European Commission
TEMPUS

Tempus 158989-Tempus-1-2009-1-BE-Tempus-JPHES
Creation of university-enterprise cooperation networks for education on sustainable technologies

Dissemination booklet

Zoltan Zavargo
Vineta Srebrenkoska
Emilija Fidančevska
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Project ID	158989-Tempus-1-2009-1-BE-Tempus-JPHES
Project Type	Higher Education and Society (HES)
Target Countries	RS, BA, MK
Title	Creation of university-enterprise cooperation networks for education on sustainable technologies
Objectives	1. To bring new curricula on sustainable industry for the staff from industries involved in the project 2. To adopt experience from EU partners on sustainable industry in the newly developed curricula 3. To bring the knowledge of staff from industry closer to standards in EU partner countries 4. To bring the strategy for education for the staff from industry on sustainable industry issue
Subject Area Code	500
Duration	3 years
Tempus Grant	636.512 EUR
Co-financing	67.214 EUR
Grant holder	Catholic University College Ghent (KAHOSint-Lieven)
Co-ordinator	Geert De Lepeleer
Other partners	Vienna University of Technology Faculty of Technical Chemistry, Institute of Chemical Engineering Vienna, Austria
	University of Applied Sciences Trier Institute for Applied Material Flow Management Birkenfeld, Germany
	University of Novi Sad, Faculty of Technology Novi Sad, Serbia
	University of Nis, Faculty of Technology Leskovac, Serbia
	University of East Sarajevo, Faculty of Technology Department for Food Technology Zvornik, Bosnia and Herzegovina
	Tuzla University, Faculty of Technology Tuzla, Bosnia and Herzegovina
	University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy Department of Inorganic Technology Skopje, The former Yugoslav Republic of Macedonia
	University Goce Delcev, Faculty of Technology Stip, The former Yugoslav Republic of Macedonia
	VOKA-Chamber of Commerce East-Flanders Ghent, Belgium

Chamber of Economy of Vojvodina Novi Sad, Serbia
Regional Chamber of Commerce and Industry Leskovac, Serbia
Chamber of Commerce and Industry Bijeljina Region Bijeljina, Bosnia and Herzegovina
The Chamber of Economy of Tuzla Canton Tuzla, Bosnia and Herzegovina
Economic chamber of Macedonia, Department of chemical industry Skopje, The former Yugoslav Republic of Macedonia
Alltech Serbia a.d. Senta Senta, Serbia
Sugar Factory “TE-TO” Senta Senta, Serbia
DCP Hemigal Leskovac, Serbia
Birać Zvornik, Bosnia and Herzegovina
Vegafruit d.o.o, Technical department Doboj istok, Bosnia and Herzegovina
BOMEX Refractory Pehčevo, The former Yugoslav Republic of Macedonia
EUROKOMPOZIT Prilep, The former Yugoslav Republic of Macedonia

The Project has been funded by the support of the European Commission.
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Introduction
Geert De Lepeleer

As a coordinator of this Tempus project it is a great honour for me to write this introductory chapter.

The past three years gave us once again a great example of the strength of Tempus in gradually but surely improving the quality of higher education in the partner countries. Improving the cooperation between the academic world and the work field is an important key factor in the further implementation of the Bologna declaration in the partner countries. I am convinced that industry staff learnt a lot from university professors and vice versa. In the long term, this is profitable for both parties. I also hope that involving guest lecturers from industry and internships for students can be further developed.

There is a great synergy between the universities from Bosnia and Herzegovina, Serbia and the Former Yugoslav Republic of Macedonia. The cooperation agreement between the partner universities guarantees the sustainability of the project results. Therefore, a detailed strategic plan has been developed.

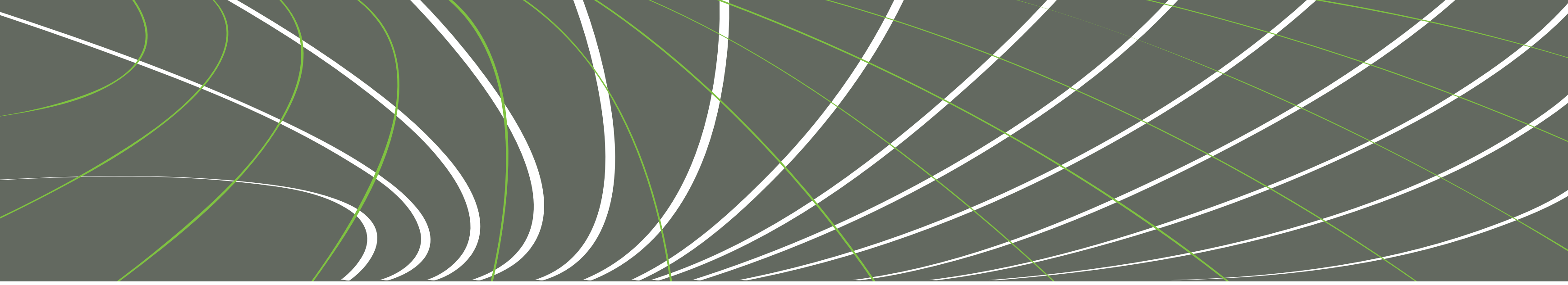
Moreover, the cooperation on the further development of sustainable technologies remains an important topic in the European policy. This is an ideal subject for further cooperation: not only between the EU partners and the partner countries but also between the academic partners and the industry partners. Sustainable technologies do not only offer great chances in further promoting the idea of lifelong learning, but also open great possibilities for stimulating innovation and entrepreneurship.

Especially I want to express my gratitude to all project partners with whom I have been ideally cooperating within this project: my KAHO colleagues, the EU partners, the partner universities, the individual experts and the representatives from industry. All of them have been contributing to a really good atmosphere, showed great hospitality and I really do appreciate all efforts done by all partners involved in the project. The successfully implemented project outcomes are the result of a close cooperation between all project partners.

My special thanks go to Prof. dr. Zoltan Zavargo, the dean of the faculty of Technology in Novi Sad in Serbia for assisting me in the coordination of the project and to my colleague Ms Ellen Matthijs for taking care of the financial and administrative project management.

Yours sincerely,

Geert De Lepeleer
International Project Coordinator KAHOSint-Lieven



1. Mission and vision

The aim of this project was to improve the university-enterprise cooperation in the process of creating sustainable industry in Serbia, Bosnia and Herzegovina and the Former Yugoslav Republic of Macedonia. To achieve this goal special courses on sustainable industry have been created and held to industry. In this way the LLL process and the cooperation between industry and universities in the WB countries was enhanced.

The project partners recognized the importance of sustainable development. The sustainable concept of zero emission seems to be an answer to both industry and society. The aim of zero emissions is maximum resource productivity and virtually no waste. Creating a zero emission industry is a great challenge for EU. It enables sustainable development, safe today and safe for the future. At the same time it reduces significantly our energy and material resources. During the life of this project the WB partners had the opportunity to see many attractive solutions of the Zero emission concept in EU partner countries.

For WB countries it is of great interest to be as close as possible to this trend. It is obvious that in the future this kind of activities will be very intensive. EU and WB will need many experts in these fields. The staff from the industry, primarily engineers and management staff, but also all other cooperators should master the new knowledge in order to handle this new environmental management technique.

According to the Application the specific objectives of the project are:

1. To bring new curricula on sustainable industry for the staff from industries involved in the project
2. To adopt experience from EU partners on sustainable industry in the newly developed curricula
3. To bring the knowledge of staff from industry closer to standards in EU partner countries
4. To propose strategy for education for the staff from industry on sustainable industrial production

Mission statement

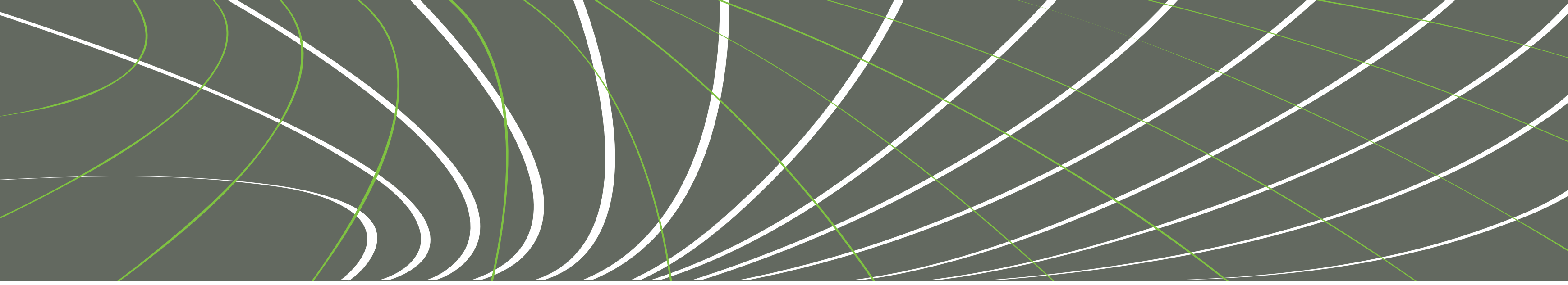
The mission of each WB partner university is to spread knowledge on sustainable technologies, spread the idea on zero emission concepts and strengthen the link between university and enterprises and WB universities.

Vision statement

In the middle term: the project consortium wants to be recognized as a valuable partner in providing courses on sustainable technology.

In the long term: the project consortium wants to be a valuable partner in the process of building a sustainable industry.

Primary stakeholders are staff from the industry; other stakeholders: graduated students, public services and local administration. The WB partners will realize the mission providing courses on sustainable technologies for the project's stakeholders. The stakeholders can also take part in the teams with specific tasks on sustainable industrial entrepreneurship in a given industry partner organization and its performance.



2. Sustainable technologies and lifelong learning EU's experience

Sustainable technologies

Having in mind the definition of sustainability „Sustainability means meeting the needs of the present without compromising the ability of future generations to meet their own needs." sustainable technologies should not have negative impact on the environment and should not deplete natural resources.

The sustainable technologies should create environmental friendly processes, processes that ideally have no harmful emission on the environment and creates no wastes (Cleaner production). Productions can be more or less clean but in reality rarely no side-products or wastes will be produced. The only right solution is that by-products or/and wastes should be reused in the same process, in other processes or in another industry (Zero emission concept). Ideally, no net waste is produced. If not possible the minimum waste should be safely deposed. In some cases the formation of pollutants from the process cannot be avoided. Special technologies must prevent the emission of such pollutants to environment (end-of-pipe technology).

It seems that zero emission concept can be accomplished by cleaner production processes and if necessary by adoption of end-of-pipe treatment. This solution makes technologies sustainable. The minimal amount of waste that cannot be handled in the process will not cause trouble to the environment. One more aspect must be taken into account, the sustainability of resources. That is possible by using energy efficient technologies and renewables. At this moment, it seems to be an answer to what sustainable technologies are.

Material Flow Management

Institute for Applied Material Flow Management, Birkenfeld, Germany

The Institute for Applied Material Flow Management is located in Environmental Campus Birkenfeld. It is called "Zero Emission Campus" designed according to Zero emission concept and supplied with energy and heat free of CO_2. The Campus can cover its entire heating and power demands with renewable energy. **Environmental campus Birkenfeld** is a practical example of zero emission concept. The buildings in the Campus are reconstructed according to energy efficient building concept. There are active and passive utilization of solar energy as well as the energy of the ground. Other energy efficient tools like heat recovery are also used. A new approach of zero-emission water concept was introduced.

The IfaS promoted Material Flow Management as a tool for sustainability and green business development. The aim is to minimize external inputs like heat, energy and water. The minimized need for inputs is achieved by using renewable, by wastes and by recovery.

Institute for Applied Material Flow Management cooperate with companies on projects like designs of regional material flow management strategies and tailor-made training and further education programs. The Material Flow Management is a tool for achieving a Zero Emission Concept in practice. In the case of industry the Industrial Material Flow Management is applied. When applying general goals of Enterprises must be followed and, depending on the goal, different System Borders can be analyzed. Particular attention must be paid to Life Cycle Analysis, Eco-Efficiency, Cleaner Production and ECO-Profit as well as Environmental Management. The key elements of eco-efficiency are: re-engineer processes, re-valorize by-products, re-design products and re-think markets. Regional district heating concept was presented as an example for a company internal MFM and regional MFM paying attention to stakeholder management, biomass potential, heat energy demand analysis, logistics and supply concept as well as sustainable technology concept.

Sustainable education or education for sustainability is realized in the frame of the educational courses at the Institute for Applied Material Flow Management. The interdisciplinary education for sustainable development, training in zero emission system design and applied research for sustainability are realized through the IMAT programs.

In these programs students provide knowledge on material flow management, ecological economics, clean technologies/environmental technologies, understanding of holistic and complex material and ecological systems, project and change management, intercultural communication/networking, financing, environmental management.

