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EaPGREEN
Partnership for Environment and Growth

Programme carried out with the financial assistance of the European Union

Resource Efficient and Cleaner Production

Competitive Business - Cleaner Environment - Green Economy

Primer

Promoting RECP among small and medium size enterprises in Georgia

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Tbilisi, 2015

UNIDO Resource Efficient and Cleaner Production Demonstration Project in Georgia (www.recp.ge).
Greening Economies in the Eastern Partnership Countries (EaP GREEN)
(www.oecd.org/env/outreach/eapgreen.htm)
This publication has not been edited or approved by UNIDO.

Table of Contents

Background

The Publication “Resource Efficient and Cleaner Production - Competitive Business - Cleaner Environment - Green Economy” is prepared in the frames of the Resource Efficient and Cleaner Production Demonstration component of the Greening Economies in Eastern Partnership Countries – EaP GREEN Programme. The EaP GREEN is funded by the European Union, with the aim to facilitate to the green economic development among the Eastern Partnership Countries (Georgia, Armenia, Azerbaijan, Ukraine, Belarus and Moldavia). The Programme in the beneficiary states has been implemented by international organizations OECD, UNECE, UNIDO and UNEPR; the Resource Efficient and Cleaner Production Demonstration Project in Georgia is implemented by UNIDO.

The present publication is intended to facilitate to the adoption of the Resource Efficient and Cleaner Production (RECP) in Georgia. Main approaches of the RECP and benefits that the RECP can bring to enterprises. The Publication focusses on economic, environmental and other benefits that industrial enterprises can enjoy from the RECP; case studies on real Georgian enterprises are delivered for more credibility. The case studies are drawn on the findings and recommendations of the RECP audits fulfilled in Georgian enterprises in the frames of the RECP Demonstration Project in 2014.

The publication is intended for a wide range of readers, including those interested in the sustainable economic development, cleaner environment and human welfare in our country. However, the main focus is made on the representative of small and medium size businesses, which can learn about the RECP methods, ways for their application and potential benefits. We hope that this publication can influence on their vision of effective planning and management of production cycle, resource saving and environmental protection in their plants. We also hope that the publication will give them incentive for the adoption of the RECP methods at their plants so that to promote to the green economic growth in Georgia.

Introduction

The green economy, protection of the environment and effective use of resources are the topic of the day to date. The NGO sector and civil society in general request enterprises to implement various measures aimed at the protection of the environment and natural resources. Entrepreneurs are willing to protect the environment and make their plants the best in all aspects; however, they are careful about the implementation of such actions, since they incur certain costs and entrepreneurs concern that the environmental protection might become a financial burden for their enterprises.

Entrepreneurs anyway have to implement in their enterprises measures envisaged the legislation. It is indisputable that additional efforts towards the resource efficiency and environmental protection will incur extra expenditure. Though, it is rarely accentuated what benefits can reap the enterprise in return and that the implementation of environmental measures can bring financial profit in some cases.

The present publication is prepared to present environmental measures in this context. We would like to demonstrate how beneficiary could be for the enterprise the implementation of some environmental protection measures and the adoption of the Resource Efficient and Cleaner Production (RECP) in particular. Besides, we will try to demonstrate that these techniques are effective in Georgian reality as well and they are affordable in our country. Several case studies on Georgian enterprise are delivered to demonstrate this.

Thus, if you are interested in increasing efficiency and profitability of your enterprise, and at the same time are willing to contribute to the environmental protection, this publication is for you. If you spend a couple of hours and read it to the end, you may get different vision of your enterprise. You might reflect on the possibilities, which could be financially (and not only financially!) attractive to you and can help you to obtain the reputation of the green enterprise.

Section 1 Competitive Business

Section 1.1 What is RECP

The sustainable use of natural resources and pollution prevention are the topics of the day. In this regards the resource efficiency has become of particular importance for the production sector, in order to achieve more output with less resources and minimize the waste. The end of the last century fostered the development in this direction and the methodology that enables the achievement of the mentioned goals was named as a Resource Efficient and Cleaner Production (RECP).

The Resource Efficient and Cleaner Production aim at:

- The optimization of the resource use in the production sector
- The minimization of environmental impacts and
- The increase of human welfare.

The RECP is "doing more with fewer resources and less pollution". To achieve these goals, the RECP measures are directed towards:

- The optimization of the consumption of raw and auxiliary materials, energy resources and water in enterprises;
- The minimization of waste, wastewater and air emissions.

However, the question is how to save resources and reduce waste? How difficult is the implementation of such measures? Are financial resources necessary for their implementation and if yes, how much do they cost? What is necessary other than financial resources to achieve these? Or is every enterprise capable to fulfill RECP measures?

The following sections will shed light on these issues. So far we would like to say that the RECP techniques could be used at any enterprise, despite its size and type. We would like also to highlight that the RECP envisages the planning and implementation of activities, which bring environmental benefits and can be profitable for the enterprise at the same time.

Considering that the production sector is poorly developed in our country, the RECP measures might have outstanding results to production plants. The adoption of the RECP approaches could be of special importance for small and medium size enterprises, as small loses, that might be unnoticeable at large plants, might significantly influence the production price at small and medium size plant. Meantime, the RECP measures that lead to the optimization of the production process can allow them to reduce the production costs, improve the product quality and increase the competitiveness of the enterprise.

Section 1.2 Benefits of RECP

In this section we would like to tell you what benefits can bring the RECP to your enterprise and why you might become interested in the planning and implementation of the RECP measures.

As a preamble to be said that the RECP is an instrument that can bring financial and non-financial benefits to you and let you to significantly improve economic sustainability, competitiveness and image of your enterprise. Further we will elaborate on these issues in more details.

As the term 'Resource Efficient and Cleaner Production' indicates and as we have mentioned above, the RECP means the rational use of resources and reduction of losses in enterprises. It is obvious that this should be ***economically profitable*** for the enterprise, since the implemented measures ca:

- Raise the efficiency of the consumption of raw and auxiliary materials, water and energy
- Increase the materials productivity
- Reduce the production costs and net cost of products

Of course such results should be attractive and desirable for entrepreneurs, since the ***profitability*** and ***financial sustainability*** of their plant is improved. It should be mentioned that such outcomes are often achieved with small investments, normally having pretty short payback period.

The RECP means better management of the production process, which normally leads to:

- Improvement of the product quality
- Reduction of the consumer's risk

In the following sections we will provide examples demonstrating such results. We believe that for you high quality is crucially important, since it influences ***the image*** and ***sales*** of your company.

Reduction of the cost of production together with improvement of the quality of product and image of the company are the factors, which will significantly increase your competitiveness on the market.

However, this is not still a full list of the RECP benefits. The effective use materials, water and energy means ***fewer waste***, since fewer material will be occur waste, fewer water will be discharged into sewage pipes, fewer pollutants will be emitted into the air. In some cases waste toxicity can be also reduced. Of course this is beneficiary in terms of the environmental protection; though, entrepreneurs can gain equitable benefits, since:

- ❖ Reduction of waste means less expenditures for their management and disposal
- ❖ Reduction of air emissions means less expenditures for air filters
- ❖ Reduction of wastewater or the quality of pollution means less expenditure for water treatment

In total the RECP methods give opportunity for reduction of the pollution risks and environmental impact in general, i.e. improves ***environmental performance***. This means that the enterprise will be able to:

- ❖ Meet better environmental standards and legal requirements
- ❖ Reduce the risks for violation of environmental standards and issue penalties for the mentioned

Improvement of environmental performance often is followed by improved ***work conditions*** and reduction of ***the community health risks***.

