TEST case study

Soft Drinks Production Company

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

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Soft Drinks Production Company

SECTOR	Food & Beverages
SUBSECTOR:	Beverages
SIZE	Plant : 200 employees Overall: 500 employees
PRODUCTS	Soft drinks
MARKET	Local & Regional
CERTIFIED MANAGEMENT SYSTEMS	ISO9001, ISO14001, OHSAS 18001 and ISO 22000 CO_2 emissions verified according to ISO 14064-1 by SGS

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Company Key data

YEAR 2015	Unit	Value
Production	litre/an	114,552,955
Electricity consumption	kWh/an	9,393,342
HFO consumption	litre/an	121,151
Diesel consumption	litre/an	31,080
LPG consumption	kg/an	336
Water consumption	m^3/an	252,016
CO_2 emission	Ton/an	8,599
BOD_5	Kg/an	10,309 (75 mg/L of wastewater)
COD	Kg/an	18,557 (135 mg/L of wastewater)
Total cost of sales	€/an	NA
Total cost of inputs (Purchase value of raw materials, auxiliary materials, packaging energy and water)	% vs. cost of sales	66%
Estimated non-product output	% vs. cost of sales	7%

Initial Screening

The initial screening of the company did not highlighted any immediate potential for RECP improvement, as the company already:

- had in place a state-of-the-art and well operated technology meeting international standards, as well as an environmental management system certified against ISO 14000;
- had engaged with CSR for a decade, with an annual sustainability report published and audited regularly;
- had its CO_2 emissions verified according to ISO 14064-1;
- introduced a sophisticated information system for resource management and planning.

Thus, the company's only driver to join the MED TEST II project in 2016 was the top management's strong commitment towards continuous improvement and search for new approaches on how to achieve it.

New policy statement

The company:

- Already had in place an environmental policy adopted in the framework of the ISO 14001 system with commitment to continuous improvement of the company's environmental performance;
- decided to use the TEST project to upgrade its system to the levels required by the latest version of ISO 14001, ISO 14001:2015;
- therefore; elaborated a new policy statement focusing on incorporating resource efficiency;
- top management signed the new policy and distributed it to all departments of the plant, from administration to production.

TEST team

The company TEST team included:

- Production and maintenance manager (leader)
- Quality manager
- HSE manager
- Technicians
- Acting Financial Controller (representing the company's financial department)

The company TEST team was trained:

- In common training sessions with other companies as well as by in-company specific workshops, such as one on MFCA.

An external TEST team of service providers was also formed, including national RECP and energy efficiency experts and an expert on management systems, all under the coaching of international experts.

Process overview/flowchart

INPUTS

Water

Syrups, sugar & additives

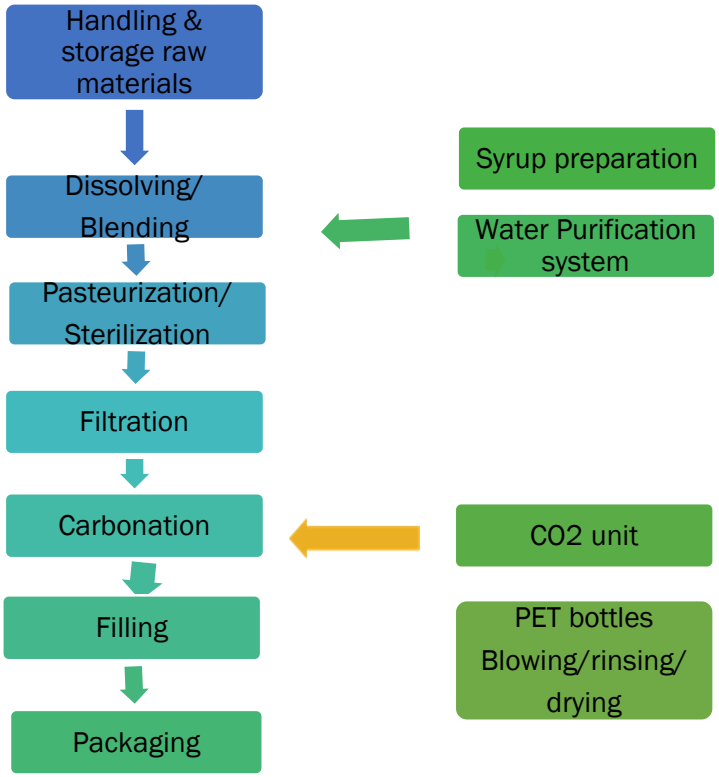
CO2

Energy (Electricity, Steam)

