RESOURCE EFFICIENT AND CLEANER PRODUCTION CENTRE

RAISING THE RESOURCE EFFICIENCY OF COMPANIES AND ENTERPRISES IN VINNYTSIA AND KYIV REGIONS: THE RECPC BEST PRACTICES

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The catalogue contains examples of the best practices of Resource Efficient and Cleaner Production Centre (RECP Centre) in implementation of resource-efficient and cleaner production methodology at the industrial enterprises, institutions and organizations in Vinnytsia and Kyiv regions.

The publication is designed for managers, engineers of the enterprises, institutions and organizations; non-governmental organizations involved in energy saving and energy efficiency; technical specialists, and university students, who are committed to learn more about resource efficiency and cleaner production.

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CONTENT

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO is a specialized agency of the United Nations with the mandate to promote industrial development in developing countries, countries with transition economy and international industrial cooperation.

UNIDO was established in 1966, since 1985 it is a specialized member of the UN. The organization has 174 member countries, maintains a network of 29 branches in different countries and regions, and has 17 focal points. Central headquarters of UNIDO in located in Vienna (Austria), representative offices are in New York, Geneva and Brussels. Worldwide organization has an extensive network consisting of more than 50 national cleaner production centres, 19 departments to promote investment and technology transfer and 9 technological centres.

Management. The highest decision-making body of UNIDO is the General Conference, which includes 174 member countries. The Conference meets every two years and sets guidelines and policies of UNIDO, approves the budget and working programs. Every four years the General Conference appoints General Director, now it is Mr. Li Yong (China). There are also such management bodies as the Industrial Development Board (IDB) and the Programme and Budget Committee (PBC).

Financing. Basic UNIDO budget includes personnel costs and operating costs and is formed from the contributions from member countries. Programmes and projects are financed mainly by voluntary contributions from donor countries and agencies, and multilateral funds.

International staff. UNIDO has more than 840 full-time employees working in central headquarters in Vienna, in fillies and representative offices; annually about 1,700 international and national experts are also attracted.

International activity. UNIDO promotes increasing the competitiveness of industrial countries, contributing to economic growth, poverty reduction and achievement of Sustainable Development Goals.

UNIDO activities are aimed at improving the quality of life of the poor in the world, using its global resources and experience in three interrelated areas:

- fighting poverty through production activities;
- development of trade potential;
- energy saving and environmental protection.

UNIDO has developed and introduced to the global community several concepts and is leading organization in their implementation in regions of the world, in particular:

- Green Industry Concept, aimed at more efficient use of natural resources and implementation of cleantech, which means making business with the principle “creating more value with less impact”;
- Resource-efficient and cleaner production Concept, an integrated UNIDO-UNEP approach, aimed at improving production efficiency through more efficient use of material resources, replacing outdated technologies on energy and ecological more efficient ones, minimizing waste.

UNIDO, based on its more than 40-years experience, provides member countries pervasive and comprehensive services, combining operational, analytical and regulatory activities both on the global and local levels.

INFORMATION ABOUT RESOURCE EFFICIENT AND CLEANER PRODUCTION CENTRE

Resource Efficient and Cleaner Production Centre (RECP Centre) was established in 2013 within the framework of the United Nations Industrial Development Organization (UNIDO) resource efficient and cleaner production programme. The project is funded by the Swiss Confederation and the Republic of Austria. Swiss Confederation in Ukraine is represented by Swiss Cooperation Office in Ukraine.

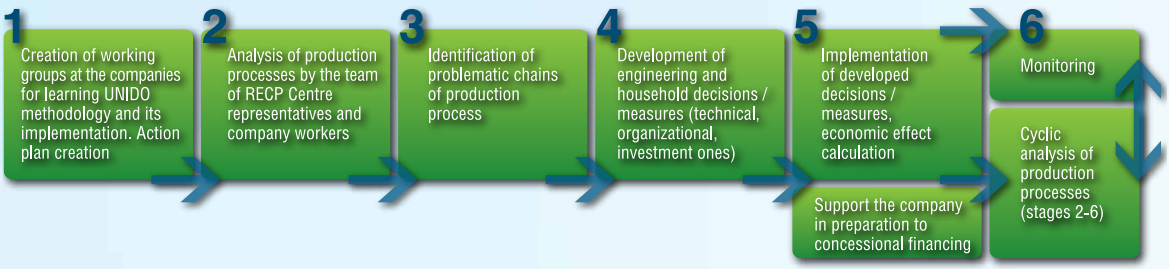
The objective of the Centre establishment is to improve resource efficiency, competitiveness of Ukrainian industry and reduce its environmental impact.

Project activities are aimed at implementation of UNIDO cleaner production methodology for providing all necessary tools for sustainable development of national industry. This allows national enterprises to meet national and international quality and environmental standards.

RECP Centre transfers its experience and supports the enterprises to:

- Create a team from the staff of the company, which constantly and systematically will use UNIDO methodology at different levels of production, realizing the goals, objectives and benefits of resource efficiency.
- Learn the way of material and energy balances creation, which allow identifying and assessing problem areas using an integral approach.
- Calculate explicit and implicit losses/costs of input materials.
- Evaluate the effectiveness of processes and equipment, the potential of the company development.
- Develop solutions for technical and technological problems with different kind of complexity.
- Raise awareness of the employees about simple and effective methods, helping to reduce the production expenditures.
- Prepare documents for concessional financing for new technologies and equipment implementation.

MAIN STAGES OF COMPLEX TECHNICAL AUDIT FOR THE COMPANY:



Further the examples of raising resource efficiency at the companies are presented, based on the results of the work implemented in 2013 at the enterprises of Vinnytsia and Kyiv regions.