The benefit got by enterprises is not limited with this. There is something else that could be provided by the RECP. In particular such measures:

- ❖ Improve organizational effectiveness of production management
- ❖ Improves motivation of the staff of the Enterprise and promote their engagement in the processes of elaboration and implementation of the mentioned measures

Finally, the RECP helps the enterprise ***to attract finances and investments***, since it can:

- ❖ Demonstrate better financial performance and organizational efficiency
- ❖ Demonstrate improved compliance to the environmental law
- ❖ Meet environmental standards of financial institutions
- ❖ Receive RECP focused loans, including loans intended for improved energy efficiency

To summarize, ***the RECP is in close connection with quality management, environmental protection and occupational health and safety***. The advantage of this approach is that in the most cases significant pay back can be obtained with small expenditures; some measures do not need expenses at all and despite of this the enterprise can get significant results.

Section1.3 RECP in Georgia – Existing Situation, Opportunities and Obstacles

Currently the entrepreneurship is not well-developed in Georgia. Major part of existing enterprises is accommodated in outdated buildings and use obsolete equipment for the production purpose; their maintenance and repairing are not properly ensured. Facility size and machinery capacity do not always fit to the needs of particular enterprise. These reasons hinder manufacturers to optimize production processes and result in increased consumption of energy, water and materials.

The availability of resources adds to the above mentioned challenges. The availability and scarcity of local resources in Georgia make many manufactures dependent on imported materials. The country suffers energy deficiency as well, and energy carriers are there expensive there. Water is relatively available as Georgia is rich in this resource; however, water is quite expensive for enterprises sourcing it from the municipal water supply system.

These factors are significant challenge for many plants and create barriers for their effective operations and development. On the other hand, these challenges have positive side as well, as they can provide the incentive for the implementation of the RECP and provide wide range of opportunities for reduction of wastage and increasing of the production efficiency.

According to some studies, the beverage production and productions intended for the export have good opportunity for the RECP implementation in Georgia. Considering the outcomes of the RECP assessments implemented Georgian enterprises in 2014 in the frames of UNIDO Resource Efficient and Cleaner Production Demonstration Project one can state that food production sector in general, as well as manufacturing of building materials and chemical production have wide range of opportunities for the RECP implementation. Considering outcomes of various assessments, opportunities are especially significant towards increased energy efficiency.

Some enterprises in our country have been successfully implementing RECP measures with support of various donors and programs, or on their own initiative. Though, it is hard to say whether all enterprises are open to adopt the RECP, or if our country provides enabling environment.

According to various studies and the forum held in Tbilisi in June 2015 in the frames of UNIDO Resource Efficient and Cleaner Production Project, drivers and barriers for RECP adoption in the industrial sector of Georgia are the following:

Drivers

- Large production volume and continuous flow, large consumption of energy, water and materials in production processes
- Internal environmental requirements
- Most companies have strong finances and could afford larger RECP investments
- Less costly RECP opportunities available with significant payback
- High hygiene and quality standards that products should meet
- High level of technical and efficiency know-how present

Barriers

- Lack of enabling policy, a generally low level of environmental regulation and lax enforcement practices
  - Low cost to discharge waste makes it more attractive to pollute than to prevent or treat
  - Taxes imposed on industry are mainly used as a revenue tool rather than to protect the environment or to promote an efficient use of resources
- Low interest in and less openness to innovations
- Lack of information and expertise
- Lack of long-term development vision and focus on short-term profit
- Poor availability of finances, among them loans (expensive loans) and fear among entrepreneurs to get loans
- Lack of motivation and uncompetitive business environment

To be mentioned, various projects have been implemented in our country in support of the RECP, which partly solved the above listed issues. In particular, demonstration projects were funded in some enterprises, awareness rising campaigns and trainings were delivered, energy efficiency loans are made available, RECP experts were prepared, Energy Efficiency Center has been established, etc. However, still lots should be done to make the RECP the priority for all enterprises in Georgia. Besides, entrepreneurs themselves should take the initiative to adopt the RECP. We hope that this publication can contribute to this process as well.

Section 2 Cleaner Environment

Section 2.1 Six RECP Issues

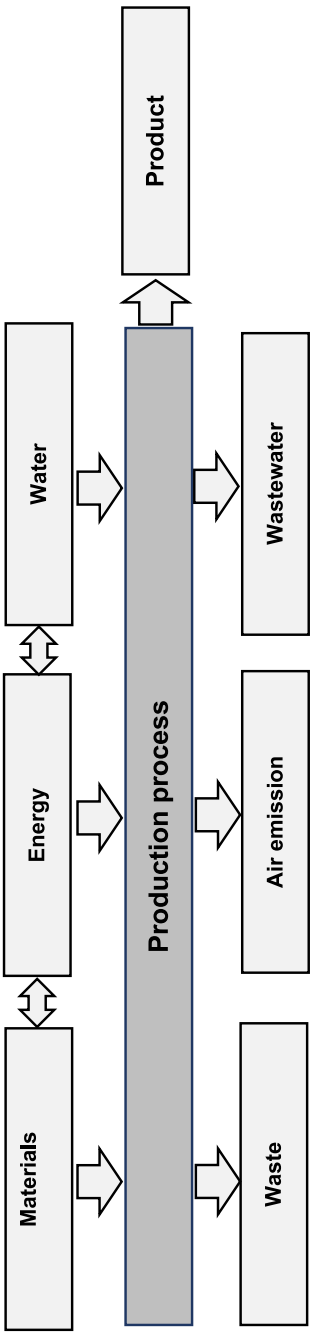
As we already mentioned, the RECP aims at rational use of resources and pollution prevention.

Effectiveness of the resource use is assessed per production unit by the consumption of:

- Raw and auxiliary materials
- Water
- Energy

While pollution indicator is assessed per production unit by the emission of:

- Waste
- Wastewater
- Air emissions



The measures implemented for improvement of these six indicators could bring benefit for the enterprise as well as for environment. The enterprise shall decide which measures to plan and to which direction. As a rule the measures are planned taking into consideration the issues urgent for enterprise.

The enterprise can plan optimization in one direction out of the listed above, however normally the results of implemented measures are reflected on other indicators as well. For example, if the enterprise manages to reduce the losses of raw and auxiliary materials, this will be automatically reflected on amount of waste; reduction of fuel consumption will reduce emission of harmful substances; and optimization of water consumption usually reduces reduction of the volume of wastewater.

Such versatility of the results is well demonstrated in the section dedicated to the benefit of the RECP and clearly described in the examples provided in other sections of the publication, describing possibilities of implementation of the RECP measures in Georgian enterprises and their expected results.

Before going to more particular issues, we would like to provide brief description of the vision identified on the forum held in Tbilisi in June 2015 in the frame of UNIDO Resource Efficient and

Cleaner Production Demonstration Project concerning the resource and waste management measures carried out in our country. The vision of the forum participants is summarized in the table below, where the figures represent the number of votes obtained by particular assessment. As demonstrated by the table the participants of the forum think that respective attention is not paid to management of resources and waste in Georgia, neither on country nor on enterprise level.

Subject	**Country level**				**Enterprise level**			
								
Materials	13	6	3		3	11	7	
Water	12	6	3		8	11	3	
Energy	10	7	3		1	11	6	1
Waste	15	6			8	9	2	
Wastewater	13	7			14	5	2	
Air emissions	10	9			15	4	3	

Now let's start with detailed description of all six issues of the RECP, and discuss the challenges and opportunities associated with each of them.

Section 2.2 Materials

Raw and auxiliary materials are important components, which mostly determine quality and cost of produced products. For production of competitive production the enterprise shall ensure consumption of high quality raw materials and minimization of losses in production process.

Enterprises which ineffectively use materials and have significant wastage can face the following changes:

- Their production costs is increased and competitiveness is decreased
- Management and disposal of waste becomes aggravated and respective expenditures increase
- Environmental impact increases and increasing efforts are required to meet requirements of the environmental law.

