Resource Efficient Production: Techniques and Practices

Primer for successful business
EAP GREEN PROGRAMME

The "Greening Economies in the European Union's Eastern Neighbourhood" (EaP GREEN) programme assists six countries of the European Union Eastern Neighbourhood Partnership in progressing faster towards a green economy framework. Decoupling strong economic growth from environmental degradation should result in higher productivity and competitiveness, better natural capital management, enhanced environmental quality of life and more resilient economies.
EaP GREEN programme has been running in Armenia, Azerbaijan, Belarus, Georgia, Moldova Republic and Ukraine. It is financed by the European Union with additional co-financing from the Government of Slovenia, the Development Bank of Austria and the four implementing Organizations, namely the Organisation for Economic Co-operation and Development (OECD), the United Nations Economic Commission for Europe (UNECE), the United Nations Environment Programme (UNEP), and the United Nations Industrial Development Organization (UNIDO).
EaP GREEN meets the commitments taken by countries, the European Union and other partners at major international forums including the Earth Summit "Rio +20".

RESOURCE EFFICIENT AND CLEANER PRODUCTION (RECP)

The global UNIDO and UNEP concept “Resource Efficient and Cleaner Production” (RECP) creates a comprehensive, strategic and coherent framework for strengthening and spreading the continuous implementation of preventive environmental strategy into the processes, products and services focused and aimed at efficiency increase and risks reduction to humans and the environment.
The primer has been designed to make the Ukrainian industrial enterprises get familiar with RECP principles and practices implementation. It contains the adapted terminology for easier RECP objectives, issues, implementation stages and benefits understanding and explanation.

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CONTENTS

INTRODUCTION ........................................................................................................................................... 2

1 COMPETITIVE BUSINESS: RECP BENEFIT AREAS .............................................................................. 3
  1.1 COST SAVINGS ...................................................................................................................................... 5
  1.2 PRODUCT INCREASE .......................................................................................................................... 6
  1.3 PRODUCT QUALITY ............................................................................................................................. 7
  1.4 ORGANIZATIONAL EFFICIENCY ......................................................................................................... 8
  1.5 LICENCE-TO-OPERATE ....................................................................................................................... 9

2 CLEANER ENVIRONMENT AND PROBLEMS SOLUTION ....................................................................... 10
  2.1 SELECTION AND EFFICIENT USE OF MATERIALS ............................................................................ 11
  2.2 SOURCE SELECTION AND EFFICIENT WATER CONSUMPTION ................................................... 13
  2.3 EFFICIENT ENERGY CONSUMPTION ............................................................................................... 15
  2.4 REDUCTION AND SAFE DISPOSAL OF WASTE ............................................................................... 17
  2.5 WASTE WATER REDUCTION AND TREATMENT ............................................................................ 19
  2.6 REDUCTION AND CONTROL OF AIR EMMISIONS ......................................................................... 21

3 WAYS TO REALIZATION AND RECP TECHNIQUES .......................................................................... 23
  3.1 GOOD HOUSEKEEPING .................................................................................................................... 26
  3.2 INPUT MATERIAL CHANGE .............................................................................................................. 27
  3.3 BETTER PROCESS CONTROL ........................................................................................................... 28
  3.4 EQUIPMENT MODIFICATION ........................................................................................................... 29
  3.5 TECHNOLOGY CHANGE .................................................................................................................... 30
  3.6 ONSITE REUSE AND RECYCLING .................................................................................................... 31
  3.7 PRODUCTION OF USEFUL BYPRODUCT .......................................................................................... 32
  3.8 PRODUCT MODIFICATION ................................................................................................................ 33

SUMMARY .................................................................................................................................................. 34

GLOSSARY .................................................................................................................................................. 35

REFERENCE MATERIAL .......................................................................................................................... 38
INTRODUCTION

READ THIS PRIMER AND MAKE YOUR BUSINESS BETTER

Small and medium business forms one of the key market economy sectors. The number of businesses has been growing in Ukraine for the recent years. The State Statistical Service proves they provide for about 99% share of all Ukrainian enterprises. Small and medium-sized enterprises (SMEs) account for about 15% of Ukrainian gross domestic product. More than half of them operate in trade and catering, about 14% are the industrial production manufacturers and 10% deal with construction activity. SME’s production activity is mainly concentrated in food, textile, chemical, machinery, construction materials and other industries.

Due to manufacturing processes, any industrial company negatively impacts the environment and bears economic losses by paying fees for polluting. Some SMEs impact the environment slightly, however total pollution due to emissions, wastewater and waste production is quite noticeable and requires implementing effective measures for reduction.

One of the SME’s impact minimizing mechanisms over environment is the implementation of management and organizational approaches ensuring resource efficiency consumption and pollution reduction with no profit drop, sometimes even vice versa – profit increasing. Rational resource management and improving environmental performance can provide a company with a competitive advantage. Over 20 year experience worldwide this fact has been successfully confirmed due to resource efficient and cleaner production methods.

RECP strategy foresees economy in raw materials, water and energy consumption; companies rejecting to use toxic materials and reducing emissions and waste. RECP’s universal nature is clear and understanding as well as demands no significant limitations to get implemented at any industrial SME.

The primer comments on the RECP content, concept and basic approaches. The key implementation stages in manufacturing production have been depicted and the examples of successful RECP practices have been presented. The principal goal of the primer is highlighting the benefits and options reasoning Ukrainian SMEs to implement RECP and increase productivity and competitiveness of the enterprises.
Industrial development growing and environmental pollution impacts resulted in humans’ attitude getting gradually changed to nature. Seeking solutions to topical problems towards both sustainable production and consumption has been constantly in progress.

Environmental management and protection approaches have evolved several phases and these are:

**Phase I**: the problem of **exhaustible** natural resources and environmental **contamination** was solved via **replacing** with another typical source and **dispersing** emissions (reducing emissions concentration by installing high chimneys designed to take the combustion gases out into the atmosphere or dumping wastes into large rivers and seas, far off the coast).

**Phase II**: human activities focused on natural resources **protection** (forest plantations, rivers and lakes, soil); **control over** air emissions as well as control over wastes and dumps by installing sewage disposal plants, so called "the pipe end".

**Phase III**: natural resources **renewal** and **recycling** (using wastes as secondary raw materials).

**Phase IV**: product increase via **decreasing** natural sources use and **preventing** contaminants formation yet at the production stage.

The last approach combination actually became the RECP concept fundamentals offering a method to seek the balance between environmental impact and economic stability of the enterprise.