Circular economy

Circular economy means use of regional material and energy resources. The concept provide an entire range of services such as collection, transport and treatment of municipal waste and materials through energetic and material recycling of group of waste and the storage of inert materials.

The society has to recognize waste as a regionally available source and material flow in the sense of a circular economy. Each region should optimize their material and energy consumption with the own local resource potential. Sustainable material flow management ensures environmental protection and minimization of national economic risk.

Circular economy with MFM approach allows the activation of local/regional potentials. The regional added value follows by activation of regional resources. The MFM methodology includes definition of material and energy flows in a system which has to be analyzed and optimized; identification of the major efficiency, sufficiency and optimization potentials; identification of regional key stakeholders, decision makers, etc. Energy efficiency is increased through material recycling. The concept eliminates the need for land fields. According to the concept, waste is treated as a resource, increasing energy efficiency and climate protection.

The Institute for Applied Material Flow Management is a part of the network in Rhineland-Palatinate, which is active in Circular Economy concept application.

Clean air technology

Institute for Chemical Engineering, Vienna, Austria

The major focus of the Institute for Chemical Engineering (Faculty for technical chemistry, Vienna University of Technology) are technological/industrial application. Due to this fact, there has traditionally been a large number of thematically diverse collaborative projects with industry. In this regard a clear focus of the available core competences on scientific and technological problems in industry as well as on the main scientific areas promoted by the various funding organizations will continue to be crucial for the further development of the institute. The institute is organized in seven research areas, which themselves consist of several working groups. The group which deals with clean air technology and Zero emission Energy are the most interesting concerning the topic of this project.

Dust separation from air and gases

Dust consists of particles that come from various sources. In human environment like homes and offices dust contains small amounts of other particles which may be found in the local environment like plant pollen, human and animal hairs, textile fibers, paper fibers and so on (Kathleen Hess-Kosa, 2002).

An aerosol is a suspension of fine solid particles or liquid droplets in a gas. Examples are clouds, and air pollution such as smog and smoke.

Technically dust and an aerosol are suspensions of fine particles in gas. At dust particles in a gas are smaller than app. 100 micrometer while at aerosol particles in a gas are smaller than app. 10 micrometer. Aerosols can contain solid or liquid particles.

The differences of dust (100µm) and aerosol (10µm) are defined by EU regulations: EU-Council Directive 1999/30 EC, PM10 and EU-Council Directive 2008/50EC.

Emission is the release of gases, vapors, aerosols and other pollutants from air pollution sources.

Immission is the concentration of gases, vapors, aerosols and other pollutants in the air at a particular place, at a particular time, which expresses the quality of the air;

Characterization of Emissions and Immissions is based on the following parameters:

- TSP: Total suspended particles [mg/m^3],
- PM10: Particulate matter smaller than 10 µm [mg/m^3],
- PM2,5: Particulate matter smaller than 2,5 µm [mg/m^3],
- PM1: Particulate matter smaller than 1 µm [mg/m^3] (USA),

where particle size is considered to be at the level of an aerodynamic diameter. The aerodynamic diameter is the diameter of a sphere of unit density (1g/cc) that has the same gravitational settling velocity as the particle in question.

Generation and sources of dust

- Condensation processes (from gases and vapors)
- Dispersion processes (from solid masses, re-dispersion of already separated dust)
- Combined processes of 1) and 2)
- Augmentation of micro organism

Concerning the sources, particle emission can be divided up into natural and anthropogenic aerosols.

Dust separators

There are five basic dust separators:

- Settling chamber
- Cyclone
- Bag house filter
- Wet scrubber
- Electrostatic precipitator

Filtering separator can be divided into depth filter and cleanable filter.

Characterisation of dust separators:

- Fractional separation efficiency
- Pressure drop, energy consumption

Fugitive dust emission

There are two kinds of dust emission: point dust source and fugitive dust source. Fugitive dust emission

- Arising from non conducted sources;
- Diffuse dust sources can be assigned by geometry: point source line source, area source or volume source;
- Dust sources which create fugitive dust are created for example by exposure of:
  - open faces (construction, mining or agricultural sites),
  - roads or parking areas,
  - stock piles or
  - bulk solid processing

At dust minimization there are 2 effects, which are acting in series:

1. Moistening effect and
2. Dust separation by water droplets.

In 1987, the American ENVIRONMENTAL PROTECTION AGENCY (EPA) undertook a rigorous approach to classify fugitive dust and introduced the NATIONAL AIR QUALITY STANDARD FOR PARTICULATE MATTER (PM-standard) [2]. The EPA furthermore classified particulate matter as one of six air pollutants, including carbon monoxide, lead, nitrogen dioxide, ozone and sulfur dioxide [3].

EPA: PM 10 = Particular matter with an aerodynamically diameter smaller than 10µm

Guideline 1999/30/EG: PM10 are particles which pass a size selective air inlet which performs for particles with an aerodynamically diameter of 10µm a separation efficiency of 50%. The PM10 restrictions in the EU are based on the 1999/30/EG.

Further specified classification of dust is:

TSP: "Total Suspended Particulate", dust particles with an aerodynamic diameter < 57 µmSP: "Suspended Particulate", is considered as "PM-30".

IP: "Inhalable Particulate", particulates with an aerodynamic diameter < 15 µm, "PM-15"

FP: "Fine Particulate", particulates with an aerodynamic diameter < 2.5µm, "PM-2.5"

Dangers for long-term exposure to fugitive dust

- Chronic injury of the lung;
- Decreased lung function in children and adults
- Shortened life expectancy, primarily due to heart/lung diseases and probably also because of cancer.

Metalworking mist separation

Metalworking fluids play very important role in different fields of application like:

- Cutting processes such as drilling, turning, milling, broaching, honing, grinding
- Shaping processes such as rolling, deep drawing, pressing
- Machine tools, machining centers and transfer systems for cutting processes
- Rolling mills for sheet metal and steel, light alloys and heavy non-ferrous metals
- Presses for molding and deep drawing parts made of steel, light alloys or non-ferrous metals.

But, metalworking fluids (MWFs) have been clearly documented as causing severe health problems due to workers coming in contact with these metalworking fluids such as contaminated toxic solvents, oil mists, coolant mists and oil containing smoke. These industrial solutions and airborne mists and aerosols enter the body through direct skin contact or through inhalation from breathing. Millions of workers who are employed in the manufacture of automobiles, farm equipment, aircraft, heavy machinery, and other hardware are exposed to machining fluid mists and smoke on a constant basis.

Different separators can be distinguished by their filtration mechanism: Filtering separators, Electrostatic precipitators, Centrifugal collectors and Combinations.

Analogies to norms and standards for dust filter

Basic norms:

EN 1822-2:2009 high efficiency air filters (EPA, HEPA and ULPA) – Part 2: Aerosol production, measuring equipment, particle counting statistics;

European Standard for Coarse and Fine Filters

In 2002, the European Committee for Standardization, Technical Committee 195, Work Group 1 (CEN/TC195-WG1) established a new standard for general ventilation filters. The introduction of this standard is under document name EN779:2002

VDI-Guideline 3926 “Testing of Filter Media for Cleanable Filters”

Clean air

“Scheuch” company

The company “Scheuch” applied innovative technologies and processes for clean air. The company has developed own product line-up, which includes centrifugal separators, fabric filters, wet and dry electrostatic precipitators, biological exhaust gas scrubbers, a variety of cooling and heat extraction systems, as well as fans, rotary valves, discharge devices, valves and control systems or control devices. All components were completely compatible with each other and were optimized for the respective application. The company „Scheuch“ has five main business segments:

- wood processing industry
- wood based panel industry
- metals industry
- Industrial minerals and energy industry.

The main attention is paid to energy industry – which included a range of innovative systems for de-dusting, reduction of pollutants, heat recovery and for the cleaning of exhaust gases generated by biomass – fired heating and combined heating and power plants, as well as plants used to recover energy from fossil fuels, scrap wood, residual materials and waste. The three main technologies are:

1. Effective dust separation – for the separation of particles and centrifugal separators for pre-separation and dry electrostatic precipitators for final cleaning were presented.
2. The ERCS process (Energy-Recovery & Cleaning-System), which was developed and patented by “Scheuch” and offers dust and particle separation and highly efficient heat recovery and energy-optimized plume removal.
3. Efficient removal of pollutants – the bag filters were presented. They showed that the fabric filter plants are extremely well suited for filtering fine dust and for use in combination with sorptive processes to reduce pollutants.

Cleaner production

Laboratory of environmental technology, KAHO Sint-Lieven, Gent, Belgium

The laboratory investigates the deposition of metal coatings and treatment of wastewater generated in the galvanization pilot processes and other labs of KAHO Sint-Lieven.

The Laboratory develops new technologies that do not produce negative influence to environment.

Wastewater generated in the process of galvanization is purified in a combined membrane separation process and an ion exchange process, which removes most of the cations and anions of metals and salts from the wastewater. The water is then treated electrochemically in order to remove metals even at very low concentrations. The complete process is monitored; the concentration of metal cations and anions in wastewater are measured by atomic absorption spectrophotometry, which allows the determination of trace concentrations of metals.

Wastewater from galvanic process is especially dangerous because it may contain metal ions that are very harmful to human body, and their treatment is very important and necessary.

AQUAFIN waste water treatment plant and IVAGO waste management

Gent, Belgium

In the AQUAFIN wastewater treatment plant, household wastewater of the city of Gent is collected and treated. The treated water is discharged to a neighbouring recipient canal. The by-product from the wastewater treatment plant is sludge which is reused or incinerated with energy recuperation. Biogas produced by sludge digestion is used to produce green power by IVAGO, an inter-communal co-operation company for waste management in Gent and Destelbergen. The main activities of IVAGO are collection of household waste, cleansing services city of Gent, marketing of collected waste fractions, communication and education programs on waste management, refuse waste incineration with energy recovery. Sustainable waste management of IVAGO follows waste hierarchy including prevention, reuse, recycling, incineration with energy recovery, avoiding landfill disposal of untreated waste.

Waste water treatment

EBS Vienna, Austria

Entsorgungsbetriebe Simmering GmbH (EbS) was founded in 1976. The city of Vienna is the sole proprietor of EbS, the *Simmering Waste Disposal Facilities*. Vienna's main wastewater treatment plant and the city's animal disposal plant have formed part of EbS since 2000. Since then the company has also invested in several water technology companies. Top-quality standards and continuously enhanced services have made EbS an environmental competence centre as well as one of the main pillars in the provision of public services. About 160 employees take care of the smooth operation of the EbS facilities and therefore contribute to the top quality of life in Vienna.

Environmental protection, occupational health and safety, and the quality of work play an important role for the EbS. Therefore, the general management decided to develop an Integrated Management System (IMS) for the documentation and continuous improvement of these factors. The IMS combines the demands of quality, environmental protection and occupational health and safety to an integrated system. The IMS was accredited by an independent institution according to the relevant standards of environment (EMAS, ISO 14001:2004), quality (ISO 9001:2000) and occupational health and safety (OHSAS 18001:1999).

In Simmering, at Vienna's lowest point, where the Danube Canal meets the Danube, lies Vienna's main wastewater treatment plant. Here around 98% of Vienna's wastewaters are purified. On dry-weather days this is more than 500,000 cubic meters, which corresponds to a flow of a medium-size river. It takes about twenty hours for the wastewater to pass through the mechanical and the two biological purification stages before it is purified and discharged into the Danube Canal. The expansion of Vienna's main wastewater treatment plant was realized from the years 2000 to 2005. The expansion included the construction of a second biological purification stage for nitrogen elimination (nitrification and denitrification). The second biological stage is added to the first biological stage, which is in operation since 1980. The application of the latest technologies with a significantly increased purification capacity will contribute considerably to Vienna's wastewater management and justify its reputation as a model city with high standards in environmental protection.

The wastewater generated by households, trade and industry remains in the main wastewater treatment plant for 20 hours. During this time, it is treated mechanically and biologically. By means of this process, more than 80% of the nitrogen, over 90% of the phosphates, and more than 95% of the organic pollutants of the wastewater are eliminated. About 30% of all pollutants are already removed by mechanical purification. Each day, about 100,000 kg of carbon, 30,000 kg of nitrogen and 5,000 kg of phosphates are removed from the wastewater. In the biological purification stage, trillions of microorganisms are continuously purifying Vienna's wastewater.