Detergents/ sanitizers

Refrigerants

Packaging materials



OUTPUTS

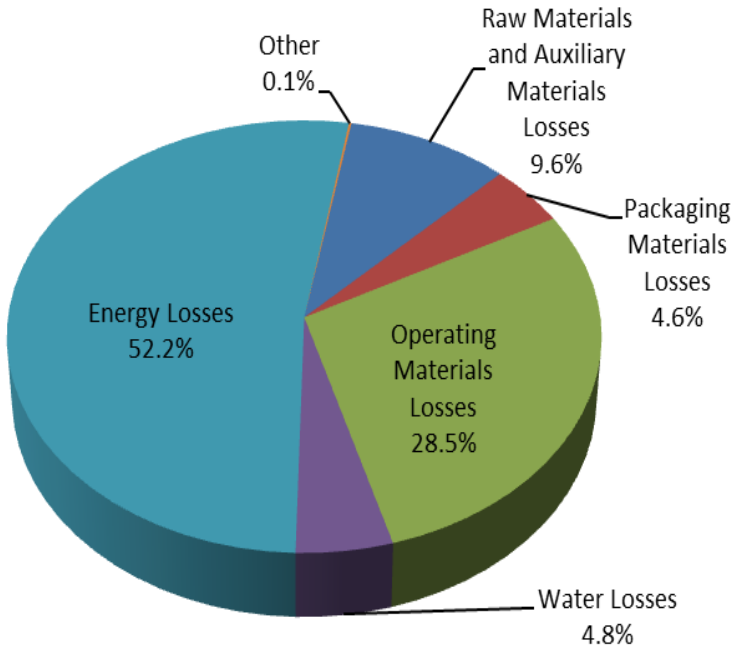
Soft drinks Products

Effluent from tanker washing, cleaning, syrups spills,

Air emissions (CO2, boiler, dust, odour)

Solid waste (off specs, expired/returns from clients)

Non-Product output costs



Approximately 7% of the purchased value in 2015 was lost due to non-product output costs

Benchmarking

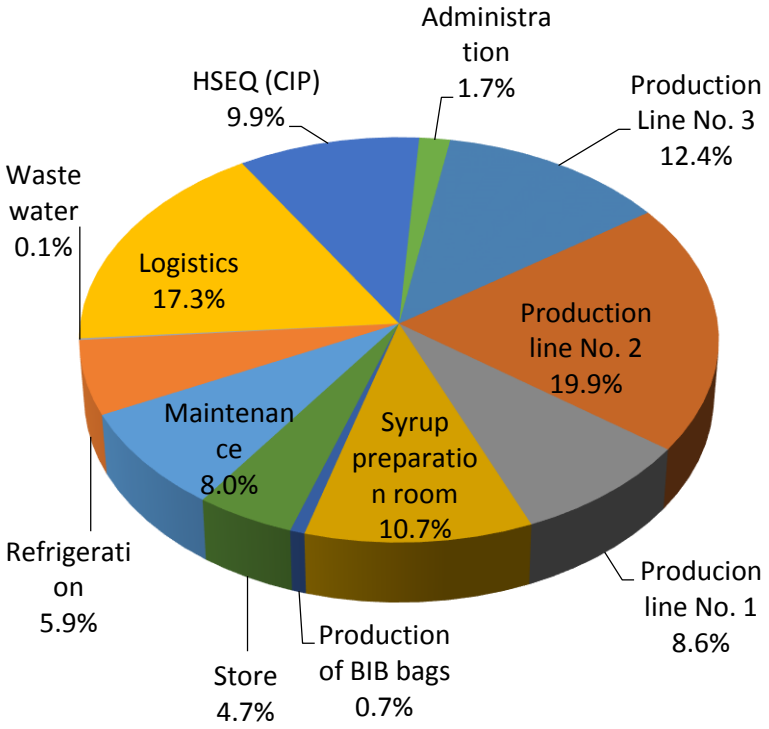
Benchmark type	Unit	KPIs in 2015	Best Practice
Concentrate	gr/$l_{beverage\ produced}$	1.81	NA
Sugar	gr/$l_{sparkling\ produced}$	118.4	NA
Electricity	kWh_{elec} /$hl_{beverage\ produced}$	8.2	1.6 (Source: UNIDO TEST Training Kit)
Thermal Energy (HFO+Diesel+LPG)	kWh /$hl_{beverage\ produced}$	1.5	NA
Water consumption	l/$l_{beverage\ produced}$	2.2	1.4 (Source: UNIDO TEST Training Kit)
Wastewater generation	l/$l_{beverage\ produced}$	1.2	NA
BOD_5, Wastewater	mg/l of wastewater	75	27-307 (Source: IFC Benchmark Tool, Case study , 2006) 200 (National Standards)
COD, Wastewater	mg/l of wastewater	135	41-487 (source: IFC Benchmark Tool, Case study, 2004) 500 (National Standards)
Solid waste	gr/$l_{beverage\ produced}$	2.5	NA
CO_2 Consumption (Injection in products)	Yield (%) Kg/$hl_{beverage\ produced}$	50.9 1.08	NA 0.5 (Source: UNIDO TEST Training Kit)
CO_2 Emissions	Kg/$hl_{beverage\ produced}$	7.5	NA

