الجَمعيّـة العِلميّـة المَلكيّـة
Royal Scientific Society

Resource Efficient and Cleaner Production (RECP) Guidelines for Jordanian Small Dairy and "Bakery and Arabic Sweet" Enterprises

التعاون الألماني
DEUTSCHE ZUSAMMENARBEIT

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Reviewed by
STENUM®

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Glossary

CIP	Cleaning-in-Place
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COP	Coefficient of Performance
CPU	Cleaner Production Unit
EMS	Environmental Management System
EnMS	Energy Management System
EU	European Union
FHNW	University of Applied Sciences of North-Western Switzerland
GGGI	Global Green Growth Institution
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GHK	Good Housekeeping
IRADA	Enhanced Productivity Centres Irada
ISO	International Standardisation Organisation
JEF	Jordan Environment Fund
JEDCO	Jordan Enterprise Development Corporation
JCI	Jordan Chamber of Industry
JREEEF	Jordan Renewable Energy and Energy Efficiency Fund
KPIs	Key Performance Indicators
kWh	Kilowatt-hour
LPG	Liquified Petroleum Gas
MFCA	Material Flow Cost Accounting
MoEnv	Ministry of Environment
MoITS	Ministry of Industry, Trade and Supply
M&V	Monitoring and Verification
MLEs	Medium and Large Enterprises
NA	Not Available
NERC	National Energy Research Centre
NOx	Nitrogen Oxides
OHS	Occupational Health and Safety
PDCA	Plan-Do-Check-Act cycle
RECP	Resource Efficient and Cleaner Production
RSS	Royal Scientific Society
SCP	Sustainable Consumption and Production
SECO	Swiss Secretary for Economic Affairs
SEs	Small Scaled Enterprises
SOP	Standard Operating Procedure
SPbP	Simple Payback Period
SPs	Service Providers
TEST	Transfer of Environmentally Sound Technology
UNEP	United Nations Environment Program
UNIDO	United Nations Industrial Development Organisation
VOCs	Volatile Organic Compounds

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Water, Environment and Climate Change Centre (WEC)/Cleaner Production Unit (CPU)

National Energy Research Centre (NERC)

Royal Scientific Society (RSS)

With the support of the “Employment-oriented MSME Promotion” project implemented by the Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

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Pilot Demonstration Small Enterprises

Al-Amaneh Dairy – Madaba

Al-Helo Bakery – Ajloun

Al-Jamal Dairy – Irbid

Al-Mamlakah Bakery – Madaba

Al-Tawheed Dairy – Irbid

Ezz Al-Kanafani (Arabic Sweets) – Irbid

Marj Al-Hamam Dairy – Amman

Sanabel Al-Shiekh Bakery – Irbid

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1 Introduction

These Resource Efficient and Cleaner Production (RECP) Guidelines for **Dairy** and **"Bakery and Arabic Sweet"** enterprises were developed by the Cleaner Production Unit (CPU)[1] and National Energy Research Centre (NERC)[2] at Royal Scientific Society (RSS)[3] -Jordan in cooperation with STENUM[4] for the service providers (SPs) to outline the activities. This initiative was supported by "Employment-Oriented MSME Promotion" project implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ)[5] to support Jordanian small enterprises to increase productivity and reduce environmental impact by implementing RECP.

This manual is meant to prepare national consultants/SPs for their work with small enterprises of the selected sub-sectors. It contains the description of the approach, its implementation steps and templates. The approach uses elements of the basic RECP modules initiated in early nineties by United Nations Environment Program (UNEP) & United Nations Industrial Development Organization (UNIDO), UNIDO developed Transfer of Environmentally Sound Technology (TEST) approach and CPU-Jordan, University of Applied Sciences of North-Western Switzerland (FHNW) and Swiss Secretary for Economic Affairs (SECO) developed RECP Quick-Scan Plus assessment, and simplifies the RECP implementation steps for the application in small enterprises (SEs). It also includes the results of the questionnaire prepared by CPU and distributed to Jordanian small dairy and "bakery and Arabic sweet" enterprises and the comments raised in a validation workshop from the relevant stakeholders.

Annex (I) shows the differences of this new developed RECP approach for SEs and UNIDO-TEST approach, since at the time of initiating these guidelines, TEST approach is the RECP integrated approach implemented in the Jordanian industries per European Union (EU) funded SwitchMed TEST project[6].

Additional tools to support practical work are:

- Guiding work plan (Annex II)
- Walk-through checklist (Annex III)
- Recommended actions to improve the Information and Accounting System (Annex IV)
- Excel sheet and guidance for baseline data record and indicators' calculator (Annexes V and VI, electronic version of the excel sheet is available at www.cp.org.jo)
- Energy Balance/Distribution of Energy Users (Annex VII, excel sheet is available at www.cp.org.jo)
- Fish bone diagram (Annex VIII, word template is available at www.cp.org.jo)
- Some examples of recommended RECP options (Annex IX)
- Training material and template for reporting in Arabic language (provided in the service package at www.cp.org.jo)

[1] www.cp.org.jo
[2] www.nerc.gov.jo
[3] www.rss.jo
[4] https://stenum.com/
[5] www.giz.de/en/worldwide/75975.html
[6] www.switchmed.eu

2 Resource Efficient and Cleaner Production (RECP)

2.1. Definition: RECP Concept

RECP aims at promoting the shift toward sustainable consumption and production (SCP). It features the identification of ideas to reduce waste, wastewater and excessive energy consumption from the processes of dairies and bakeries. RECP[7] is a preventive, systematic and continuous improvement approach which minimizes the generation of losses at the sources through efficient utilisation of resources[8] in the industrial processes, accordingly; assists the industry to prevent or reduce the generation of wastes and emissions, enables it to comply with the environmental regulations and achieve environmental and economic benefits at the same time.

Traditional environmental protection (end-of-pipe treatment) focuses on what to do with wastes and emissions after they have been created to comply with the environmental regulations. This approach was prevailing in Europe until the 1980. With increasing industrial development, pollution by industrial emissions and waste became a problem. The reactive approach tried to solve the problems by diluting the wastewater with fresh water and building taller chimneys to disperse exhaust gases. By the early 1990s it became clear that this approach could not solve the problems. The approach legislation took was to demand treatment of waste, wastewater, and emissions in managed landfills, wastewater treatment plant and exhaust gas treatment. This approach worked but was adopted reluctantly because of the high cost involved. From the 1990s on therefore the approach of prevention was promoted: to analyse products and processes, identify the sources of waste and emissions and prevent them wherever possible (Figure 1).

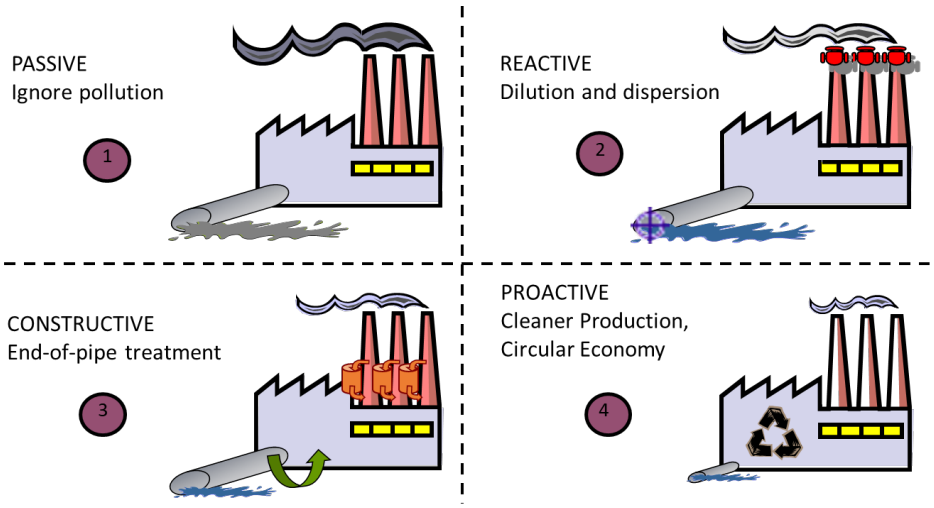


Figure 1: Progress toward RECP in the responses of businesses to pollution[9]

[7] Resource Efficient and Cleaner Production (RECP): The continuous application of an integrated environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and the environment, UNEP, 1990.
[8] Resources are not only the input natural resources needed for production including materials, water and energy, but as well needed economic and technical resources.
[9] Cleaner Production Techniques – An Overview, Farahan Ahmad, Department of Chemical engineering, University of Engineering and Technology Lahore (www.slidesshare.net)

The following generic RECP strategies/principles can support the identification of options for any production company. Table 1 represents examples of RECP options generated during applying RECP Quick-Scan Plus assessment by CPU and NERC at different SEs.

- Good housekeeping (GHK)[10]
- Improved process control
- Input material change
- Modification of equipment or products.
- Process, technology or production change
- Segregation of generated wastes
- On-site reuse/recovery or/and recycling
- Production of useful by-products

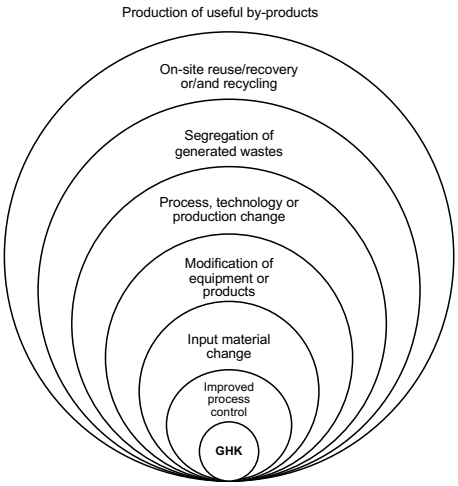
Table 1: Examples of RECP options generated during applying RECP Quick-Scan Plus assessment by CPU & NERC / RSS at different dairy companies.

RECP option	**RECP strategies/principles**
Install a mixer in the raw milk reception tank	Modification of equipment
Check the efficiency of the boiler and the temperature set point	GHK and improved process control
Re-use the same water and chemicals of the second cleaning to the first cleaning in the Clean-In-Place (CIP) system	On-site re-use
Reuse whey as cattle feed or to produce whey drinks	Production of useful by-products
Build a simple incubator (e.g. wooden box or bricks with a simple heater/ thermometer)	Process change (new equipment)

The application of the generic RECP strategies/principles will lead to improvement of the health and safe working conditions of employees, product's quality, design and productivity, and support hygiene. Figure 2 presents how these strategies and principles could be applied and hence reduce/control the generation of waste and increase the company's performance.

[10] Good Housekeeping refers to a number of practical measures based on common sense that enterprises can undertake to improve their productivity, obtain cost savings, reduce the environmental impact of their operations, and improve worker safety, GTZ - Pilot Programme for the Promotion of Environmental Management in the Private Sector of Developing Countries (P3U), 1999.

- **Good housekeeping:** take appropriate managerial and operational measures and actions to prevent/reduce inefficiencies and to enforce the existing operational instructions.
- **Improved process control:** modify operational procedures, equipment instructions and process record keeping in order to control or reduce the generated waste and produce efficiently.
- **Input material change:** substitute input material by environment-friendly or better-quality raw material/fuel. Could also include the use of renewable energy.
- **Modification of equipment or products:** modify the existing production equipment and utilities, and improve the design of the products in order to reduce or control the generated waste and produce efficiently.
- **Process, technology or production change:** modify the technology, processing sequence/technique and operational procedures in order to control or reduce the generated waste and produce efficiently.



- **Segregation of generated wastes:** segregate food waste from non-food waste items in order to have the opportunity to recycle or treat food waste. Segregating food waste would reduce odor and pest nuisances inside working environment, improve waste management, improve public health and reduce contamination of recyclable items.
- **On-site reuse/recovery or/and recycling:** reuse of the wasted materials in the same process for another useful application within the company. And when applicable/legally allowed, treat the generated waste to reuse the treated waste inside the company.
- **Production of useful by-products:** some by-products; that cannot be avoided from food waste; can be used to produce useful resources and by-products. These by-products should be produced with a minimum additional work.

Figure 2: Onion model for the generic RECP strategies/principles

It is worth to mention that in 2014, a High-Level Committee and a Green Economy Unit were established by a decree of the Prime-Ministry. The green economy unit in the Ministry of Environment (MoEnv) aims at enhancing the implementation of resource efficiency and circular economy practices in different sectors and areas of Jordan. Resource efficiency is one of the green growth impacts that the Green Growth National Action Plan (2021-2025) - developed by the MoEnv and Global Green Growth Institution (GGGI) in consultation with all relevant stakeholders - has aimed to achieve.

2.2. RECP Benefits

Do you know that increasing the temperature in a chilled room by 1 °C will reduce energy cost by 4%?

Do you know that 100m of bare steam pipe with a diameter of 150 mm carrying saturated steam at 8 kg/cm^2 would waste 25,000 litres fuel oil per year?

If you leave water running from a hose with 1/2-inch outlet diameter, the loss will be 2.5 m^3 per hour!

Do you know that by using a bucket and a wristwatch you can characterize such losses?

RECP is a first step to continuous improvement of the company's operations. It will assist the company to:

- Optimize the utilization of resources and minimize the generation of waste and pollution.
- Create the awareness and knowledge in the field of resource efficiency and build the company's capacity on RECP approach.
- Reduce production cost by minimizing losses, and accordingly being able to increase competitiveness and market share.
- Increase the efficiency of production and productivity through better utilization of materials, water, energy, equipment, labour and time, better production planning, more efficient supply chain and waste re-use and recycle.
- Improve health, safety and morale of employees.
- Assist the company to solve any environment legal non-compliance and reduce the investment for end-of-pipe solutions.
- Improve cost accounting/pricing and monitoring systems in addition to the information and management systems for better tracking of resources utilization.
- Being recognized as green industry that can apply for available national resource efficiency initiatives such as the related financing programs, awards and incentives.

3 RECP Implementation Steps

This section aims to provide the steps and framework that support the implementation of RECP approach. Figure 3 describes the main phases; which are defined on the basis of the Plan-Do-Check-Act (PDCA) cycle; to implement the RECP approach in small enterprises (5-19 employees) noting that the work on modifying/updating the cost accounting, information, management and monitoring systems, will start from the beginning of the assessment. Figure 4 describes the detailed steps that should be implemented in each phase.

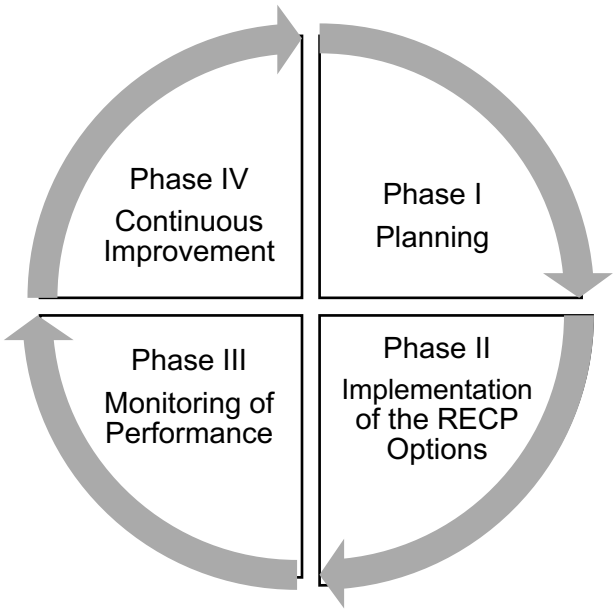


Figure 3: RECP Implementation Phases

Phase I: Planning (Plan)

1. Obtain management commitment
   - Kick-off meeting
   - Environmental Policy (optional)
2. Establish the RECP team
3. Walk-through assessment
   - Collection of quantitative data (Baseline and Benchmarking)
   - Identification of RECP quick-win options
   - Identifying the focus areas (if needed)
4. Revealing sources and causes of inefficiency
5. Identification and screening of RECP options
6. Action plan

Phase II: Implementation of the RECP Options (Do)

1. Direct implementation of good housekeeping (GHK) and no/low cost RECP options
2. Training of the staff
3. Link to existing national financial programs
4. Follow up the implementation of improvement measures and recommendations[11]

Phase III: Monitoring of Performance (Check)

1. Monitoring to check, maintain and increase performance in resource utilization.
2. Verification of the implemented options

Phase IV: Continuous Improvement (Act)

It is the company's actions to continually improve its performance in resource efficiency and integration of RECP in its management and decisions.

Figure 4: RECP Implementation Steps

Annex (II) includes a guiding work plan to implement the RECP approach.

Report the undertaken activities at the end of each step and review its content with the company.

Organize meetings with the owner/manager to get approval on specific actions.

In addition to the RECP steps, recommend to have specific chapters for introduction, process description, etc. and annexes of the filled templates, flow charts, etc.

[11] Recommendations for information, cost accounting and management systems, hygiene, health and safety conditions, and development of new products/by-products.

4 Planning

This phase forms the base for a smooth and effective implementation of RECP approach. It consists of obtaining the owner/manager support and commitment, involvement by himself/herself or assignment of a focal point, reviewing the environment policy or creating a new one, collecting baseline data and defining and selecting the focus areas.