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### RECP is seeking for sustainable production and consumption

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Problem of exhaustible natural resources and environmental contamination was solved via replacing with another source and dispersing emissions (reducing emissions concentration by installing high chimneys designed to take the combustion gases out into the atmosphere or dumping wastes into large rivers and seas, far off the coast).</td>
</tr>
<tr>
<td>II</td>
<td>Human activities focused on natural resources protection (forest plantations, rivers and lakes, soil); control over air emissions as well as control over wastes and dumps by installing sewage disposal plants, so called &quot;the pipe end&quot;.</td>
</tr>
<tr>
<td>III</td>
<td>Natural resources renewal and recycling (using wastes as secondary raw materials).</td>
</tr>
<tr>
<td>IV</td>
<td>Product increase via decreasing natural sources use and preventing contaminants formation yet at the production stage.</td>
</tr>
</tbody>
</table>

### RECP IS A BALANCE BETWEEN ENVIRONMENTAL IMPACT AND ENTERPRISE ECONOMIC STABILITY

What is your business evolution phase?
Lack of control, technological failures, equipment capacities not meeting manufacturing processes demands – all these lead to overrun of materials, fuels and energy, thus increasing production costs and environmental burden.

RECP implementation enables the enterprise evaluating its potential savings and efficient use of all resources to achieve lower production costs, reduce wastes and air emissions, increase resource efficiency and competitiveness.

Are you happy with your enterprise efficiency?

HAVING IMPLEMENTED RECP YOUR ENTERPRISE WILL GET THE BELOW BENEFITS:

1. COSTS SAVINGS
2. PRODUCT INCREASE
3. PRODUCT QUALITY
4. ORGANIZATIONAL EFFICIENCY
5. LICENCE-TO-OPERATE

Read more about each benefit. Proceed, please.
1.1 COST SAVINGS

RECP includes management approach aimed at saving materials, energy and water due to technical and organizational solutions. Lowering specific indicators of consumption directly affects unit costs, cost savings, compliance with environmental requirements thus reducing the costs of waste disposal and pollution fees.

Cost savings is a process of financial accumulating or savings through more efficient energy use, materials and water management, reducing waste and emissions.

<table>
<thead>
<tr>
<th>Options</th>
<th>Investments [€]</th>
<th>Savings Resource savings</th>
<th>Savings [€/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair and proper water pipelines maintenance (low cost measures)</td>
<td>500</td>
<td>1,200 m³ (water)</td>
<td>550</td>
</tr>
<tr>
<td>Installing the automated system for commercial electricity metering (AMR), frequency regulators and reactive power compensation system</td>
<td>65,000</td>
<td>740 MWh + 1,005 MVAr (reactive power)</td>
<td>62,800</td>
</tr>
<tr>
<td>Repair and equipment replacement for cement supply and transportation</td>
<td>74,000</td>
<td>1,730 t (cement)</td>
<td>102,700</td>
</tr>
<tr>
<td>Installing heat generators</td>
<td>46,000</td>
<td>460,000 m³ (gas)</td>
<td>153,000</td>
</tr>
</tbody>
</table>

**COST SAVINGS** 319 050 €/YEAR
Costs of raw material and resources for final product production make up the bulk of its cost. Boosting production performance ensures significantly improving the company’s economics, preventing loss of materials, energy, water, and at the same time reducing the amount of waste, wastewater and emissions, hence, facilitating production costs reduction and ensuring cost savings.

**Product increase** is a manufacturing efficiency boost determined by the resources consumption to unit costs ratio.

Do you feel having the potential for product increase at your enterprise?

**BEST PRACTICE**

One of the biggest business enterprises in Kyiv combines producing and selling a wide range of concrete products, concrete and solutions for industrial and individual building.

The conducted comprehensive assessment of manufacturing processes, raw materials and energy consumption enabled revealing the potential to increase productivity and develop a series of measures to further prevent excessive and unnecessary resources loss. Consistent implementation of these measures greatly lowered the overall resources consumption while improving production process within entire enterprise scale:

<table>
<thead>
<tr>
<th>PRODUCT INCREASE (% PER YEAR)</th>
<th>POWER</th>
<th>WATER</th>
<th>MATERIALS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+62 %</td>
<td>+19 %</td>
<td>+7 %</td>
</tr>
</tbody>
</table>
Improving input materials parameters, their efficient consumption and using less toxic components allows enhancing the final product quality, increasing demand and expanding the target market. It should be mentioned that higher quality products and cleaner production loosen pressure on the environment due to longer product life cycle and lifespan.

Product quality is a combination of technical and environmental properties of the end product enabling to meet the consumer needs.

**BEST PRACTICE**

An enterprise in Kharkiv produces mineral wool using inorganic fiber materials derived from rock basalt silicate melt. Having implemented RECP principles the enterprise managed to increase product quality.

Replacing the old polymerization chamber with a more modern one provides for reducing input materials consumption per one ton of products and as well as reducing by 3% losses of finished products (wastage), not mentioning the energy consumption.

The modification of product technical characteristics, such as density, size, etc., ensures extending its product mix and boosting annual profit by 5 - 6%.

Do you wish to increase the quality of your products?
1.4 ORGANIZATIONAL EFFICIENCY

The RECP concept presupposes that organizational efficiency consists in company's management and personnel being guided and motivated to keep continuous improvement and product increase.

For best results and effective ideas the teamwork and various level personnel involvement is required.

Personnel involvement can be facilitated if:
- management of the company positively greets new ideas and judgements;
- there exists and works a bonus system;
- there is a clear understanding of environmental pollution impact and consequences;
- the personnel gets advanced training;
- a healthy working environment gets maintained.

Serial personnel surveys to reveal company's current situation evaluation enables identifying problem areas, inefficient equipment and unnecessary technological resources losses, thus pushing to start searching for appropriate solutions.
The relationship with society and market position is an integral part of the enterprise operation. Meeting customers’ demands, social responsibility and legislation compliance provide for:

- solid foundation for successful development;
- creating a positive company image on national and international levels;
- support from the state;
- expanding markets;
- enhancing public confidence.

License-to-operate is a perception, acceptance and support provided by the public, market, state and company environment caring over products quality and people’s well-being.

**BEST PRACTICE**

An enterprise manufacturing ceramic building materials got evaluated on products meeting ISO 14024 international standards. It was awarded the International Environmental Certificate justifying the environmental and human health impact reduction, product characteristics improvement in respect to material security, production methods and auxiliary ingredients as a result of cleaner production technologies and energy efficiency measures implementation. The Environmental Certificate is recognized in 60 countries, including the EU and USA. The products meet the highest quality standards and this is the key to win consumer’s confidence. The packing gets appropriately labeled.

