green construction/sustainable building models. • Building information modelling (BIM). • Introducing on-site solutions such as compost bins to reduce matter going to landfills. • Recycling & re-using of construction wastes.

CHALLENGE (25)

FOOD/ MATERIAL CONSUMPTION	**Very High Consumption Of Food Raw Materials During Food Processing.**
UNDERLYING CAUSES	• The food sector is heavily dependent on materials from agricultural crops and livestock products, and therefore consumes large quantities of water, fertilizers and pesticides, while causing many environmental risks. • Most raw materials of food industries have short shelf life (validity duration/expiry date), needing special storing and inventory conditions/system such as the control of temperature and humidity. Given the persistent shortage of electricity, absence atmosphere control and few adequate inventory management systems, most factories encounter spoilage of massive amount of raw materials. Adding to that and due to poor storage conditions significant amount of raw

	materials are eaten by insects, rodents or birds. • The startup and calibration of the machines and production lines generate sizable amount of wasted raw and packing materials. In cases of sudden electricity shutdowns factories are susceptible to losing full batch of products especially in dairy and bakery products. • There is a big challenge related to dairy products and cheese, which is the loss of water from cheese juice "drinking water", and the percentage of milk loss is estimated at 80%. For example, out of every 1 ton, 800 kilograms of water are produced, and this waste is produced on a daily basis and in large quantities. • The food sector also consumes large quantities of non-food items, especially for packaging such as glass and metals (aluminum, foils and laminates, tinplate, and tin-free steel), paper and paperboards, and plastics. • Due to the economic situation, the majority of food companies started to fill food products in very small packages for sale for 1 Shekels. This has tripled the use of packaging materials and causes a huge waste of plastic packaging.

IMPACT	**HIGH**
	• High percentage of losses and waste during the manufacturing process (ranging from 5 to 15% depending on the subsector). The highest losses are found in the olive milling subsector (10-15%), then grain/wheat and dairy subsectors (5-10 percent), while losses are lower in beverages and mineral water, as well as in the confectionery and bread industries (3-7 percent).
	• On average, factories can have losses per month as follows:
	  ○ Dairy – $1,500 – $2,500.
	  ○ Olive milling – $3,500 – $5,000.
	  ○ Beverages and mineral water – $1,500 – $2,500.
	  ○ Grain/wheat industries – $1,500 – $2,500.
	  ○ Confectionery industries – $ 1,500 – $ 3,000.
	  ○ Bread industries - $2,000 – $3,000.
	• Increased demand for raw materials thus increasing the consumption of water, fertilizers and pesticides, as well as greenhouse gas emissions. In addition, increasing the consumption of packaging and non-food materials.

TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of material consumed in the production process, thus reducing unit cost, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** Controlling losses and waste saves an average of $1,500-$3,000 per month per factory by subsector, reducing the amount of raw materials imported and used in production, reducing emissions of chemicals, water, energy and greenhouse gases during raw material production and processing.

POTENTIALS	HIGH • Introducing innovative solutions for startup and calibration of the machines and production lines. • Introducing innovative solutions to improve resource efficiency of machines. • SMART industry solutions to reduce the material consumption in food manufacturing, cold storage and transportation. • Introducing more advanced computerized systems to run the manufactory. • Packaging Minimization (decreasing the weight of material used in each pack, decreasing the size or volume of the package or using less material, using consumable or edible package, and modifying the product design, e.g. avoiding unnecessary multiple wrapping of a product with different materials. • Using recycled materials.

CHALLENGE (26)

<table>
<tr><th>FOOD/ ENERGY</th><th>High Energy Consumption During The Food Processing.</th></tr>
<tr><td>UNDERLYING CAUSES</td><td>

Energy is consumed by the food industry to keep food fresh and safe for consumption. This is achieved by different processing operations (boiling, evaporation, pasteurization, cooking, baking, frying, etc.), safe and convenient packaging (aseptic packaging) and storage (freezing, chilling).
The machines and equipment used in the production process are relatively old with some operational inefficiency that increases energy consumption.
Persistent electricity problem in the Gaza Strip increases the direct cost of energy consumed for production through the use of the diesel generators as an alternative source of power.

