TEST case study

Detergent production

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

The SwitchMed Programme is funded by the European Union

Detergent production

SECTOR	Chemical
SUBSECTOR:	Detergent
SIZE	250
PRODUCTS	Detergents in powder. liquid. paste. Bleach
MARKET	Local market
CERTIFIED MANAGEMENT SYSTEMS	ISO 9001

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Company Key data

Reason to join TEST project

The first reason for joining the TEST project is to optimize the consumption of resources in order to improve competitiveness and environmental performance.

YEAR 2015	Unit	Value
Production	Ton/year	**29,664**
Electricity consumption	kWh/year	**1,281,20**
Gaz consumption	Ton/year	**835.4**
Water consumption	m^3/year	**8,490**
CO_2 emission	Ton/year	**3,477.17**
BOD5	Kg/year	**n/d**
COD	Kg/year	**n/d**
Total cost of sales	€/year	**13,327,956**
Total cost of inputs (Purchase value of raw materials. auxiliary materials. packaging energy and water)	€/year	**7,527,872**
	% vs. cost of sales	**56.4%**
Estimated non-product output	€/year	**877,466**
	% vs. cost of sales	**6.6%**

Process overview/flowchart

INPUT

Raw Matériel

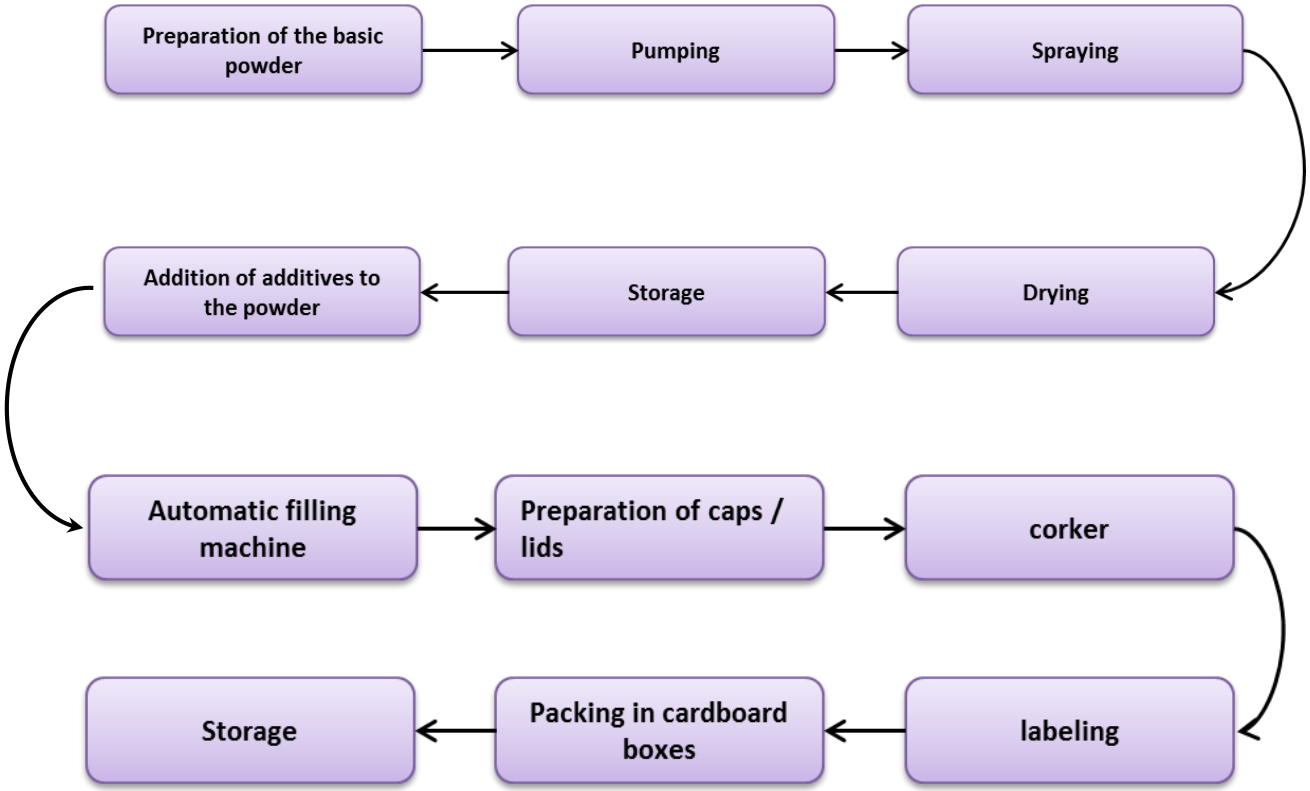
White STPP
SODIUM SULPHATE
TINOPALE (20KG)
SODIUM CARBONATE
SILICATE
CAUSTIC SODA
BETAINE (1050kg)
LABSA
Water
Colorant
Parfum