Sustainable waste management

ZAK, Kaiserslautern – Mehlingen, Germany

Waste Management Centre ZAK, Kaiserslautern – Mehlingen, is a joint venture of the city and county (Landkreis) of Kaiserslautern. ZAK occupies 88 ha and has 77 employees. Its total asset in 2008 was about 93 million Euros. All kinds of waste from the neighboring area (about 250.000 habitants) are sorted, recovered and treated. The waste is subjected to 200 bar pressure to remove any liquids and to compress the remaining solid trash into compact, highly combustible blocks with caloric output. ZAK uses about half of the trash to produce electricity via an incineration process, while the remaining half sends to another heating & power plant for processing. The landfill for unused solid waste occupies about 21 ha or 5.6 million m^3. It had been built from 1976 to 1978 and is planning to be closed in 2016. It accepts currently about 400,000 tons of mineral waste per year. The biogenic liquids from the compression are put into a reactor where the methane gas is produced. This methane gas is burned together with shredded wood (obtained from old furniture and pallets and natural wood) in a biomass power plant, which produces electricity that goes back into the power grid and heat (20 million kWh of electricity and 4 million kWh of heat per year). The energy comes also from three wind turbines located there. If the same amount of energy is produced from coal, it will emit 20,000 tons of CO_2 annually. The biological wastes are composted to produce fertilizer. ZAK also accepts both hazardous waste and other small amounts of household waste (oil, paint, acids, fungicides, fertilizer, glue and spray cans, etc.) or yard waste, which is then sorted and disposed. In ZAK's Environmental Education Center more than 500 children and young people have been taught through environmental experience every year since 1998.

Sustainable waste management

IVAGO, Gent, Belgium

The objective of IVAGO is sustainable waste management. IVAGO is active in four areas: collection of household waste from private residences, collection of similar waste from companies (SMEs, hotels and restaurants), public cleaning and sanitation services for the city of Gent, incineration of household waste and similar waste in an incineration plant, performing exhaust gas treatment (deNOx i CO_2) and energy recuperation.

IVAGO has incinerator equipped with an energy recovery system to maximize the conversion of the energy of the flue gases into steam. This steam is used both for production of electricity and for heat supply to the nearby University hospital.

Long term strategy of IVAGO is the control of costs of waste processing by waste emission prevention, recycling and reuse, information about waste streams, change of behaviour towards waste and feedback of results.

IVAGO in its structure, has a center for the selection of waste being sent for recycling: demolition waste, green waste, metals, white goods & brown goods, wood, tyres, household hazardous waste (batteries, paint residues, oils), textile, etc. The stages of recycling and reuse include: a) Selective door-to-door collection (glass, paper, kitchen and garden waste, bulky household, packaging waste such as plastic bottles, metal and drink cans, etc.); b) Selective collection appartment blocs; c) Application principle "the polluter pays".

Sustainable waste management

Incineration Plant MVA Pfaffenau in Vienna, Austria

The "MVA Pfaffenau" plant was built to the highest technological, emission control and environmental impact standards achievable at the time of its construction. The quality of emission control well exceeds the quality required under current regulations.

About 50 people take care of the running of the plant. Consuming 250,000 tons of residential waste per year, MVA Pfaffenau produces 65 GWh of electricity and 410 GWh of district heating per year.

The residential waste is collected by the municipal refuse collection service and brought directly to the plant. About 200 trucks per day empty their loads into the refuse bunker, which has the capacity of approximately 18,000 cubic meters.

The refuse bunker is equipped with two grab cranes which are used to mix the waste and deliver it to the inlet hoppers of the two fluidized bed incinerators which, combined, incinerate 32 tons of waste per hour at a furnace temperature of 850°C.

At the back end of the combustion grates, slag and other residue is discharged for wet purging. A magnetic separator removes any ferrous metal for recycling and the slag is fed into the slag collection bunker.

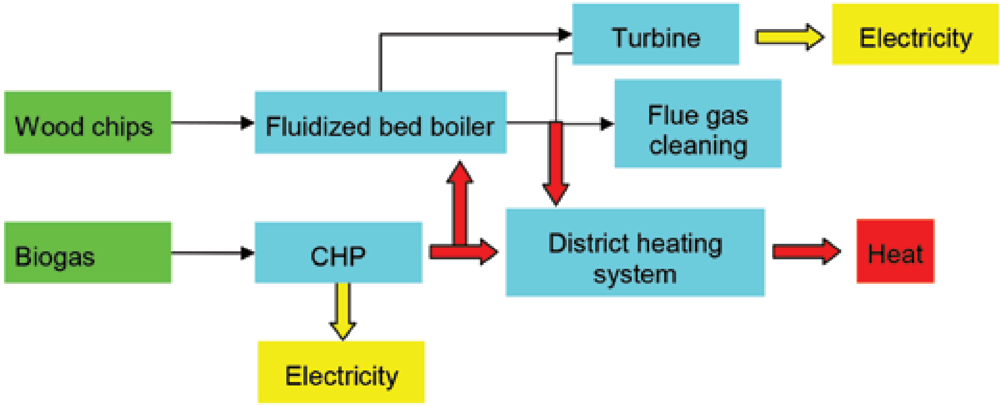
The waste heat boilers of the incinerators absorb the heat from the incinerator flue gas to produce steam, at 40 bars and 400°C, which is fed through a steam turbine coupled to a generator, producing electricity. The exhaust steam from the turbine is then passed through the heat exchangers of the district heating installation. Here the steam is condensed and fed back into the water circuit of the waste heat boilers. Meanwhile, the residual heat absorbed by the district heating heat exchangers is piped away to heat up to 50,000 households connected to the district-heating network of Vienna.

The exhaust gases from the boilers are cleaned to a very high environmental standard using a series of precipitators, scrubbers, filters and a deNOx unit.

Circular Economy

Biomass CHP Plant of OIE in Neubruecke

The liberalization of the electricity market has put the new challenges onto OIE AG as the company in energy industry. Competition, efficiency and future-oriented actions in the interests of consumers are the goals, which they are focused on.



Biomass heat and power plant (Biomass CHP) located in Neubrücke, has the development concept based on the regenerative use of wood fuels and biogas in cogeneration plant (wood chips: 29 MW thermal and 8.3 MW electric energy; biogas from anaerobic digestion: 430 kW thermal and 2 X 310 kW electric). The investment was completed in 2003 and the cost was 15 million Euros. The basic concept of of the Biomass CHP plant is based on the input of wood (biomass) and biogas and is given in the following picture.

By connecting the existing OIE's heating, network heat extraction was doubled and thus an active contribution to reduction of CO_2 emissions. This concept is thermodynamically optimized process with an efficiency of 28%. Fluidized bed combustion was implemented in boiler construction for high efficiencies; steam flow was 37.5 t/h, at pressure of 60 bars, temperature of 450˚C and with the efficiency higher than 91%. Open floor nozzle drive constant total gas volume for optimum fluidization. Allocation of fresh air / recirculation gas to bed is set to stoichiometric conversion of the fuel while residual oxygen content in the exhaust is about 3% (wet). Feed water to boiler is preheated to increase thermal optimization. Wood demand per year: 60,000 t, different types of wood (quality A I to A IV) but not contaminated one. Biogas feed is about 220 Nm3/h.

Flue gas cleaning: SNCR process with ammonia water (25%), ash sorption with hydrated lime and lignite coke and bag filters based on PTFE. In water preparation complete desalination is used (conductivity: <0.1 uS / cm) with advantage of Chemical-free desalination using EDI technology (Electro-deionization). As it can be seen from the following table, all emissions (MW) are beneath allowed emissions values.

Emissions (Continuous measurements)	MW	HW	TM
Dust mg/Nm^3	1	30	10
NOx mg/Nm^3	150	400	200
CO mg/Nm^3	4	100	50
SO2 mg/Nm^3	8	200	50
HCL mg/Nm^3	6	60	10
C sat. mg/Nm^3	2	20	10
Hg mg/Nm^3	0.01	0.05	0.03
MW = measured value, typically HM = Half-hourly average value TM = daily average			

Circular economy

Bioethanol plant in Tulln, Austria

The Sugar factory Tulln (Zuckerforschung Tulln Ges.m.b.H.**)** is also active in the preparation, processing and application of agricultural products, not only in the foodstuffs area, but also in the area of renewable fuels.

The bioethanol plant annually processes up to 620,000 tons of cereals to produce up to 240,000m^3 or 190,000 tons of bioethanol as well as up to 190,000 tons of the high-quality, GMO-free, protein-rich animal feed Actiprot.

During the production of bioethanol, some of the carbon dioxide stored in the renewable raw materials (primarily wheat and corn) is released. The planned plant will recover, clean and liquefy over 100,000 tons of the biogenic carbon dioxide released from these renewable raw materials. This liquefied CO2 will be available for use in various industrial applications, particularly for carbonated beverages.

In Austria, 5% bioethanol by volume is currently added to petrol in line with the mandatory admixture legislation. The bioethanol is also used in the new and environmentally sensitive fuel SuperEthanol E85, which consists of up to 85% bioethanol, the remainder being petrol.

During a recently performed research and development project concerning bioethanol production Sugar factory Tulln has found that the process can be significantly enhanced through the incorporation of commercially available cellulose enzymes to the fermentation process. Up to 55% of the cellulose fraction within the fermentation substrate can be converted to produce an approximate 2.5% additional increase in BioEtOH per kg of raw material.

Circular economy

Energy Landscape Morbach, Germany

Energy landscape Morbach is an example of shaping a future. Biomass, wind power and photovoltaic are here for business, research and citizens. The energy landscape Morbach is a unique concept for the intelligent use of local resources to save costs and resources in the region Morbach.

On the grounds of the former U.S. ammunition depot Rappaerath/Morbach the park for producing renewable energy was built. The produced electricity is fed into a grid; the produced heat is used to supply heat demands. Biogas and wood pellets are produced. The electricity is produced from wind power and photovoltaic.

Advanced energy conversion

Biomass gasification

Another interesting/promising possibility for using of renewable is Biomass gasification. Biogeneous residues are pretreated using energy from the Plant. The next step is gasification. The obtained gas can be used for industrial heat or co-firing. Alternatively gas can be cleaned, upgraded and use as fuel or for synthesis purpose.

There is demonstration plant in Austria (started with operation in 2001.) using of such a gas. The plant is used for combined heat and power generation. Besides heat and power production, biomass gasification gas can be used for Synthetic gas (SNG), fuels (diesel), methanol, hydrogen and other chemicals production.

Carbon Footprinting

Carbon footprinting (CFP) is a term used to describe the amount of greenhouse gas emissions caused by a particular activity or entity. It is a measure of the impact our activity has on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating, transportation etc.

Carbon footprint helps to introduce first life cycle thinking, better understanding of own processes, possibility to optimize processes or choose among alternative processes, give a possibility to optimize sourcing, providers, supply chain, etc.

Zero energy emission technologies

Chemical Looping Combustion for CO_2 Ready Steam Generation

One of the main problems concerning environmental protection is global warming connected to emission of greenhouse gases (GHG), mainly CO_2, in the atmosphere. Carbon capture and storage (CCS) is one of the ways to reduce emission of CO_2 in the atmosphere and thus deplete global warming. The technology captures the CO_2 from flue gas as the result of combustion of fossil fuel use in power generation and other industries. Captured CO_2 is then transported and stored in underground geologic formations in order to store it securely away from the atmosphere.

There are several Carbon capture routes: Industrial processes, Post-combustion capture, Pre-combustion capture, Oxi-combustion and Unmixed combustion. A Chemical Looping Combustion (CLC) is a new process for oxidizing fuels using metal oxides as oxygen carriers transporting oxygen from combustion air to fuel. There is no mixing of combustion air and fuel and the flue gas (combustion products) are not diluted by N2. Chemical looping combustion typically is performed in two coupled fluidized beds. In a fuel-reactor (one bed) a metal oxide is used as the bed material providing oxygen for combustion. The second bed (air-reactor) re-oxidization is inserted before the fuel is reintroduced into the fuel reactor and completing the loop.

Isolation of the fuel from air simplifies the number of chemical reactions in combustion. Employing oxygen without nitrogen and the trace gases found in air eliminates the primary source for the formation of nitrogen oxide (NOx), producing a flue gas composed primarily of carbon dioxide and water vapor; other trace pollutants depend on the fuel selected.

A Chemical looping combustion (CLC) has been shown as an interesting technique for carbon capture. Carbon capture is facilitated by CLC because the two redox reactions can be made to occur in separate vessels. This gives CLC clear benefits when compared to competing carbon capture technologies, as the latter generally involve a significant energy penalty associated with either post combustion scrubbing systems or the work input required for air separation plants. This has led to CLC being proposed as an energy efficient carbon capture technology. Briefly, CLC can achieve both an increase in power station efficiency simultaneously with low energy penalty carbon capture.

Juwi, Germany

Zero-Emission Company

During the visit to “JUWI” company, we were introduced to the concept of zero-emission technology. The company’s business strategy is based mainly on the utilization of solar and wind power energy. We visited the areas where they installed solar panels and windmills to generate electricity. In Germany, among others, this company has installed over 400 wind turbines that produce over 600 MW of energy. They use solar energy with 1,400 PV installations, and installed capacity more than 600 megawatts. This means, that annual CO_2 savings is approximately 325,000 tons. They also produce biogas and biomass from dried pellets and apply it for heat energies production as well as electricity power generation.

