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Resource Efficient and Cleaner Production

Competitive Business - Cleaner Environment - Green Economy

Promoting RECP among Small and Medium Size Enterprises in Georgia

REPUBLIC OF SLOVENIA
GOVERNMENT OF THE REPUBLIC OF SLOVENIA

QeEB

Resource Efficient and Cleaner Production

Competitive Business - Cleaner Environment - Green Economy

Promoting RECP among Small and Medium
Size Enterprises in Georgia

Second Edition

TBILISI 2016

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)

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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, Moldova). The Programme in the beneficiary states has been implemented by international organizations OECD, UNECE, UNIDO and UNEP; 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. It describes main approaches of the RECP and benefits that the RECP can bring to enterprises. The Publication focuses on economic, environmental and other benefits that industrial enterprises can enjoy from the RECP implementation; case studies on real Georgian enterprises are delivered for more credibility. The case studies are based on the RECP assessments fulfilled in Georgian industrial enterprises in the frames of the RECP Demonstration Project in 2014-2015.

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 group of readers is deemed to be representatives of small and medium size businesses, which will be provided an opportunity to learn about the RECP methods, their application ways and potential benefits. We hope that this publication can change their vision of effective planning and management of production processes, resource saving and environmental protection. We also hope that the publication will give them incentive for the adoption of the RECP methods at their plants and thus promotes the green economic growth in Georgia.

Introduction

The green economy, protection of the environment and effective use of natural resources are the topic of the day to date. Economic growth and industrial development on one hand, and responsible consumption and production, preservation of natural resources, use of cleaner energy sources, mitigation of climate changes and maintenance of the life on the earth on the other hand are among the global Sustainable Development Goals of the United Nation's Sustainable Development Agenda adopted in 2015. In order to achieve global goals, governments of individual countries develop national action plans, introduce legal requirements and create other instruments that provide incentive for the sustainable economic development. The civil society is also interested in environmental protection and tries to contribute to the solving of existing problems with active engagements.

As an integral part of our society, entrepreneurs are also willing to protect the environment and make their plants the best in all aspects. They undertake certain measures to ensure legal compliance, though there are lots of other possibilities for the industrial sector to minimize environmental pollution and utilization of natural resources.

It should be acknowledged that many enterprises in Georgia need re-equipment and modernization and respective investment, sometimes quite considerable. Though, at the same time, it is rarely accentuated what benefits can reap the enterprise in return and that the implementation of some environmental measures can be financially profitable for enterprises. Most probably the lack of such information is the reason why entrepreneurs are cautious about environmental protection and have a concern that related costs might become a financial burden for them.

The purpose of this publication is to fill this gap and show to the reader benefits of some environmental measures and potential payoffs of the RECP implementation in particular. Besides, we will try to demonstrate that RECP techniques could be effective in Georgian reality as well and they are affordable in our country. Several case studies on Georgian enterprise are given 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. The information given in the publication may change your vision of own enterprise and make you think about financially attractive possibilities, which at the same time could be favourable in terms of the environmental protection and help you to obtain the reputation of a green enterprise.

Section 1 Competitive Business

Section 1.1 What is Resource Efficient and Cleaner Production

The sustainable use of natural resources and pollution prevention are the topics of the day all over the world nowadays. 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 industrial 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 aims at:

- ✓ The optimization of the resource use in enterprises;
- ✓ The minimization of environmental impacts; and
- ✓ The increase of human welfare.

The RECP is doing more with fewer natural resources and less pollution. The Resource Efficient and Cleaner Production methodology can help with:

- ➢ 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 are: how to save resources and reduce waste? How difficult is the implementation of such measures? Are financial resources necessary for their implementation? What is necessary other than financial resources to implement RECP measures? Or is every enterprise capable to fulfil such measures?

The following sections will shed a light on these issues. We would like also to highlight that the RECP envisages the planning and implementation of activities, which bring environmental benefits and is profitable for the enterprise at the same time. It enables to reduce production costs and improve product quality, thus increasing competitiveness of an enterprise.

The RECP techniques could be used at any enterprise, despite its size and type. Many large and small enterprises can gain considerable benefit if they apply this methodology and approach. However, the RECP implementation might be of special importance for small and medium size enterprises, as even small loses might significantly influence the production price and profit of such plants.

Section 1.2 Benefits of Resource Efficient and Cleaner Production

The RECP is an instrument that enables entrepreneurs to gain financial and non-financial benefits, and improve economic sustainability, competitiveness and image of their enterprise.

As the term 'Resource Efficient and Cleaner Production' indicates and already mentioned above, the RECP means the rational use of resources and reduction of losses during production. It is obvious that this should be ***economically profitable*** for the enterprise, since the implemented measures can:

- Raise the productivity of materials, water and energy consumed;
- Reduce production costs and net cost of products.

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

The RECP implies the upgrading and better control of production processes, which in some cases can also improve the product quality. In the following sections we give case studies clearly demonstrating such results. We believe that a high product quality is crucially important for entrepreneurs, since it influences ***the company image and sales***.

Lower production cost, higher product quality and better company image are the factors, which can increase your ***competitiveness*** on the market.

However, RECP benefits are not limited to the improved economic indicators only.

The effective use of materials, water and energy means ***fewer waste***, since fewer material will occur in waste, fewer water will be discharged into sewage pipes and fewer pollutants will be emitted into the ambient air. Of course this is beneficiary in terms of the environmental protection; though, entrepreneurs can gain equitable benefits, since:

- Reduction of waste means less expenditure on their management and disposal;
- Reduction of air born pollutants means less expenditure on air filters;
- Reduction of wastewater volume, or pollution level means less expenditure on effluent treatment.