PROPOSED TECHNICAL DECISIONS FOR ENHANSING RESOURCEEFFICIENCY AT THE COMPANIES OF DIFFERENT INDUSTRIES

METALL PROCESSING SECTOR:

1. GAS CUTTING PLANT

COMPANY DESCRIPTION

This company is specialized in metal sheet cutting and processing. The business produces coppers and boilers for households with a power rating of up to 600 kW and gas torches and gas fired burners for metallurgical processes in metal processing industries like melting and heating with a power rating up to 17 MW. The company has 120 employees, processed 140 tons of metal and consumed 108 MWh of electricity, 960 MWh of gas, and 4'500 m^3 of water in 2013.

PROCESS DESCRIPTIONS

The applied process to cut metal sheets is based on the use of a gas flame melting the metal as shown in Figure 1. This type of cutting results in considerable losses of metal, high consumption of gases mixture and negative impacts on the environment and human health. This type of cutting also requires specific handling efforts with regards to adjustments, finish grinding and other processing of parts because of low accuracy.

The enterprise has a complex 400 kVA electric substation. Gas is supplied to the enterprise from a medium pressure gas pipeline. The heating and hot water supply system is based on their own gas-and-solid fired boiler.

The enterprise is equipped for a complete machine-building cycle that includes: bridge cranes and equipment for shearing, bending, conventional forming, turn-milling, welding, and metal painting. Overall a total of 137 units of equipment exist on site.

TASKS FOR ENHANCING RESOURCEEFFICIENCY OF THE COMPANY:

- Reduction of metal losses;
- Rust output reduction (dust and aerosols);
- Substitution of outdated technology equipment used in technological processes (removing liquid gas, flame gas cutting plant replacement);
- Reduction of smoke and dust emissions to reduce negative environmental impact;
- Improvement of working place conditions through essential reduction of metal vapours (chromium, nickel etc.)

OPTIONS AND IMPROVEMENTS:

Good housekeeping and low priced measures:

1. Installation of an automated utility metering system (3'500 EUR CAPEX), that allows to save 10% of electrical energy (-10,8 MWh/y).
2. Installation of a 120 kW wood-fired boiler, manufactured by the enterprise itself. It allows replacing consumption of 22'000 m^3 of natural gas with 54 tons of local wood.

Metal cutting installations: Replace outdated metal sheet cutting installation with a fibrous ytterbium laser. This allows decreasing work efforts by 30-35% and reduces waste and necessary improvement steps due to deviations by 5-8% of processing time. Modern equipment introduction results in a reduction of CO_2 emissions of about 70 tons CO_2/y. Reduction of metal waste from melted metal drops is estimated to about 600-750 kg/y

COSTS AND BENEFITS OF PROPOSED MEASURES

MEASURES	FINANCIAL			ENVIRONMENTAL	
	Investments [€]	Savings [€/y]	Payback [y]	Energy [MWh/y]	Material [Units/y]
Good housekeeping and low priced measures	3'500	1'000	3,5	-10,8	0
	5'000	4'400	1,1	-220	-22'000 m^3 of gas +54 tons of wood
Metal cutting installations	161'000	54'200	3	-955	-12 tons of metal
TOTAL	169'500	59'600	3,5	1'185	See above

FINANCING

For larger investments third party funding might be needed. The RECPC is well aware of the requirements of financial institutions for project financing. In this case third party funding from financial institutions of 100'000 € has been sought.

2. SEAL-LOCKING DEVICES PRODUCTION

COMPANY DESCRIPTION

Main production of the company is seal-locking devices and self-closing load-gripping devices, grappling hooks, screw bolts, plugs, rack and pointing connectors, choke relays, scissors for cutting rope and wire, sealers etc. In general production line consists of over 50 articles. There are 332 workers at the company. In 2011 the company processed 1'135 t of rolled steel, consumed 1'422 MWh of electricity, 201'100 m^3 of natural gas and 7270 m^3 of water.

PROCESS DESCRIPTION

Main type of production is seal-locking devices (90%). Housings are made by turning circles on automatic six spindle machines. Housings are covered with a protective layer and labelling is applied. This technology leads to significant losses of rolled metal and negative environmental impact as a result of misuse of zinc, energy loss from not insulated equipment, water overconsumption.

Main type of production is seal-locking devices (90%).

Natural gas is supplied to the enterprise by gas pipe line and is used in own boiler house for heating system and hot water supply.

The company has equipment for full production cycle, including crane bridges and equipment for cutting and bending, static stamping, turning and shaping, welding and dyeing of metal.

GOALS OF THE RECP PROJECT:

- Reducing rolled metal consumption;
- Reducing water consumption;
- Reducing energy losses in galvanic shop and negative environmental impact (reducing vapour and dust emissions).

OPTIONS AND IMPROVEMENTS

Low-cost measures:

1. Administrative measures, such as close shower when not needed, and installation of shower heads, aerators, water flow limiters, and dual flush systems in the toilets. This will allow to save annually 1'800 m^3 of water and about 4'000 m^3 of gas (saving on heating water for shower).
2. Water use in galvanic shop can be reduced by 20% due to optimization of the cascade rinsing and installation of rotameter designed to lower water consumption.
3. Reducing energy consumption in galvanic shop may be done by insulation of degreasing baths, where almost 18 MWh/year of electricity is lost to heating and evaporation of badly insulated baths.