Materials can be lost on different phases of the production cycle, including:

- Transportation of raw and auxiliary materials, and final products
- Storage of raw and auxiliary materials, and final products
- Processing of raw materials
- Packaging of final products

Thus, to minimize losses of materials it is necessary to assess and optimize full production cycle. This could be the change of conditions of transportation or storage, identification of opportunities of reuse or recycling produced waste, improvement of production processes, etc.

Together with efficiency the safety of materials, products and waste also matters. Entrepreneurs should take this issue into consideration while selecting materials in order to minimize a negative impact on the environment, workers, local community and consumers. To be mentioned, the elimination of hazardous waste enables the cutting of waste management costs, because the collection, handling, storage and disposal of hazardous waste in a safe way requires higher expenses.

Measures for optimization of the use of materials

- Storing and transportation of materials and products in respective conditions
- Management of material and product supplies using FIFO method
- Changing production technology
- Improved management of production processes
- Change of the form of product or wrapping
- Date of expiry of manufactured product
- Regular maintenance of machinery
- Reuse or recycling of industrial waste
- Monitoring of the use of materials
- Training of personnel and awareness raising among them

Case Study

Company Name	**LTD QB Construction**	
Sector, size and location	LTD QB Construction is a small size building material manufacturing plant, which is specialized on foam-concrete block production. The company is situated in Tbilisi City and distributes its products throughout Georgia. In total six persons are employed at the building material plant.	
Activity/ Initiative Taken	**Brief Summary** QB Construction makes foam-concrete blocks from cement, sand and foamier, which are mixed, molded and cut into blocks. According to the RECP team estimates, the company wasted over 5% inputs due to cracking of blocks during drying and cutting with use of a hand-made cutter machine. The RECP team proposed to invest into new cutting machine to minimize cracking.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☑ *Productivity increase* ☑ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	The installation of a new block cutting machine can improve product quality, increase material productivity by 5% and save 20,000 €/year. As a result, overall organizational efficiency and financial sustainability of the company will increase.
Environmental Benefit	**Category**	***Description and Justification***
	☑ *Materials* ☑ *Water* ☑ *Energy* ☑ *Waste* ☑ *Effluents* ☑ *Air emissions*	The above described RECP measures can save 135 t cement, 100 t sand, 90 m^3 water and 600 kWh energy per year. At the same time amount of solid waste will reduce by 90%, or about 500 t/y. Carbon intensity per product unit will be reduced by 10% as well.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☑ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The installation of the new block cutting machine requires 7,000 € investment. It can improve the productivity of all inputs by 5%, and enable the company to save 20,000 € annually. The payback period for the investment is only about 4 months. In addition, the QB Construction can enjoy improved product quality.

Section 2.3 Water

Water and especially fresh water is the resource significant influence on the socio-economic development of any country. Georgia is rich in water and Georgian enterprises do not suffer water deficiency nowadays; though, this resource is not equally available throughout the country.

The rational use of water is important in order to avoid:

- Degradation of water resources
- Negative impact on ecosystem
- Water deficit in social economic sector

Inefficient water user can create water deficit to others. Irrational use of water can have negative consequences on such users as well, because they need to pay extra cost.

High water cost is an issue for large water consumers receiving water from the municipal system, as the water tariff significantly increased during last decade.

Enterprises processing own water source (boreholes) have much lower tariff on water and at first glance the reduction of water consumption might be less topical for them. However, in such cases the water cost consist not only of the water tariff, but also includes:

- Expenses made for the procurement and maintenance of water pumps
- Costs of electricity consumed by water pumps

Inefficient use of water can incur high financial losses at enterprises sourcing water from the municipal system and having own water supply as well, if wastage takes place after treatment, or heating. In such case the following is added to water expenses:

- Cost for operation and maintenance of water treatment system
- Cost of used reagents
- Energy costs

Due to mentioned, rational use of water could be very important for all enterprises. In the event of rational use of water an enterprise can cut: the following expenses:

- ❖ Water bill
- ❖ Electricity bill
- ❖ Fuel cost
- ❖ Expenditures for purchasing and maintenance of pumps
- ❖ Expenditures for operation and maintenance of water treatment system
- ❖ Expenses for using chemicals

In long term prospective indirect benefit from sustainable use of water resources is also important for entrepreneurs. In particular, if entrepreneurs use water rationally, they will avoid water deficit and increase of water tariff.

Measures for optimization of water consumption

- Changing washing technology (e.g. washing with pressure)
- Dry cleaning
- Water recycling, including the use of wastewater of one production process for another production porcess
- Improving technological process
- Timely maintenance of water supply system and ensuring proper operation
- Monitoring water consumption and timely elimination of detected losses
- Training of personnel and awareness raising among them

Case Study

Company Name	**MN Chemical Georgia LLC**	
Sector, size and location	The company is situated in the industrial zone of Rustavi City. It produces feed grade manganese oxide (MnO) and the natural manganese dioxide (MnO2). The plant processes about 12,000 t of manganese concentrate in total, producing ca. 9,000 t MnO and 150 t MnO_2 per annum. The products are mostly exported to EU countries. The company employees 50 persons.	
Activity/ Initiative Taken	**Brief Summary** Main production processes at the plant include drying, grinding and reduction of manganese concentrate, followed by sewing and packaging. Auxiliary processes at the plant include cooling of MnO and treatment of exhaust gasses. These auxiliary processes consume over 90 ths m3/y water, though water circulation is ensured. The RECP team suggested changing the technology used for MnO cooling. This would enable to cut water use by 30%, and at the same time provide the opportunity for saving up to 10% of natural gas consumed.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	The cost of the proposed measures was estimated at 50,000 €, what is rather high investment. However, savings expected as a result of reduced water and gas consumption would be over 60,000 €/y, and the investment could be paid back during first year of the operation.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☑ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The RECP team suggested replacing of the existing water cooling system with an air system in the MnO cooling process. This can save up to 30,000 m^3 water per year. Such a technology change provides the opportunity for waste heat recovery and cutting the natural gas consumption by 180,000 m^3/y. As a result, the plant can reduce CO_2 emissions by up to 400 t/y.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☑ *Technology change* ☑ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	MnO production process occurs at 900°C, and the product is cooled with use of water. Water circulation is ensured; though, water partly evaporates in the cooling process and considerable amount of make-up water is required. The RECP team proposed to change the existing cooling technology. They suggested installing an air cooling system. This measure would enable to completely avoid water use for MnO cooling. Besides, hot air masses generated in this process could be directed to the manganese concentrate drying process and in this way reduce natural gas consumption for this purpose.

Section 2.4 Energy

Georgia is not among countries with abundant energy resources. Internal energy resource of the country is basically hydro power and great part of energy is imported. Due to that, Georgia is distinguished with high energy cost in the post soviet world. Despite the high cost, according to 2009 data, industrial sector of Georgia consumes 2.5 times more energy than EU countries. High energy consumption further aggravates energy deficiency in our country. Besides, low energy efficiency increases environmental load.

Causes for energy losses in Georgian industry are as following:

- Depreciated facilities and machinery, operational parameters of which (size, capacity) often exceed the needs of particular enterprise
- Poor insulation of hot and cold systems, or lack of insulation
- Lack of automatic control system for machinery
- Operation of non-fully loaded machinery
- Insufficient management of production processes
- High losses of semi-products throughout the production process, when proceeding production processes require energy use, etc.

Increasing energy efficiency is crucial for the production sector and for the country in general. Taking into consideration low indicator of energy efficiency, we could assume that industrial sector has great potential for increasing energy efficiency. Based on the assessments, 5-15% of energy can be saved in Georgian enterprises at low or no cost. As a result industrial sector can save 15-54 million Euros. Medium or high cost measures can save up to 15 -30% of energy consumed that comprises up to 54 – 108 million Euros saving for the production sector.

