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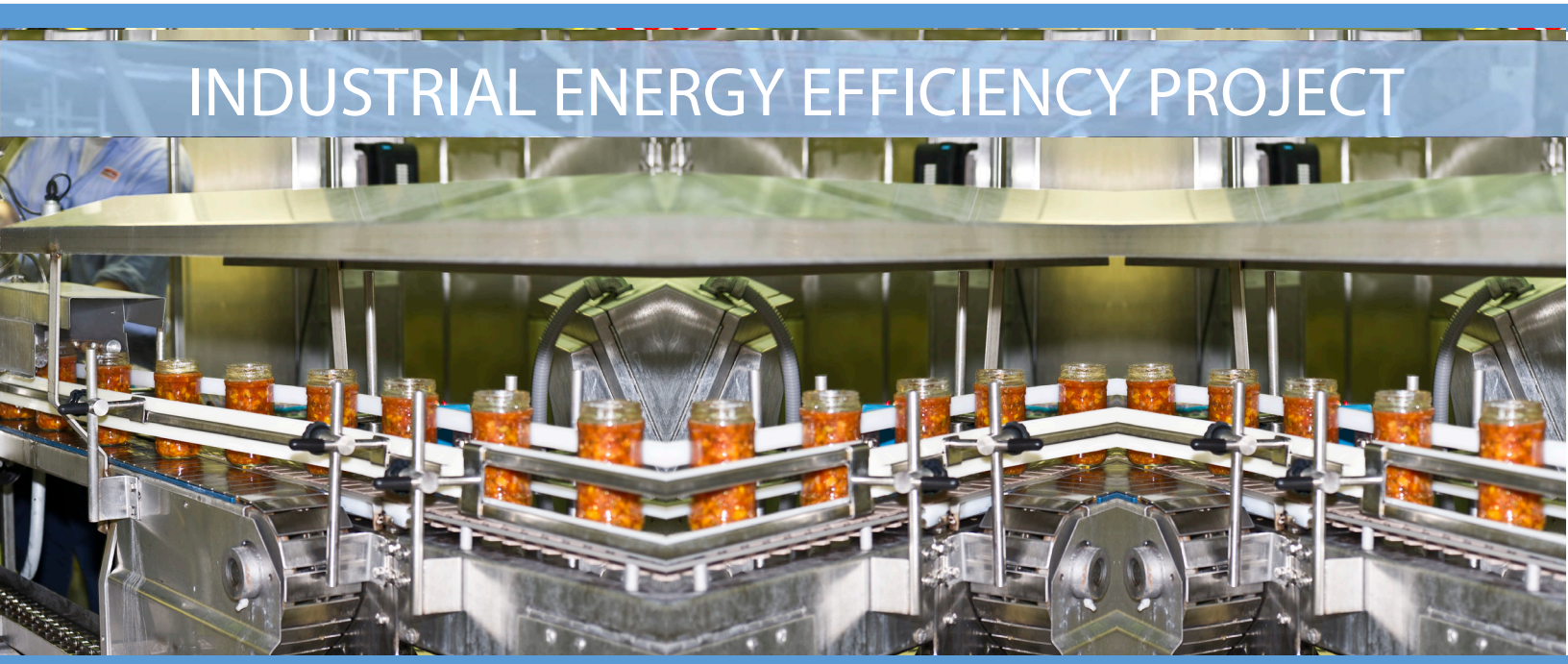
INDUSTRIAL ENERGY EFFICIENCY PROJECT



Integration of Energy Efficiency Into Food Manufacturing Sector Strategy

August 2017

مركز تحديث الصناعة
INDUSTRIAL MODERNISATION CENTRE

إتحاد الصناعات المصرية
FEDERATION OF EGYPTIAN INDUSTRIES

الهيئة المصرية العامة للمواصفات والجودة
Egyptian Organization for Standardization and Quality

الهيئة العامة للتنمية الصناعية
Industrial Development Authority

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1. Introduction

1.1 Background

The Ministry of Trade and Industry (MTI) has developed and launched the Ministry's strategy for 2020 in November 2016. Concurrently, an Industrial Energy Efficiency Strategy and Policy (IEESP) Report was developed for the ministry by the United Nations Industrial Development Organization (UNIDO) within the scope of the Industrial Energy Efficiency (IEE) Project in Egypt, funded by the Global Environmental Facility (GEF) and implemented by UNIDO in cooperation with the Egyptian Environmental Affairs Agency (EEAA), MTI and the Federation of Egyptian Industries (FEI).

Following the formulation of the IEE policy recommendations in 2015, the Ministry of Trade and Industry requested UNIDO to provide technical inputs to integrate the IEESP recommendations into the sectorial strategies being developed under a broader stream of resource efficiency.

To date, this exercise was already undertaken for the sectors of chemicals, building materials and textiles. The current document focuses on the food manufacturing industry.

1.2 Objective of the Report

The overall objective is to lead the Egyptian Food manufacturing industry to high energy efficiency to ensure and foster world wide competitiveness, improve the security of energy supply and guarantee sustainable production in Egypt. This strategy addresses three distinct sectors falling under the same umbrella of food manufacturing industry (FMI) namely Food sector, Beverages sector and Tobacco sector. As the report addresses food, beverage and tobacco, when referred to the three sectors the term (FMI) is used. When the report wishes to mention each sector alone, food sector, beverages sector and tobacco sector, these terms will be used.

1.3 Methodology

The FMI is highly diversified with a wide range of different products and sub products, with each involving distinct processes that shape them into distinct industries. Therefore, this report aims to identify the energy intensive operations and allocate them to appropriate subsectors rather than analyzing each subsector individually to avoid redundancy of information and formulate pivotal tailored strategies. Classification is based on literature to include energy intensive operations widely noted by scholarly articles, professional

journals, and international reports on the energy reduction strategies in the FMI.

Under the 18 subsectors (discussed below), two subsectors will be excluded from the analysis of the FMI later in the report due to ambiguity including the Manufacture of prepared meals and Manufacture of other food products n.e.c (not elsewhere classified). In many cases however some absolute data represent the whole sector and so these 2 subsectors might be included as a consequence.

The current document is divided, after this introductory section, into seven main parts. Four of those address the sector Profile, Sector Growth & Export Requirements and Energy Considerations, and are meant to provide an adequate understanding of the sector. The subsequent tailoring of the policies recommended by the IEESP benefit from an outline of the relevant characteristics of the sector based on the preceding analysis . The document concludes with specific programs related to the FMI sector, composing an action plan for implementation.

2. FMI Sector Profile

2.1 Composition of FMI

Egypt's FMI is diversified with a large number of companies that manufacture edible oils, ready meals, soup, spreads, butter and margarine, flavored milk, chocolate confectionary, gum, ice-cream and frozen desserts, snacks, breakfast cereals, processed meat and seafood, rice, pasta and noodles, baby food, and yoghurt and sour milk products. There are many categorizations for the FMI. For the purpose of this report, CAPMAS categorization is chosen as the report heavily relies on the national data census of CAPMAS.

CAPMAS categorizes the food industry's activities using the International Standard Industrial Classification (ISIC) following ISIC Rev.4, Division: 10, and classified as:

Food:

1010. Processing and preserving of meat
1020. Processing and preserving of fish, crustaceans and molluscs
1030. Processing and preserving of fruit and vegetables
1040. Manufacture of vegetable and animal oils and fats
1050. Manufacture of dairy products
1061. Manufacture of grain mill products
1062. Manufacture of starches and starch products

1071. Manufacture of bakery products
1072. Manufacture of sugar
1073. Manufacture of cocoa, chocolate and sugar confectionery
1074. Manufacture of macaroni, noodles, couscous and similar farinaceous products
1075. Manufacture of prepared meals and dishes
1079. Manufacture of other food products n.e.c.
1080. Manufacture of prepared animal feeds

Beverages:
1101. Distilling, rectifying and blending of spirits and production of ethyl alcohol
1103. Manufacture of malt liquors and malt
1104. Manufacture of soft drinks; production of mineral waters and other bottled waters

Tobacco:
1200. Manufacture of Tobacco

Domestic food production is dominated by micro, small and medium-sized companies. Only 11 are listed on the stock exchange, of which a handful are large household brands that started out as family businesses, such as Juhayna, Edita and Arabian Food Industries (Domty). Despite being publicly traded, decision-making authority still rests with their founders. Also listed are food companies originally owned by the government, such as Cairo Soaps and Oils, that went public during the privatization program of the 1990s[1].

There are 77,199 establishments under the food sector, 91 establishments under the beverages sector and 69 establishments under the tobacco sector. Figure 2 shows the number of establishments under each of their sub-sectors.

[1] https://amcham.org.eg/publications/business-monthly/issues/265/January-2018/3679/

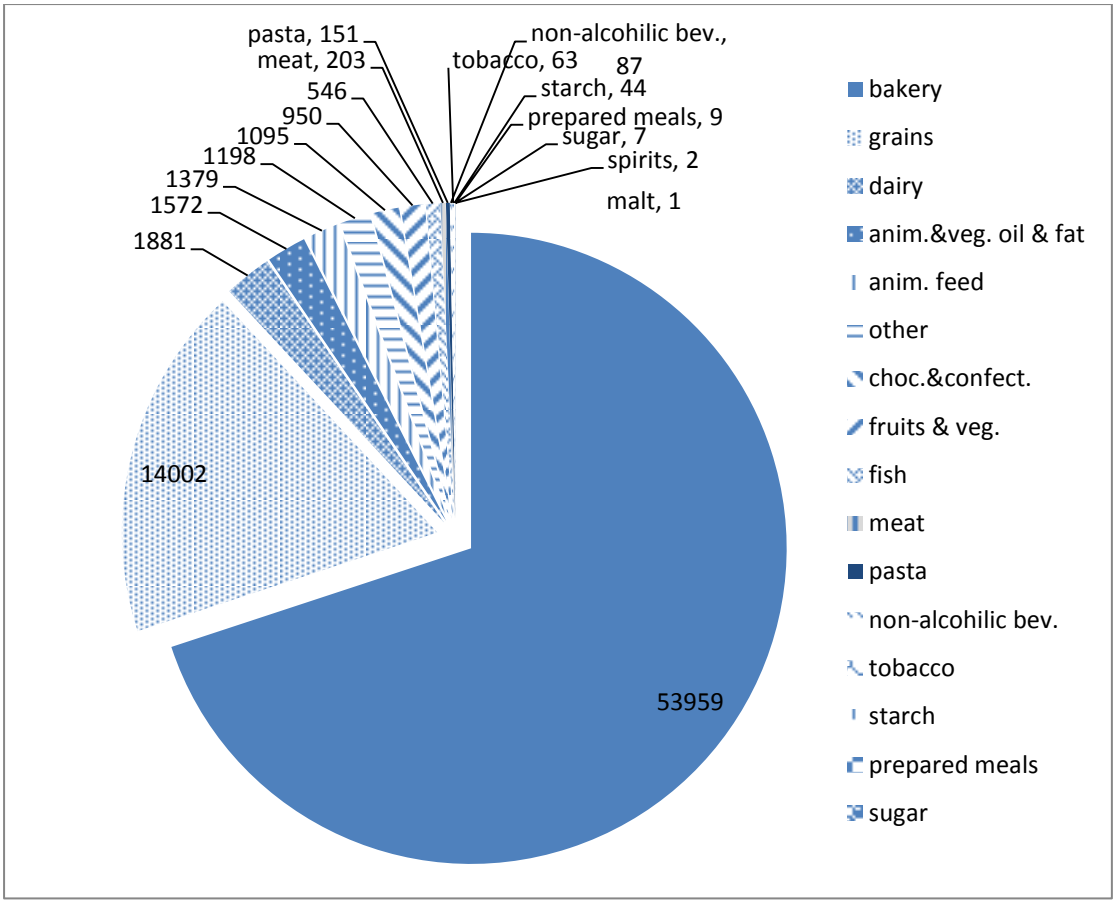

Figure (1): Number of establishments per subsector

Source: CAPMAS, 2014[2]

As presented in Figure (1), the manufacture of bakery, grain mill products, dairy products, animal & vegetable oil & fat and animal feed constitute the five major industries in terms of number of establishments.

Figure (2) below further elaborates the size of each subsector in terms of number of establishments and number of labor working as a percentage of the total number of establishments and total labor of the whole FMI.

2

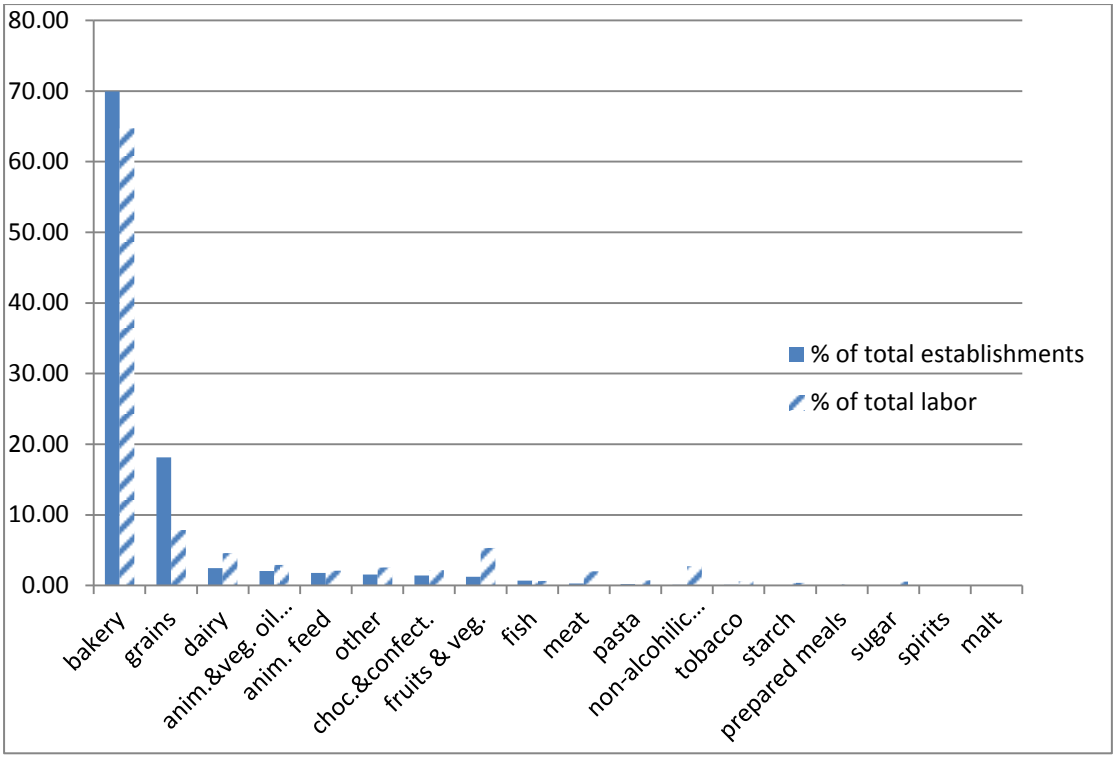

Figure (2): Percentage of total establishments and total labor of the FMI per each subsector.

Source: CAPMAS, 2014 [3]

It is clear how the manufacture of bakery products dominates the FMI, followed by the manufacture of grains in terms of both labor and establishments. It is also remarkable that the percentage of labor employed in the two subsectors of fruits & vegetables and non-alcoholic beverages is much higher than the percentage of their establishments. It is yet too early to draw inferences.

2.2 Contribution to the Egyptian Economy

The Egyptian FMI has one of the highest production values of any industrial sector in Egypt comprising 5% of the country's GDP valued at LE 108 billion ($13.5 billion) in 2014[4], employing more than 570 thousand employees[5]. "In calendar year 2017 (January-December) the food processing and manufacturing sectors generated $22.2 billion in sales". More than $8 billion of these sales come from the larger companies, while smaller companies' sales

[3] Distribution of establishments in the private sector according to economic activity and categories of workers - Economic census in 2014

[4] https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Food%20Processing%20Ingredients_Cairo_Egypt_11-9-2015.pdf

[5] CAPMAS 2014

might be considerably understated[6], meaning that sales volumes can be higher in reality.

2.3 Age of Establishments

The age of Food, Beverages and Tobacco enterprises might represent a major factor affecting the targeting process for the energy efficiency in this sector. Figure (3) shows the percentage of enterprises established per ten years period.

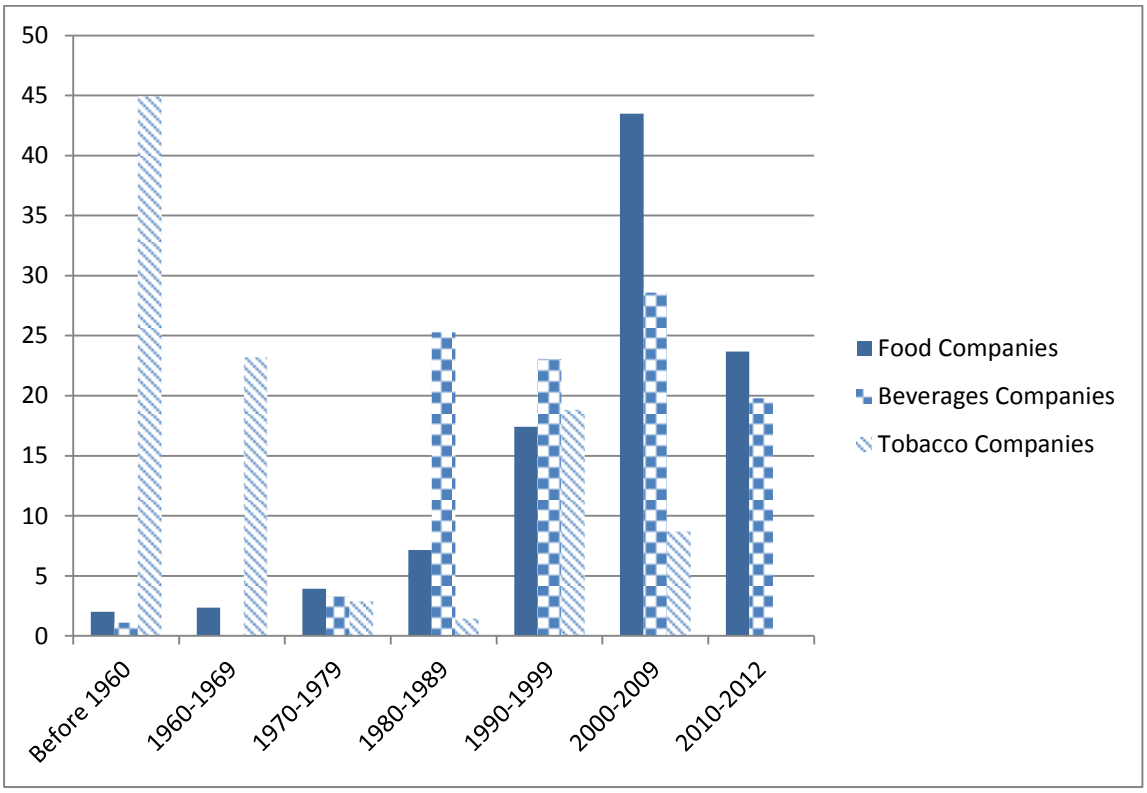

Figure (3): Percentage of Enterprises Per Year of Establishment

Source: CAPMAS, 2014 [7]

The figure shows that the food sector has massively grown with about 67% (51,849 establishments) being established in the period from 2000 to 2012. Also half of the current beverage companies (44 companies) were established during the same period. Tobacco, however, did not witness much growth since the 90's with only 9% of the total tobacco companies (6 companies) being established between 2000 and 2009 and none afterwards.

While this indicates that most establishments are considered relatively new, technologies used in production cannot be assessed whether they are modern or obsolete technologies.

[6]https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Egypt%E2%80%99s%20Largest%20Food%20Companies%20by%20Sales_Cairo_Egypt_2-14-2018.pdf
[7] CAPMAS, 2014. Age of Establishments for Manufacturing Industries, 2014.

2.4 Size Distribution

As highlighted in the IEESP Report, the Egyptian industry is highly polarized in terms of size. The concept of small and medium-sized enterprises differs from a country to another according to their specific economic and social conditions. The definition also varies according to its purpose; the criteria of defining the projects could be the labour, capital equity, added value, etc.

In this report, the main criteria suitable for categorizing the different projects is the number of employees, as this is the information mostly available and periodically published. A survey is made to the different definitions of local and international organizations as shown in the Table (1).

Table (1): Enterprise categorization according to number of employees

Organization		Category according to number of employees
Local Authorities		
1	Law 141 / 2004 concerning the development of small enterprises[8]	Small: < 50
2	Egyptian Central Bank decree, dated 3 December 2015	Micro: < 10 Small and Medium: up to 200
3	Ministry of Foreign Trade [9]	Micro: <5 Small: 5-49 Medium: 50-99
4	Small, Medium and Small Enterprises Development Agency[9]	Micro: <5 Small: 5-49 Medium: 50-99
5	Ministry of Industry[9]	Small and Medium: 10-100
6	Federation of Industries[9]	Small and Medium: < 100
7	Ministry of Administrative Development[9]	Small: < 20
8	Ministry of Local Development[9] Law 110/19975	Craft projects: > 9
9	Central Agency for Public Mobilization and Statistics[9]	Small and Medium: 50 - 100
10	National Planning Institute[9]	Small and Medium: 10-49
International Organizations		
1	International Labor Organization	Micro: 1–9 Small: 10–99 Medium: 100–249
2	World bank / IFC	Micro: 1–9 Small: 10–49

[8] The draft Law for the development of small, medium and small enterprises is currently being prepared by the Ministry of Commerce and Industry and it was sent to the Council of Ministers for approval, this will cancel Law 141/2004.
[9] ICFS. (2006). A clear definition of small enterprises. Cairo: International Center for Future and Strategic Studies.

Organization		Category according to number of employees
		Medium: 50–249
3	European Union	Micro: 1–9 Small: 10–49 Medium: 50–249

This report based its size distribution on the categorization most agreed which incidentalkly also fits best the Egyptian context and laws. Accordingly, and as Table (1) illustrates, ***Micro enterprises*** are ones that have less than 10 employees based on the Egyptian central bank decree, dated 3 December 2015, the International Labor Organization[10], World bank / IFC[11] and the European Union[12]. There is also a large consensus regarding ***Small enterprises according to*** Law 141 / 2004, IFC and the European Union are categorized as projects with employees not exceeding 50. Regarding ***Medium enterprises*** and apart from the fact that the Egyptian Labor Law number 12 / 2003 have higher requirements for organizations having more than 50 workers (which indicates the importance of this number to define its categorization of enterprises), most of the resources listed above in the table define them as those enterprises employing more than 50 employees.

Due to variation regarding the maximum number of employees for an enterprise to be considered as medium, this report categorizes enterprises exceeding 100 employees as ***Medium to Large enterprises***. Moreover, this is the case since the categories of data published by CAPMAS for the census 2015 (providing fundamental data for this report) are not clustered above 100 employees. On that basis the size distribution followed in this report is categorized as follows:

- Micro enterprises: 1-9 workers
- Small enterprises: 10-49 workers
- Medium enterprises: 50-100 workers
- Medium to Large enterprises: 100+ workers

Accordingly, table (2) below shows the size distribution of the FMI sector:

[10] Small and medium-sized enterprises and decent and productive employment creation report, International Labor Conference, 104th Session, 2015
[11] IFC, MSME Country Indicators, 2010
[12] Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises

Table (2): Subsectors' enterprises sizes in terms of number of labor

Class #	Subsector	No. of employees	No. of establishments	Total Labor
	Food Sector			
1010	Processing and preserving of meat	1-9	129	507
		10-49	50	767
		50-99	5	326
		100+	18	9934
		Total	**203**	**11535**
1020	Processing and preserving of fish, crustaceans and molluscs	1-9	460	1130
		10-49	82	1845
		50-99	2	132
		100+	2	507
		Total	**546**	**3614**
1030	Processing and preserving of fruit and vegetables	1-9	698	2830
		10-49	182	2961
		50-99	28	1856
		100+	42	22935
		Total	**950**	**30581**
1040	Manufacture of vegetable and animal oils and fats	1-9	1523	4573
		10-49	14	284
		50-99	22	1697
		100+	14	10275
		Total	**1572**	**16829**
1050	Manufacture of dairy products	1-9	1644	5019
		10-49	203	3988
		50-99	7	525
		100+	27	16930
		Total	**1881**	**26461**
1061	Manufacture of grain mill products	1-9	13710	29225
		10-49	188	3820
		50-99	67	4642
		100+	37	7595
		Total	**14002**	**45282**
1062	Manufacture of starches and starch products	1-9	38	54
		10-49	1	35
		50-99	3	291
		100+	2	1695
		Total	**44**	**2075**
1071	Manufacture of bakery products	1-9	45400	244870
		10-49	8481	102162
		50-99	39	2596
		100+	39	24084
		Total	**53959**	**373713**

Class #	Subsector	No. of employees	No. of establishments	Total Labor
1072	Manufacture of sugar	10-49	5	63
		100+	2	3141
		Total	7	3204
1073	Manufacture of cocoa, chocolate and sugar confectionery	1-9	950	4399
		10-49	125	2262
		50-99	8	593
		100+	12	5418
		Total	1095	12671
1074	Manufacture of macaroni, noodles, couscous and similar farinaceous products	1-9	68	369
		10-49	69	1523
		50-99	9	554
		100+	5	1708
		Total	151	4155
1080	Manufacture of prepared animal feeds	1-9	1257	3740
		10-49	95	2399
		50-99	13	964
		100+	14	5010
		Total	1379	12114
	Beverages Sector			
1101	Distilling, rectifying and blending of spirits and production of ethyl alcohol	1-9	1	2
		10-49	1	37
		Total	2	39
1103	Manufacture of malt liquors and malt	100+	1	330
		Total	1	330
1104	Manufacture of soft drinks; production of mineral waters and other bottled waters	1-9	69	357
		10-49	7	215
		50-99	1	60
		100+	10	15200
		Total	87	15831
	Tobacco Sector			
1200	Manufacture of Tobacco	1-9	18	148
		10-49	38	664
		50-99	2	141
		100+	4	2524
		Total	63	3477

Source: CAPMAS, 2014[13]

[13] Distribution of establishments in the private sector according to economic activity and categories of workers - Economic census in 2014

Subsectors like the manufacture of bakery products and manufacture of grain mill products consist of large numbers of micro establishments. In addition, the manufacture of bakery also largely consists of small enterprises. On the other hand the manufacture of sugar is dominated by large factories. Regarding the manufacture of macaroni, noodles, couscous and similar farinaceous products, it is largely led by medium-sized enterprises and the Manufacture of vegetable and animal oils and fats is dominated in number of establishments by micro & small enterprises,

Subsectors like the manufacture of soft drinks and mineral water, manufacture of starch and its products, manufacture of dairy products, and processing and preserving of fruits and vegetables, although have high percentages of micro, small and medium enterprises, the large enterprises in these subsectors are responsible for the employment of a significantly larger portion of the labor in their respective subsectors. Processing and preserving of fish, crustaceans and molluscs is led by small and medium enterprises.