Measures requiring investment:

Significant steel share (42%) is lost due to imperfect technology of seal-locking devices production. Replacing the technology of housings for seal-locking devices production can give the opportunity to save 4 million grn./year.

COSTS AND MEASURES OF PROPOSED MEASURES

MEASURES	FINANCIAL			ECOLOGICAL	
	Investments [€]	Savings [€/y]	Payback [y]	Electricity [MWh/y]	Material [Units/y]
1. Reducing water consumption sanitary-hygienic purpose	350	1'050	0,33	0	1'800 m^3 of water, 4 000 m^3 of natural gas
2. Reducing water consumption in galvanic shop	170	300	0,56	0	300 m^3 of water
3. Reducing energy consumption in galvanic shop	30	1'350	0,02	17,98	0
4. Reducing consumption of rolled steel	500'000	333'400	1,5		415 t of steel
TOTAL	500'550	336'100	1,49	17,98	See as above

FINANCING

Other measures that need bigger investment must be financed by a third party. RECP Centre is fully aware of financial institutions requirements for project financing. In this case there is the possibility of obtaining concessional loan in the amount of 500'000 €.

MECHANICAL ENGINEERING INDUSTRY:

STAMPING AND FORGING TECHNOLOGIES

COMPANY DESCRIPTION

The company specializes in the manufacturing and general maintenance of railroad cars. The company employs more than 350 workers. The amount of metal treated can exceed 25'000 t/y. Power consumption is 10'000 MWh/y, natural gas consumption is 2'408'000 m^3, liquid oxygen consumption is 994 t, CO_2 consumption is 466 t, paint consumption is 190 t, water consumption is 183'457 m^3.

PROCESS DESCRIPTION

Key technological processes during fabrication for cars maintenance involve forging, hot die stamping, cold stamping, bending and cutting. For all these mentioned processes details are heated in chamber and spectacle furnaces. Gas from the factory gas-distributing unit comes to the shop, where it is burned in seven chamber and 6 spectacle furnaces. The process of heat treatment of details has periodical basis, and flue gases are emitted without utilization into the atmosphere. Gas cutting equipment is used for metal cutting. This results in a significant loss of metal, high consumption of oxygen, natural gas and negative environmental impact and influence on human health.

GOALS OF THE RECP PROJECT:

- Reducing natural gas consumption;
- Reducing negative environmental impact (reducing hazardous chemicals and greenhouse gases emissions).

OPTIONS AND IMPROVEMENTS

Low-cost measures:

Furnaces of the shop are operating on a periodical basis. Every working day natural gas is spent on heating furnaces to operating temperatures. These losses can be reduced if furnaces work non-stop. For example, continuous operation of chamber furnace for 5 days a week, followed by a break in the work, will allow reducing natural gas consumption for 83'000 m^3/year.

Measures requiring investment:

1. As a result of the introduction of induction heating installations, spectacle gas furnaces will be taken out of service. The volume of reduction of natural gas consumption will be 54'054 m^3/year. Total investment for installation with the capacity of 60 kW is estimated to be 14'000 euro.
2. Heat recovery of flue gases for heating the air in chamber furnaces will reduce gas consumption and greenhouse gas emissions. Total investment is estimated to be 129'000 euro. This will save 110'000 m^3 of natural gas, leading to reduction greenhouse gas emissions by 208 t CO_2/year.
3. Replacement of old gas cutting equipment for plasma cutting equipment will allow not only reducing energy consumption (104'000 m^3 of gas), but also reducing time for metal processing and reducing metal and oxygen consumption (891 t). Total economic impact of the introduction of plasma cutting is estimated to be 47'000 euro/year.

Table 1 summarizes the financial and ecological production parameters of proposed technical solutions and options.

COSTS AND MEASURES OF PROPOSED MEASURES

MEASURES	FINANCIAL			ECOLOGICAL	
	Investments [€]	Savings [€/y]	Payback [y]	Natural gas [thousand m^3/y]	Materials/ CO_2 emissions [units/y]
1. Optimization of working schedule	0	26'000	0	83	0
2. Inductive heating	14'000	20'000	0,7	54	-29 MWh of electricity
3. Heat recovery	129'000	36'000	3,5	110	
4. Plasma cutting	70'000	47'000	1,5	104	891 t O_2 metal – N/A
TOTAL	213'000	129'000	1,7	351	See as above

FINANCING

Other measures that need bigger investment must be financed by a third party. RECP Centre is fully aware of financial institutions requirements for project financing. In this case there is the possibility of obtaining concessional loan in the amount of **213'000 €.**

STAMPING AND FORGING TECHNOLOGIES

COMPANY DESCRIPTION

The analyzed company produces construction materials, in particular, assembled reinforced concrete constructions, commercial concrete, construction bricks, blocks, ready-mixed mortar, perlite and perlite bricks. The production capacity is 58'000 m^3/y of finished products and the company employs 470 persons. In 2011 28'100 m^3 of commercial concrete, 17'600 m^3 of assembled reinforced concrete and about 12'000 m^3 of construction bricks, blocks and commercial solution were produced. For that 3'082 MWh of electricity, 10'000 MWh of gas and 12'900 m^3 of water were used in 2011.

PROCESS DESCRIPTION

The technological process of reinforced concrete constructions production includes dosing and mixing of dry components in a concrete mixing machine, damping of concrete, addition of special additives, mixing in damp condition and supply to casting mold or to mixtures (commercial concrete). During these processes 17'300 t of concrete, 36'800 t of sand, 52'700 t of road metal, 1'300 t of ash, about 300 t of additives and 12'900 m^3 of water are processed per year. To reinforce the concrete a welded reinforcing cage is installed in the mold, concreted and consolidated, after this a final thermal treatment with steam is applied to finish the product.