Priority flows

Quantification of NPO costs and estimate of potential for improvement led to identification of the following priority flows:

- Energy (electricity and thermal)
- Water
- Chemicals
- Packaging materials (Cans & Preform)
- Sugar
- Concentrate

Non-Product output costs/cost centres



Distribution of NPO costs per the main cost centres of the company in 2015

Priority flows and focus areas

Priority Flow	Focus areas
Energy	Utilities (energy measurements showed low potential for improvement within the production lines)
Water	Production lines (CIP, washing of cans and bottles) Refrigeration (Cooling towers)
Sugar	Syrup preparation room (sugar bags handling and loading process)
Chemicals	HSEQ and maintenance (Stock management) of chemicals used in CIP (cleaning operations)
Cans	Store (damaged products caused by handling) Production lines
Concentrate	Production lines (Filling operations)

Information system based on MFCA – key findings

- Energy was identified as the main priority flow representing more than half of the total NPOs. Operating materials have a share of 28% of NPO costs and it was recommended to improve stock management and cost accounting for this material group. End of Pipe treatment and disposal costs have a share of only 0.1%.

- Further analysis breakdown of material NPOs, pointed out the negative financial consequences of the loss of material deriving from products returned by customers and the important financial losses of operating materials such as chemicals used for cleaning operations.

- The distribution of NPO costs per the main cost centers of the company was first estimated and then gradually refined. It showed, that especially one production line had a significant high share of total NPO costs. This outcome encouraged the company to reduce the operating hours of this line by 50% in the year 2017.

Information system based on MFCA

Recommendations implemented in the company

It is recommended to further improve stock management, separate liquids from solid materials and provide security containments for all liquid chemicals.
It is recommended to include chemicals into stock management and monitor volumes and consuming cost centres consistently.
It is recommended to adjust the wastewater usage ratios and to further investigate the water/wastewater balance.
It is remarkable that the company already collects hazardous waste. It is recommended to keep a statistics on the related amounts.
It is recommended to check the cost distribution to the main processes, as MFCA expert did it based on estimates of the Operations and the Production Managers.

Focus areas and cause analysis

To identify specific sources and root causes of losses the TEST Teams used detailed diagrams of the processes as well as observations of the use of the priority flows and balances. Additional data from the monitoring of specific energy and water flows and expert estimates were also used.

- **Example of identified causes of inefficiency for Clean In-Place (CIP):**
  - ✓ Manpower: Poor manual control (including the rinsing time or dosing of caustic solution).
  - ✓ Management: Production plan, marketing strategy.
  - ✓ Technology: No recycling of the rinse water.
  - ✓ Input materials: Using caustic solution that needs large amounts of water for rinsing.
  - ✓ Product: Drinks flavors are changed 3-4 times a day, which affects water usage due to changes from one flavor to the other.

Focus areas and cause analysis

Based on the conducted energy efficiency measurements and assessment was implemented an analysis of significant energy users (SEUs) and energy profiles for the processes and important utility systems. Here are provided examples of identified causes of inefficiency for SEUs:

Measurements Findings	Root causes
Lighting Systems	
Most of the existed lighting units have high energy consumption comparing to the standard level of illumination	Most of the lighting units used are inefficient lighting units
Steam System	
There is a heat loss due to the high pressure	There is about 4 bars are considered as excess pressure in the steam pressure setting cause this loss
Cooling System	
NH_3 cooling station has a COP of 1.07	This station needs well thermal insulating for the glycol pipes, NH_3-Glycol heat exchangers (HE), also the type of the used HEs (Flat plate type) is not suitable for NH_3 phase changing.
There are heat gains for the Glycol-Soda flat plate heat exchangers	The Glycol tank doesn't have well thermal insulation
There are heat gains for the Glycol tank	The heat exchangers don't have thermal insulation
Two Glycol circulating pumps have high design power consumption	The circulating pumps are oversized according to the required glycol flow rate
Compressed Air System	
All air compressors operate intermittently in the no-load mode	There is an air leakage in the compressed air network
There is an additional energy consumption due to the pressure drop	There are about 3.5-5 bars are lost due to the pressure drop from 40 to 35 bar between the storage and the end-users