4.1. Obtain management commitment

The main objective of this step is to get the owner/manager support and commitment in implementing RECP approach through conducting a **kick-off meeting** with him/her to introduce the RECP approach to him/her (and senior staff of the company such as production, accountant and maintenance supervisors as available), give him/her/them an overview about this approach and how it could be beneficial for the company. Case studies of implementing RECP in similar areas of production can be presented in this meeting, see Box 1. Without the support and participation of the owner/manager, the implementation will fail in an early stage.

First pilot demonstration of this tool at 8 small enterprises; 4 dairies, 3 bakeries and one Arabic sweet in 2022 identified cumulative saving of 125,188 JOD/Year with a payback period of 0.3 Year and following resource saving and environmental impact, www.cp.org.jo:

- **Energy savings: 1,180,348 kWh/Year**
- **Raw Material savings: 85,324 kg/Year**
- **Water savings: 1,530 m^3/Year**
- **Waste reduction: 37,096 kg/Year**
- **Carbon Dioxide (CO_2) reduction: 320,544 kg/Year**

Owner/manager support and commitment are needed to:

- Give RECP importance within the company.
- Get the approval to assign focal point (that could be himself/herself).
- Facilitate the process of data collection and the implementation of RECP approach.
- Encourage the company's staff to change their attitudes towards environmental protection and encourage them to embed RECP steps into the operational practices in all processes throughout the company.

Also, the owner/manager commitment could be guaranteed through modifying the company's environment policy (if existing) or create an environment policy statement integrated RECP.

RECP Case Studies[12]

Box 1
Case Study 1/Bakery

Improve the Arabic Bread Furnace	
The size of used diesel burner is greater than the required for the baking process, as the temperature of the flue gases reaches (300 degrees Celsius) which indicates that the heat generated by the combustion was not utilized in the required manner. This is due to the large size of the burner relative to the quantity of produced bread, its weight and the speed of the baking line. In addition, the furnace runs for 30 minutes at the beginning of the day to warm up before starting the baking process, as a result of losing heat during its idle period. Part of this problem is due to the open chimney, which allows air to pass through the furnace throughout its downtime, which contributes to cooling the furnace. Note that there is no fan for the chimney and the process of withdrawing the products of combustion depends on the speed of the outside air and the surrounding weather conditions.	
RECP Option	– Replacing the existing diesel burner with another two-speed (high and low) burner that works on diesel and LPG, as it works at high speed when starting and warming up the furnace, and then runs at low speed when the baking stage begins. – Installing moving gates (dampers) on the chimney so that they are closed when the baking process is finished, to prevent the occurrence of an air stream passing through the oven that takes its heat during the blackout periods. – Installing an electric fan on the chimney connected to the start of the burner to regulate the process of drawing air from the furnace during combustion and not to allow different weather conditions to control the amount of air drawn into the furnace as a result of the irregular speed and direction of wind and pressure from day to day. This affects the efficiency of the furnace and the quality of the product. – Improving the thermal insulation of the furnace. – Adding a ground gas burner that passes under the conveyor belt for baking inside the oven to maintain the required temperature and reduce the burden on the diesel burner. – Adding a second dough cutter that works in parallel with the existing one to increase productivity and reduce the baking period, while adjusting the width of the first fermentation line.
Environmental Benefits	– 26,000 Litre Diesel/Year (Extra 573 LPG Cylinders/Year will be consumed) – 48.9 Ton CO_2/Year
Economic Benefits	– Annual saving of 12,200 JOD – Investment: 5,000 JOD – Payback period: Less than 5 months

[12] From the pilot demonstration of this developed RECP Service Package by CPU & NERC / RSS as per these guidelines in 2022.

Case Study 2/Dairy

Better Control of Milk Filling in Plastic Containers	
Spills of milk are noticed from the manual filling in plastic containers to produce yogurt, accordingly 37.1 kg of milk is lost per day.	
RECP Option	Pumping milk from the boiling vessel after cooling by means of a food-grade hose equipped with automatic filling and unloading tool inside the containers.
Environmental Benefits	13,356 Kg Milk/Year (less Milk to the sewage system)
Economic Benefits	– Annual saving of 12,020 JOD – Investment: 200 JOD – Payback period: Less than a month

4.1.1. General Information of the Company

The SP team should familiarize himself/herself/themselves with the company. SP will collect general information for the company, products and processes, and will write a simple overview about the company in the technical report to be checked by the company's RECP focal point.

The following template shows the requested general information of the company and how to mention it in the report (Table 2), noting that the information during preparation can be collected from online/personal communication and/or in the kick-off meeting.

Table 2: Template for the company's general information

Name of company	
Date of establishment	
Address	
Telephone number	
Fax number	
No. of employees	7
Working hours scheme	6.5 hours per day, 5 days/week
Products	Yoghurt, Labaneh (hard yoghurt), Shanineh (butter milk), Jameed (hard shanineh), White Cheese (boiled or pasteurized), Butter, Ghee (samen baladi) and Cream
Production capacity	500-700 kg/day of Yoghurt, Labaneh, Shanineh, Butter, Cream, Samneh Baladi and Jameed, and 300 kg/day of Cheese

Customers & Markets	3 shops belong to the company owner in ……. in addition to mini markets around the town
Suppliers	Mainly from 2 farms in …….. (65 km far) for cow milk and from ……. (for sheep milk only for just 3 months in the year)
Water sources/capacity	Tankers (capacity of 4-6 m^3 every 3 days)
Industrial wastewater disposal method/quantity	To sewage / NA
Energy (Electric and Thermal) capacity	280,180 kWh/Year
Certificates/Awards/Management systems/ISO	None
Previous supporting programs	None
Implemented Resource Efficiency Measures	Installing LED Lamps
Resource Efficiency Measures planned to be implemented	Install Solar Water Heater
Overview of the production processes	Table 3

Table 3: Example of Dairy production processes and utilities

Production processes / Dairy Company
Reception of Milk
Pasteurization of Milk
Production of Yoghurt, Labana, Shanina, Butter, Cream, Samneh Baladi and Jameed
Production of White Cheese
Incubation Room
Cooling Chamber
Cleaning Processes
Utilities (Boiler, Chiller, Air Compressor, water/wastewater treatment, etc.)

4.1.2. Environmental policy (optional)

One of the ways to show the company's commitment toward RECP is issuing environmental policy statement of that, accordingly this can be offered to be prepared with the support of the consultant/SP at this step. However; this is an optional step.

The content of the environmental policy will be prepared by the consultant/SP, discussed with and reviewed and approved by the company's owner/manager. If the company already has an environmental policy, it will be reviewed and modified together with the consultant/SP to integrate specific resource efficiency objectives. Then the officially issued policy statement will be communicated with the employees, customers, local communities and in order to ensure the continuous improvement in the field of RECP. RECP integrated environmental policy will be reviewed annually. The following box (Box 2) shows an example of a policy statement.

Box 2: RECP Integrated Environment Policy Statement

ABC Company is a small company in …….. production in Jordan.

The company is committed to minimize its environmental negative impact and increase the efficiency in the utilization of resources (raw materials, water and energy).

ABC is committed to abide by Resource Efficient and Cleaner Production (RECP) and all environmental and industry related regulations.

We maximize our commitment to continually improve our processes and satisfy customers' needs & expectations.

ABC always provides the framework to highly achieve its goals, control its employees to be committed to quality & environmental instructions and report quality & environmental concerns to ensure continuous improvement.

……

General Manager

4.2. Establish the RECP team

To implement the RECP approach, there is a need to establish a small group to conduct the project. During the project, the SP will gradually involve employees to build awareness and cooperation as needed during RECP implementation to ensure the adoption of RECP culture among the key employees with low turnover.

The involvement of a team in the company including the consultant/SP team in all RECP steps is required. Owner/manager commitment will pave the way for effective and successful implementation of RECP approach in the company. Finding smart options and opportunities for improvement depends on the participation and collaboration of staff who are responsible of the routine operations and maintenance activities and who can identify problems and opportunities for improvement. The number of team's member depends on

the size of the enterprise, in small enterprises, the team could be formed by one up to two/three persons.

The company's team should consist of a Focal Point (could be the owner/manager) who is able to take decisions and have a strong knowledge and well understanding of the function and business of the different processes at the company. The role of the focal point is to:

- Initiate and support the implementation of RECP approach
- Organize and facilitate the execution of RECP approach
- Responsible for data and information collection
- Participate in the brainstorming sessions with the consultant/SP
- Participate in identifying waste problems and opportunities for improvement
- Participate in the generation and implementation of RECP options
- Manage the implementation of RECP options
- Review RECP report

Following table could be used to register the RECP internal and external team.

Table 4: RECP Team List

Name	**Organization**	**Position**	**Contact details (E-mail and phone number)**

If the company does not have any knowledge on RECP approach, the consultant/SP must take this as his/her responsibility. Training sessions should be customized to the company needs.

The consultant/SP team should consist of resource (material, water and energy) efficiency expert(s). The role of the SP is:

- Be familiar with the company’s manufacturing sector (Dairies and Bakeries)
- Apply all steps of the phases I and II of RECP approach mentioned in these guidelines
- Initiate regular communication with the company's team
- Participate in the brainstorming sessions with the company's team
- Analyse the data and set a baseline
- Participate in the generation and implementation of RECP options
- Conduct measurements for energy or water consumption (if needed)
- Provide training on RECP approach for the company's team
- Prepare the RECP report and discuss it with the company's team

4.3. Walk-through Assessment

The core element of this RECP approach is a walk-through assessment. Walk-through is done to collect as many observations as possible from the work place. These walks benefit from the close collaboration with the employees.

What is the goal of a walk-through assessment?[13]

- Assessment of the current production process to identify inefficiencies of the use of materials, energy, water and chemicals as well as the identification of sources of losses/inefficiencies. And direct observations are the most efficient way to do it.
- Collection of much as possible process relevant information from operators. Employees are usually more open to providing feedback and explaining the reasons why they do the work the way they do it when they are in their own workspace. One more benefit is that they can describe and demonstrate what they are doing and why they are doing it in that way.
- Collection of ideas for improvement of the resource efficiency, reduction of losses/inefficiencies, reduction of emissions, improvement of working conditions, etc. A fresh set of eyes from different areas of the companies can be extremely valuable.

Walk-through should be conducted when the plant is in operation, and avoid conducting it when the production is low and when equipment is under maintenance. The walk-through should follow the process from the receiving of raw materials to the finished products covering all utilities (i.e. boilers, air compressors, chillers, etc.). The Walk-through Checklist template attached in **Annex (III)** can be used to implement this step. This template also presents the type of questions that could be asked during the walks.

This step includes the following activities that will be implemented by the internal and external team assigned in the previous step:

- Conduct the first meeting of the RECP internal and external team to assign the roles. A guiding work plan is attached in Annex II. It is recommended to prepare a specific work plan for the company including specific activities/actions, models of communication/delivery, responsible, timeframe/deadline, deliverables/outcomes and status.
- Conduct a walk-through inside the company and collect data about the company and its processes/utilities (Annex III).
- Investigate the potential and possible actions to improve the information and accounting system of the company (Annex IV).
- Collect the quantitative data (Baseline and Benchmarking) to be utilized later to evaluate the progress after implementing the RECP feasible options and to assist in identifying the potential for improvement (Annex V and VI).
- Identify the areas of resources inefficiency and possible RECP options. And calculate the environmental and economic benefits of the GHK and low/no cost options (if possible) for that are accepted to be implemented from the technical/organizational point of view, in order to enhance their implementation. See sections 4.7 and 4.8.
- Identify the Focus Areas for further detailed analysis (next steps) utilizing where most of losses/inefficiencies generated and potential room for improvement. The qualitative

[13] Source: ILO, SCORE manual, 2021

assessment section in Annex III can be utilized to assist in identifying the focus areas if needed.

- Draft the first report including a summary of priorities and feasible (GHK, low/no cost) RECP options that can be directly implemented (template for reporting is available in Arabic at www.cp.org).
- Present the results of this step to the owner/manager.

During the walk-through, it is important to:

- Look for waste (hazardous and non-hazardous), wastewater and energy inefficiency, then describe and quantify best possible solutions mainly good housekeeping (GHK) and low-investment measures that can be implemented directly by the company. Here estimated quantities could be referred to, based on the company's team experience and through simple and short-time measurements utilizing simple tools such as buckets and wristwatch, boiler efficiency or calculating tools such the ones used for energy saving from surface insulation, in order to utilize these data in calculating the environmental and economic feasibility of these measures if possible.

Cover all the areas of the company in the walk-through including the storage areas/warehouses, disposal areas and waste, and look for things that are not supposed to be thrown away.

Look for the inefficiency in the utilities including cooling, compressed air and heating systems, and water and wastewater treatment.

- Take notes and pictures after requesting the approval of the company.
- You can draw a simple chart of the company layout and make different signs on each area (production, warehouse, maintenance workshop, utility, etc.) regarding the energy inefficiency/waste/emission that can be utilized later to identify the focus areas as shown in Figure 5 attached below.

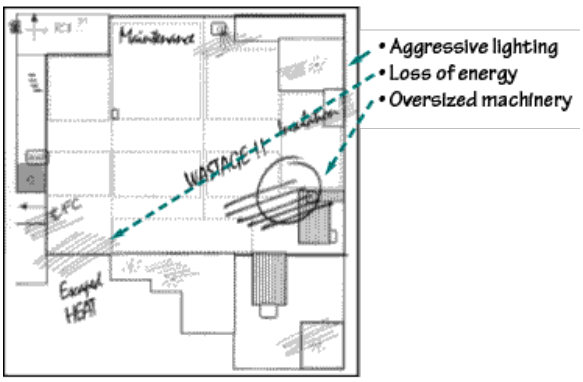


Figure 5: Eco-mapping[14]

[14] Source: https://www.ecotoolkit.eu/ecomapping.php

- Ask the employees why they do the work the way they do it, about how the work is documented, how they manage special situations, and why operations are performed in a particular order. The answers could lead to propose some improvement options. The checklist provided in Annex (III) could be a useful tool to identify potential opportunities for improvement. Identify training needs. Use the time well to explain environmental impacts and ways to reduce them. This relates also to availability of standard operation procedures and data.
- Discuss the noticed observations with the workers or production staff as they are fully aware for the reasons for these observations and could identify the amounts and sources of waste as mentioned above.
- Weighing of generated solid/liquid waste and metering of water and wastewater are recommended to be evaluated at this step and accordingly recommendations to install low cost sub-meters and/or simple tools (such as power clamp, a bucket and a watch, a spring scales, infrared temperature sensor, etc.) and procedures for estimating the energy efficiency, the water flow or weighing the generated waste per each main process could be investigated.

Recommend drawing a flow chart with the company's RECP team to identify the processes as per the following templates (Figures 5 and 6). Example of process flow charts for some products in Dairy and Bakery are shown in figures 7 and 8 below.

A detailed process flow chart for any production process/line would facilitate the assessment by clearly identifying the inputs, outputs and environmental problems areas. Highly recommended to identify the activities which are neglected in the traditional flow chart (such as cleaning, storage and handling of materials, equipment maintenance and repair, etc.).