Energy

Gas
Electricity (kWh)
fuel oïl
Diesel fuel

Packaging materials

Bags
Plastic bags
Plastic bottle
Cardboard



OUTPUT

Products

Powder Bags 10KG
Powder Sachets
LAUNDRY HAND POWDER PLASTIC BAG

By products

lumps
Fine powder
Non-compliant Powder (non-recycled)

Air emissions

CO2

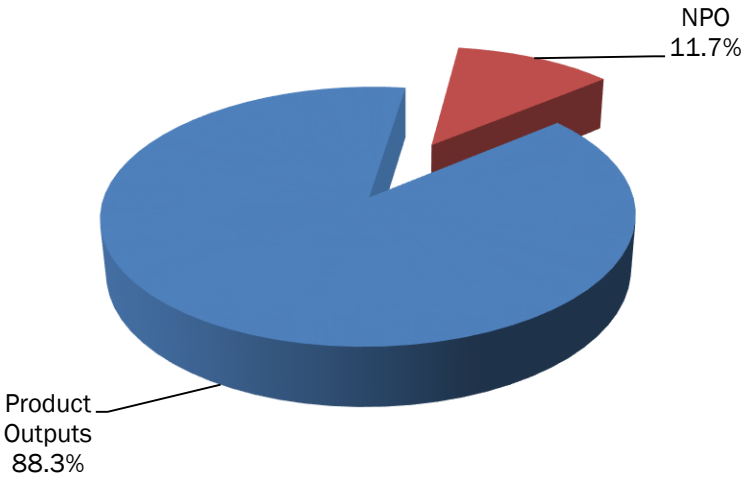
Solid Waste

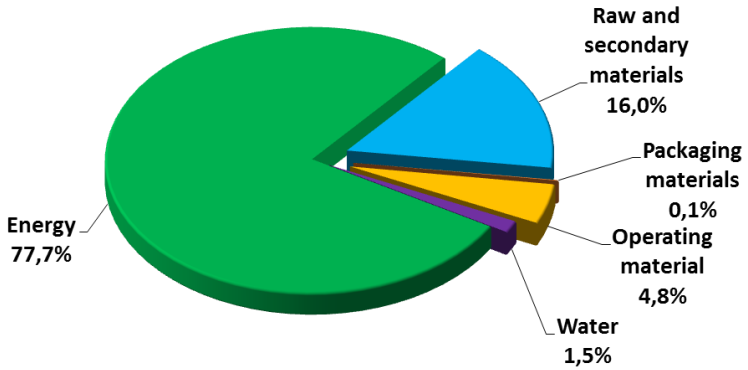
Big-bags
Cubitainer
Piping
Conveyor belts
Bags
Sachets
Damaged pallets
Wood
Torn cardboard boxes
Packaging items (PET. SPEKLES. Scotch. ...)
Metal waste:
Scrap ferrous and non-ferrous metals

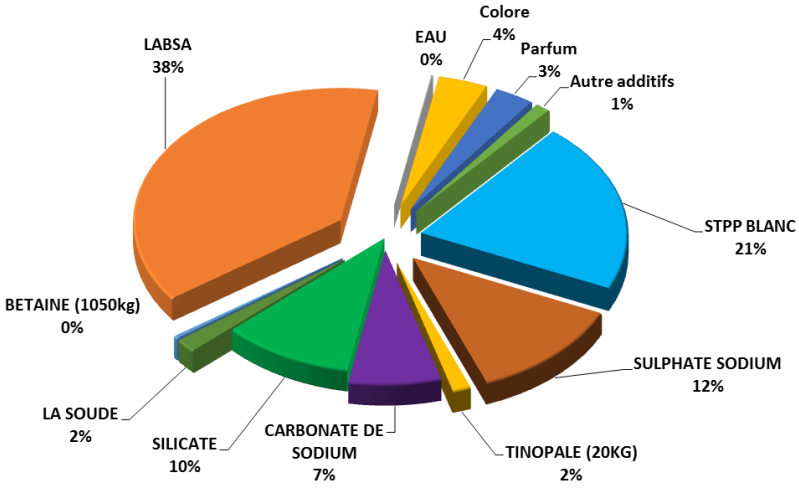
Benchmarking

Benchmark type	Unit	Company	Best practice
Electricity	kWh/T. of product	43.21	10 - 30
Butane	kWh/T. of product	355.13	230 - 270
Municipal Water	l/T. of product	286.20	100 - 120
Solids waste	Kg./T. of product	936.6	820-950