In total the RECP methods enable the reduction of ***environmental impacts***. This means that after the RECP implementation, the enterprise could be able to:

- Demonstrate improved compliance to environmental standards and legal requirements;
- Reduce the risk for environmental pollution, violation of environmental standards and be fined for these reasons.

Improved environmental performance often brings ***better work conditions*** and ***reduces community health risks***. Again, this is not full list of benefits that enterprises can enjoy from the RECP. In particular the RECP can:

- Improve management system and organizational effectiveness;
- Increase the motivation of management team and entire personnel, facilitate to their engagement in the designing and implementation of RECP measures.

Finally, the RECP helps enterprises ***to attract finances and investments***, since they can:

- Demonstrate better financial performance and organizational efficiency;
- Demonstrate improved compliance to the environmental law;
- Increase compliance to environmental standards of financial institutions;
- Receive RECP focused loans and in particular loans intended for improved energy efficiency.

To summarize, ***the RECP is in close connection with the quality management of products and production process, environmental protection and occupational health and safety.*** The attractiveness of this approach is that in many cases significant pay back can be obtained with small investments; some measures do not need expenses at all and despite this, they can bring tangible results to enterprises.

Section1.3 RECP in Georgia – Existing Situation and Opportunities

The industrial sector is not well-developed currently in Georgia. Major part of existing enterprises is accommodated in old buildings and use obsolete equipment, which are not always properly maintained and repaired. Facility size and machinery capacity do not always fit to needs of particular enterprise. Therefore production processes are not optimized and increased consumption of energy, water and materials do occur.

The availability of resources adds to the above mentioned challenges. The lack and scarcity of local raw materials in Georgia make many manufactures dependent on the import. The country suffers energy deficiency as well, and energy carriers are expensive there. Water is more 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 enterprises in Georgia and create barriers to their effective operation and development. Implementation of the RECP will help enterprises in Georgia to overcome the above described challenges.

In 2013, UNIDO launched a four year Resource Efficient and Cleaner Production Demonstration Project in Georgia, which aims to increase the resource use efficiency and improve environmental performance of industrial sector and other establishments. Priority sectors identified for the Project are food production, chemical production and building materials production are priority sectors selected for the Project and 18 small and medium size Georgian enterprises of these sectors were assessed in terms of the RECP in 2014-2015. The RECP assessments showed that all three sectors have a significant potential to save resources and reduce environmental pollution; though, the most prominent are energy saving opportunities. In

particular, energy efficiency of individual production processes could be increased by 5-50%; these eighteen plants altogether can save about 12 GWh electric power and 275,000 m3 natural gas. The total investment required for such achievement is about 700,000 EUR, what can save about 750,000 EUR annually to these plants. The payback period of energy efficiency measures varies from several months up to 3 years.

The following sections of the publication provides case studies about Georgian companies assessed in the frames of the UNIDO Resource Efficient and Cleaner Production Demonstration Project so that to clearly demonstrate the possibility for RECP implementation in Georgia.

Section 2 Cleaner Environment

Section 2.1 Six RECP Issues

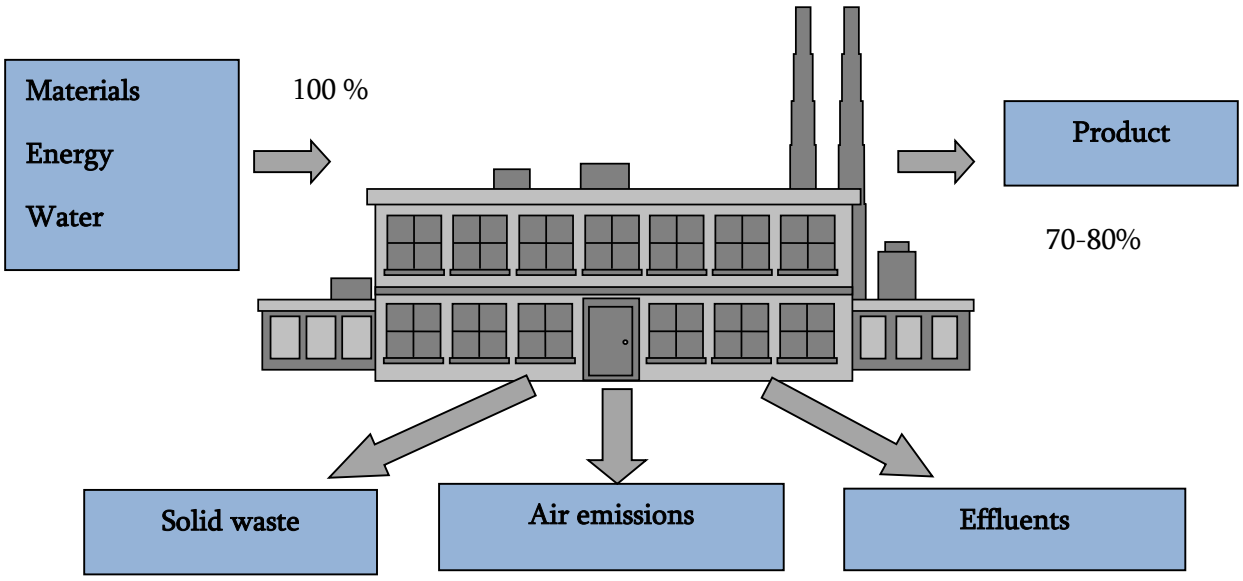
As already mentioned, the RECP aims at rational use of natural resources and pollution prevention.

Effectiveness of the resource use is assessed by materials, water and energy consumed per product unit.

And, the amount of waste, effluents and air born substances per product unit are used as the pollution indicator.