Sustainable building

Gent, Belgium

One of the research goals in Europe is to develop the sustainable construction of energy independent buildings. In Belgium, at KAHO Sint-Lieven, several examples of such attempts were presented.

- Construction of a low-energy passive cabin
- Design and building of four very low energy teaching rooms in KAHO
- Analysis and optimization of performance criteria and calculation methods for very low energy school buildings
- Zero energy consuming buildings
- The role of private houses as energy producing systems with particular attention to solar energy

The aim of KAHO is to link education, research and society related service in the process of realization of sustainable building concepts.

Efficient energy use

KAHO Sint-Lieven campus Dirk Martens Aalst, Belgium

The campus Dirk Martens did the following energy saving investments:

- the rooftop of the main building was additionally insulated (+18cm)
- the equipment for energy consumption monitoring was bought
- the energy consumption was compared with consumption to similar situations
- the heat energy is produced near to the point where heating is needed
- ventilation is a major cause of energy losses, In order to minimize this energy loss:
  - The amount of fresh outdoor air was tuned: the pulsed air is a mixture of 40% fresh outdoor air and 60% recycled air. In the air mixing chamber the percentage of fresh air addition is controlled by motor driven valves.
  - the energy is recovered by heat exchange between inlet and exhaust
  - the speed of fans is controlled
  - The ventilation air stream is adjusted automatically based upon measurement of CO_2 content of the extracted air.
- High efficiency boilers were installed. Monitoring of the condensation process revealed that the condensing boilers effectively do condense!
- Programmable clocks are installed and used.

Efficient energy use

Sugar factory Tulln, Austria

Sugar factory in Tulln, in Austria, belongs to food company AGRANA; which has three sectors, and Sugar factory Tulln, with other Sugar factory in Leopoldsdorf, is part of company sector for sugar production (AGRANA Zucker GmbH). Sugar factory Tulln (in further text: Factory) is a large plant, in last campaign it processed about 1.5 million tons of sugar beet, and produced about 400 000 tons of sugar. Factory is founded in the year 1937; and the major improvement was installing a plant for obtaining sugar and betaine from molasses, which is in operation since 2002. About half of sugar beet, 47% is received directly from farmers (from distances shorter than 40 km), and another half, 53% from longer distances, is transported to the Factory by railroad. For continuity in production process, in a Factory there is the daily stock with capacity of 10 000 tons sugar beet.

Production process scheme in one sugar factory, as in Factory in Tulln, is complex; with many unit processes: mechanical (slicing, filtration, centrifugation, packaging), physical (concentration, crystallization, drying), as well as chemical (extraction, purification). The main process steps are: (i) sugar beet extraction (obtaining of sugar, as a raw sugar juice, from washed and sliced sugar beet with hot water); (ii) sugar juice purification (treatment of raw juice with milk of lime and carbon dioxide, which is prepared in separate equipment – limestone furnace); and (iii) evaporation and crystallization (purified juice is concentrated by evaporation to produce a thick juice, which is filtered and transferred to vacuum pans when the liquor is slightly supersaturated, the pan is seeded with fine icing sugar to initiate crystallization; the mixture is centrifugally separated to extract crystalline sugar, which is dried, conditioned for packaging or bulk loading). About 20% of produced sugar is for household consumption (only one sugar packaging plant for a whole Austria is in Factory Tulln, and there is a stock with capacity of 8000 tons of sugar), and about 80% of produced sugar is for industry, which is delivered by special trucks.

Energy and environmental data:

- consumption of ~ 1100 kWh energy per ton of sugar;
- energy from natural gas: consumption of 10 000 m3 natural gas per hour;
- cogeneration (combined heat and power): boiler: 140 tones of steam on 40 bar steam turbine, 15 MW of electricity;

- type and amount of wastes and by-product from sugar beet processing (annually): 80 000 tons of beet soil, 60 000 tons of beet pulp, 60 000 – 70 000 tons of molasses (obtaining of ~ 25 000 tons of sugar from molasses, 10-15% of sugar remains in molasses);
- two-steps biological treatment of wastewater from lagoons: ~ 5000 m3/day of treated wastewater into Danube.

L.e.e. s.à.r.l., Luxemburg

Financing of R&D projects in the Clean Technologies Sector

The company was founded in 2000 with the number of 12 employees. This company is a service-oriented with high core competence in the fields of planning, development, construction and support for agricultural and industrial biogas plants which are deployed within a wider concept. With experience in 100 projects in Europe, Canada and China, they offer a global and energetic business view of region all over the world. Today they extend their competences in the area of solid biomasses.

Some of projects of the company:

1. ProGrass

A new technique of grass valorization;

Producing buildings insulation by using grass fibers

2. Enercom

High-efficient poly-generation of electricity, heat, solid fuels and high-value compost / fertilizers from sewage sludge and greenery waste mixed to biomass residues, thereby offering a new, safe, environmentally friendly and cost-effective path for the disposal of sewage sludge, maximizing energy output, greenhouse gas reduction and cost-effectiveness.

3. Bioprofarm

Valorization of the agricultural biomass to generate energy

4. Bio cycle

Using software biogas plants management in order to improve their environmental and economic performance.

5. Inergpro

Improve the cooperation between industry and vocational training and the realization of European structures for cooperation in the scope of renewable energies.

Experience with enterprise-university cooperation

Areal Company, Germany

Areal is a corporation for sustainable water management. Clear, clean water stands for nature and health, while fertile earth is the foundation for growth and life. A**real** considers the preservation of these precious goods, not only as a question of the consequent utilization of modern technical means, but also one of ecological imagination and long experience.

Areal has a long experience and is at the forefront of science and technology in the area of:

1. decentralized, natural waste water treatment(reed bed filters) for household and community sewage, commercial and special burdened waste water (e.g. vini-cultural waste water)
2. research concerning sustainable water management concepts (part of material flow management)
3. producing artificial soils (sewage sludge humification, terra preta)
4. As a system-provider areal offers complete packages or individual services according to the wishes of the clients in:
   - Project development;
   - Planning;

- Documentation:
- Professional implementation:
- Business management and
- Installation maintenance.

Breydel, Antonio Vleeswaren bvba, Gent, Belgium

Policy of Breydel for the protection of the environment

The factory Breydel Gent is a meat processing plant, primarily for production two types of products ham and bacon. In addition, the factory makes other kind of meat products from meat trimmings obtained during the production of the two major products. Trimmings are used for ground meat products: lunchmeat and meat pies.

The Breydel factory disposes of modern facilities, which has an adequate infrastructure to conduct the business.

According to the Policy of Breydel the whole process is under control: installations, machines and products; a full description of the process, including dull control of raw materials and products (quantities). Special attention is paid to the factors that may cause a negative impact on the environment: production of waste and wastewater, possible pollution of air and soil, emission of noise, light (spots) and bad odors; use of energy.

Waste products

Waste products are separately collected: fat and bones, paper, plastics, ink cartridges and other (remains in production), then silt and fat from the well, fat from sieves, brine (from production process) and sludge from the waste water installation.

The factory disposes of a full wastewater treatment system, treating all effluents from the entire production process. The wastewater is purified in one single cycle following the treatment steps: pumping in of effluents, denitrification, aeration (nitrification and oxidation of organic carbon), settling of sludge, discharge of clean water and solidified sludge waste. A full water balance is made by registration the water consumption and the amounts of discharged water.

Technicians of the factory monitor and register all required parameters, reporting to the factory management team and to the government.

Air pollution

Emissions of exhaust gasses are monitored; installations are well maintained and regularly tested.

Pollution of soil

Dangerous and toxic products (cleaning products) are correctly stored, according to procedures and legislation.

Possible nuisance by noise, light and off odors

Noise: ventilation systems (lower speed) and condensers; compressors (acoustic isolated technical block); traffic (system of circulation); engines of the trucks (turn off).

Energy saving installations

Heating of process water by solar panels (48m²), in boilers (4000 liter); recuperation of heat from refrigeration compressors and a condensing boiler (kettle).

The ventilation system in the offices is using heat energy from the air (heat pump with heat exchanger). Energy consumption is reduced by the use of frequency controlled pumps, low energy lighting systems, sun blinds; thermostatic valves on the radiators and convectors; isolation of the building (K-level <30; legal standard requirement K <55).

Plans for the future

Photovoltaic sun panels are planned to be installed (±200) for production of electricity (±40MWh/year) for the plant.

Energy management
- Control of all deviations from usual energy consumption rates
- Continuous registration of energy consumption (monthly-year)
- Continuous registration kWh production by photovoltaic panels
- Calculation of indicators
- Control of energy cost by optimization of energy purchasing contracts
- Good maintenance of the system

General rules
- Close follow up of legislation
- Advise on and introduction of environmentally sound products and systems
- Control every process step on a regular basis using an appropriate task system
- Good internal communication through regular information sessions for cooperators and visual inspection of the workplace

Volvo Cars, Gent

Environmental management system

In line with the environmental policy of Volvo Car Corporation, Volvo Cars Gent strives for a continuous improvement in its environmental performance by taking due account of principles of prevention, technical developments, economic feasibility and commits itself to communicate this yearly to all interested parties. The company wants to be compliant with all the legal and regulatory environmental provisions that apply to its activities, products, services, assessments and audits will be performed on a regular basis to ensure this compliance.

Volvo Cars Gent wants to keep the impact on the environment as low as possible by maintaining results already achieved, and combining them with improvements in the following areas:
- environmental awareness among employees at every level;
- introduction or modification of processes and equipment;
- usage of green energy only;
- usage of natural resources;
- application of the processing hierarchy of waste materials;
- use of hazardous substances and preparations;
- open dialogue with the community.

Wherever possible, measurable and time-bound environmental objectives will be set and the necessary measures (allocation of responsibilities and resources) will be defined in a company program, in order to ensure that these objectives are achieved.

Volvo Cars Gent maintains an eco-management system which meets the requirements of the Volvo Car Corporation's general management system and ISO 14001 in order to ensure that its environmental policy and corresponding environmental objectives comply with modern environmental standards and facilitate management supervision of environmental aspects of the production process.

Legislation

Flemish Regulation Concerning Environmental Permits:
1. VLAREM: the coordinated Flemish environmental legislation

Under VLAREM there are two types of legislation
VLAREM I, permits and
VLAREM II, Standards.
The content of the VLAREM I is:
2. Objective
- Wherefore an environmental permit is needed?
  The classification/sections
- How can an environmental permit be requested and obtained?
  The procedures.

3. Specifications
- When an environmental permit is necessary?
- Who gives the permit?
- Determination of the content of a notification
- Where and how the environmental permit needs to be requested?
- Description of the progress of the procedure
- How to make an appeal?
- The possible amendments and additions, enclosure and refuse of the permit

4. Classes

Based on the possible disruption(s) or negative influence(s) on the environment the negative impact on the environment is classed in three levels:
- Class 1: permit for most disturbing class of factories or production plants
- Class 2: permit for a factory, considered as disturbing
- Class 3: notification required by the class for hardly disturbing industrial activities.

5. Legislation

Detailed list of sections and subsections. The legislation can be applied to:
- Waste and waste products
- Waste water
- Noise and smell
- Air emissions
- Groundwater
- Etc.

At the present environmental license valid for 5 to 20 years. There are 3 kinds of environmental conditions:
- General environmental conditions, applicable to all disturbing activities.
- Sector environmental conditions, apply to particular disturbing activities.
- Particular environmental conditions: apply to particular exploitation units or specifically imposed by the government.

CASE STUDY

De Ruiters – Paint and Lacquer Company.

The company is located in an industrial area, outside of the city. The activities of the company are: production of paint and glues as well as distribution of wallpapers.

The effluents of the company are: domestic and factory effluents. The factory has its own physical-chemical purification installation.

What is to be determined?

- Class (1, 2, 3) according to Vlarem
- Environmental coordinator (A/B/C)
- Environmental audit
- Annual environmental report
- Specific Investigation on soil pollution for acquiring the environmental permit

Lifelong learning

KEY QUESTIONS!
How much life have we lost in living?
How much wisdom have we lost in knowledge?
How much knowledge have we lost in technology?

Introduction

Europe is living through a period of change — challenging and at the same time exciting. For the sustainable growth and employment is needed new momentum where the priorities are innovation, creativity and mobility. For that the focus is on education and training, by providing new learning opportunities.

Learning occurs throughout life. Education cannot be envisioned as a finite thing, a "preparation" for life, but must be viewed as a part of life itself. Recently the education was not universally approached as a lifelong process. Except for getting certification, most people did not have a conscious attitude about being lifelong learners. But now the term lifelong learning is a part of everyday conversation in educational parlance. Presently, there are education departments with the title Lifelong Learning and university courses on lifelong learning.