Non-Product Output costs







Approximately 11.7% of the purchased value in 2015 (877,466 €/yr) was lost due to product losses in manufacturing, energy, waste water and waste generation.
It corresponds at 6.6% of the turnover (13,327,993 €)

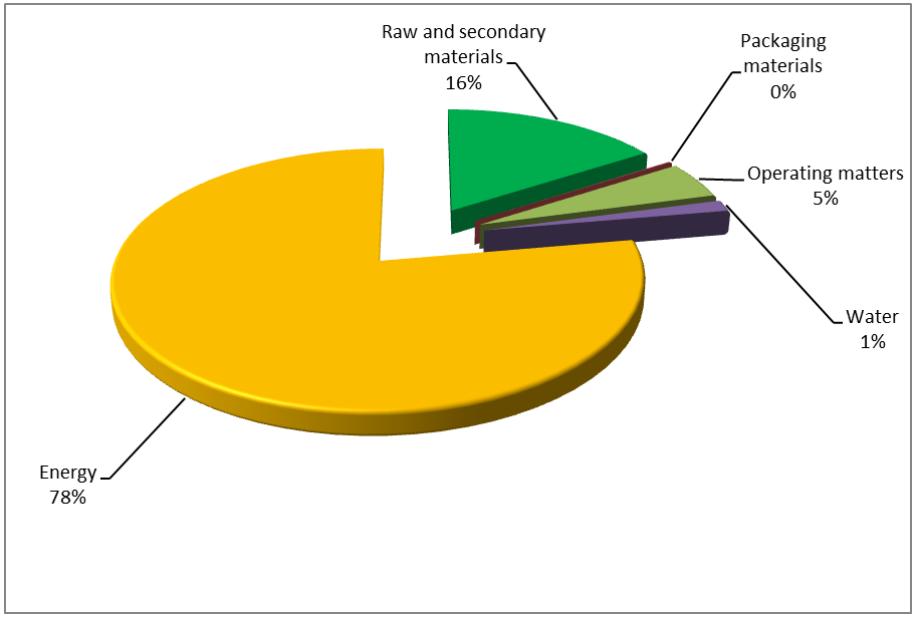
Priority flows

Description	€ (unless otherwise indicated)	NPO percentage	NPO cost
1.1. Raw and secondary materials			
Raw material (solid):	2,567,925	3.00%	77,079
Raw material (liquid):	3,084,709	2.00%	61,694
additives:	498,365	0.26%	1,278
Subtotal	**6,150,999**	**2.28%**	**140,051**
1.2. Packaging materials			
Subtotal	**390,576**	**0.18%**	**691**
1.4 Operating matters			
Subtotal	**91,834**	**100%**	**91,834**
1.5.Water			
Water	**13,734**	**93%**	**12,773**
1.6. Energy			
Gas	490,945	100%	490,945
electricity (kWh)	129,011	100%	129,011
fuel oil	61,651	100%	61,651
Gas oil*(used for company distribution trucks in the country, and not for any use in the plant)	212,855	0%*	0
Subtotal	**894,463**	**76,20%**	**681,607**
TOTAL COSTS	**7,527,872**	**11,66%**	**877,466**

Priority flows

The following table shows the distribution of Non-Product Outputs.

	€	Percentage [%]
1. NON PRODUCT OUTPUTS (NPO)	877,466	100.0%
1.1 Raw and secondary materials	140,051	15.96%
1.2 Packaging materials	691	0.08%
1.3 Operating matters	42,344	4.82%
1.4 Water	12,773	1.46%
1.5 Energy	681,607	77.66%



The priority flows are the following:

1. Energy with 77.6% of NPO.
2. Raw materials with 16% of NPO
3. Operating material with 5% of NPO

Information system - MFCA

Key findings

- The MFCA methodology allows the company to know more about the environmental cost and the priority flow and focus areas that represent sources of cost reduction and therefore the potential to realize additional gains.