**Environmental labeling examples**

- **Green Crane: Ukraine**
- **The Blue Angel, Germany**
- **The EU “Flower”**
- **Green Seal, USA**
- **Green Dot, Germany**
- **Euro Leaf: The new organic logo of the European Union (EU)**
- **Möbius strip, International recycling symbol**
- **Euro Leaf, the organic product symbol, EU**
Any product manufacture does make waste and causes damage to the environment to certain extent. Even up-to-date advanced technologies can’t avoid waste production. Enterprises often face problems regarding low quality material, water and heat losses, excess waste and sewage water production, lack of control over air emissions. Complex approach to above mentioned problems solution via implementing RECP technologies totally ensures maximum benefit for both the environment and business.

RECP identifies the following six areas of issue solving:

1. SELECTION AND EFFICIENT USE OF MATERIALS
2. SUPPLY SOURCES AND EFFICIENT WATER CONSUMPTION
3. EFFICIENT ENERGY CONSUMPTION
4. REDUCTION AND SAFE WASTE DISPOSAL
5. REDUCTION AND TREATMENT OF WASTE WATER
6. REDUCTION AND CONTROL OF AIR EMISSIONS

Read more about problems solution and typical RECP approaches. Proceed please.
The enterprises face the following problems with materials

The quality and price for raw materials at any enterprise are crucial when choosing the supplying source.

In particular, any enterprise faces the challenges with exhausting resources, their territorial availability and high cost due to the complexity and power consumption needed for primary materials processing and logistics, as well as environmental pollution due to mining process etc.

Efficient raw materials use within minimal waste production contributes to productivity boost. However the recycled materials use plays a significant role in high-quality and economically attractive products manufacture.

**WAYS TO INCREASE MATERIAL USE EFFICIENCY**

Considering the above mentioned motives allows increasing the enterprise efficiency and ecological impact due to:

- optimal choice, raw material replacement with secondary products derived from other industries;
- shortening transportation distance to reduce vehicles harmful emissions;
- choice of material that needs no additional processing and treatment thus saving power and labour sources;
- product quality increasing.

**RECP SUGGESTS THE FOLLOWING TYPICAL OPTIONS**

Among efficient material choice and use measures you can focus on:

- well-organized input materials accounting and quality control at all stages of its usage;
- replacing material components with alternative and less toxic but maintaining or even boosting final product quality;
- using wastes as raw material in other manufacturing processes;
- producing byproducts from material waste or remnants.
# BEST PRACTICE

## Raw material reduction

**Enterprise inspected:**
The enterprise produces cardboard package about 70 mln m$^2$ per year and is located in Ukrainka town, Kyiv region. It processes annually: cardboard – 160 mln m$^2$, paper – 116 mln m$^2$, starch – 780 t, flexographic paint – 71 t and PVA glue – 30 t.

**Problems detected:**
The technological process results in producing large amount of paper waste (paper trimmings). In addition, excess paint and glue consumption were recorded.

**Options implemented:**
The below given was implemented:
- Replacing expensive corn starch with cheaper potato starch enabled cost savings without losing the product quality and reduced glue additives to 3 tons per year;
- Implementing additional anilox for paint allowed reducing paint amount by 20%;
- Implementing modification admixtures led to glue reduction by 20%.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Financial savings</td>
</tr>
<tr>
<td>150,500 €</td>
<td>485,300 €/year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investments</th>
<th>Financial savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>150,500 €</td>
<td>485,300 €/year</td>
</tr>
</tbody>
</table>

## Useful byproduct implementation

**Enterprise inspected:**
An enterprise produces superpressure brick 750,000 units annually in Vinnytsia region. The manufacturing process demands shelly limestone, clue and power consumption.

**Problems detected:**
The “rubble” is considered the main product and is used for decorating buildings. The technological process implies chopping off the brick side resulting in producing lots of waste (broken bricks).

**Options implemented:**
Broken brick waste is actually pieces of multicoloured ceramic stones. It can be further used to cover walk paths and grass lawns. In this case, broken bricks are the byproduct. After have been chipped in the crushing plant the rest brick particles should be reused to produce goods. This procedure enables primer material savings as well as utilization savings.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Financial savings</td>
</tr>
<tr>
<td>1,600 €</td>
<td>400 €/year</td>
</tr>
</tbody>
</table>
2.2 SOURCE SELECTION AND EFFICIENT WATER CONSUMPTION

WHICH WATER RELATED PROBLEM NEEDS URGENT SOLUTION?

Surface water installations cover only 4% of Ukrainian area while water resources get formed mainly by inflows from neighboring countries. That is why Ukraine is a poor country in terms of sufficient water supply availability. Ukraine annually consumes water about 13 billion m$^3$ whereas industrial needs are over 6 billion m$^3$ of water.

The manufacturing process consumes water as raw material in heating and cooling systems, to wash equipment and transport, for sanitary needs etc. Very often, however mistaken, water is considered inexhaustible and cheap. The availability and quality of water both for technological and drinking needs is getting worse, while the consumption rates get constantly increased. The majority of enterprises in Ukraine were built like 30 years ago, their water pipelines got outdated and worn out, here and there regularly occur water inrush resulting in significant losses of water and money.

Hence the problem of water and its efficient consumption as well as protecting rivers and lakes has been top urgent nowadays.

WHAT IS THE TRIGGER TO START EFFICIENT WATER CONSUMPTION AT THE ENTERPRISE?

Significant costs for water incoming flows, water transport, water supply systems maintenance, water purification and proper sewage systems operation can be easily reduced due to implementing water management and ongoing good maintenance.

RECP measures provide:
- water consumption;
- detect options for water reuse resulting in the enterprise economical status;
- lowering fee for water use and sewage water dumping;
- reducing costs to power pumps and other facilities.

The below given are the measures to efficient water consumption:

- installing incoming water meters and meteres along basic water consuming areas;
- inspection and repairing water pipelines and sanitary facilities;
- training personnel to efficient water consumption;
- installing automated water shutters;
- installing automated systems for equipment washing;
- installing reverse water supply systems;
- installing reservoirs to coolect rainwater.
Good water management

**Enterprise inspected:**
A higher school academic building in Kyiv, Ukraine.
Overall students studying – 21,265, post-graduates – 851, PhD doctoral students – 33, total maintenance staff – 7,638.

**Problems detected:**
Excessive water consumption, poor pipelines and sanitary fittings.

**Options implemented:**
- pipelines repair / replacement;
- meters installed;
- installing reducing gears (pressure adaptors) on incoming pipelines followed by adjusting;
- organizational / awareness raising measures in water consumption and students’ environmental awareness boost.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>83 920 €</td>
<td>35 344 €/year</td>
</tr>
</tbody>
</table>

151 936 m³/year

Rainwater collection

**Enterprise inspected:**
A plant in Dnipro city, Ukraine, manufactures metal constructions for both construction and heavy industries having in total 95,000 tons of products annually. Annual water consumption exceeds 24,000 m³.