Each size category of enterprise operates differently on many levels including the legal structure, financial mode and capabilities, administrative and organizational structure, business capacity, the targeted and potential markets, human resources skills among many others. Understanding where each subsector falls and the nature of these sub-industries is very important to strategy formulation.

2.5 Geographical Distribution

Figure (4) below shows which governorates have highest FMI activities according to the CAPMAS census of 2015. Cairo is on top, housing 28.9% of FMI activities, followed by Al-Sharqiya, Giza, Alexandria, Al-Qalyobia and Al-Menoufeya accounting for 14.7%, 11.4%, 9.1%, 8.8% and 5.1% respectively.

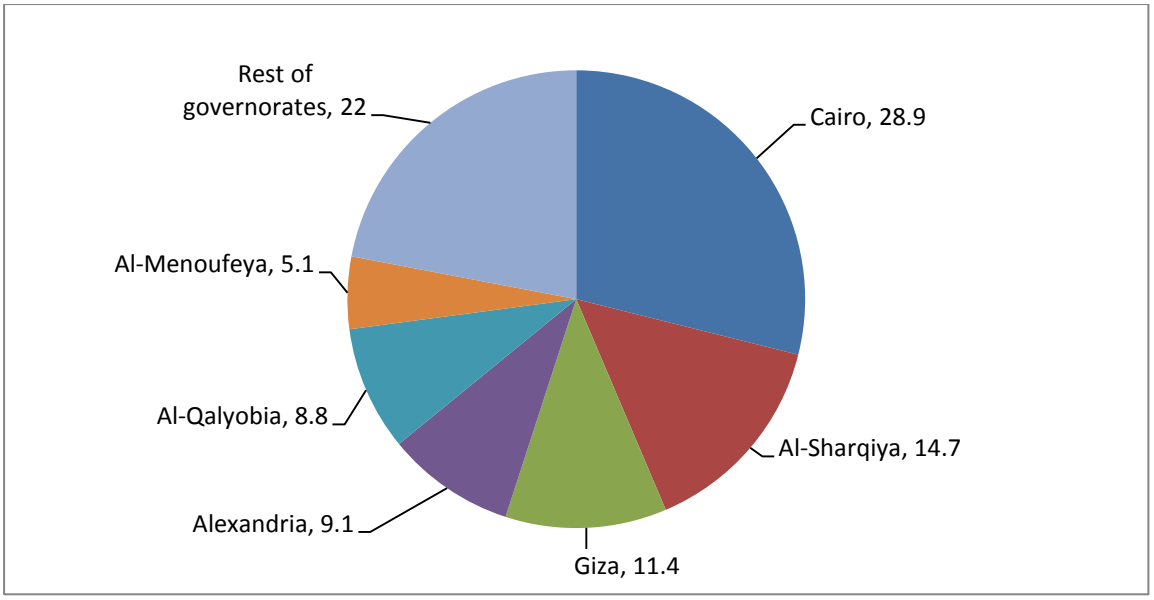

Figure (4): Percentage of FMI activities distributed according to the most productive governorates for the year 2015

Source: CAPMAS, 2017[14]

Looking at the geographic distribution from the angle of electricity consumption, Table (3) below shows the geographic and electricity consumption percentage by food, beverage and tobacco sectors across the governorates for the year 2014-2015.

[14] CAPMAS, Annual Bulletin of Industrial Production Statistics in Private Sector Establishments, 2017

Table (3) Percentages of electricity consumption in food, beverage and tobacco sectors across governorates

Governorate	Food	Beverage	Tobacco
Cairo	3.37	10.10	0.43
Alexandria	16.20	20.68	8.04
Port Said	0.47	1.58	0
Suez	2.86	0.10	0
Damietta	0.82	0	0.01
Al-Daqahleya	3.79	8.81	0.22
Al-Sharqiya	14.76	4.14	0.17
Al-Qalyobia	7.67	19.12	0.08
Kafr El-Sheikh	2.07	0.26	0
Al-Gharbiya	3.53	10.21	0
Al Menoufeya	8.75	2.83	3.47
Al Beheira	10.35	3.83	0
Ismailia	0.97	0	0
Giza	13.06	13.87	86.93
Bani-Suef	2.02	0.33	0
Fayoum	0.56	0	0
Al-Minya	1.21	0	0
Assyout	1.28	0.13	0.65
Sohag	2.60	0.41	0
Qena	1.66	0.04	0
Aswan	1.46	0.3	0
Luxor	0.24	0.01	0
Red Sea	0.09	0	0
New Valley	0.05	0	0
Matrouh	0.10	3.24	0
North Sinai	0.08	0	0
South Sinai	0	0	0
Total	100	100	100

Source: CAPMAS, 2014-2015.[15].

Out of the 28 governorates, FMI companies in terms of electricity consumption are concentrated in 9 governorates including: Cairo, Alexandria, Giza, Al-Daqahleya, Al-Sharqiya, Al-Qalyobia, Al-Gharbiya, Al-Menoufeya and Al-Beheira. This reaffirms the concentration of FMI companies in the 6 previously stated governorates (Cairo, Giza, Alexandria, Al-Menoufeya, Al-

[15] Electricity Consumption of Manufacturing Industries, annual report: http://egyptera.org/Downloads/reports/%D8%AA%D9%82%D8%B1%D9%8A%D8%B1%20%D8%A7%D9%84%D8%B5%D9%86%D8%A7%D8%B9%D8%A9%2014-15.pdf

Sharqiya, Al-Qalyobia), in addition to highlighting that three other governorates (Al-Daqahleya, Al-Gharbiya, and Al-Beheira) have a considerable share of activity in the sector.

Highest percentage of electricity consumption used in the food companies is allocated across Alexandria, Giza, Al-Sharqiya and Al-Beheira. Highest percentage of electricity consumption used in beverage companies is found in Cairo, Alexandria, Al-Qalyobia and Giza. Regarding the manufacturing of Tobacco, the highest percentage of electricity consumption used is in Giza mainly and followed by Alexandria.

3. FMI Growth

The FMI had an average annual growth rate of 8% between 1991 and 2001. In recent years, the processed food sector has attracted many investments[16]; currently and in the period between 2011 and 2016 the sector averaged an annual growth rate of almost 15 percent. This is mainly due to the increased domestic consumption and exports. Domestic food consumption increased from $32 billion (EGP 180 billion at EGP 5.56 to $1.00) in 2008 to nearly $45 billion (EGP 800 billion at EGP 17.84 to $1.00) in 2017[17].

Moreover, more recent growth rate is due to the recent import restrictions enforced by the government along with the currency floatation; domestic companies decided to invest in brand development and expansion to replace imports with Egyptian options as well as foreign companies expanding in Egypt. For example, foreign giant companies such as Ülker from Turkey "started to place emphasis and gained substantial market share by expanding their factory in Egypt and obtaining a leading position"[18].

[16] https://www.globaltrade.net/f/market-research/text/Egypt/Processing-of-Food-and-Agricultural-Products-An-Overview-of-the-Food-Market-in-Egypt.html
[17] http://agriexchange.apeda.gov.in/MarketReport/Reports/Food_Processing_Ingredients_Cairo_Egypt_12-26-2017.pdf
[18] http://capedecision.com/onewebmedia/2015%2003%2003%20Egyptian%20Packaging.pdf

4. Exports

4.1 Export Orientation

Manufactured food exports comprised one of the top five export products which accounted for 80% of Egypt's manufactured exports in the average period 1980- 2008. The manufactured food exports grew slowly from the 1980s, but witnessed doubling of the exports value between 2001 and 2008, from US$414 million to US$1.054 billion. Success in that period is attributed to the country's partnership agreements with the European Union as well as government assistance and private-sector expertise that managed to upgrade the production of some goods such as frozen vegetables, dairy products, juices, herbs and spices, and confectionery[19].

Egypt's total exports of processed and manufactured foods are worth $2.6 billion as of November 2017. As Egypt enjoys an import duty exemption on processed and manufactured food products in nearly all of the Arab and African export destinations combined with taking advantage of its strategic location in the region, almost half of its exports ($1.1 billion) go to Arab countries including Saudi Arabia ($289 million), Libya ($144 million), and Jordan ($123 million).[20] Among these exports were edible oils ($397 million), processed cheese ($152 million), and sugar and confectionary ($143 million)[21].

Total exports of the food and agricultural products to the US were worth $115 million in 2016. In addition exports to US in 2017 were dominated by processed fruit and vegetables, spices, essential oils and herbs[22].

Despite the increase in exports value, Egypt's share in the international market remains the same which is less than 0.5%.[23]. Many reasons exist behind Egypt's weak competitiveness in the international market include the lack of proper post–agriculture facilities, market needs and requirements, as well as market information and quality standards systems[24].

Figure (5) below demonstrates the FMI exports value although doubled comparing 2008 to 2015, it has not witnessed any significant movements since 2010.

[19] http://www.usc.es/econo met/journals1/aeid/aeid11110.pdf
[20] http://agriexchange.apeda.gov.in/MarketReport/Reports/Food_Processing_Ingredients_Cairo_Egypt_12-26-2017.pdf
[21] http://agriexchange.apeda.gov.in/MarketReport/Reports/Food_Processing_Ingredients_Cairo_Egypt_12-26-2017.pdf
[22] https://www.export.gov/article?id=Egypt-Agricultural-Sectors
[23] http://www.eces.org.eg/MediaFiles/Uploaded_Files/61743e47.pdf
[24] http://www.usc.es/econo met/journals1/aeid/aeid11110.pdf

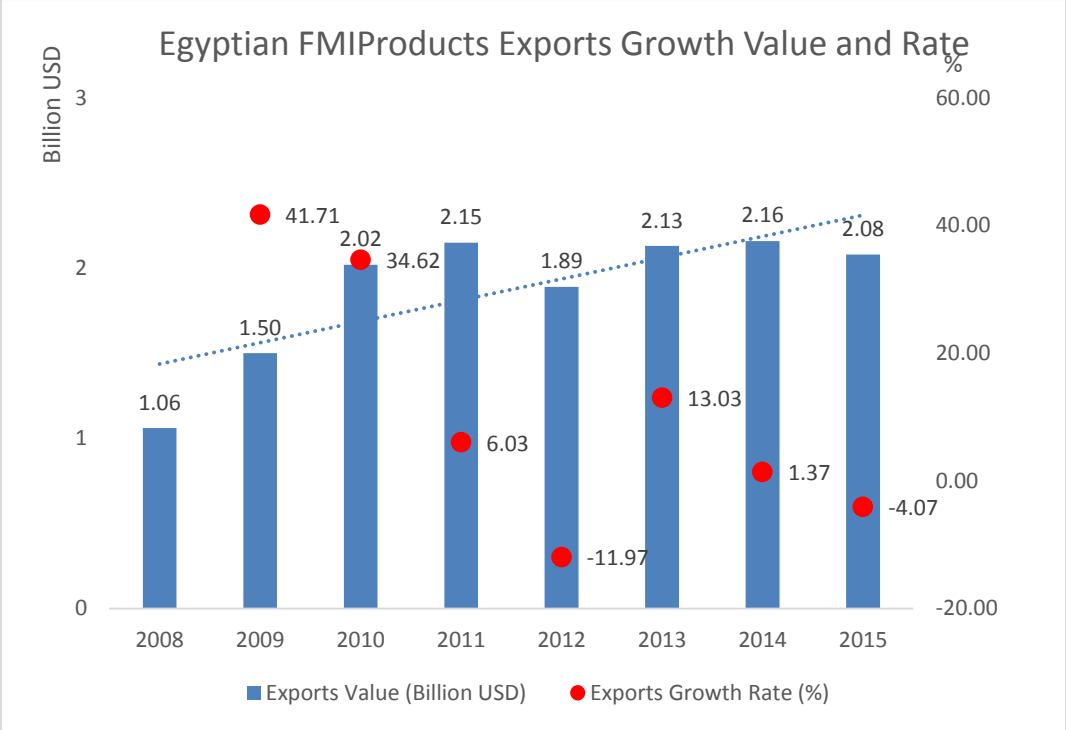

Figure (5): Egyptian Food Products Exports Growth Value and Rate

Source: ECES, 2016[25]

To understand which facilities and which subsectors are involved in exporting, Figure (6) below shows how many facilities in each subsector export and the percentage of these facilities from the whole subsector.

The graph shows the following:

- The total number of exporting facilities are 154 establishments.
- Subsector of processing and preserving fruits and vegetables have the highest number of factories (89 establishments) involved in exporting and also representing 9.3% of the subsector.
- The one Malt manufacturer and another one of the two Spirits manufacturers that exist are involved in exports
- Only one factory in the manufacture of sugar out of the 7 sugar factories exports.
- There are a total of 14 and 11 facilities that export bakery and dairy products respectively which constitute the second and third places in terms of number of facilities involved in exporting in FMI.
- The manufacture of Tobacco is relatively remarkable as an exporter with 7 exporting facilities (10%) out of 63

[25] http://www.eces.org.eg/MediaFiles/Uploaded_Files/61743e47.pdf

- The rest of the subsectors have both insignificant percentages and number from the exporting perspective.

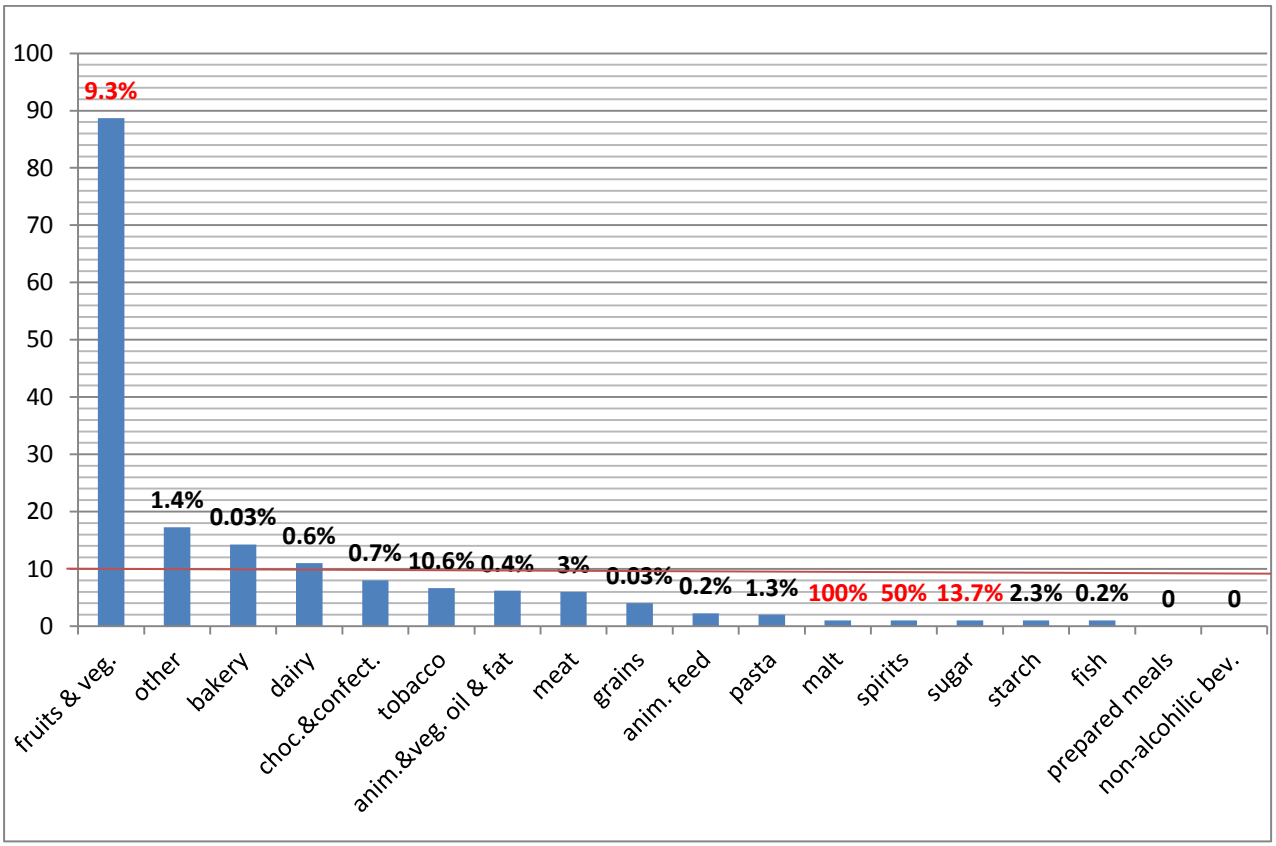

Figure (6): Number & percentages of exporting facilities

Source: CAPMAS, 2014[26]

The following figure (7) shows the size distribution of the exporting facilities in FMI, highlighting that exporting facilities are largely characterized by being medium and large enterprises except for processing and preserving fruits & vegetables (which accounts for the majority of exporting facilities) is dominated by small enterprises.

[26] Distribution of establishments in the private sector according to economic activity and categories of workers - Economic census in 2014

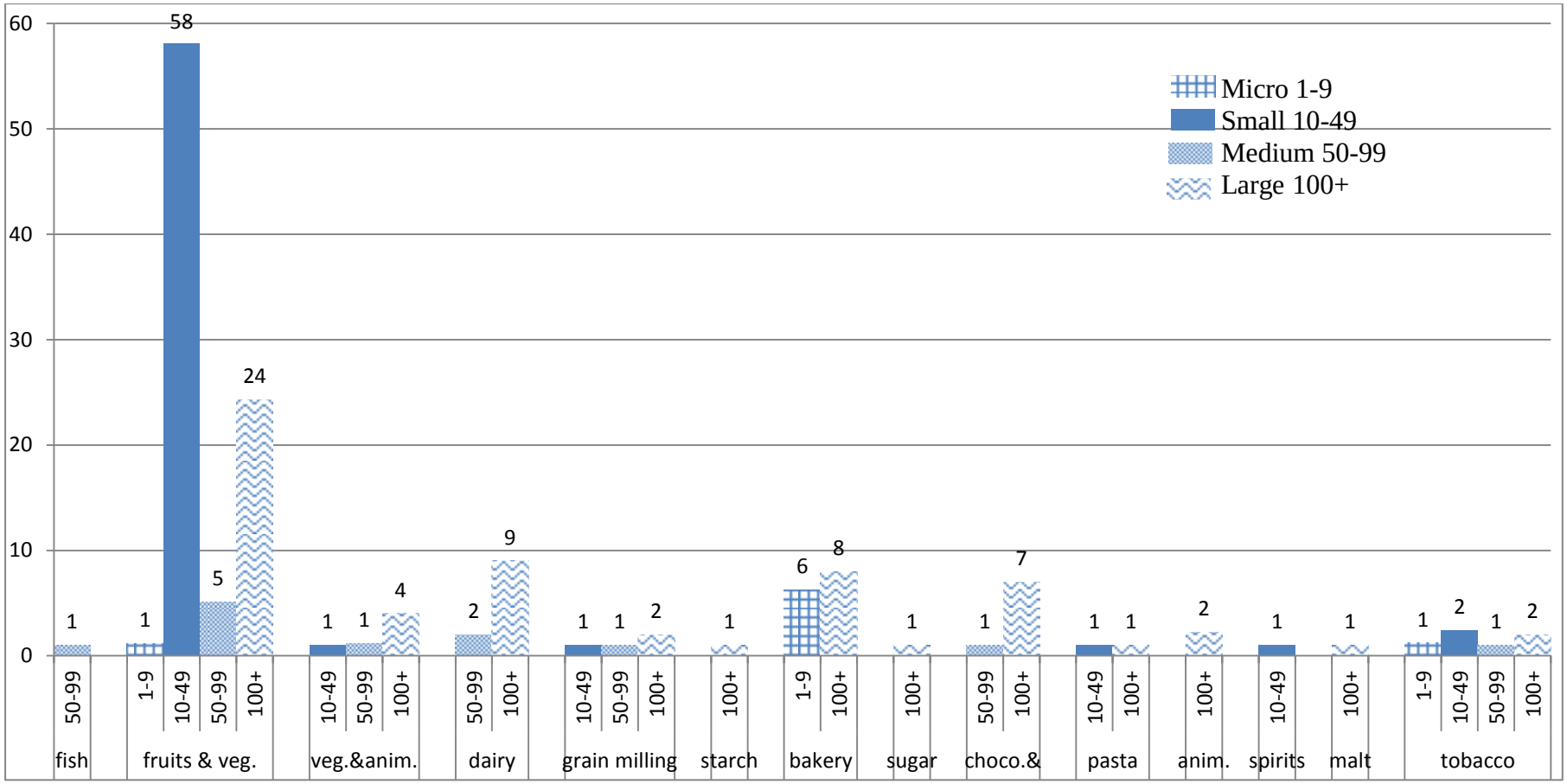

Figure (7): Size distribution of FMI exporting facilities / Source: CAPMAS,2014[27]

[27] Distribution of establishments in the private sector according to economic activity and categories of workers - Economic census in 2014

Figure (8) below shows exactly which products according to the year 2013-2014 have highest export values in the FMI.

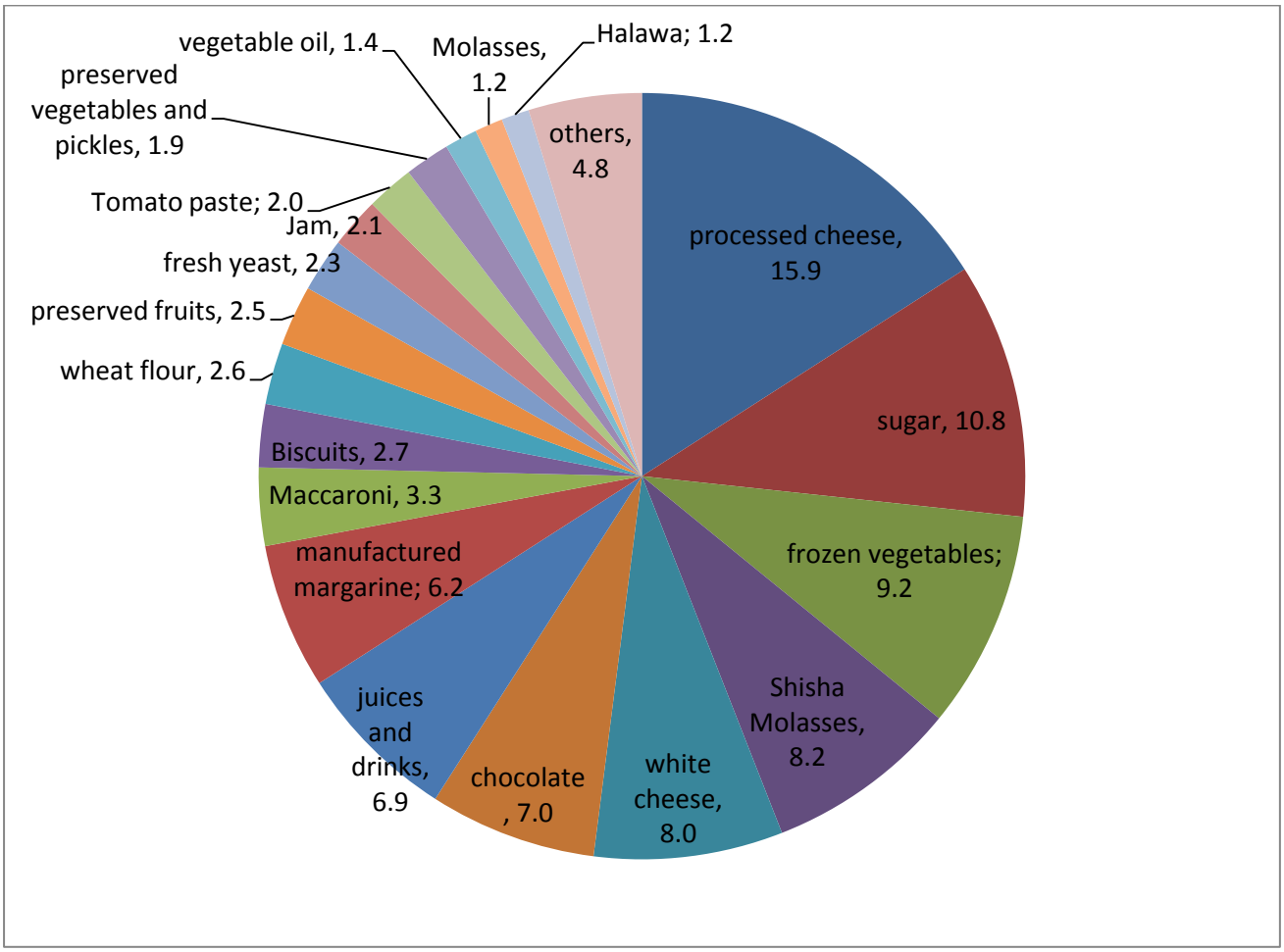

Figure (8): Percentage of exports from total food exports of most important products for the year 2013-2014

Source: CAPMAS 2016[28]

Figure (8) shows that processed cheese is on top of the food exports in Egypt, dominating by 15.9% of all food exports in terms of value of money, followed by sugar, frozen vegetables, shisha molasses and white cheese.