Saving Catalogue – identified measures

ID	Initiative
Water:	
1	Last rinse can be saved and used for another rinse, (pre-rinse tank option) which is there but is not implemented.
2	Recycle the hot water (80-95C) for cans and PET washing.
3	Install a small RO treatment unit to treat the backwash water from the cooling towers to be reused.
4	Cut down the operating hours of line No. 2
5	Savings from purchasing water-efficient products (i.e. taps, shower heads, toilets, etc.) and using trigger-operated controls for hoses at all halls.
6	Investigate to reactivate the existing 'pigging' system" in pipelines or install new ice pigging
7	Investigate the use of activated oxygen cleaning (ozone cleaning).
Raw and Packaging Materials	
8	Establish a monitoring system for sugar (improved information system) to identify losses during early stages such as sugar's handling, loading, and when it is stored, before it goes to the syrup preparation process.
9	Apply an automatic early warning system for controlling the sugar and water mixing operation.
10	It is recommended to stamp defected filled cans and to reuse them for the guests and management or to the staff in the Cafeteria opened.
11	Control the temperature of the hall and the inlet preform through applying a new policy in this regard.
12	Control the quality of submitted preform.
13	Avoid heater malfunction and calibration of other heaters to increase temperature.
14	Apply regular maintenance of the air conveyor in the PET Production Line (before filling).
15	Calibrate the lines to control a fixed level of CO_2 in the mixer.

Saving Catalogue – identified measures

Energy	
16	Replacing inefficient lighting units with more efficient LED units
17	Ammonia Refrigeration cycle Upgrading for the existing refrigeration station
18	Glycol Cycle efficiency improving
19	Reducing steam pressure setting from 6 bar to 2 bar
20	Arresting 90% of the leakages in the low pressure compressed air system
21	Arresting 90% of the leakages in the High pressure compressed air system
22	Reducing the pressure setting from 35 bar to 24 bar when producing 500 ml bottles
23	Implementing "AFS retrofit cabinet" project for the PET AF high pressure compressor
24	Heat Recovery from the 40 bar air compressor
25	Installing Solar heating system to support the steam Boilers

Measure 4

(Cut down the operating hours of line No. 2)

Description of the solution	As shown in MFCA analysis – NPO costs breakdown - 19.9% of NPO costs was originating from the production line no. 2. This line did not cover its opeartional costs due to the high losses. It was also the major consumer of the heavy fuel oil. Therefore, it is better to cut down the operating hours of this line to operate 78 days per year only in 2017 instead of original 156 days per year. As per MFCA tool shifting production from line no 2. to another line that is not utilized at its full capacity will reduce overall NPO costs by 4.25%.
Economic benefits	€ 125,000 per year
Environmental benefits	Water; 5,800 m^3/year Energy; 965,000 kWh/year 270 ton CO_2/year
Capital investments	0.0

Measure 15

(Calibrate the lines to control a fixed level of CO_2 in the mixer)

Description of the solution	Reduction of the CO_2 consumption was achieved through simple measures such as: • minimizing the leakage • recalibration of the control system (of the tanks' level and the speed of response).
Economic benefits	€ 16,200 per year
Environmental benefits	76 tons of CO_2 per year
Capital investments	€ 930

Measure 17

(Ammonia Refrigeration cycle Upgrading for the existing refrigeration station)

Description of the solution	Improving performance of the refrigeration station by well-insulating parts of the ammonia cycle (ammonia drums, pipes and heat exchangers). This measure will reduce the heat transfer between the ammonia and the surrounding and reduce the operating time and consumption of the electrical energy.
Economic benefits	€ 96,250 per year
Environmental benefits	Energy Saving: 767,997 kWh/yr Reduced CO_2 emission: 430 ton/yr
Capital investments	€ 5,300 for the actual type of the insulation changed to foam

Measure 22

(Reducing the air compressor pressure setting from 35 bar to 24 bar when producing 500ml CSD & 500 ml bottles)

Description of the solution	Since the small capacity bottles (500 ml) don't need high pressure of compressed air in the Blow Moulder, good improvement measure for this size of bottles is changing setting of the compressor pressure from35 to 24 bar. Its implementation will lead to reduction of the operating time of the compressor and to reduction of energy consumption.
Economic benefits	€ 17,900 per year
Environmental benefits	Energy Saving: 142,755 kWh/yr Reduced CO_2 emission: 80 ton/yr
Capital investments	€ 1,300 (to apply some modifications on the moulds, control system and pressure transducer to be able to implement this measure)

Management system integration

EMS Upgrade Guide was prepared as part of TEST project that describes the steps that should be taken by the company to utilize the technical TEST report, upgrade EMS to ISO 14001:2015 management system, and be ready for the certification audits.