Lifelong learning has emerged as one of the major challenges for the worldwide knowledge society of the future. A variety of events support this claim: (a) 1996 was the "European Year of Lifelong Learning"; (b) the United Nations Educational, Scientific and Cultural Organization (UNESCO) included "Lifetime Education" as one of the key issues in its planning; and (c) the G7-G8 group of countries named "Lifelong Learning" as a main strategy in the fight against unemployment.

An operational environment of mass markets, simple products and processes, slow change, and certainty has been replaced by customer orientation, complex products and processes, rapid and substantial change, uncertainty, and conflicts. In today's competitive global marketplace, lifelong learning demands lifelong learning. In the past, hard work and loyal service led to a secure future.

Today, employers provide a place on those who continually acquire skills and knowledge and who have the resilience and flexibility to adjust to the evolving needs of the global labor market. Thus, the ability to engage in lifelong self-directed learning is the single most important competence that people must possess.

Lifelong Learning: A Definition

Lifelong learning may be broadly defined as learning that is pursued throughout life: learning that is flexible, diverse and available at different times and in different places. Lifelong learning crosses sectors, promoting learning beyond traditional schooling and throughout adult life (post-compulsory education). This definition is based on Delors' (1996) four 'pillars' of education for the future.

Learning to know
mastering learning tools rather than acquisition of structured knowledge

Learning to do
equipping people for the types of work needed now and in the future including innovation and adaptation of learning to future work environments

Learning to live together, and with others
peacefully resolving conflict, discovering other people and their cultures, fostering community capability, individual competence and capacity, economic resilience, and social inclusion.

Learning to be

education contributing to a person's complete development: mind and body, intelligence, sensitivity, aesthetic appreciation and spirituality

Lifelong learning can arouse creativity, initiative and responsiveness in people thereby enabling them to show adaptability in post-industrial society through enhancing skills to:

- manage uncertainty,
- communicate across and within cultures, sub-cultures, families and communities,

Negotiate conflicts.

The European Commission found that lifelong learning has "Four broad and mutually supporting objectives: personal fulfillment, active citizenship, social inclusion and employability/adaptability". In this regard, lifelong learning has life wide dimensions that transcend narrow economic and vocational aspects.

The European Lifelong Learning Initiative defines lifelong learning as "a continuously supportive process which stimulates individuals to acquire all the knowledge, values, skills and understanding they will require throughout their lifetimes... and to apply them with confidence, creativity, and enjoyment in all roles, circumstances, and environments."

This definition emphasizes lifelong learning as *(a) continuous* (it never stops); *(b) supportive* (it isn't done alone); *(c) stimulating and empowering* (it's self-directed and active, not passive); *(d) incorporating knowledge, values, skills, and understanding* (it's more than what we know); *(e) spanning lifetime* (it happens from our first breath to outlast); *(f) applied* (it's not just for knowledge's sake); *(g) incorporating confidence, creativity, and enjoyment* (it's a positive, fulfilling experience);and *(h) inclusive of all roles, circumstances, and environments* (it applies not only to our chosen profession, but to our entire life).

"Learning" is understood to mean the constructive conversion of information and experience into knowledge, insights and skills.

Lifelong learning contexts

According to the National Education Act B.E. 2542 (1999) Lifelong education means education that integrates **formal**, **non-formal** and **informal education** in order to create opportunities for continuous development of life quality.

Formal education specifies the aims, methods, curricula, duration, assessment and evaluation conditional to its completion.

Non-formal education has flexibility in determining the aims, modalities, management procedures, duration, assessment and evaluation conditional to its completion. The contents and curricula for non-formal education shall be appropriate, respond to the requirements, and meet the needs of individual groups of learners.

Informational education shall enable learners to learn by themselves according to their interests, readiness, abilities and opportunities offered by people, society, environment, media or other sources of knowledge.

Educational institutions are authorized to provide any one or all of the tree types of education.

Lifelong learning is therefore about:

- Acquiring and updating all kinds of abilities, interests, knowledge and qualifications from the pre-school years to post retirement. It promotes the development of knowledge and competences that will enable each citizen to adapt to the knowledge-based society and actively participate in all spheres of social and economic life, taking more control of his or her future.
- Valuing all forms of learning, including: formal learning, such as a degree course followed at university; non-formal learning, such as vocational skills acquired at the workplace; and informal learning, such as inter-generational

learning, for example where parents learn to use ICT through their children, or learning how to play an instrument together with friends.

Lifelong Learning (LLL) has the following objectives:

- To promote knowledge, skills and competence,
- To meet the needs of individuals / citizens, the needs of society,
- To increase employment opportunities.

Realistic and sustainable perspectives are based on existing educational structures, activities and experience and which define a structured framework for lifelong learning that is flexible and open to the necessary continuous process of further development. The structured framework has been devised to match not only the **life phases** of the individual from early childhood to old age but also essential aspects of lifelong learning, which constitute **development focuses**.

At the same time, the combination of life phases and development focuses seeks to counteract the separation of the individual educational sectors.

The development focuses are: a) inclusion of informal learning, b) self-directed learning, c) development of skills, d) networking, e) modularization, f) learning guidance, g) new learning culture/popularization of learning, h) fair access.

During "**childhood**" learning greatly influences access to education and thus the individual's chances of success in life. The target groups include not only the children themselves, but also their parents, teachers at day-care centers as well as teachers at primary school. Essential elements during this phase of life include the scope and quality of **informal learning**, the **development of skills** on the basis of new educational plans, the **networking** of kindergartens, schools, parents, child and youth service institutions, as well as **learning guidance** particularly for parents.

During "**adolescence"** most learning processes take place in school. Learning during this phase of life is characterized by educational programs organized by others and by the obligation to learn. The **development of skills** is particularly important and this means that schools impart basic skills such as learning and action skills, social and personal skills as well as the ability to work in a team in addition to subject knowledge. It is also very important to foster the ability of adolescents to organize their own learning and to make them practice independent learning (**self-directed learning**).

During the next phase of life, which begins when "young adults" enter the world of work or start their initial vocational training and which ends when they take up regular employment, the following focuses are of major importance: the inclusion of informal learning, self-directed learning and the development of (social, professional, cultural and personal) skills? **Networking** takes place mainly between schools, companies, higher education institutions, associations, job centers and institutions of continuing education. **Learning guidance** with respect to questions of vocational training, academic studies and continuing education or training plays an important role. In this phase, the main features of the **new learning culture** are relevance to practical work and orientation towards transferability. It is important to help young adults understand that entry into the world of work does not put an end to learning but means transferring to another stage of learning.

"**Adult life**" is a phase, which is increasingly determined by change, and for some by breaks and interruptions – a fact that clearly demonstrates the need for lifelong learning. Because of their strong involvement in professional life and family life time is very scarce for adults. Therefore, the possibility to structure their own learning (**self-directed learning**) is very important for them. Personal, social and occupational **skills** can be further developed in courses offered for continuing general, vocational and political education.

The term "**the elderly**" is defined as including mostly adults who will soon enter retirement or are already retired. Formal learning becomes less important and learners have greater freedom to decide for themselves whether, how and for what purpose they should take part in learning activities (**self-directed learning**).

Achieving or retaining independence and autonomy even at an advanced age is one major goal of lifelong learning during this phase of life. With regard to the **development of competencies**, it is obvious that preserving skills and abilities is more important than developing new ones. The older people also acquire new skills in order to pass on their experience and knowledge or to do voluntary work.

The concept of lifelong learning is based on three fundamental attributes:

- it is lifelong and therefore concerns everything from cradle to grave
- it is life-wide recognizing that learning occurs in many different settings
- it focuses on learning rather than limit itself to education.

When it comes to the implementation of lifelong learning for all it is important to look closer at the implication of these attributes.

Lifelong Learning and Traditional Learning

Lifelong learning is more than adult education, which often is restricted to providing people with opportunities to engage in (school-like) learning activities during their adult life. Lifelong learning involves and engages learner's of all ages in acquiring and applying knowledge and skills in the context of authentic, self-directed problems. By integrating working and learning, people learn within the context of their work on real-world problems.

The learner's involvement in goals setting is a prerequisite to motivated and self-regulated learning. Goal setting implies the personal commitment of the learner and is an integral part of learning in life. The learning is rewarding because the learner is in the process of realizing his or her goals. In traditional learning, motivation is often lacking because students are not involved in goals setting. Learning goals are often unclear to students and seem to have no clear relation to life goals. Students are often not compelled to feel that these are their goals, but rather those of the teacher, the school, or society. The goals are fixed and predetermined, providing students with little or no chance of involvement.

Traditional learning tends to motivate by extrinsic rewards, such as praise from the teacher or others, grades, or financial compensation. As a result, students can develop a dependency on praise, leading to feelings of insecurity and non development of task motivation. Learning flows from a variety of activities, for example, observing how other people do something, discussing with others, asking someone, looking up information, trying something for oneself and learning from trial and error, and reflecting on all the previous activities.

Learning in real life usually combines activities from different categories and is always interwoven with the socio material world. In contrast, traditional school learning tends to focus mainly on one type of activity, processing symbolic information.

Evaluation of learning in life is directed toward achieving life goals. Evaluation is not an end product, but leads to renewed orientation, other learning activities, or a change in goals. The learner decides if and why the gained knowledge and skills were satisfactory. At school, the teachers and administrators decide on the criteria and also decide whether the students have satisfied the criteria or not. Traditionally, criteria are often related to the learning goals, but not to life goals. In real life, learners decide on the type of activities in which to engage, often with input from others, but the final responsibility is with the learner. In traditional learning, most of the regulating is done by the teacher and educational system. This makes learning look like a neat, step-by-step procedure, from the beginning of the book to the end, from the start of the program to the examination. Learning processes in real life are much less predictable and straightforward.

Traditional learning	Lifelong learning
• The teacher is the source of knowledge. • Learners receive knowledge from the teacher. • Learners work by themselves. • Tests are given to prevent progress until students have completely mastered a set of skills and to ration access to further learning. • All learners do the same thing. • Teachers receive initial training plus ad hoc in-service training. • "Good" learners are identified and permitted to continue their education.	• Educators are guides to sources of knowledge. • People learn by doing. • People learn in groups and from one another. • Assessment is used to guide learning strategies and identify pathways for future learning. • Educators developed individualized learning plans. • Educators are lifelong learners. Initial training and ongoing professional development are linked.

Figure 1 Traditional vs. Lifelong Learning

Traits and Skills of Lifelong Learners

"Wisdom is not a product of schooling, but the lifelong attempt to acquire it".

Einstein

The concept of lifelong learning is to create a society of individuals who are motivated to continue learning throughout their lives–both formally and informally.

The lifelong learner is defined as a person who takes responsibility for their own learning and who is prepared to invest "time, money and effort" in education or training on a continuous basis. Lifelong learners possess a particular set of personal attributes.

The individuals most likely to participate in learning, either formally or informally throughout their lives, (have) acquired:

- the necessary skills and attitudes for learning, especially literacy and numeracy skills;
- the confidence to learn, including a sense of engagement with the education and training system; and
- Willingness and motivation to learn.

People can be involved in lifelong learning in different ways. Lifelong learning encompasses both formal and informal types of education and training. A person who attends a parenting skills course run by a community provider is as much a lifelong learner as a full-time post-graduate student undertaking university-based research. Lifelong learning also includes work-based training that does not necessarily lead to formal qualifications. The key factor in defining a lifelong learner is not the type of education or training in which they are involved, but the personal characteristics that lead to such involvement. Lifelong learners must have the *motivation* and *capacity* to learn, in any type of setting, with any type of teacher, or simply by themselves.

There is no single factor motivating a lifelong learner. Motivations include upgrading job skills, to start a business, to learn about a subject or to extend their knowledge, to meet new people, to develop self-confidence, to get involved in the community or to develop personal skills.

Lifelong learning is attitudinal — that one can and should be open to new ideas, decisions, skills, or behaviors. Skills for lifelong learning relate to the need to acquire, process, and transfer knowledge. Lifelong learners need to be able to determine what they need to learn and how to make and carry out a learning plan. They need to know how to locate appropriate information, evaluate its quality, organize it, and use it effectively. They need to be critical and creative thinkers, problem solvers, and decision makers, and they need to practice regular self-reflection.

Steps to lifelong learning can be articulated as (a) reflection, (b) setting goals, (c) assessing knowledge and skills, (d) creating a learning plan, (e) putting the plan into action, and (f) evaluating and refocusing.

Lifelong learning's core values of learning, exploring, and serving, realize benefits for the mind, body and spirit and make it an incredibly powerful tool for personal transformation and enhancement.