As processed cheese and white cheese together account for approximately 24% of all food exports which are represented under dairy manufacturing companies, this subsector can be considered as highly important from an exporting point of view. It also ranks as the fourth source for exporting in FMI (in terms of number of establishments).

Frozen vegetables along with preserved fruits, tomato salsa and preserved vegetables and pickles account for 15.6 % from total food exports in addition

[28] CAPMAS, 2016. The Annual Bulletin of the Movement of Production and Foreign Trade and Availability for Consumption of the Most Important Industrial Goods for 2013-2014.

to juices (respective percentage is not added as percentage relates to other drinks outside the category), which also makes the subsector of processing and preserving fruits and vegetables another key subsector from an exporting angle.

Although the manufacture of sugar is only comprised of only one exporting facility, its value of export is significantly high representing more than 10% of the total exported food products in Egypt.

In the manufacture of tobacco and despite that there are only 7 exporting facilities in this subsector, export of shisha molasses comes in as the 4th highest export product in terms of value of money which makes it a key export product.

Conclusion:

The most important subsectors from an exporting point of view based on (1) percentage of food exports value, (2) number of exporting facilities and (3) percentage of export facilities from the total number of companies per each subsector are:

- The manufacture of fruits and vegetables: has the second highest rate in terms of export value and the high rates in number of facilities which also represents highest percentage from the total subsector facilities
- The manufacture of dairy products has the highest rate of exports value and comprises a relatively considerable number of exporting facilities (third largest number although constitutes a very low percentage from the whole subsector size)
- Although the manufacture of sugar and manufacture of tobacco are limited to a few facilities , they are responsible for a high a value of FMI exports as well as form a relatively high percentage from the total exporting facilities (in terms of number of establishments).
- Despite that the manufacture of bakery products' contribution to the total value of exported products is relatively low accounting for 2.7%, it rates as the second largest subsector in terms of number of exporting facilities.

4.2 European FMI export requirements

The most important aspects of legislative requirements based on the General Food Law by EU as relevant for exporters from developing countries include (1) control of food imported to the European Union and (2) contaminants.[29] This implies the importance of food safety as a prime concern when it comes to importing food.

[29] https://www.cbi.eu/market-information/processed-fruit-vegetables-edible-nuts/buyer-requirements/

Exporting food generally requires a long list of requirements to adhere to that are typically concerned with product quality, safety, packaging and labeling. Other requirements include: Traceability, compliance and responsibility in food and feed that go beyond the products' specifications and rather addresses the origins and processes involved in the production of the products[30].

European importers will not deal with a supplier/exporter that cannot provide some proof of food safety certification as the basis for cooperation. The majority of European buyers will ask for Global Food Safety Initiative (GFSI) certification. For fruit and vegetable processors and traders, the most popular certification programs are: International Featured Standard (IFS); British Retail Consortium Global Standard for Food Safety (BRC); Safe Quality Food Program (SQF); Food Safety System Certification (FSSC 22000). Majority of food safety certification programs are based on existing ISO standards such as ISO 22000[31].

Beyond food safety, various certifications exist that are mainly concerned with the social responsibility towards the farmers and many exist under each subsector of the FMI including:

- Sedex: a general non-profit membership organization to evaluate and manage performance around labor rights, health & safety, the environment and business ethics. Sedex provides different names of certifications for different focuses.
- SGF certification: covers not only food safety but also product quality and Corporate Social Responsibility (CSR) principles

In the next several years, the strongest impact of sustainable initiatives is expected in the juices subsector. Leading European beverage and food companies have formed a coalition aiming for 100% sustainable juice and puree by 2030. With the support of the European Fruit Juice Association, they will work on the certification/verification of their supply chains and address specific sustainability issues such as smallholder inclusion, working conditions, soil erosion and degradation, and climate resilience[32].

It can be drawn from a quick survey that big chains and supermarkets have their own certifications and standards that exporters have to comply with. For example, Marks & Spencer's Field to Fork makes sure of food quality provided to them and only certified suppliers are allowed to cooperate. Another example is Tesco, a major food retailer in UK which as well as

[30] https://www.food.gov.uk/business-guidance/general-food-law
[31] https://www.cbi.eu/market-information/processed-fruit-vegetables-edible-nuts/buyer-requirements/
[32] Ibid

applies a program named "Nature's Choice" to ensure that fruit, vegetables and salad are grown to high safety, quality and environmental standards[33].

4.3 The State of Environmental Export Requirements in the Egyptian Export Market

While UK and Europe do not make it to the top on Egypt's export destinations for food, yet the nature of their markets offer the highest potential for energy efficiency requirements considering that they have the highest environmental standards to other countries importing from Egypt.

Accordingly data in this section is based on interviews with exporters in the field in order to retain relevant information. A total of three phone interviews were done with: Product manager in an ISO certification company, owner of a major fruit and vegetable exporter to UK and Europe and a general manager of a large manufacturer and exporter of frozen potatoes.

In general and as stated by the product manager in an ISO certification company and confirmed by the two exporters, the most important certifications obtained in Egypt in order to export food products to most countries that are concerned with quality and safety of food products are HACCP (Hazardous Analysis Critical Control Point), ISO 22000, GLOBAL G.A.P.S (Good Agricultural Practices), British Retail Consortium (BRC) and ISO 9001. These certifications relate to:

1. **HACCP:** this certificate addresses food safety through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product[34]. Required by **US** exporters as well as having to register at the Food and Drugs Association (FDA).
2. **ISO 22000:** International Standards addresses food safety management[35].
3. **GLOBAL GAPS:** Certification that concerned with enforcing best agricultural methods for the production of hygienically safe products for human consumption. Most commonly required by EU countries
4. **BRC:** Global Standard for Food Safety (BRC). Mainly required by UK.
5. **ISO 9001:** addresses various aspects of quality management to ensure that their products and services consistently meet customer's requirements, and that quality is consistently improved[36].
6. **ISO 45001:** Occupational health and safety management systems - to improve employee safety, reduce workplace risks and create better, safer working conditions, all over the world[37].

[33] https://www.tesco.ie/crreview08/downloads/tesco_suppliers_and_ethical_trading.pdf
[34] https://www.fda.gov/Food/GuidanceRegulation/HACCP/
[35] https://www.iso.org/iso-22000-food-safety-management.html
[36] https://www.iso.org/iso-9001-quality-management.html
[37] https://www.iso.org/iso-45001-occupational-health-and-safety.html

The first four certifications are concerned as described with the quality of food and its safety on human health; concerned with the environment in terms of contamination of soil, water etc., also for guaranteeing food safety and guaranteeing the sustainability of the product quality in the future. Therefore environment is a focal point to guarantee the consistency of quality provided by supplier. Buyers will request one of these four certifications depending on familiarity in the buyer's home country, with HACCP by US customers, GLOBAL GAPS by European buyers, BRC by UK and the entire aforementioned are based on the ISO 22000.

ISO 9001 is not related to the above and required in addition as well as the ISO 45001 concerned with occupational health and safety.

Despite the existence of different certifications that are required by importers from Egyptian exporters, the government of Egypt enforced obtaining a GLOBAL GAPS as a mandatory prerequisite for exporting fresh food in general whether to Europe, Arab countries or others. This was after many fresh food cargos were rejected from importing countries due to residues pesticides and contaminants which led to the enforcement[38]. The Ministries of Agriculture and Trade made any agricultural exports impermissible without obtaining the certificate which sets specific standards regarding cleanliness and traces of pesticides and fertilizers in the exported products[39].

UK is characterized by having the strictest measures even in comparison to Europe. Russia also imports a significant amount of food products however does not enforce any kind of additional measures to the above four mentioned certifications.

Exporting to UK offers a potential for increasing competitiveness through energy efficiency as reported by an exporter to Tesco to require obtaining their "Nature's Choice" which is considered to be "highly sophisticated". However, although "Nature's Choice" claims principles like environmental standards and resource efficiency[40], in reality it audits agricultural practices that guarantee safety and quality of crops. Its interest beyond food safety and quality extend mainly to social accountability issues and responsibility of the supplier to the involved community.

4.4 Conclusion

While there are many certifications required by most importers from Egyptian food suppliers, with Egyptian authorities increasing exports standards, none of the requirements are concerned with the environment in terms of resource efficiency. The nature of FMI and its exports logically create concerns about food safety which entails hygiene of manufacturing process, and best practices in terms of safety and to guarantee consistency of food quality produced (from an agricultural aspect). Social issues are also within the scope of interests due

[38] Environics interview with a major exporter to UK and Europe
[39] https://www.arabfinance.com/en/news/details/egypt-economy/401675
[40] https://www.tesco.ie/crreview08/downloads/tesco_suppliers_and_ethical_trading.pdf

to the global awareness of the importance of labor rights and social accountability. There seems to be no current interest beyond these topics especially that there was no mentioning of ISO 50001 concerned with Energy Management Systems from Egyptian exporters which indicates the low importance of energy efficiency as a prerequisite for exporting in that field. Thus, environmental considerations are not a requirement unless it directly impacts the food safety excluding resource efficiency from their concerns.

5. Energy Considerations

5.1 National Energy Landscape

Three major factors influence the current energy landscape on the national level; costs, regulations and availability. Although energy, whether electricity or fuel, is currently available, the Egyptian society and the Egyptian industry in particular have suffered from serious shortages a few years ago which have been imprinted in the collective memory.

This might have contributed to the acceptance of the current substantial hikes in energy costs, which would be expected on July every year for a number of years ahead. This has undoubtly raised the general interest in energy efficiency. However, the reaction of industries is rather mixed, while some would be interested in energy efficiency, some have moved to cheaper sources of energy, and others have the market power to be able to transfer the burden of higher energy costs to their consumers.

Finally, energy efficiency and resource efficiency in general arenot regulated in Egypt. A single exception is the requirement in the Electricity Law (law 87/2015), which requires that facilties with contracted power of 500kW have a responsible to improve energy efficiency, and specify the responsibilities for those with contracted power of 10MW and above including an energy register to be inspected. A penalty of EGP 50,000 is imposed on non-complying facilities.

5.2 Energy Use in Local FMI

Processing food employs a large number of labor and operates machinery that consumes substantial energy. Energy for industrial purposes is generally used for process and assembly, steam and cogeneration, process heating and cooling, and lighting, heating, and air conditioning for buildings. As such the sources of energy are both electricity and fuel[41].

[41] https://www.eia.gov/outlooks/ieo/pdf/industrial.pdf

The overall industrial consumption of energy accounts to 45% of the total Egyptian energy consumption[42] with the FMI consuming 8% of the total energy consumption in the industrial sector[43].

According to CAPMAS in 2013, all industries consume 24.7% of the total electricity used[44]. Similarly and as reported by the Electricity Regulatory and Consumer Protection Authority, the FMI comes in fourth place in electricity consumption among industries in 2012/2013, consuming 3190.86 million KWh, representing 9.02 % of the total electrical energy used in manufacturing industries, and 2.28 % of the total electrical energy consumed in all purposes in Egypt.

As the number of beverage companies and tobacco companies are significantly less than food companies, their share of electricity consumption from the total industrial consumption represents 0.65% and 0.34% respectively[45] making food as a subsector electrical consumption account for approximately 8% of the total electrical energy used in manufacturing industries.

Regarding fuel consumption, according to CAPMAS 2014, Food sector consumes about 9% from the total fuel consumption by manufacturing industries, while beverage companies and tobacco companies account for 0.2% each from the total fuel consumed in the manufacturing sector[46].

Table (4) below shows the percentages of costs of total energy as well as separately fuel and electricity from the total added value per food, beverage and tobacco industries. Although reliable sources consider the food sector along with beverages and tobacco to be energy-intensive industries[47], it is clear that in relative terms the food sector is the one that could be considered as such.

It is to be noted that prices of energy have witnessed substantial increases since this CAPMAS analysis has been undertaken in 2014. As a result, the actual figures might be different today, however, the comparative analysis is expected to be applicable.

[42] http://ieeegypt.org/for-the-first-time-in-egypt-benchmarking-3-energy-intensive-industries/
[43] https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2016/20171120-iv-aegypten-aly.pdf?__blob=publicationFile&v=2
[44] Statistical Yearbook 2013 – chapter 6 - Industry & Energy
[45] Electricity Regulatory and Consumer Protection Authority, General Administration of the Information and Documentation Center, Annual report 2012/2013
[46] CAPMAS, 2014. Resource Cost Percentages for manufacturing industries for the year 2014.
[47] https://www.eia.gov/outlooks/ieo/pdf/industrial.pdf

Table (4): energy share of the total added value in EGP

Sector	Electricity cost as % of the total added value (approximately)	Fuel cost as % of the total added value (approximately)	Total energy cost as % of the total added value (approximately)
Food	2.31	5.34	7.65
Beverage	0.8	1	1.8
Tobacco	0.2	1	1.2

Source: CAPMAS, 2014 [48]

Figure (9) below shows in details the energy consumption rate as a share of its total added value per each sub-sector (in EGP):

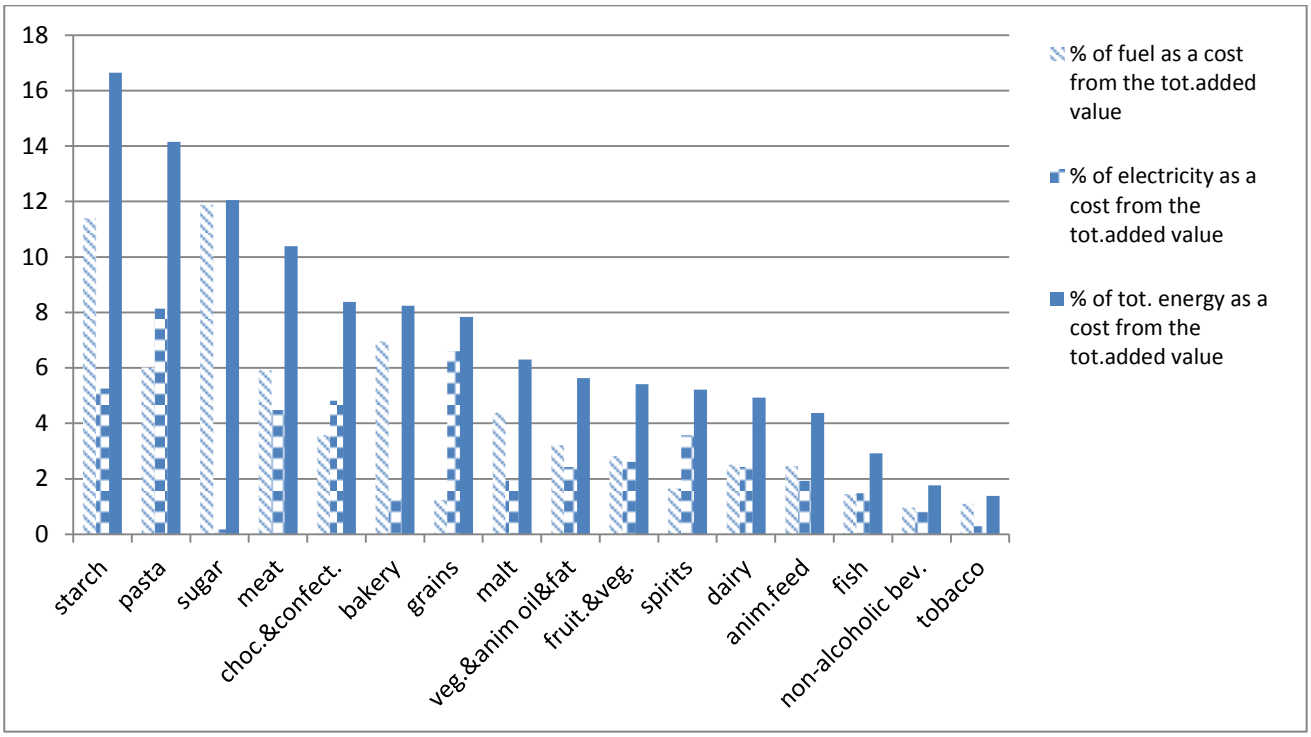

Figure (9): Percentage of energy cost of total added value

Source: CAPMAS, 2014[49]

As seen from the figure, the manufacture of starch and starch products, manufacture of pasta, manufacture of sugar and the processing and preserving of meat consume the highest rates of energy/value added all above 10%.

[48] CAPMAS, 2014. Resource Cost Percentages for manufacturing industries for the year 2014.
[49] Distribution of establishments in the private sector according to economic activity and categories of workers - Economic census in 2014

Figure (10) below shows the energy consumption of each subsector as a percentage in values of EGP from the whole sector's energy consumption (also in values of EGP)

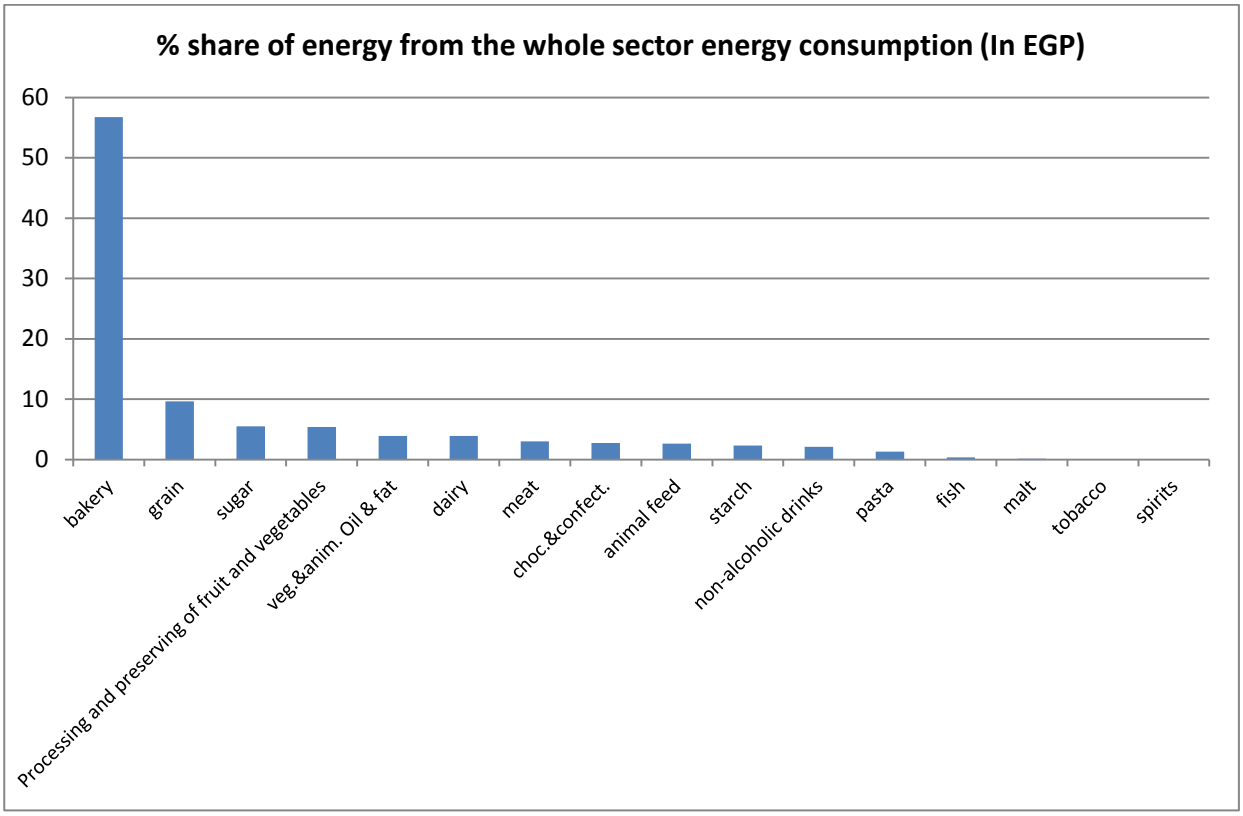

Figure (10): Energy share by each sub-sector from the whole FMI energy consumption

Source: CAPMAS, 2014[50]

As illustrated, the manufacturing of the bakery sub-sector consumes more than half of the energy consumed in the whole sector and consequently if targeted in the right way can help reduce energy consumption remarkably (yet the fact that it is dominated by a large number of micro and small enterprises makes it rather challenging), followed by manufacturing of grain, sugar and processing and preserving fruits and vegetables. As data above shows where energy is mostly consumed, highlighting which subsectors within the Egyptian context can be considered as high potentiality for energy conservation, the following section comprises a matrix to further lay down potential subsectors that can benefit from energy efficiency.

In addition to the FMI's relatively large consumption of energy, its contribution to the economy and the importance to increase its competiveness in the global market make energy efficiency worthy of consideration. In fact, estimates show that that the food sector implementing energy saving measures

[50] Distribution of establishments in the private sector according to economic activity and categories of workers - Economic census in 2014

can reduce energy consumption by 25-60% based on a study of the Egyptian food sector carried out by the FEI[51]. This makes it highly rewarding for the sector to adopt energy efficiency strategies.

Previous case studies showed potential of energy conservation measures on energy consumption reductions. SEAM project implemented by EEAA showcased two successful stories with Edfina Company for preserved food and Kaha Company for preserved food. Initial investments done by both companies were 462,185 EGP and resulted in annual savings of 548,572 EGP. Table 5 (a) & (b) are the saving measures implemented with their rate of savings from each measure:

Energy Savings - Cost Benefits, Edfina

	Mazot Savings (tons/year)	Costs of Works (LE)	Annual Savings (LE)	Payback (months)
Insulation of steam pipes	440	124,212	80,080	19
Replacement of leaking steam traps	111	13,976	20,202	9
Replacement of leaking steam valves	86	46,990	15,652	36
Installation of pressure regulators	294	43,560	53,508	10
Recovery of steam condensate	29	33,182	9,060	44
Improved boiler efficiency	85	0	15,470	0
TOTAL	**1,045**	**261,920**	**193,972**	**17**

Table (5a): energy saving measures - results, SEAM project

Energy Savings - Cost Benefits, Kaha

	Solar Savings (tons/year)	Costs of Works (LE)	Annual Savings (LE)	Payback (months)
Insulation of steam pipes	162	61,946	72,900	10
Replacement of leaking steam traps	71	14,477	31,950	6
Replacement of leaking steam valves	61	38,860	27,450	17
Installation of pressure regulators	343	45,170	154,350	4
Recovery of steam condensate	74	39,812	33,300	15
Improved boiler efficiency	77	0	34,650	0
TOTAL	**788**	**200,265**	**354,600**	**7**

Table (5b): energy saving measures - results, SEAM project

A case studied by SwitchMed (an EU funded program) on several Egyptian companies (working in food, textile and chemicals sectors) showed significant reduction in energy consumption after implementing several energy conservation interventions. Results of the food cases are demonstrated in table (6) below.

[51] https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2016/20171120-iv-aegypten-aly.pdf?__blob=publicationFile&v=2

Table (6): Energy saving rates for 14 food manufacturing companies in Egypt

Food and beverage sector	No. of employees	Investment Euro	Saving Euro / yr.	Avg. PbP yr.	Water % / yr.	Material % / yr.	Energy % / yr.
Arab French Company-SAVENCIA Fromage & Dairy (AFDL Milkana)[1]	250	52,890	93,341	0.6	29 %	0.5 %	24 %
Borg El Arab for Industry[1]	30	80,800	155,744	0.5	90 %	0.2 %	13.9 %
El Dawlya For Juice[2]	220	86,388	111,165	0.8	25.3 %	-	8.8 %
El Magd Company for Food Industry (Sonbola)[1]	24	6,238	12,346	0.5	5 %	0.36 %	43 %
El Marwa for Food Industries[2]	120	333,270	144,204	2.3	52 %	1 %	5 %
El Sakr Company[1]	100	331,958	287,637	1.1	54 %	4 %	14 %
ICAPP Company[1]	750	111,000	61,899	1.8	-	-	32.6 %
Iceman Company[1]	132	260,910	134,398	1.9	76 %	-	42 %
International Company for Agricultural Dev. (Farm Frits)[1]	1200	410,000	769,969	0.5	37 %	-	36.9 %
Misr Cafee Company[2]	1200	341,400	220,573	1.5	1.9 %	-	18 %
NCMP Company[2]	836	221,500	489,762	0.5	46 %	-	21.2 %
Oil Tec for Oils & Detergents[2]	420	1,054,150	923,933	1.1	46 %	-	81 %
Orion for Food Industries[1]	150	291,182	289,449	1.0	66.8 %	1.8 %	27 %
Saudi-Egyptian Company for Salts and Minerals (SecoSalt)[2]	400	7,539,500	1,640,018	4.6	38.5 %	-	73.6 %

(1) Cost savings compared to the production year 2015
(2) Cost savings compared to the production year 2016

Source: MED TEST II – SwitchMed – UNIDO – conference, 2018

In addition to the small sample, results are not generalizable as the sample involves small, medium and large enterprises, yet dominated by large ones and so comparative conclusions cannot be drawn. Despite that, the case study shows a potential of energy saving in all enterprises. Although all companies listed in the table are involved in the FMI, each company's saving rate is significantly different than that of others. Highest energy saving rate is recorded by Oil Tec for Oils and Detergents estimated at 81% and Saudi-Egyptian Company for Salts and Minerals saving 73.6%. Three other companies managed to save between 30% and 45%, another three saved between 20% and 30%. Among the rest of the companies three saved energy ranging between 10% to 20% and only two saved between 5% and 10%.

These energy saving rates illustrated in this case study indicate high reduction on energy consumption resulting from implementing energy saving measures in FMI's different subsectors and in different facility sizes. Across the many energy conservation measures carried out through the 14 FMI companies, the measures taken the most were steam and compressed air systems optimization as well as process modernization which entailed replacement of equipment using updated technologies[52].