**Problems detected:**
Excessive water consumption for business needs namely, territory cleaning and watering plants.

**Options implemented:**
Rainwater collection in warm seasons for further watering the territory and trees can save water over 2,000 m³.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>200 €</td>
<td>500 €/year</td>
</tr>
</tbody>
</table>

2,000 m³/year
2.3 EFFICIENT ENERGY CONSUMPTION

WHAT ARE TYPICAL ENERGY CONSUMPTION PROBLEMS FOR ENTERPRISES?

Ukrainian industries consume energy as much as about 320 MJ annually when burning gas, coal, diesel fuel, petrol etc. Typically, the cost of energy makes up the significant production costs share. Rising prices for fuel and electricity in Ukraine trigger energy efficiency issue to become more urgent and important, especially for SMEs. Outdated energy-consuming facilities, compressed air losses through leakage in damaged pipelines, absence of insulation in heating systems and inside industrial facilities etc. result in excessive energy losses. However, equipment modernization and replacement with new energy efficient facilities requires significant investment which is not always acceptable and affordable for enterprises.

Therefore minimizing energy and heat losses can be easily fixed with implementing energy efficient management and renewables.

WHAT DOES EFFICIENT ENERGY CONSUMPTION RESULT IN?

Among various rational energy use measures energy consumption reduction ranks first and provides for the biggest economic and environmental effect:
- reducing energy;
- CO$_2$ and other green-house emissions reduction;
- energy dependence lowering etc.

RECP SUGGESTS THE BELOW GIVEN TYPICAL OPTIONS

There is a variety of technical solutions to save energy sources. Some of them are:
- implementing automatized manufacturing systems;
- installing heat and energy meters along all basic energy consuming areas;
- thermal insulation for buildings and facilities;
- adjusting optimal equipment operation modes;
- using alternative fuels;
- partial or complete replacement of equipment production line with modern energy efficient equipment;
- installing motion sensors for lighting automation.
BEST PRACTICE

Energy management systems

Enterprise inspected:
A gas-cutting equipment production is located in Vinnytsia, Ukraine. The enterprise manufactures boilers, gas and autogenous welding equipment for metal processing in mechanical engineering industry. Over 140 tons of metal gets processed annually.

Problems detected:
Poor control over consumption in the manufacturing process, excessive natural gas consumption and outdated energy-consuming technological facilities.

Options implemented:
- installing AMR;
- installing Ukrainian originated solid fuel boiler;
- natural gas replacement with pellets;
- technological process modernization via implementing energy efficient gas-cutting facilities.

Results achieved:

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>169,500 €</td>
<td>59,600 €/пік</td>
</tr>
<tr>
<td></td>
<td>1,185 MWh/year</td>
</tr>
</tbody>
</table>

Thermal insulation for buildings

Enterprise inspected:
One of the largest high-quality welded steel manufactures with production volumes about 12,000 t per year is located in Zhytomyr town. The enterprise has 4 administrative and industrial buildings on its territory.

Problems detected:
Significant heat gets lost through the windows and enclosed constructions.

Options implemented:
Facade and window frames insulation in the heated premises allows savings natural gas over 18,000 m³ annually.

Results achieved:

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>16,000 €</td>
<td>4,800 €/year</td>
</tr>
<tr>
<td></td>
<td>18,000 m³/year</td>
</tr>
</tbody>
</table>
2.4 REDUCTION AND SAFE DISPOSAL OF WASTE

WASTE PRODUCTION CONSEQUENCES

Ukraine produces up to 1 billion tons of industrial and household waste annually. The accumulation amount covering over 1 km gross area totals over 45,000 tons thus Ukraine ranks the list with the biggest technologically dangerous countries.

Mining industry produces the overwhelming waste amount. Metallurgical, chemical and food industries are the processing ones and they produce and accumulate the largest waste bulks on site.

An excessive waste production leads to economical losses. Waste is the result of initial raw material treatment and processing, so loosing waste means loosing money. Thus the enterprise suffers economically due to waster production excess.

REDUCTION AND WASTE DISPOSAL PROVIDES THE FOLLOWING BENEFITS:

Following the efficient and safe waste management the enterprise manufacturing process will obtain:

- **economic benefits**:
  - saving money for waste accumulation, transporting and utilization;
  - lowering the product self-cost;
  - reducing the bill for environmental pollution;
  - additional income from wasteselling;

- **ecological benefits**:
  - freeing the area occupied with waste;
  - avoiding toxic waste components impact over humans and environment;

- **organizational benefits**:
  - productivity increase;
  - perspective for environmental certification and labeling;
  - strengthening consumer confidence.

WHAT ARE THE RECP TYPICAL OPTIONS?

Among the variety of typical RECP solutions we suggest the below given:

- waste sorting;
- waste reuse in the production process;
- selling waste as raw material for other business;
- refusing to use toxic and dangerous matters in manufacturing process;
- installing equipment for prior waste processing for the further use.

2.5 WASTE WATER REDUCTION AND TREATMENT
BEST PRACTICE

EFFICIENT WASTE USE

Enterprise inspected:
A cloth factory in Bohuslav town produces woolen and semi-woolen fabrics about 700,000 m² annually. Such output needs over 400 tonnes of materials.

Problems detected:
Accumulating huge amounts of waste dust due to cloth manufacturing – about 30 t per year.

Options implemented:
Cloth dust is actually dehydrated organic remnants and could be further used to produce heat or as raw material for fuel briquetts for other business.

Results achieved:

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect: Waste reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>0 €</td>
<td>2,584 €/year</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 t/year</td>
</tr>
</tbody>
</table>

Waste return into the production

Enterprise inspected:
A plant for concrete solutions production with 50-60 m³/hour or 200-250,000 m³/year capacity has been operating in Kyiv city. The production gets delivered to the customers in concrete mixing trucks.

Problems detected:
Solid concrete waste accumulated in concrete mixers-trucks.

Options implemented:
The plant has already installed a recycling system to return washing water from the concrete mixing trucks. As long as this water contains cement, sand and crushed stone, the return process allows getting the above mineral components back into the production.

Results achieved:

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect: Waste reduction, Raw material savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>0 €</td>
<td>7,500 €/year</td>
</tr>
<tr>
<td></td>
<td>2,110 t/year</td>
</tr>
</tbody>
</table>
WHAT ARE THE PROBLEMS RELATED TO WASTEWATER?
According to statistics provided by the State Water Resources Agency of Ukraine, about 8 billion m³ wastewater gets annually dumped into cumulative aquatic resources whereas 2 billion m³ is contaminated wastewater. Utilizing large amounts of water results in forming up three types of wastewater – household, industrial and surface. Industrial facilities produce over 60% of wastewater.