Picture 1: Dosing system, mixing machine and casting mold

The electricity (3'082 MWh/y) is mainly consumed by electric motors in concrete mixing machines, compressors and other electric equipment. Most of the gas (not considering perlite production) is consumed by boilers for steam production to finish the concrete products – 0,37 MWh/m^3 of concrete, which is two times higher than global benchmarks. In total 10'000 MWh/y of gas is spent for production purposes. Significant water usage (12'900 m^3/y) is explained by the lack of a closed consumption cycle, losses from pipe line sand equipment due to non-watertight connections, excessive consumption in the process of concrete production, as well as the lack of measuring equipment for production processes.

GOALS OF THE RECP PROJECT:

To improve the plant's efficiency the following main objectives for the analyzed processes were identified with the management:

- Reduction of water consumption;
- Reduction of condensed air losses;
- Reduction of gas consumption;
- Reduction of electricity consumption;
- Reduction of irrevocable losses in the process of concrete manufacturing.

OPTIONS AND IMPROVEMENTS

Low cost measures:

1. Repair of pipelines and replacement of insulation and leaking valves, and a periodic maintenance will allow saving of 10% of water and up to 20% of condensed air.

Investing required measures:

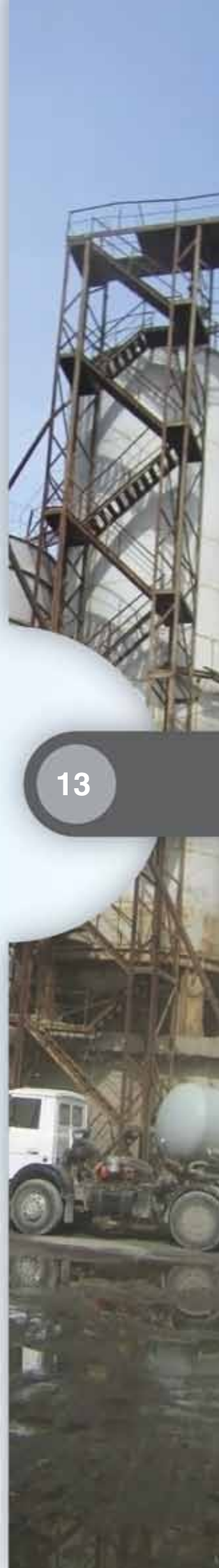
2. Use of distributed sources of heating instead of one remote boiler – i.e. thermal generators of hot moisture laden air with total capacity of 1 MWt, which will allow reduction in gas consumption by 46%.
3. Introduction of an automated system of commercial measurement of power consumption and installation of frequency convertors on motor drives and partial replacement of drives will allow reduction of electricity consumption by 25%. The introduction of a reacting power compensation system will allow reducing its consumption by 50%.
4. Repair and replacement of equipment in handling, storage, transportation and dosing sectors will reduce concrete losses and allow saving of about 10% of concrete per year.

COSTS AND BENEFITS OF PROPOSED MEASURES

MEASURES	FINANCIAL			ENVIRONMENTAL	
	Investments [€]	Savings [€/y]	Payback [y]	Energy [MWh/y]	Material [Units/y]
1. Repair and maintenance of pipelines (low cost measures)	500	550	0,9		1'200 m^3 of water
	750	2'500	0,3		300'000 m^3 of condensed air
2. Use of thermal generators	46'000	153'000	0,3		460'000 m^3 of gas
3. Introduction of automated system of commercial measurement of power consumption, installation of frequency convertors, introduction of reacting power compensation system	65'000	62'800	1,0	740 + 1'005'000 kVAr of reacting power	
4. Repair and replacement of equipment for concrete transportation	74'000	102'700	0,7		1'730 t of concrete
TOTAL	186'250	321'550	0,6	See above	See above

FINANCING

For larger investment, namely 185'000 €, third party loans are needed. The RECPC is well aware of the requirements of financial institutions for project financing.



PAPER PROCESSING SECTOR:

CARDBOARD PACKAGING COMPANY

COMPANY DESCRIPTION

This company is specialized in corrugated cardboard packages production. The installed capacity is 70 million m^2/year of corrugated cardboard (41 kilotons/year). The company has 300 employees, processed 160 million m^2 of cardboard, 116 million m^2 of paper, 780 tons of starch, 70 tons of flexographic paint, 30 tons of PVA adhesive and consumed 4'500 MWh of electricity, 9'200 MWh of gas, 3'100 MWh of steam, produced from a nearby heat and power station, and 50'800 m^3 of water in 2011.

PROCESS DESCRIPTION

The enterprise has 2 corrugators, a gluing line with gluing machine, 2 cutting and 4 nibbling machines (2 for rotary cutting and 2 for flat cutting), a painting line with painting aggregate, 1 big shredding machine, number of smaller shredding machines and a modern boiler plant with 5,2 MW gas-fired-boiler (8 tons/h steam capacity, 1,8 MPa maximum pressure, 210 °C maximum temperature).

The manufacturing processes were conducted in three shifts, so that they have at least 3 stops during every 24 working hours. The company used to change the orders during these 3 stops, so that was the reason they used to discharge almost all the materials that didn't reached the end of the production process.

GOALS OF THE RECP PROJECT:

- Reduction of paper waste and energy (gas) consumption;
- Reduction of paint losses;
- Glue usage reduction.