[52] MED TEST II – SwitchMed – UNIDO – conference, 2018

5.3 Perceived Value of Energy Efficiency in FMI subsectors

This section aims at highlighting which subsectors in the FMI in Egypt are considered to consume high energy reflecting the reality in the Egyptian context rather than adopting information that might be irrelevant. The below figure (8) shows which sub-sectors represent highest potentiality of interest in adopting energy efficiency measures based on whether (1) energy cost represents a relatively high share from the total added value per each subsector, so there is interest of the facility to save money and/or (2) consume high energy rates in relation to the rest of the subsectors so there is the interest of the state to cut on energy consumption (all subsectors pay the same price for electricity according to decree 157-2018 and same price for fuel under decree 110-2013 except for bakeries where recent increase in fuel prices (affected on 23 June 2018) are borne by the government to keep bread prices fixed[53]).

The X and Y axis represent the percentage of energy share from the whole sector and percentage of energy cost from the total added value respectively. The reference point for the X axis is the average value of the energy consumption in all FMI which is (6.25%). The 6.25% value is considered the "hypothetical zero" in the X axis shown in the figure above in which any value above it will be considered as high energy percentage share and any value below it will be considered as low energy percentage share from the whole sector. With applying the same concept on the Y axis the average value of the percentages of energy cost from the total added value -the "hypothetical Zero"- is (7.23%) in which any value above it will be considered as high energy percentage cost and any value below it will be considered as low energy percentage cost.

The matrix is clustered into 4 categories and allocates subsectors accordingly into:

- A: represents subsectors that have higher potential interest by both the facility and the state to cut down on energy consumption
- B: represents subsectors that have higher potential interest by the facility to cut down on energy consumption (lower interest from the state)
- C: represents subsectors that have higher potential interest by the state to cut down on energy consumption (lower interest from the facility)
- D: represents subsectors that have lower potential interest by both the facility and the state to cut down on energy consumption

[53] https://www.cnbc.com/2018/06/16/reuters-america-update-4-egypt-hikes-fuel-prices-in-imf-backed-austerity-drive.html

Figure (11a) clarifies as to which subsectors energy efficiency measures will be more rewarding. The manufacture of Grain and Bakery represent highest potential of interest as they are high consumers of energy and at the same time, cost of energy represents a relatively high portion of the total added value.

However and since the subsector of manufacture of bakery products' values are relatively high in terms of energy consumption, it hugely impacts the results of the allocation of the rest of the subsectors on the matrix, which gives somehow skewed results. Therefore, the coming figure omits the manufacture of bakery products and analyzes the rest of the subsectors by plotting a new median (hypothetical zero for X-axis equals to 6.67 and for y-axis equals to 7.15) to critically analyze the whole sector.

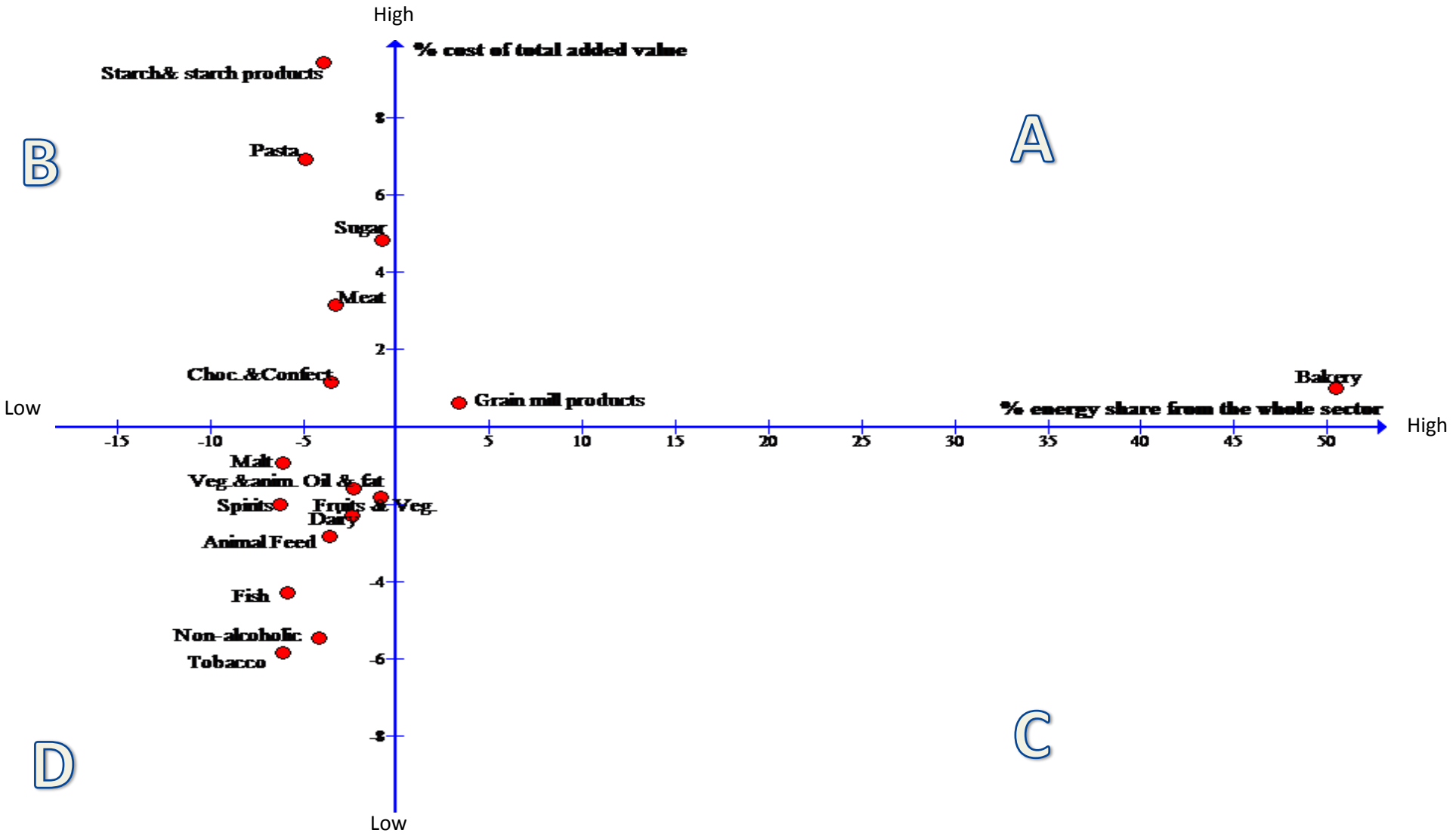

Figure (11a): %of cost of added value Vs. % energy share of the whole sector

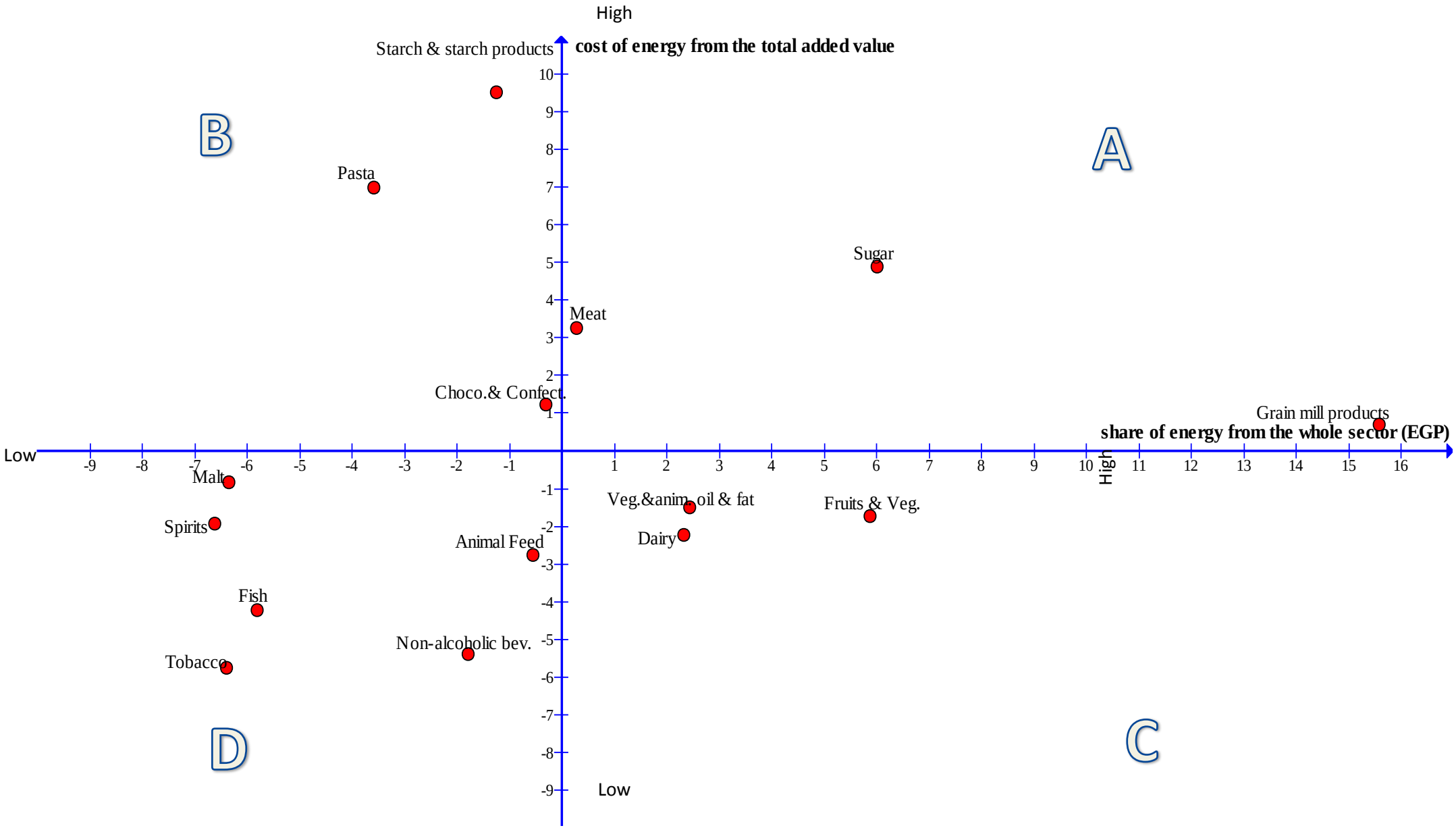

Figure (11b): Energy consuming subsectors without the manufacture of bakery products

There is a clear difference between the Figure (11a) and (11b). Figure (11b) clarifies that the processing of meat industry and the manufacture of sugar are among the subsectors which represent high potentiality of interest by both the government and facilities in relation to other subsectors. The other subsectors of (1) Manufacture of macaroni, noodles, couscous and similar farinaceous products, (2) Manufacture of starches and starch products & (3) Manufacture of cocoa, chocolate and sugar confectionery remain zoned as category B where the cost of energy from the total added value is significant enough for these subsectors to engage in energy efficiency efforts.

Moreover, figure (11b) clarifies which subsectors can be considered of interest by the state including (1) Processing & preserving fruits & Vegetables, (2) Manufacture of vegetable and animal oils and fats and (3) Manufacture of dairy products. Targeting subsectors in that zone is considered to be challenging as they have no interest in saving energy as its cost from the total added value relatively insignificant, yet they consume a proportion from the whole sector's energy use and thus represent a good target group for energy efficiency strategies.

Subsectors in Category D comprised of the remaining six subsectors do not offer great potential of interest by the state nor the facilities as the energy share from the total added value is insignificant and they consume a minor portion from the whole sector's energy use

Interest Potentiality:

Category A:

- Manufacture of Grain and Grain Products
- Manufacture of sugar
- Processing and preserving of meat

Category B:

- Manufacture of macaroni, noodles, couscous and similar farinaceous products
- Manufacture of starches and starch products
- Manufacture of cocoa, chocolate and sugar confectionery

Category C:

- Processing & preserving fruits & Vegetables
- Manufacture of vegetable and animal oils and fats
- Manufacture of dairy products

Therefore, strategies maybe specifically focusing on priority subsectors while it can be more flexible and generic targeting the rest of the subsectors highlighting cost-effectiveness elements of short-term simple energy conservation measures. In order to do that, the next part of the report illustrates the energy-intensive operations in the FMI per each subsector

5.4 Energy-intensive operations in the FMI

In general, the most energy consuming operation units involved in manufacturing food include: sterilization, pasteurization, chilling, freezing, evaporation and dehydration[54]. Steam generation (using boilers), refrigeration, compressed air and electrical power systems are the main medium systems used to process the aforementioned operations. Electricity is mainly used in cooling processes and refrigeration, compressed air as well electrical power systems, while fuel is mainly used for processing heat for steam generation and in the baking industry among others. Table (7) below shows the energy-intensive operations involved in each sub-sector as well as the process used for the respective operations. Moreover it shows the energy source used for each activity.

Table (7): energy sources for each subsector's energy intensive operations

	Subsector	**Energy Intensive Operations**	**Consumption Form**				
			Fuel		**Electricity**		
			Boiler	**Burner**	**Refrigeration & Refrigeration Cycle**	**Air & Gas Compres-sion**	**Motor Systems**
1	Processing and preserving of meat	- Cleaning/ Washing - Rendering - Boiler losses	√				
		- Chilling			√	√	
		- Sterilizing	√				
2	Processing and preserving of fish, crustaceans and molluscs	- Cleaning/ Washing - Precooking - Drying	√				
		- Chilling			√	√	
3	Processing and preserving of fruit and vegetables	- Cleaning	√			√	
		- Washing - Precooking/ cooking - Blanching	√				
		-Chilling			√	√	
		-Peeling -Cutting -Canning -Packaging					√

[54] Wang, L. (2009). Energy efficiency and management in food processing facilities. Boca Raton: CRC Press/Taylor & Francis Group

	Subsector	Energy Intensive Operations	Consumption Form				
			Fuel		Electricity		
			Boiler	Burner	Refrigeration & Refrigeration Cycle	Air & Gas Compres-sion	Motor Systems
4	Manufacture of vegetable and animal oils and fats	- Degumming - Deodorization distillation - Evaporation	√				
		- Dehulling - Oil extraction					√
5	Manufacture of dairy products	- Pasteurization - Sterilization - Evaporation - Concentration	√				
		- Drying		√			
		- Pumping					√
		- Chilling			√	√	
6	Manufacture of starches and starch products	- Steeping - Evaporation	√			√	
		- Drying	√	√			
7	Manufacture of grain mill products	- Milling - Separation and preparation (cleaning, tempering, etc)					√
		- Packing				√	
8	Manufacture of sugar	- Milling - Preparation - Handling					√
		- Evaporation - Concentration - Juice treatment	√				
		- Separation					√
9	Manufacture of bakery products	- Baking	√				
		- Shaping - Cutting - Mixing					√
		- Fermentation and proofing		√			
		- Chilling			√		
		- Washing	√				
10	Manufacture of cocoa, chocolate and sugar confectionery	- Size reduction					√
		- Melting - Roasting - Evaporation	√	√			
		- Tempering	√				√
		- Mixing and shaping					√
		- Chilling				√	

	Subsector	Energy Intensive Operations	Consumption Form				
			Fuel		Electricity		
			Boiler	Burner	Refrigeration & Refrigeration Cycle	Air & Gas Compres-sion	Motor Systems
11	Manufacture of macaroni, noodles, couscous and similar farinaceous products	- Drying	√				
		- Mixing					√
12	Manufacture of prepared animal feeds	- Pelleting - Milling - Mixing					√
		- Conditioning	√				
13	Distilling, rectifying and blending of spirits and production of ethanol	- Boiling - Washing	√				
		- Chilling			√		
		- Pumping - Conveying					√
14	Manufacture of malt liquors and malt	- Boiling and heating	√				
		- Chilling			√		
		- Pumping - Motors - Milling					√
		- Compressing				√	
15	Manufacture of soft drinks; production of mineral waters and other bottled waters	- Washing	√				
		- Chilling			√		
		- Air compression				√	
		- Water filtration/ purification - Pumping					√
16	Manufacture of tobacco	- Drying		√			
		- Pumping					√

Table (7) therefore presents energy intensive operations per each subsector as follows:

Processing and preserving of meat:

Despite having different feed, meat processing for cattle and poultry undergo similar processes. Starting from slaughtering to canning or precooking, meat processing consumes about 80% of its energy as fuel mostly, to produce either steam or hot water that are used for different operations; most significantly rendering, sterilizing ,and cleaning or washing of equipment and cans. Another source of thermal energy consumption is the heat loss from the boiler

that generates steam for the manufacturing process. Electricity is mostly used for the purpose of refrigeration for storing meat; be it pre-processed or processed product.[55]

Processing and preserving of fish, crustaceans and molluscs:
Fish processing involves similar processes to meat processing but has major differences due to its different nature. The major element of energy consumption is the refrigeration required for storing and ice production. Warm water for cleaning and washing, precooking, and drying consume; collectively; a considerable amount of thermal energy in the form of steam.[56]

Processing and preserving of fruit and vegetables:
The process of vegetables and fruits preparation and processing varies according to the desired final product. The product can be frozen packs or cans; and it can be either raw or precooked/cooked. However, all vegetables and fruits have almost the same requirements in general. Washing or cleaning of the received produce shares a considerable amount of the consumed energy since washing is usually done with warm water. In case of can washing, warm water is required before filling the cans. Blanching is one of the processes used to achieve a product suitable for trading purposes. Furthermore, motor system based operations; including mechanical preparation, sizing and canning; consumes a significant amount of energy in the fruit and vegetables processing. The largest energy consumer is, however, the refrigeration step to assure the preservation of both products and raw produce.[57]

Manufacture of vegetable and animal oils and fats:
Whether the sources are vegetal or animal, edible oil processes involve two main phases; extraction and refining. The extraction phase mainly uses mechanical energy with the aid of heat in some cases; while the refining phase uses chemical and thermal treatment of the oil to prepare the oil for consumption.[58]

Manufacture of dairy products:
Dairy industries involve the processing of milk-based products. Products vary in shapes and forms, but having milk as their main direct ingredient. The main energy consuming processes are the heating processes that are required for pasteurization and sterilizing of raw milk and some of the packing materials.

[55] http://www.unep.fr/shared/publications/pdf/2482-cpmeat.pdf (P21,22: Energy Consumption)
https://www.sciencedirect.com/science/article/pii/S0360544205001738?via%3Dihub (P2053: Table 3)
[56] http://www.unep.fr/shared/publications/pdf/2481-cpfish.pdf
https://brage.bibsys.no/xmlui/bitstream/handle/11250/2480564/No_Widell.pdf?sequence=1 (Figure 5)
http://www.enerfish.eu/uploaded/downloads/downloads_5.pdf (Figure 3)
[57] https://www.nyserda.ny.gov/-/media/Files/Publications/Fact-Sheets/Industrial/food-processing-fs.pdf (wxhibit 1)
https://www.sciencedirect.com/science/article/pii/S2210784316300882 (fig. 2 P661)
https://www.energystar.gov/ia/business/industry/Food-Guide.pdf (fig 4.4; table 4.2, 4.4)
[58] http://www.fao.org/docrep/v4700e/V4700E0a.htm
http://www.unep.fr/shared/publications/pdf/2481-cpfish.pdf (P 13)

Other energy consuming processes are the evaporators and concentrators that use thermal energy to vaporize water from the milk emulsion. In case of products that are solid in nature; such as cheese, pumping is considered as an energy consuming process. Also, some products like powder milk require the use of dryers which use heating from fuel burning for the purpose of drying. Refrigeration, like in most FMI, is a main energy intensive step that is used for storing and preserving both products and raw milk.[59]

Manufacture of starches and starch products:
The majority of energy that is used in starch manufacturing is in the form of thermal energy that is used for steeping, evaporation and drying during the process of converting the source produce (like maize) to starch. Thermal energy is either provided via direct use of fuel burning or generating steam by boilers to be utilized in the process.[60]

Manufacture of grain mill products:
Grain milling mainly consumes mechanical energy. Energy is mainly used for the milling step followed by other mechanical separation and preparation processes that are used to make the processed grain suitable for operating (like removal of foreign bodies). Another energy consuming activity is packing of the final milled grain.[61]

Manufacture of sugar:
Sugar refining involves heating and treating the sugar juice in order to obtain a thick concentrate. The processes that lead to obtaining the concentrate require significant amount of energy. After concentration, crystallization and separation processes take place to extract the sugar crystals; consuming further amounts of energy. These mentioned processes take up to almost half of the consumed energy. The other half goes mainly to the handling and milling of beetroot and cane in order to produce the juice.[62]

Manufacture of bakery products:
Bakery products are versatile but follow the same major operations. Most of the energy goes to the baking process, and other processes like proofing and fermentation in the form of thermal energy to provide a suitable environment for the fermentation process. Shaping and other mechanical processes can be considered consuming if seen collectively. In some cases; like in cakes; freezing for the products is needed; so if the plant produces cakes or similar products, freezing is to be taken into account regarding energy consumption.[63]

Manufacture of cocoa, chocolate and sugar confectionery:

[59] https://www.energystar.gov/ia/business/industry/downloads/Dairy_Guide_Final.pdf (fig 4.3, 4.4)
[60] https://www.energystar.gov/sites/default/files/buildings/tools/LBNL-52307.pdf (table 5, fig 9)
[61] http://www.arpnjournals.com/jeas/research_papers/rp_2014/jeas_0914_1221.pdf (Table 2)
[62] http://nopr.niscair.res.in/bitstream/123456789/17795/1/JSIR%2058(2)%2076-82.pdf (table 3)
[63] https://www.energystar.gov/sites/default/files/buildings/tools/Baking_Guide.pdf (tables 2-6)

Chocolate based industries can be divided into two sections: Chocolate from beans, and chocolate product manufacturing. Extracting chocolate from cocoa mainly consumes energy in the phases of roasting, shell removal and size reduction. The rest of the chocolate products manufacturing mainly uses energy for tempering, forming and chilling.[64]

Manufacture of macaroni, noodles, couscous and similar farinaceous products:
Producing farinaceous products mainly involves mixing of several materials followed by drying from the energy consumption point of view; other processes aren't of much significance.[65]

Manufacture of prepared animal feeds:
Mechanical operations are the main operations in the production of animal feed; thus consume the most energy. Mixing, pelleting, milling among other mechanical processes consume energy in the form of electricity for motor systems. Another form of energy that is used is the steam that is required for condition the raw material in order to process them so as to produce them in the desired form. [66]

Distilling, rectifying and blending of spirits and production of ethanol:
Spirits require milling of the inlet grains, fermentation and distillation. Milling consumes energy for the motor systems. Other consumers of electric energy in the motor systems are the drivers of materials in the operation. Fermentation requires minor use of energy for temperature adjustment to create a suitable environment for the yeast. While distillation can be considered a more energy consumer since it requires further heating and cooling.[67]

Manufacture of malt liquors and malt:
Like the to-be-later-discussed beverage industry, malt liquors require gas compression and chilling which –in many cases- require a refrigeration cycle which in turn requires compression systems. Compression is a main energy consumer. Another source of energy consumption is the operation of milling and moving the materials; be it solid or fluid; throughout the production line by motors or pumping. Furthermore, for sterilizing and fermentation purposes, heating and boiling are required.[68]

[64] http://www.sollich.com/images/downloads/GuidelineEnergyEfficiencyintheConfectioneryIndustry.pdf (overview 1)
[65] J. Klemes, R. Smith, J-K Kim-Handbook of Water and Energy Management in Food Processing-CRC Press (2008) (Pasta P852,853)
[66] http://www.bine.info/fileadmin/content/Publikationen/Projekt-Infos/2014/Projekt_07-2014/ProjektInfo_0714_engl_internetx.pdf (fig 2)
[67] https://www.britannica.com/topic/distilled-spirit (the process)
[68] https://www.energystar.gov/ia/business/industry/LBNL-50934.pdf (table 3)

Manufacture of soft drinks; production of mineral waters and other bottled waters:

Soft drinks require energy for the preparation of water to processing, gas compression for carbonization and related processes and chilling. More energy can be used for washing purposes of cans and bottles prior to filling.[69] For soft drinks to be produced, suitable water should be used. Similar methods of treating water is used for soft drinks and bottled water; all of which involve the primary separation of impurities from water, then the filtering phase which is usually the most energy consuming, especially if done with advanced techniques such as reverse osmosis.

Manufacture of tobacco:

The main processes in the tobacco manufacturing are drying and pumping. Tobaccos leaves need to be cured before being used; thus drying of leaves are required through burning fuel. Cooling is used in large quantities but since no refrigeration is required, pumping of cool water is the main electricity consumer in the process of cooling.[70]

5.5 Application on Egyptian Food Industries

Following the same concept of energy intensive operations and as the processes are common across subsectors, the FEI carried out a study to quantify the potential energy reduction resulting from energy conservation measures[71]. Results are shown in the table below.