The RECP audits of 10 enterprises within the frame of UNIDO RECP Demonstration Project has clearly demonstrated the mentioned opportunities. The assessment revealed that factually all ten enterprises suffered significant energy losses and various measures can increase their energy efficiency by 5 – 50%.

Definitely, this is a rough estimate, but still demonstrates high potential for the energy saving in Georgian industry and possible benefit of improved energy efficiency.

Increased energy efficiency will give opportunity to the enterprises to improve environmental performance. In particular, they will be capable to reduce air emission of flue gasses, and emission of carbon dioxide among them.

It should to be mentioned that, some financial institutions operating in Georgia have energy efficiency loan schemes that offer lower interest loans to entrepreneurs to promote energy efficient measures in the production sector.

Measures for optimization energy consumption

- Optimization of operation regime of machinery (for example pumps and engines) and provision of automatic management system
- Installation of energy efficient machinery
- Regular maintenance of machinery
- Improving control over production process
- Provision of insulation of hot and cold systems and facilities
- Regular maintenance of energy equipment (water boilers, steam generators, pipelines) ensuring proper operation
- Provision of energy source close to energy consumers
- The use of waste heat, for example, the installation of a heat exchanger
- Avoiding the loss of water and raw materials
- Training of personnel and awareness raising among them

Case Study

Company Name	**Rusmetali LTD**	
Sector, size and location	The company operates a ferro-alloy plant in Rustavi City. The plant is specialized on silica-manganese production and produces around 20 thousand ton of this product. The ferro-alloy plant works in 24 hr mode, and about 400 people are employed there.	
Activity/ Initiative Taken	**Brief Summary** Silica-manganese production is an energy demanding process, requiring 1560-1700°C temperature. Rusmetali ferro-alloy plant operates two electric arch-furnaces for silica-manganese alloy production. The capacity of each furnace is 9 MW, and the plant consumes over 100 GWh electric power per year. RECP team assessed energy efficiency of the production process and recommended the modification of the electric arch-furnaces.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	According to the RECP team's assessment, the recommended energy saving measure requires around 25,000 USD investment and can save for the company over 250,000 USD/year on electric power consumption. The company will get an immediate payback if implements the recommendation.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The RECP team developed measures which can increase the combustion efficiency of the arch-furnaces from 79% to 83%. Due to high capacity of the arch-furnaces, this 4% increase in energy efficiency can curtail electric power consumption by 4 GWh/y. Corresponding indirect reduction of CO_2 emission will be about 300 t/y.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☑ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The above described effects could be achieved if an automatic oxygen blasting and automatic purge system is installed in the furnaces. This system enables better control of the combustion process and can improve the combustion efficiency by 4%. It also enables optimization of furnace operation mode, what can further increase energy efficiency and at the same favour to higher productivity.

Section 2.5 Waste

Waste is the losing of material that the enterprise could not be able to transform into the product. Waste is a headache for the enterprise, hence requires management and disposal in order to avoid environmental pollution, adverse impact on the plant workers and population, and well incompliance with the legal requirements.

Waste is quite expensive for enterprises, as the cost includes expenses made on raw materials, machinery, workforce and waste management and disposal. Therefore, it is in the entrepreneur's interest to minimize waste.

Today waste management standards are not high in Georgia. However, together with development of the country, approach to this issue is changed and the requirements become stricter. Recently Georgia adopted the new Waste Management Code and new Waste Classification List, which are approximated to EU standards. Besides, measures are taken with the focus on landfill management, which will gradually make stricter the conditions for waste disposal. New legislation and the processes for improving waste management process in the country will increase topicality of waste management for industrial sector.

It is impossible to avoid waste fully. However, there are factors which precondition great loss of resources and their transformation into waste. These are the following:

- Inadequate conditions for transportation and storage of materials
- Inadequate management of production processes
- Malfunctioning or inappropriate design/alignment of production lines and machinery
- Careless attitude of workers, etc.

To minimize waste an enterprise shall detect and eliminate such problems.

According to the results of EU cleaner production projects, 20% reduction in waste is possible by zero expenses; besides, further 10 -20% reduction is possible with relatively small expenses, payback period of which could be from one to three years.

Such results could be attractive for all enterprises, moreover that reduction of waste improves the company's environmental and financial performance.

Waste reduction measures

- Improving the management of production processes and housekeeping practicies
- Waste reuse and recycling
- Segregated waste collection to enable reuse or recycling
- Composting organic waste
- Using waste as fuel
- Training of personnel and awareness raising among them

Section 2.6 Air Emissions

In fact, the operation of any enterprise is followed by emission of hazardous substances. The volume and type of emitted pollutants depend on production processes in a particular enterprise. Emission sources can be fuel used, bulk materials, chemicals supplies, ventilation system of facilities, etc.

In our country air emissions are regulated by the legislation. Enterprises shall comply with air quality standards in order to avoid environmental pollution, and health effects for workers and local community.

Enterprises have to implement certain measures to avoid environmental pollution and meet legal requirements. For example, the enterprise might need air filters, high chimney, covering of bulk materials, provision of ventilation system in chemical storage facilities, etc..

The volume of air emitted substances is linked to the effective use of raw materials, energy and water: lower efficiency of resource consumption lead to higher air emissions. Thus, if an enterprise has an inefficient boiler, it will need more fuel to produce steam or heat water, and more flue gasses will be emitted respectively. Water losses after heating increase fuel consumption and air emissions as a result.

Of course an enterprise cannot fully to eliminate air emissions of hazardous substances, through resource efficiency measures can minimize them. On its part, the minimization of air emissions can help the plant to prevent air pollution and reduce costs of air protection measures. For example, the optimization of the boiler's combustion system, or waste heat recovery reduce fuel consumption and might eliminate the need for the installation of a high chimney, or high capacity air filters.

Measures for reducing air emissions

- Imrpoving energy efficiency, including optimization of combasting process, using energy of flue gases and used steam
- Using energy sources, which have less or less hazardous emissions
- Regular maintenance of machinery
- Improving management of production processes
- Provision of hermetic containers for chemicals
- Protection of bulk materials from wind and precipitations
- Training of personnel and awareness raising among them

Case Study

Company Name	**Bakery 'Devis Puri'**	
Sector, size and location	The bakery is established in Temka district of Tbilisi City. It produces 8 sorts of bread, in total over 1.5 mln pieces per annum. The product is sold in the capital city. The plant is operated 24/7. It employs 30 people, working in shifts.	
Activity/ Initiative Taken	**Brief Summary** The bakery uses carts for the delivery of dough into stoves and removal of backed bread. The carts are old, and their rollers need frequent lubrication to operate properly. Lubricant, which is used oil, evaporates during the baking process and can affect the product quality. The RECP team recommended replacing cart rollers to minimize the need for lubrication.	
Business Case	***Category***	***Description and Justification***
	☐ *Cost savings* ☐ *Productivity increase* ☑ *Product quality* ☐ *Organizational efficiency* ☑ *License-to-operate*	The replacement of cart rollers will positively affect the product quality and the company can be able to demonstrate improved compliance to the food safety standards. As a result, the bakery will obtain a sounder license to operate from the government and consumers.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☐ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The recommended measure can reduce the emission of organic pollutants in ambient air and work space can become safer as well; however, the positive impact on air quality will not be substantial.
Technique	**Category**	***Description and Justification***
	☑ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The replacement of cart rollers will minimize the need for lubrication. This can improve the product quality, as waste machine oil used for lubrication evaporates during bread baking and can deteriorate the product quality. The replacement of cart rollers is simple modification of the existing equipment. According to the estimates, the company needs only about 200 € for this. The company will not have monetary payback from this measure; however, its mandate to operate and reputation can enhance following to product quality improvement.