OPTIONS AND IMPROVEMENTS:

Low cost measures:

1. Cutting process optimization, i.e. cutting process optimization and transition to system of accounting in kilos, instead of square meters, which is accepted in international practice and reorganization of the operating shifts with minimal changes of orders (no investments needed), that allows to save 1'800 tons of paper and cardboard and 670 MWh of gas, from corrugated cardboard boxes production per year.
2. Use of potato-starch instead of corn-starch allows saving 3 tons of additives.

Investing required measures:

3. Use of modifying additives: starched paste modification by modifying admixtures, for example, by the hydrophobic admixture of CP-88* (solid residual for 3-side cardboard production will be reduced in this case from 15-18 g/m^2 down to 12-14 g/m^2). This leads to a reduction of glue consumption of 20% (savings of over 12'500 €/year).
4. Use of additional aniloxes and use of paint adjustment equipment: reduction of waste paint of at least 20% (will result in savings of 50'000 €/year)
5. Substitution of PVA adhesive by hot-melt glue: acceleration of gluing process, increase of case-hardening and reduction of defects and waste.

COSTS AND BENEFITS OF PROPOSED MEASURES

MEASURES	FINANCIAL			ENVIRONMENTAL	
	Investments [€]	Savings [€/y]	Payback [y]	Energy [MWh/y]	Material [Units/y]
1. Cutting process optimization	0	380'000	0	670	1'800 tons of paper
2. Use of potato-starch	0	12'500	0	0	3 tons of additives
3. Use of modifying additives	20'000	12'500	1,6	0	78 tons of glue
4. Use of additional aniloxes and paint adjustment equipment	120'000	50'000	2,4	0	13,3 tons of paint
5. Substitution of PVA adhesive by hot-melt glue	10'500	3'300	3,2	0	27 tons of glue
TOTAL	150'500	485'300	0,31	670	See above

FINANCING

The company has no need of external funding. The RECP-options are realized by the company using its own resources and at its own expense.

TEXTILE SECTOR:

WOOL MANUFACTURING

COMPANY DESCRIPTION

This cloth factory produces wool-blended fabrics for shawls, scarves, pure- and half-woolen plaids, blankets, footwear and fabrics for work clothes for the metallurgical and chemical industry, and provides services on manufacturing wool fabrics and products from clients' materials.

Annual production amounts to **700'000 m²** of wool-blended fabrics. Weight of input materials used amounts to **411 t** annually with total cost of **3,8 mln grn.**; the factory consumes **1'636 MWh/y** of electricity for the amount of about **1 mln grn.** and waste amounts to **63 t/y** with total costs of **300'000 grn.** The factory uses **3'183 m³/y** of water from town water supply system and **36'571 m³/y** of technical water from the company's water intake on the Ros' river.

PROCESS DESCRIPTION

During technological process sheep wool undergoes a three stage cleaning process with detergents with a wool temperature regime from 20 to 540 C, drying and carbonizing process for plant substances destruction (hay or straw residues). A centrifuge is used for wool dyeing, where chemical dyes and fixing agents (acetic acid) are supplied under pressure, chemical fibres are added and thoroughly mixed up in a so-called Kozlov machine. For manufacturing of various types of fabrics after being conveyed through carding machines threads of 4-10 class are manufactured of fore yarn and fabrics procurement is done on weaving machines. Fabrics may be saturated with fire-proof or chemically stable agents. All fabrics undergo secondary washing and drying; after being conveyed through a packaging workshop all fabrics are delivered to the finished products warehouse.

Energy resources are used in all production processes: In 2013 601'908 m³ of natural gas (62% of energy costs) and 1'636,37 MWh of electricity were consumed (37% of energy costs; other 1% goes for diesel and gasoline).

From the 39'754 m³ of water used annually 6'600 m³ of water is used for wool washing, 10'301 m³ for steam production, 19'670 m³ for technological processes (fabrics dyeing and washing) and the rest, 3'183 m³ for household needs of the company.

GOALS OF THE RECP PROJECT:

- Reduction of natural gas and electricity consumption;
- Increase of the energy efficiency through reduction of water use and more efficient treatment;
- Obtaining of thermal energy from waste products (briquettes) to substitute fossil fuels.

OPTIONS AND IMPROVEMENTS

No and low cost measures:

1. Dust from fabrics manufacturing presents dehydrated vegetative organics, which may be used as fuel. Thus, it is feasible not to dispose it as waste spending the money but to combust it in the existing oven and receive thermal energy.
2. Measurement of used energy resources is done in the whole factory only with input consideration; the factory exceeds electricity consumption by 5-6%. Installation of automated system of commercial measurement of power consumption will decrease electricity consumption.
3. Insulation of 4 baths in wool washing workshop with foam plastics will reduce heat loss and will save 7'465 kWh of electricity.
4. Returning condensate into boiler will reduce chemically treated water consumption and gas consumption used for water heating from environmental temperature to condensate temperature and save 7'400 m³ of gas.
5. 34% of water is lost through evaporation. Casing installation above the baths will allow decreasing the necessity of fresh water supply into baths and reducing associated costs.

COSTS AND MEASURES OF PROPOSED MEASURES

MEASURES	FINANCIAL			ECOLOGICAL	
	Investments [€]	Savings [€/y]	Payback [y]	Electricity [MWh/y], Gas [m³/y]	Material [Units/y]
1. Use of dust from fabrics manufacturing as fuel briquettes	0	2'584	0	0	30 t of waste
2. Installation of automated measurement system of power consumption	660	3'426	0,2	82 (electricity)	0
3. Insulation of baths for wool washing	190	501	0,4	7'465 (electricity)	0
4. Return of condensate from a drying machine in wool washing workshop	100	1'610	0	7'400 (gas)	N/A
5. Installation of casing above the baths	218	122	1,8	0	1'153 m³ of water
TOTAL	1'168	8'243	0,14	7'547 (electricity) 7'400 (gas)	See above

FINANCING

The company has no need of external funding for the identified measures. The RECP-options may be realized by the company using its own resources and at its own expenses.