Experience with I/O analysis

- The input-output analysis allowed the company to know the difference in volume between inputs and outputs and to quantify these non-product outputs (losses) on quantity and value (money).

Information system - MFCA

Recommendations

- The company did not use its general balance for the establishment of the material balance sheet. We recommend for the next financial year to first use the accounting balance and then to introduce the elements of detail since the extra accounting situations
- We recommend that all inputs (including packaging materials) be followed by weight so that a correct material balance can be achieved for the company.
- The company does not have a system for monitoring losses of raw materials. It is recommended to regularly monitor the losses on raw materials.
- The company also does not have a system for monitoring volumes of waste. It is recommended to carry out regular weighing's for the monitoring of waste volumes.
- It is recommended for the operating materials to separate the materials and services on the concerned account.
- It is recommended to gradually include these materials in inventory management and also record volumes.
- It is recommended to repeat the assessment on future exercises. Thus. the improvements would become visible.

Information system - MFCA

- It ‘s recommend to put in place a certain number of indicators in accordance with priority flows and focus areas mentioned in the MFCA
- Put a monitoring /tracking plan on the ERP system
- Proceed with the acquisition of equipment for monitoring the weight of the different products
- Adapt the automatic loading mode to all product references
- Exploit on real time the machine production data to calculate the operational performance
- Add the required new meters needed to energy and Production Management System such meters for electricity. water. LPG. compressed air. production data. to facilitate the implementation of the monitoring on real time.
- Optimize parameters of stations downstream and upstream of the tower and add operational indicators to follow the performance
- Implement an information and monitoring system to directly establish the loss rate (NPO) obtained by type of production

Selection of focus areas:

The focus areas were selected in relation with priority flows and based on the split of the NPO by key cost centers and by mutual agreement with company management.

CATEGORIES OF ENVIRONMENTAL COSTS	Total €	Cost centers (production process. services. etc.)									
		Storage of Raw Materials / Storage of Finished Products	Raw material handling and transfer	Slurry Making	Slurry pumping	Base powder transfer & sifting	Post addition	Packaging	Maintenance	Logistics	Administration
1. NON-PRODUCT OUTPUT (NPO)	*877,466*	*3.3%*	*12.7%*	*12.4%*	*4.4%*	*58.4%*	*0.9%*	*2.1%*	*4.9%*	*0.1%*	*0.7%*
1.1. Raw and secondary materials		19.9%	72.0%	2.7%	0.0%	1.8%	1.8%	1.8%			
Subtotal	140,051	27,870	100,837	3,781	0	2,521	2,521	2,521	0	0	0
1.2. Packaging materials											
Subtotal	691	0	0	0	0	0	0	691	0	0	0
1.4 Operating matters											
Subtotal	42,344	0	0	0	0	0	0	0	40,227	0	2,117
1.5. Water											
Subtotal	12,773	0	0	11,495	0	0	0	0	0	0	1,277
1.6. Energy		0.19%	1.51%	13.78%	5.68%	74.87%	0.76%	2.27%	0.38%	0.19%	0.38%
Gas		0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	490,945	0	0	0	0	490,945	0	0	0	0	0
Electricity (kWh)		1.0%	8.0%	25.0%	30.0%	15.0%	4.0%	12.0%	2.0%	1.0%	2.0%
	129,011	1,290	10,321	32,253	38,703	19,352	5,160	15,481	2,580	1,290	2,580
fuel oil		0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	61,651	0	0	61,651	0	0	0	0	0	0	0
Subtotal	681,607	1,290	10,321	93,904	38,703	510,297	5,160	15,481	2,580	1,290	2,580
Total Category 1	877,466	29,160	111,157	109,181	38,703	512,817	7,681	18,693	42,807	1,290	5,975

Focus areas

In the light of the above analysis, we find that the area "Base powder transfer and sifting" is a focus area with 58.4%, followed by the "Raw material handling and transfer" zone with 12.7% and the "slurry making" with 11.4%.

However, if the energy and water NPOs are excluded in this analysis, it is noted that focus area 1 is "Raw material handling and transfer" with 55.1% of NPO.