Section 2.7 Wastewater

Production of wastewater in the enterprises is associated with the activity such as washing and procession of raw materials or by products, washing production lines or storages and sanitation, using water for domestic purposes and so on. According to international practice, wastewater shall be treated to determined norms before discharging to environment or municipal sewage system, in order to:

- ❖ Avoid pollution of water resources and environment in general
- ❖ Ensure proper operation of municipal water treatment facilities

Wastewater mean loss of water resources and materials, which appear in it as pollutants. This loss gets significantly increased, if:

- ❖ Water supply system (pipes, taps) is damaged and water pours out
- ❖ Washing sanitation equipment is not targeted for efficient use of water
- ❖ Washing process is not controlled and so on

Treatment of wastewater requires expenditures, which depend on volume and pollution level of the wastewater.

It should be mentioned that management of wastewater is not topical for Georgian enterprises, since the state does not control water discharge respectively. Water discharge norms are not determined for the enterprises which have access to municipal sewage system and they have no responsibility for pre-treatment of wastewater respectively.

Despite of this the enterprises shall be interested in reduction of the volume and pollution quality of wastewater, which will make possible to:

- ❖ Reduce water and electricity losses
- ❖ Save chemicals used for washing sanitation
- ❖ Reduce wastewater treatment cost at plants which have treatment facilities
- ❖ Reduce the risks of penalties for incompliance with legislative requirements for pollution of environment

It is to be mentioned that provision of modern municipal wastewater treatment facility is planned for some big cities of Georgia. After implementation of this project, wastewater shall be treated before being discharged to sewage system, in order not to impede operation of municipal water treatment facility.

Thus, the issue of treatment of wastewater and expenditures associated with it will become topical for many enterprises. Do not wait for that time, start right now with measures for waste management, save funds and resources and meet the next day prepared.

The measures for reducing volume and/or pollution level of wastewater

- Implementing measures to prevent water losses
- Recirculation of water, including use of wastewater of one production process for another production process
- Separated management of wastewater produced from different production processes
- Using waste heat in case of thermal pollution
- Training of personnel and awareness raising among them

Section 3 Making it Happen

In previous sections we have discussed a lot about resource saving, pollution prevention and benefits of these measures for enterprise. In this section we will provide brief information about the RECP methodology and techniques. Each RECP technique will be discussed in common and practical case studies on the real enterprises will be provided. The information provided has a general character and technical issues requiring special knowledge or experience is avoided.

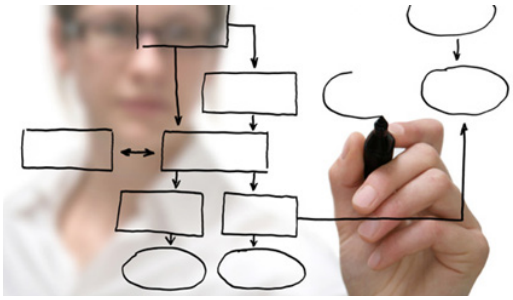
Section 3.1 Introduction to RECP Methodology

Planning and implementation of the RECP measures envisages the following steps:

- **Establishment of the RECP team** – the team should comprise of persons, who have good knowledge of technological processes of the enterprises, have access to information and have authority for decision making. An external expert could be engaged in the team to ensure unbiased assessment.
- **Initial assessment** – the RECP team should study in advance the enterprise with its production processes and facilities. In particular, it should be identified what kind of materials are used and what and where are the losses; this will enable identification of problematic sections and issues.

Some single problems can be solved at this stage. For example broken taps can be replaced immediately and unnecessary lights can be switched off and so on.

- **Identifying priorities** – Out of detected problems the RECP team should stop on one or two priorities (for example energy and water), to continue the work. While identifying the priorities the importance of losses as well as complexity of problem and cost for its elimination shall be taken into consideration.
- **Detailed assessment** – at this stage the RECP team studies the priorities in details, collects and analyses the data, assesses losses and develops balance of consumed resources, studies the reasons of problem and develops options for solution.



- **Feasibility study** – the RECP team selects the best options and starts detailed work on them. In particular makes technical and economic feasibility analyses and chooses the best option for implementation.
- **Implementation, monitoring and assessment of planned actions** – at this stage planned work will be implemented. It is necessary to monitor obtained results, in order to assess the progress of implemented measures.

As you see this scheme does not differ from the stages of planning – implementation of other projects. Thus, experience gained in other projects will be useful for you and your team in implementation of the RECP projects.

Section 3.2 RECP Techniques and Definitions

In this section we introduce the RECP techniques and give definition of terms so that to have common understanding during detailed discussions. The RECP techniques include:

- **Good housekeeping** - effective planning and management of housekeeping and production processes to minimize losses.
- **Input change** – the replacement of raw and auxiliary materials with alternative materials, which are less hazardous, or help with waste reduction, or produce less hazardous waste.
- **Better process control** – control and management of production processes to improve efficiency and reduce losses.
- **Equipment modification** – alignment and maintenance of production machinery in a way to maximize efficiency and minimize losses.
- **Technology change** – substitution of the technology used in the production with more effective technology, which enables reduction of losses.
- **On site reuse and recycling** – the processing of generated waste by the enterprise to produce some products.
- **Useful byproduct** – processing of industrial waste so that to convert it into material, energy or water that can be used by other plant.
- **Product modification** – alteration of products in a way to reduce environmental impact during production, consumption or disposal.

Sometimes it is difficult to determine to which method does particular measure belong; however it does not matter how we call it, the results of its implementation have key importance.

In the following sections we'll provide brief information about the methods, enabling effective use of resources and reduction of losses. We are providing practical examples of each of them. We would like to mention that part of these methods might be well known for you, and even could already be used for improving effectiveness of your enterprise.

Section 3.3 Good Housekeeping

All kinds of activities in the enterprise require adherence to particular norms and rules. The results of activities depend on effectiveness of determined procedures and their proper implementation by the personnel. Incorrect procedures or their poor implementation could cause loss of resources or production.

Changing production procedures and management measures with purpose to reduce losses, means good housekeeping. Examples of such measures are as following:

- Organizing warehouse facilities and improving management system, to ensure proper storing conditions for materials and products, and use of materials until expiration of their validity.
- Registering used resources and waste and regular analyses of these data, for timely detection and elimination of increase of losses.
- Regular technical inspection of facilities, for timely detection of losses.
- Minimization of idly running and partly loaded operation of machinery to avoid energy losses.
- Separation of different types of waste, to make possible their reuse or recycling.
- Procedures aiming at avoidance of spills.
- Preparation and improvement of instructions for operation, for proper determination of working procedures.
- Training of personnel, to inform them about determined procedures and their meaning.

As a rule, implementation of these measures does not require additional expenditures, or is possible with small expenses; while the results could be quite important. Any enterprise can improve effectiveness of management, despite of its size or financial condition. Encouraging personnel and its engagement in the process is really important for proper implementation of planned procedures.

It should be mentioned that in Georgia many enterprises do not pay much attention to measures for increasing effectiveness of their operation. Often the management of enterprise has not assessed possible losses of leaking water pipe, unnecessary lights, part load operation of machinery, ignoring registration, untrained personnel and so on. Therefore, there is great potential of improvement with this regard in the enterprises of our country.