Table (8): Estimated potential of energy reduction per process

Process Heating

Measures	Potential of Energy Saving
Install economizer to recover exhaust gas heat for warming feed water	Up to 30%
Reduce blow down losses by boiler feed water preparation	15%
Recover exhaust gas heat to preheat Combustion air of burner	10%
Use thermal insulation for boilers and heat pipes	10%
Adjustment of Air/ Fuel ratio of the burner	7%

[69] http://www.baseco.com/files/Published%20Papers/Soft%20Drink%20Manufacturing%20Paper.pdf (fig. 2)

[70] http://www.cendid.com/tobacco.html

[71] https://www.german-energy-solutions.de/GES/Redaktion/DE/Publikationen/Praesentationen/2016/20171120-iv-aegypten-aly.pdf?__blob=publicationFile&v=2

Compressed Air

Measures	Potential of Energy Saving
Reduce leakage air losses	40%
Use speed controlled compressors	40%
Implement more efficient screw compressors	10%
Regular maintenance of the distribution net	10%
Decrease pressure by about 1 bar	7%

Electric Motors

Measures	Potential of Energy Saving
Adjust the speed of the motor to the load	10 - 50%
Switch off drives when not used	1 - 20%
Avoid the use of belts for power transmission from motor to the machine	2 - 10%
Use energy efficient drives	2 - 6%
Use proper dimensioned drives	1 - 3%

Refrigeration and Cooling

Measures	Potential of Energy Saving
Control of outlet pressure in cold compressor	15%
Appropriate loading and avoiding unnecessary low temperatures	10 - 15%
Minimize cold demand by stronger heat insulation	10%
High efficiency motors for ventilators and compressors/ condensers	5%

Conclusion

The multiple subsectors of the food manufacturing sector have a high diversity and involve different processes. However, these processes are built on similar interrelated manufacturing operations, mainly boilers for steam generation, electrical power systems for motor drives of equipment and refrigeration, compressed air for chilling and freezing and fuel systems like ovens for e.g.

baking and drying. Therefore, energy conservation measures across all subsectors revolve around a number of main concepts, including:

- Optimization of and maintenance of refrigeration systems,
- Optimization of, reduing leaks and energy recovery in steam generation and distribution systems,
- Reducing energy consumption in Compressed Air Systems through repairing air leaks, reducing air pressure by changing motor speed and reducing air inlet temperature ;
- Using high efficiency equipment;
- Using heat exchangers and heat pumps to utilize waste heat;
- Using non-thermal processing when practical; and
- employing cogeneration systems to maximize benefit from fuel and energy in industries using both sources.

These are considerd in some details in Annex I

6. Industrial Energy Efficiency Strategies and Policies

This is an application of the Industrial Energy Efficiency Startegy and Policies issued in a dedicated report (UNIDO, 2015) which should be consulted in conjunction with this application on a specific sector. Accordingly, it is attached to the current report which avoids repetition as much as feasible with the 2015 IEESP report. However, the general framework is summarized below.

6.1 Vision

Alternative visions were thoroughly discussed[72] and IEE vision was agreed to be:

"The Egyptian industry continuously achieves the optimum energy efficiency level economically viable for the Egyptian society"

The **optimum energy efficiency level** implies that a facility's technical opportunities as well as financial and organizational ability to reduce its energy consumption should be fully exploited, but it is not required to go further. This can only be perfected at the facility level, and therefore requires the establishment for the relevant internal decision making and planning system.

"**Economic viability**" needs to be seen in light of the fact that decisions are taken at the industrial entity level based on perceived costs and benefits to the enterprise (energy saved, monetized and non-energy benefits if any).

Prices are currently incrementally adjusted to the financial cost of supply, and for some energy commodities, especially those which cross border trade represents a substantial share, it might also go further to be adjusted to the marginal costs being the international market prices or the opportunity costs of foregone exports. Economic costs would even go further than this level to include environmental and social costs. However, it will be difficult during the adjustment period to consider those.

Accordingly, it will be too early to bring on board what is economically viable for the Egyptian society, as stated in the vision. This is only achievable on the longer term and focus on the foreseeable future will be on the financial viability as perceived by the industrial facility.

[72] With a specially established think tank and a series of stakeholder workshops

6.2 Strategic Objectives

According to the IEE report, three key strategic objectives address the three main pillars of the Industrial Energy Efficiency ecosystem. As shown in figure 13, these are:

1. Drive industrial sector demand for Industrial Energy Efficiency
2. Ensure responsive supply:
3. Enable government institutions to plan, regulate and monitor IEE ecosystem

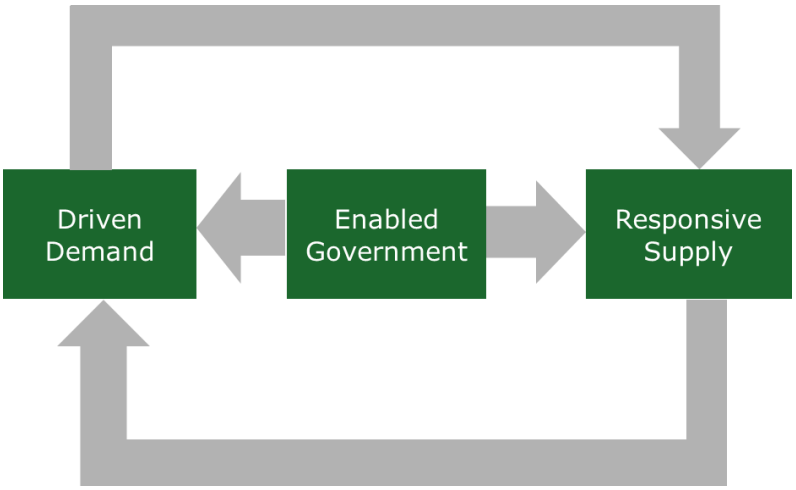

Figure (12): Strategic Objectives

Without any of these pillars, the market for energy efficiency is not expected to adequately perform. Demand is, however, the main market trigger. Experience shows that the supply, of goods, services or even soft finance, does not sustain a market in which robust demand is not ensured.

For the strategy to achieve the objectives, it will have to be sensitive to the characteristics of the different target groups within the industrial sector, namely;

- Large- intensive
- Large- non intensive
- Small-intensive
- Small – non intensive.

Driving demand for Industrial Energy Efficiency will differ according to size. Some of the small industries, having less than 50 employees, have outdated technologies, limited skills…etc. This implies the need for extensive support to be able to replace equipment, as well as the need for training to be able to apply IEE interventions. On the other hand, a number of large inductions have the technical, financial and organizational capacity to undertake energy efficiency inteventions, and the role of a policy would be to incite them to act.

For the second objective concerned with ensuring **responsive supply**, the services provided by the different parties will differ according to the category given their different needs and nature. For example, small and medium enterprises (SMEs) need more support in training and capacity building than larger companies who have in-house expertise or can afford to hire/ outsource experts.

Regarding the third objective which is to **enable the government**, the government's role will change slightly according to the different categories. For example, there should be a consensus between the government and large industries given the political power they have arising mainly from their size relative to the market and number of employees. On the other hand, more government support is expected to be provided to small industries to be able to optimize their energy consumption and reach their energy saving potential. In other words, while energy savings on a national level would imply a government focus on energy intensive industries, the government is responsible towards helping smaller industries as well to overcome the impact of subsidy reform through energy efficiency.

6.3 Policies

Sets of policies were proposed to address each strategic objective while taking into account the following common challenges:

1. Government Funding, mainly reflected in limited ability to subsidize EE investments.
2. Data Challenges including; actual measurements, availability and accessibility if measured, reliability and consistency.
3. Informal Sector, as this sector can hardly be targeted directly before it is formalized. Currently, the ministry of industry is considering viable approaches to formalize these entities. When formalized, they might add to the pool of micro-enterprises which have their own challenges.
4. Micro-Enterprises are challenging to address due to their large numbers, limited technical capacity, and non-bankability.

In order to increase implementability, given the existing challenges, policies for which the following requirements are critical were not considered for the current phase:

- Extensive micro-data for implementation
- Strong regulatory capacity for implementation and enforcement
- Substantial state financing, subsidies for implementation

Moreover, key success factors for the IEE strategy were identified. A major factor is that for EE to be sustained, it should become a core business issue, and thus becomes a regular part of a facility's responsibilities. This means that it should positively affect profit margins, give a competitive advantage and open up a new market or preserve current markets. Another factor which seems to be critical for sustainability is establishing a formal mechanism for data collection at the facility level.

Accordingly, a main premise at the core of policies proposed to trigger demand is to ensure that an energy management system (EnMS) is implemented by facilities through a variety of means and leverages by the government. EnMS would require the compilation and reporting of data, as well as Energy Efficiency planned and implemented as planned. An EnMS has the advantage of being an internal and comprehensive system managed by the company itself and entailing periodical audits, data reporting, among others.

Moreover, given current challenges, government funding should be rationalized. Sectors should also be prioritized; and finally, any suggested measure has to be as much as possible compatible with the facility's capacity and aptitude.

The policy proposed for SMEs bridges the gap between their present need for EE, especially magnified by the energy subsidy reform, and the actual demand for it by extending technological (in terms of equipment and services) and financial support. As for energy intensive SMEs, a dedicated program will promote energy efficient technologies.

6.4 Phasing

Phasing was thus essential to take into consideration the size and energy intensity categorization of industrial facilities as a reference. Policies are phased such that they target at first the most organizationally, technologically and financially competent and capable (i.e. predominantly large energy intensive) industrial sub-sectors. Looking forward, the majority of policies proposed are continuously expanding in terms of size (from large to small) and energy intensity (from intensive to less intensive).

The goals for a first stage of policy implementation to adapt to the abovementioned constraints, is to

- Achieve substantial energy savings through EE,
- Establish an EE culture in industrial and regulatory bodies; and
- Widen the scope of policies for the following years through relieving major constraints especially with regards to inadequate data and capacity.

The drive towards EnMS perfectly serves the near term goals of IEE mentioned above, in terms of energy savings, cultural change and data/information availability. Policies which effect is limited to technological improvement are less likely to sustain energy performance on the long term.

6.5 Support of Energy Efficiency to Industrial Strategies

MTI's Egypt's Industrial Development Strategy IDS : "The Engine of Growth 2050" aims that by the year 2025, Egypt will be a leading industrializing nation in the MENA region in terms of industrial performance as well as a main export hub for medium-technology manufactured products. The IDS proposes the promotion of medium and high technology activities as new

industrial niches for the Egyptian manufacturing industries[73]. This is aligned with energy efficiency goals of using less energy, therefore reducing cost, increase added value and increase Egyptian products reputation making it easier to target niche markets and transferring industry towards a medium-tech industry as proposed in the strategy.

The MTI strategy for 2020 is the main umbrella under which this energy efficiency strategy for the industrial sector, including the FMI sector, is developed. Accordingly, the compatibility of the two documents has to be ensured. In addition, the MTI has developed more specific strategies through the support of a number of donors, including the Industrial Innovation strategy, the SME strategy and the Technical and Vocational Education and Training (TVET) strategy. These are the general industrial strategies, in parallel to which several sector strategies were, or are being, developed.

Annex II condsiders the relations with these other strategies as well as the support energy efficiency provides to the achievement of their objectives

7. Application to the FMI Sector

7.1 Relevant Characteristics of the Sector

Based on the sector overview in the previous sections, the characteristics seen to potentially have a major influence on the energy efficiency strategy for the sector are summarized as follows:

- **Different subsectors have substantial differences on multiple levels** in terms of size, export value, energy consumption and production operations.

- **The relative value of energy efficiency is higher among 7 FMI subsectors out of a total of 16, as a result of the cost of energy representing a higher ratio of their value added.** These include (1) manufacture of bakery products, (2) manufacture of grain mill products, (3) manufacture of sugar, (4) processing and preserving of meat, (5) manufacture of starches and starch products, (6) manufacture of macaroni, noodles, couscous and similar farinaceous product and (7) manufacture of cocoa, chocolate and sugar confectionery,.

- **There are a number of key subsectors which form a higher potential basis** than those previously stated (which have potentially higher interest than other subsectors for energy efficiency) based on their (1) consumption of industrial energy, cost of energy from the total added value, (3) value of exports as energy efficiency can increase from the competitiveness of

[73] http://www.tralac.org/files/2012/12/Egypt-National-Industrial-Development-Strategy_EN.pdf

Egyptian products in the global market and thus contribute to the sector's overall development and (4) the size of the facilities per each subsector as large and medium as opposed to small and micro due to the large enterprises' competence to make decisions and take actions regarding energy efficiency (according to IEE strategy).

- **Manufacture of Sugar**, since it (1) consumes a high portion of energy from the whole sector, (2) energy cost share from the total added value is also high, (3) constitutes third highest value of exported products, (4) few number of facilities exist (7 companies) in the whole sector which makes it easier to target and (5) is dominated by large enterprises
- **Processing & preserving fruits & vegetables**, since it (1) consumes high portion of energy from the whole sector, (2) constitutes the second highest value of exported products and (3) although most of the subsector is dominated by micro, small and medium enterprises, large enterprises in this subsector are remarkably big (and responsible for most of the exported value) and so, also like manufacture of sugar form a great potential for energy efficiency.

- **The sector witnesses a high rate of growth, most FMI companies were established between 2000 and 2012 (data after 2012 is not available).** This should not be taken to mean that they use modern technologies, but is an opportunity to take if the sector is to move to higher energy efdficiency.

- **Manufacture of bakery products has a significantly different nature** than the rest of the subsectors and should be dealt with alone, as it is the sector with the highet ratio of energy cost to value added, it is distinctively dominated by small and micro enterprises and energy is exceptionally subsidized with lower prices than the rest of the subsectors.

- **FMI is concentrated in 6 main governorates:** Cairo, Al-Sharqiya, Giza, Alexandria, Al-Qalyobia and Al-Menoufeya

- **There is a remarkable similarity in energy intensive processes across subsectors**

  Fuel is mainly used for steam generation as well as direct burning which are most commonly used for cleaning, sterilization, evaporation, pasteurization, cooking, blanching, drying and fermentation (among others). Electricity is mainly used for operating machinery (to do all sorts of things from peeling, cutting, packaging, extracting, pumping, etc. of which motor systems are dominant. It is also used for refrigeration and chilling as well as air and gas compression systems.

- **Subsectors are differently dominated by different sizes** and some subsectors are diffused between large, medium, small & micro enterprises.
  - Subsectors dominated by **large enterprises** include: manufacture of sugar
  - Subsectors dominated by **micro enterprises** include: manufacture of bakery products and manufacture of grain mill products.
  - Subsectors led by **micro and small enterprises** include: Manufacture of macaroni, noodles, couscous and similar farinaceous products and manufacture of vegetable and animal oils.
  - Subsectors led by **micro, small and medium enterprises** include: manufacture of soft drinks and mineral water, manufacture of starch and its products, manufacture of dairy products, processing and preserving of fruits and vegetables and processing and preserving of fish, crustaceans and molluscs – however, large enterprises in these subsectors (except for processing of fish) are gigantic employing the higher portion of labor in their respective subsectors.
  - Subsectors **not led by a certain size of enterprises** include: processing of meat, manufacture of animal feed and manufacture of cocoa, chocolate and sugar confectionery

- **Simple techniques with no and low investments could remarkably reduce energy consumption in this sector,** through maintenance and optimization of equipment and systems, fixing air leaks and recovering heat through heat exchangers among others based on national and international experiences.

- **Food exports market:**
  - **Food exports in the global market are largely concerned with food safety** and there is no interest in environmental considerations beyond what affects products' quality and safety (except for social accountability and labor issues).
  - **Limited number of exporting facilities:** number of exporting facilities is relatively low and dominated by medium and large enterprises.
  - **FMI exports are concentrated in a few subsectors** including (by order of importance in terms of export value and/or number of export facilities) Manufacture of dairy products, processing and preserving fruits and vegetables, manufacture of sugar and manufacture of tobacco.

7.2 Categorization of IEE Policies

The policies proposed in the IEE report, targeting driving demand, ensuring responsive supply and enabling government. The exhaustive description of

these policies in the attached IEE report include the following points which will not be repeated in the current report.

1- Policy Summary
   Which includes a description and rationale, an account of beneficiaries and risks as well Relation to other policies
2- Policy Goals
3- Policy Owner
4- Policy Activities
   Which compose a road map to reach the policy implementation stage.
5- Policy stakeholders
   Which includes those who would support (Hands-on), and those who would facilitate (Not directly involved), as well as those who will evaluate
6- Policy indicators :
7- Policy timeframe and phasing strategy
8- Enabling Conditions
   Which includes the requirements for Infrastructure, Human capacity, Financial resources and budgeting and Government support

Some of the policies are cross cutting all sectors, and these will be briefly addressed below, while others could be specifically tailored to this specific sector. Table (9) clarifies the policies falling in these different categories.

Table (9): IEE Policies, relevance to the FMI sector

Drive industrial sector demand for Industrial Energy Efficiency	**Ensure responsive supply**	**Enable Government**
General Cross Cutting Policies relevant to the Sector		
Policy 3: Establish system for grid-connected combined heat and power (CHP) Policy 4: Phasing out selected equipment	Policy 7: Ensure Quality of Energy Management System Consulting Services through certification Policy 9: Minimum Energy Performance Standards (MEPS)	Policy 13: Ensure proper & effective governance mechanism of all related IEE policies and procedures Policy 12: Mandatory reporting for registered facilities as a condition to renew their license
Policies to be tailored to the Sector		
Policy 1: Include EnMS in export requirements Policy 2: EnMS as condition for state procurement Policy 5: Reach out to SMEs through intermediaries Policy 6: Ensuring efficient energy performance of new facilities, operations and processes	Policy 8: Link Qualified consulting Services to rising demand on Energy efficiency technologies Policy 10: Create an awareness mechanism that leverages integrated information related to IEE Policy 11 Soft financing of IEE projects - Capitalize on FEI fund - Tap on existing projects - Augment cooperatives fund - Attract additional Donor funds	

7.2.1 Policies Irrelevant to the Sector

As opposed to the textile sector, none of the policies proposed in the IEE were found irrelevant to the FMI sector. Even for policies 1 and 2 which were in principle targeting large energy intensive facilities, it was found reasonable that these be tailored to the specific conditions of this sector.

7.2.2 General Cross Cutting Policies

These are policies to be adopted by the MTI, irrespective of the specific sector, as they are effectively cross cutting all industrial sectors. These mainly address issues external to facilities, and related to supply of services and goods. These are namely, Minimum Energy Performance Standards (MEPS) for equipment used across sectors, e.g. boilers, compressors and motors, to ensure that the efficiency of equipment on the market is not below certain thresholds. This is to be coupled with the phasing out of inefficient equipment cross cutting all industrial sectors. Similarly, the certification of energy management system consultants ensures that quality service is provided to industry in general, rather than a specific sector. Finally, it is unlikely that any of these, and other policies, will be affectively implemented without a proper allocation of responsibilities to capable and committed governmental entities.

In the IEE strategy and policies report, the certification of technical consultants was considered different enough from that of management oriented consultants to justify that these are set as two different policies. In fact, while the latter is cross cutting, the former is related to the potential focus of the sector EE strategy and might be tailored accordingly.

These policies are briefly described below, but are described in higher details in the IEE strategy and policies report

- ***Policy 3: "Establish system for grid-connected combined heat and power (CHP)"***

Establishment of operational system for grid-connected combined heat and power (CHP) should be encouraged in all large energy intensive industries. The operational system should be established such that the electricity prices encourage CHP and resolve any issues that might arise with regards to grid management; metering and accounting systems, etc.

The policy builds on the base provided by the electricity law 87/2015, which obliged authorized electricity transmission and distribution companies to buy or pay the value of electricity produced from recovered energy with less than 50 MW capacity (clause 45). For capacities larger than 50 MW, electricity prices and contracts will be set on a case by case basis as electricity companies are not obliged by law to purchase electricity. Moreover, Decree no. 230/2016 issued by the Ministry of Electricity and Renewable Energy, specifies the method of calculating feed-in tariffs of selling electricity to the grid.

- ***Policy 7: "Ensure Quality of Energy Management System Consulting Services through certification".***

This policy entails the establishment of a certification mechanism for consulting firms and individuals in the field of Energy Management Systems. This is proposed to encompass a renewal processes to the certification holders in order to ensure that they are actively operating in this field. The proposed mechanism also allows for categorizing the consulting firms based on a point system that aids in having structured clusters of different levels of consultancies.

EnMS consulting firms should be able to submit an executive summary of auditing reports to the certifying body for the number of industrial facilities served allowing for data gathering and analysis to build knowledge on sectorial trends and know how. Some of this information, while respecting confidentiality, will be available on the information base established by FEI (policy 10).

The policy builds on previous efforts, including the training and certification of a number of national consultants on EnMS and ISO 50001 supported by the UNIDO IEE project in Egypt. These consultants have already worked with various industries in establishing EnMS systems and they are qualified to work with the FMI sector. Several other training initiatives have taken place. Through a USAID project, some time ago, training of energy managers have been rooted in Egypt according to the ASMEE (American Society of Mechanical and Electrical Engineers) standards, and currently through an EU funded project, EUREM, a large number of individuals are being trained.

- ***Policy 9: "Minimum Energy Performance Standards (MEPS)"***

This policy requires Minimum Energy Performance Standards (MEPS) to be developed with a focus on equipment that comply with the following prioritization criteria:

- Have high potential energy saving
- Are used across a large number of industries

In order to give local industries the opportunity to adapt to new regulations, it is also recommended to avoid equipment for which there is local production in the first phase of implementation.

A number of current initiatives fit perfectly in this policy. For example, the Egypt National Cleaner Production Centre (ENCPC) has worked on the Industrial Electrical Motor Driven Systems (EMDS) Efficiency Program in Egypt, funded by IFC. Moreover, the IEE project in Egypt has already delivered training in Energy Efficiency in motors and compressors. UNIDO is currently in the final stages of launching a project focused on the efficiency of motor systems.

- ***Policy 4: "Phasing out selected equipment".***

In conjunction with the MEPS policy above, this policy imposes replacement of selected installed cross-cutting equipment based on specified criteria including nameplate performance specification, size and age.

The primary approach to replacement is based on size and age, i.e. equipment larger than a set capacity and older than a set age is replaced unless the owner of the equipment proves that it has an acceptable efficiency. Minimum Energy Performance Standards (MEPS) are the reference against which equipment replacement is compared, such that equipment which efficiency is less than e.g. 80% that of the MEPS (depending on the case) should be replaced. The percentage should be set such that, when replacing the majority of equipment, an acceptable payback period (less than 5 years) is achieved. This policy is dependent on Policy 9 and cannot be implemented independently.

Policy 12: "Mandatory reporting for registered facilities as a condition to renew their license"

This policy is more of a long term plan which aims at creating robust data (i.e. reliable and consistent) to enable effective decision making through mandatory reporting for registered facilities as a condition to renew their license. Data collection includes general data and information, data on industrial production, data on energy consumption.

Noting that license renewal is every 5 years, it is a requirement that yearly data must be submitted on time. As such, industrial facilities will be obliged to deliver the required data and face risks of having their license revoked if they do not deliver or deliver inaccurate data.

Policy Owner and Stakeholders

The policy will be the responsibility of the new and renewable energy unit within IDA as it is the official custodian of all energy efficiency related data. It is, however, proposed that internally teams for renewable energy and energy efficiency be identified as their scope of work, and thus their required qualifications, will be different.

The unit will be responsible for identifying data to be collected, creating data template (in cooperation with ENCPC), collecting data in a timely and consistent manner, verifying accuracy of data collected, formatting and storing this data, issuing periodical reports and ensuring their dissemination to all concerned entities and coordinating with the national energy system. It will also inform IDA's responsibles of its no objection to renew licenses when all data reporting requirements are met.

Supporting entities will include the IMC that will be responsible for developing communication plans and developing surveys to measure satisfaction; the Central Agency for Public Mobilization and Statistics

(CAPMAS) to support the database creation and ensure that the database at IDA is compatible with that of CAPMAS, as well as; the Ministry of Industry, Ministry of Electricity and Renewable Energy, Ministry of Petroleum and Mineral Resources and the Supreme Energy Council for identifying data required for their decision making processes to the IDA. Finally, ENCPC will support IDA to develop templates for the data report to be collected from the different facilities, integrating the inputs from different organizations data

Phasing Policy

The first phase will focus on building capacity of personnel and system by:

- Hiring the right caliber of employees
- Providing training to bridge any existing gaps
- Building IT infrastructure
- Including data reporting as a criterion to acquire the license

Trickles of data reporting will start before the application of this policy through policies 1 and 2. In other words, while the system will be built in the first phase, there should be enough data collection through other policies to initiate and test the system before it is applied on large energy intensive facilities first, and extending incrementally to smaller facilities and less energy intensive sectors.

- ***Policy 13: "Ensure proper & effective governance mechanism of all related IEE policies and procedures"***

For this sector, as well as others, a proper and effective governance mechanism of all related IEE policies and procedures is to be ensured. This policy proposed the establishment or an Energy Efficiency Task Force within the "Policy and Strategy Unit" of the MTI to specifically handle this issue.

Other than the need to coordinate the many actors involved in the formulation and implementation of policies, a concerted effort for follow up, monitor, evaluate and re-orient, as needed, should be exerted. For each policy, stakeholders involved and steps to be taken as well as indicators are already proposed jn the IEESP report. Moreover, the task force will also have the responsibility to ensure that those taking responsibility in different organizations are adequately trained to undertake their duties.

At a more operational level, IDA should play a critical role to overcome the current scarcity of micro data, and ensure that data is progressively compiled and analyzed to better understand the sector's status and trends and feed back to policy formulation, refinement and updating. Data will be generated through a number of policies including policy 7 above, as well as 5, 6, 8 and 11 below (to which 12 will be added on a longer term), and will have no value if not compiled, analyzed and results provided to those concerned.

7.2.3 Policies Tailored to the FMI sector

As this energy efficiency sector strategy is part of the overall strategy of the Ministry of Industry targeting year 2020, it will work on a short term five year plan. As mentioned earlier, the aim during this period will not be to have a total coverage of all the energy efficiency opportunities in the sector, and the focus will be to:

- Achieve substantial energy savings through EE,
- Establish an EE culture in industrial and regulatory bodies; and
- Widen the scope of policies for the following years through relieving major constraints especially with regards to inadequate data and capacity.

Based on the discussion above, the following policies will be tailored taking into account the relevant characteristics of the sector. Two of those especially influenced this process, namely

- The relative importance of energy costs to value added reflected in priorities and phasing, and
- The high similarity of equipment and systems across diverse sub-sectors, which shapes the technical approach to training and the certification of consultants.

Most of the policies will address existing plants. However, given the foreseen increase in FDI, triggered by the currency floatation and the growth in exports, and the potential reaction of existing facilities to upgrade to face the resulting increased competition in the local market and/or exploit additional opportunities for exports, should be utilized to ensure that new investments are energy efficient.