Saving Catalogue – identified projects

Category	N°	Measure
Energy	1	Optimization of the subscribed power after improvement of the power factor
	2	Improvement performance of indoor lighting installations
	3	Improvement of the outdoor lighting system (& large interior volume)
	4	Autonomous PV production in own consumption (1.600 m2 - 265 kWp)
	5	Replacement of current engines with high efficiency motors
	6	Reconfiguration of different compressors for more efficient management + detection and repair of leaks and improvement of the compressed air distribution system
	7	Heat recovery + condensed water from the atomizer chimney
	8	Thermal insulation of hot surfaces
	9	Establishment of a management system for electrical. thermal and water energy and support for the implementation of the ISO 50001 standard on energy management
Process	10	Improve preventive and corrective maintenance
	11	Optimize the parameters of the Tower (from the slurry at the tower exhaust)
	12	Organization of big bags by setting up silos
	13	Shelving: RM Storage
	14	Integration of the production process into the current ERP / SAP system
	15	Improve the organization and visual management of the workshop through the 5S approach
	16	Automation of the transfer of the product: between the mixer and the packaging machines (10 KG ...)

Saving Catalogue – identified projects

Category	N°	Measure
Environnement	17	Improvement and compliance of the layout of stores and storage rooms
	18	Reduction of process dysfunction
	19	Putting in place a rational waste management policy
	20	Confinement of the compressor by using noise attenuating walls (phonic screen)
	21	Define the qualities of liquid discharges and atmospheric emissions
	22	Minimizing the risk of fire by moving the gas tank
	23	Installation of an exchanger-condenser at the outlet of the atomizer - as an alternative to project no. 7
International Expert	24	Minor changes at the Slurry reactor
	25	Optimization of Slurry Manufacturing
	26	Placing a scraper on the Magnetic Filter
	27	Colorful Sulfate Blend
	28	perfuming
	29	Lump Recycling

Autonomous electricity production by PV self-consumption (1,600 m2 - 265 kWp)

Description of the solution	It is proposed to install a photovoltaic system on roofs (1,600 m2) operating over the sun, consisting essentially of photovoltaic panels allowing the direct conversion of solar energy into electrical energy, the structure carrying solar panels and a converter of the direct current generated by alternating current.
Economic benefits	The expected gains are estimated at 29,572 €
Environmental benefits	281.6 tons of CO_2 avoided. 383,130 kWh
Capital investments	204,075 €.
Other barriers	No risks

Optimizing the parameters of the process(from the slurry preparation till the outlet of the spraying tower)

Description of the solution	The current parameters of the tower are not optimized, whether in terms of energy consumption, product quality, and material losses. The capacity of the tower is only exploited at 50%, the under-capacity is generated by the speed of the air in contact with the material to be dried which is currently limited to 6m/s, whereas it should be rather at 8m/s. We recommend a detailed expertise and the implementation of calibrated measuring instruments in order to know in real time all the parameters allowing an optimization of the production of the drying tower, the thermal balance, the rate of material losses..
Economic benefits	We estimate that a productivity gain of 20% is possible (from 60% to 80% of the current capacity of the tower (64 Ton / 8h). The current annual production of about 14,477 tons will therefore increase to 19,300, or 4,826 tons more at a minimum capital gain estimated at 43,5075 euros.
Environmental benefits	Reduction of the specific consumption ratios of electricity, LPG and water. Reduction of dust emissions from the tower. The improvements in the process will reduce specific consumption: - electrical energy of 7.7 kWh / ton of final product - thermal energy of 64 kWh / ton of final product - 79 liters / ton of water
Capital investments	Restoration of all the equipment of regulation, monitoring, measurements and hiring of a team specialized in regulation and monitoring. Budget estimation 90,235 €
Other barriers	No barriers

Heat recovery + condensed water from the atomizer chimney-Energy

Description of the solution	On leaving the chimney of the atomizer there is a lot of heat and moisture from particularly the spray drying system for producing laundry powder. The proposed project consists in the installation of a heat exchanger-recuperator which will have double function: 1. Recover the calories contained in these effluents and 2. Condense the water into steam contained in the effluents. including the dust of dry matter (powder) to be recycled at the top of production. The expected gains relate to the energy recovered in the form of hot air that can be used directly for combustion and for the production of hot air at the atomizing tower as well as condensed water that can be recycled at the head of production.
Economic benefits	These gains are difficult to evaluate. They will require a complementary technical-economic feasibility study to establish the volume of gaseous emissions and its moisture content and particulate matter in suspension. We have estimated thermal gains at just under 100 tons of LPG per year. and water savings of more than 4,000 m3 / year. overall a gain of 65,980 € / year.
Environmental benefits	4,000 m^3/year 295 T.CO2/year
Capital investments	Including the cost of the technical-economic feasibility study. we estimated the investment at around 95,000 €
Other barriers	