</td></tr>
<tr><td>IMPACT</td><td>
LOW
DAIRY

It is estimated that the dairy manufactories in Gaza consumes up to 250 - 280 kWh/ton of electricity, while up to 30 - 40 L/ton of diesel are consumed when using diesel generators. The following table illustrates the energy consumption of some of the dairy products.
<table>
<tr><th>Product</th><th>Energy consumption per ton (kWh)</th></tr>
<tr><td>Fluid milk</td><td>200 – 250</td></tr>
<tr><td>Yoghurt</td><td>300 – 400</td></tr>
<tr><td>Cheese/Labnah/Feta</td><td>500– 700</td></tr>
<tr><td>Ice cream</td><td>800 – 900</td></tr>
</table>

Increased per unit cost of production (4 – 7% of unit cost)
Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage.

HIGH
BEVERAGES AND MINERAL WATER

It is estimated that the beverages and mineral water

</td></tr>
</table>

	manufactories in Gaza consumes up to 500 kWh/ton of electricity while up to 4 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (12 – 17% of unit cost) MED **GRAIN AND WHEAT MILLS** • It is estimated that the grain and wheat mills in Gaza consumes up to 90 - 100 kWh/ton of electricity while up to 5 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (4– 7% of unit cost) • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage. HIGH **OLIVE MILLS** • It is estimated that the olive mills in Gaza consumes up to 35 - 50 kWh/ton of electricity while up to 5 L/ton of diesel are consumed when using diesel generators. • Increased per unit cost of production (20– 25% of unit cost) • Increase greenhouse gas emissions as a result of the use of the electricity grid, and the use of fuel generators operated during the grid power outage.
TECHNICAL AND FINANCIAL FEASIBILITY	HIGH Overall, there are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of energy consumed in the production process, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	LOW **DAIRY** There is an opportunity to reduce the amount of energy consumed in production from 250 - 280 kWh/ton of electricity, 30 - 40 L/ton of diesel to 75 - 90 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 5%. This will result in a decrease in greenhouse gas emissions per ton of dairy products to almost zero. HIGH **BEVERAGES AND MINERAL WATER** There is an opportunity to reduce the amount of energy consumed in production from 500 kWh/ton of electricity, 4 L/ton of diesel to 350 – 400 kWh/Kg of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 4 -7 %. This will result in a decrease in greenhouse gas emissions per ton of beverages and mineral water to almost zero. MED **GRAIN AND WHEAT MILLS** There is an opportunity to reduce the amount of energy consumed in production from 75 kWh/ton of electricity, 5 L/ton of diesel to 50 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 4 -7 %. This will result in a decrease in greenhouse gas

	emissions per ton of grain and wheat milled products to almost zero. HIGH **OLIVE MILLS** There is an opportunity to reduce the amount of energy consumed in production from 50 kWh/ton of electricity, 5 L/ton of diesel to 25 - 30 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 10 - 15 %. This will result in a decrease in greenhouse gas emissions per ton of olive oil produced to 6 Kilogram of carbon dioxide.
POTENTIALS	HIGH • Renewable and alternative energy sources (such as solar panel systems). • Introduce and adopt more efficient Heating, Ventilation, and Air Conditioning (HVAC) systems. • Energy Saving Techniques and Services. • Upgrade old, and high energy consumption equipment with new more efficient ones.

CHALLENGE (27)

FOOD/ ENERGY	High Energy Consumption During Food Products Transport.
UNDERLYING CAUSES	• Transport from the food factories to retailers widely distributed throughout the Gaza Strip. Except for the milling subsector where the energy consumption increase in the supply of raw materials than during the distribution phase. • There is a traffic for trucks throughout the Gaza Strip, particularly for the import of raw materials and the distribution of finished products within the provinces. There are too many retailers in the food sector so traffic is relatively high, which means that GHG emissions are also relatively high. • Dairy products consume fuel in large proportions because dairy products need to be cooled. Cars and trucks intended for transportation are mobile refrigerators. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	HIGH • It is estimated that the average monthly vehicle fuel consumption per factory (including in different subsectors) is 6000 – 9000 liters, at a total cost of $8,640 - $12,960. That's mean a total release of 15,600 – 23,400 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	HIGH There are a number of opportunities available and it seems technically and financially feasible as it can solve the challenge by offering a monthly saving of $3,024 – $4,536 per factory. The opportunities could also guarantee a good economic return for business developers (service providers).
POTENTIAL	HIGH