- **Addressing New Facilities**

With respect to new and upgraded facilities, it is immaterial to focus on one or the other sub-sectors. A policy to address energy efficiency in new facilites should in theory apply to all to ensure that energy efficiency should be a major criterion to consider for permitting new facilities, as per policy 6 of the IEE document.

- ***Policy 6: "Ensuring efficient energy performance of new facilities, operations and processes"***

This policy should ensure that efficient energy performance of new facilities, operations and processes through limiting license provision to facilities employing production technology at least at par with that of the most efficient of local manufactures/technologies. This will be reflected in two main components, the first is the selection of equipment and the design of production process, and the second is the implementation of operational and planning procedures ensuring a sustained and continuously improving energy management.

In addition to abiding to the MEPS of selected equipment (policy 9 above). there are many ways to ensure the right selection of technology. First, The applicant would be required to compare alternative technologies in terms of energy productivity or specific energy consumption, and be required to adopt the one with the highest productivity (lowest specific energy consumption) unless "convincingly" justified. This will require that request for offers from suppliers, or EPC contractors, specify energy efficiency of equipment as an evaluation criterion. For companies, shopping (rather than tendering), the information platform (policy 10 below) should provide an effective vehicle for information about suppliers.

The information could be simplified to serve smaller facilities, which might not have the technical capabilities to independently assess and compare suppliers. Certified consultants (policy 8 below) would have the ability to provide support to smaller investors in selecting equipment to SMEs who are willing and able to pay their fees. There are at least two reasons to avoid the provision of this service through a governmental entity; first, it will impose a high demand which might be hard to meet both in terms of effort and expertise, and most impoirtantly there is a high potential of a conflict of interest.

For both applicants and reviewers, international best practices could represent a good reference for production technology when complemented by a survey of best performing local plants. This survey will only be needed for the initiation of the system, as data will be subsequently generated and compiled through its implementation (as well as other policies).

In order to sustain a good energy performance, the applicant should clearly commit to establish an EnMS (noting that the EE plan will not include significant interventions such as equipment change for some time), and to periodically reporting on specific energy consumption.

This policy is complemented by policies 7 and 8 which ensure quality consulting services for energy management systems and EE technologies respectively through certification. It is, however, unrelated to policy 11 for funding EE, as this funding is only applicable to existing and modernizing plants .

Policy Owner and Stakeholders

Implementation of the policy will be through IDA which will modify licensing criteria for new facilities to include EE assurance. The Environmenatal Agency, EEAA, should also include consistent requirements in its Environmental Impact Assessment EIA guidelines. Pre-policy, ENCPC will support in surveying the best performing industries in each sub-sector of concern for system initiation as well as setting templates for EE plans, and energy reporting in cooperation with IDA.

- **Existing Facilities**

The actions required from existing facilities could include replacement of specific equipment and optimization of operating procedures and most importantly an operationa Energy Management System (EnMS), which will allow for a sustained improvement of energy performance. A number of the policies proposed will also apply to "New" facilities, as they become relevant when “New” facilities have reached an operational stage. As mentioned above the primary focus during an initial stage will be on energy intensive sub-sectors (in terms of cost of energy relative to value added).

Policy 1: “Incorporate EnMS in export procedures”

This policy requires sectors exporting energy intensive goods to have an operative energy management system (EnMS), reported energy data and approved and implemented EE plan. Incorporating EnMS for export can be carried out through an export duty imposed on targeted products and waived on a product if it is produced from a facility complying with requirements.

Reviewing the exported products (section 4.1) and the share of energy use relative to the sector and the value added, the sub-sectors producing most of the main exported products represent a high share of the energy used by the sector. These are namely

- Sugar;
- Fruits and vegetables;
- Vegetable and Animal oil and Fats;
- Dairy; and
- Chocolate and Confectionary

Of those, and based on figures 11 a/b, Sugar and Chocolate & confectionary are also sub-sectors for which energy represents a higher than average share of the value added they produce, which is taken as a proxy for their own interest in energy efficiency. Baked products do not represent a high share of exports but a substantial number of facilities are involved and the sub-sector represent a dominant share of the energy used by the sector.

Given a reasonable grace period and the already mild requirements of the EnMS, only requiring that a system be established and interventions making good financial sense for the facility be implemented according to an agreed time schedule, this policy will practically have no negative effect on exports. On the contrary, it should reduce costs and make exported products more competitive or increase profits. This should be clarified to all concerned. Nevertheless, it is understood that this policy will meet considerable resistance from the industry using the pressure to increase exports as their main argument, especially since resource conservation requirement do not figure strongly in current requirements of international buyers.

Policy Owner and Stakeholders

IDA will be responsible for implementation of this policy as it will assess the industrial facility's compliance. The following roles will be assumed by the RE and EE unit under IDA to mobilize the different relevant units internally in IDA and coordinate with other external entities in the government and elsewhere. Prior to policy implementation, IDA will have:

- Set systems for EE plans and data acquisition, consulting the relevant industries
- Set data verification, storage and analysis system

Afterwards, IDA will:

- Receive, verify and process the data
- Follow-up, assess and approve plans
- Issue EnMS status certifications
- Maintain databases and feed energy data into a local database (to support decision-making) and ultimately into a national energy information system, when established.
- Issue and disseminate reports

The ENCPC will support in setting systems for EE plans and data acquisition, consulting the relevant industry. The export councils of relevant industries and FEI will negotiate the appropriate export duty for goods and the Foreign Trade Sector will draft the relevant decree on export duty.

Phasing Policy

Phasing according to sizes will not be perceived as fair. However, phasing according to sub-sectors is possible. In such case, starting with sectors with a large number of exporting facilities is recommended. These will be Fruits and vegetables and Dairy to be followed by Chocolate and Confectionary; Baked products , and Vegetable and Animal Oil and Fats. As only one facility of the sugar sub-sector exports.

Relation to other Policies

This policy is complemented by policies 7 and 8 which ensure quality consulting services for energy management system and EE technologies, respectively through certification. Policies 2 and 6 are also related to EnMS implementation and they serve the same purpose. The data collected through these policies prepares for policy 12 and needs policy 13 for it to actualize.

- ***Policy 2: "Incorporate EnMS as a condition for state procurement"***

The state is an actual large buyer of FMI products in cases such as those of army and police force purchases for the large number of conscripts, as well as that of the school food programs, and government hospitals.

Where the State is not by itself a large consumer of FMI products, this policy could apply to those products which could be acquired through the ration cards or the bread points. Simiar to the case in which the State is a major

buyer, being an approved supplier to ration card consumers opens a large market segment which would have been less accessible.

This policy entails incorporation of conditions for state procurement as the buyer has the right to stipulate certain conditions on the products it acquires. The conditions will be a part of the tender documents include that such product is sourced from manufacturing facilities with an operative EnMS system, which report energy data and implement their plans to pursue EE.

Policy Owner and Stakeholders

IDA is responsible for this policy too as it will assess the industrial facility's compliance. The following roles will be assumed by the new RE and EE unit under IDA to mobilize the different relevant units internally in IDA and coordinate with other external entities in the government and otherwise. Prior to the policy IDA will

- Set systems for EE plans and data acquisition,
- Consulting the relevant industries
- Set data verification, storage and analysis system

Afterwards, IDA will:

- Receive, verify and process the data
- Follow-up, assess and approve plans
- Issue EMS status certifications
- Maintain databases and feed energy data into a local database (to support decision-making) and ultimately into the national energy information system, when estyablished
- Issue and disseminate reports

Pre-policy, NQI will create an inventory of energy service providers/consultants catering for all industries and establish a system to accredit EMS consulting firms as per policy 7. On continuous basis, NQI will train relevant personnel from the industries targeted on EnMS implementation. As for other support entities:

- General Authority for Government Services (GAGS) will revise the tender documents and ensure its integrity
- Depending on the case Ministry of Health, Education, Defense, Interior or Supply will include the requirements in their tender documents

Phasing Policy

The first phase of implementation is proposed to be implemented by the ministries of Defense, to set the example for other entities. It might be closely followed by the ministry of Interior. Meanwhile, GAGS and other ministries should have prepared their internal procurement systems to follow suit.

Relation to other Policies

This policy is complemented by policies 7 and 8 which ensure quality consulting services for energy management system and EE technologies, respectively through certification. Policies 1 and 6 are also related to EMS implementation as they serve the same purpose. The data collected through this policy is a precursor to that collected through policy 12.

- ***Policy 8: "Link Qualified consulting Services to rising demand on Energy efficiency technologies."***

The policy aims to provide the market with qualified technical consulting firms / individuals in different engineering fields (mechanical – electrical – chemical- engineering). It is, however, tailored to the conditions of the FMI sector and specifically to the fact that the diverse the sub-sectors mainly use a limited numb er of equipment and their associated systems (please see table 7); namely boilers, burners, chillers, compressors and motors.

The first component of this policy in the IEE strategy and Policy document is to facilitate the registration of Energy Consulting firms in the different engineering fields (technical consulting firms) through developing well designed criteria to ensure coherence and compliance.

The second component of the policy is concerned with establishing an accreditation mechanism for energy consulting firms and individuals in the main engineering fields (electrical – mechanical – chemical) in order to ensure the supply of quality engineering consulting services to the industrial sector. A renewal processes to the accreditation holders from the engineering consulting firms is also proposed including a point system in order to ensure that they are actively operating in their respective fields.

For the FMI sector, this process will be utilized to provide an early response to the needs created through policies 1 an 2 above. The program through which this is achieved is discussed in details in section 7, but could be summarized as fielding consultancy firms wishing to be accredited to undertake a set number of audits of facilities of various sizes and locations, report on their findings and in cooperation with the audited facilities develop an EE action plan.

This support could be synchronized with the announcement of policies 1 and 2, and would ideally take place during the grace period, so as to have the concerned facilities ready for implementation. In addition, this process should result in

- Better understanding of the sub-sector's energy performance, feeding back through the intermediary of IDA to the information platform of policy 10;
- Outline of a number of bankable projects, feeding into funds made available through policy 11;
- Accredited firms able to sustain a virtuous cycle of improvement.

<u>Policy Owner and Stakeholders</u>

This policy will be implemented by NQI which will be responsible for management of the registration and renewal processes, formulation with a steering committee the training syllabus outline in order to avail it for training centers to be delivered, managing the processes of the technical assessment with the Industrial Training Center (ITC), accrediting the technical consultants in one or more specific engineering field(s) (mechanical – electrical – processes), classifying consultants based on a point system and manage the database of registered consultants and produce analysis.

The pre-certification auditing campaign will represent a gap analysis and training needs which will guide the training design.

The ITC will collaborate with NQI to qualify the training centers that will be eligible to deliver a specific technical training and set the consultant's assessments and generates the results. Moreover, the Industrial Modernization Center of MTI will formulate a technical committee that will help NQI set the accreditation standards and criteria, comply with policy standards to prohibit, in due time, a consulting service to take place without being accredited and communicate periodically with all IMC and FEI beneficiaries with the latest updated consultant list and manage the satisfaction feedback and survey. Some of this information, while respecting confidentiality, will be available on the information base established by FEI (policy 10)

Phasing Policy

Due to the need for a focused strategy to ensure timely and efficient implementation, this policy was proposed by the IEE strategy and policies report to be first applied to consulting firms and individuals in the field of Combined Heat and Power (CHP) and waste heat recovery followed by electric motor system and compressors as they are already addressed by ENCPC (see Policy 9 below). Steam and and refrigeration systems could easily be added to this list.

- ***Policy 10: "Create a mechanism that leverages integrated information related to IEE"***

Providing information to relevant stakeholders is critical in many respects. However, the diversity of stakeholders, their conditions and interests implies that although information might be the same, different messages and channels will be used. This policy is geared towards raising the efficiency of awareness actions though unifying the information platform to be used by one or more actors for raising awareness on the benefits of energy efficiency in the FMI industry. The information to be compiled and constantly updated would be targeting

- Direct stakeholders, which include the facilities of the sector with its various sizes and activities to which information about IEE financing options (of which some examples are included in Annex III), technologies and financial feasibility as well as relevant policies, experiences and benchmarks would be conveyed together with evolving EE requirements for the local and international markets. Information about equipment suppliers and service providers will also be relevant to this group.

- Indirect stakeholders including banks, equipment suppliers and energy consulting services are both subject and target of awareness.
- Industrial associations, as both indirect stakeholders and potential support to dissemination

Access to this information platform would be secured free of charge for all actors, not only for direct use of facilities and consultants, but also for indirect

use of those active in awareness activities. As effort and resources should be dedicated to initiate, update and maintain this platform, an initial infusion would be needed from FEI's own resources to be replaced as soon as feasible by revenues from advertisements of equipment suppliers and/or service providers.

Policy Owner and Stakeholders

The owner of this platform is FEI as the federation is set to enhance the performance and productivity of the sector members in addition to providing tools that facilitate the overall commercial and business effectiveness.

It is expected from FEI to dedicate a unit concerned with

- Information compilation and analysis
- Initiation and maintenance of the platform,
- communication and awareness according to a communication plan set annually with milestones, key activities, including publications, round-table discussions,
- Response to inquiries; as well as
- cooperation with relevant stakeholders ensuring participation and retrieval of relevant information from all stakeholders

The need for Cooperation

The FEI has its own in-house expertise which should provide technical inputs, in terms of technological options as well as records and analysis of local experiences[74]. However, the cooperation of other nodes of expertise, such as ENCPC and IMC in the MTI, will be beneficial as a means to collect relevant information generated through the proposed process through which policy 8 will be initiated. Contacts with other nodes of communications such as investors associations and the cooperative unions will be as important in ensuring the participation of its members and collecting and gathering feedback from its beneficiaries and collectively compiling information for general dissemination through the FEI.

The means to encourage collaboration and information sharing by facilities, and associations, should be considered. A possible approach would be to have a yearly award for energy efficiency in facilities of specific sub-sectors.

Another important source of information would be the data generated through requiring reporting of energy data/information as per policies 1 and 2, and on the longer term through policy 12. Together with Policy 6 focused on newly established facilities, it could provide a good basis for local benchmarking and local best available technologies.

Accordingly, a number of programs will be initiated to implement this policy

- Information base, established and constantly updated
- Awareness to processing plants,
- Awareness to exporters ; and

[74] Based on the Consultant's experience, the cases which have the most impact on local industries, are those implemented, and operated, by their local peers.

- Given the limited number of facilities having contracted power above 10 MW, direct contact to these facilities will be established, and interaction will be ensured through the process described in policy 7. Successful implementation of EnMS in these facilities could be used in an awareness campaign targeting those which contracted power is above 500kW.

The information made available to larger facilities will be qualitatively different from that provided to small and micro facilities. The means to reach the latter facilities is also different. While larger facilities would have the means to directly access the information base, smaller and micro facilities might require intermediaries as per policy 5 below.

Phasing Policy

In general, there should be no phasing of this policy. However, if resources to populate the knowledge base and disseminate its contents are limited, priority should be given to the sub-sectors for which energy costs represent a higher share of the value added than the total FMI sector. A per figure 11 a/b, these include sugar, Meat processing, Starch and starch products, Pasta, Chacolate & confectionary and baked products. This is based on the expectation that these facilities will be the ones most interested for improving their energy efficiency, thus ensuring a quicker "return on investment". These could be closely followed by Dairy, Fruits & Vegetables and Vegetable and Animal Oil and Fats, as these are part of the group to which policies 1 and 2 will apply.

- ***Policy 5: "Reach out to SMEs through intermediaries"***

Small industries have certain characteristics that necessitate targeting through a tailored approach. They possess limited financial, technical and organizational capacities. Given their large numbers and wide geographic distribution, it is proposed that industrial associations be mobilized to provide tailored support to these industries.

Accordingly, this policy aims to build-up and strengthen the capacities of these industrial associations such that they can independently support their members on matters regarding IEE. These organizations thus become the interface through which SMEs receive assistance. The government will follow-up on the progress of these associations and provide them with direct assistance, at least in the following:

- Ensure unrestricted access to the FEI information base (policy 10);
- Develop guidance sheets for no cost/low cost interventions, based on representative sample of small and micro enterprises, which could be preliminarily based on the outputs of policy 8 to be augmented by information acquired through policy 11;
- Support facilities, as much as feasible, to mobilize funding;
- Provide guide to replies to Frequently Asked Questions;
- Provide access to certified consultants (policy 8); and eventually
- Establish an award scheme for best performing enterprises

Policy Owner and Stakeholders

The Agency for Development of Micro, Small and Medium enterprises (MSMEDA) was established by Decree 947/2017. This new entity should mobilize different capacities inside and outside the MTI, to support industrial associations, including cooperatives.

The Agency should use the network closer to the ground, to which support will be given, to ensure continuous and more effective two-way communications with the target facilities. These will include FEI, and its chambers, other industrial associations as well as production cooperatives, whether sectoral or geographic as the case may be. These will have a dual role; to communicate needs of support of their members to the Agency and to support their members in implementing IEE, either directly or through mobilizing other actors as follows.

The Environmental Compliance Office (ECO) of FEI should extend their financial and technical services to include more small and medium facilities as per policy 11. The Ministry of Finance and/or the Central Bank of Egypt could establish a cooperation protocol with Cooperative Union to provide it with funds to finance its members, mostly micro facilities, on carrying out IEE based of clear terms and conditions. As for ENCPC it will undertake necessary audits and research to develop and update guidelines and assist in assessing award nominees. Finally IDA would receive and verify and process of the data including data from audits for financing and audits for awards and maintain databases and feed energy data into its local database (to support decision-making) and provided the results of its analysis to the IEE information platform (policy 10 above)

Phasing Policy

This policy will be phased over SMEs according to their energy intensity, starting with the most energy intensive. In the case of FMI, and as per figure 11 a/b, these include sugar, Meat processing, Starch and starch products, Pasta, Chacolate & confectionary and baked products. This is based on the expectation that these facilities will be the ones most interested for improving their energy efficiency, thus ensuring a quicker "return on investment". These could be closely followed by Dairy, Fruits & Vegetables and Vegetable and Animal Oil and Fats, as these are part of the group to which policies 1 and 2 will apply.

Relation to other Policies

Financing mechanisms as elaborated in policy 11a which capitalize on the FEI fund to subsidize IEE projects including financial schemes (soft financing) for SMEs, and policy 11b which addresses the fund for cooperatives for IEE purposes. This policy is also complemented by policy 8 which ensures quality consulting services for EE technologies, through certification.

- ***Policy 11a: "Capitalize on FEI fund to subsidize Industrial Energy Efficiency Projects"***

This policy aims to capitalize on the Federation of Egyptian Industries funds in order to subsidize Industrial Energy Efficiency Projects with special focus on small and medium enterprises (SMEs). In order to ensure that these funds are being put to best use, a ceiling can be set (i.e. maximum amount of money per facility). This ceiling will be more attractive to smaller facilities (as larger ones may need larger amounts).

Policy Owner and Stakeholders

FEI would be responsible for managing the fund, defining criteria for fund disbursement, evaluating the eligibility of the different facilities, finance the projects and monitor and evaluate outcomes, as well as provide data to IDA for storage and analysis. The Ministry of Finance or the Ministry of International Cooperation would infuse and/or direct funds to FEI.

Phasing Policy

The first stage implementation of this policy will focus on, but not be exclusive to, SMEs with the highest energy intensity, as they are the most sensitive to price increases. Once the policy proves its success it will be rolled out to SMEs with lower energy intensity requirements. The order of priority is proposed to be the same as policy 5 and 10 above.

- ***Policy 11b: "Augment cooperatives fund to finance IEE projects"***

This Policy will augment the funds available to the Central Productive Cooperative Union in order to finance industrial energy efficiency projects. In order to increase this fund, it is proposed that the Ministry of Finance establishes a cooperation protocol with the Cooperative Union to finance its members in order for them to undertake EE projects and interventions based on specific terms and conditions. The flow of funds will only be sustained if data is provided, audits are undertaken and transparent criteria are set which include a relatively long payback (e.g. more than 3 years) period.

Policy Owner and Stakeholders

MSMEDA will be responsible for promoting and coordinating a cooperation protocol with the Cooperative Union to finance the EE projects and interventions of its members based on specific terms and conditions. The IMC and Industrial technological development sector of MTI (including ENCPC) will undertake necessary audits to assess progress and communicate it to MSMEDA. As for IDA, it will receive, verify and process the data (including data from audits), communicate goals met to Ministry of Finance and maintain databases and feed energy data into a local database (to support decision-making), the results of its analysis to the information base established by FEI (policy 10) and ultimately into the national energy information system, when established.

The Ministry of Finance will infuse and/or direct funds to cooperatives union fund sourced from the national budget and/or directed from donors and international banks. Other sources of funds could be investigated including Corporate Social Responsibility contributions from large enterprises of the sector.

Phasing Policy

As for policies 5, 10 and 11a, the first stage implementation of this policy will focus on, but not be exclusive to, facil;ities with the highest energy intensity, as they are the most sensitive to price increases. Once the policy proves its success it will be rolled out to those with lower energy intensity requirements. Moreover, the amount of finance to be made available to the Union will gradually increase over time in accordance to the interest expressed by the facilities and the success of projects undertaken by them.

8. Action Plan for the FMI Sector

This section only considers the policy actions tailored to the sector. Although the general cross cutting policies are by definition relevant to the sector, it is assumed that MTI would implement them irrespective of the sector. As there will be no additional actions, and accordingly costs, related to the specific sector, these are not considered below.

Although each policy is presented independently, it is clear from the outline below that substantial efficiency could be achieved if all are considered collectively. Auditing is a case in point, as for policy 6, it will be needed to establish a baseline reference to which proposed technologies for new facilities are to be compared, and for policy 11 a/b, it will be required to identify bankable projects. Moreover, auditing is proposed to be integrated in the certification process of consulting firms and individuals, which could not only feed in the previously mentioaned policies but also as a source of information to enrich the information platform discussed below in policy 10.

As explained in a previous section, the subsectors taking precedence are those in Quadrant A of figure 11b, as these are both consuming a higher than average share of the total sector's energy consumption and their energy costs represents a higher than sector's average share of value added. Convesely, the ones with the lowest priority as those in Quadrant D. Most of the programs described below conform to these priorities.

Policy 1: Incorporate EnMS in export procedures.