Integration of the production process into the current ERP / SAP system-Process

Description of the solution	The current ERP system does not cover production which generates losses in productivity and reliability of information The integration of the production process in the current ERP will allow to: • Eliminate manual data entry production • View production data in real time • React in real time and do not wait until the end of the day • Traceability of the production • Reliability of information • Monitoring the time of non-availability of production equipment
Economic benefits	Improve productivity. reduced product losses. decrease energy consumption: Estimation of gains of 2% of NPO equivalent to 848,250 € x 2% = 16,965 € / year
Environmental benefits	Minimize losses due to inefficiencies on materials, water and energy. The estimation of electrical saving is 25,630 KWh, with cost of 2,578 € For material, the estimation of saving is 2,801 € For water the estimated saving is 276 € (around 170 m3), and for the fuel oil the estimated saving is 1,233 €. Total environmental saving is 6,879 €
Capital investments	27,100 € needed to take the production modules of the current ERP and implement reliable information system in the plant.
Other barriers	

Establishment of a rational waste management policy -Process

Description of the solution	The waste management within the company must be reviewed according to the regulatory framework in force and universally used best practices. The implementation of a waste management policy involves: ▪ The realization of a dynamic inventory of the waste generated by the company. ▪ Critical analysis of the production of this waste. ▪ Put in place good practice procedures to reduce this production. ▪ Set up a systematic waste classification procedure according to their typology (refer to the Moroccan Catalog of Waste) and quantification. ▪ Set up a waste station according to the type of waste produced. ▪ Sign a partnership agreement with one or more approved companies for the recovery and / or disposal of waste produced.
Economic benefits	The implementation of a waste management policy will make it possible to better understand the production process and consequently promote actions to minimize the production of this waste and thus improve productivity. In addition, this action will avoid administrative penalties and fines of 20 to 186,800 € depending on the seriousness of the non-compliance, (for calculation purposes, as we have not all the information, we retained an estimated global saving of 50,000 € / year)
Environmental benefits	The implementation of a waste management policy (hazardous waste in particular) as required by the regulations in force will enable the company to comply with this regulation. will minimize the costs associated with the generation of waste. This will limit the degradation of the quality of the environment.
Capital investments	Estimated budget is around 90,000€
Other barriers	NA

Management system integration

- Impact on potentially reduced environmental compliance costs (reduction of waste water by 5,084 m3, and solid waste by 552 tons/ year)
- Integration of RECP into ISO 9001 existing management systems, and the company has started the preparation of ISO 14001 certification, and for this they have recruited a Manager for the implementation
- Culture behavior change for the company employees and management
- We have recommended a systematic use of TEST tools such MFCA
- Other less tangible benefits gained by company such the reduction of thermal & electrical energy consumption, optimization of the production process and the technological upgrading of detergent equipments

Results

Action	Investment euro	Savings euro /Yr	PBP Years	Water and Raw Materials /Yr	Energy MWh/Yr	Environmental Impacts /Yr.
Electric power and compressed air	27,030	14,350	1.9	-	117	
Thermal energy and water saving	121,260	89,410	1.4	4,159 m3 of water	1,749	
Production of electricity with PV	202,374	29,572	6.9	-	383	Total:1,152 T CO2
Reorganization of the production workshops	123,120	66,380	1.9	400 m3 of water 300 t of raw material	-	Solid waste: 552
Improving technology and optimizing production	295,310	560,900	0.5	525 m3 of water 252 t of raw material	1,265	Liquid waste: 5,084 m3
TOTAL	**769,094 €**	**760,612 €**	**1.1**	**5,084 m3 of water 552 t of raw material**	**3,513 MWh**	

Conclusion

- 93% out of 29 RECP opportunities implemented/under implementation/planned
- Economic Savings 760,612 € with an average PBP of 1.1 years
- Total annual Water savings :59.9 %
- Total annual Energy savings : 29.6%
- Total annual Raw Material savings :1.9%

- Non-Product output costs reduced by 66%
- CO_2-emission reduction by 33.1 %