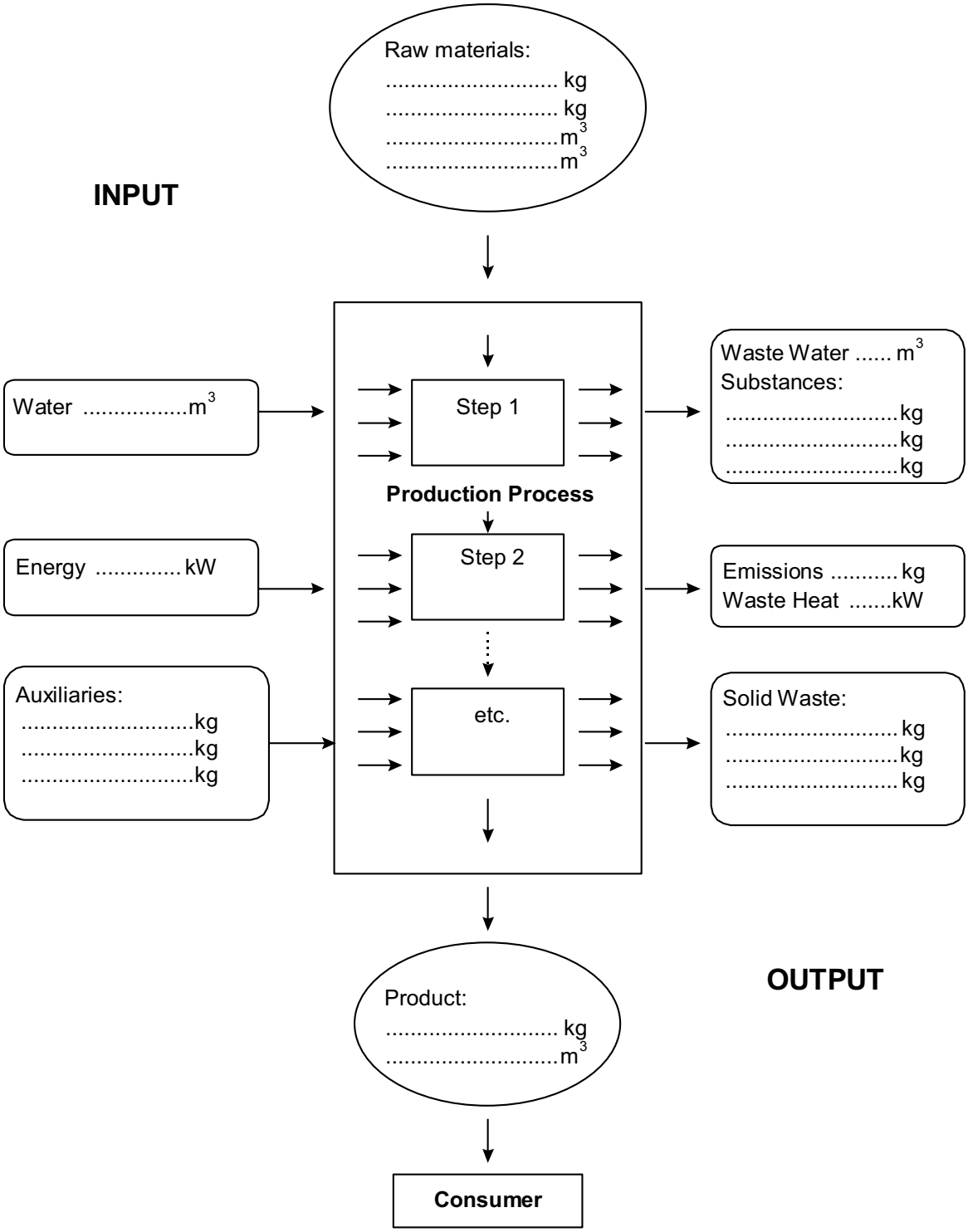


Figure 6: Flow Chart of the Complete Production Process[15]

[15] Source: Good Housekeeping Guide for Small & Medium-Sized Enterprises, GIZ and SBA, 1998

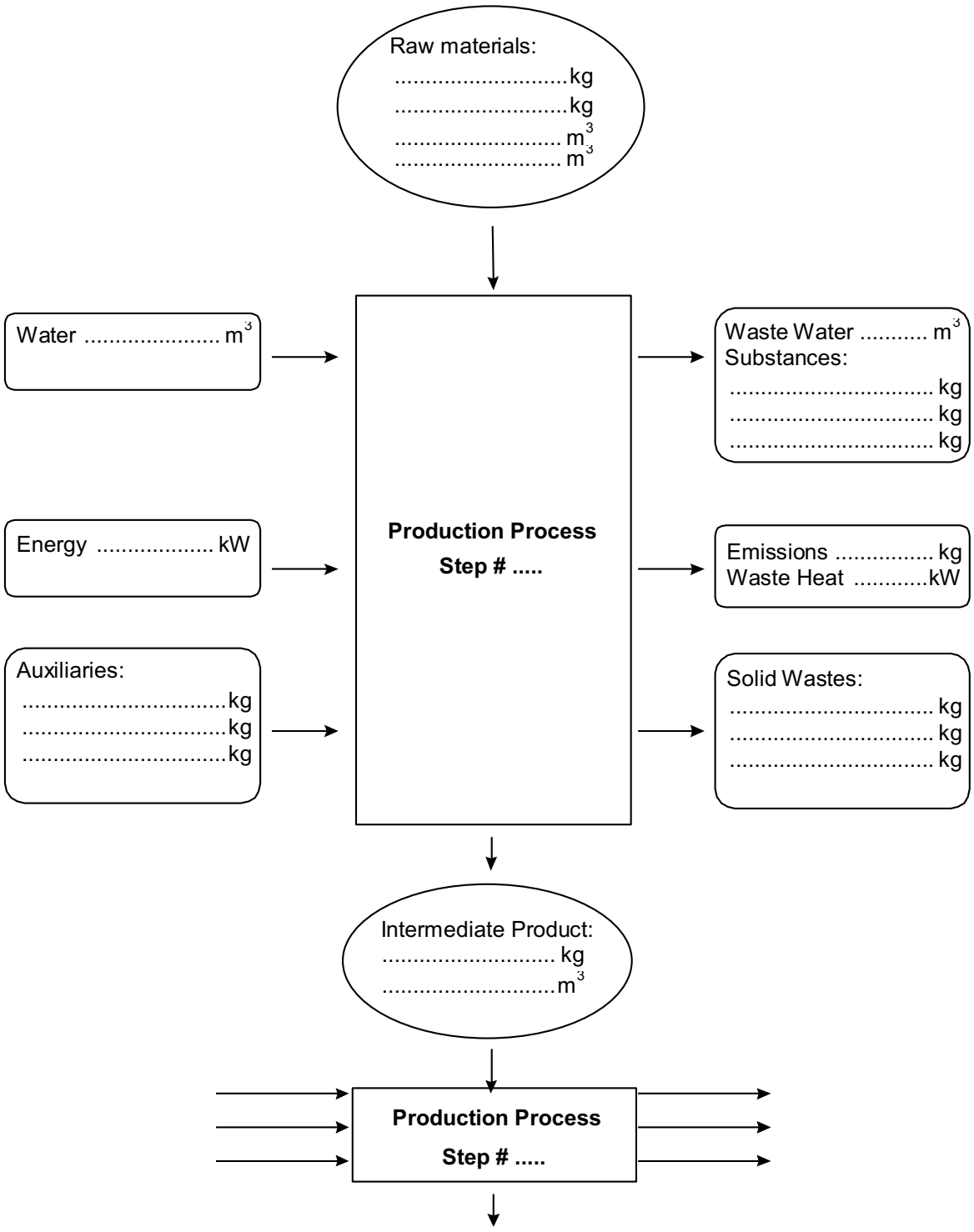


Figure 7: Flow Chart of Individual Steps of the Production Process[16]

[16] Source: Good Housekeeping Guide for Small & Medium-Sized Enterprises, GIZ and SBA, 1998

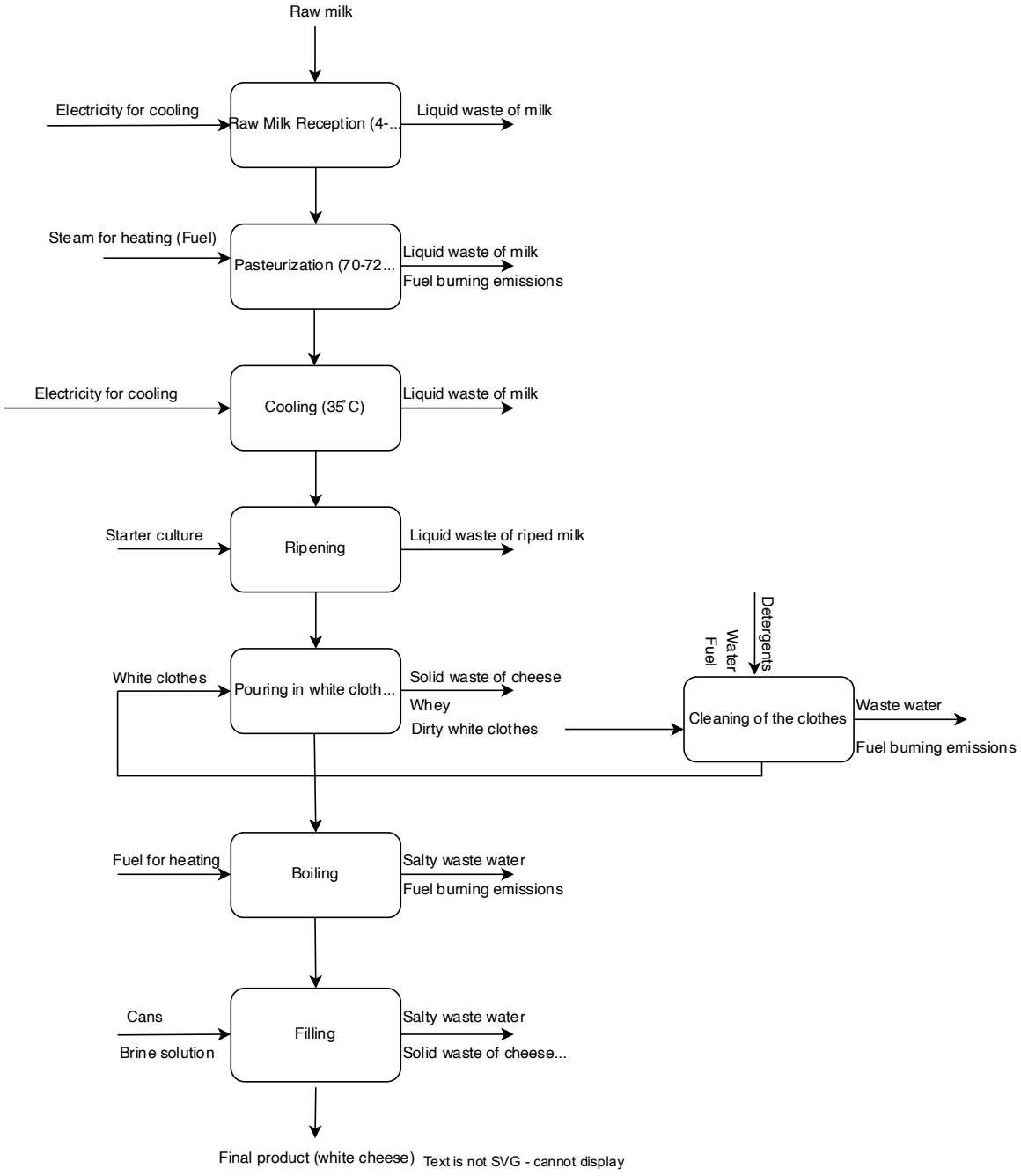


Figure 7: Example of White Cheese Production Flow Chart

Inputs →	**Processes** →	**Outputs**
Main Raw and Auxiliary Material – Flour 850 kg/day – Sugar 17 kg/day – Salt 1.7 kg/day – Yeast 12.8 kg/day Water 442 litre/day Electricity 11.4 kWh/day	Reception of materials and dough preparation	Solid waste including the packaging materials of raw materials (17 Flour bags/day) Indirect CO_2 emissions
Electricity 75.7 kWh/day	Dough cutting and fermentation	Solid waste (minor) Indirect CO_2 emissions
Electricity 30.6 kWh/day Diesel 71.1 Litre/day Packaging Materials (Plastic Bags)	Baking, Packaging, Handling and Selling of products	Products 1,100 kg of Arabic Bread/day 200 kg/day water losses (Vapor) CO_2 emissions 192 kg/day Solid waste (mainly of products) 18 kg/day
Water 20 Litre/day Cleaning detergents and chemicals Washing Gel Hypochlorite	Cleaning	Wastewater 20 Litre/day

Figure 8: Example of Arabic Bread Production Flow Chart

As mentioned earlier and after the SP being familiar with the company, it is a good time to collect any observations, experiences, etc. giving first options from improvement (from interviewing operators, observations during the walk-through, or the experience of the SP). During the walk-through and after filling out the checklist template attached in Annex (III), a list of observations and possible improvement measures/options (examples of these measures/options can be found in Annex IX) could be identified, some of these improvement measures/options could be immediately implemented without any further cost. Following tables 5 and 6 show examples of the observations and RECP measures/options mainly good housekeeping (GHK) ones that can be identified at this stage for Dairy and “Bakery and Arabic Sweets” Companies.

Table 2: Examples for GHK/low or no cost options for Dairy Company

Option	RECP Principle	Benefits for the company
Fix the fly traps or buy new ones	Good housekeeping	Protect the products from infection and improve the hygienic conditions
Insulate the hot water transfer pipes	Good housekeeping	Reduce diesel consumption
Use a valve to fill yoghurt cans after incubation instead of manual filling	Process modification	Reduce waste yoghurt spills
Add a cover to the vessels used for cheese boiling and crude cheese production	Good housekeeping	Reduce energy consumption
Insert a water flushing step after caustic washing and before acidic washing	Process modification	Improve the cleaning efficiency and reduce acid consumption, especially if it is reused more than one time
Do not store Nitric Acid (68%) in the production hall	Good housekeeping	Improve the hygienic and safety conditions
Cover the products in the incubator and in the refrigerator	Good housekeeping	Protect the products from infection and improve the hygienic conditions
Reuse of caustic soda solution	Good housekeeping	Reduce production cost
Apply a proper dosage of chemicals	Good housekeeping	Reduce consumption of chemicals

Table 3: Examples for GHK/low or no cost options for Bakery and Arabic Sweets Company

Option	RECP Principle	Benefits for the company
Fix the leakage of cold air that is observed from the refrigerators located at the basement. And manage the refrigerators' operation since they are in operation regardless of needed capacity for ready product.	Good housekeeping	Reduce electricity consumption Reduce production cost
The doors of the electric furnaces were opened during baking of some products in order to control the colour of the finished product, which causes losses of heat. Keep the doors closed during baking and use temperature	Good housekeeping	Reduce electricity consumption Improve time needed for baking Reduce production cost

Option	RECP Principle	Benefits for the company
sensor and timer to control the baking process.		
Losses of raw materials and semi-products occurred at all stages of production processes, the losses shall be collected in bins and weighed to investigate the improvement control/reuse/recycle measures.	Good housekeeping	Reduce the amount of waste generated Collected waste can be used as a useful resource for animals
Losses of the finished products occurred during packaging due to breakage in the product. Investigate the quality of packaging materials and the production of by-product of these out-of-specification products which are not marketable but can be used by human with no potential health risk.	Good housekeeping	Reduce the amount of waste generated
Raising staff awareness of the need to reduce waste, and apply waste sorting and good housekeeping practices.	Good housekeeping	Improve productivity. Reduce production cost. Reduce losses in raw and packaging materials Reduce losses in semi- and final products Reduce the amount of waste generated

4.4. Collection of Quantitative Data (Baseline and Benchmarking)

The analysis of input (resources) and output (products and losses) conducted in the walk-through (Annex III and figure 6) can be utilized to be able to implement this step for the main/key inputs and outputs.

4.4.1. Key performance indicators

At this stage you need to collect technical and historical data about the manufacturing and process inputs (energy, material and water), product outputs and waste (air emissions, solid waste and wastewater), these data will help you to have a good understanding of the company's manufacturing and production processes, enables you to evaluate the direct and indirect cost of losses/inefficiencies, to identify key performance indicators (KPIs) for the company's system boundary and to establish an initial baseline for each indicator. An initial baseline shows the situation before implementing RECP options, and it is expressed based on the amount of product (see Annexes V & VI). It is recommended to establish the initial baseline based on data for one complete year, as short periods can be subject to variations and may not be sufficiently representative. Data from the recently completed financial year is commonly used to establish the baseline; however, using calendar years or production seasons might also be acceptable.

This step will provide an assessment of the overall efficiency of the production and will enable the RECP team to prioritize the flows of water, energy, raw and auxiliary materials with regard to **inefficient utilization** (benchmarking/potential for improvement), **cost of observed solid & liquid waste (optional)** and **environmental concerns** (scarcity of the resource like water, toxicity, hazardous, legal binding).

These indicators are (Annex V enables you to calculate these indicators):

- Material (raw, auxiliary and operating including chemicals) use indicator
- Water use indicator
- Energy use indicator
- Generated solid waste indicator
- Wastewater indicator
- Air emissions indicator

Annex VI summarizes how the data can be collected and how the indicators can be applied, as well as, can be utilized to serve as checklist during the walk-through for data collection.

After establishing the baseline, a benchmarking analysis could be conducted. Benchmarking is defined as the process of comparing the performance and practices of a specific company against those of other companies in the same industrial sector, being recognized as applying the best practices and available best techniques/technologies (Table 7). However, benchmark values are not always available, so in this case the company's performance could be evaluated at different points in time, such as comparing the same specific KPIs of 2 or more previous years and investigate the progress and potential area of improvement (Table 8).

Table 4: Example of baseline KPIs in a Bakery & Arabic Sweets for the Year 2019

Input	Unit	KPI (2019)	Best practice Benchmark
Flour	$Kg/Kg_{product}$	0.42	Not Available (NA)
Energy (Electricity & Thermal)	$kWh/ kg_{product}$	Electricity: 0.448 Thermal Energy (Fuel): 0.927	Electricity[17] (Baking): 0.125 – 0.167 Electricity[18] (All Production Processes): 0.218
Water	$Liter/kg_{product}$	0.58	1.17[19]
Wastewater	$Liter/kg_{product}$	0.25	0.468[19]
Solid Waste	$g/Kg_{product}$	70	1.5[20]
Packaging Materials	$g/Kg_{product}$	300	155 - 620[20]

[17] Source: European Commission (2006), Integrated Pollution Prevention and Control, Reference Document on Best Available Techniques in the Food, Drink and Milk Industries.
[18] Source: Industrial Energy Efficiency Accelerator Guide to the Industrial Bakery sector, Carbon Trust, 2011
[19] Source: Consolidated Benchmarking Report South East Water Corporation, Australia, 2013
[20] Source: EU_Food Benchmark Version No. 2

Table 5: Example of baseline KPIs in Dairy company in previous Year I and Year II.

Input/output	Unit	KPI - Year I	KPI - Year II	Best Practice Benchmark
Water consumption	l / l processed milk	2.07	1.56	1.0 – 1.5[21]
Energy (Electricity & Thermal)	kWh/ l milk	0.405	0.381	0.07[20]
Acid (HNO_3, 100%)	g/kg processed milk	0.54	0.30	0.2 – 5[22]
Caustic soda (NaOH, 100%)	g/kg processed milk	1.80	0.73	0.2 – 10[22]

The best benchmarking is the national one utilizing the data of similar industries in production and size; this will help the company to recognize the possible improvement in its resources consumption from a company works in similar conditions. Since no national benchmarks are available currently, it is recommended to request such data from small Dairy and "Bakery and Arabic Sweet" enterprises in a specific tailored survey.