Normally the enterprises dump off contaminated industrial and technological waters. As a result, the aquatic resources suffer chemical and thermal pollution, thus in due course leading to soil erosion at water intake plant.

The fee for dumping off wastewater in Ukraine gets gradually increased.

It is extremely important to fully understanding the consequences of water resources contamination and bearing responsibility for determining actual wastewater capacities, their type, reduction and treatment processes.

WHAT BENEFITS DOES AN ENTERPRISE GET DUE TO WASTEWATER REDUCTION AND TREATMENT?
Reduction of wastewater and harmful substances concentration in it will enable the enterprise:

- reducing the bill for wastewater dump off;
- saving money for fresh water consumed due to circulating;
- return back valuable substances to the production due to wastewater treatment;
- promoting conservation of aquatic ecosystems and reservoirs’ economic life;
- reducing harmful effects over human health;
- saving of the most important natural resources of Ukraine.

WHAT ARE THE TYPICAL RECP OPTIONS?
RECP options to reduce wastewater production:

- installing separate meters for industrial and household wastewater;
- installing biogas production systems running on effluents;
- heat recovery on effluents;
- extracting valuable components from wastewater for further reuse;
- installing water recycling systems;
- collecting condensate and its return in the manufacturing process.
- installing systems for wastewater treatment.
**BEST PRACTICE**

### Reducing water run-off

**Enterprise inspected:**
An enterprise manufacturing concrete products, slag stones and ceramsite concrete blocks is located in Kyiv city.

**Problems detected:**
Inadequate sanitary facilities, leakage and excessive water consumption for everyday needs.

**Options implemented:**
- installing water meters separately to keep records of everyday needs;
- repair and maintenance of sanitary construction;
- advising and instructing personnel about efficient water consumption matters.

Having implemented water management guides the enterprise reduced water consumption and sewage water, respectively, by 28% per year.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect</th>
<th>Environmental effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>5,641 €</td>
<td>4,480 €/year</td>
</tr>
</tbody>
</table>

\[287 \text{ m}^3/\text{year}\]

### Return water conditioning

**Enterprise inspected:**
A meat-processing plant is located in Kyiv region.

**Problems detected:**
Every day butchering and meat-processing produced wastewater about 80 m\(^3\). The wastewater got collected into containers and then delivered to the storm sewage facilities at municipal waste disposal plant. The RECP principles were implemented at the plant to reduce wastewater production and ensure cost savings.

**Options implemented:**
- return water conditioning technology got developed;
- the conditioning facilities got built and starting operating at the enterprise.

**Results achieved:**
Return water conditioning allowed producing industrial water good enough by properties to further replenish the fresh subsoil waters stock via a bioplato. The sludge dehydratated mechanically is applicable as soil fertilizers.

<table>
<thead>
<tr>
<th>Economic effect</th>
<th>Environmental effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>82,100 €</td>
<td>20,140 €/year</td>
</tr>
</tbody>
</table>

\[29,200 \text{ m}^3/\text{year}\]
2.6 REDUCTION AND CONTROL OF AIR EMISSIONS

WHAT ARE THE TOP URGENT AIR EMISSIONS PROBLEMS?

Industries, heat and power plants and transport are the main sources of air pollution. The operating enterprises suffer irregular manufacturing processes and facilities that produce air emissions containing different toxic components, organic compounds vapor, fine droplets and solid particles. Greenhouse gases have significant negative impact due to water vapor, carbon dioxide, methane, ozone, nitrous oxide and chlorofluorocarbons contained. Metallurgical, electricity production and distribution industries rank first for producing over 85% CO\(_2\) emissions. Combusting 1 kg of coal gets 2.3 kg of CO\(_2\) emitted; burning 1 m\(^3\) of natural gas produces 1.9 kg CO\(_2\).

Above all, the emissions impact working conditions at the plant and workers' health as well. This negative influence leads to occupational diseases and labour productivity drop. Therefore each and every company bears total responsibility for the amount of harmful air emissions produced. At the same time the state must constantly provide incentives by introducing fees for standard and overstandard emissions for the enterprises to control and reduce harmful air emissions.

WHY IS IT NECESSARY TO CONTROL AND REDUCE AIR EMISSIONS?

Reducing harmful and greenhouse emissions will enable the enterprise:
- reducing air pollution;
- reducing greenhouse emissions;
- reducing emissions fees;
- ensure good working environment and conditions;
- returning valuable components back into production;
- improving company’s image for increasing environmental performance;
- reducing fuels consumption.

WHAT ARE THE TYPICAL RECP OPTIONS?

Total pollutants amount and CO\(_2\) emissions reduction is possible if:
- modern dust and gas purifying equipment gets installed;
- manufacturing process gets updated;
- harmful and toxic components usage in production process gets reduced;
- energy efficient equipment with low CO\(_2\) emissions gets installed;
- conventional fuels get replaced with alternative energy sources.
Implementing resource-efficient and cleaner production (RECP) methodology is possible at any enterprise producing goods or providing services, regardless of industry and production capacity. This methodology involves implementing various strategies to reduce environmental impacts and enhance sustainability. Here are two examples of how RECP was realized at different enterprises:

### Reducing CO₂ Emissions

**Enterprise inspected:**
An enterprise in Zaporizhzhia is specialized in melting glass and has a production capacity over 47,000 tons per year.

**Problems detected:**
Due to significant heat losses through furnace lining and the ones extracted with flue gases the enterprise suffers huge natural gas amount consumption. Naturally CO₂ emissions are considerable as a result.

**Options implemented:**
- Partial furnace lining modernization;
- Utilizing flue gases heat for batch drying;
- Optimizing furnace operation mode.

The implemented RECP options provide for natural gas savings up to 24,000 m³ and 400 MWh of electricity annually, thus reducing greenhouse gases emissions by 170 tons of CO₂ per year.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>210,448 €</td>
<td>72,093 €/year</td>
</tr>
<tr>
<td></td>
<td>170 t/year</td>
</tr>
</tbody>
</table>

### Air Pollution Reduction by Suspended Substances

**Enterprise inspected:**
A plant in Brovary town annually produces more than 3.5 thousand tons of metal structures and air-ventilated facades for buildings.

**Problems detected:**
When applying a layer of powder paint on metal structures in the existing sputtering chamber the paint got wasted through the ventilation system in the form of suspended solid particles and dust deposition. Applying water-repellents over facade tiles was imperfect and led to excessive raw material consumption.