Case Study

Company Name	**Asphalt Plant #1 of Road Company Tbilisi**	
Sector, size and location	Asphalt Plant #1 of the Company is situated in Kvemo Ponichala District of Tbilisi City. The plant produces coarse-grained and fine-grained asphalt-concrete for road construction. The production capacity of the plant is 120 ton asphalt per hour, and total annual output is around 75,000 ton asphalt. The company hires 38 people for the plant operation.	
Activity/ Initiative Taken	**Brief Summary** Raw materials used for the production of asphalt-concrete are: gravel, sand, bitumen and mineral powder. Besides, the plant consumes diesel fuel, natural gas and electric power to operate production equipment, dry inert materials and heat bitumen. The RECP team discovered that energy efficiency of the asphalt plant is low, and various feasible options exist to improve the situation. Among them could be improved housekeeping practices that can cut by 30% the energy consumed for the inertial material drying.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	The good housekeeping measure recommended by the RECP team will cost 3,000 €, that can save around 10,500 €/y for the company. The payback period for the investment is 3-4 months.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The recommended measure can save about 32,000 m^3 natural gas per year and cut CO_2 emissions by 70 ton.
Technique	**Category**	***Description and Justification***
	☑ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The RECP team discovered that stocks of inert materials were exposed to atmospheric precipitation and soak during rains. Due to this, gas consumption for drying and heating of wet inert material for asphalt mixture required about 30% more energy. To solve this issue the RECP team suggested to cover stockpiles with a waterproof film in rainy days.

Section 3.4 Input Change

The next technology of the Resource Efficient and Cleaner Production is the input change that has the following objectives:

- ❖ Using materials less harmful for the environment
- ❖ Production of less harmful waste
- ❖ Reduction of waste

Typical examples of the input change are:

- ❖ Using renewable energy source instead of fossil fuel
- ❖ Reusing/recycling waste instead of new materials, among them utilization of wastewater and waste heat
- ❖ Using less hazardous materials
- ❖ Using local resources instead of imported materials

For implementation of such measures, modification of production infrastructure might be necessary. For example, for switching to electricity from natural gas or liquid fuel, the enterprise will need modification of its equipment. The decision might be profitable for the enterprise, despite of expenses made for re-equipment.

Though, not all measures do need infrastructural changes. In some cases the use of low quality materials can lead to larger losses at enterprises. For example, the use of lower quality glass-ware for bottling can result in higher volume of broken glass. If enterprise replaces it with better quality glass-ware, the packaging losses will be reduced and even expenditures might be reduced. Besides, such change will improve product quality.

Although some measures might not reduce production cost, they can facilitate reduction of environmental impact, improvement of labor conditions and meeting legislative requirements. In some cases, such change might have positive influence on production quality.

Case Study

Company Name	**Sin (Al) Ltd**	
Sector, size and location	Sin (Al) Ltd is a small-scale metallurgical enterprise established in 1998 in Tbilisi City. It produces aluminum ingots from aluminum scrap and aluminum dross. Annual production volume of the plant is about 400 t aluminum. The plant employees 6 labourers, which work in shifts.	
Activity/ Initiative Taken	**Brief Summary** For aluminum production the Sin (Al) operates two furnaces: one for processing of aluminum scrap and another for aluminum dross. The both furnaces are fired on used motor oil, and consume around 75 t waste oil per year. The used oil is not an environmentally friendly fuel, and the RECP team recommended avoiding its usage. For this purpose, it was suggested to replace the existing furnaces with electric induction furnaces.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☑ *License-to-operate*	The price of a new electric induction furnace of the same capacity is around 40,000 €. This furnace is energy efficient, can significantly cut down the energy consumption per product unit and save up to 7,000 €/y for the plant. The payoff period is up to 6 years. However, important is that the measure would enable significant improvement of indoor and outdoor air quality, work conditions, and improve the compliance to environmental and OHS standards.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The use of the new furnace can help the company to save energy equivalent to 590 GWh/y. Equivalent CO_2 emissions will reduce by 85%. Besides, the company can prevent flue gasses from the burning of waste oil that usually contain heavy metals (lead, zinc, etc.), NOx, SOx, CO, particulates, etc.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☑ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☑ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	Waste machine oil is hazardous, its burning requires special conditions and careful treatment of flue gases to avoid pollution of ambient air with heavy metals, organic compounds and other pollutants. Temperature regime of Sin (Al)'s furnaces is not sufficient to ensure decomposition of organic compounds; and adequate air treatment system is rather expensive and unaffordable for small size plants. Therefore, the plant faces high risk to be incompliant with national air quality standards. To solve the above described issues the RECP team suggested installing electric induction furnaces instead the existing one.

Section 3.5 Better Process Control

Better process control is essential precondition for reduction of losses, including optimization of control over operation of machinery, for avoiding losses.

Improvement of production processes envisages the following measures:

- Monitoring of production processes, including operation parameters (pressure, temperature, humidity, cost and so on)
- Registering materials and waste on different stages of technological process, to determine the loss on each stage
- Installation of additional meters of water and electricity and recording data regularly, to make possible timely detection of losses and identification of their possible location
- Provision of automatic management systems, to ensure optimal operation of machinery
- Making records to ensure data accessibility and their analyses

As demonstrated from this short list, measuring controlling devices shall be provided for machinery to implement such measures; however, in some cases machinery can be already equipped with such devices and the enterprise might need just elaboration and implementation of respective monitoring function.

Improved control of the processes requires small or medium expenditures; however it could bring big payback, since provides opportunity for rational use of technological processes, machinery and resources. As a rule implementation of such measures is positively reflected on quality of production.

Case Study

Company Name	**JSC Kula**	
Sector, size and location	The Company established on the basis of former canning factory in 2009 in Gori City. Kula produces various juices and canned products using organic fruit and vegetable of local origin. There are over 200 products in its assortment.	
Activity/ Initiative Taken	**Brief Summary** Kula's plan is a large energy consumer. One of energy demanding processes at the plant is a sterilization. The RECP team identified that the sterilization process is poorly controlled in the cannery, that reduces its energy efficiency. The assessment showed that proper management of the sterilization process can reduce natural gas consumption by 1.5%.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☑ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	Monitoring and control of the sterilization process is a low cost investment requiring only ca. 3,000 €. It allows to save around 2,200 €/year and pay the investment back in 1.3 years. This measure can improve the product quality and management system, and increase overall organizational efficiency of the company as a result.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	Suggested measure allows curtailing natural gas consumption by 5,700 m^3/year. At the same time, CO_2 emission will be reduced by 10 ton/year.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☑ *Better process control* ☐ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The sterilization process implies treating of products at high temperature and high pressure, and consumes significant amount of energy. Canneries shall optimize the sterilization process to ensure food safety and at the same time avoid degradation of sensory properties of products due to overheating. To achieve this, the RECP team suggested the installation of additional monitoring equipment and introduction of respective record keeping. Such measures can allow maintaining sterilization time, pressure and temperature at the required level. This measure will enable the company to cut energy consumption and improve the product quality.

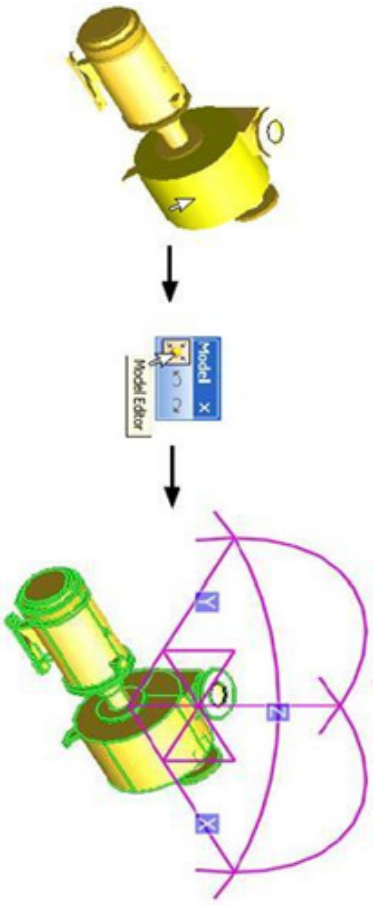


Section3.6 Equipment Modification

Modification of equipment means change of machinery the way to ensure optimization of production processes and minimization of losses.