This step will assist as well to evaluate the company's information and cost accounting systems and put recommendations to improve them through investigating how the monetary and volumetric data of inputs are recorded in the company's accounting, warehouse and production sheets, and how they are distributed per each product (i.e. Labaneh, Cheese, Yougurt, etc.) when collecting the data to calculate the KPIs (see Annex IV).

It is recommended to review the following sources to be familiar with the manufacturing processes, RECP case studies and best practices, and benchmark values[23]:

- IFC Industry Sector Guidelines, Environmental, Health, and Safety Guidelines (ifc.org)
- Case studies from the Mediterranean Region: factsheets of industries participating in the SwitchMed (TEST II) project, Case studies | UNIDO (test-toolkit.eu)
- IFC Food Sector benchmark Tool, IFC Food Benchmark Tool
- MED TEST country best practices, Best Practices | UNIDO (test-toolkit.eu)
- Sector specific industry manuals

[21] Environmental, Health, and Safety Guidelines, DAIRY PROCESSING, IFC (2007)
[22] EU BREFs [2019/2031 of 12 November 2019]

[23] However, benchmark values mentioned in these resources are developed based on one or more of the following:
- Size of the company (applied at Medium and Large Enterprises (MLEs))
- Production process and technology
- Location of the company (USA, Europe, Mediterranean Region, etc.)

4.4.2. Cost Assignment and Environmental Concern for Solid/Liquid Waste (optional)

The aim of this section is to assign the direct and indirect cost of losses/inefficiencies generated from the main raw materials (i.e. flour in bakery and Arabic sweets production and milk in dairy production), cleaning materials (i.e. nitric acid in dairy production) and packaging materials to assist in identifying the potential of saving the generated wastes and accordingly continue further analysis of them (sections 4.5, 4.7 and 4.8). Also, environmental concerns of the generated wastes could be investigated at this stage to provide attention to the generated wastes that do not comply with the environmental regulations and standards and accordingly consider them for further analysis.

Following directions and table (9) can be used to assign the cost of the generated solid/liquid wastes and identify any environmental concerns.

1. Identify the generated liquid and solid wastes from the company.
2. Identify the volume of the generated wastes through simple measurements, estimation through mass balance (input materials – product output = generated waste) or referring to the company's record.
3. Identify the contents of the selected generated wastes from input raw, cleaning and packaging materials. Consider the main/key inputs with relatively highest cost (maximum 5 inputs) and if possible estimate the man-power and energy spent on these wastes.
4. Calculate the cost of the generated wastes.
5. Analyse the results to evaluate the environmental and economic potential to conduct further analysis to reduce the generated specific wastes.

Table 6: Cost assignment and environmental concerns of generated wastes in specific period.

Generated waste	**Amount**	**Characterization of generated waste (non-toxic, domestic, toxic, etc.)**	**Key/main contents of the generated waste and % of each input**	**Cost of the waste's contents**	**Cost of generated waste**	**Environmental Concerns**
Final product of sweets	1000 kg	Domestic	Dough (flour, starch, ghee, salt and soft water) (55%) Ghee for frying (10%) Nuts (20%)	Dough: 0.45 JOD/kg Fat: 2.5 JOD/kg Nuts: 3.8 JOD/kg	(Dough cost (0.55*0.45) + Fat cost (0.1*2.5) + Nuts cost (0.20 * 3.8)) * 1000 = 1,258 * 1.1 (estimation of 10% other overhead cost) = 1,383 JOD	No environmental concerns noting that this waste is provided to the nearby farmers to feed sheep

4.5. Identifying the focus areas (if needed)

In this step, the RECP team identifies focus areas for further detailed analysis. Experience consultants can do that based on their knowledge. These are the areas (processes and utilities) where most of losses/inefficiencies are generated, and the areas which have potential room for improvement to be selected. The basic information for the priorities will come from:

- Eco-mapping tool mentioned earlier (Figure 5, section 4.3).
- Brainstorming discussion with the company's team based on the collected information (Annex III).
- Through distributing the losses and inefficiencies over the different processes and utilities for specific flow (water, materials and energy). Selected flows are the ones which have potential for improvement based on the previous step (benchmarking) and/or have relatively high cost of their losses comparing to other flows. Following tables show some examples for generated wastewater and solid waste, and energy consumption distribution to identify the focus areas for these flows by identifying the processes/utilities that have relatively higher percentages.

Annex VII guides you to conduct energy balance and identify the energy users.

Table 7: Generated wastewater distribution for a dairy company

Area	**Wastewater m^3/day**	**Wastewater distribution %**	**Source of data (Measurement, Flow meter, Calculation, Estimation)**
Cleaning processes			
Steam boiler water make up			
Cooling towers water make up			
Production line			
Domestic use (e.g. employees showers)			
Water treatment (Softeners, Reverse Osmosis (RO), etc.)			
Total		100.0	

Table 8: Losses of raw materials (solid waste of dough) distribution for Arabic Sweets company

Area	**Losses Kg/day**	**Losses %**	**Source of data (Record, Weighing or Estimation)**
Preparation			
Dough resting and cutting			
Rolling and cutting of the dough			
Filling			
Baking			
Handling			
Packaging			
Total		100.0	

Table 9: Template for energy distribution

Energy use by Activities for specific period

Area	**Electricity**		**Fuel**	
	(kWh)	**(%)**	**(kWh)**	**(%)**
Production				
Refrigeration				
Lighting …… …… ……				
Total				

Figure (10) illustrates the electrical energy consumption proportion for each type of electrical system in the company.

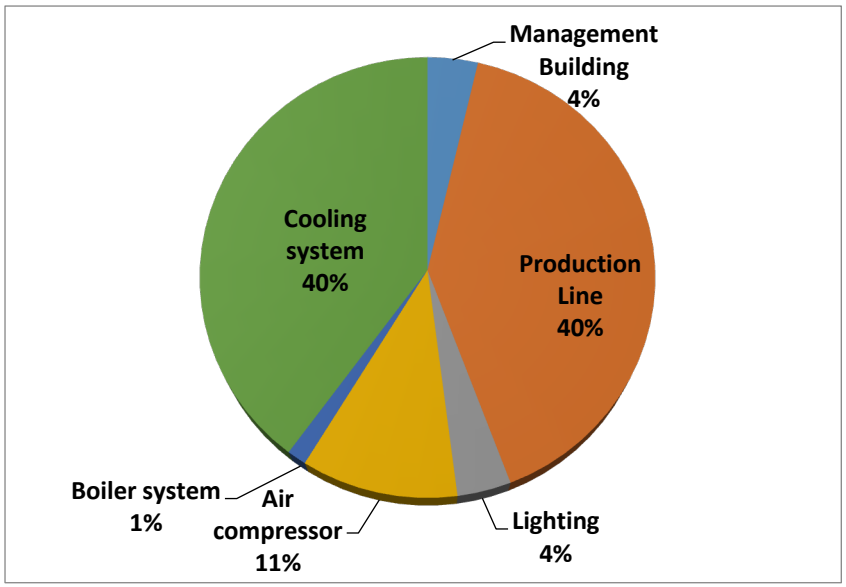


Figure 9: Summary of Electrical Energy Consumption Distribution in the company

Figure (11) illustrates the overall energy consumption (Electrical & Thermal) proportion for each type of energy system consumers in the company.

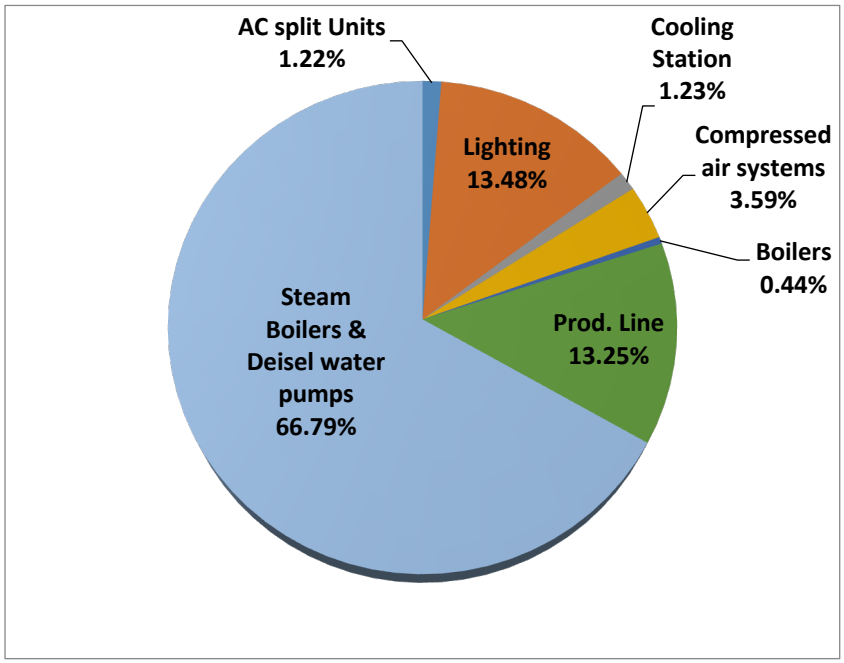


Figure 10: Summary of Overall Energy Breakdown in the company (Energy Significant Users)

Depending on the complexity of processes and the number of wastes identified, discuss the need to implement this step with the company's team based on the operations of the company, asking the question: could the whole processes and utilities be included in the next analysis or it is better to identify focus Areas?

The following box (Box 3) shows a priority selected in "bakery and Arabic sweets" and dairy companies.

Box 3: Examples on the identification of focus areas

Dairy - Cleaning process

The cleaning process is one of the major activities that is done in a daily manner and generates wastewater. It is one of the most water consuming activities as shown clear in the company records, so it is an appropriate area to reduce water consumption.

Arabic Sweets - Kunafa production line

The Kunafa production process is energy intensive with obviously low energy efficiency and also it has noticeable losses of raw and auxiliary materials, and finished products.

4.6. Reporting

Prepare the first draft of the technical report including a summary of priorities and feasible (GHK, low/no cost) RECP options that can be directly implemented to be presented to the owner/management. This will assist in achieving quick wins at the beginning of the RECP assessment to guarantee the top management support and company's RECP team assistance.

4.7. Sources and Root Causes analysis of inefficiency

This step is aimed to do further assessment and analysis for the chosen focus areas in order to identify the sources (specific process or utility) and causes of losses/inefficiencies.

This technique could be applied to investigate the root causes of inefficiency for all sources and areas during the walk-through assessment and is not allocated only for the identified focus areas.

Raw material and water measurements, mass balances, and energy efficiency measurements could be applied at this step as needed to identify the sources and root causes of inefficiency for the identified focus areas. Following tables (13 & 14) shows some examples of the sources at which losses/inefficiencies occurred based on mass balances of generated solid waste (Arabic Sweet) and energy efficiency measurements (Dairy), and root causes identified by brainstorming session with the company and by comparing the

measurements' results with the best available practices like cooling system's coefficient of performance (COP).

Table 10: Processes at which relatively large amounts of losses of materials could occur and root causes analysis of inefficiencies in Arabic Sweet company

Focus Area	Source	Root Causes
Kunafa production area	Kunafa spinning LPG fired machines	The design of the collection tray is inappropriate and should be modified
Soft kunafa production area	Soft Kunafa Roasters	A residue of roasted Kunafa is left inside the machine
Burma production area	Burma frying machine	The oil is disposed depending on the staff experience and not depending on specific measurements
Burma production area	Burma filling	Large amount of Kunafa dough and some of the filling, in addition to the consumed energy are lost due to the empty rolls' edges mainly if they are longer than needed
Baklava production area	Baklava filling and cutting	Large amount of ready (final product) of Baklava is lost because of inappropriate shape of the pieces at the edges of the tray
Dough preparation area	Dough cutting machine	The produced pieces of dough are more than needed and this causes losses in the dough after the rolling machine

Table 14 shows an example of the root causes of the losses of energy at each energy significant user revealed from energy efficiency measurements.

Table 11: Root causes of the losses of energy for Dairy Company

Focus Area	Source of energy inefficiency based on Energy Efficiency Measurements Findings	Root causes
Lighting Systems	Most of the existing lighting units have high energy consumption comparing to the standard level of illumination	Most of the lighting units are inefficient lighting units
Heating System	There are heat losses in the production line	There are un-insulated steam pipes
		There is no recovery of the lost heat

Focus Area	Source of energy inefficiency based on Energy Efficiency Measurements Findings	Root causes
Cooling System	Water chiller has a COP of 2.13	This chiller needs upgrading for the compressors, condenser units and pipes insulation in addition to the exposure of condensers to sun.
	Cold store cooling units have a COPs less than 2.5	These cooling units need upgrading for the condensers and pipes insulation, also there are some outdoor units operate with one fan instead of two fans.
	Most of the cold stores have heat gains from the surrounding/ambient.	The stores are not well-insulated
		The stores doors opening time is more than needed which increase the air change rate in the stores with the surrounding

The fishbone diagram (Annex VIII) is also a useful tool for conducting root causes analysis for specific source of inefficiency based on conducting brainstorming analysis of the reasons of inefficiency per specific categories.

To create fishbone diagram, identify firstly the source of inefficiency or problem, then decide on the categories for the problem, useful categories in the classic fishbone diagram include 1) people, 2) technology, 3) methods, 4) materials, 5) equipment 6) environment and 7) products. Then generate a list of causes for each category based on the consultation and discussion with company's team, the diagram should be adapted to the needs of the company by using the brainstorming method through organizing a meeting for this purpose. The diagram should help to answer why does the inefficiency/problem occur?

The following example analyses the causes of losses of the final products in bakery production for related and useful categories.

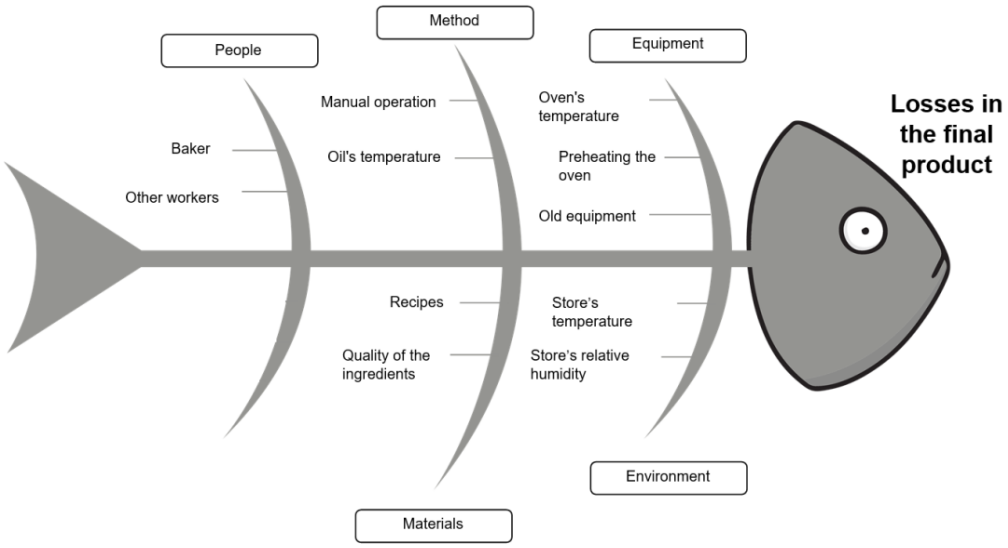


Figure 11: Example of fish bone for Bakery production[24]

4.8. Identification and Screening of RECP Options

This step aims to generate all possible RECP options for each of the cause of waste or loss identified in the previous section. These options should help to increase the water and energy efficiency, reduce waste and emission generation and raw material consumption and improve the financial situation and environmental performance of the company. The RECP team will refer to possible means, such as examples provided in Annex IX, further literature review, personal knowledge and experience, external expertise, case studies as per the references mentioned in section 4.4.1 and **brainstorming sessions**; to identify RECP options and collect ideas for improvement.

Please remember the RECP strategies/principles when generating the options:

- **Good housekeeping**
- **Segregation of generated wastes**
- **Input material change**
- **Process, technology or production change**
- **Improved process control**
- **On-site reuse/recovery or/and recycling**
- **Production of useful by-products**
- **Modification of equipment or products.**

The RECP team will not only consider identifying the options to increase the efficiency of production and productivity through better utilization of resources (water, energy, raw and auxiliary materials) identified by the previous steps, but as well could utilize the team

[24] Source of the template: 25 Great Fishbone Diagram Templates & Examples [Word, Excel, PPT] (templatelab.com)

brainstorming sessions to discuss how to identify options for further needs or opportunities such as (see Annex III and Box 4):

- Best possible utilization of equipment, labour and time.
- Having more efficient supply chain.
- Possible applications for generated waste re-use and recycle.
- How to improve the know-how on the check of product's quality (self-inspection), cleaning, hygiene (room / building, personal and production), good distribution practice (storage and transportation), and health and safety conditions.
- How to develop new products or by-products.
- How to solve any existing environment legal incompliance.
- How to find new market opportunities.
- Plan to have International Organization for Standardization such as food safety (ISO 22000).