**Options implemented:**
- Installing a sputtering chamber with built-in recovery system can increase process efficiency and reduce paint consumption.
- Installing a closed workspace for applying water-repellents reduces excessive raw material consumption.

**Results achieved:**

<table>
<thead>
<tr>
<th>Economic effect:</th>
<th>Environmental effect:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investments</td>
<td>Savings</td>
</tr>
<tr>
<td>2,800 €</td>
<td>3,000 €/year</td>
</tr>
<tr>
<td></td>
<td>1,7 t/year</td>
</tr>
</tbody>
</table>
capacities. RECP does work the most efficiently if its principles and approaches get regularly implemented thus ensuring constant achieved results upgrading.

**RECP PRINCIPAL OBJECTIVES:**

1. **Efficient resources use** by optimizing the consumption of materials, energy and water at all production stages, productivity increase, i.e. reducing resources consumption per unit of produced goods and services.

2. **Minimization of environmental impact** leads to measures and technical solutions development and further implementation to ensure the reduction of emissions, waste, their return to production cycle or use as secondary material as well as the implementation of drainage technology and water circulation cycles.

3. **People’s well-being** – minimizing risks and compliance requirements for economic and environmental security (clean environment, better working conditions, etc.) and social development support.

**RECP IMPLEMENTATION STEPS**

A five-step procedure forms up the fundamental base for RECP implementation:

- **Data collection and analysis.** This is an initial assessment aiming to reveal company’s general
economic status and collect data related to energy, material and water flow rates as well as wastewater, wastes and emissions production.

**Detailed assessment** of an enterprise or its specific manufacturing processes aims at revealing unproductive losses and identifying potential for resources conservation.

**Developing resource efficient options** is a search for and discussing opportunities to implement organizational and technological activities aiming to reduce energy and other resources consumption.

**Implementing RECP techniques guarantees efficient and sustainable enterprise operation**

**RECP TECHNIQUES TO ACHIEVE RECP OBJECTIVES**

RECP offers enterprises a comprehensive management strategy to improve the overall environmental performance and more efficient resources use resulting in economic impact and decrease risks for human’s health.

Consistent implementation of the above steps allows efficient RECP technique implementation and continuous production processes improvement to achieve the best results towards sustainable business development.
benefits and reducing environmental impact. So RECP implementation uses the following fundamental techniques:

1. **Good housekeeping** provides for keeping maintenance conditions well, timely maintenance of various systems, control and optimal distribution of material and human resources allowing the enterprise to improve performance parameters with no additional costs input.

2. **Input material change** – replacing hazardous and toxic substances in production process with similar in characteristics and less harmful feedstocks thus increasing productivity and improving environmental situation.

3. **Better process control** of input and output resources flow (materials, energy, and water) allows to quickly responding to deviations in performance and parameters.

4. **Equipment modification** is aimed to achieve the best consumption and production rates and can affect local production line components and manufacturing process as a whole.

5. **Technology change** is an effective measure to improve enterprise performance rates. It can change such production process parameters as temperature, pressure, equipment modes or method for raw materials processing.

6. **Recycling and available sources reuse** helps avoiding losses of raw materials and energy in the form of waste or heat.

7. **Production of useful byproducts** from production residues and waste instead of their conventional recycling is economically beneficial and environmentally acceptable.

8. **Product modification** in accordance with environmental safety requirements and customer’s needs satisfaction boosts its market competitiveness.

Over 40 enterprises in Ukraine have successful experience of using these techniques.

Read more about each RECP technique.

### 3.1 GOOD HOUSEKEEPING

**Good housekeeping** is regular implementing measures and actions to keep up enterprise operation that ensure working conditions support and optimal equipment modes, their maintenance and current repairs to avoid possible cost overruns and loss of raw materials and energy, maintenance costs and provide appropriate working conditions for personnel.
WAYS TO REALIZATION AND RECP TECHNIQUES

WELL-KNOWN AND WIDESPREAD OPTIONS

- regular maintenance and repairs of production equipment and systems;
- proper sanitary equipment maintenance (valves, pipes, toilet tank etc.);
- using energy efficient lighting (LED bulbs, circuit breakers, etc.);
- insulating windows, floors, walls and frame fillings to conserve heat;
- record keeping for incoming raw materials, periodic inventory, control over waste production and amount;
- regular briefings at work on resource efficient consumption and industrial safety;
- keeping workplace and production facilities clean;
- collecting rainwater to water greenery and the enterprise territory.

BEST PRACTICES

A company in Vinnytsia region produces shutoff-and-filling devices. For good housekeeping and rational water use the company installed:

- automatic water shutdown in shower-rooms;
- aerators and water consumption limiters on shower heads;
- low water consuming flushing systems in toilets.

Thus the enterprise can annually save 1,800 m$^3$ of water and about 4,000 m$^3$ of gas (used earlier for water heating purposes prior to RECP implementation). Moreover reduced water consumption led to less domestic sewage production.
3.2 INPUT MATERIAL CHANGE

**Input material change** is a search and selection of secondary materials suitable to replace primary raw materials, using less hazardous or toxic substances in the manufacturing process, using alternative fuels, etc. to improve the products environmental parameters and reduce environmental impact.

### WELL-KNOWN AND WIDESPREAD OPTIONS

- Introducing into manufacturing processes primary materials which waste is suitable for further processing or byproducts manufacture;
- Partial or complete raw materials replacement with materials having better technological quality and being more affordable;
- Using alternative energy sources (PVs, solar collectors) and alternative fuels (sawdust, pellets, wood waste, biogas, etc);
- Using and involving into production process secondary resources to replace fossil fuels, fresh water and raw materials that need complex and energy-consuming processes (e.g., using slag to replace sand or cement, reusing effluents).

The above approach implementation is depicted in the example when a paper mill in Ukrainka town refused using PVA glue anymore and replaced it with hot-melt glue.

This input material change has led to time period reduction for elements bonding of the cardboard packaging, increasing its durability and reducing defects. Moreover, the costs for glue and substandard products waste amount got reduced.
3.3 BETTER PROCESS CONTROL

**Better process control** means applying systematic measures to account resource consumption, waste and wastewater generation, determining and controlling process parameters and equipment operating modes at all production stages.

**WELL-KNOWN AND WIDESPREAD OPTIONS**

- installing additional meters for electricity, heat, water and sewage in the areas of intensive resource consumption;
- technological processes automation (such as dosage, transportation, heating, power on/off, etc.);

- installing cheching and measuring tools;
- installing AMR automated power consumption system;
- record keeping for waste production.