Why to study during the entire life? The answer is the list of the top 10 benefits of lifelong learning:

- Lifelong learning helps fully develop natural abilities.
- Lifelong learning opens the mind.
- Lifelong learning creates a curious, hungry mind.
- Lifelong learning increases our wisdom.
- Lifelong learning makes the world a better place.
- Lifelong learning helps us to adapt to change.
- Lifelong learning helps us to find meaning in our lives.
- Lifelong learning keeps us involved as active contributors to society.
- Lifelong learning helps us to make new friends and establish valuable relationships.
- Lifelong learning leads to an enriching life of self-fulfillment.

Education for Sustainable Development

Many companies and organisations are aware that a broad growth in knowledge is necessary and that this growth must be based on practical aspects of working life. Certain achievements are made, especially some concerning short-term learning, but there is less understanding of long-term learning and the way in which economic incentives and career pathways should be linked to this learning.

Ecologically Sustainable Development fosters a democratic society, a stable economy and a sustainable environment.

The goals of implementation of lifelong learning in the framework of sustainable development are to:

1. Integrate the values of sustainable development into all aspects of learning
2. Encourage behavioural change to allow a more sustainable and just society for all.

Education for Sustainability programs has potential to develop community identity, bring people together and foster a sense of connection with local landscapes. Community plays a significant role in sustaining natural systems and city infrastructure such as storm water and waste management.

Categories of human advancement needs are: personal and cultural development, social and community development and professional development and sustainable employability.

Three kinds of progress are significant for culture: progress in knowledge and technology, progress in the socialisation of man and progress in spirituality. The last is the most important. Technical progress and extension of knowledge, does indeed represent progress, but not in fundamentals. The essential thing is that we become more finely and deeply human.

Sustainable future for the country can be provided if the citizens have the key skills and functional literacy that determine global competitiveness, social cohesion and healthy environment.

"Not the strongest species survive, nor the most intelligent, but those who respond quickly to change"

Charles Darwin

Only nations acquire knowledge and effective use can be winners in the modern world.

Conclusion

Lifelong learning is now recognized by educators, governing bodies, accreditation organizations, certification boards, employers, third-party payers, and the general public as one of the most important competencies that people must possess. Promoting lifelong learning as continuous, collaborative, self-directed, active, broad in domain, everlasting, positive and fulfilling, and applicable to one's profession as well as all aspects of one's life has emerged as a major global educational challenge. Meeting this challenge will require changes in the way teachers teach and learners learn, as teachers take on a more facilitative role and learners take more responsibility for setting goals, identifying resources for learning, and reflecting on and evaluating their learning.

Lifelong learning at KAHO Sint-Lieven, Gent, Belgium

At the KAHO Sint-Lieven there is a Service for advanced courses (SAC). The mission of the Service (SAC) is:

- To develop educations that responds meet to the demands of the society.
- To be open to cooperate with external organizations in order to develop and to organize (professionally and socially) relevant educations.
- To involve as much as possible the teaching staff and students from KAHO Sint-Lieven. This education should have an impact and feedback from these educations to the bachelor and master education.

The main activities of the SAC are:

- Symposia (update courses)
- Postgraduate courses (< 20 credits)
- Postgraduate study programmed (>20 credits)
- Continued education (60 credits)

The postgraduate study programmers in technology area:

- Prevention advisor level 1 (postgraduate study points 40 credits)
- Energy coordinator (pgsp 20 credits)
- Environmental coordinator level A (pgsp 25 credits) and B
- Bio-ecological Building (pgsp 24 credits)
- Meat processing technology (pgsp 48 credits)

Financing

- There is no financial input from the Educational department of the Flemish Government. Tuition fees are paid by the participants (companies) e.g.:
- Prevention advisor: 4400 €
- Environmental coordinator: 3200 €
- Energy coordinator: 2100 €
- Bio-ecological building: 2400 €

Trainings about renewable energy.

There are trainings for Energy coordinator. Two kinds of trainings are offered: Energy expert level A and Energy expert level B.

After the course, the Energy coordinators are able to help firms, organizations and private families to save energy and money on their energy cost. The course lasts 1 semester (1 day/week). At the end of the training the student has to submit a thesis. Annually, approximately 30 students graduate as "energy coordinator".

3. Sustainable technologies
Review of knowledge of the staff from industry

Introduction

At the end of the 90's the knowledge and responsibility of various social groups on global environmental problems was the subject of numerous studies (Ball, 1991, Wain K, 1987, Titmus, 1999). The importance of education on the sustainability potential can be seen in Figure 2.

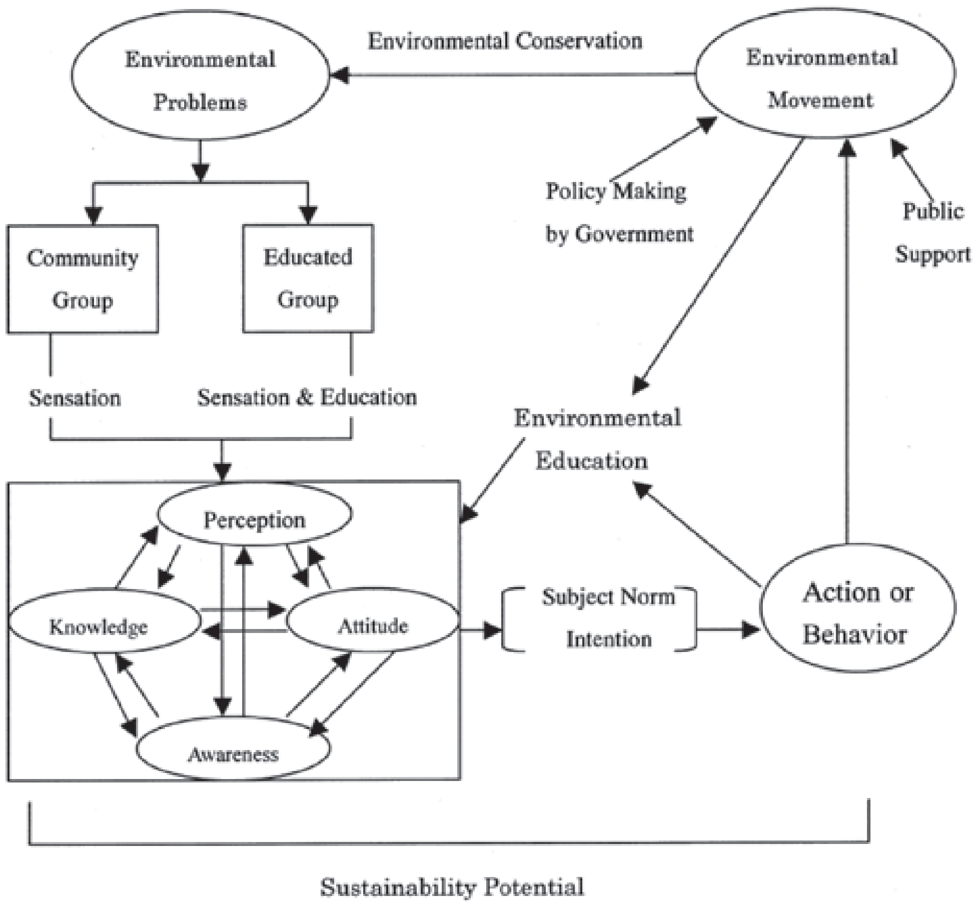


Figure 2 Scheme of Sustainability Potential

The Second Minnesota Report Card on Environmental Literacy (National Education Act B.E. 2542, 1999) is the typical example of the level of knowledge assessment concerning environmental problems at the level of Minnesota State.

The review and analysis of the existing knowledge of the staff from industry on sustainable issue was the basis for creating courses for the staff from industry on sustainable technologies issue involved in this project. The objective of the Project has been to enhance the level of knowledge of the staff from the industry in Serbia, Bosnia and Herzegovina and the Former Yugoslav Republic Macedonia. To achieve this goal special course on sustainable technologies was created and held. In the near future, the tested staff will be responsible for the application of new attainments and technologies on environmental issues.

In this review the level of knowledge of the staff from industry has been analyzed in 13 companies in Serbia, Bosnia and Herzegovina and the Former Yugoslav Republic of Macedonia. The most of the companies cover food and pharmaceutical technology (4 + 5). Three (3) companies deal with inorganic technologies and metallurgy. One company deals with the production of lubricants and industrial oils.

The mentioned companies have more than 10,000 employees. The analysis covers over 100 employees who are directly responsible for production, control and environmental protection.

The structure of the Questionnaire

In order to have objective information on the level of knowledge of the staff from the industry, 3 types of Questionnaires have been created. The 1st Questionnaire covers the questions concerning the management system of the company. The 2nd one is a set of questions focusing on technical and technology details important for the production process. The 3rd – the most important one – consists of questions on sustainability. The latter was the basis for assessment of the level of knowledge. The overview of the questions given in the 1st and 2nd Questionnaire can be seen in Table 1 and Table 2, respectively.

Table 1 Basic data of the company

Basic data of the company
Name of the company
Address
Web address
Activities
Number of employees
Main products
Main customers
Institutions with which the company has cooperation agreement on environmental protection
HSEQ system
Is there an integrated system of management in the company?
Is there a HSEQ system in the company?
Is there a vertical HSEQ organisational system in the company?
Give the HSEQ organisational scheme
Give the qualification structure of each HSEQ organisational unit

Give the description of the jobs of each HSEQ organisational unit
Give the names of the documents which define the HSEQ jobs and the organisational structure
HSE system
Is there a HSE organisational system in the company?
Is there a vertical HSE organisational system in the company?
Give the organisational structure of the HSE.
Give the qualification structure of each HSE organisational unit.
Give the description of the jobs of each HSE organisational unit.
Give the names of the documents which define the HSE jobs and the organisational structure
Organisation structure and environmental protection
Give the organisation scheme of the company
Give the qualification structure of each organisational unit
Give the jobs description of each organisational unit
Give the name of the documents which define the environmental protection jobs and organisation structure

Table 2 The company's technology data

Description of technology	• Description of technology • Raw material mass balance and their ecological features • Consumption of energy, water and chemicals • Products, their features and their usage
Waste streams	• Waste gases • Waste water • Waste packaging
Monitoring and accidents	• Monitoring programme • Accidents • Sanitation of accidents

Table 3 Questionnaire of environmental knowledge

Test
1. Give the definition of sustainability?
2. What is OUR COMMON FUTURE?
3. What is Rio declaration?
4. What is Agenda 21?
5. What is Basel convention?
6. What is standard 14001?
7. Basic features of the 14001 standard?
8. Does Serbia have a Strategy for sustainable development?
9. Give 2 indicators of sustainable development.
10. What are the global problems of environment?
11. What is IPPC?
12. What is BREF?
13. What is DG Environment?
14. What is EMAS?
15. What is the difference between EMAS and ISO 14000 standard?
16. What waste does your company generate?
17. What is BAT?
18. Is there a regeneration procedure for wastes in your company?
19. What are the millennium goals?
20. Indicate 1 millennium goal.
21. Indicate the name of 3 agencies for environmental protection.
22. What is the difference between EPA and UNEP?
23. What is Environmental impact assessment?
24. What is LCA?
25. What is Greenhouse effect?
26. What is GHG?
27. What is remediation?

28. Give 2 methods for waste water treatment
29. What is the difference between renewable and non-renewable energy sources?
30. Give 3 renewable energy sources
31. What is the difference between municipal and industrial waste?
32. What is euro diesel?
33. What is the cause of acid rains?

The proportion of the set of questions in the test was as follows

- General knowledge on environment (***17.6%)***
- Sustainable development (***14.3%)***
- Pollution and provisions to reduce pollution (***26.5%)***
- Environmental protection methods of analysis and management (***17.6%)***
- Environmental institutions (***8.8%)***
- Renewable energy sources (***8.6%)***

Tests results

The results of the tests in the 13 companies show a wide variety of knowledge, from a very high to very low level. The achived resultas (all test lists) in percentage for all companies can be seen in Figure 3.