Box 4: Examples of questions that can be asked to guide you to generate RECP options

- Do you know that for a typical disinfection in a dairy with hot water at least 80°C for 10 min or 85°C for 5 min shall be applied?
- Do you know that you need acidic detergent to clean surface soiled with something of a mineral nature scale / milk scale?
- Do you know that you need alkaline detergent (pH 10.0 - 13.5) that creates "soapy" feeling on hands to clean surfaces soiled with organic matter (fat and protein)?

Then the generated RECP options should be filtered and screened to identify:

- The options that can be implemented directly (GHK, low and non-cost options)
- The options that need further assessment and analysis

The options that can be rejected because they are not feasible due to financial, environmental or technical/organizational reasons such as: high investment, high payback period *(to be discussed with the top management, for small industry 2-3 years are commonly acceptable)*, generate new unacceptable environmental impacts, there is no available space for implementation, need staff training, technically unpractical, etc.

The options that need further assessment and analysis should be evaluated according to the following aspects:

- Technical feasibility
  The purpose of the technical assessment is to study whether the generated RECP options are realistic and would not affect the following aspects:
    - Product quality and capacity
    - Space requirements
    - Compatibility with the existing equipment
    - Occupational health and safety aspects
    - Additional training or maintenance

- Environmental feasibility
  An environmental assessment of the generated options should be done to investigate the

negative and positive environmental impacts of each option and whether the negative impacts exceed the positive ones. The environmental impacts can be evaluated according to the changes in:

  - The amount of solid waste generated, wastewater discharged and air emissions
  - Water, material and energy consumption
  - The need for wastewater treatment
  - The reusability of waste

- Economic feasibility
  The economic assessment helps RECP team to evaluate the cost effectiveness and profit of the generated options and hence helps the company's management to decide whether the option will be implemented or not. For small enterprises, it is expected that the company will implement low cost investment measures. Therefore, simple payback period (SPbP) method could be used to assess the profitability of implementing a new investment. The simple payback period is defined as SPbP = Capital cost/investment in JOD **divided by** annual net savings (avoided cost + profit – new running cost) in JOD.

Tables shown below could be utilized to conduct the feasibility analysis for the RECP options that need further assessment and analysis.

Table 12: Option Feasibility Analysis

RECP option	
Description of the problem	
Description of the solution	
Technical feasibility	
Environmental feasibility	
Economic feasibility	
Other aspects (Suppliers, OHS, Product Quality, etc.)	

Tables which are attached in Annex (IX) show some of RECP options that could be implemented in small Dairy and "Bakery and Arabic Sweet" companies. Then the approved feasible RECP options could be summarized in the following table.

Table 13: RECP Feasible Options

RECP Option	Investment cost (JOD)	Annual Saving (JOD)	Payback period	Environmental Benefits after implementing the option in terms of reductions in waste generation and resource consumption
				Energy: kWh/year Water: m^3/year Material: kg/year Solid waste: g/year Wastewater: m^3/year CO_2: kg/year

RECP options for direct implementation including the ones generated in the walk-through assessment can be put in a separate table as per the following example.

Table 14: Examples of RECP options for direct implementation[25]

Option	Economic feasibility		Environmental benefit
	Investment	Saving	
Reduce the leakages from steam valves by using high quality cascades	Minimal	228.7 JOD/year	Reduce water and diesel consumptions (reduce steam leakage by at least 20%).
Scheduling the defrost time and fix the leakages from NH_3 pipes	No investment	Can't be estimated.	Avoid the possibility of NH_3 dissemination to surrounding air and reduce energy consumption.
Install photo cells for doors inside the production hall to control the open-close periods	300 JOD	350 JOD/year	Reduce the cooling load in the production hall and so less electrical energy consumption will be needed.
Dry clean up before water washing	No investment	672 JOD/year	Reduce solid waste, COD (by 50%), water consumption by 20 to 30%, cleaning WW and detergents.

[25] These options are generated by CPU and NERC at RSS during the demostartion of Quick-Scan Plus assessment at one of the companies in Jordan in 2007. However, this table is presented here to give an example about some of RECP options that could be implemented immdeiatly without any further technical, economic and enviromental assessment and analysis. All figures menioned in the table are estimated based on the technology adopted by the company and the cost of resources at that time of study.

4.9. Action plan

After assessing the feasibility of the identified RECP options, the RECP team should present these options and get the owner/manager approval, and this will be the right time for the company to choose which of the proposed options will be implemented, based on internal priorities and resources.

Latterly when the team finished the consultation and the review of the suggested options, the team will formalize the RECP action plan through specific meetings. The action plan will detail the following:

- Specify the option (already assessed) & its targets (savings)
- Specify how the targets are intended to be reached (actions).
- Resource requirements (finance, manpower, licenses, space, etc.).
- The persons responsible for undertaking those activities.
- A time scale for completion with intermediate milestones.

The following table shows a recommended template for the action plan for one of the feasible approved RECP options that needs relatively high investment and long time for implementation.

Table 15: RECP Action Plan for the Suggested Option

RECP Option (description and targets):

Action	Needed resources (human, investment, training, etc.)	Responsibility	Timeframe	Frequency of follow up

Follow up	State of Implementation (Implemented/Under Implementation/Planned to be Implemented/Rejected at the time being)	Implemented by/Date	Notes (progress achieved / challenges faced)
1st follow up			

When developing the action plan, keep in mind the following:

- Action plan formats depend on each company: choose whatever everybody understands!
- Realistic activities measurable and achievable.
- Responsibilities clearly defined: before engaging people ask them!
- Specific time schedule for completing activities.
- Resources needed specification including plans for acquiring those resources.

5 Implementation of the RECP options

This phase includes:

- Direct implementation of GHK and low/no cost RECP options.
- Apply training for the staff or linking to relevant existing training programs according to the needs identified in generating the RECP options.
- Link the RECP feasible options that need relatively high investment to existing national financial[26] programs.
- Implement the improvement measures and recommendations for information, cost accounting and management systems.

Implemented options range from GHK measures and organizational measures to technical upgrades, recycling and the installation of appropriate technology.

The RECP team should finalise the action plan and get permission from management for the implementation of the most feasible options. It is expected that the companies implement its RECP options according to the action plan and put in place a respective monitoring scheme. Special attention should be paid to the need for training of the staff, as well as, the options to improve the cleaning process, hygiene, health and safety conditions and development of new products. The project could be a failure if it is not backed up by adequately trained employees. Training needs should have been identified during the technical evaluation.

Good housekeeping measures should be implemented first, as they bring benefits at no cost to the company. They deserve as much attention as traditional equipment upgrades. The effects of good housekeeping measures can be sustained by making the people who influence operations accountable.

This step shall as well include linking to existing financial funding programs to implement RECP options that need investment beyond the industry's allocated budget for development and improvement.

The generated recommendations to improve the information, cost accounting and management system that could be investigated from the first step of RECP assessment, should be recorded to check their implementation and the reasons prevent their implementation if faced.

[26] The interest rate of the loan shall be considered in the financial feasibility study.

Table 16: Examples of recommendations to improve the information, cost accounting and management system

Recommendation	Status (Done/Under Implementation/Planned to be Implemented/Cannot be implemented (why?))
The monetary and quantity of each purchase material shall be recorded separately for better tracking of the efficient utilization of this material.	
Track the use of each specific material; i.e. to produce labaneh, cheese or yoghurt. This will enable you to have better pricing of different products.	
Apply standard operation procedures to control the staff performance and control the personal errors and inefficient actions.	
Weigh the solid waste generated from different processes on a daily manner by requesting the staff to collect them in specific containers and weigh them at the end of production.	
Avoid storing solid materials nearby liquid materials.	

The action plan prepared in the previous step will be utilized here to monitor and follow-up the status of implementing the RECP options. Also, it will enable the RECP team to identify the further needed actions to secure the resources (financial, human, etc.), coach-up the company's staff and modify production planning among others to proceed.

6 Monitoring of Performance

6.1. Monitoring to check, maintain and increase performance in resource utilization

RECP emphasizes on continuous improvement. Monitoring and evaluation are needed to assess the level of achievement. There are two main steps in this regard and they include:

- Monitoring of implemented RECP options
- Evaluation of implemented RECP options

You need to develop a monitoring schedule for each option. The monitoring period for each option may differ. At the initial stage the monitoring may be done more frequently. When success of the implementation can be ascertained, you may even stop monitoring once the objective has been achieved.

To evaluate the success of each option, companies can use key performance indicators (KPI). KPI is a specific method used to make comparison and to see the level of improvements made. It provides a performance snapshot and can be used to improve processes, systems, and activities continuously.

The typical indicators to evaluate the effectiveness of the implemented RECP options are:

– Reductions in wastes and emissions per unit of production.
– Reductions in resource consumption (including energy) per unit of production.
– Improved profitability.

There should be periodic monitoring to determine whether positive changes are occurring and whether the company is progressing toward its targets.

To evaluate the actual achieved savings from implementing the RECP options, the company shall monitor some parameters such as the ones shown in the following table and compare them with baseline KPIs of previous year to evaluate the performance progress and take necessary actions to sustain and improve it. And, it is better to have a specific monitoring system for each option as possible as mentioned above.

Table 17: Performance monitoring

Parameter	**Unit of monitoring**	**Frequency (Monthly / Quarterly / Semi-annual / annually)**	**Value (After implementation)**	**KPI (Before implementation during ……)**	**Evaluation / needed actions**
Raw material	kg/ton of product				
Water consumption	m^3/ton of product				
Fuel Consumption	litre or kWh/ton of product				
Electricity consumption	kWh/ton of products				
Wastewater	m^3/ton of product				

6.2. Verification of the implemented options

To apply mass, water and/or energy efficiency measurements, calculations and analysis to identify the actual achieved savings from implementing a specific RECP Option. Also, taken pictures before and after RECP options implementation could be utilized for this action, make sure they are posted in the enterprise as motivation for continuous improvement. See an example to verify the achieved results of implementing energy saving measures in figure 13.

Verification of the implementation of energy improvement options								
#	Improvement Option	Parameter	Before implementation	After Implementation	Recommended value	Percentage of Completion	Saving based on the RECP assessment	Expected saving based on Monitoring and Verification (M&V) measurements
1	Arresting 90% of the leakages in the steam system	Steam Leakages (kg/Year)	15,873	1,587	< 1,587	100%	1,235 Litre Diesel	1,235 Litre Diesel
2	Pipe insulation in the steam system	Un-insulated pipes (m)	86	10	0	88%	9,890 Litre Diesel	8,703 Litre Diesel
3	Pressure setting reducing from 9.7 to 7 bar for compressed air	Has not been done yet					9,878 kWh	0
4	Controlling of cold stores door openings	Has not been done yet					4,099 kWh	0
						Total	**11,125 Litre Diesel 13,977 kWh**	**9,938 Litre Diesel 0 kWh**

Figure 13: Verification of savings

7 Continuous Improvement

The implementation of RECP approach is an on-going process, therefore, the company needs to establish a system to ensure the continuity of implementing this approach and this could be achieved by integrating RECP approach with the company's management and decision-making system and Environmental Management System (EMS)[27] if it is in place. This phase focuses on the company's actions to continually improve its performance in resource efficiency and integration of RECP in its management and decisions. RECP will be more sustainable if the program is integrated into the overall company culture, management and daily operations. RECP should be integrated with and

[27] The US Environmental Protection Agency (EPA) defined the Environmental Management System (EMS) as a framework that helps an organization achieve its environmental goals through consistent review, evaluation, and improvement of its environmental performance. The assumption is that this consistent review and evaluation will identify opportunities for improving and implementing the environmental performance of the organization.

have equal status to programs (if existing) such as quality assurance, health and safely, environmental management, etc.

The SP can assist the company at this stage by supporting it to engage with the national related efforts to incentivise the adoption of resource efficiency practices and to be aware of the national programs/opportunities/actors in the area of green/circular economy (i.e. MoEnv initiatives), green finance (i.e. Jordan Renewable Energy and Energy Efficiency Fund (JREEEF), Jordan Environment Fund (JEF), Industrial Development Fund/Ministry of Industry, Trade and Supply (MoITS) and Central Bank of Jordan), excellence award (i.e. King Abdallah II Excellence Award on Environment Sustainability and Green Factory Award/Jordan Chamber of Industry (JCI)) and technical assistance (i.e. JoPack, Jordan Enterprise Development Corporation (JEDCO) and IRADA programs) through link it to the relevant stakeholders, programs and websites/portals.

The company can do the following to follow-up and improve its efficient production on a continuous basis:

- Analyse the results of the previous step of performance evaluation to identify the gaps between expected and achieved results, and their root causes. And accordingly take actions to improve the information and management system as well as to integrate and sustain the RECP experience.
- Regular implementation of the RECP approach (phases I, II and III) to investigate new improvement opportunities mainly when developing new products or increase the plant's production capacity.
- Keep the company's focal point (and the RECP internal team if established) active and organise regular meetings to check the performance, monitoring recorded data and performance indicators, and accordingly find solutions for any detected inefficiencies.
- Continue with monitoring, data recording and evaluation.
- Use a green board for feedback from employees.
- Provide recognition and incentives to employees for their good ideas and resource efficient performance.
- Reuse the economic benefits generated from implementing RECP options to promote the continuous implementation of RECP approach, therefore, it is highly recommended to set up a separate account for the financial savings generated after implementing RECP options and for the investment in new ones.

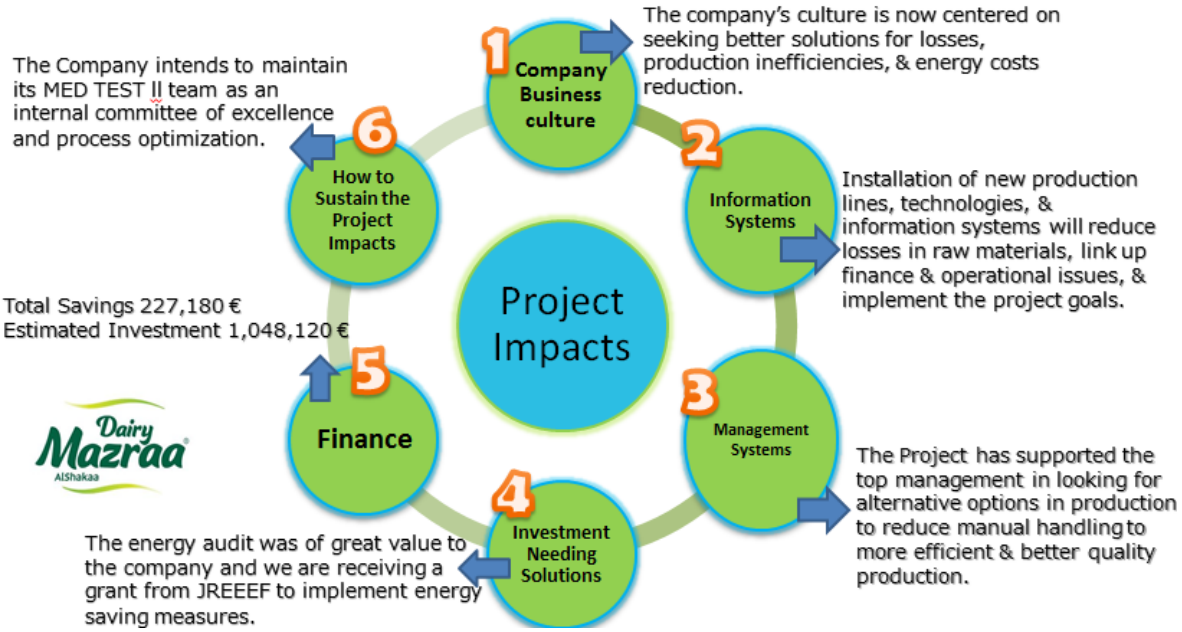


Figure 12: Continuous improvement plan of Farm Dairy which implemented RECP/TEST approach.[28]

[28] Source: Plant Manager of Farm Dairy as per his presentation in the Dissemination Event of MED TEST II project in Jordan in 2018.

Annex (I)

Comparison between these RECP guidelines for dairy and “bakery & Arabic sweet” enterprises and UNIDO-TEST approach.

RECP approach	**Resource Efficient and Cleaner Production (RECP) Guidelines for Dairy and “Bakery and Arabic Sweet” Enterprises**	**Transfer of Environmentally Sound Technology (TEST)**
Scope	Roll-out of the RECP approach to SEs of the food processing selected sub-sectors in Jordan	Full application of RECP, and partial implementation of Material Flow Cost Accounting (MFCA), Environmental Management System (EMS) and Energy Management System (EnMS)
Target group	SEs (5-19 employees) and SPs	Medium and Large Enterprises (MLEs) and SPs
Time (Planning Phase)	3 to 4 months	9 to 12 months
Sector	Dairy and “Bakery and Arabic Sweet” sector	All sectors

Annex (II)

Guiding work plan:

Step	Action	Responsible	Estimation of time needed	Targets/Outcomes
1.1 Obtain management commitment	Kick-off meeting with the management Modify/update existing or create Environment Policy integrated RECP concept and principles (optional)	RECP Service Provider (SP)	2 hours 2 hours	Management commitment and support Assign the company's RECP focal point and provide his/her contact details Issuance of RECP integrated Environment Policy (optional)
1.2 Establish the RECP team	Email or SMS message sent of the team and their contact details Assign a date and time for the 1st meeting	SP Owner/manager RECP focal point	1 hour	RECP Team (internal and external) established
Training on the planning phase	Could be organized in group-based module of two companies or more or one-day training at the company	SP	Group-based: 2 days At company: 0.5 day[29]	Internal RECP team is aware of the planning phase, how to be implemented and its outcomes.
1.3 Walk-through assessment	Conduct the 1st meeting with RECP Team and prepare the work plan[30] (optional)	SP and the RECP focal point	2-3 hours	Roles assigned and work plan prepared including specific activities/actions, models of communication/delivery, responsible, timeframe/deadline,

[29] For this small sized companies, it may be difficult to fully assign the RECP team for full 1 or 2 days training, so most practical option shall be discussed with them and could be organized to be conducted online.
[30] Mention the needed quantitative data (Baselines and Benchmarking) when preparing the work plan to allocate the responsible to provide them, how to provide and when.