**BEST PRACTICES**

An example of this technique is the installation of meters and implementing metering system for energy resources consumption in some facility areas at a plant producing plastic medical products in Belgorod-Dnistrovkyi town. Such monitoring allows quickly responding to daily or seasonal excessive power consumption or its misuse resulting in total energy consumption reduction by 3 - 5% annually.
3.4 EQUIPMENT MODIFICATION

**Equipment modification** is a process of enterprise technical and technological base improvement, modernization and renovation aiming to achieve optimum equipment parameters modes, increase productivity, extend facility useful lifespan, improve product processing accuracy, ensuring safe and reliable equipment operation etc.

**WELL-KNOWN AND WIDESPREAD OPTIONS**

- replacing obsolete equipment with energy and resource efficient;
- integrated tool stock update;
- applying automation and production organization means;
- full or partial production line modernization to reduce the production cycle duration;
- additional equipping with electrotechnical installations to increase their productivity;
- updating and replacing mechanical parts for equipment enhancements.

Best practices

Bread-making process is considered very energy-consuming and manufacturers are interested in finding ways to reduce energy consumption.

A Vinnytsia bakery plant save about 40,000 m³ natural gas per year due to prior industrial furnaces modification by replacing gas burners with pellets. The payback period – 1 year.

This technical solution actually meets another RECP technique for input material change.
3.5 TECHNOLOGY CHANGE

Technology change is a processing method replacement and input material transformation (materials, energy, water, etc.) at different production stages to improve its quality performance or reduce resources consumption.

WELL-KNOWN AND WIDESPREAD OPTIONS

- Implementing new technology processes that will reduce raw materials consumption;
- Changes in production technology by using alternative raw materials to reduce product prime cost without compromising the quality and safety;
- Identifying effective methods for raw materials preparation or processing to reduce energy consumption;
- Using recycling to return the waste back into production;
- Selecting optimal technology process parameters (temperature, pressure, treatment period, etc.).

BEST PRACTICES

A company is located in Kyiv and manufactures railcars and components. It has implemented technology change technique to reduce energy consumption and improve productivity. Gas metal cutting process got replaced with plasma cutting with the help of modern equipment.

This option enabled reducing natural gas consumption by 104,000 m³ per year; oxygen consumption by almost 900 tons. Moreover, plasma cutting process needs less time and metal losses get reduced.
3.6 ONSITE REUSE AND RECYCLING

Onsite reuse and recycling presupposes changing physical, chemical or biological properties of wastes at any enterprise for their further onsite use or return to the production process as secondary resources (raw materials, energy, and water).

WELL-KNOWN AND WIDESPREAD OPTIONS

- Waste heat recovery from the flue gases emissions to heat air, gases or water;
- installing equipment to process and further reuse different types of waste (shredders, crushers, presses, extruders, granulators, separators, etc.);
- valuable components recovery from waste;
- transition to close loop cooling water systems;
- installing a heat exchanger to extract thermal energy from wastewater;
- condensate return and reuse into industrial processes;
- return water cleaning for further use.

Companies working in engineering industry consume various raw materials suitable for further reuse and recovery. An enterprise in Vilniansk town implemented the reuse technique and started to produce hardware for rail transport. Vilniansk enterprise introduced aluminum recovery from the sludge got accumulated at wastewater treatment plants. The derived material (aluminum) can be further used as a coagulant.
3.7 PRODUCTION OF USEFUL BYPRODUCT

**Production of useful byproduct** – this is a technique when an enterprise manufactures byproducts being commercially attractive for a consumer. But the key point is that byproducts get produced from waste material or the main product residues.

**WELL-KNOWN AND WIDESPREAD OPTIONS**

- Processing residual materials and materials suitable for energy production (braces, pellets, biofuels);
- waste products further use or processing;
- producing byproducts from substandard materials (e.g. byproducts with lower requirements as to application, durability, shape, etc.);
- changing physical parameters of waste, which can be further used (materials reconditioning, plastic granulation, concrete grinding etc.).

**BEST PRACTICES**

Using waste or residues for useful byproducts manufacturing guarantees the enterprise benefits in terms of reducing primary resources consumption and gaining significant economic profits. A sugar plant in Vinnytsia region has successfully implemented the above described RECP technique. Thus the enterprise uses beet pulp as the raw material for the biogas plant. The beet pulp gets fermentized to produce biogas. The used out pulp stock then gets sold as fertilizer for local farmers. It should be noted that this waste disposal technique helps sufficiently improve the environmental situation in the sugar plant neighbourhood.
3.8 PRODUCT MODIFICATION

Product modification means providing some modifications in products aiming to improve their mechanical, physical and chemical properties; increasing products environmental and economic attractiveness; simplifying utilization methods and extending the life cycle.

WELL-KNOWN AND WIDESPREAD OPTIONS

- Change in product appearance to reduce the waste generation in the manufacturing process;
- choosing packaging type to prolong the products expiration date;
- using additives to raw material to improve the product performance;
- improving recipes by replacing toxic and hazardous materials;
- providing design changes to simplify product maintenance, repair and disposal.

An enterprise manufacturing semi-finished food in Odessa region applied product modification technique for ravioli and dumplings production. It resulted in productivity increase by 25% and less waste generation due to shape modification and dough placement. This became possible when replacing a standard formation matrix with a compact and modern matrix. Moreover, this option implementation ensures power consumption reduction by over 50%.
LET’S USE YOUR COMPANY POTENTIAL TO IMPROVE RESOURCE EFFICIENCY!

Having implemented the above described techniques and practices your enterprise will be able to:

- increase efficiency within current market economic environment in Ukraine;
- reduce energy consumption and material use;
- reduce production costs by reducing the resource consumption specific rates;
- reduce environmental impact and risks to human health;
- save money even with growing rates on energy and water;
- expand the range of products produced;
- increase company’s competitiveness in domestic and foreign markets;
- get closer to international quality standards for manufacturing processes and products;
- increase public and government confidence;
- improve company’s image among consumers;
- contribute to improving human’s well-being and national economy sustainable development.

IMPLEMENTING RECP TECHNIQUES AND PRACTICES CONTRIBUOTES TO SUSTAINABLE PRODUCTION IN UKRAINE

ЦЕ ШЛЯХ ДО УСПІХУ, ДОСТУПНИЙ КОЖНому ПІДПРИЄМСТВУ
GLOSSARY

The glossary suggests topical adapted terms explaining the objectives, problems and RECP implementation phases for Ukrainian enterprises, adding original terms in English. The terms are bilingual for your convenience.