Within the frame of the RECP shall be viewed the following measures:

- ❖ Optimization of dislocation of production lines
- ❖ Optimization of communications, including optimization of distribution and supply lines of water, electricity, natural gas and steam
- ❖ Substitution of big capacity machinery, inappropriate for the enterprise, with necessary capacity units
- ❖ Optimization of working parameters of production process (temperature, pressure, speed)
- ❖ Provision of insulation of hot and cold systems
- ❖ Equipping machinery with automatic management system



Such measures require small or medium expenditures, which often can bring significant payback in short term.

In Georgian enterprises often can be met boilers with poor thermal insulation, steam pipes, cold machines; often machinery of more than necessary capacity is installed in the enterprise, which causes big energy losses. Consequently, our country has big potential for implementation of such measures and improving energy efficiency.

Case Study

Company Name	**Bakery 'Devis Puri'**	
Sector, size and location	The bakery is established in Temka district of Tbilisi City. It produces 8 sorts of bread, in total over 1.5 mln pieces per annum. The product is sold in the capital city. The plant is operated 24/7. It employs 30 people, working in shifts.	
Activity/ Initiative Taken	**Brief Summary** The bakery was built in soviet times, and the facility and equipment are outdated. During the assessment the RECP team discovered that the exhaust pipes were in a poor condition, released flue gases inside the bakery building, deteriorated indoor air quality and endangered workers health. The RECP team recommended fixing this issue.	
Business Case	***Category***	***Description and Justification***
	☐ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☑ *License-to-operate*	According to the estimates, the issue could be fixed with very low cost investment. Only around 100 € is required for the repairing of the exhaust pipes. This investment does not have monetary payback to the company. However, at such a negligible cost the company can enjoy increased organizational efficiency as a result of higher quality of indoor air; besides, the bakery can better meet OHS standards and demonstrate improved compliance to the legal requirements.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☐ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The RECP team has not assessed the indoor air quality with use of special metering equipment. However, the recommended measure could definitely improve the air quality in the bakery, as it prevents the release of flue gases inside the facility and thus prevents air quality deterioration in the work space.
Technique	**Category**	***Description and Justification***
	☑ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The RECP team found out that joints of the exhaust pipes were not properly arranged, and flue gases escaped through openings into the bakery room. The team recommended to insulate pipe joints properly. This is not a troublesome work and could be implemented at low cost. Still it can bring notable benefits to the company, as it can help to avoid OHS risks and incompliance to the OHS regulations.

Section 3.7 Technology Change

Technology change envisages substitution of technology used in the enterprise with more effective technology. Typical examples of technology change are as following:

- Substitution of machinery with energy efficient ones, for example installation of energy efficient boilers and compressors
- Change of the order of processes in technological cycle, for example change of the order of the processes of washing and sorting materials
- Using technology which enables the use of waste, for example the use of waste heat
- Substitution of chemical procession with mechanic
- Substitution of oil cooling system with air cooling system
- Using solar energy, instead of fuel, for heating water

Change of technology often requires procurement of modern machinery and big investments, with several years payback period. However, such investment significantly reduces operation costs of the enterprise.

Implementation of technology change measures is especially topical at Georgian enterprises, which are majorly equipped with depreciated, ineffective equipment as cannot effort the purchasing of modern machinery due to high price.

Case Study

Company Name	**JSC Kula**	
Sector, size and location	The Company established on the basis of former canning factory in 2009 in Gori City. Kula produces various juices and canned products using organic fruit and vegetable of local origin. There are over 200 products in its assortment.	
Activity/ Initiative Taken	**Brief Summary** JSC Kula consumes significant energy in production and auxiliary processes. The RECP team revealed that the steam system of the plant is of low efficiency, and recommended to modify it. As a result, the company will be able to cut the natural gas consumption by 15%.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	The recommended measure requires 70,000 €, what can save around 23,000 € per year for the plant. The payoff period for the investment is around 3 years. Together with the financial benefit, new boilers can improve environmental performance of the company.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The recommended measure will allow saving of 54,000 m^3 natural gas per year; at the same time will reduce CO_2 emission by 110 ton/year, as well as air emission of CH_4, CO, NOx.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The gas fired steam boilers are one of the largest energy consumers at Kula cannery. Steam generated is used in various processes, including fruit concentrate production, sterilization, etc. The RECP team revealed that the boilers were equipped with inefficient burners, the boilers were rather remotely installed from the main steam consumer and long steam supply piping adversely affected energy efficiency. To improve the situation, the RECP team recommended to replace the boilers, and install new boilers closer to the main steam consumer.

Section 3.8 Onsite Reuse & Recycling

The RECP methods described above envisaged prevention and reduction of losses/waste. In this and following sections we will discuss reduction of losses with the methods of waste management.

One of such methods is onsite reuse and recycling of waste. This means use or recycling of waste by the enterprise for producing products. It should be mentioned that the RECP method does not mean recycling waste in other enterprise, treatment of wastewater, or burning organic waste.

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Typical examples of waste reuse and recycling are:

- Water recirculation
- Cascade wash or washing with backflow
- Reuse of washing substances
- Use of condensate waste heat
- Separated collection of raw material waste and returning into the process
- Returning raw materials, or interim products entrapped in air treatment system back to technological process
- Using raw material wrapping for wrapping output

For reuse or recycling waste it is necessary to use the method of separated collection. Besides, the use of such possibilities requires modification of production infrastructure.

Such measures are implemented in part of Georgian enterprises. For example, in some cases water recirculation in cooling systems, use of waste heat by means of thermal change, reuse of wrapping material and others are provided. However, there are more opportunities in this regard.

Case Study

Company Name	**Rusmetali LTD**	
Sector, size and location	The company operates a ferro-alloy plant in Rustavi City. The plant is specialized on silica-manganese production and produces around 20 thousand ton of this product. The ferro-alloy plant works in 24 hr mode, and about 400 people are employed there.	
Activity/ Initiative Taken	**Brief Summary** Raw materials used for silica-manganese production are manganese ore, coke, dolomite and quartzite. They are grinded and mixed in proper proportion, and the mixture is melted at 1560-1700°C with use of electric arch-furnaces to receive the product. The RECP team assessed resource effectiveness for the production process and recommended improvement measures.	
Business Case	***Category***	***Description and Justification***
	☐ *Cost savings* ☑ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	After implementation of the recommended measure the plant will be able to increase manganese recovery by 2,700 ton from the same amount of ore concentrate. This can increase company income by 550,000 USD. The measure does not require investment and only operation costs will increase.
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The recommended measure will increase energy consumption by 11.4 GWh/y and CO_2 emissions by 850 t/y. Though energy use and CO2 emissions per product unit will not change significantly. On the other hand, resulted slag will be more environmentally friendly.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☐ *Technology change* ☑ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	Technology of silica-manganese production used at the plant does not allow for full recovery of manganese from ore and about 15% of manganese ends up in the slag. Repeated smelting of slug can increase manganese recovery, reduce manganese content in slag to 3-5% and increase productivity.

Section 3.9 Useful Byproduct

In some cases use of waste on site is not possible; however it is possible to provide these waste to other enterprises as raw materials or byproducts. Such waste are called byproducts. Their typical examples are the following:

- Using water coming out of cooling systems for heating buildings or greenhouses
- Transferring slag for production of construction waste
- Using non organic waste in cement production
- Combusting waste produces in processing food products or their use for feed
- Using feather produced in poultry plant
- Use of manure from livestock farms
- Use of leather remained in slaughterhouses

In order to transform waste into byproducts, it is essential to implement the practice of separated collection. In some cases, this requires implementation of particular infrastructural measures.