Measures implemented for the improvement of these six indicators could bring benefits both for an enterprise and the environment. The enterprise decides itself which measures to plan and to which direction. As a rule, the measures are planned taking into consideration particular challenges faced by the enterprise.

The enterprise can plan optimization in one direction out of the listed above; however, normally results of implemented measures reflect on other indicators as well. For example, if the enterprise manages to reduce losses of raw and auxiliary materials, this will automatically reflect on waste amount; the reduction of fuel consumption will reduce air emission of noxious substances; and optimization of water consumption usually reduces wastewater volume. The following sections contain case studies which describe specific benefits that RECP application can bring.



Section 2.2 Materials

Various raw materials such are inertial materials, ores, timber, etc. should be extracted from the environment to produce various goods. Therefore, their efficient use is important both for environmental protection and economic interests.

Raw and auxiliary materials (e.g. reagents) are important components, which affect the quality and cost of produced products. For a competitive production the enterprise shall ensure consumption of high quality raw materials and minimization of losses in production processes.

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

- The production costs is increased and competitiveness is decreased;
- Management and disposal of waste become complicated and respective expenditures increase;
- Environmental impact increases and increased 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;
- Processing of raw materials;
- Packaging of final products;
- Handling and storage of raw and auxiliary materials, and final products;

Thus, it is necessary to assess and optimize full production cycle to ensure that material losses are at minimum. This could be the change of transportation, handling and storage conditions, identification of opportunities the on-site reuse or recycling produced waste, improvement of production processes, etc.

The safety of materials, products and waste also matters together with efficient use. 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. Besides, 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 materials use

- Storing and transportation of materials and products in respective conditions;
- Proper management of material and product stocks;
- Change of the production technology;
- Improved control of production processes;
- Modification of products or packaging;
- Increasing of shelf life of manufactured product;
- Regular maintenance of machinery and equipment;
- Onsite reuse or recycling of industrial waste;
- Monitoring of the use of materials;
- Training of personnel and awareness raising.

Case Study

Company Name	**QB Construction Ltd**	
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 in the plant.	
Activity/ Initiative Taken	QB Construction makes foam-concrete blocks from cement, sand and foamier, which are mixed, molded and cut into blocks. The assessment of the production processes showed that the company wasted over 5% inputs due to the use of a hand-made block cutter machine. Therefore, it is necessary to procure a new, factory-made cutting machine to minimize block cracking during the cutting process.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☑ *Productivity increase* ☑ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	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	☑ *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, the 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	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☑ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The company needs 7,000 € investment to purchase a new block cutting machine. However, this measure 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 company can enjoy improved product quality.

Section 2.3 Water

Water and especially fresh water is the resource that significantly influences 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. Major portion of water resources is concentrated in the Western Georgia, whilst the demand is highest in the Easter Georgia. Besides, water availability is affected by pollution level as well.

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

- Degradation and deficit of water resources;
- Adverse impact on ecosystems;

Inefficient water user can create water availability issues 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 have significantly increased during last decade in the country, such enterprises have high expenses on water use.

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 both from the municipal system and own source, if water 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:

- ✓ Water bill;
- ✓ Electricity bill;
- ✓ Fuel cost;
- ✓ Expenditures for purchasing and maintenance of pumps;

- ✓ Cost for operation and maintenance of water treatment system;
- ✓ Use of chemicals and related expenses.

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 in future.

Measures for optimization of water use

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

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	Kula cannery uses water for washing of raw materials and bottles, as well as for washing and sanitation of production facilities and machinery. The annual water use of the company is 12,500 m^3, what is not so high. However, the RECP assessment of the plant revealed that water use per product unit is quite high and some simple measures were developed to reduce waster consuption in the company.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	The company requires ca. 2,000 € investment to ensure water saving, what can bring up to 600 € annual saving. The payback period for the investment is 3.3 years.
Environmental Benefit	☐ *Materials* ☑ *Water* ☐ *Energy* ☐ *Waste* ☑ *Effluents* ☐ *Air emissions*	The developed measure can help the plant to reduce water use by ca. 3,000 m^3 in a year. Wastewater produced by the plat will be cut by approximately same volume.
Technique	☐ *Good housekeeping* ☐ *Input change* ☑ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The RECP assessment of the plant showed that some water saving measure could be applied there to reduce waste use. In particular, with use of water saving taps and pressure nozzles the company can cut water consumption by approximately 25%.

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. Despite scarcity of energy resources, amount of specific energy needed to produce goods and services in Georgia is 2–2.5 times higher than in Western countries[1,2]. High energy intensity aggravates energy availability in our country. Besides, low energy efficiency increases environmental load.

Causes of energy losses in Georgian industry are as following:

- Depreciated facilities and machinery, operational parameters of which (size, capacity) often exceed needs of particular enterprise;
- Poor insulation of hot and cold systems, or absence of insulation;
- Lack of automatic control system for machinery;
- Operation of non-fully loaded machinery;
- Insufficient control of production processes.

Increasing energy efficiency is crucial both for the production sector and the country in overall. Taking into consideration low indicator of energy efficiency, there is significant potential to increase energy efficiency in Georgia and industrial sector in particular. According to surveys implemented by international organizations, Georgia can save up to 20% of energy and in particular approx. 1 TWhr power, 250 mln. m^3 natural gas and 1 mln. m^3 firewood if energy saving measures will be put in place[3]. Besides, Georgian enterprises can save 5-15% of energy at low or no cost and as a result, the industrial sector can save up to 18-54 million Euros. Medium and high cost measures can save up to 15-30% of energy consumed by the industrial sector that corresponds to 54 – 108 million Euros[4].