Step	Action	Responsible	Estimation of time needed	Targets/Outcomes
				deliverables/outcomes and status.
	Conduct a walk-through inside the company and collect data about the company and its processes/utilities	SP RECP focal point	1-2 visit/ 2-4 man-day	SP and the RECP team are aware of the company's processes/utilities, basic data/information, etc.
	Collection of quantitative data (Baseline and Benchmarking)			Baseline data established to evaluate the progress after implementing the RECP feasible options. KPIs identified for key raw materials, water, energy and wastes to investigate potential for improvement through benchmarking.
	Identifying the Focus Areas (if needed)	SP Company RECP Team	1-2 Hours	Focus areas identified for further analysis
	Draft the 1st report including a summary of priorities and feasible (GHK, low/no cost) RECP options that can be directly implemented to be presented to the top management/owner	SP: reporting and summary SP and RECP focal point: meeting with Owner/manager	2-4 man-days	Quick wins achieved at the beginning of the RECP assessment to guarantee the top management support and company's RECP team assistance.
1.4 Revealing sources and causes of inefficiency	Apply water, material and energy efficiency measurements and balances as required for the identified focus areas, and assessment of the results to reveal the sources and causes of inefficiency. Also, fish bone could be utilized by conducting brain storming sessions to identify the causes of	SP RECP Team	1 visit/ 2 man-days	Sources and causes of inefficiency identified

Step	Action	Responsible	Estimation of time needed	Targets/Outcomes
	inefficiency at specific identified sources.			
1.5 Identification and screening of RECP options	Conduct brainstorming session to generate RECP options as much as possible *(there is no stupid ideas)* utilizing this guideline to assist in identifying RECP options, also refer to other references, experience of the company's RECP team and SP experience.	SP RECP Team	1visit/ online meeting 1 man-day	RECP options generated
	Apply feasibility analysis of the generated options.	SP	1-2 man-days	Feasibility (environmental, financial and technical) of RECP options identified
	Discuss the feasibility analysis with the company's RECP team to screen the RECP options and identify the acceptable ones.	SP RECP Team	1 visit/online meeting 0.5 man-day	Feasible RECP options identified and screened
1.6 Action Plan	Prepare an action plan of the feasible screened RECP options and get the top management/owner approval on it.	SP RECP focal point	1 visit/online meeting 1 man-day	Action plan of feasible options Top management/owner approval for RECP options implementation
Training on phases II and III	Could be organized in group-based module of two companies or more or one-day training at the company	SP	Group-based: 1- day At company: half a day	Internal RECP team is aware of these phases, how to be implemented and their outcomes.

Step	Action	Responsible	Estimation of time needed	Targets/Outcomes
Phases II & III: Implementation of the RECP options and Monitoring of Performance	Shall be discussed as per the case of each company.	SP RECP focal point	1-2 visits/3-4 man-days	Implementation of RECP options Monitoring of performance Recommendations for improvement Verification of actual savings of resources
Preparing the final technical report		SP	2-4 man-days	One documented reference of the conducted RECP assessment, achieved results, action plan and monitoring plan.
Continuous Improvement	The company shall design that according to its case and management system.	RECP focal point	----	Continuous implementation of RECP approach in the company integrated in the culture and management of the company.

Note: 15-25 man-days and 4-5 site visits are needed per each small enterprise based on the pilot demonstration of these RECP guidelines at 8 SEs in 2022.

Annex (III)

Walk-through Checklist Template

Information on the Company

Date	.....
Persons present during the Walk-through	.....
Name of company	.....
Other information	.....

Estimation of potential areas for improvement by the company

Where does the management see room for improvement? Are there obvious losses of resources?	....
Efforts made so far to ensure efficient use of resources?	....
Which processes and materials are especially cost-intensive?	....

Energy management

Energy type **Annual consumption**	□ **Electricity** □ **Diesel** □ **LPG** □ **other** …..... kWh …..... l …..... m^3 ….....
Energy consumers	....
Is there a maintenance plan for technical energy systems?	□ preventive maintenance (internal, external) □ partially available □ not available
Other information	....

Occupational health protection

Do employees suffer from health problems?	□ **no** □ **occasionally** □ **yes** **If yes, which health problems** .....
Do employees suffer from health problems?	□ yes □ not always □ no Which hygiene and safety rule do apply? .....
Is personal protective equipment in use?	□ yes □ not always □ no

Industrial safety and accident prevention

Do you have risk of accidents?	□ yes □ don't know □ no If yes, which risks were identified? .....
Are accident prevention aids available?	□ yes ….. □ don't know □ no
Are the employees informed about accident prevention?	□ yes □ don't know □ no
Are regular training sessions held?	□ yes □ don't know □ no

Material handling[31]

How are materials moved?	□ manually □ automatically
Do obvious losses occur during handling*? ***Leaks, splashes, incorrect fillings, over-consumption etc.**	□ no □ low losses □ yes If yes, do you estimate the amount .....
Are additional preventive measures needed for better material's movement?	□ no □ yes .....
Comments	....

[31] Include all type of materials (raw, auxiliary and operating)

Production and consumption statistics

		per the year		per (specify)		Data basis	Comments
		Quantity [Unit]	Cost [JOD]	Quantity [Unit]	Cost [JOD]	(CE / I)[1]	Main consumers, sources of waste, wastewater, emissions
Production							
Water							
Raw & Auxiliary Materials							
Waste							

[1] CE = company estimate I = Invoice (invoicing period)

Qualitative Assessment[32]

Processes

Process:	

Process sketch, information on inputs (raw materials, chemicals, water, energy), outputs (products, waste water, air emissions, types of waste, waste heat, by-products)

Input	(Eco-) toxic problem materials	□ none	□ small quantities	□ large quantities
	Raw, auxil. & operating materials	□ negligible	□ small quantities	□ large quantities
	Energy consumption (process)	□ low	□ moderate	□ high
	Costs (input materials, energy)	□ low	□ moderate	□ high
Waste	Solid waste (incl. packaging waste)	□ none	□ small quantities	□ large quantities
	Special- (or hazardous) waste	□ none	□ small quantities	□ large quantities
Wastewater	Wastewater	□ none	□ small quantities	□ large quantities
	Problematic wastewater components	□ none	□ small quantities	□ large quantities

[32] Useful mainly to identify the focus areas if needed, also remind you to draw the flow charts and recognise the potential sources of inefficiencies, as per tables in pages 59-64.

Emissions	Air emissions	☐ none	☐ small quantities	☐ large quantities
	Disposal preparation costs	☐ low	☐ moderate	☐ high
Technology	State of the art	☐ suitable	☐ optimisation candidate	☐ unsuitable
	Level of automation	☐ fully automatic	☐ semi-automatic	☐ manual
	Faulty batches, scrap etc.	☐ none	☐ small quantities	☐ large quantities
	Maintenance, servicing, cleaning	☐ suitable	☐ optimisation candidate	☐ unsuitable
	Cost of maintenance, stoppages	☐ low	☐ moderate	☐ high

Storage and stock management

Storage 1	**Stored materials, raw materials, products, waste?**		
Storage 1	Stock management scheme operated?	☐ yes	☐ partly	☐ no
	Storage order, tidiness	☐ excellent	☐ needs optimisation	☐ unsuitable
	Safety concept	☐ complaint	☐ needs optimisation	☐ none
	Available safety measures	☐ fire alarms	☐ manual fire extinguishers	☐ sprinklers
		☐ drip troughs	☐ storage basins	☐ none

Storage 2	Stored materials, raw materials, products, waste?

Storage 2	Stock management scheme operated?	□ yes	□ partly	□ no
	Storage order, tidiness	□ excellent	□ needs optimisation	□ unsuitable
	Safety concept	□ complaint	□ needs optimisation	□ none
	Available safety measures	□ fire alarms	□ manual fire extinguishers	□ sprinklers
		□ drip troughs	□ storage basins	□ none

Energy	Process heat
Process heat	Heat sources □ steam ..... °C ..... bar □ hot water ..... °C □ ..... Consumers ..... ……..... Losses □ none □ small quantities □ large quantities Maintenance, insulation □ good, preventative □ needs optimisation □ unsuitable
Boiler 1 **Type** …….. ……..	Energy source □ gas □ electrical current □ diesel Nominal capacity / fuel consumption ..... Operating hours ..... Technology □ suitable □ needs optimisation □ unsuitable Maintenance □ good, preventative □ needs optimisation □ unsuitable
Boiler 2 **Type** …….. ……..	Energy source □ gas □ electrical current □ diesel Nominal capacity / fuel consumption ..... Operating hours ..... Technology □ suitable □ needs optimisation □ unsuitable Maintenance □ good, preventative □ needs optimisation □ unsuitable
Boiler 3 **Type** …….. ……..	Energy source □ gas □ electrical current □ diesel Nominal capacity / fuel consumption ..... Operating hours ..... Technology □ suitable □ needs optimisation □ unsuitable Maintenance □ good, preventative □ needs optimisation □ unsuitable
Comments	

Energy	Compressed air
Compressed air ductwork system	Accumulator pressure ..... bar Consumers ..... ……..... Losses (leaks) □ none □ small quantities □ large quantities Maintenance □ good □ needs optimisation □ unsuitable
Compressor 1 Type …….. ……..	Working pressure ..... Nominal capacity / Current consumption ..... Operating hours ..... Technology □ suitable □ needs optimisation □ unsuitable Maintenance □ good, preventative □ needs optimisation □ unsuitable
Compressor 2 Type …….. ……..	Working pressure ..... Nominal capacity / Current consumption ..... Operating hours ..... Technology □ suitable □ needs optimisation □ unsuitable Maintenance □ good, preventative □ needs optimisation □ unsuitable
Compressor 3 Type …….. ……..	Working pressure ..... Nominal capacity / Current consumption ..... Operating hours ..... Technology □ suitable □ needs optimisation □ unsuitable Maintenance □ good, preventative □ needs optimisation □ unsuitable
Comments	

Energy	Refrigerating systems			
Refrigeration energy Cooling agent system	Cooling media ☐ brine ..... °C ☐ cooling water ..... °C ☐ others ..... Consumers ..... ……..... Losses Maintenance, insulation	☐ none ☐ good	☐ small quantities ☐ needs optimisation	☐ large quantities ☐ unsuitable
System 1 Spec. …….. ……..	Refrigerant ..... Nominal capacity / Current consumption ..... Operating hours ..... Technology Maintenance	☐ suitable ☐ good	☐ needs optimisation ☐ needs optimisation	☐ unsuitable ☐ unsuitable
System 2 Spec. …….. ……..	Refrigerant ..... Nominal capacity / Current consumption ..... Operating hours ..... Technology Maintenance	☐ suitable ☐ good	☐ needs optimisation ☐ needs optimisation	☐ unsuitable ☐ unsuitable
System 3 Spec. …….. ……..	Refrigerant ..... Nominal capacity / Current consumption ..... Operating hours ..... Technology Maintenance	☐ suitable ☐ good	☐ needs optimisation ☐ needs optimisation	☐ unsuitable ☐ unsuitable
Comments				

Housekeeping Conditions	
Question	**Proposed RECP option as mentioned in Annex (VII)**
Are there noticeable spills or leaks? Is there any evidence of past spills?	Please See Annex (IX) Options no. 1, 4, 8, 16, 18, 20, 23, 31, 35,37,38,39 & 40.
Are raw materials or products stored and handled at proper storage areas?	Please See Annex (IX) Options no. 1 & 6
Are there damaged or defective containers, bags, drums, etc?	Please See Annex (IX) Options no. 1, 8, 24 & 30
Are all containers, bags, drums labelled and well identified?	--
Are storage areas free from insects, pests or their remains?	Please See Annex (IX) Options no. 3 & 6
Are storage areas dry and well ventilated?	--
Are there temperature gauges and is the temperature monitored regularly and documented?[33]	--
Is there an effective inventory system, are the stock monitored and recorded?	Please See Annex (IX) Options no.23 & 24
Are chemicals (i.e. insects and pests control) and cleaning supplies stored away from food and other food related supplies (packaging material etc.)?	--
Production processes & Utilities	
How are materials transferred from area to another?	--
Are there noticeable spills, drips and leaks on the floor?	Please See Annex (IX) Options no. 1, 4, 8, 16, 18, 20, 23, 31, 35,37,38,39 & 40.

[33] Storage conditions differ according to the type of raw material and product, according to the literature, the following storage conditions should be achieved:

- The optimum storage temperature for milk and fresh dairy products is usually <4°C (2).
- For long-term storage, butter freezing facilities must operate at below -15°C, and temperatures down to -30°C are not uncommon. Sufficient space should be allowed between cases and pallets to allow air circulation, which encourages even chilling (2).
- The temperature of storage varies for different types of cheese. Quick ripening soft cheeses require a low temperature of 4.5°C whereas the harder cheeses, requiring longer ripening periods, are normally stored at up to 18°C (2).
- Yoghurt is cooled to less than 5 °C and filled into pots ready for storage and distribution (8).

Are there any areas where dust created during transferring, weighing or unloading?	Please See Annex (IX) Options no.47 & 65
Is there any situation where workers do not have appropriate tools for mixing, weighing, handling, etc.?	Please See Annex (IX) Options no. 49
Is the equipment operating at its designed capacity?	Please See Annex (IX) Options no.27 & 63
Is there any equipment available that is not in use and could increase efficiency?	--
Do the workers have any comments about the sources of waste and emissions?	--
Do employees suffer from health problems?	--
Are the employees informed about industrial hygiene and safety?	Please See Annex (IX) Options no.25
Do you monitor the working environment with regard to health and safety working conditions?	Please See Annex (IX) Options no.25
Do you have documented standard operating procedures (SOP) for the production processes of different products?	Please See Annex (IX) Options no.20
Waste (solid waste and wastewater) and emissions issues	
From which processes and areas do wastes and emissions generated?	Please See Annex (IX) Options no.1, 16, 17, 18, 22, 24, 30, 35, 36, 37, 38, 40, 49, 51, 58, 59, 60 & 61
How are wastes removed from the process area? Where do they go?	Please See Annex (IX) Options no.17, 18, 22, 30, 31, 38, 58, 59, 60 & 61
Are wastes segregated?	Please See Annex (IX) Options no.22, 30 & 59
Are there any opportunities for reuse or recycling of wastes?	Please See Annex (IX) Options no.13, 17, 18, 38, 58, 60 & 61
Which costs are created by the management, treatment (if exist) and disposal of waste?	--
How does the company dispose the solid waste and wastewater?	Please See Annex (IX) Options no.13, 17, 18, 22, 30, 38, 58, 60 & 61
Information and Accounting System (See Annex IV)	
Do you know the value and cost of having a good and accurate information system?	--
Do you record the amount of raw materials and ingredients that are used in the production?	Please See Annex (IX) Options no. 23

Do you record the main processing conditions in the production process (i.e. time, temperature, etc.)?	Please See Annex (IX) Options no. 62
Do you record the cash used to buy raw materials, ingredients and packaging materials versus the type and volume of purchased materials?	--
Do you keep record for your daily sales?	--
Do you know how to calculate your profit or loss?	--
Do you know how to calculate the actual amount and cost of raw materials and ingredients used in the production?	--
Do you know how to calculate your weekly or monthly production rate?	--
Do you know how to do a comparative report for your monthly consumptions and sales?	--
Do you know how to monitor and improve your business productivity?	--
New market opportunities and products	
Are you planning to enter a new market? What do you need and how RECP could assist you to achieve this goal?	--
Are you planning to produce new products or by-products? What do you need to achieve this goal?	--
General personal hygiene & food safety	
Are production area and tools (floor, surfaces, sinks, bowels, pots, etc.) clean and sanitized?	Please See Annex (IX) Options no. 1, 4, 8, 20, 35, 47 & 65
What kind of materials (chemical, soap, water, etc.) do you use to clean and sanitize the surfaces used for ingredients processing and product packaging?	--
Are cleaning and sanitizing compounds stored away from the production area?	--
Are the workers wearing clean clothes (gloves, clean apron, hair covers, etc.)? Do they change the gloves and wash their hands when they have to leave the production area?	Please See Annex (IX) Options no. 1 & 25
Do you eat, drink or smoke in the production area?	Please See Annex (IX) Option no. 25

Are the products well packaged/wrapped to prevent product contamination?	Please See Annex (IX) Option no. 6
In case you have to transfer cold products to the market, do you transfer them in cold containers? How do you control the container's temperature for long rides?	--
What is the source of water (municipal water, potable water, rainwater) used in the production?	--

Energy

Survey of Behaviour		
This Survey analyses schedule of operation and activities developed		
Question	**Options**	**Answer**
Sunday through Thursday, how many hours does the facility operate daily?	0-24 hrs	
How many hours does the facility operate daily on weekends?	0-24 hrs	
What kind of activities does the company fulfil? You can choose from several options	Kneading Baking Sales Administration Others	
In course of your workday do you have a break?	Yes/No	
How long is your break?	Hrs	
When you leave your workday or break, do you leave electrical equipment or appliances on?	Yes/No	
Which appliances or equipment remain on?	Refrigeration Equipment Oven Lighting Others	
Do you unplug the cables of electrical equipment or appliances that you do not use?	Yes/No	
What are the electrical equipment or appliances that you disconnect?	Baking machine Mixer Oven Fan Television Refrigerator	

	Others None	
How do you consider the operation and condition of the electrical equipment?	Good Fair Bad	
Other advanced questions	**Answers**	
Is there a load curve?		
Do you pay for reactive power?		
Underload of transformer?		