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost savings</strong></td>
<td>Accumulating financial resources or savings due to more efficient energy use, materials and water management, reducing waste and emissions.</td>
</tr>
<tr>
<td><strong>Product increase</strong></td>
<td>Efficiency increase determined by the ratio of resources consumed per output unit.</td>
</tr>
<tr>
<td><strong>Product quality</strong></td>
<td>A set of technical and environmental properties of the end product determining its ability to meet the consumer needs and demands.</td>
</tr>
<tr>
<td><strong>Organizational efficiency</strong></td>
<td>A company’s ability to operate and achieve certain goals with optimal cost-to-result ratio.</td>
</tr>
<tr>
<td><strong>Licence-to-operate</strong></td>
<td>Perception, acceptance and support provided by the public, market, state and company environment caring over products quality and people’s well-being.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Selection and efficient use of materials</strong></td>
<td>The process of raw material selection and delivery options performed due to material territorial availability, logistics, quality and pollution as a result of its production.</td>
</tr>
<tr>
<td><strong>Sourcing and efficient use of water</strong></td>
<td>Providing an enterprise with high-quality water with minimal flow rates.</td>
</tr>
<tr>
<td><strong>Selection and efficient use of energy</strong></td>
<td>Transition to less energy consumption enough to ensure good manufacturing processes and efficient enterprise operation in total.</td>
</tr>
<tr>
<td><strong>Reduction and safe disposal of waste</strong></td>
<td>Ensuring waste environmental recycling for further reuse for own needs or selling; implementing RECP techniques to reduce waste generation.</td>
</tr>
<tr>
<td>Terms</td>
<td>Definitions</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
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<td><strong>Good housekeeping</strong></td>
<td>Regular implementing measures and actions to keep up enterprise operation that ensure working conditions support and optimal equipment modes, their maintenance and current repairs to avoid possible cost overruns and loss of raw materials and energy, maintenance costs and provide appropriate working conditions for personnel.</td>
</tr>
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<td><strong>Input material change</strong></td>
<td>Search and selection of secondary materials suitable to replace primary raw materials, using less hazardous or toxic substances in the manufacturing process, using alternative fuels, etc. to improve the products environmental parameteres and reduce environmental impact.</td>
</tr>
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<td><strong>Better process control</strong></td>
<td>Applying systematic measures to account resource consumption, waste and wastewater generation, determining and controlling process parameters and equipment operating modes at all production stages.</td>
</tr>
<tr>
<td><strong>Equipment modification</strong></td>
<td>Process of enterprise technical and technological base improvement, modernization and renovation aiming to achieve optimum equipment parameters modes, increase productivity, extend facility useful lifespan, improve product processing accuracy, ensuring safe and reliable equipment operation etc.</td>
</tr>
<tr>
<td><strong>Technology change</strong></td>
<td>Processing method replacement and input material transformation (materials, energy, water, etc.) at different production stages to improve its quality performance or reduce resources consumption.</td>
</tr>
<tr>
<td><strong>Onsite reuse &amp; recycling</strong></td>
<td>Technological processes to change physical, chemical or biological properties of wastes at any enterprise for their further onsite use or return to the production process as secondary resources (raw materials, energy, and water).</td>
</tr>
<tr>
<td><strong>Production of useful byproduct</strong></td>
<td>Technique assisting the enterprise to manufacture byproducts being commercially attractive for a consumer. But the key point is that byproducts get produced from waste material or the main product residues.</td>
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<td><strong>Product modification</strong></td>
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</tr>
</tbody>
</table>
### Objectives of RECP

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resource efficiency</strong></td>
<td>Decreasing resource consumption in manufacturing process per unit of goods and services produced.</td>
</tr>
<tr>
<td><strong>Impact minimization on the environment</strong></td>
<td>Developing and implementing options and technical solutions that ensure the reduction of air emissions, waste production, their return to the production cycle or using as secondary material; implementing no drainage technologies and water circulation cycles.</td>
</tr>
<tr>
<td><strong>People's well-being</strong></td>
<td>Minimizing risks and meeting economic and environmental safety requirements (clean environment, better labour conditions, etc.); social development support.</td>
</tr>
</tbody>
</table>

### Steps of RECP Implementation

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data collection and analysis</strong></td>
<td>Enterprise pre-assessment covering overall housekeeping and fuels, water, wastewater, waste and air emissions data collection.</td>
</tr>
<tr>
<td><strong>Detailed assessment</strong></td>
<td>Overall company operation inspection and/or its certain processes to identify and reveal unproductive losses; potential assessment for possible resources savings.</td>
</tr>
<tr>
<td><strong>Development of resource efficient solutions</strong></td>
<td>Search and discussing the possibility to implement RECP organizational and technical options aimed at energy and resources consumption reduction.</td>
</tr>
<tr>
<td><strong>Ecological and economic assessment</strong></td>
<td>Developing environmental and economic feasibility studies proving the resource and energy conservation implementation; RECP options investment assessment.</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Practical implementation of options, processes and technological changes to increase productivity and minimize environmental impacts and reduce risks to human health.</td>
</tr>
</tbody>
</table>
REFERENCE MATERIAL

UNIDO Cleaner Production Toolkit. [http://recpc.kpi.ua/ru/resursnye-materialy/posobie-yunido-po-chistomu-proizvodstvu]

Introduction to UNIDO. Inclusive and Sustainable Industrial Development. [https://www.unido.org/fileadmin/user_media_upgrade/Who_we_are/Structure/Director-General/DG_UNIDO_FINAL_WEBs.pdf]


PRE-SME – Promoting Resource Efficiency in Small & Medium Sized Enterprises
Industrial training handbook


[http://recpc.kpi.ua/ru/projects-ru/eap-green/project-in-ukraine]


RECP Centre, Ukraine, UNIDO (2014).

Resource Efficient and Cleaner Production Centre in Ukraine (2015). RECP conception
[http://recpc.kpi.ua/ua/pro-nas-2/kontseptsiya-rechv]

Resource Efficient and Cleaner Production Centre in Ukraine (2015). Eap GREEN Programme
[http://www.recpc.kpi.ua/ua/projects-ua/eap-green]

[http://www.menr.gov.ua/dopovidi]
THE EXECUTORS OF DEMONSTRATION PROJECT IN UKRAINE “RESOURCE EFFICIENT AND CLEANER PRODUCTION” within EaP GREEN PROGRAMME framework:

United Nations Industrial Development Organization (UNIDO)  
Address: International Centre in Vienna, PO box 300, A1400, Vienna, Austria.  
Web: www.unido.org/eapgreen  
www.green-economies-eap.org

Resource Efficient and Cleaner Production Centre (Ukraine)  
Address: build.6, Peremohy ave., 37, Kyiv, 03056, Ukraine.  
Web: www.recpc.kpi.ua  
www.recpc.org