The RECP assessments undertaken in 8 enterprises in 2014-2015 within the frame of UNIDO RECP Demonstration Project has clearly demonstrated the mentioned opportunities. The assessment revealed that factually all eighteen enterprises suffered significant energy losses and various measures can increase their energy efficiency by 5 – 50%.

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.

Some international financial institutions operating in Georgia have energy efficiency loan schemes that offer relatively low interest loans to entrepreneurs to promote energy efficient measures in the production sector. Among such initiatives should be mentioned the program

[1] National report on the state of the environment of Georgia 2007-2009
[2] UNECE, Environmental Performance Reviews – Georgia, third review, 2016
[3] UNECE, Environmental Performance Reviews – Georgia, third review, 2016
[4] Markus Johannesson, Policies for RECP and CP in the Georgian Industry: Policy Scenario built on an ex-ante policy evaluation of the Georgian system for environmental protection, IIIEE Theses 2013:19, Lund, Sweden, September 2013.

Energocredit of the European Bank for Reconstruction and Development (EBRD), which supports sustainable energy projects in the Caucasus and in Georgia among others. Some of national banks including the Bank of Georgia, TBC Bank, Bank Republic, Basisbank, VTB bank and micro-financial institution Kredo are involved in implementation of this program. Besides, Procredit Bank has Eco-Credit program, which targets the same goal.

Measures for optimization of energy use

- Optimization of operation mode of machinery (e.g. pumps and engines) and provision of automatic control system;
- Installation of energy efficient machinery;
- Regular maintenance of machinery and equipment;
- Improved control of production processes;
- Provision of insulation of hot and cold systems and facilities;
- Regular maintenance of energy equipment (water boilers, steam generators, pipelines) and ensuring proper operation;
- Installation of energy sources close to energy consumers;
- The use of waste heat, for example, the installation of heat exchangers;

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	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 assessment of the plant showed that energy efficiency is low, and various feasible options exist to improve the situation. Among other measures 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 recommended good housekeeping measure 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	☐ *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 each year.
Technique	☑ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	During the RECP assessment attention was given the fact that stocks of inert materials are kept in open air and exposed to atmospheric precipitation. Due to this, drying and heating of wet inert material to prepare asphalt mixture required about 30% more energy. To solve this issue the company can implement quite a simple measure such is covering inert material stockpiles with a waterproof film in rainy days.



Section 2.5 Waste

On one hand, waste is the losing of material that the enterprise could not be able to transform into the product. And on the other hand, 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 to improve 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 lead to high losses of resources and their transformation into waste. These are:

- Supply of low quality, or improper materials;
- Inadequate conditions for transportation, handling and storage of materials and products;
- Insufficient control 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[5].

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

[5] United Nations Economic Commission for Europe. Environmental Performance Reviews: Georgia, Second Review, United Nations, New York and Geneva, 2010

Waste reduction measures

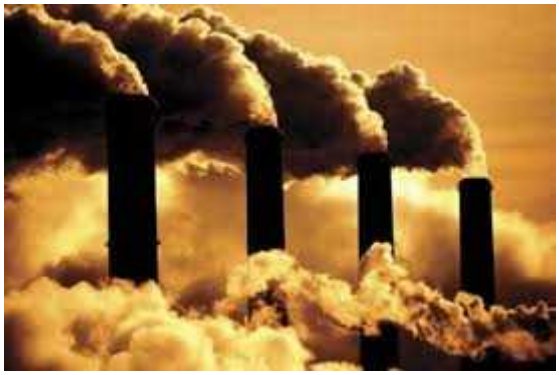
- Supply of proper materials;
- Improving the management of production processes and housekeeping practices;
- Onsite reuse or recycling of industrial waste;
- Segregated waste collection to enable reuse or recycling;
- Composting organic waste;
- Using waste as fuel;
- Training of personnel and awareness raising regarding waste prevention and minimization measures.

Case Study

Company Name	**JSC Kindzmarauli Corporation**	
Sector, size and location	The company is one of well-known wine producers in Georgia. It is located in Kvareli City, Kakheti Region which is distinguished with wine making. JSC Kindzmarauli makes around 15 brands of wine, which are sold on local and international markets. The company produces 5 million litters of wine each year.	
Activity/ Initiative Taken	For wine production, the company uses various sorts of grapes, which are grown in Kakheti Region. Grapes are crushed and pressed to produce juice for wine. As a result, around 950 ton of skins, rachis and seeds is generated. The company applies part of this organic waste in own vineyards to enrich soil, some are taken by local population, and residual is disposed on the municipal landfill. The company can compost organic waste to minimize the need for landfilling.	
Business Case	***Category***	***Description and Justification***
	☐ *Cost savings* ☑ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	Grape skins/rachis is organic waste, which could be converted into a byproduct, particularly into organic fertilizer. About 5,000 Euro is required to arrange a compost pit. The cost of obtained fertilizer will be about 3,200 Euro in a year, and the company will be capable to return the invested money in 1.5 years.
Environmental Benefit	☐ *Materials* ☐ *Water* ☐ *Energy* ☑ *Waste* ☐ *Effluents* ☐ *Air emissions*	The recommended measure can reduce waste by 85%. Besides, the need for the landfilling of organic waste will be eliminated.
Technique	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☐ *Technology change* ☑ *On site reuse/recycling* ☑ *Useful byproduct* ☐ *Product modification*	The company uses part of grape skins for soil enrichment in its vineyards. However, organic waste is of low value in this condition. Composting will convert is into high value fertilizer, which can really increase the productivity of vineyards. Besides, the company will be capable to sell excessive compost on local market.