FOOD PROCESSING SECTOR:

SUGAR PLANT

COMPANY DESCRIPTION

This company is specialized in sugar production. The annual production is 10'800 tons of sugar. The company also produces heat energy, electricity, lime carbonate, treacle and pulp. The company employs150-200persons, processed 2'016 tons/day of sugar beets, produced 2'668 MWh of electricity and consumed 43'728 MWh of gas and 228'600 m^3 of water (225'300 m^3 for technical purposes, i.e. for beet washing, diffusion and juice evaporation) and additionally a small amount of 1 MWh of network electricity in 2013.

PROCESS DESCRIPTION

The enterprise has steam capacity from two16 tons/h and one 20 tons/h gas-fired-boilers (2 MPa maximum pressure, 380 °C maximum temperature) and owns a combined cycle gas turbine power plant with two1'500 kW gas-turbine generators for electricity production.

The used production system is outdated but was widely used in CIS countries and all over the world up to the 80 s of the previous century. However, progress in development of thermal and technological equipment allowed reducing fuel consumption by 2,2% to process the beets.

GOALS OF THE RECP PROJECT:

A modernization of the cycle arrangements at the enterprise could reduce the specific flow of steam significantly, however to reach best practice levels a complex and expensive modernization of the factory would be necessary.

To improve the plant's efficiency the following main objectives for the analyzed processes were identified with the management:

- Modernization of steam-pipelines;
- Reduction of water losses;
- Reduction of energy losses.

OPTIONS AND IMPROVEMENTS

Low cost measures:

1. Heat insulation of condensate return piping after 1 st and 2 nd evaporation plants.
2. Pressed pulps water return: it reduces the juice pumpage at the normative losses of sugar on a diffusive aggregate and reduces the expense of feed water on diffusion. The juice pumpage reduction allows cutting down steam usage for juice evaporation.

Measures that require investments:

3. Use a biomass (pulp- or pellets-fired) boiler installation for steam production. A major part of energy needs could be covered by the use of alternative types of bio-fuels through the biomass boiler with a capacity of 20 tons/h. The potential is defined by the limited power of transformers, by the required independence from the external electricity grid, and by the inheritance of biomass boilers. Basic advantage of pulp as fuel is its availability at the enterprise and the resulting independency however the required initial investments would be higher. In the offered calculations the cost of pellets delivery and potential price volatility was not taken into account.

COSTS AND BENEFITS OF PROPOSED MEASURES

MEASURES	FINANCIAL			ENVIRONMENTAL	
	Investments [€]	Savings [€/y]	Payback [y]	Energy[1] [MWh/y]	Material[1] [Units/y]
1. Insulation of condensate return piping after 1st and 2nd evaporation plants	3'900	3'700	1,06	95,47	9'547 m^3 of gas
2. Pressed pulps water return	30'000	63'370	0,5	1'646	164'600 m^3 of gas
3. Biomass fired boiler installation options:					
3.1 pulp-fired	385'000	163'150	2,36	-1'284[1)]	708'000 m^3 of gas
3.2 fuel pellets-fired	191'650	272'000	0,7	-1'284	989'800 m^3 of gas
TOTAL 1. with pulp fired option	418'900	230'220	1,82	457,5	See above
2. with pellets fired option	225'550	338'840	0,67	457,5	

[1)] Positive environmental benefits indicate savings compared to the current situation, negative signs indicate additional energy or materials are needed compared to the current situation.

FINANCING

For larger investments third party loans are needed. The company seeks external funding of 200'000 € from financial institutions for the projects.

RAISING ENERGYEFFICIENCY OF BUILDINGS:

1. ADMINISTRATIVE BUILDINGS: EDUCATIONAL BUILDING OF NTUU “KPI”

COMPANY DESCRIPTION:

The object is educational building №18 of the National Technical University of Ukraine “Kyiv Polytechnic Institute” in Kyiv. Main production/services include full-time and part-time education for the students, intellectual property, second higher education, and postgraduate studies. The building is operating 2’416 hours per year. There are 2’530 students (full-time education 2110, part-time education 420). There are 234 employees. The building consumes 346’269 kWh/y of electricity, 1’687 Gcal/y of thermal energy and 10’560 m^3/y of cold water.

Plumbing equipment is in a poor state, water-supply pipes of the basement got rusted, and there are leaks and water losses. Temperature schedule of heat supply is not maintained, there is also low level of thermal comfort of the premises (tint = 15,5 °C), input ventilation is not working well. While composing the temperature map of the building it was confirmed that additional heaters are used in residential buildings, the use of which was not envisaged.

After analyzing the structure of energy consumption it was noticed that a significant part of power consumption (over 40%) is spent on maintaining comfortable indoor conditions, namely heating in winter and air conditioning in summer. Providing temperature comfort is the main and most energy intensive sector within the educational building.

GOALS OF THE RECP PROJECT:

- Reducing electricity and heat consumption;
- Providing a comfortable environment for studying and work;
- Reducing irrational water consumption.