FINANCIAL AND TECHNICAL ADDED VALUE	• There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 35% per factory (saving up to 3,150 liters per month, with a total cost of 4,536$). • There is an opportunity to reduce 15,600 – 23,400 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	**HIGH** • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles. • Online marketing.

CHALLENGE (28)

FOOD/ GHG EMISSIONS	**GHG Emissions Resulted From The Use Of Boilers And Generators For Food Production During The Grid Electricity Power Cut.**
UNDERLYING CAUSES	• The food production mainly depends on boilers that are powered by diesel fuel which generate/emit high amounts of GHG Emissions. • GHG Emissions resulting from using the generators during the electricity supply turn off.
IMPACT	**LOW** **DAIRY** On average, each factory consumes 750 – 1,000 liters of fuel for boilers and to run the generator on a monthly basis, which costs $1,080 – $1,440. In addition, the factory releases 1,950 – 2,600 kilograms of carbon dioxide per month. **MED** **BEVERAGES AND MINERAL WATER** On average, each factory consumes 2,000 liters of fuel to run the generator on a monthly basis, which costs $2,880. In addition, the factory releases 5,200 kilograms of carbon dioxide per month. **HIGH** **GRAIN AND WHEAT MILLS** On average, each mill consumes 10,000 liters of fuel to run the generator on a monthly basis, which costs $14,400. In addition, the factory releases 26.000 kilograms of carbon dioxide per month. **HIGH** **OLIVE MILLS** On average, each mill consumes 3,000 liters of fuel to run the boilers and generator on a monthly basis, which costs $4,320. In addition, the factory releases 7,800 kilograms of carbon dioxide per month.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** Overall, there is an opportunity available (as described in the potentials section below) and it seems technically and financially feasible as they can solve the challenge by reducing the amount of

	energy consumed in the production process, as well as the greenhouse gas emissions, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**LOW** **DAIRY** There is an opportunity to reduce the amount of energy consumed in production from 250 - 280 kWh/ton of electricity, 30 - 40 L/ton of diesel to 75 - 90 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 5%. This will result in a decrease in greenhouse gas emissions per ton of dairy products to almost zero. **HIGH** **BEVERAGES AND MINERAL WATER** There is an opportunity to reduce the amount of energy consumed in production from 500 kWh/ton of electricity, 4 L/ton of diesel to 350 – 400 kWh/Kg of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 4 -7 %. This will result in a decrease in greenhouse gas emissions per ton of beverages and mineral water to almost zero. **MED** **GRAIN AND WHEAT MILLS** There is an opportunity to reduce the amount of energy consumed in production from 75 kWh/ton of electricity, 5 L/ton of diesel to 50 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 4 -7 %. This will result in a decrease in greenhouse gas emissions per ton of grain and wheat milled products to almost zero. **HIGH** **OLIVE MILLS** There is an opportunity to reduce the amount of energy consumed in production from 50 kWh/ton of electricity, 5 L/ton of diesel to 25 - 30 kWh/ton of electricity, 0 L/ton of diesel respectively with unit cost reduced by up to 10 - 15 %. This will result in a decrease in greenhouse gas emissions per ton of olive oil produced to 6 Kilogram of carbon dioxide.
POTENTIALS	**LOW** Renewable and alternative energy sources.