Section 2.6 Air Emissions



In fact, the operation of any industrial enterprise entails emission of air born substances. The volume and type of emitted pollutants depend on production and housekeeping processes in a particular enterprise. Emission sources can be fuel combustion, bulk materials, chemicals supplies, production processes, housekeeping operations, ventilation system of facilities, etc.

Air emissions are regulated by the legislation in our country. Enterprises shall comply with air quality standards in order to avoid environmental pollution, and health effects for workers and local community. Separately should be mentioned about greenhouse gas emission, which among others include carbon dioxide and contribute to global climate changes.

Enterprises have to implement certain measures to avoid environmental pollution and meet legal requirements. For example, the enterprise might need air filters, high stack, 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 resources - materials, energy and water: lower efficiency of resource consumption lead to higher air emissions of pollutants. For example, 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; etc.

Of course, an enterprise cannot fully eliminate air emissions of noxious substances, through some resource efficiency measures can minimize them. 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 stack, or high capacity air filters.

Measures for reducing air emissions

- Improving energy efficiency, including optimization of combusting process, us
  gases and steam condensate;
- Using energy sources, which have less or less hazardous emissions;
- Regular maintenance of machinery and equipment;
- Improved control of production processes;
- Keeping chemicals in hermetic containers;
- Protection of bulk materials against wind and rain action;
- Training of personnel and awareness raising regarding proper use of machinery and materials/ chemicals.

Case Study

Company Name	**MnChemical Georgia Ltd**	
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 (MnO^2). 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	Main production processes at the plant include drying, grinding and reduction of manganese concentrate, followed by sewing and packaging. Majority of these processes are energy demanding, and owing to low energy efficiency they consume even more energy. Therefore, there is considerable energy saving potential in the plant. One of such opportunities is to recover waste heat of flue gasses that are released from the manganese reduction furnace. In such case, the company can cut about 11% of the natural gas consumed.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	The implementation cost of the designed measure is 8,000 €, while the company can save around 65,600 € each year and will be able to return the investment in 1.5 months only.
Environmental Benefit	☐ *Materials* ☑ *Water* ☑ *Energy* ☐ *Waste* *Effluents* ☑ *Air emissions*	The recovery of waste heat contained in off gasses of the reduction furnace can save about 192,000 m^3 natural gas each year and reduce direct emissions of CO_2 by 330 ton/year.
Technique	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☑ *Technology change* ☑ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The temperature of the manganese furnace' combustion chamber is around 990°C and high temperature off gases are released from the stack. The RECP assessment showed that waste heat contained in off-gases could be used for the concentrate drying process, what can significantly reduce natural gas consumption for this purpose. To achieve this, process flow chart should be changed. In particular, a pipeline that transports off-gases of the reduction furnace to the ore drying dram should be constructed.



Section 2.7 Wastewater

Production of wastewater in enterprises is associated with activities such as washing and procession of raw materials or semi-products, washing and sanitation of production lines and facilities, water use for housekeeping purposes, etc. According to international best practices, wastewater shall be treated to established standards before discharging to the environment or municipal sewage system, in order to avoid:

- Pollution of water resources and environment in general;
- Malfunctioning 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 spills uncontrolled;
- Washing and sanitation equipment is not water efficient;
- Washing process is not controlled, etc.

Wastewater treatment requires expenditures, which depend on the volume and pollution level of wastewater. Therefore, enterprises should be interested in reduction of the volume and pollution degree of wastewater, which will make possible for them to:

- ✓ Reduce water and electricity losses;
- ✓ Save chemicals used for washing and sanitation;
- ✓ Reduce wastewater treatment cost at enterprises which have treatment facilities;
- ✓ Reduce the risk to be fined for the incompliance with legislative requirements and environmental pollution.

It should be mentioned that provision of modern municipal wastewater treatment facility is planned for some large cities of Georgia. After implementation of these projects, industrial facilities will be required to pre-treat wastewater before release to the sewage system so that to prevent adverse impact on a municipal water treatment facility.

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

The measures for reducing wastewater volume and/or pollution level

- Implementing measures to prevent water losses;
- Water recycling, including the use of wastewater of one production process for another production process;
- Separated management of wastewater produced from different production processes;
- Recover waste heat in case of hot water discharge;
- Training of personnel and awareness raising regarding efficient use of water resources.

Case Study

Company Name	**Lagi Ltd**	
Sector, size and location	Lagi Ltd is a small size non-alcoholic beverage plant in Tbilisi. The main product of the company is a lemonade, which is made using traditional Georgian recipes and recipes elaborated by personnel. The plant produces 10-12 sorts of the lemonade, and annual production is over 1.5 million bottles.	
Activity/ Initiative Taken	The company makes the lemonade with use of liqueurs that are made from local fruit. Syrup that sweets the lemonade is prepared on site. Sugar solution is brewed to appropriate consistency for this purpose. After the brewing syrup is cooled with water. Practically clean cooling water is discharged directly into the sewage system, though it could be used for various purposes.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	About 2,000 $ is required to install a system (pipes, tank, pump) for collection and reuse of cooling water. This investment can save about 900 $ for the company, and its payback period comprises 2.2 years. However, the company can save more eventually, as the production volume is growing.
Environmental Benefit	☐ *Materials* ☑ *Water* ☐ *Energy* ☐ *Waste* ☑ *Effluents* ☐ *Air emissions*	The water recycling system can save ca. 500 m^3 in the bottling plant. The wastewater volume will be cut by the same value. The designed measure can reduce the water use by 10%, and wastewater discharge into the municipal sewer by 13%.
Technique	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	The plant uses quite expensive water supplied from the municipal system to cool syrup. The cooling system of the brewing kettles cannot recycle water and cooling water is discharged directly into the municipal sewer, though it is actually clean and could be readily used for various purposes, such are washing of the production line and facilities, etc. On the other hand, water discharged from the cooling system is warm and it would be preferable to use in processes where hot water is required (e.g. in the boiler). In such case, the company can save water and energy at the same time.