Survey of Equipment - Bakery				
This survey analyses the power of each equipment and time of use.				
Question	**Answers**			
How many mixers or kneaders does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the nominal power in (W)?				
Time of daily use between week?				
Time of daily use on Weekend?				
How many leavening chambers does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the nominal power in (W)?				
Time of daily use between week?				
Time of daily use on Weekend?				

How many Fuel ovens does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the firing rate of the burner?				
Time of daily use between week?				
Time of daily use on Weekend?				
How many electric ovens does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the nominal power in (W)?				
Time of daily use between week?				
Time of daily use on Weekend?				
How many refrigerators does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the nominal power in (W)?				
Time of daily use between week?				
Time of daily use on Weekend?				
Is there other equipment (Fans, Pumps, etc.)?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
Type of equipment				
What is the nominal power in (W)?				

Time of daily use between week?				
Time of daily use on Weekend?				
Have any changes been made to appliances or equipment in the last year? (YES/NO)				
What devices or equipment have been changed?				
Approximately, how long ago was changed in the last year?				
What equipment or appliances do you run on a daily basis? (Refrigerators, Other)				
How many hours this equipment is turned on? (0-24 hrs)				

Survey of Equipment – Dairy				
This survey analyses the power of each equipment and time of use.				
Question	**Answers**			
How many cookers/Pasteurizers does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is capacity of the cooker (Litre)?				
Time of daily use (hours)?				
The age of the equipment (years)?				
How many Mixers does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is capacity of the mixers (Litre)?				
What is the nominal power in (W)?				

Time of daily use (hours)?				
The age of the equipment (years)?				
How many Incubators does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is capacity of the incubator (Litre)?				
What is the nominal power in (W)?				
Time of daily use (hours)?				
The age of the equipment (years)?				
How many refrigerators does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the nominal power in (W)?				
What is capacity of the refrigerator (Litre)?				
Time of daily use (hours)?				
The age of the equipment (years)?				
How many Packaging lines does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				
What is the nominal power in (W)?				
What is capacity of the equipment (Litre/hr)?				
Time of daily use (hours)?				
The age of the equipment (years)?				
How many filling lines does the facility have?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
What is the brand of the equipment?				

What is the nominal power in (W)?				
What is capacity of the equipment (Litre/hr)?				
Time of daily use (hours)?				
The age of the equipment (years)?				
Is there other equipment (Fans, Pumps, etc.)?				
	Equipment 1	**Equipment 2**	**Equipment 3**	**Equipment 4**
Type of equipment				
What is the nominal power in (W)?				
Time of daily use between week?				
Time of daily use on Weekend?				
Have any changes been made to appliances or equipment in the last year? (YES/NO)				
What devices or equipment have been changed?				
Approximately how long ago was changed in the last year?				
What equipment or appliances do you run on a daily basis? (Refrigerators, Other)				
How many hours this equipment is turned on? (0-24 hrs)				

Production Survey - Bakery	
This survey analyses the mass used for each product in the bakeries	
Questions	**Answers**
Approximately how much flour is used daily in (kg)?	
Approximately how much flour is used Sunday through Thursday in (kg)?	
Approximately how much flour is used on Weekends?	

Approximately how many loaves of bread are produced daily?	
Approximately how many loaves of bread are produced from Sunday to Thursday?	
Approximately how many loaves of bread are produced on weekends?	
Approximately how many cakes are produced from Sunday to Thursday?	
Approximately how many cakes are produced on weekends?	
Approximately how many sweets (Cookies, biscuits, etc.) are produced daily?	
Approximately how many sweets (Cookies, biscuits, etc.) are produced from Sunday to Thursday?	
Approximately how many sweets (Cookies, biscuits, etc.) are produced on weekends?	

Survey of production and energy consumption – Dairy	
This survey analyses the mass used for each Dairy product in addition to energy consumed	
Production Questions	**Answers**
Approximately how much raw milk is used daily in (kg)?	
Approximately how much milk is used in a month (kg)?	
Approximately how much dairy is produced in a month (kg)?	
Approximately how much cheese is produced in a month (kg)?	
Approximately how much ghee is produced in a month (kg)?	
Approximately how much butter is produced in a month (kg)?	
Energy Consumption Questions	**Answers**
What is the average monthly electricity bill (kWh or JOD)?	
Approximately how much LPG bottles are replaced in a month (kg)?	

Survey of Lighting		
This survey analyses the power and time of use of lighting.		
Questions	**Answers options**	**Answers**
How many hours per day are the lights on by area?	Production: Sales:	
Do you turn off the lights you are not occupying?	Yes/No	
Are there sectors which can be controlled independently?	Yes/No	
Are switches labelled?	Yes/No	
How many lights do you have in the facility?		
What is the nominal power in (W)?		

Survey of Maintenance		
This survey analyses maintenance of equipment and energy savings measures		
Questions	**Answers options**	**Answers**
Have you performed maintenance on electrical installations and equipment?	Yes/No	
What electrical facilities or equipment have been maintained?		
How often is the maintenance or renewal of the machines performed?	Years	
Do you know about the energy consumption by electrical installations and equipment?	Yes/No	
Does the facility have an energy plan?	Yes/No	
Have you ever performed an energy consumption breakdown of the facilities?	Yes/No	
Have you ever implemented any energy saving measures?	Yes/No/unknown	

Annex (IV)

Recommended Actions to Improve the Information and Accounting System

<table>
<tr><th>Question</th><th>Actions to take</th></tr>
<tr><td>Do you know the value and cost of having a good and accurate information system?</td><td>Value of having good information system:
– detailed knowledge about the production processes of your business
– identification of trends
– accurate control over finances and product quality
– identification of individual costs to allow changes to a product or process to optimise profits
– keeping track of money owed to the business

Cost of having good information system:
– time spent learning how to keep records
– time spent writing the records
– cost of materials such as notebook and pens

Workers should know the value of having accurate information system and why it is being collected.</td></tr>
<tr><td>Do you record the amount of raw materials and ingredients that are used in the production?</td><td>Records of the amount and quantity of raw materials and ingredients should be kept to ensure that the workers mix together the same quantity of raw materials and ingredients at each batch. The following table can be used to record the needed information:

<table><tr><td>Product name:</td><td></td><td></td></tr><tr><td>Raw material/ingredient</td><td>Batch number</td><td>Quantity (Kg) / volume (L)</td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Do you record the main processing conditions in the production process (i.e. time, temperature, etc.)?</td><td>Records to the main processing conditions should be kept to ensure that the workers process raw materials and ingredients according to the recipe and under the same processing conditions each time. The following table can be used to record the needed information:

Product name: yoghurt
Batch number: 02</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><th>Process</th><th>Parameter</th><th>Target condition</th><th>Actual condition</th><th>Effect of the change from the target on the quality of final product</th></tr>
<tr><td rowspan="2">Pasteurization of raw milk</td><td>Temperature</td><td>62.7 ± 1 °C</td><td>63 °C</td><td rowspan="2">Out of specification product - health and safety issues</td></tr>
<tr><td>Time</td><td>30 ± 0.5 min</td><td>20 min</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Do you record the cash used to buy raw materials, ingredients and packaging materials versus the type and volume of purchased materials?</td><td>Record of the cash used to buy raw materials, ingredients and packaging materials should be kept. The following table can be used to record the needed information:
<table>
<tr><th>Date</th><th>Item (raw material, ingredient or packaging material)</th><th>Supplier</th><th>Quantity (Kg)/volume (L)</th><th>Quality*</th><th>Cash out (JD)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
* determined after inspection upon arrival

Having records for the purchased raw materials, ingredients and packaging materials over a specific period of time would help you to manage and plan your inventory.</td></tr>
<tr><td>Do you keep record for your daily sales?</td><td>Record of the daily cash that comes into your business should be kept. The following table can be used to record the needed information:
<table>
<tr><th>Date</th><th>Product</th><th>Quantity sold (Kg, bag, jar, etc.)</th><th>Cash in (JD)</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
When you have records for the daily sales, this would help you to find out whether demand for a certain product is increasing or decreasing. Accordingly, you can draw up future plans to cope with the expected changes in demand.</td></tr>
</table>

<table>
<tr>
<td>Do you know how to calculate your profit or loss?</td>
<td>Profit and loss describe how money comes into and leaves your business during a specific period of time. This allows you to have an indication about the progress of your business and compare your trend with other months. The following table can be used to record the needed information:
<table>
<tr><td colspan="4">Period: month, week, etc.
Product:</td></tr>
<tr><th>No.</th><th>Item</th><th>In (JD)</th><th>Out (JD)</th></tr>
<tr><td>1</td><td>Income from sales</td><td></td><td></td></tr>
<tr><td>2</td><td>Purchases of raw materials, ingredients and packaging materials</td><td></td><td></td></tr>
<tr><td>3</td><td>Salaries</td><td></td><td></td></tr>
<tr><td>4</td><td>Rental costs</td><td></td><td></td></tr>
<tr><td>5</td><td>Transportation</td><td></td><td></td></tr>
<tr><td>6</td><td>Electricity/fuel cost</td><td></td><td></td></tr>
<tr><td>7</td><td>Water cost</td><td></td><td></td></tr>
<tr><td>8</td><td>Any other costs (expired raw materials or products)</td><td></td><td></td></tr>
<tr><td>9</td><td>Gross profit (JD)</td><td>= item No. 1</td><td></td></tr>
<tr><td>10</td><td>Total expenses (JD)</td><td></td><td>=∑ item 2-8</td></tr>
<tr><td>11</td><td>Net profit/loss (JD)</td><td colspan="2">= item No. 9 – item No. 10</td></tr>
</table>
</td>
</tr>
<tr>
<td>Do you know how to calculate your weekly or monthly production rate?</td>
<td>The production rate is calculated as follows:

$$Production\ rate\ (kg\ or\ litres/day) = \frac{amount\ of\ product\ sold\ per\ week\ or\ month\ (kg\ or\ litres)}{Number\ of\ working\ days\ per\ week\ or\ month}$$

The number of working hours per day or the number of working days per week or month should be recorded.

Example:
Your monthly sales are 50 Kg cheese, assuming that production takes place for 8 hours each day for 20 days per month, then the daily production rate will be:

$$Production\ rate\ \left(\frac{Kg}{day}\right) = \frac{50\ Kg}{20\ day} = 2.5\ Kg/day$$</td>
</tr>
<tr>
<td>Do you know how to do a comparative report for you monthly consumptions and sales?</td>
<td>A comparative monthly report is used to compare the current month’s results with the previous months. According to the results of comparison, the business owner can decide if the operation is under control. The following table can be used to compare the results between the months:</td>
</tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td colspan="3">Product name:</td></tr>
<tr><td>Month</td><td>Monthly consumption (JD)
(raw material, ingredients or packaging materials)</td><td>Monthly sales (JD)</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Do you know how to monitor and improve your business productivity?</td><td>In order to assess whether your production process needs specific improvement measures and options, it is necessary to record the consumption of resources (main or essential raw material, main or essential ingredients, packaging materials, water and energy) and waste. These figures can be used to calculate a baseline for the following indicators:
– Material / ingredient use indicator: actual consumption; not the amount planned to be used in the recipe but the actual amount used during production; of raw materials and ingredients per unit of product.
– Water use indicator: total volume of water used per unit of product
– Energy use indicator: total energy (kWh or MJ) used per unit of product
– Generated waste indicator: total amount of waste (ton) produced per unit of product

After establishing the baseline, your performance could be evaluated at different points in time, by comparing the baseline after implementing any measures and options for improvement with the first baseline before applying the options. Or by comparing the actual consumption of material/ingredient per unit product with the ideal amount of material/ingredient described in the recipe, the ideal consumption is what your consumption would be if you process the raw materials and ingredients with no waste. This number will give you a target value that could help you to reduce waste and prevent losses. The closer your ideal and actual consumptions are, the more profitable your business.</td></tr>
</table>

Annex (V)

Sheet for Baseline Data Record and Indicators' Calculator (Excel Sheet is available at www.cp.org.jo)

Company Name

Input / Output	Value	KPI during Baseline I[34] in ( ) [35]	KPI during Baseline II[23] ( )[24]
Material use (kg or ton)[36]			
Water use (m^3 or L)			
Energy use (kWh)			
Generated solid waste (kg or ton)			
Wastewater (m^3 or L)			
Air emissions (ton CO_{2eq})			
Product output (mass or volume unit)			

[34] KPI = value of input material, water or energy or output solid waste/waste/emissions / value of product output
[35] Please insert the baseline I or II period, it could be one year, quarter, month, etc
[36] Raw, auxiliary and operating including chemicals

Annex (VI)

How to gather needed data to calculate the KPIs

Material use indicator: total amount of materials (ton) used by the company per unit of product		
Needed data	**Source of data**	**Possible challenges and solutions**
– Raw and auxiliary materials – Packaging materials – Operating materials (materials that are needed for production but are not part of the final product like lubricants and chemicals used for cleaning) – Purchased recycled materials	– Company's information system – Invoices from suppliers – Purchase receipt reports – Stock and inventory records	– Reuse of materials: if some materials are recovered from the waste and reused again in the production processes, it should not be added to the total amount of material consumed as they already added. – In case materials are available in unit (bag, container, etc.), they should be converted to mass unit, i.e. if the company used 2000 bags of wheat per year and the approximate weight of 1 bag is 0.1 ton, then the total amount of wheat used is 2000 x 0.1 = 200 ton/year.
Water use indicator: total volume of water used by the company per unit of product		
Needed data	**Source of data**	**Possible challenges and solutions**
– Drinking water – Municipal water – Ground water – Other process applications	– Invoices from suppliers – Purchase receipt reports – Water meters – Company's information system – Calculations or estimations	– If the company recycles wastewater and reuse it again in the production processes, this water should not be added to the total volume of water as they already added. – In case water volumes are not available, then the volume should be estimated based on the number of units and the capacity of each unit. – Using of different sources: if the company obtains water from different sources, the volume of water used from each source shall be calculated or estimated and added to the total volume.

Energy use indicator: total energy (kWh or MJ) used by the company per unit of product			
Needed data	**Source of data**	**Possible challenges and solutions**	
– Purchasing of fuel – Electricity – Heating – Other forms of energy needed for the operation and maintenance	– Bills and invoices – Purchase receipt reports	– In case different types of fuels used within the company (i.e. natural gas in cubic meters and diesel or heavy fuel oil in litres), these values should be converted into energy unit using net calorific value. – In case the data of fuel available in unit, then the volume or weight of each unit should be estimated and multiplied by the number of units.	
Generated solid waste indicator: total amount of waste (ton) produced by the company per unit of product			
Needed data	**Source of data**	**Possible challenges and solutions**	**Example of sources for generated waste**
– Waste sent to landfill – Hazardous waste – Municipal waste – Garden waste – Waste sent to recycling outside the company's site	– Invoices or bills from disposal utilities or companies – Weighing – Calculations – Estimates	– If the data of the waste are available in volume unit of the container, then the weight of the waste should be calculated and multiplied by the number of containers. The weight of the waste = the weight of full container– the weight of empty container. – In case some waste is sold as a product to another company, it should not be included in total waste. – If the company pays monthly fees to dispose the waste regardless the quantity, then the amount of	**Dairy Processing** – Receipt and storage of raw materials. – Storage of products – Start up and shutdown processes – Deposits in the surface of the equipment – Damaged, expired or returned back products – Packaging waste – Solid waste generated from regular maintenance of the equipment – Spills and leaks from pipes and hoses – Solid waste from milk filtration and clarification – Sludge from centrifugal separators Cleaning and sanitizing of storage vessels, tanks and production lines **Bakery & Arabic Sweets** – Receipt and storage of raw materials

		waste disposed could be estimated. – If there is no record on waste disposal, then the amount of waste disposed could be estimated.	– Storage of products – Damaged, expired or returned back products – Solid waste generated from regular maintenance of the equipment – Cleaning and sanitizing of storage vessels, tanks and benches – Manual operation could lead to losses of semi products at all stages of production (dough, filling ingredients, etc.) – Handling and transfer of raw materials – Unloading of flour in the mixers – Packaging materials
Wastewater indicator: total volume of wastewater (m^3) produced by the company per unit of product			
Needed data	**Source of data**	**Possible challenges and solutions**	**Example of sources for generated wastewater**
– Wastewater that leaves the company boundaries by pipes, tanks or other forms of removal – Water from processes, sanitary uses and cleaning – Unplanned discharges, providing that the volume can be measured/estimated – Water seepage into groundwater	– Invoices, receipts or bills – Measurements	– If the company pays monthly fees of water discharged regardless the quantity, then the volume of discharged water should be estimated. – If the company discharged unpolluted water flows, there is no need to include this source in the total volume.	**Dairy Processing**[37] – Raw material storage and receiving – Washing of trucks and storage tanks – Cleaning and sanitizing of dairy processing equipment and production lines, especially between products changes when different types of products are produced – Start-up, product change over and shut down – Cleaning of the floors due to break down of equipment and breaking of packages resulting in spilling

[37] Wastewater from dairy processing has a high organic content (chemical oxygen demand and biological oxygen demand) due to the presence of milk solids (lactose, protein, carbohydrates and fat). Whey may also contribute to high organic loads in wastewater. May contain salts from cheese production, acids, alkalis and detergents, disinfectants, including chlorine compounds, hydrogen peroxide and quaternary ammonia compounds. May contain pathogenic viruses and bacteria.