OPTIONS AND IMPROVEMENTS

Low-cost measures:

1. The material for insulation is «ALYUFOM®», reflecting thermal insulation of chemically cross linked expanded polyethylene with unilateral foil which is mounted on the wall without any additional adhesive materials). Thermal conductivity coefficient is 0,031 W/m * K. Total area of the wall under radiator is 520 m^2.
2. For buffet buildings with natural ventilation there is an option to use decentralized heat exchanger of ventilation air TEFO-3 with recovery degree of 75%, which will improve ventilation and annually save about 2,4 MWh of heat energy.
3. There is a proposition to replace existing incandescent bulbs with energy saving lamps «Nova syla», which have a higher light efficiency and longer lifespan.

Investing required measures:

1. Replacement of old wooden windows with new metal plastic windows and partial brick laying of windows in the corridors in the place where they look to the court building “A” (h = 0,6 m), as well as thermal insulation of external walls. Comparing to replacing the entire window area for new metal plastic windows, partial brick laying measure is more appropriate in terms of investment payback.
2. There is an option to install thermal walling, providing outside insulation of walls, without isolation of slopes and enforcement ribs. Savings by reducing heat loss through the walls is 27 kWh/m^2 per year.
3. For roof insulation there is a proposition to use 25 cm layer of expanded clay aggregate (loose thermal insulation material) with a thermal conductivity coefficient of not lower than 0,12 W/m* K and with furnishing waterproofing (for example, 2 layers of roofing material). Additionally, it is proposed to close the air inlets on the technical floor with veneer sheets. Total area of holes closed is 90 m^2.
4. Flushing all internal building heating systems will increase heat generation of heating equipment, improve microclimate conditions and reduce the cost of building heating. Hydraulic balancing of the heating system will help normalize indoor temperature and improve sanitation conditions, as well as reduce heat overspending. There is a recommendation to install balancing valves on the internal struts of heating system of the building.
5. Modernization of heating unit of the building means replacement of outdated elevator unit, implementing automatic weather control system and reduction of the temperature in after-hours, as there is no need to maintain operating temperature at that time. In order to limit support temperature conditioning and reduce heat consumption in internal heating system, temperature control device must be installed.
6. Floor insulation is assumed to be done outside the areaway.
7. Well-timed maintenance and replacement of plumbing equipment, defective zones of pipes (250 m length and 100 mm diameter) in basement and reduction of time interval for monitoring the water meter readings will annually save about 6’000 m^3 of water.

Implementation of these measures will allow reducing energy consumption up to 40% and creating comfortable conditions for studying and work.

COSTS AND MEASURES OF PROPOSED MEASURES

MEASURES	FINANCIAL			ECOLOGICAL	
	Investments [€]	Savings [€/y]	Payback [y]	Energy [MWh/y]	Materials/ CO_2 emissions [units/y]
Low cost measures					
1. Installation of the reflector with radiators	1'530	478	3,2	11,9	2,4 t/y CO_2
2. Installation of recuperative heat exchangers of buffet air temperature	635	105	6	2,4	0,5 t/y CO_2
3. Replacement of incandescent bulbs in toilettes	55	82	0,67	1,2	0,24 t/y CO_2
TOTAL	2'220	665	3	15,5	3,14 t/y CO_2
Investing required measures					
4. Replacement of windows	456'300	39'000	11,7	695	140,8 t/y CO_2
5. Wall insulation	114'500	22'900	5	601,7	121,5 t/y CO_2
6. Roof insulation and fixing holes at the technical plant	111'400	12'380	9	220	44,1 t/y CO_2
7. Flushing of heating system of the buildings and its hydraulic adjustment	29'400	5'880	5	186	37,6 t/y CO_2
8. Modernization of heat supply station	26'500	16'600	1,6	411,7	83 t/y CO_2
9. Insulation the floor above the areaway	3'950	718	5,5	12,6	2,5 t/y CO_2
10. Ongoing repairment works and replacement of defective plumbing equipment and water-supply pipes in basement	3'530	1'765	2	–	Water saving – 6'000 m^3/y
TOTAL	745'580	99'243	7,5	2'127	429,5 t/y CO_2 6'000 m^3/y of water

FINANCING

Bigger investment (745'000 €) must be financed by a third party. RECP Centre is fully aware of financial institutions requirements for project financing. In this case there is the possibility of obtaining concessional loans or grants.

2. NTUU «KPI» SPORTS CENTRE

COMPANY DESCRIPTION

Building №24 of the National Technical University of Ukraine «KPI» is the Centre Sports. At the premises of the building there are also rooms of the Faculty of Biomedical Engineering of the National Technical University of Ukraine «KPI». The Centre has 2 swimming pools (1'250 m^2 and 66 m^2), 2 saunas, 8 gyms, a shooting range, a large stadium and a football field. The total building area is 19,923 m^2. The number of employees is 347 workers, the maximum estimated number of visitors is 2'760 people. In 2013 electricity consumption was 664,8 MWh, thermal energy consumption was 4'249 Gcal and water consumption was 53'041 m^3.

The building is in use during the whole year, but learning process is running from September to June. Trainings in the halls for visitors (students, teams and others) are held throughout the year, whereas swimming pools are working about 9 months a year. The largest share of energy and water consumption is in swimming pool, electricity consumption is 344,4 MWh (51,8%), heat consumption is 1'980 Gcal (46,6%), and water consumption is 43'812 m^3 (82,6%).

GOALS OF THE RECP PROJECT

- Reducing expenditures and eliminating thermal energy losses;
- Providing regulatory level of microclimatic conditions in swimming pools (decreasing humidity rate and increasing air temperature);
- Modernizing of water collection system.