SECTION 1: PROGRAM DEFINITION

Program Name:	Incorporate EMS in export procedures
Program Owner:	IDA
Scope of the program:	Energy intensive, large and exporting sub-sectors namely, cement industries and ceramics industries
Rationale behind it:	Sectors exporting energy intensive products should have an operative energy management system (EMS), reported energy data and approved and implemented EE plan.
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget Enhance Energy & Resources Efficiency

Section 2: Program Operational Conditions

	High	Medium	Low
Priority:	√		
	Risk	Likelihood	Impact
Risks Associated	*Unfair practices* To mitigate, criteria upon which EnMS certification is offered and criteria upon which EnMS implementation is considered satisfactory should be clear, transparent and publicly available	Low	Low (with mitigation)
Stakeholders / Implementation Partners:	**Policy Owner** IDA **Supporting stakeholders** ENCPC Export councils of relevant industry and FEI Foreign trade sector **Facilitating stakeholders (not directly involved)** NQI NQI / ITC Foreign trade training center **Evaluating stakeholders** Policy Unit at MOI		
Budget Initial Investent	EGP 200,000 (study of export duty per product, including consultation) Total depends on decision concerning number of products EGP 200,000 capacity building		
Budget Operation	EGP 150,000 increase 10% Yearly (system management, mostly salaries)		

Donor:	None needed
Pre-requisites	Establishment of RE and EE unit under IDA Pre-policy, NQI will create an inventory of energy service providers/consultants catering for all industries and establish a system to accredit EMS consulting firms

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying: (In yearly quarters)	Q 4 2019
End date: (In yearly quarters)	Continuous

Task break down:	Duration	Owner	Precedence
Activities already done for other policies/sectors • Set templates for data and plans for each sector • Set mechanisms for data collection, assessment, analysis and revision. • Set mechanisms for plan collection, assessment, analysis and follow-up.	3 months (Q1 2019)	IDA	
Personnel capacity building	On going	IDA/NQI	
Determine export duty on specific products	3 months (Q2 2019)	IDA/FT Sector	

Milestones:	• Annouce export duty on targteted products (Q3 2019) • Set mechanisms for data collection, assessment, analysis and revision • Set mechanisms for plan collection, assessment, analysis and follow-up

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Number of facilities on which export duty applies	Annually	Foreign trade sector, General Organization for Export and Import Control (GOEIC)	N/A	None (3 years after policy is in force)
% Compliance to plans	Annually	IDA	N/A	over 90% of facilities achieved their actual savings 70% or more of their planned savings for a specific year (5 years after policy is in force)
% facilities submitting correct data	Annually	IDA	N/A	100% (3 years after policy is in force)

Planned Outcomes	• Sustained energy consumption reduction: Facilities will be continuously seeking the best fit reduction in energy consumption per unit product for their facilities. • Extensive information on industries: Data generated periodically from

	the facilities in an agreed format providing a much needed information database

Policy 2: Incorporate EMS as a condition for state procurement

SECTION 1: PROGRAM DEFINITION

Program Name:	Incorporate EMS as a condition for state procurement
Program Owner:	IDA
Scope of the program:	FMI products of which the State is a large consumer , or for which decision by the State to include in ration card opens this wide market
Rationale behind it:	The government has the right to stipulate certain conditions on the products it acquires or cause to be acquired including that such products are sourced from manufacturing facilities with an operative EnMS system, which report energy data and implement their plans to pursue EE.
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget Enhance Energy & Resources Efficiency

Section 2: Program Operational Conditions

	High	Medium	Low
Priority:	√		
	Risk	Likelihood	Impact
Risks Associated	*Unfair practices* To mitigate, criteria upon which EnMS acceptance is granted and criteria upon which EnMS implementation is considered satisfactory should be clear, transparent and publicly available	Low	Low
Stakeholders / Implementation Partners:	**Policy Owner** IDA **Supporting stakeholders** National Quality Institute (NQI) Industrial training council (ITC) General Authority for Government Services (GAGS) Relevant ministries, which purchase or cause FMI products to be purchased **Facilitating stakeholders (not directly involved)** NQI ITC		

	Evaluating stakeholders Policy Unit at MOI
Budget Initial Investment	All acivities wih the exception of agreement with ministries are already covered through other programs
Budget Operation	EGP 150,000 increase 10% Yearly (system management, mostly salaries)
Donor:	None needed
Pre-requisites	Establishment of RE and EE unit under IDA Pre-policy, NQI will create an inventory of energy service providers/consultants catering for all industries and establish a system to accredit EMS consulting firms

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying the strategy: (In yearly quarters)	Q4 2017
End date: (In yearly quarters)	On going

Task break down:	**Duration**	**Owner**	**Precedence**
Activities already done for other policies/sectors • Set templates for data and plans for each sector • Set mechanisms for data collection, assessment, analysis and revision. • Set mechanisms for plan collection, assessment, analysis and follow-up.	3 months (Q1 2019)	IDA/FEI	
Personnel capacity building	On going	IDA/NQI	
Consultations and consensus building with different ministries	Q2/3 2019	IDA/GAGS	

Milestones:	• Policy announcement, including schedule below (Q4 2019) • Policy application by the ministry of Defense (Q1 2020) • Policy application by the ministry of Interior (Q3 2020) • Policy application by the ministry of supply (Q1 2021) • Policy application by the ministry of health (Q2 2021) • Polcy application by the min istry of education (Q3 2021)

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Number of bidders for tenders	Annually	Government entity issuing the tender	N/A	Annual increase
% Compliance to plans	Annually	IDA	N/A	over 90% of facilities having their actual savings 70% or more of their planned savings for a specific year (5 years after policy is in force)
% facilities submitting correct data	Annually	IDA	N/A	100% (3 years after policy is in force)

Planned Outcomes	• Sustained energy consumption reduction: Facilities will be continuously seeking the best fit reduction in energy consumption per unit product for their facilities. • Extensive information on industries: Data generated periodically from the facilities in an agreed format providing a much needed information database

Policy 6: Ensuring efficient energy performance of new facilities, operations and processes

SECTION 1: PROGRAM DEFINITION

Program Name:	Ensuring efficient energy performance of new facilities, operations and processes
Program Owner:	IDA
Scope of the program:	Large and medium facilities (small facilities could be considered at a later stage)
Rationale behind it:	Ensuring efficient energy performance of new facilities, operations and processes through limiting license provision to targeted facilities unless: • the production technology employed is at least at par with that of the most efficient of local manufacturers, or at least energy efficiency is thoroughly considered and technology selected justified. • If the promoter is committed to establish its EnMS (noting that the accompanying EE plan will not include significant interventions such as equipment change for some time)
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget Enhance Energy & Resources Efficiency

SECTION 2: PROGRAM OPERATIONAL CONDITIONS

	High	Medium	Low
Priority:		√	
Risks Associated	Risk	Likelihood	Impact
	The lack of information on the "best in class" locally makes the reference for decision making lacking . An initial survey could be considered, or a thorough analysis be required from the project promoter .	High	Low (after mitigation)
Stakeholders /	**Policy Owner**		

Implementation Partners:	IDA **Supporting stakeholders** ENCPC/ECO-FEI **Facilitating stakeholders (not directly involved)** NQI ITC **Evaluating stakeholders** MTI Policy and Strategy Unit
Budget, Initial Investment	EGP 300,000 for survey prior to policy implementation EGP 25,000 for updating EIA guidelines (already considered for other sectors, double counting should be avoided) EGP 50,000 for setting, and consultation, on requirements for planning and reporting (already considered for other sectors, double counting should be avoided)
Budget Operation	EGP 150,000/year (10% increase per year) for data base maintenance
Donor:	None needed
Pre-requisites	Pre-policy implementation, ENCPC will support in setting systems for EE plans and data acquisition mechanism, which would be similar to other sectors. A survey of the most advanced FMI facilities (in each sub-sector) could be considered, given budget availability, to inform decision maker of the local best in class reference.

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying: (In yearly quarters)	Q2 2019
End date: (In yearly quarters)	On going

Task break down:	Duration	Owner	Precedence
Research local market	3 month (Q1 2019)	IDA/ENCPC	
Update EIA guidelines and EE conditions imposed	H2 2019	IDA	
Database maintenance	Continuous	IDA	Database established (**already accounted for other sectors**)

Milestones:	Data base established (Q1`2019) EE requirements announced (Q3 2019) EE requirements applied (Q4 2019)

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target

Facilities denied a license due to failure to abide by EE requirements	Annually	IDA	N/A	0%
% facilities submitting correct data	Annually	IDA	N/A	100% (3 years after policy is in force)
Planned Outcomes	• Sector upgrade: Introduction of EE technologies to the market, improving the sector's energy performance • Raising awareness: Signaling to the other market players that the best technologies are available and operative locally. This can be supported by case studies.			

Policy 5: Reach out to SMEs through intermediaries

SECTION 1: PROGRAM DEFINITION

Program Name:	Reach out to SMEs through intermediaries
Program Owner:	The Agency for Development of Micro, Small and Medium projects MSMEDA
Scope of the program:	Small and Medium industries
Rationale behind it:	Industrial SMEs are distributed geographically, are large in number and possess limited financial, technical and organizational capacities. Given these constraints this policy aims to build-up and strengthen the capacities of industrial organizations (FEI's Chamber of food industries as well as production cooperatives) such that they can independently support their members on matters regarding EE.
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget and Enhance Energy & Resources Efficiency

SECTION 2: PROGRAM OPERATIONAL CONDITIONS

	High	Medium	Low
Priority:		√	
	Risk	Likelihood	Impact
Risks Associated	The agenda of the Agency is full and energy efficiency might not be a priority. Energy efficiency should be considered under resource efficiency and waste minimization which are pressing issues to improve productivity.	Moderate	Moderate

Stakeholders / Implementation Partners:	**Policy Owner** The Agency for Development of Micro, Small and Medium projects **Supporting stakeholders** Production cooperatives and Federation of Egyptian Industries (FEI) Ministry of finance **Facilitating stakeholders (not directly involved)** MTI Industrial technological development sector (including ENCPC) IDA **Evaluating stakeholders** The Agency for Development of Micro, Small and Medium projects (MSMEDA) MTI Policy and Strategy Unit
Budget Initial investment	• EGP 300,000 for first audits Could be considered in conjunction with audits in for policy 11 a and b below Award program replaces it later as a source of information • EGP 25,000 Tailoring award program already developed for other sectors • EGP 120,000 training for personnel capacity building
Budget Operation	• EGP 1,000,000 Awards granted for first and second rounds (2 years), To be replaced by CSR contributions of large companies in the sector afterwards • EGP 100,000 Publishing and dissemination To be replaced by CSR contributions of large companies in the sector afterwards • EGP 250,000 for System management (mainly salaries)
Donor:	None needed

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying: (In yearly quarters)	Q3 2019
End date: (In yearly quarters)	On going

Task break down:	Duration	Owner	Precedence
1. Conduct audits to develop best practices guidelines	2months (Q1 2019)	ENCPC	
2. Publish first version of guidelines (Distributed through industrial associations)	Q2 2019	MSMEDA	Activity 1
3. Engage financiers	H1 2019	Agency/Ministry of Finance	
4. Develop award programs, including criteria, application templates and data required	Q2 2019	Agency	
5. Publicize and grant awards	Yearly	Agency	Activity 4
6. Disseminate case studies (through industrial associations)	Yearly	Agency	Activity 5

Milestones:	• Funding system operational (Q3 2019) • First awards granted (Q1 2020)

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Guidelines issued for all FMI sub-sectors	Annually	Agency	N/A	100% of industrial sectors (in 3 years)

Number of award applicants	Annually	Agency	N/A	More than 20% yearly increase
Number of facilities requesting finance	Annually	Production cooperatives and FEI	N/A	100% annual increase (for the first 5 years)

Planned Outcomes	• Awareness: Heightened awareness regarding potential for EE with SMEs • Improved conditions: Alleviating burdens on SMEs due to energy price hikes • Capacity building: Strengthening the role of industrial associations • Better insight on SME by obtaining energy data regarding SMEs industries from awards, audits and financed projects. • Institutional strengthening: Stronger reliance on, and affiliation to, industrial organizations

Policy 8: Link Qualified consulting Services to rising demand on Energy efficiency technologies

SECTION 1: PROGRAM DEFINITION

Program Name:	Link Qualified consulting Services to rising demand on Energy efficiency technologies
Program Owner:	National Quality Institute (NQI)
Scope of the program:	Technical consultants and consulting firms
Rationale behind it:	This policy is needed due to the foreseen rise of demand that will put pressure on the quality of the services performed in the different engineering fields.
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget and Enhance Energy & Resources Efficiency

Section 2: Program Operational Conditions

	High	Medium	Low
Priority:	√		
	Risk	Likelihood	Impact
Risks Associated	Limited NQI capacity to manage all sub-sectors (especially likely given demands related to other industrial sectors)	Likely	Low with Mitigation (gear program to common processing technologies)
Stakeholders / Implementation Partners:	**Policy Owner** National Quality Institute (NQI) **Supporting stakeholders** ITC IMC		

	FEI **Facilitating stakeholders (not directly involved)** Donor Funded projects Technical training centers **Evaluating stakeholders** Ministry of trade and industry-Policy unit and/or Egyptian Accreditation Council (EGAC)
Budget: Initial Investment	EGP 25,000 Tailor registration and certification system (already designed for other sectors) EGP 50,000 design training and prepare material EGP 50,000 equipment and training needed in NQI to manage system
Budget Operation (yearly)	All based on 2 iterations per year EGP 150,000 Training EGP 1,500,000 Audits accompanying training EGP 50,000 workshop to discuss results EGP 50,000 transpose information to other uses (awareness, financing, …)
Donor:	None needed
Pre-requisites	

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying: (In yearly quarters)	Q1 2019
End date: (In yearly quarters)	On going

Task break down:	Duration	Owner	Precedence
1. Establish the registration mechanism	1month Q1 2019	NQI	
2. Build the operating model of the accreditation prerequisites and processes, including templates and forms and renewal process	3months Q1 2019	NQI	
3. Communicate system to service providers and beneficiaries	Q3 2019 onwards	NQI	
4. Training registered entities wishing to be accredited	Periodical (starting twice a year) Q4 2019	NQI/ENCPC	
5. Audit program as field training (scope selected to feed into policies 5 above and potential bankable projects to 11a/b below)	Periodical in conjunction with training	IMC/ENCPC	
6. Certified individuals or firms apply for renewal	Suggested to be every 2 or 3 years	NQI	
7. Information acquired feeds into policy 10, as database and as disseminated material (within confidentiality constraints) 8. Information complements IDA's database, as needed	Periodical in conjunction with training	FEI IDA	

Milestones:	• Accredited Consulting Firms & Individuals

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Number of consulting services providers registered	Annually	NQI	N/A	N/A
Number of consulting services providers accredited in specific technical field	Annually	NQI	N/A	N/A
satisfaction rate of beneficiaries	Annually	IMC/FEI	N/A	>75%
% of non-renewed consulting firms of total registered firms	Annually	NQI	N/A	<< the registration growth rate (to maintain a rich pool of consultants)

Planned Outcomes	• Pool of qualified technical / engineering consultants: A regulated market with accredited consultants to ensure that the service offered is up to standards • Satisfaction due to receiving quality services: Mapping the beneficiaries satisfaction ensuring continuous feedback mechanism to avoid defaults • Input to bankable projects • Input to information base and dissemination

Policy 10: Create an awareness mechanism that leverages integrated information related to IEE

SECTION 1: PROGRAM DEFINITION

Program Name:	Create an awareness mechanism that leverages integrated information related to IEE
Program Owner:	Federation of Egyptian Industries (FEI)
Scope of the program:	Banks, government, industrial sector, with its various sizes and activities, and energy consulting services, in addition to all owners indicated across the other policies
Rationale behind it:	There is a need to tackle the general lack of information and awareness regarding Energy Efficiency, as well as provide a common knowledge platform
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export

	Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget and Enhance Energy & Resources Efficiency

Section 2: Program Operational Conditions

	High	Medium	Low
Priority:	√		
	Risk	Likelihood	Impact
Risks Associated	None		
Stakeholders / Implementation Partners:	**Policy Owner** Federation of Egyptian Industries (FEI) **Supporting stakeholders** IMC **Facilitating stakeholders (not directly involved)** IDA, NQI, EOS, MOF, ERA, Banks, Industrial Sector, Energy Consulting Services **Evaluating stakeholders** FEI MTI's Policy and Strategy Unit		
Budget: Initial Investment	• EGP 150,000 initial awareness campaign • EGP 50,000 develop communication plan Information base should have been already established for other sectors, which uses FEI existing platforms. If this is not the case, an additional investment will be needed		
Budget Operation (yearly)	• EGP 25,000 Incremental costs of adding information of the FMI sector to an existing information base • EGP 50,000 dissemination of information On the longer term, cost will be borne by advertising equipment suppliers		
Donor:	None required		
Pre-requisites			

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying: (In yearly quarters)	Q2 2019
End date: (In yearly quarters)	On-going

Task break down:	Duration	Owner	Precedence
Compiling and filtering information received	Q2 2019	FEI	Information Platform established and Information generation activities undertaken
Developing a communication plan, focusing on different interests of sub-sectors	Q3 2019	FEI	
Implement communication plan	Continuous form Q4 2019	FEI	
Monitor the impact of awareness mechanism	Q2 2020	FEI	

Milestones:	•

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Number of data requests	3 months	FEI	N/A	N/A
Number of independent hits	3 months	FEI	N/A	Yearly growth rate >50% during the first 3 years

Planned Outcomes	• More integrated systems which mutually support towards boosting energy efficiency would allow all players to perform their roles more effectively. • This includes greater integration between Energy Consulting Services, Equipment suppliers and training entities as well as government in terms of planning, regulating, and monitoring. • Increased support from the banking sector as they become more aware of the different needs, technologies and nature of the energy efficiency. • Increased awareness across different industrial facilities: A decreased awareness gap between the different industrial facilities regarding the potential savings, technologies, services, financing and focus areas.

Policy 11a: Capitalize on FEI fund to subsidize Industrial Energy Efficiency Projects

SECTION 1: PROGRAM DEFINITION

Program Name:	Capitalize on FEI fund to subsidize Industrial Energy Efficiency Projects
Program Owner:	Federation of Egyptian Industries (FEI)
Scope of the program:	Industrial Energy Efficiency Projects with special focus on small and medium enterprises (SMEs).
Rationale behind it:	Some IEE projects may come at a cost that would be considered high for some facilities. This makes facilities, especially small ones hesitant to make the investment without external subsidized support of some sort. Therefore this policy opens the doors to industrial facilities to get on board and overcome their energy challenges.
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget and Enhance Energy & Resources Efficiency

Section 2: Program Operational Conditions

	High	Medium	Low
Priority:			
	Risk	Likelihood	Impact
Risks Associated	This policy may face risks that pertain to the implementation side	Likely	Low with mitigation, a strong monitoring and evaluation process must be put into place to guarantee that funds are managed in a transparent manner.
Stakeholders / Implementation Partners:	**Policy Owner** Federation of Egyptian Industries (FEI) **Supporting stakeholders** Ministry of Finance		
Budget: Initial Investment	• EGP 25,000,000 infusion from ministry of finance • EGP 50,000 consultation with beneficiaries to refine funding system		
Donor:	None needed		
Pre-requisites	A funding system is effectively operational already in FEI		

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying (In yearly quarters)	Q1 2019
End date: (In yearly quarters)	On going

Task break down:	**Duration**	**Owner**	**Precedence**
Refine the mechanism for evaluating and selecting from applicants	6 months (H1 2019)	FEI/Ministry of Finance	
Build a database of approved service providers	6 months (H1 2019)	FEI	
Manage fund disbursement	Continuous	FEI	
monitoring and evaluation	Continuous	Ministry of Finance/MTI policy and strategy unit	
Put forward a fund-raising and lobbying party to further increase the funds available	Continuous (start Q4 2019)	FEI	

Milestones:	• Refined funding mechanism approved

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Disbursed funds	Bi-annually	FEI	N/A	N/A
% Energy saved due to implementing IEE projects from FEI loans	Annually	FEI	N/A	N/A

Planned Outcomes	• This policy should enable FEI to channel energy efficiency subsidization efforts to deserving small and medium enterprises that otherwise would not be able to afford the investment.

Policy 11b: Augment cooperatives fund to finance IEE projects

SECTION 1: PROGRAM DEFINITION

Program Name:	Augment cooperatives fund to finance IEE projects
Program Owner:	The Agency for Development of Micro, Small and Medium projects
Scope of the program:	Food Industry cooperatives
Rationale behind it:	This Policy will augment the funds available to the cooperatives in order to finance industrial energy efficiency projects for its members. In order to increase this fund, it is proposed that the Ministry of Finance establishes a cooperation protocol with the Cooperative Union to finance its members in order for them to undertake EE projects and interventions based on certain terms and conditions
Which MTI Strategy 2020 Strategic Objectives it supports:	Increase industrial growth Increase the contribution of industrial product to GDP Increase the growth rate of export Provide decent and productive job opportunities
Which of the ten dimensions does it support:	Expand R&D Budget and Enhance Energy & Resources Efficiency

SECTION 2: PROGRAM OPERATIONAL CONDITIONS

	High	Medium	Low
Priority:	√		
	Risk	Likelihood	Impact
Risks Associated	The fund may be used to finance projects other than energy efficiency projects or remain under-utilized. Thus, apart from specifying the amount of finance to be made available to the Union, the protocol states that the amount will gradually increase over time in accordance with the interest expressed by the SMEs and the success of projects undertaken by them.	Likely	Low (with mitigation, A strong monitoring and evaluation process must be put in place to guarantee that funds are managed in a transparent manner)
Stakeholders / Implementation Partners:	**Policy Owner** The Agency for Development of Micro, Small and Medium projects **Supporting stakeholders**		

	Production cooperatives Ministry of Finance IMC and MTI's Industrial technological development sector (including ENCPC) **Facilitating stakeholders (not directly involved)** NQI /ENCPC **Evaluating stakeholders** The Agency for Development of Micro, Small and Medium projects
Budget: Initial investment	• EGP 300,000 for initial audits , to assess financial needs Could be considered in conjunction with audits in policy 5 above • EGP 50,000, to tailor as needed protocol terms and conditions, the mechanism for evaluation and selection and the monitoring and evaluation system • EGP 50,000 training and capacity building of personnel • EGP 10,000,000, Preliminary funding for EE investments in MSMEs
Budget Operation	EGP 250,000/ year for system management (mainly salaries)
Donor:	

SECTION 3: IMPLEMENTATION TIMELINE

Start date for deploying: (In yearly quarters)	Q2 2019
End date: (In yearly quarters)	On going

Task break down:	Duration	Owner	Precedence
1. Assess financial needs through targeted audits	3months (Q 1 2019)	ENCPC	
2. Tailor the protocol's terms and conditions, the mechanism for evaluating and selecting applicants and the monitoring and evaluation system	Q2 2019	Agency (in cooperation with cooperatives and Ministry of finance)	None
3. Operationalize cooperation protocol	Q3 2019	Agency	Activity 1-4
4. Manage fund disbursement	Continuous	Cooperatives	Activity 1-4
5. Monitor disbursement and compliance with terms	Periodical	Agency	Activity 1-4

Milestones:	• Implementable system for funding EE in MSMEs through cooperatives • Funds allocated through Ministry of finance • Funding system announced

SECTION 4: MONITORING & EVALUATION

Key Performance Indicator	Frequency of Measurement	Data Owner	Baseline	Target
Increase in disbursed funds	Measured every quarter to track growth in reach	Ministry of finance	N/A	N/A
Increase in loan applications	Measured every quarter to track growth in reach	Cooperatives	N/A	N/A
% Energy saved due to implementing IEE projects from Cooperatives Union	Every 6 months	Cooperatives	N/A	N/A

Planned Outcomes	• Increased reach to SMEs: This policy enables cooperatives to provide a channel for the finance associated with energy efficiency projects to deserving small enterprises that otherwise would not be able to afford the investment nor would be successful at applying for grants to finance it. Some small enterprises do not deal with banks, limiting their financing options. • Overcome the challenge with non-bankable facilities as much as feasible. To this end it is able to reach and provide support to the non-bankable segment of SMEs and facilities that face challenges and obstacles in their access to finance. • Improved conditions: Alleviating burdens on SMEs due to energy price hikes • Institutional strengthening: Stronger reliance on, and affiliation to, industrial organizations • Better knowledge on small industries: Micro-data of the different small industries will be acquired

Annexes

Annex I

Energy Saving measures in the FMI

The report shows how most of the food manufacturing subsectors share closely-related processing concepts. Therefore, this annex presents the energy saving measures that can be done clustered, into simple and complex measures; simple measures (no or low investments) are those techniques that do not require major changes, adjustments or high financial investments, while complex (high investments) measures are those characterized to bring about some changes and/or incorporate relatively high initial investments[75].

1.1) Simple measures include

1.1.1) Energy Conservation in Refrigeration through Maintenance and Optimization: keeping regular maintenance for the refrigerators and remove unnecessary parts of the products to reduce cooling load and hence energy.

1.1.2) Energy Conservation in Steam Generation System through:

- **Optimal Design and Operation:** The energy savings for a boiler system can be divided into two categories: design and operation optimization and waste-heat recovery. The optimization may include
  - Proper size of a boiler
  - Proper pressure and temperature of steam
  - Optimal amount of excess air
  - Optimal amount of blowdowns
- **Energy Recovery from Flue Gas:** Stack heat recovery systems can improve boiler efficiency by as much as 15%. When possible, heat from the stack should be recovered. An economizer can efficiently recover wasted stack heat and transfer it to boiler makeup water. The limiting factor for flue gas heat recovery is that the economizer wall temperature should not drop below the dew point of acids in the flue gas.
- **Energy Recovery from Blowdown Water:** If the right equipment is used, up to 78% of the heat stored in blowdown water can be recovered. To reduce energy loss through the high-temperature and high-pressure blowdown water, the heat content in the blowdown water can be recovered via either a heat exchanger or a flash steam generator.

1.1.3) **Energy Conservation In Compressed Air Systems: energy saving for a** compressed air system can be achieved by[76]

[75] https://www.oxford.gov.uk/info/20064/conservation/1200/checklist_for_energy_efficiency_measures_in_historic_buildings/2

[76] Kaya, D., Phelan, P., Chau, D., & Sarac, H. I. (2002). Energy conservation in compressed-air systems. International Journal of Energy Research, 26(9), 837-849. DOI: 10.1002/er.823

- **Repairing of Air Leaks:** Air leaks are the greatest single cause of energy loss from a compressed air system in manufacturing facilities. The cost of compressed air leaks is the cost of the energy required to compress the lost air from the atmospheric pressure to the compressor operating pressure. Leaks often represent as much as 25% of the output of an industrial compressed air system (Terrell, 1999). Eliminating air leaks totally is impractical, and a leakage rate of 10% is considered acceptable in practice (Cerci et al., 1995). The cost of compressed air leaks increases exponentially with the increase in leak diameters. Repairing of air leaks may involve replacement of couplings or hoses, replacement of seals around filters, shutting off air flow during break periods, or repairing breaks in lines. All these costs should be very low (estimated at $20/leak). Therefore, the payback period for the implementation cost is very short (Cerci et al., 1995).
- **Reduced Air Pressure:** A small change in motor speed can cause a significant change in energy consumption. Different tools and process unit operations may require compressed air at different pressures. Therefore, energy conservation can be achieved with energy efficient motor retrofits.
- **Reduced Air Inlet Temperature:** Compressors generate heat during operation. The energy consumption increases with the increase in air intake temperature. If the air intake temperature increases by 10°C from the outside temperature of 25°C, the energy consumption of the compressor will increase by 3.35%. For multi-stage compression, the heat generated by compression work may increase the air temperature to be as high as 205°C if no cooling unit is installed. Cooling the air between stages or using its heat for another process that requires heat can increase the density of the air and reduce the power required for compression (Mull, 2001).

1.2) Complex measures include:

1.2.1) High-Efficiency Motors:

Most industrial equipment in manufacturing facilities is powered by electric motors. The electrical energy that a motor consumes to generate a specified power output is inversely proportional to its efficiency. Electric motors cannot completely convert the electrical energy consumed into mechanical energy. The ratio of the mechanical power supplied by a motor to the electrical power consumed during operation is called the efficiency of the motor. Therefore, high-efficiency motors cost less to operate than their standard counterparts. Motor efficiencies range from about 70% to over 96%.

Replacement of equipment using a standard motor with an energy efficient motor can result in a decrease in energy consumption. To obtain optimal energy efficiency, compressors should run at their full-specified load. In addition, variable-speed motors can be used to meet varying air demands.

Motor drives are large electricity users in the FMI, which consumes about 48% of the total electricity use, respectively (Wang, 2009). The energy loss in a motor is in the range of 5 to 30%. The energy losses in motors are usually caused by low power factor, improper motor load and poor control.

Most motors operate in a fashion that requires both real power due to the presence of resistance and reactive power due to the presence of inductance in the motors. Increase of power factors should be considered for improving electrical efficiency and reducing the energy costs of motors. Motors are designed to operate most efficiently under their rated loads. Therefore, it is an effective way to conserve energy by matching the required loads with the rated loads of motors.

1.2.2) Waste heat recovery:

Any processing air, vapor and water effluent streams above the ambient temperature may be an energy source. Boiler flue gas, boiler blowdown water, steam condensate, exhaust gas from dryers and ovens, cooling air and water from air compressor and large motors, and vapor from cookers are the examples of waste heat sources. By recirculation and recovery of waste heat the energy consumption of food processing facilities could be cut by 40%.