		– If there is no record on volumes of water discharged, then the total volume should be estimated using water balance.	**Bakery & Arabic Sweets**[38] Cleaning and sanitizing operations including equipment cleaning and floor washing.
Air emissions indicator: estimated amount of $CO_{2\ eq.}$ emissions (ton) per year is the common used indicator			
Needed data	**Source of data**	**Possible challenges and solutions**	**Example of sources for air emissions**
– Combustion processes – Cooling	– Invoices, receipts or bills – Measurements or calculations	– To estimate the emissions of CO_2 from combustion, there is a need to know the carbon content. However, this value is not available for some types of fuels. In this case, an estimation of the carbon content based on the composition of the fuel could be used. – To calculate CO_2 emissions from electricity consumption; multiply the electricity consumed in kWh (power of used equipment in kW x operating hours) by	**Dairy processing** – CO_2 is emitted from the combustion processes. Other exhaust gas (nitrogen oxides (NOx) and carbon monoxide (CO)) result from the combustion process. – Dust emissions results during dairy processing activities include fine milk powder residues in the exhaust air from the spray drying systems and bagging of product. – The refrigerant comes from the emissions leakage of the cooling or refrigeration systems. **Bakery & Arabic Sweets** – CO_2 is emitted from the combustion processes. Other exhaust gas (nitrogen oxides (NOx) and carbon monoxide (CO)) result from the combustion process.

[38] Wastewater from bakery and Arabic sweets processing is rich in oil, fat and grease (FOG), it contains also flour, sugar, filling ingredients, yeast and detergents. The pre-treatment of such water before it is charged is a requirement, because the existence of FOG content retards the mass transfer of oxygen and the toxicity of excess cleaning detergent can decrease the biological treatment efficiency. However, the pre-treatment depends on the size of the company.

		the emission factor of 0.4585 Kg CO_2/ kWh (Source: Jordan Second Biennial Update Report, 2021). – Default emission factors for CO_2 from stationery combustion in Manufacturing industries for different fuels are available in page 18 at Chapter 2 of Volume 2 of IPCC 2006 Guidelines – Specifically table 2.3[39]	– Volatile organic compounds (VOCs) can be released from yeast fermentation, drying processes and combustion processes. – Emissions of dust can be released from the leakage of flour powder during unloading in the mixers or breakage of the bags. – The refrigerant comes from the emissions leakage of the cooling or refrigeration systems.

[39] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

Annex VII

Energy Balance (Distribution of Energy Users)

With the data from surveys, the energy balance can be generated on monthly basis or yearly basis, based on the availability and accuracy of the data from month to another. Additionally, points of highest consumption can be identified according to the area, the type of production equipment, and energy consumption of other electrical equipment types present in the company.

To carry out the energy balance, the following equation can be used:

$$H_m = H \cdot D + H_O \cdot D_O \qquad (1)$$

Where $\mathrm{H_m}$ is the hours of use per month, H the hours of daily use on weekdays per device, H_O the hours of daily use during weekend per device, D the number of working weekdays per month, and D_O the number of working weekend's days per month.

Moreover, the device consumption can be defined as follows:

$$E_d = P \cdot L.F. \cdot H_m \qquad (2)$$

Where E_d is the device energy consumption per month (kWh/month), P is the rated power consumption (kW), and $L.F.$ is the load factor (Actual power/Rated power).

For Thermal energy consumption calculations, the fuel consumption must be multiplied with its heat content to convert it into energy unit (kWh) as follows:

$$E_{Fuel} = \frac{\dot{m} \cdot H_m \cdot H_C}{3600} \qquad (3)$$

Where E_{Fuel} is the thermal energy consumption per month (kWh/month), $\mathrm{H_m}$ is the hours of use per month, $\dot{m}$ is the fuel consumption rate (kg/hr), and H_C is the fuel heating content (kJ/kg).

The energy consumption due to production processes E_P (kWh/month) can be defined as follows:

$$E_P = E_{Process1} + E_{Process2} + \cdots + E_{Process\,n} \quad (4)$$

Where $E_{Process1}$ is the energy consumed by process #1, whereas $E_{Process\,n}$ is based on the last number of processes in the overall production.

As example for Bakery, the monthly production consumption E_P can be expressed as follows:

$$E_P = E_{Kneading\ process} + E_{Leavening} + E_{Baking} \quad (5)$$

Where $E_{Kneading\ process}$ is the energy consumed by the kneading (kWh/month), $E_{Leavening}$ the energy consumed by the leavening (kWh/month), and E_{Baking} is the energy consumed by baking (kWh/month).

The total energy consumption can be defined as follows:

$$E_T = E_P + E_R + E_L + E_O \quad (6)$$

Where E_P is the production energy consumption (kWh/month), E_R the refrigeration energy consumption (kWh/month), E_L the lighting energy consumption (kWh/month), and E_O the others energy consumption (kWh/month).

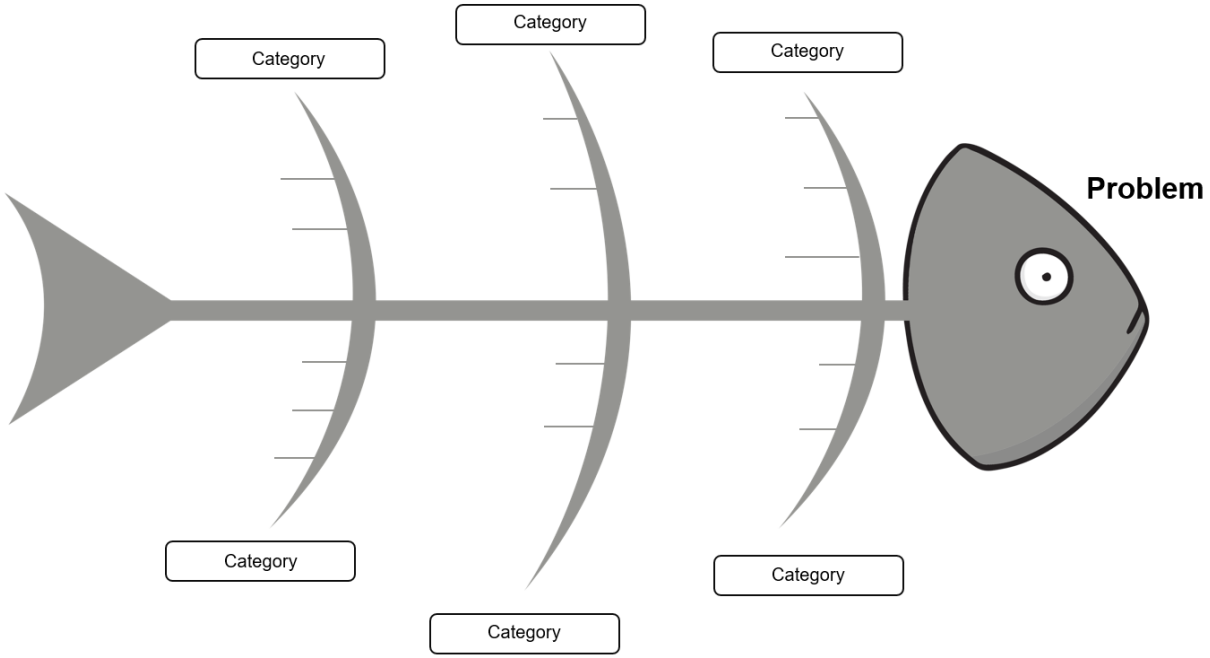
Table below shows the proposed results of the energy balance calculations for the factory

Energy use by Area

Area	**Electricity**		**Fuel**	
	(kWh)	**%**	**(kWh)**	**%**
Production				
Refrigeration				
Lighting				
Others				
Total				

Annex VIII

Fish bone diagram[40]



Category could be: people, method, equipment, product, environment, technology, materials

[40] 25 Great Fishbone Diagram Templates & Examples [Word, Excel, PPT] (templatelab.com)

Annex (IX)

Some examples of recommended RECP Options

Recommended RECP options and measures in dairy production:

No.	Option	RECP Strategy/Principle	Benefits for the company
1	Raise awareness and training of the staff and improving the worker thoroughness in the production and cleaning processes	Good housekeeping	Reduction in raw material, water and energy consumption. Reduction of organic waste generated
2	Aware the staff to reduce using electrical energy in illumination by opening the curtains to bring more sunlight	Good housekeeping	Reduce the expenses with electricity
3	Install fly traps and maintain them periodically	Good housekeeping	Protect the products from infection and improve the hygienic conditions
4	Periodic cleaning of the production site, outer side of the equipment	Good housekeeping	Improve the hygienic conditions
5	Fit drains with screens or traps to prevent solid materials entering the effluent system	Good housekeeping	Prevent blockage of the drains
6	Store the product on plastic pallets and cover the product with plastic sheets or cloth	Good housekeeping	For hygienic purposes
7	Improve the insulation of cooling or heating systems and pipes	Good housekeeping	Reduce energy losses and fuel consumption
8	Clean up scrap in the production area	Good housekeeping	Avoid any possible accident
9	Install plastic curtains for incubation and cooling rooms	Good housekeeping	Save electrical energy
10	Cover the vessels used for cheese boiling and crude cheese production	Good housekeeping	Reduce energy consumption (LPG)
11	Use continuous rather than batch cleaning processes as applicable	Good housekeeping	Water saving by reduce the frequency of cleaning
12	Pre-soak floors and equipment to loosen dirt before the final clean	Good housekeeping	Water saving

13	Reuse relatively clean wastewaters (those from final rinses) for other cleaning steps or in non-critical applications	Good housekeeping	Water saving
14	Install nozzle that control the flow of water for manual cleaning processes	Good housekeeping	Water saving
15	Check the boiler efficiency regularly (air/fuel control, residual oxygen, condensate return, condensate traps, water/steam losses, insulation)	Improve process control	Reduce diesel consumption
16	Use automatic to fill yoghurt cans after inoculation instead of manual filling	Process modification	Reduce waste inoculated milk spills
17	Produce new product (i.e. animal feed, ricotta and fruit drink) from whey	Production of useful by-products	Reduction of environmental load on wastewater
18	Collect the waste of solid materials to be used animal feed	Production of useful by-products	Reduce waste and improve profit
Other options			
19	If using pasteurization: depending on size of operation, use continuous pasteurization		
20	Have Standard Operation Procedures for cleaning and production processes		
21	Cooling: clean condenser, clean evaporator, control pressure, use de-super heater		
22	Packaging: returnable possible? Plastic: thin, print lid only, …		
23	Documentation, monitoring, controlling: control milk losses, benchmarking (internal, peers, external)		
24	Maintain good inventory control to avoid waste of raw ingredients.		
25	Ensure that employees are aware of the environmental, health and safety aspects of the company's operations and their personal responsibilities.		
26	Schedule regular maintenance activities to avoid breakdowns.		
27	Optimize and standardize equipment settings for each shift (if applicable).		
28	Identify and mark all valves and equipment settings to reduce the risk that they will be set incorrectly by inexperienced staff.		
29	Improve start-up and shut-down procedures.		
30	Segregate waste for reuse and recycling.		
31	Install drip pans or trays to collect drips and spills.		
32	Use automated cleaning-in-place (CIP) systems for cleaning to control and optimize water use		

33	Use high pressure rather than high volume for cleaning surfaces
34	Install meters on high-use equipment to monitor consumption
35	Report and fix leaks promptly
36	Ensure that vessels and pipes are drained completely and using pigs and plugs to remove product residues before cleaning
37	Use level controls and automatic shut-off systems to avoid spills from vessels and tanker emptying
38	Collect spills of solid materials (cheese curd and powders) for reprocessing or use as stock feed
39	Install in-line optical sensors and diverters to distinguish between product and water and minimize losses of both
40	Install and maintain level controls and automatic shut-off systems on tanks to avoid overfilling
41	Use dry cleaning techniques where possible, by scraping vessels before cleaning or pre-cleaning with air guns
42	Implement switch-off programs and installing sensors to turn off or power down lights and equipment when not in use
43	Favour more energy-efficient equipment (A^+ (or more))
44	Improve maintenance to optimize energy efficiency of equipment
45	Eliminate steam leaks
46	Capture low-grade energy for use elsewhere in the operation.

Recommended RECP options and measures in bakery production:

No.	Option	RECP Strategy/Principle	Benefits for the company
47	Use a vacuum cleaner to remove dust from floors rather than compressed air, a brush or water	Good housekeeping	For hygienic purposes Saving water
48	Raise awareness and training of the staff and improving the worker thoroughness in the production and cleaning processed	Good housekeeping	Reduction in raw material, water and energy consumption. Reduction of organic waste generated
49	Use dosage equipment and scales to weigh raw materials as per the recipes	Process Control	Avoid use more amount than needed and to control producing same quality of product

50	Clean up scrap in the production area	Good housekeeping	Avoid any possible accident
51	Purchase raw materials in bulk packages instead of small packages	Good housekeeping	Reduction in the cost and reduction in the packaging material waste
52	Aware the staff to reduce using electrical energy in illumination by opening the curtains to bring more sunlight	Good housekeeping	Reduce the expenses with electricity
53	Use natural light, make sure not to overheat (south/north orientation)	Good housekeeping	Energy saving
54	Consider shutting down ovens when they are not operating at full capacity	Good housekeeping	Reduce the expenses with electricity and fuel consumption
55	Reuse relatively clean wastewater (those from final rinses) for other cleaning steps or in non-critical applications	Good housekeeping	Water saving
56	Install nozzle that control the flow of water for manual cleaning processes	Good housekeeping	Water saving
57	Think of high-pressure cleaning	Process modification	Water saving
58	Processing Eggshells into Fertilizers	Waste management	Reduce the solid waste
59	Separation of recyclable and non-recyclable wastes	Onsite re-use or recycle / Production of useful by-products	Generate extra profit by trading recyclable wastes (papers, cartoon, metals, etc.). Reduce the volume of solid waste
60	Processing of rejected or unsold bread to bread crumb by heating it in an oven and then reducing its size using a food processor or use it as animal feed	Production process	Reduce the solid waste
61	If you generate breadcrumbs in relatively large quantities, package and sell.	Production of useful by-products	Reduce the solid waste
62	Making special fermentation space and control the fermentation conditions (temperature, humidity and time)	Production process	Reduce consumption in raw materials and water Reduce the waste

63	Use the total internal area of the oven	Production process	Increase productivity and save energy Reduce the emissions generated from fuel consumption or electricity
64	Insulate ovens	Production process	Reduce energy consumption and recover heat from ovens
65	Check the cleanness of substations (dust)	Good housekeeping	For hygienic purposes
66	Check load curves for loads outside production times/switch off	Process Control	Save energy
67	Check reactive power/compensate	Process Control	Save energy

Recommendations for improvement of energy efficiency in Bakery Production

After analysing the energy audit, once the bakery processes and activities with the highest consumption have been identified, improvement activities and actions are proposed. They should cover general logistics needs, habits of use, economics, and energy consumption reduction. The main improvement areas in bakery are summarized in the following points:

Kneading: the input power (W) and production capacity (kg per cycle) should be investigated for the kneading equipment, whereas the potential of changing the existing kneading equipment with a higher capacity and less power equipment should be studied and proposed.

Fermentation: Process management should be investigated regarding partially using of the fermentation chamber due to the limitations of kneading process, whereas any mismatch in the capacities between the sequenced processes will increase the time of use and energy consumption.

Baking: Thermal insulation of the oven should be investigated as well as the good combustion air to fuel ratio for fuel-sourced ovens. Moreover, the partial use of oven due to constraints in the previous processes should be investigated, which will increase the time of use.

Refrigeration: The performance of the refrigerators should be investigated by considering the location of the refrigerators in relation to the hot areas (ovens) and age and energy label of the refrigerators.

Lighting systems: Lux level for the different areas in the bakery should be investigated in addition to the power of the existing lights, which LED lights can be proposed instead the exiting lights as well as installing motion sensors in the stores and low occupied areas.

Plug loads: all plug loads should be investigated regarding disconnection after working hours and breaks.

Sub-metering: Potential of installing fuel electricity sub-meters in the significant energy consumption areas should be investigated to monitor the energy consumption indicators (kWh/kg flour) in daily wise to insure best bakery operation.

Consider heat recovery, https://www.exodraft-heatrecovery.com/solutions/bakery/

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