Section 3 Making it Happen

In previous sections we discussed about resource saving, pollution prevention and benefits of these measures for an enterprise. In this section we will provide brief information about the RECP methodology and techniques; provide general recommendations and case studies on Georgian enterprises. The information provided has a general character and does not comprises technical issues requiring special knowledge or experience.

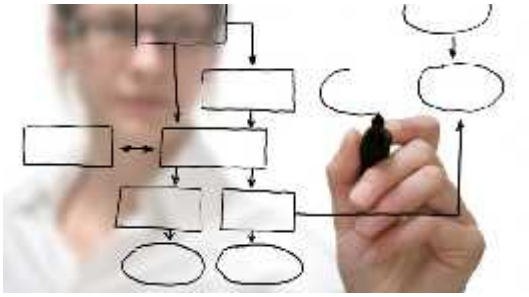
Section 3.1 Planning and Implementation of RECP

Planning and implementation of RECP measures envisages the following steps:

- **Establishment of a RECP team** – the team should comprise persons, who have good knowledge of technological processes of given enterprise, have access to information and authority to make decisions. An external expert could be engaged in the team to ensure unbiased assessment.

- **Initial assessment** – the RECP team should have a glance at all production processes, main and auxiliary facilities and housekeeping practices of the plant. In particular, the RECP team should record what kind of materials are used at each production site, what are their losses and where these losses occur, and identify problematic sites and issues based on these information.

  Some simple problems can be solved already at this stage. For example broken taps can be replaced and unnecessary lights can be switched off immediately, etc.



- **Identifying priorities** – Out of detected problems the RECP team should identify priority issues (for example energy, water) for further work. Priority identification should be based on the importance of this particular losses, complexity of problem solving, costs required for the elimination of issues, and potential results.

- **Detailed assessment** – at this stage the RECP team thoroughly investigates priority issues, in particular collects and analyses relevant data, assesses losses, studies causes of problems and develops solution options.

- **Feasibility study** – the RECP team selects most promising problem solution options and starts comprehensive assessment. In particular makes technical and economic feasibility analyses and chooses the best option for the implementation.

- **Implementation, monitoring and assessment of planned actions** – at this stage planned works are implemented. It is necessary to monitor obtained results in order to assess the effectiveness of implemented measures.

As you see, this scheme does not differ from the planning and implementation cycle of other projects. Thus, experience gained in other projects can help you and your team in implementation of the RECP projects.

Section 3.2 RECP Techniques and Definitions

Here we list 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 after the use.

Sometimes it is difficult to determine to which method does a particular measure belong to; however it does not matter how we call it, but results of its implementation are of 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 give a case study on each RECP method. We would like to mention that some of these methods might be well known for you, and you might already successfully used them for improving effectiveness at your enterprise.

Section 3.3 Good Housekeeping

All kinds of activities in the enterprise require the adherence to particular procedures and rules. Results of activities depend on effectiveness of determined procedures and their proper implementation by personnel. Incorrect procedures or their poor implementation can cause wasting of resources or products. The examples of such measures are as following:

- Organizing warehouse facilities and improving its management system to ensure proper storing conditions for materials and products, and use of materials until validity period expires;

- Record keeping on used resource and generated waste, and regular analyses of these data to timely detect and eliminate increased losses;

- Regular technical inspection of facilities and machinery to timely detect malfunctioning and related losses;

- Minimization of idly running and partly loaded operation of machinery to avoid energy losses;

- Separate collection of different waste types to make possible their reuse or recycling;

- Preparation and improvement of work instructions to establish proper procedures for each work type;

- Training of personnel to inform them about established procedures and their purpose;

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

It should be mentioned that in Georgia many enterprises do not pay much attention to measures that can lead to good housekeeping practices. Often the management of an enterprise does not assess possible losses of leaking water pipe, unnecessary lights, operation of partly loaded machinery, lack of record-keeping, untrained personnel, etc. Therefore, there is a great potential of improvement with this regard in 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	Among raw materials used for asphalt production is bitumen, which is heated to be added to sand and gravel mixture. The RECP assessment showed that about 7% of energy is lost because the bitumen transportation pipes do not have thermal insulation. Respectively, insulation of pipes can eliminate such a wastage.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	The measure recommended for the increasing of resource efficiency will cost 1,800 €, that can save around 7,350 €/y for the company. The payback period for the investment is about 4 months.
Environmental Benefit	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The recommended measure will enable the company to save 19,400 m^3 natural gas and15.8 MWh power each year. At the same time, this means cutting of CO_2 emissions by 40 ton/year.
Technique	☑ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☑ *Equipment modification* ☐ *Technology change* ☐ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	To produce asphalt, bitumen is heated at 150-160°C in the reservoir and then sent to asphalt plant via ca. 200 m long pipe. As the hot bitumen transportation pipes are not insulated, the company losses 7% of energy consumed for the asphalt production. Insulation of pipes is easy task and does not requires significant finances. The recommended measure can bring the company financial profit, and improve its environmental performance at the same time, as the company can save energy and reduce air emissions.

Section 3.4 Input Change

The next RECP technique is the input change that has the following objectives:

- Using materials that are 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 fuels;
- ✓ Reuse/recycling waste instead consumption of new materials, and among them utilization of wastewater and waste heat;
- ✓ Using less hazardous materials;
- ✓ Using local materials 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, an enterprise needs modification, or replacement of its equipment. The decision might be profitable for an 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 breakage. If an enterprise replaces it with better quality glass-ware, packaging losses and respective expenditure will be reduced. Besides, such change can improve product quality.