The EMS Upgarde Guide is divided into three parts:

- EMS kit with a table that describes how to utilize TEST report and how to integrate RECP with EMS; it contains the required procedures and amendments on current system in order to upgrade it by integration of RECP.

- Appendix 1 containing SWOT Analysis, List of Interested Parties and Communication Plan.

- Appendix 2 containing all environmental aspects obtained from the service provider, and describing related controls and way of their implementation.

Procedures and information system

- New resource efficiency procedures were integrated into the company's EMS adding new aspects, objectives, measures and action plans. For example in line with the objective of reducing water consumption, several new water meters were planned to be installed in addition to the existing ones to provide data for calculating the OPIs and KPIs at the level of the company. Where and how to collect and process these data is specified in a new water conservation procedure with guidelines describing among others how to process and document information, what must employees do to develop, implement and maintain water conservation measures including for example development of a leak prevention program. The latter specify to whom and how to provide needed training and information, what is the division of responsibilities and how is controlled performance and achievement of particular targets, etc.

- The company would like to add the verification audit by the service provider team to the steps of TEST to verify the real savings of implementing the RECP measures by a third party mainly for energy saving measures.

Performance Monitoring

Parameter	Unit of monitoring	Frequency	Value (2017)	KPI (2015)	Evaluation/needed actions
Water efficiency	l/l of products	Monthly	1.6 (1)	2.2	Actual saving of water is approximately 27.3%
Wastewater	l/l of products	Monthly	0.6	1.2	
BOD_5	mg/l ww	Monthly	26	75	
COD	mg/l ww	Monthly	65	135	
Fuel Consumption	kWh/hl of products	Monthly	0.7	1.5	Actual saving of energy is approximately 26.8%
Electricity efficiency	kWh/hl of products	Monthly	6.4 (2)	8.2	
CO_2 consumption	kg/hl of products	Monthly	0.89	1.08	
Solid waste	gr/l of products	Monthly	1.3	2.5	Actual reduction of solid waste is approximately 48%
Materials (Concentrate, Preform, Sugar, Chemicals, etc.)	gr/l of products	Monthly	135	150	

Original targets for 2017 were as follows:

(1) Water efficiency: 1.9 l/l of products

(2) Electricity efficiency: 7.8 kWh/hl of products

Results

A total of 25 feasible RECP measures were identified, added in the catalogue of savings and presented to the top management for its approval. The top management approved 21 of these measures and these were included in the TEST Action Plan. By the end of the first TEST cycle, 16 measures were already implemented, 2 were in the process of being subjected to more detailed feasibility studies, and 3 were planned for implementation.

Company performance measured through KPIs in 2017 (in comparison to the baseline year 2015) shows that the implementation of the RECP measures led to greater reductions in the use of resources than what was originally planned (as shown on the previous slide performance Monitoring).

The TEST project identified total annual savings amounting to EUR 652,800. This result was obtained through an estimated investment of EUR 152,000, and an average payback period of 0.2 years.

Conclusions

- The TEST project and its results were presented in a meeting organized by the holding company. Company members were very proud of the results achieved. For its part, the holding company decided to spread the good practice of TEST within its other companies in the Middle East.
- Existing resource efficiency objectives were reconfirmed and more ambitious targets were set for the longer term. The company's TEST team will continue to perform in-depth analysis of the focus areas which could not be assessed during the first TEST cycle. Regular meetings with top management will also continue to discuss progresses and new priorities.
- It was also decided to install additional water meters, create a permanent monitoring program and use new data for further expansion of the water balance.
- MFCA analysis was crucial for quantifying NPO costs and for pointing out the right priorities at the beginning. However the top management decided to restrict the use of the defined MFCA accounts (and repetition of the detailed MFCA analysis every year) due to the perceived high labor intensity of this work.
- The company information system is based on work with priority flows, KPIs, OPIs and specific targets to guide and monitor achievements of continuous improvement. The company will continue to monitor selected NPO costs also within the next TEST cycles.
- The company also decided to share its experience with the systematic application of RECP with its stakeholders; in addition to harvesting the economic and environmental benefits of RECP, this decision led to increasing the company's broader social capital.