In Georgia part of enterprises uses this method. However, often the problem is unavailability of the enterprises which use byproducts.

Case Study

Company Name	**Rusmetali LTD**	
Sector, size and location	The company operates a ferro-alloy plant in Rustavi City. The plant is specialized on silica-manganese production and produces around 20 thousand ton of this product. The ferro-alloy plant works in 24 hr mode, and about 400 people are employed there.	
Activity/ Initiative Taken	**Brief Summary** Silica-manganese production technology used at Rusmetali ferro-alloy plant generates 1.3 ton of slag per 1 ton of the product. The total volume of slag generated at the plant is around 27,000 m^3/y. This is solid waste for the company; however, the company management has found slag market and it is entirely sold to building material producers.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	The company received 14,000 USD per year from the slag selling. Besides, these measure enables the company to avoid slag disposal costs and improves its environmental performance
Environmental Benefit	**Category**	***Description and Justification***
	☐ *Materials* ☐ *Water* ☐ *Energy* ☑ *Waste* ☐ *Effluents* ☐ *Air emissions*	Slag selling reduces the amount of solid waste by 27,000 m^3/y at the plant.
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☑ *Useful byproduct* ☐ *Product modification*	Usually, slag from metallurgical plants is treated as a useful byproduct, as it can be used for the production of building materials (e.g. building blocks), or for road construction. The company has been able to find building material producers, which fully purchase slag generated from the silica-manganese production process.

Section 3.10 Product Modification

Last method of the RECP is the product modification. This method aims at changing the product the way to reduce environmental impact during the production process, consumption or disposal of given products.

General approach to the product modification implies product change, preservation, change of its composition, or shape in a way to enable:

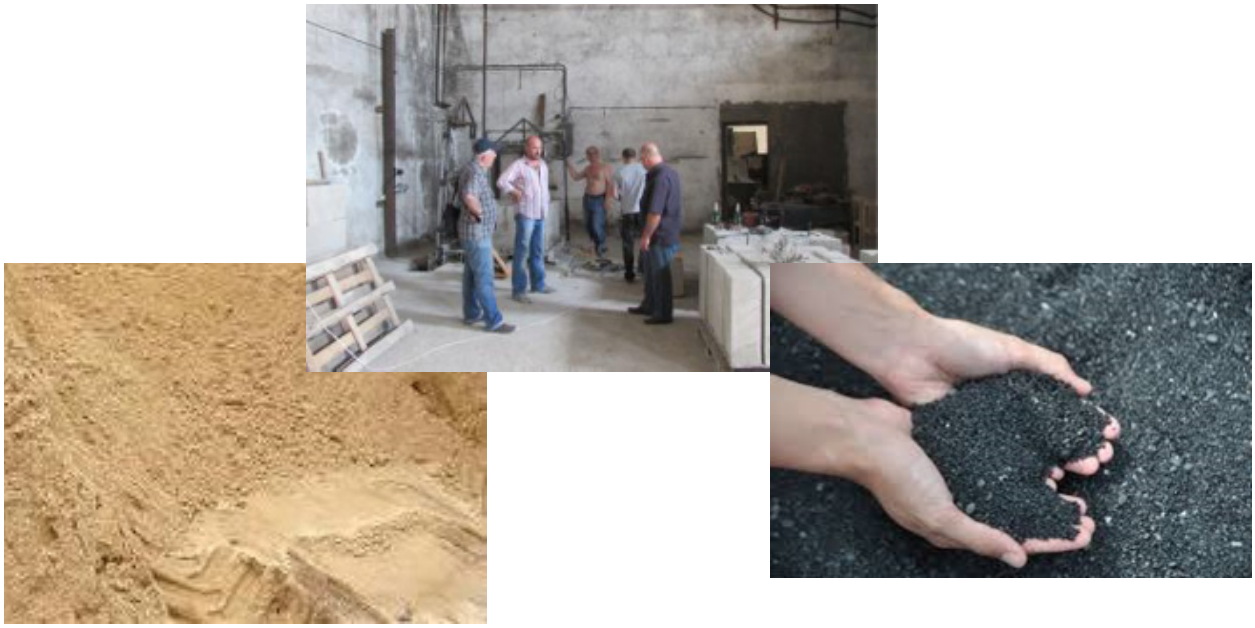
- Using less inputs during production
- Producing less waste in production process
- Using less water and energy during consumption
- Renewal, repair and recycling of product
- Optimizing shelf life
- Using of less hazardous materials for the production
- Saving of packaging materials
- Facilitate to transportation operations, etc.

The product modification might cut production costs, or save waste management and other environmental costs. However, acceptance of new product by the consumer might also become an issue.

In some cases modification of product helps entrepreneur in selling it. For example, we all prefer energy efficient washing machine or refrigerator; bicameral fridges are better than previous unicameral and so on. However, in other cases an entrepreneur may need to implement efficient marketing strategy to demonstrate advantages of modified products.

Case Study

Company Name	**LTD QB Construction**	
Sector, size and location	LTD QB Construction is a small size building material manufacturing plant, which is specialized on foam-concrete block production. The company is situated in Tbilisi City and distributes its products throughout Georgia. In total six persons are employed at the building material plant.	
Activity/ Initiative Taken	**Brief Summary** Foam-concrete blocks of QB Construction are made from cement, sand and foamier. By the time of the RECP assessment the company used yellow sand in the production process. Blocks made from this material are easily cracked during cutting process. The RECP team proposed to replace yellow sand with black sand to avoid cracking.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☑ *Productivity increase* ☑ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	Replacement of yellow sand with black one is a no cost measure, which can save 12,000 € per year on the operation cost, improve financial sustainability of the plant, improve product quality, and reduce solid waste.
Environmental Benefit	**Category**	***Description and Justification***
	☑ *Materials* ☑ *Water* ☑ *Energy* ☑ *Waste* ☑ *Effluents* ☑ *Air emissions*	The recommended measure can reduce defective products and waste at the company, what will reflect on the productivity of used resources (raw materials and auxiliaries, water, power).
Technique	**Category**	***Description and Justification***
	☐ *Good housekeeping* ☑ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	Yellow sand used for foam-concrete block production is relatively expensive, and replacement it with black sand can save over 12,000 € for the company without any investments. Though cheaper, black sand is more appropriate material for foam-concrete block production, as it makes blocks less prone to cracking during production process.



Moving Forward!

To summarize the implementation of the RECP methods can bring following benefits to the enterprise:

- Saving materials, water and energy
- Increasing output of used resources
- Reduction of production and product costs
- Improving product quality
- Reduction of waste and their management costs
- Improving labor conditions
- Improving motivation of the enterprise personnel and its engagement in the process
- Reduction of pollution of environment and improving environmental figures of the company
- Reduction of the risks of incompliance with the legislation
- Reduction of consumer's risk
- Improving organizational efficiency
- Improving image and competitiveness of the company
- Improving access to financial resources

We believe you'll agree that the list is quite impressive. Of course it could not be said that one measure will bring benefit to all directions; however several indicators could be improved simultaneously. In some cases the measures could be implemented with small expenses or even for free. Some measures might require big investments; however payback period is often short.

To illustrate the mentioned we provided several case studies on real enterprises in our country. These case studies clearly demonstrate the improvement potential in Georgian industry in terms of resource efficiency and potential benefits of the RECP implementation.

If we managed to persuade you at least slightly in benefit of the RECP approaches, make first steps to this direction. Start with the simplest projects, to test the methodology and obtain experience. By all means implement monitoring of implemented measures, to make sure in their efficiency. Remember, never be satisfied with your achievements, identify various oppor-