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

Case Study

Company Name	**QB Construction Ltd**	
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 in the plant.	
Activity/ Initiative Taken	QB Construction makes foam-concrete blocks from cement, sand and foamier. The RECP assessment showed that the company used yellow sand in the production process. Blocks made from this material are easily crack during cutting process. To avoid this, the company needs to replace yellow sand with black sand.	
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	☑ *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	☐ *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.

Section 3.5 Better Process Control

Better process control is essential precondition for reduction of losses. It envisages control and optimization of the production process flow and among them operation of machinery in order to avoid losses.

Better process control may comprise the following measures:

- Monitoring of production processes, including monitoring of operation parameters (pressure, temperature, humidity, flow, etc.);
- Keeping records on materials and wastes at different stages of the technological process to determine losses on each stage;
- Installation of water and electric meters for individual production processes and taking their records regularly to enable 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, additional measuring devices might be required for machinery to implement such measures. However, in most cases machinery are already equipped with such units and the enterprise might need just elaboration and implementation of respective monitoring procedure.

Improved control of the processes requires small or medium expenditures; however, it could bring significant payback, since provides opportunity for optimization of technological processes, proper control of machinery operations and rational use resources. In many cases, the implementation of such measures can improve the product quality.

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	Energy consumption is high at Kula plant. One of energy demanding processes at the plant is a sterilization. The RECP assessment implemented with the participation of the plant personnel identified that better control of the sterilization process can cut natural gas consumption by 1.5%.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☑ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	Better control of the sterilization process requires ca. 3,000 Euro investment. It allows the company to save around 2,200 Euro/year and pay the investment back in 1.3 years. This measure can improve the product quality as well.
Environmental Benefit	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	Suggested measure allows cutting natural gas consumption by 5,700 m^3/year. At the same time, CO^2 emission will be reduced by 10 ton/year.
Technique	☐ *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 pressure, and consumes significant amount of energy. To ensure food safety enterprises sometimes treat products at higher temperature, what means higher energy consumption for them. Therefore, optimization of the sterilization process is important for the food safety on one hand and avoidance of production losses on the other hand. To enable this, the company needs to install additional monitoring devices and keep records so that to maintain sterilization time, pressure and temperature at required values. The implementation of this measure will enable the company to cut energy consumption and improve the product quality.



Section3.6 Equipment Modification

Equipment modification means change of machinery and equipment in a way to ensure optimization of production processes and minimization of losses.

This RECP techniques considers measures such are:

- Optimization of production lines layout;
- Optimization of utilities, including water, power, natural gas and steam distribution and supply lines;
- Substitution of inappropriately high capacity machinery with necessary capacity units;
- Optimization of working parameters (temperature, pressure, speed) of production processes;
- Insulation of hot and cold systems;
- Equipping machinery with automatic control systems.

Such measures require small or medium expenditures in many cases and these often can bring significant payback in short term.

Poorly insulated boilers, steam pipes, cold units, etc. are common in Georgian enterprises. Besides, installed machinery are often higher capacity than it is necessary for a particular plant and cause significant energy losses. Consequently, there is big potential in our country for implementation of such measures and improving energy efficiency.

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	JSC Kula consumes significant energy in production and auxiliary processes. The RECP assessment of the production process revealed that modification of the steam system can 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 Euro, what can save around 23,000 Euro per year for the plant. The payback period for the investment is only about 3 years. Together with the financial benefit, new boilers can improve environmental performance of the company.
Environmental Benefit	☐ *Materials* ☐ *Water* ☑ *Energy* ☐ *Waste* ☐ *Effluents* ☑ *Air emissions*	The recommended modification of steam system can save 54,000 m3 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	☐ *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. Generated steam is used in various processes, including fruit concentrate production, sterilization, etc. The RECP assessment showed that the boilers were equipped with inefficient burners. Besides, they were rather remotely installed from the main steam consumer and long steam supply piping adversely affected energy efficiency. To improve the situation, the company needs to replace the boilers, and install new boilers closer to main steam consumers.



Section 3.7 Technology Change

Typical examples of technology change are as following:

- Substitution of machinery with energy efficient units, 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 washing and materials sorting processes;
- Using technology which enables waste reuse/recycling, for example waste heat recovery;
- Substitution of chemical treatment with mechanical processing;
- Substitution of oil cooling system with air cooling system;
- Using solar energy instead of fuel for water heating;

Technology change often requires procurement of modern machinery and high investments, with several years payback period. However, such investment significantly reduces operation costs of an enterprise.