CHALLENGE (29)

FOOD/ GHG EMISSIONS	**GHG Emissions Resulted From Food Products Transport Vehicle Fuel Combustion.**
UNDERLYING CAUSES	• Transport from the food factories to retailers widely distributed throughout the Gaza Strip. Except for the milling subsector where the energy consumption increase in the supply of raw materials than during the distribution phase. • There is a traffic for trucks throughout the Gaza Strip, particularly for the import of raw materials and the distribution of finished products within the provinces. There are too many retailers in the food sector so traffic is relatively

	high, which means that GHG emissions are also relatively high. • Dairy products consume fuel in large proportions because dairy products need to be cooled. Cars and trucks intended for transportation are mobile refrigerators. • Most factories and wholesalers do not have a transport plan to ensure maximum efficiency, thereby increasing fuel consumption and thus greenhouse gas emissions.
IMPACT	**HIGH** • It is estimated that the average monthly vehicle fuel consumption per factory (including in different subsectors) is 6000 – 9000 liters, at a total cost of $8,640 - $12,960. That's mean a total release of 15,600 – 23,400 kilograms of carbon dioxide on a monthly basis.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** There are a number of opportunities available and it seems technically and financially feasible as it can solve the challenge by offering a monthly saving of $3,024 – $4,536 per factory. The opportunities could also guarantee a good economic return for business developers (service providers).
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** • There is an opportunity to apply fleet management solutions that can maximize transport efficiency, reduce fuel consumption and cost by up to 35% per factory (saving up to 3,150 liters per month, with a total cost of 4,536$). • There is an opportunity to reduce 15,600 – 23,400 kilograms of carbon dioxide per factory on a monthly basis.
POTENTIALS	**HIGH** • Fleet management solutions (fleet management, GPS vehicle tracking, Asset tracking, fuel management, etc.) • Green fleet and Eco driving. • Battery electric and solar vehicles.

CHALLENGE (30)

FOOD/ WASTE	**High Waste Generated by Food Processing.**
UNDERLYING CAUSES	• The quality and quantity of wastes produced depend on the type of food being processed. There are big differences from sector to sector, and even site to site: generalization is not only difficult, but could also be misleading. Food wastages levels are often inferred from mass balances. It is estimated that about 10 - 12% of food product at the farm gate is lost, much due to spoilage, and only about 5 - 10%, on an average, is lost during processing[5]. It can be inferred that, although the percentage loss during food processing is low, wastage mass or volumes are very

[5] Estimations by the consultants

	high. Food processing operations produce many varied types of wastes that can be categorized into solid, liquid and gaseous wastes. • Human error is the main cause of waste in the food industry. Errors are a result of wrong planning/ordering, storage, inventory, and/or lack of training and standardization among staff and managerial practices. • Given the persistent shortage of electricity, absence atmosphere control and few adequate inventory management systems, most factories encounter spoilage of massive amount of raw materials. • The startup and calibration of the machines and production lines generate sizable amount of wasted raw and packing materials. In cases of sudden electricity shutdowns factories are susceptible to losing full batch of products especially in dairy and bakery products. • There is a big challenge related to dairy products and cheese, which is the loss of water from cheese juice "drinking water", and the percentage of milk loss is estimated at 80%. For example, out of every 1 ton, 800 kilograms of water are produced, and this waste is produced on a daily basis and in large quantities. • The food sector produces large quantities of non-food waste, especially as a result of packaging such as glass and metals (aluminum, foils and laminates, tinplate, and tin-free steel), paper and paperboards, and plastics. • Due to the economic situation, the majority of food companies started to fill food products in very small packages for sale for 1 Shekels. This has doubled the use of packaging materials and causes a huge waste of plastic packaging.

IMPACT	**HIGH**
	• High percentage of losses and waste during the manufacturing process (ranging from 5 to 15% depending on the subsector). The highest losses are found in the olive milling subsector (10-15%), then grain/wheat and dairy subsectors (5-10 percent), while losses are lower in beverages and mineral water, as well as in the confectionery and bread industries (3-7 percent).
	• On average, factories can have losses per month as follows:
	  ○ Dairy – $1,500 – $2,500.
	  ○ Olive milling – $3,500 – $5,000.
	  ○ Beverages and mineral water – $1,500 – $2,500.
	  ○ Grain/wheat industries – $1,500 – $2,500.
	  ○ Confectionery industries – $ 1,500 – $ 3,000.
	  ○ Bread industries - $2,000 – $3,000.
	• For instance, the flour industry generates 5-10% of wheat processing as wastes. Bread waste is amounted to 25 kg per capita per year, of which 17 kg is wasted within households, 8 kg in bakeries and retail.
	• The environmental impact of packaging wastes is considerably high and, in many cases, outweighs their benefits. The key