OPTIONS AND IMPROVEMENTS

Low-cost measures:

1. At a time when there is no need in hot water in the shower system (holidays, examinations period), controlling disconnection of one heat exchanger DHW of shower system will reduce heat energy consumption for 267 MWh/year.
2. Due to the lack of control over the thermal curtain in the vestibule there are huge heat losses, while there is no demand for its work at all. Controlling the work of thermal curtain in the vestibule will reduce heat consumption by 59 MWh/year.
3. For now water meters are used just generally for the building. Installation of equipment for monitoring water consumption by different customers will determine where the water is consumed in excess, which would reduce water consumption by 5'000 m^3 and heat (for water heating) by 93 MWh/year.

4. Installation of automatic weather control of heat source losses in the heating shop of the building will save about 325 MWh/year of heat.
5. Bad state of plumbing equipment leads to significant water losses. Modernization of water collection system, such as replacing old plumbing equipment, will reduce water consumption by 15'560 m^3 and reduce the cost of thermal energy for water heating by 250 MWh per year.
6. Since the open surface of the pool in after-hours is exposed to evaporation (heat and water losses), which could be avoided by covering the surface of small pool in after-hours, which will reduce heat and water losses, resulting in savings of 8 MWh of thermal energy and 12 m^3 of water per year.

Investing required measures:

1. Replacing lighting in the gambling hall for LED lighting will solve this problem without increasing power consumption levels.
2. Bad state of walling shell of the building leads to excessive heat losses. Thermal modernization of protecting constructions of the building will save 1'163 MWh/year of heat.

COSTS AND MEASURES OF PROPOSED MEASURES

MEASURES	FINANCIAL			ECOLOGICAL	
	Investments [€]	Savings [€/y]	Payback [y]	Energy [MWh/y]	Material [Units/y]
Low cost measures					
Monitoring deactivation of one heat exchanger for shower rooms for swimming pool	0	16'000	0	267	0
Monitoring the work of air-heat protection of the anteroom	0	3'490	0	59	0
Establishing technical record-keeping of water consumption by different consumers	350	8'770	0,04	93	5'000 m^3
Establishing automatic weather regulating of consumption of a heat-transfer agent	3'500	19'390	0,18	325	0
Modernizing of water collection system	6'000	24'570	0,24	250	15'560 m^3
Covering small swimming pool	500	480	1,04	8	12 m^3
TOTAL	10'350	72'700	0,14	1'002	20'572 m^3
Investing required measures					
Replacing lighting in the gambling hall	31'235	–	–	0	0
Thermal modernization of protecting constructions of the building	937'500	69'250	13,5	1'163	0
TOTAL	968'735	69'250	14	1'163	0

FINANCING

Part of low-cost measures is implemented. Project for modernization of lighting system is done, now financing of the project should be agreed.

COMMERCIAL OFFER

The Resource Efficient and Cleaner Production Centre (RECPC) is the leader in promoting resource efficiency and cleaner production in Ukraine.

We will help to improve the competitiveness of your company on national and foreign markets by means of:

- reducing manufacturing and operational costs ;
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- optimizing product design;
- minimizing waste in production process;
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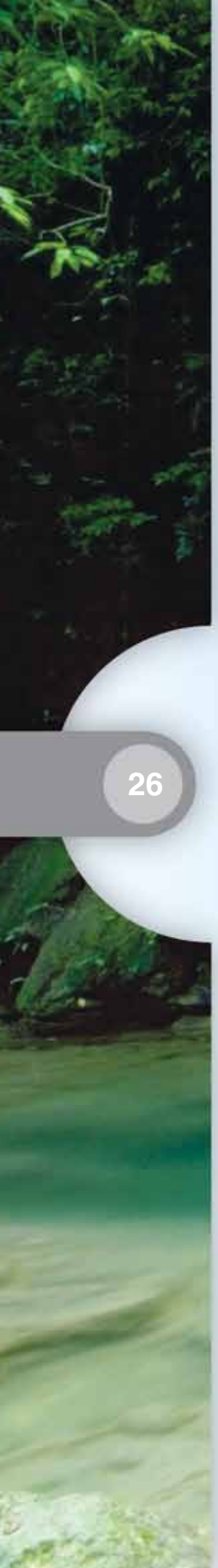
The Centre has 40 certified experts and all necessary equipment to carry out specific measurements for preparation of material and energy balances based on which recommendations on process optimization and equipment modernization are developed:

- **Fluke Ti-400,** thermal imager for temperature measurement of various equipment ranging from -20 °C to +1'200 °C;
- **Testo 875-I,** thermal imager with wide viewing angle and 33 Hz refresh rate for thermogram in the temperature range up to 350 °C;
- **Testo 330 LL,** professional portable gas analyzer for measuring CO_2, CO (up to 4'000 ppm) and NO concentration in flue gases;
- **Testo 435-4,** high-precision instrument for measuring speed of flows and consumption for ventilation and conditioning systems;
- **Testo 845,** infrared pyrometer for remote temperature measurement up to 950 °C;
- **Testo 470,** tachometer for noncontact and mechanic measuring electric drive rotation speed;



- **Testo 606-1,** electronic hygrometer for measuring construction materials and timber moisture;
- **ATE-9538,** meter-recorder with a set of thermocouples to measure the speed and temperature of air flow, relative humidity, light;
- **ACM 3192,** analyzer registrar with 3-phase power for measurement of active, reactive, and apparent power (up to 9’999 MW, 9’999 MVAr, 9’999 MBA respectively), power factor, phase angle;
- **TUF-2000,** ultrasonic flowmeter;
- **APPA109N,** multimeter;
- **APPA39MR,** clamp pliers.

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Our experts are always ready to answer your questions.

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