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

Case Study

Company Name	**TMT Ltd**	
Sector, size and location	TMT Ltd is a small-size cannery in Kaspi City, which started operation in 2006 on the basis of an old, Soviet time plant. The company produces over twenty products, including jams, juices, ketchups, etc. and major part of these is exported to foreign markets. The number of its employees is up to 30.	
Activity/ Initiative Taken	The cannery processes locally grown fruit and vegetable to produce products. Raw material is sorted, washed, boiled, squeezed, etc. to make products. The RECP assessment of the plant showed that continuously flowing water is used to wash fruit and vegetable, and significant water resource is wasted due to this. Meantime, the installation of water recycling system and change of washing technology could improve the situation.	
Business Case	***Category***	***Description and Justification***
	☑ *Cost savings* ☐ *Productivity increase* ☐ *Product quality* ☑ *Organizational efficiency* ☐ *License-to-operate*	According to the assessment, the installation of washing water recycling system will cost about 1000 Euro. This measure can save up to 1,700 Euro per year, and the company can return the investment in halve a year.
Environmental Benefit	☐ *Materials* ☑ *Water* ☐ *Energy* ☐ *Waste* ☑ *Effluents* ☐ *Air emissions*	The recommended measure can save up to 960 m^3 water each year, what means that the plant will reduce water consumption by 20%. The volume of wastewater discharged into the sewer will be reduced by same amount.
Technique	☐ *Good housekeeping* ☐ *Input change* ☐ *Better process control* ☐ *Equipment modification* ☑ *Technology change* ☑ *On site reuse/recycling* ☐ *Useful byproduct* ☐ *Product modification*	Changing of washing technology and in particular adoption of three-step washing method is recommended for the plant. In such schemes, materials are washed with fresh water on the second and third steps, and washing water is transferred to the first washing step. The method is effective and can significantly cut water consumption. A water recycling system, in particular pipes, small tank and pump should be installed in the plant to enable the adoption of such washing method.

Section 3.8 Onsite Reuse & Recycling

The above described RECP techniques envisage prevention and reduction of losses/waste at the source. In this and following sections we will discuss the reduction of losses through reuse/recycling of generated waste.

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In particular, this RECP techniques implies onsite waste use or recycling. However, this techniques does not mean measures such are waste reuse/recycling in other enterprises, treatment of wastewater, or burning organic waste, etc.

Typical examples of onsite waste reuse and recycling are:

- Water recycling;
- Multistage washing, or washing with backflow;
- Reuse of washing solutions;
- Recovery of condensate heat;
- Collection of wasted raw materials, semi-products and defective products, and returning them into the production process;
- Trapping of raw materials or semi-products entrapped in an air treatment system and returning them back to a technological process;

  Using raw material packaging for packing of products;

Segregated waste collection method is necessary to enable reuse or recycling. Besides, the use of such possibilities may require modification of production infrastructure.

Some of enterprises in Georgia already use such measures. For example, they use water recycling in cooling systems, recover waste heat by means of thermal changers, reuse packaging materials, etc. However, there are much 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. It employs about 400 people.	
Activity/ Initiative Taken	Raw materials used in 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 assessment showed that the recycling of industrial waste can increase material productivity.	
Business Case	***Category***	***Description and Justification***
	☐ *Cost savings* ☑ *Productivity increase* ☐ *Product quality* ☐ *Organizational efficiency* ☐ *License-to-operate*	The company has opportunity to increase manganese recovery by 2,700 ton from the same amount of ore concentrate, and this will increase its income by 550,000 Euro. The measure does not require investment and only operation costs will increase.
Environmental Benefit	☑ *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 CO_2 emission per product unit will not change significantly. On the other hand, resulted slag will be more environmentally friendly.
Technique	☐ *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 onsite reuse/recycling of waste 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;
- Using slag for production of construction materials;
- Using inertial waste in cement production;
- Combusting organic waste from food processing industry, or use it for animal feeding;
- Using feather produced in poultry farm;
- Use of manure from livestock farms;
- Use of leather remained in slaughterhouses;

In order to transform waste into byproducts, it is essential to ensure segregated collection.Some enterprises successfully use this techniques in Georgia. However, often the problem is unavailability of plants which could process these 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. It employs about 400 people.	
Activity/ Initiative Taken	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	☐ *Materials* *Water* ☐ *Energy* ☑ *Waste* ☐ *Effluents* ☐ *Air emissions*	Slag selling enabled the company to reduce the amount of solid waste by 27,000 m^3/y.
Technique	☐ *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

The last RECP techniques is product modification. This techniques aims at changing the product in a way to reduce environmental impact during the production process, consumption, or disposal.

General approach to the product modification implies altering of product's composition or shape in a way to enable:

- Using less materials 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, marketing of renewed product might become an issue.

In some cases the product modification can help am entrepreneur in selling it. For example, we all prefer energy efficient washing machine or refrigerator; bicameral fridges are better than former unicameral, etc. However, in other cases an entrepreneur may need to apply efficient marketing strategy to demonstrate advantages of modified products.

Moving Forward!

To summarize, the implementation of the RECP techniques can bring following benefits to an enterprise:

- ✓ Save materials, water and energy;
- ✓ Increase productivity of consumed resources;
- ✓ Reduce production and product costs;
- ✓ Improve product quality;
- ✓ Reduce waste and related management costs;
- ✓ Improve labour conditions;
- ✓ Increase motivation of the enterprise personnel and engagement in the process;
- ✓ Reduce environmental pollution and improve environmental performance of the company;
- ✓ Reduce legal incompliance risks;
- ✓ Reduce consumer's health and safety risk;
- ✓ Improve organizational efficiency;
- ✓ Improve image and competitiveness of the company;
- ✓ Improve access to financial resources;

This list is quite impressive, is not it? Of course, it could not be said that single RECP measure can bring all above listed benefits; however, it may improve several indicators at the same time (e.g. increase material productivity and reduce waste, or increase product quality and organizational efficiency, etc.).

In some cases RECP measures could be implemented with small expenses, or even at no cost. Some measures might require big investments; however, payback period is often short.

To illustrate the mentioned we gave various case studies on real enterprises operating in our country. These case studies clearly demonstrate the improvement potential in Georgian industry in terms of resource efficiency on one hand and potential benefits of the RECP implementation on the other hand.

Hope that we managed to persuade you that the RECP can make your business more efficient and successful. If so, make first steps in this direction. Start with simplest projects to test the RECP approach and obtain experience. Ensure monitoring of implemented measures to make sure they are effective. And remember, never be satisfied with your achievements, identify various opportunities to improve your company and move ahead!

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