	environmental issues related to wasted packaging is the use of packaging materials like plastics and steel which are either non-recyclable or uneconomic to recycle (a large amount of such wastes invariably end up in landfills). • The using of disposal one-use bottles, plastic bottles, and containers are responsible for much of the solid waste. For example, the beverage and dairy industry together accounts for over 50% of the total packaging waste produced.
TECHNICAL AND FINANCIAL FEASIBILITY	**HIGH** By-products are common in the food industry, for example in the milling industry producing one ton of flour, produces about 270 kilograms of wheat bran, which is used in the animal fodder production. Most of the organic waste that results from food production is used in the manufacturing of feeder or agricultural fertilizers. Olive milling also produces a large amount of olive cake waste, which unless treated causes a lot of environmental risks. There are a number of businesses that have introduced olive cake treated as an energy source for industrial or domestic heating purposes. Overall, there are a number of opportunities available and it seems technically and financially feasible as they can solve the challenge by reducing the amount of waste produced in the production process, thus reducing unit cost, while still achieving a good economic return for manufactures as well as business developers.
POTENTIAL FINANCIAL AND TECHNICAL ADDED VALUE	**HIGH** Controlling losses and waste saves an average of $1,500-$3,000 per month per factory by subsector, reducing the amount of raw materials imported and used in production, reducing wastes and emissions of chemicals, water, energy and greenhouse gases during raw material production and processing.
POTENTIALS	**HIGH** • Introducing innovative solutions for startup and calibration of the machines and production lines. • Introducing innovative solutions to improve resource efficiency of machines. • SMART industry solutions to reduce the material consumption in food manufacturing, cold storage and transportation. • Introducing more advanced computerized systems to run the manufactory. • Packaging Minimization (decreasing the weight of material used in each pack, decreasing the size or volume of the package or using less material, using consumable or edible package, and modifying the product design, e.g. avoiding unnecessary multiple wrapping of a product with different materials. • The wastes from food industry can be used for different purposes: the recovered materials can either be recycled, or be used to recover energy by incineration or anaerobic digestion. Solid food wastes can be used as animal feed after reducing their water content. Solid wastes can also be upgraded by fermentation. A number of fermented foods are produced this way. Composting and ensilaging are also examples of solid waste fermentation process. Solid wastes rich in carbohydrate

	can also be converted to sugars by enzyme-assisted hydrolysis: an example is the enzymatic hydrolysis of lactose and galactose sugar using galactosidase. Solid wastes rich in sugar can be fermented to produce carbon dioxide and ethanol. The latter a valuable product, and has also been earmarked as an alternative fuel for the future. • Waste water of dairy products can be used as supplements and animal food, and it can be purified and used for cleaning. It can also be used in the manufacture of food products of great nutritional value. • Packaging Materials Recycling: With a view to make packaging from sustainable materials, a number of biodegradable alternatives can be introduced. First generation materials consist of synthetic polymers and 5–20% starch fillers. These materials do not biodegrade after use, but will bio-fragment, i.e. they break into smaller molecules. Second generation materials consist of a mixture of synthetic polymers and 40–75% starch. Some of these materials are fully bio-based and biodegradable. • Introducing treated olive byproducts as an energy source for industrial or domestic heating purposes. • Further treatment to olive byproducts to extract olive oil and use it for industrial purposes (detergents, cosmetics, and medicines manufacturing)

5.9 Gaza context and green economy limitation

The study has indicated significant potential of investing GCE models in Gaza. Gaza has the advantage that environmental challenges are not yet explored. The results showed that youth have the potential to work on the identified challenges through successful small enterprises that generate income for them, improve profitability for industrial sector, and benefit the environment. Still, the analyses of some challenges and their potentials to be transformed into business opportunities have revealed several limitations. Limitations are related to Gaza context and its implications on the performance of industrial sectors and the potentials of green economy solutions. Following are the main constraints that limit the scope of transforming environmental challenges into economically attractive enterprises:

5.9.1 Scope of industrial sectors:

Compared to any other context, Industry in Gaza strip is too small in size of investment and market. Some of the presented challenges represent high potentials. However, the small size of the sector limits the economic feasibility of investing in GCE solutions. The large scale of industry the large number of factories attracts entrepreneurs to invest in GCE models even when the profit margin is too small. In contrary, small size of industry and little number of factories may not attract the entrepreneurs to invest in GCE models. The filtration of the challenges and context analyses of the short listed challenges took in consideration the sector size in Gaza as major determinant of its economic attractiveness.

5.9.2 Importation of raw material

In other contexts, the procurement and utilization of natural resources to produce raw material is major environmental challenge. Exploring alternative raw material, or developing environmental friendly approaches to extract the raw material with reduced negative impact on the natural resources. The situation in Gaza is different as raw materials are not extracted from the local environment. In most sectors, the raw material is imported and the negative impact on the environment does not occur locally. Such fact, limits the potential to invest in solving the challenges related to the raw material procurement in Gaza strip. Still there is some potential with some sectors such as agribusiness where raw material is produced using the local natural resources.

5.9.3 Weak economy and limited markets

Gaza has been locked down for almost 15 years with restriction on inputs and products movement cross the boarders. Frequent violence caused significant losses to all economic s sectors including industry. The cut off of public employees' salaries has imposed additional load on the local economy. This has limited the investment potential in general as the associated risks are huge compared to any other context even when compared to the West Bank. Such situation is expected to affect the willingness of youth to invest in GCE models. This implies the need to design proper intervention strategy that omits the risk for youth.

5.9.4 Limited enabling environment

The GCE models require an enabling environment that encourages investment in solving environmental challenges. This includes a set of conditions that enhance private sector to invest in GCE.

5.9.4.1 Policies and regulations

Enhancing policies and regulations are essential to promote investment in environmental solutions and GCE models. In several industrial countries government subsidize investment in environmental solution and GCE models. Such model is not applicable in Palestine as the public sector does not have the capacities to subsidize GCE.

Valuation of natural resources and enforcing the payment of it real value including its social cost are major determinant whether the industry would invest in reducing the consumption of natural resources. The authorities usually evaluate the real price of utilization of natural resources including its social cost. Industry as well as other economic sectors is obligated to pay the real value of the natural resources such as water. The private sector therefore will be ready to invest in any technology to minimize the use of natural resources. In Gaza, the value of water resources is not properly assessed. Even the low prices of water and electricity that does not count for its social and environmental costs are not paid by the private sector. Local authorities are not able collect water supply fees. Therefore, private sector may not be interested in investing to reduce the water utilization or water waste in the industry. The investment in power reduction may be different as the cost of alternative power resources (diesel generator) may encourage the industry to invest in other options that have less cost.

5.9.4.2 Lack of environmental standards

Development environment related standards encourage investment in GCE models. The standards are either enforced by the authorities or promoted through subsidies or improved market. In other countries, the governments develop standards to ensure less harm to the environment along the value chain of all economic sectors. These standards are applied through set of policies and regulations. In some cases, these standards are enforced by the local authorities while in other contexts are promoted through subsidies. In other cases, the standards are promoted through the increased demand in the market. In Gaza, there are several laws that enforce no harm to the environment. However, still the lack of capacities limits the implementation of those laws.

5.9.4.3 Consumers awareness and ability to pay for environmental products

Awareness of the environmental challenges and their potential impact on the quality of life of the current and future generation is vital to promote marketing of GCE products. In communities where awareness is high, consumers are willing to pay higher prices for products that cause less harm to the environment. This encourages investment in GCE models. Palestine in general and Gaza in particular are still in need to develop such awareness.