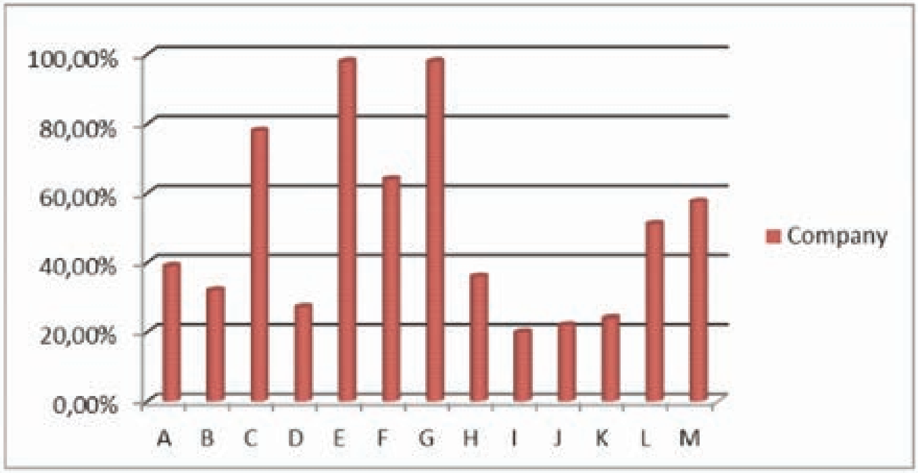


Figure 3 Overall results (3 tests) in percentage

The highest results have the companies which have an integrated system of managament (companies E i G). The achieved level of 50% correspond with companies which have organisation units for environmental protection (companies M, F and C). The level of up to 30% has been achieved in 5 companies (B, D, I, J and K).

General environmental knowledge

Concerning general environmental knowledge, the following results have been achieved (Figure 4)

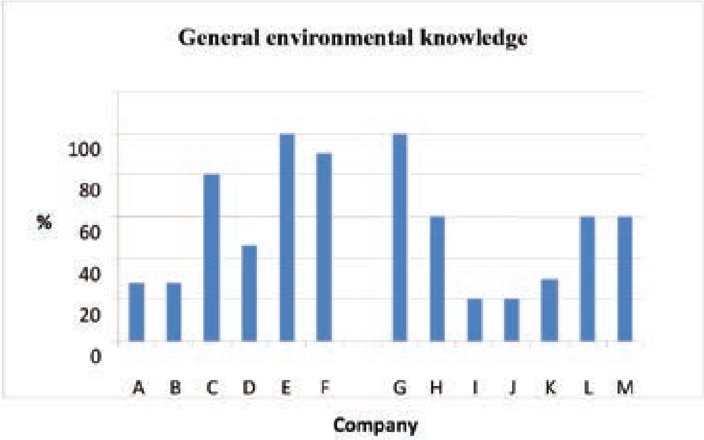


Figure 4 Test results on general knowledge on environment

It is interesting that the level of general knowledge on environment is independent of the education level of the tested staff. It can be correlated with the level of environmental managament system in the copmpany. The companies with the achieved high level knowldege have a clear environment programme in practice.

The relatively low level of knowledge (bellow 40%) indicates the need of Introductory course oriented to the basic knowledge on environment issues.

Concerning the sustainable development the following results have been achieved (Figure 5)

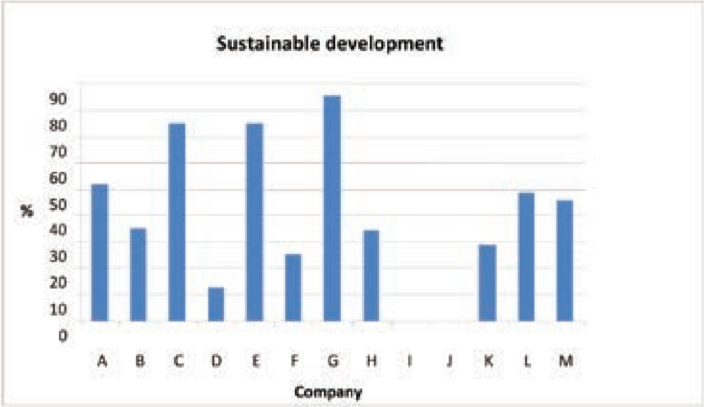


Figure 5 Test results on sustainable development knowledge

If 2 companies (E and G), with the achieved high level knowledge are excluded, the sustainable development issue is unknown in more than 80% of the remaining companies. In 2 companies there was no answer to this question. The level of knowledge concerning waste and waste management in 60% companies is below 50%.

For example, the IPPC issue is unknown in 11 companies. Moreover, the IPPC directive, which includes the procedure of getting integrated license, is also unknown, even in companies with some organizational structure on environmental protection (Figure 6)

Figure 6 Test results on waste management knowledge

The test results concerning ISO 14000 standard, environmental impact assessment methods and life cycle analysis, show that the level of knowledge is rather low (Figure 7).

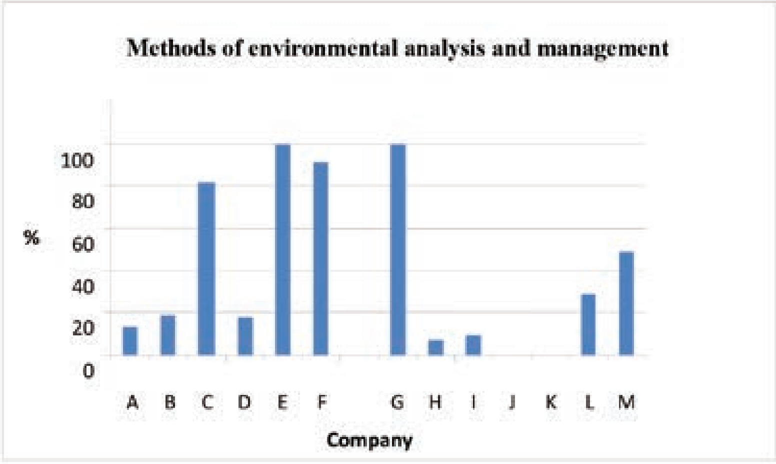


Figure 7 Methods of environmental analysis and management

While the level of knowledge on ISO 14000 standard is acceptable, the level of knowledge on LCA is unknown to 85% of the companies.

ENVIRONMENTAL KNOWLEDGE

Detailed analyses

Company A

In this company 24 employees were tested, all with higher education. Out of maximum 5880 points, 2305 has been achieved or 39%. The achieved results are given in Table 4

Table 4 Company A – Test results

Questions	Positive answers %
Set of questions on General environmental knowledge	52
Set of questions on Sustainable development	28
Set of questions on Pollution and provisions for pollution reduction	39
Set of questions on Environmental protection methods of analysis and management	13
Set of questions on Environmental institutions	26
Set of questions on Renewable energy sources	66

The tested staff has showed a very good knowledge concerning renewable energy sources. The lowest knowledge refers to Environmental protection methods of analysis and management (14000 standards, EMAS procedure etc.). The positive answers on waste management have been given by 39% of the tested staff.

Company B

The same number of staff has been tested as in Company A. The tested staff has higher education. The achieved points on the test were 1889 or 32%.

It is interesting to note that the employees have the best knowledge on renewable energy sources (47% positive answers). The minimum points have been achieved on questions concerning environmental agencies and institutions (17% positive answers).

The graphical representations of the overall test results in companies A and B are given in Figure 8.

Table 5 Company B – Test results

Questions	Positive answers %
Set of questions on General environmental knowledge	35
Set of questions on Sustainable development	28
Set of questions on Pollution and provisions for pollution reduction	44
Set of questions on Environmental protection methods of analysis and management	19
Set of questions on Environmental institutions	17
Set of questions on Renewable energy sources	47

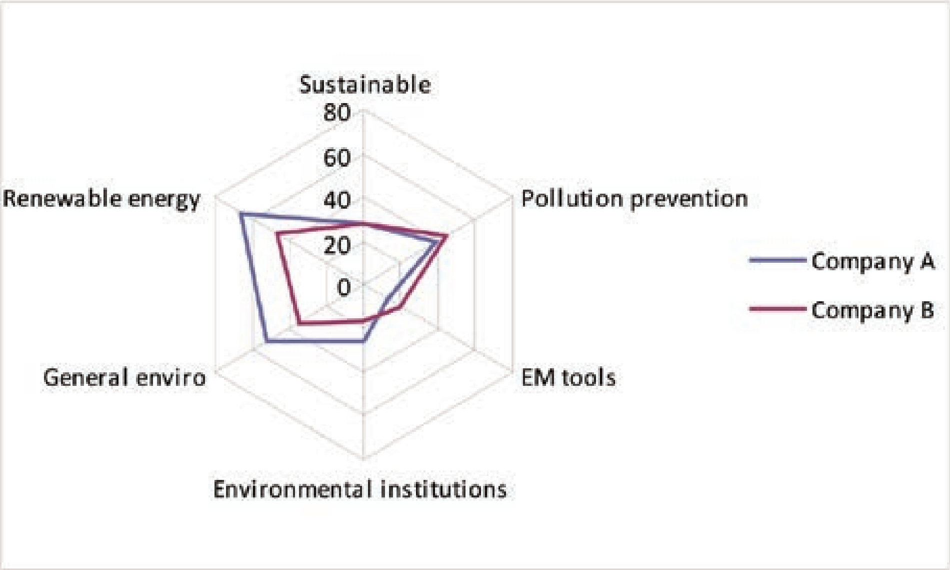


Figure 8 Overall test results

General environmental knowledge

The best knowledge in Company A refers to general knowledge on environment (76% out of total). In company B the maximum achieved points correspond with questions concerning millennium goals (49% out of total). It must be emphasized that the majority of the tested staff indicate the poverty as the most important millennium goal.

Sustainable development

The majority of the positive answers have been given to the question: Does Serbia have a Strategy on sustainable development? Comparing the results, the number of positive answers differs highly. In Company A the positive answers to this question were 84%, while in Company B 53%. Unfortunately, the indicators of sustainable development are rather low in both companies (4% positive answers in Company A and 8% positive answers in Company B).

Pollution and provisions for pollution reduction

The level of knowledge in Company A is rather high (over 82% positive answers), while in Company B it is 55%. The answer to the question: "Is there a method for pollution treatment in your company?" both companies have a high level of positive answers (Company A: 80% and Company B 87%).

Unfortunately, the knowledge on questions concerning the process, which generates the wastes and wastes treatment, is rather low. This indicates that the actual knowledge on these issues is lower. This conclusion can be confirmed by the very low knowledge concerning BAT (14% in Company A) and knowledge concerning remediation (29% in Company B).

Environmental protection methods of analysis and management

The majority of positive answers have been given to the question: "What is ISO 14001 standard?" In Company A 83% positive answers have been detected, while in Company B 43,5%. The minimum number of positive answers has been given to the question: "What is LCA?" In Company B, the minimum knowledge can correspond with the Impact analysis (16%). The obtained results indicate that the level of knowledge concerning assessment of technology processes and products impact on the environment is not known to the majority of the tested staff.

Environmental institutions

The environmental institutions are rather unknown to the tested staff. Just 10% of the tested staff in Company A has been able to indicate 3 institutions. In Company B the results are slightly better (15%).

Renewable energy sources

Rather high positive answers have been given to the question: "Indicate at least 3 renewable energy sources (87% in both companies). It is surprising that very low positive answers have been given to the question: "What is euro diesel?" (15% in Company A). In Company B very few tested staff has had an answer to the question: "What is the difference between renewable and non renewable energy sources?"

Conclusions

1. The obtained results of the tests show a wide variety of knowledge, from a very high to very low level.
2. The highest results have the companies which have an integrated system of managament
3. The achieved results showed that it does not depend on the activities of the company
4. Far less knowledge in all companies refers to IPPC directive, EIA , LCA etc.)
5. The lower knowledge in all companies is the waste management issues
6. The results indicate the need of Introductory course oriented to the basic knowledge on environment issues.

4. University-enterprise cooperation networks for education on sustainable technologies

4.1 Courses on sustainable technologies

Course 1
Sustainable technologies in Food industry

Course 2
Sustainable technologies in Pharmaceutical and cosmetic industry

Course 3
Sustainable technologies and Chemical engineering

Course 4
Sustainable technologies and Materials engineering

Actual course version
www.techno-sus.com

4.2 Short content of the course topics

Common topics for all courses

Sustainable technologies
1. Zero emission concept

The linear model of development seems not to be sustainable. The results are exhaustion of the natural resources and waste accumulation. The Zero emission model, as in nature, predicts the circulation of material flows and consequently reduces the emission of material and energy to a minimum, ideally zero. The amount of generated waste is minimum, because almost all flows are used. Besides environmental there is also economic benefit. The import of resources are minimum, local/regional resources are used efficently and new jobs are created.

The problem of waste control and reduction, can be handled by three concepts. The first is End-of-Pipe pollution control technologies, the second is Cleaner Production concept and finally the Zero emission concept. "The end of pipe" treatment or control of already generated waste while the Cleaner production involves the treatment of production needs more efficient use of resources by reducing pollution. The Zero emission concept, however, seems to be the final solution to waste control and reduction. However, the limits of the previous two concept have to be known. In the final Zero emission solution in the previous two concepts, especially Cleaner production, cannot be omitted.

The Industry with zero emission, industrial clusters, eco-industrial parks and circular economy are given as the practical impacts/benefits of the Concept.