In food processing facilities, there are large amounts of low-temperature waste-heat streams. Waste-heat streams can be used directly to increase the temperature of boiler feed water. It is possible to reduce 15%–50% to the fuel requirement of a boiler if all waste heat in a food processing facility can be extracted into the boiler feed water. It is technically feasible to recover heat energy from waste streams either directly or indirectly to reduce boiler energy requirements from 3% to 10%. Waste heat from many high-temperature unit operations can be recovered with heat exchangers for lower-temperature uses. Heat pumps can be used to upgrade low-temperature heat sources to higher-temperature energy sources. In some cases, thermal storage systems are required to store either high-temperature or low-

temperature surplus recovered thermal energy or energy generated during off-peak demand periods for use during peak demand periods. [77]

1.2.3) Non-thermal Processing

Thermal processes are usually considered to be energy intensive. In addition, the slow heat transfer through food products due to the low thermal conductivity of foods is usually a limiting factor for thermal treatment of food products. Non-thermal pasteurization techniques including food irradiation, pulsed electric field treatment, and high-pressure processing, as well as microwave sterilization have been developed to replace or combine with conventional thermal sterilization and pasteurization processes for saving energy and improving product quality and safety. These non-thermal processing times are usually short. For example, during high-pressure processing, foods are exposed to pressure up to 600 MPa for a few minutes. Pulsed electric field treatment is based on the delivery of pulses at a high electric field intensity of 5–55 kV/cm for a few milliseconds. Food irradiation occurs for several seconds to several minutes. Most alternative preservation processes can achieve the equivalent of pasteurization but not sterilization (Amymerich et al., 2008).[78]

1.2.4) Cogeneration

Cogeneration is the process of sequentially producing both electricity and steam from a single fuel source. A cogeneration facility uses some of the thermal energy for food processing and space heating from an electric power plant. Otherwise, this thermal energy is rejected to the environment. Furthermore, if industrial steam is generated at a pressure and temperature above that required for end use, steam can be brought down to the desired pressure and temperature through a turbine generator for additional electricity (Teixeira, 1986). Cogeneration can produce a given amount of electric power and thermal energy for 10% to 30% less fuel than a power plant, which produces the same amount of electricity alone (Capehart et al., 2005). For many food processing facilities, cogeneration offers a way to provide both low-cost electric power and large amounts of thermal energy needed for processing heat. Since both processing heat and electricity are required in food processing facilities, a combined heat and power system can be used to efficiently and economically provide electricity or mechanical power and useful heat from the same primary energy source[79].

[77] Wang, L. (2009). Energy efficiency and management in food processing facilities. Boca Raton: CRC Press/Taylor & Francis Group.
[78] Wang, L. (2009). Energy efficiency and management in food processing facilities. Boca Raton: CRC Press/Taylor & Francis Group.
[79] Wang, L. (2009). Energy efficiency and management in food processing facilities. Boca Raton: CRC Press/Taylor & Francis Group.

1.3) Specific Subsector Saving Measures from International Experiences:

1.3.1) Cogeneration in a pasta manufacturing factory: In a pasta manufacturing factory, the process consumed, on average, about 1.3 MJ of thermal energy and 1.28 MJ of electricity to produce each 1 kg of pasta. A combined heat and power generation plant with a gas turbine as its mover was used in the factory (Panno et al., 2007). A typical gas turbine works above 800°C and the temperature of flue gas is 430°C–540°C. The temperature of the flue gas from a recovery heat exchanger is between 130°C and 160°C, which can be used to produce high-temperature sub-cooled water for pasta drying at a temperature of about 140°C. The overall efficiency of electricity generation was estimated at 22%–26% while the overall CHP system efficiency was about 70%–80%. The CHP system reduced the primary energy demand by up to 9% and CO2 emission by up to 9% in the pasta plant (Panno et al., 2007)[80]

1.3.2) Energy-efficient drying technology in sugar industry: By using mechanical screw presses to remove as much water as possible from sugar beet pulp before drying, the British Sugar Beet factory at Wissington, in the United Kingdom, decreased the energy consumed by its dryers, saving 55.8% in primary energy use (Best Practice Programme, 1997, in Wang, 2009). As a result of measures such as these, between 1990 and 2009 the company achieved a 25% reduction in the amount of energy used to produce a tonne of sugar. The company is currently seeking to achieve a 30% reduction in the amount of energy it uses to produce a tonne of sugar by 2020, as measured against the same 1990 baseline (British Sugar, 2010).[81]

1.3.3) Increasing waste heat recovery in chocolate manufacturing: In 2010, food and beverage company Nestlé upgraded the coal-fired plant at its chocolate factory at Halifax in the United Kingdom to a system that could was able to trap waste heat wasted from refrigerating chocolate and then convert it in order to shape chocolate products. The new system, which reportedly has a 15% higher energy efficiency rate than the previous system, has enabled the factory to reduce its CO2 reduction by 1.1 million pounds annually, and saves the company almost USD 400 000 in energy costs a year (Kaye, 2013).[82]

[80] Wang, L. (2009). Energy efficiency and management in food processing facilities. Boca Raton: CRC Press/Taylor & Francis Group.
[81] http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=COM/TAD/CA/ENV/EPOC(2016)19/FINAL&docLanguage=En
[82] http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=COM/TAD/CA/ENV/EPOC(2016)19/FINAL&docLanguage=En

1.3.4) **Combined heat and power plants reducing fuel consumption in sugar industry**: At British Sugar factories, coal, oil or gas are used to fuel water boilers which produce the steam needed for electricity generation for the factory. The steam is used again in the evaporation stages, and later to heat the sugar juice throughout the process. At several factories, more electricity is generated than the factory requires. In 2008, in addition to meeting over 94% of its own electricity requirements, British Sugar's CHP plants generated an additional 700 000 MW hours of electricity which for export to the local electricity network. Combined cycle gas turbines have been installed at two factories in the United Kingdom, enabling the company to extract around 80% of the energy contained within the fossil fuel used during a production campaign – double the amount extracted by a conventional power station. This substantially reduces fuel consumption and associated CO2 emissions (British Sugar, 2010)[83]

1.3.5) **Energy-efficient drying technique for modern pasta manufacturing factories:** A modern pasta drying process at high temperatures has four steps: shaking pre-dryer to enhance the mechanical strength of pasta, pre-dryer at 90°C to reduce water content of pasta from 35% to 16%, dryer at 75°C–80°C to reduce the water content to 12.5%, and product cooling to a temperature of about 35°C (Panno et al., 2007). The process consumes, on average, about 1.3 MJ of thermal energy and J of electricity to produce each one kilogram of pasta. The highest energy losses occured in the drying chamber walls due to air leakages. The energy efficiency could be thus improved by isolation of the drying chamber[84].

1.4) Saving measures from national experiences:

1.4.1) **Replacing old steam boilers and obsolete production lies with modern and environmentally friendly ones can save energy losses and reduce emissions:** Old boilers in a factory located in Kafr Saad city in Damietta governorate, which manufactures poultry feed by mixing a number of important nutrients for chicken growth have old steam boilers which significantly contribute to the loss of about 25% of energy consumed (along with other negative environmental impacts), can reduce energy losses to 10% by modernizing equipment and steam boilers[85]

[83] http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=COM/TAD/CA/ENV/EPOC(2016)19/FINAL&docLanguage=En

[84] Wang, L. (2009). Energy efficiency and management in food processing facilities. Boca Raton: CRC Press/Taylor & Francis Group.

[85] http://www.eco-fei.org/food-sector/

1.4.2) **Egyptian Food sector case study by SwitchMed:** shows that across many energy conservation measures carried out through 14 food and beverage companies, that the most energy reduction measures that were taken were steam and compressed air systems optimization as well as process modernization which entailed replacement of equipment using updated technologies[86].

[86] MED TEST II – SwitchMed – UNIDO – conference, 2018

Annex II

FMI Sector Energy Efficiency in the context of Wider Strategies

The MTI strategy for 2020 is the main umbrella under which this energy efficiency strategy for the FMI sector is developed. Accordingly, the compatibility of the two documents has to be ensured. In addition, the MTI has developed more specific strategies through the support of a number of donors, including the Industrial Innovation strategy, the SME strategy and the Technical and Vocational Education and Training (TVET) strategy. These are the general industrial strategies, in parallel to which several sector strategies were, or are being, developed.

Energy Efficiency is also compatible with strategic documents other than those developed by MTI. This annex addresses the compatibility with these multiple documents.

1. Industry-wide Strategies

The MTI 2020 strategy proposes a number of measures for achieving the 2020 objectives and goals. The vision driving the strategy is encapsulated in the following statement:

"Industrial development becomes the growth locomotive driving forward the sustainable inclusive economic growth in Egypt, responsive to domestic demand and supporting exports growth, so that Egypt becomes a vital player in the global economy, capable of coping with global fluctuations."

The main goals of the 2020 strategy are:
1. Increase the annual industrial growth rate to 8%.
2. Increase the contribution of industrial product to Gross Domestic Product from 18% to 21%.
3. Increase the micro, small and medium enterprises sector's contribution to GDP.
4. Increase the growth rate of exports to 10% annually.
5. Provide 3 million decent and productive job opportunities.
6. Institutional development

Energy Efficiency contributes to the above main goals as shown in table (A-1).

Table (II-1): Contribution of Energy Efficiency to MTI 2020 Strategy

MTI 2020 Strategic Goals	In Relation to Energy Efficiency
Increase the annual industrial growth rate to 8%.	To be within energy constraints, need to increase energy efficiency
Increase the contribution rate of industrial product to Gross Domestic Product from 18% to 21%.	Energy efficiency should reduce costs and consequently increase value added of industrial products and thus their contribution to GDP
Increase the growth rate of exports to 10% annually.	Similar to production growth, to be within energy constraints, need to increase energy efficiency. Moreover, lower costs resulting from energy efficiency would increase competitiveness. Finally, carbon foot print might become a competitive factor, although seemingly not in the short term.
Provide 3 million decent and productive job opportunities.	Part of these jobs could be in energy management. It will represent a small amount in the range of thousands of jobs and most of these jobs will result from industrial growth.

2. MSMEs and Entrepreneurship National Strategy

Support to the development of Micro, Small and Medium-sized Enterprises (MSMEs) and Entrepreneurship has become an over-arching priority for the Government of Egypt (GOE). In November 2016, MTI has launched a National Strategy to "Enhance Industrial Development and Exports" that laid the Ministry's plans for developing the industrial sector (five sectors were prioritized). Within the same document one pillar focused on developing MSMEs and linking the goals with the different prioritized sectors. The main policy areas of the MSMES strategy are:

1. Legal and Regulatory Environment. Objective: reducing the administrative burden and simplifying the regulatory environment for MSMEs, and Institutionalized mechanism for coordination and implementation of strategy
2. Access to finance. Objective: strengthening access to finance including financing products diversification, and innovative tools
3. Entrepreneurship Policies. Objective: Improving entrepreneurship's conducive environment and policies
4. Exports and integration into value-chains. Objective: expanding the capacity of MSMEs to integrate in local and global value chains
5. Business Development Services. Objective: Creating access to BDS

6. Cross Cutting Themes: Objective: Addressing women's entrepreneurship, environment, and technology.

The second pillar of the MSMEs Strategy related to access to finance can be directly linked to Policies 10 and 11 of the IEE Strategy by proposing raising the awareness of industries to the funds offered by the Central Bank of Egypt to support EE initiatives and provision of soft loans.

The fourth objective of the MSMEs strategy related to expanding the capacity of the MSMEs to integrate local and global value chains can be linked to Policy 5 of the IEE strategy as these support organizations should encourage sustainable business performance and assist MSMEs in being recognized for that.

As for Policy 10 of the IEE Strategy which proposes creating an awareness mechanism that leverages integrated information related to IEE, it can be linked to objectives 3, 5 and 6 of the MSMEs strategy by providing a link in the proposed web portal to the IEE platform to offer support to industrial startups, and including in the BDS database the service providers concerned with IEE knowledge and technology transfer that are relevant to SMEs.

The IEE Strategy could be linked to the MSMEs objectives as shown in Table (A-11).

Table (II-3): Linking IEE Polices to MSME Strategy Pillars

MSME Strategy Pillars / Actions	Cross-link with IEE strategy		
	Policy 5: Strengthen industrial organizations to provide IEE support	***Policy 10 : Create an awareness mechanism that leverages integrated information related to IEE***	***Policy 11: Strengthen industrial organizations to provide IEE support***
2. Access to Finance: • The SME strategy states that commercial banks are reluctant to provide tailored financial services/programs for SMEs because of the high risk and costs associated with it. • Thus, the Central Bank of Egypt (CBE) announced a new program to improve SMEs access to credit which aims at availing EGP 200 bn of bank credit over 4 years with competitive rates.		• The CBE program should be made known on the IEE platforms and encourage facilities to apply for these loans to finance EE measures. The banks offering financial services to SMEs should take advantage of the awareness mechanism suggested in policy 10 to regularly promote their products and services.	• A portion of CBE's EGP 200 bn should be channeled through the existing FEI fund to expand it. FEI - Environmental Compliance Office (ECO) will in turn provide its members access to soft loans. Support will ??? be extended to establish a dedicated ??? managed by the cooperative ????
3. Entrepreneurship Policies[87]: • Support start-ups through incubators, boot camps and business plan competitions • Information dissemination on existing service providers through web portal (This will include the activity of collecting information on existing providers, their services and procedures).		• As a support to startups, information on existing service providers will be disseminated through a web portal. This web portal should have a link to the IEE platform to offer support to industrial startups.	

[87] Difference between entrepreneurship policies and MSMEs policies: entrepreneurship policy is defined as policy measures taken before and up to three years after the start of business, MSME policy concerns measures after the first three years and is defined as publicly funded measures.

MSME Strategy Pillars / Actions	Cross-link with IEE strategy		
	Policy 5: Strengthen industrial organizations to provide IEE support	***Policy 10 : Create an awareness mechanism that leverages integrated information related to IEE***	***Policy 11: Strengthen industrial organizations to provide IEE support***
4. Internationalization and Inter-firm Linkages: • Non-exhaustive suggested actions: • Develop proactive capacity of existing MSME support organizations to assist MSMEs with export marketing opportunities, including ensuring a supply of trained private sector "brokers" to provide services to MSMEs.	• Support organizations should encourage sustainable business performance and assist MSMES in being recognized as such. • For example, assisting them in obtaining the required certification e.g. ISO for energy or environmental management.		
5. Business Development Services: • Non-exhaustive suggested actions: • Creating Database of existing MSME Business Development Services (BDS) providers including their qualifications, areas of expertise, services provided and cost, to be shared with partners.		• Include in BDS database the service providers concerned with IEE knowledge and technology transfer that are relevant to SMEs such as IMC	
6. Cross Cutting Themes: Non-exhaustive suggested actions: ***Environment (Clean Economic Growth & Climate Change):*** • Facilitative access to BDS including technology transfer, especially in the new growth sectors like renewable energy, logistics and recycling		• Include in BDS database the service providers concerned with IEE knowledge and technology transfer that are relevant to SMEs such as IMC	

4. Promotion of Small and Medium Enterprises Industrial Innovation Strategy

The Industrial Innovation Strategy was developed under the leadership of the Ministry of Trade and Industry with the objective of driving innovation in the industrial sector and competitiveness forward. This strategy takes the goals of Egypt's Sustainable Development Strategy (Egypt's Vision 2030) and MTI's Strategy 2020 further, as well as defines 11 key measures that contribute to reach the respective Key Performance Indicators (KPIs) from MTI´s and its affiliated institutions' side.

These measures build on the MTI's efforts by:

- Stimulating Innovation – an innovation culture that creates more ideas and motivates more companies to consider innovation as a promising way to increase competitiveness
- Enabling innovation – provision of improved framework conditions and knowledge to support industry and academia on how to innovate and accelerate innovative ideas
- Facilitating innovation –mechanisms to support industry and academia to turn those innovative ideas into actual products, processes, services and business models
- Commercialize innovation –new products and technologies on the market. The private sector in Egypt needs better support in obtaining access to national and international clients in order to be an integral part of national and global value chains

It is proposed to link this innovation strategy to Policies 5 and 10 of the IEE policies and strategy as detailed in table (II-4). Moreover, some additions as linked to industrial energy efficiency in the innovation strategy are also proposed.

Table II-4: Link between Innovation Strategy and IEE Policies

Elements of the innovation support chain	Measures of the innovation support chain	Cross link to IEE Strategy		Proposed Additions to the Innovation Strategy as linked to IEE
		Policy 5: Strengthen industrial organizations to provide IEE support	***Policy 10 : Create an awareness* mechanism *that leverages integrated information related to IEE***	
• **Stimulating Innovation**	• **<u>R&D</u>** • A Matching Fund is a collaborative fund aiming to develop innovative and competitive Egyptian products by supporting collaborative and applied R&D projects. • It aims to boost the industrial sector in Egypt by exploiting the research power in Egyptian universities and research centers, with the goal of developing innovative and competitive Egyptian products. • Takes the product from the ideation stage, through the proof-of-concept and prototyping stages, until it becomes a complete product ready to be introduced to the market.			• It is highly encouraged that the in-house R& D collaborate with members from academia and work towards acquiring the Matching Fund. However, it is suggested that innovation should not be restricted to products but also processes and technologies as there is plenty of room for innovation in these as well.

Elements of the innovation support chain	Measures of the innovation support chain	Cross link to IEE Strategy		Proposed Additions to the Innovation Strategy as linked to IEE
		Policy 5: Strengthen industrial organizations to provide IEE support	***Policy 10 : Create an awareness* mechanism *that leverages integrated information related to IEE***	
	• **<u>Awareness</u>** • The innovation strategy suggested Awareness for Innovation **(InnoAware)** as a measure to raise awareness about the importance of innovation for the competitiveness of the Egyptian Industry.		• Extend awareness campaigns **(InnoAware)** to innovation in resource use (e.g. rationalized water and energy use, reusing waste heat/ products, integrating RE in the facility.	
	• **<u>Knowledge sharing</u>** • The innovation strategy suggested developing and maintaining an online portal **(InnoPort)** to inform different industrial stakeholders (particularly SMEs) about innovation and related topics.		• The information sharing / awareness platform suggested under Policy 10 could be featured under the **InnoPort** (the central information portal owned by the MTI to increase knowledge about industrial innovation) as it would have a wider reach and more useful information to the company not just energy efficiency. The IEE platform should be accessible from the InnoPort and vice versa.	• Knowledge should also be reachable for those who are not "tech-savvy" i.e. available through periodical publications in Arabic and not just the website

Elements of the innovation support chain	Measures of the innovation support chain	Cross link to IEE Strategy		Proposed Additions to the Innovation Strategy as linked to IEE
		Policy 5: Strengthen industrial organizations to provide IEE support	***Policy 10 : Create an awareness* mechanism *that leverages integrated information related to IEE***	
	• **<u>Awarding</u>** • The innovation strategy suggested the **InnoAward** which acknowledges innovative companies and their efforts in order to create awareness for innovation and motivate companies to innovate.	• Policy 5 includes creating awards for the best energy performance in SMEs. • Innovation in improving energy performance may be promoted and SMEs undertaking the most innovative EE interventions and achieving measurable savings should also be awarded. The award can be granted along with the suggested **InnoAward**.		• The suggested InnoAward could include EE as one of the criteria upon which an award is granted
• **Enabling innovation**	• **<u>Industry and academia</u>** • The innovation strategy promotes collaboration between industry and academia.	• The collaboration between industry and academia should be reflected when forming guidelines on EE to be handed out to SMEs. Guidelines on EE handed out to SMEs should encourage critical thinking that enable innovation in energy efficiency and not only dictate specific, rigid measures to reduce consumption.		

Elements of the innovation support chain	Measures of the innovation support chain	Cross link to IEE Strategy		Proposed Additions to the Innovation Strategy as linked to IEE
		Policy 5: Strengthen industrial organizations to provide IEE support	***Policy 10 : Create an awareness* mechanism *that leverages integrated information related to IEE***	
• **Facilitating Innovation**	• **<u>Technology and Innovation Centers (TICs)</u>** • The innovation strategy suggests under the **TICs Support Scheme** strengthening the role and capacity of Egyptian TICs as an important service provider for Egyptian companies.			• The **TICs Support Scheme** will improve the ability of TICs to support enterprises in the broad field of innovation and thus can offer facilities assistance technical and otherwise along with ENCPC/IMC.

5. Relation to Ministry's TVET Strategy

The MTI Vocational Education and Training Strategy specifies that the productivity and vocational training department conducts training for more than 80,000 workers in upper and middle management, supervisors and foremen in industrial facilities. Training is currently being carried out in the fields of Industrial and production engineering, management systems and economic, technical and financial affairs.

Therefore, training in EnMS has to be introduced along with the other management systems. It is proposed to provide training to students who have not yet joined the workforce as well as for those who already joined the workforce and their companies. Upper and middle management should also be aware of the importance of having an EnMS in place. This will be particularly beneficial for the companies that are implementing an EnMS.

The productivity and vocational training department has an industrial apprenticeship system for more than 44 jobs. This system is setup by an agency specialized in setting specifications for professions, skill levels and the necessary applied technological knowledge. It is therefore advisable that applied technological knowledge includes energy efficient technologies and processes and means of rationalizing energy use in factory operations.

Annex III

Examples of Energy Efficiency Financing Facilities

1. Environmental Compliance Office and Sustainable Development (ECO SD)[88]

Then Environmental compliance office and sustainable development (ECO SD) of the Federation of Egyptian Industries (FEI) is providing a fund for Renewable energy and energy efficiency sector. This fund helps the different facilities to improve the energy efficiency through implementing a full energy management system. This leads to reduce the production costs and increases the competitive capacity of the products in local and international markets.

In this regards, ECO SD is providing the following:

- Preparing specialized technical studies on the applications of energy efficiency improvement for the industrial sectors.
- Providing soft loans (up to 3 million EGP) dedicated for financing the best technologies available.
- Helping with the efforts exerted locally aiming to save energy and improve the efficiency of its utilization by making a preliminary and detailed survey for companies.
- Implementing training sessions for the energy auditors in accordance with the ISO 50001 certificate for energy management.
- Providing integrated solutions and support in choosing the best available technologies.
- Adjusting the thermal performance of the operating boilers and furnaces in order to improve the combustion efficiency.
- Implementing the programs of the "Energy Management Systems". Diagnosing the situation of The energy consumption in the facility and the sources of energy loss, and applying the policies aiming at more efficient energy utilization.
- Performing all the measurements required for implementing the energy saving technologies in cooperation with acknowledged standards authorities.
- Measuring and correct the power factor.

2. Green technology Financing Facility[89] (GEFF)

In 2011, European Bank for Reconstruction and Development (EBRD), expanded its operations to include Egypt and some other countries of Southern and Eastern Mediterranean – SEMED region. EBRD developed the Sustainable Energy Financing Facilities (SEFF), because of the massive need for investment in energy sustainability in most of countries. Therefore, it developed financing facilities specially dedicated to medium- and small-scale energy efficiency and renewable energy investment projects.

[88] http://www.eco-fei.org/
[89] https://ebrdgeff.com/egypt/

Financing is based on the EBRD extending credit lines to local banks that participate in the Facilities. The EBRD's Egypt Sustainable Energy Financing Facility (EgyptSEFF), implemented by National Bank of Egypt (NBE), has recognized the best projects to highlight the successful completion of the pilot programme.

The second phase of this program was through Green Economy Financing Facility "GEFF", which provides loans to energy efficiency and renewable energy investments in Egypt. This loans could be for a technology, as replacing equipment, or for assisted projects.

- The pre-approved equipment and materials, which, exceeds minimum performance requirements and perform beyond current market practices resulting in clear benefits and environmental improvements. GEFF provides a Technology Selector Tool to help to identify the most suitable high-performing equipment and materials eligible for financing.
- Assisted Project Loans offers additional benefits such as an attractive investment incentive grant and free technical assistance.

Assisted Projects contributing to an improvement in energy performance should achieve Energy Savings equal to or greater than 20%.

Table (III-1): examples of applying the GEFF tool to save energy for the dyeing equipment[90]

System	Technology	Sub- Technology
Electric system	variable-speed drive (VSD)	Voltage – source inverter Current source inverter
	Transformers	Three phase low voltage dry type transformers
	Compensation system	Power factor correction panel
Energy management system	Sensors and metering	Power sensors and metering
		Pressure sensors and metering
		Temperature sensors and metering
		Mass flow rate sensors and metering
Energy Supply (electricity and thermal)	Solar Water Heaters	Evacuated tube collectors
	PV Solar	Mono/Polycrystalline PV panels
HVAC System	Cooling towers	Axial fan cooling towers
		Centrifugal fan cooling towers
	Chiller	Single or Double-effect absorption chiller
		Mono and multi split units
Lighting system	Lighting control system	Occupacy sensors
	Lamps	LED Lamps

[90] http://ebrdgeff.com/egypt/database/

3. GREEN for Growth Fund (GGF)

The Green for Growth Fund is a unique Public Private Partnership with the goal to promote the development of energy efficiency and renewable energy markets in Southeast Europe and the Middle East and North Africa (MENA) through the provision of dedicated financing[91]. The GGF was initiated as a public-private partnership in 2009 by Germany's KfW Development Bank and the European Investment Bank, with financial support from the European Commission, the German Federal Ministry for Economic Cooperation and Development, the European Bank for Reconstruction and Development, and the Austrian development bank.

The fund will be through the local banks in Egypt such as Cairo Bank, Alex Bank and the national bank of Egypt up to 30 million dollars. The funding will be utilized for measures that support renewable energy (RE) and investments in energy efficiency (EE) measures throughout the country.

The industrial applications of this fund would serve the FMI companies as these could save energy through the following activities:

- Replacing old industrial boilers
- Replacing old ovens / Dryers
- Replacing pumps, motors and air compressors
- Investing in combined heat and power plants
- Investing in modern production lines

These additional investments can also help save energy:

- Installing energy efficient lighting
- Upgrading cooling chambers/refrigerated cabinets

[91] http://www.ggf.lu/project-portfolio/investments/egypt/#