6. Results Validation

The study went through two cycles of validation of main findings. The first validation workshop for members of the Project Advisory Committee (PAC) was held on November 26, 2020. The second workshop for representatives of the six industrial sectors was held on December 9, 2020. The workshops started by representing the study objectives, methodology, key findings, and recommendations. Participants were then given space to reflect on the main findings of the study, and all comments were noted. In the second validation workshop with representatives of the industrial sectors, participants were divided into six groups according to their area of specialty. Each group had a facilitator from the consulting firm, Enable or PFI team members to present the main findings and get feedback. As a result, the 30 challenges identified by the study were cross-validated by the participants. The following is a summary of the outcomes of the two validation workshops.

1. It was clear that participants in the two workshops had difficulty understanding the methodology of the study, which was clear from the type of questions and comments provided. This was expected because the scope of the study and the proposed methodology were quite new.
2. PAC members were cautious about the level of detail in the study, as they felt that consultants were paying more attention to the details.
3. Both PAC members and the industrial sector representatives criticized the duplication of challenges, particularly those related to energy and greenhouse gas emissions. They suggested unifying the common challenges of all industrial sectors. The consultants explained that they were constrained by the proposed methodological approach, particularly the analysis of hotspots. In addition, having the same causes does not mean that innovative solutions must be the same, and different sectors can have different solutions.
4. It was obvious that some representatives of the industrial sector did not differentiate between industrial and environmental challenges, and therefore felt that challenges were not their main priorities. However, during the workshop, the consultants clearly stated that the study addressed environmental aspects rather than the political economy.

5. The results of the study were generally supported by PAC members and representatives of the industrial sector and they agreed on the key challenges identified.
6. Industrial sector representatives made changes and suggestions for some of the figures included in the challenges analysis.

Finally, participants in the two validation workshops were pleased with the study because it was the first study in Gaza to highlight key environmental challenges at the industrial level, and could be a good start for future studies in this area.

7. Recommendation

1- The study has achieved the shortlisting of 30 challenges as required in the ToR. All the short listed challenges represent good opportunity to build GCE model. However, prioritization was based on a set of criteria that reflect the potential of transforming the challenge into GCE opportunity. Therefore, the consultant recommends furthering shortening the list based on the filtration rank and context analyses. The higher rank reflects the likelihood of the challenge to be transformed into attractive business idea. The context analyses provided further illustration of potential business opportunity.

2- The study has revealed several barriers that may limit the success of GCE in Gaza. This implies the need to work on these barriers in any future program. For instance, there is a need to work at the policies and regulations level to ensure promotion of environmental sound business planning. The design of such interventions is beyond the scope of this study and would need in depth review of national context to define the gaps and suggest mitigation measures and design and proper intervention strategy.

3- The study has presented context analyses of the 30 shortlisted challenges. This includes brief description of the potential GCE model that can be derived from each challenge. This however, is not enough. Further business planning is needed for each GCE model. This would involve assessing technical, economic and marketing potential of each challenge.

4- Economic attractiveness is more important for investors than the environmental added value. This should always be the basis for making the suggested model attractive for industrial sector and entrepreneurs. Therefore, economic and marketing viability of the proposed model are vital to ensure acceptance by both parties. The entrepreneur ideas need to be developed into detailed business plans and discussed with industrial sectors to ensure marketing of the presented solutions. Building of such business models involves technical, business and marketing skills. Youth may not have the skills to build such model. Therefore, the businesses plans need to build by experts not as the common model of incubation where youth are asked to develop the ideas into business plan. The model may invest in selecting entrepreneurs who have good potential to establish and operate small enterprises and provide them with business plans and incubation services.

5- Investment environment in Gaza strip is too risky. Therefore, future design of incubation program should ensure omitting the risk for youth entrepreneurs. It also needs to ensure good coaching services that provide technical, business and marketing guidance. GCE is still innovative approach in Palestine and limited knowledge and experience is available. Therefore, incubation services should consider learning from International experience and adopt it to the local context.

6- Further studies are needed to explore the potential of each industrial sector in utilizing inputs from local environment considering decreasing the inputs costs and causing no harm to the environment.

7- Community and private sector awareness on the environmental hazards of their production and consumption behavior need to be improved. This will help promoting the products of GCE models and create demand based production of environmental safe products.