2. Environmental sustainability and industry

Technology has a very important role in sustainable development. The technologies are used to extract resources and to get useful products. The linear model of development results in exhaustion of the natural resources and waste generation. The linear model of development is to be replaced by sustainable one like cyclic sustainable development model. The main component of both models is given and discussed. It is essential to have a clear picture of the main differences between these two models.

The possible impact on the environment during product or process life is given in the part Life cycle assessment (LCA): The effect of our activities is given in the following part Carbon footprint.

In the following it is explained which material is appropriate for eco design.

Sustainable agriculture and food production combine the goals of sustainable development. Sustainable technologies use less energy, fewer limited resources, do not deplete natural resources, do not directly or indirectly pollute the environment, and can be reused or recycled at the end of their useful life.

The Environmental Management System is important part of sustainability, especially related to industry. According to ISO 14000 the term Environmental Management means management with respect to all environment components. The Environmental Management System is part of an overall management system of the organization. The System includes organizational aspects, planning activities, responsibilities, procedures, procedures for developing, implementing, achieving, reviewing and maintaining environmental management policy.

The Environmental risk assessment also have important role in sustainable development. In this part of the course the concept of environmental risk assessment, environmental hazards and environmental risks, as well as risk analysis basic components are given. The main stages in the implementation of environmental risk assessment as well as benefits are also covered.

3. Legislation

A comparative study of legislation in the field of environmental protection and sustainable development in The Former Yugoslav Republic Macedonia, Bosnia and Herzegovina and Serbia

In this part of the course the comparative study in three West Balkan's countries: The Former Yugoslav Republic Macedonia, Bosnia and Herzegovina and Serbia are presented. The study shows that there are similar solutions concerning environmental protection issue in all three countries. The differences in solutions are minor.

4. Sustainable technologies

"Green Chemistry" is a universally accepted term to describe the movement towards more environmentally acceptable chemical processes and products. Green Chemistry can be achieved by applying environmentally friendly technologies.

The next very important issue concerning sustainable technologies is BAT (Best Available Techniques). The BAT is focused on minimizing the amount and/or toxicity of the industrial waste. Best Available Techniques are defined as the most effective and advanced stage in developing activities and methods of waste operation.

The next parts of the course are: Waste water treatment, Air protection, and Recycling and Solid waste management.

5. Renewable energy resources

In this part of the course the renewable energy sources are presented. First part deals with basic concepts related to energy, energy distribution as well as definition of non-renewable and renewable energy sources of energy. The following parts describe the renewable energy sources: energy of the environment, geothermal energy, wind energy and solar energy. The ways of utilization and the advantages and disadvantages of each type of renewable sources are also given. The overview of implementation of renewable energy sources in West Balkans countries is also presented. In the next section biofuels are presented. The advantages and disadvantages of each biofuels are indicating as well as the possibilities of their production in the Western Balkans countries.

6. Energy efficiency of the technology processes

Technological processes are generally energy intensive. Reducing energy consumption, environmental protection and waste management become imperative to every technological process. Increasing energy efficiency, in addition to savings in energy consumption in the broad sense includes protection of the environment and very often minimizes waste. Rational energy use and recovery of waste heat from the process are the two most important ways of reducing costs. Utilization of waste streams and renewable sources are the following two tools in order to reduce costs and to preserve the environment and reduce waste.

To increase energy efficiency, extensive knowledge is required. The first step towards reducing the energy consumption is analysis. For this reason it is necessary to have a good understanding of material and energy balances. The next step will be to adopt a program of savings. As a rule, the first steps are savings that do not require or require very little material resources. The next steps are saving measures that require greater investment.

The savings can be achieved by each individual device and system as a whole. For this reason, it is necessary to have knowledge of each unit, as sources of potential losses. Devices that provide energy such as boilers and steam systems are found in almost every technology. Heating, cooling, air conditioning, insulation and lighting systems are also independent of the type of industry. There are also a certain amount of individual operations, specific for each technology.

Finally, it is necessary to know what the whole process energy reserves are, or what the maximum energy that can be recovered.

Specific topics

Course 1

Sustainable technologies in Food industry

In this course, the sustainable development related to food industry is discussed. A number of developed countries have developed and adopted a strategy of sustainable development in food industry as well as solutions for strengthening sustainable technologies in food production and processing. These strategies gives concrete measures with an appropriate timetable in order that the proposed solution should be achieved in practice. The authors offered elements that can serve as a basis for developing sustainability in the food industry of the Western Balkans countries.

In the following part of the course the issue Hazardous substances from environment in food are given. Apart from natural ingredients (nutrients) in food, it can be found undesirable components originating from the environment or components, which are used in the processes of primary agricultural production, processing, packaging, warehousing and distribution.

In the technology process, food can be contaminated with biological, chemical and physical agents. These facts indicate that modern food production needs continuous monitoring and control of all production stages.

The next part of the course deals with pollution from food industry. Contaminants in food (hazards) are agents of chemical, microbial or physical origin. The contaminants, If enter the body can cause health problems.

Finally there is an example of Zero emission concept as well as number of case studies related to sustainability food industry.

Specific topics

Course 2

Sustainable technologies in Pharmaceutical and cosmetic industry

The course refers to the problems of sustainable development of pharmaceutical and cosmetic industry. Its activities significantly affect the environment. Failure to observe proper and timely actions can have dramatic consequences for the ecology and life of the future generations.

Accordingly, the course is divided into three parts, which perceive all the aspects: the relationship between sustainable development and environmental management, pharmaceutical and cosmetic management, and analysis of case study methodology.

In the first part the importance of the role of sustainable development of company on environmental protection is discussed.

The second part is devoted to the management of pharmaceutical, cosmetic and chemical waste.

The third part of the course deals with the importance of writing and analysis of case studies related to sustainable development. In this section some typical examples of case studies are given.

Specific topics

Course 3

Sustainable technologies and Chemical engineering

In the first part of the course the concept of sustainability related to chemical industry is covered. Some of the topics are Green chemistry and Clean technologies. The basic question is: How to achieve that chemical industry is sustainable? Basically, the approach is the same as in other industries but there are also some specifics. The renewable resources should replace non renewable and bio refineries should replace conventional one.

In the second part of the course *the pollution prevention in chemical industry* has been discussed while the third and the forth chapters focus on *the design and modeling of the sustainable manufacturing and industrial processes*. In addition, the importance of systematic methods and computer aided tools for the synthesis, design and optimization of sustainable chemical processes is highlighted. The very important issue in chemical industry related to C*ombustion processes as a source of air pollution* is also discussed. The zero emission concepts related to mass and energy in chemical industry is given in part of the course. In addition, the methodology and implementation of zero emission in chemical industry has been presented following by example of total water integration (zero liquid discharge) in the process.

The following part focuses on the treatment of textile waste and minimizing of the wastewater from textile factories. Also, an overview of techniques for wastewater treatment is presented.

Finally, some aspects of sustainability using Case studies are covered in more details such as *Pollution and environment protection from pollution in alumina production*, *Electrochemical industry, Application of electrochemistry in the environmental protection, Cement Production and environmental protection in the Cement factory Lukavac, Benefits and application of cleaner production for improving environmental protection in Sodium carbonate production (Sisecam Sodium carbonate factory Lukavac), Sodium chloride production and environment, Medical waste management in Tuzla Canton, Case study solution of environmental problems in Šaleška Valley, Disposal of hazardous waste, Process development for base oils production.*

Specific topics

Course 4

Sustainable technologies and Materials engineering

The nowadays-fast development, which results in intensive way of leaving, is as a consequence of the development of different kinds of materials which can be found in various segments of everyday life. In the first part of the course in particular thematically parts are presented the different kinds of materials like: polymer materials, metals and alloys, ceramics materials, glass, composite materials and eco-composite materials. The following themes are also covered: science and engineering of materials, nanotechnology and non-material modern electronic economy. Particular attention is given to type and usage of materials starting from the modus operandi in science and engineering of materials i.e. the: *synthesis – structure – properties – application*.

The second part of the course thematically covered the treatment of waste in the materials engineering in general, but also the actual themes from the management of waste are presented like recycling of: polymers, metal scrap, glass and refractories. The production of ceramics from waste and end of life treatment of polymer composite materials are also covered in this part of the course.

In this part of the course the particular attention was paid to the different types of materials, which can be treated as raw materials from which new or the same products can be produced. Also, the attention was paid to the treatment of waste as energy resource.

4.3 ECTS files

COURSE TITLE

Sustainable technologies in Food industry

COURSE OUTCOMES

At the end of this course “Sustainable technologies in Food industry“ trainees will have a general knowledge of sustainability and will have specialised knowledge on sustainable technology and sustainability in food industry. The trainees will be able to handle specific problems concerning sustainability in food processing or food handling.

COURSE EDUCATIONAL AIMS

The course is a part of lifelong learning programme and aims at recruiting staff from food and related industries who is involved in dealing with sustainability of agricultural and industrial processes and with corporate sustainability. Newly graduated students are also welcome. The course starts with general knowledge on sustainability, proceeds with sustainable technologies and finally ends with specific sustainability problems and cases in food industry. The general aim is to provide the students with the ability to implement the acquired knowledge and attitudes in industrial practice in order to establish a sustainable food industry.

The educational general aims of the course are:

- to provide trainees with thorough knowledge and clear understanding of the sustainability concept
- to provide trainees with state of the art knowledge on sustainable technologies and sustainable food industry.

COURSE CONTENTS

The course covers the following topics:

1. The zero emission concept
2. Environmental sustainability and industry
3. Legislation
4. Sustainable technologies
5. Renewable energy resources
6. Energy efficiency of the technology processes
7. Sustainability in the food sector
8. Food processing and generation of waste
9. Zero emission in the food industry
10. Hazardous substances from environment in food
11. Pollution caused by food industry
12. Wastewater treatment
13. Case studies

ECTS credits

6

COURSE TEACHING METHODS/COURSE ASSESSMENTS

The teaching methods will largely recline on student directed learning based on the strategic principle of team work and peer to peer learning. This principle will be applied in creating the courses and in defining the pedagogical methodology. The principle of good practice exchange and Peer learning will also be adopted.

The teaching methods will largely recline on student directed learning and – considering the targeted composition of the student population consisting of candidates who already acquired extensive professional experience – will be based on peer-to-peer learning, including the application of benchmarking and exchange of best practices.

These principles will be put forward from the start of the course and have been applied in creating the course materials and course activities in defining the pedagogical methods.

Teaching methods:	lectures, assignments and team-work
Practice:	permanent evaluation of students' work outcomes, students' attitudes and behaviour
Examination methods:	students' presentations of assignment outcomes, written exams.

STUDY LOAD

1 ECTS credit = 25 hours of study load;
6 ECTS x 25 hours = 150 hours

Study load breakdown

Study load (in hours) attributed to theoretical lectures, practical classes, self-conducted learning, case studies and examination

Lectures	30	hours
Practice	31	hours
Case studies	10	hours
Reworking lectures & Self-directed learning	75	hours
Exams	4	hours
Total	**150**	**hours**

1 hour Lecture = 2 hours	Reworking lectures & Self-directed learning
1 hour Case study = 1,5 hours	Reworking lectures & Self-directed learning
1 hour Practice = 0 hours	Self-directed learning

COURSE PLANNING

Activities	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Course contents														
	1	2	3	4	5	6	6	7	8, 9	10, 11	12	13	13		
	Trainees workload in hours														All
Lectures	3	3	3	3	3	3	3	3	3	3					30
Practice		3	3	3	3	3	3	3	3	3	4				31
Case studies	-	-	-	-	-	-	-	-	-		2	4	4		10
Reworking lectures & Self-directed learning	6	6	6	6	6	6	6	6	6	6	3	6	6		75
Exams (covers previous 2 weeks of course content)	-		1			1			1						3
Final exam														1	1
Total	9	12	13	12	12	13	12	12	13	12	9	10	10	1	150

COURSE TITLE

Sustainable technologies in Pharmaceutical and cosmetic industry

COURSE OUTCOMES

At the end of this course "**Sustainable technologies in Pharmaceutical and cosmetic industry**" trainees will have a general knowledge of sustainability and will have specialised knowledge on sustainable technology and sustainability in **Pharmaceutical and cosmetic industry**. The trainees will be able to handle specific problems concerning sustainability in **Pharmaceutical and cosmetic industry**.

COURSE EDUCATIONAL AIMS

The course is part of lifelong learning programme and aims at recruiting staff from **Pharmaceutical and cosmetic industry** who is involved in dealing with sustainability. Newly graduated students are also welcome. The course starts with general knowledge on sustainability, proceeds with sustainable technologies and finally ends with specific sustainability problems and Pharmaceutical and cosmetic industry. The general aim is to provide the students with the ability to implement the acquired knowledge and attitudes in industrial practice in order to establish a sustainable Pharmaceutical and cosmetic industry.

The educational general aims of the course are:

- to provide trainees with thorough knowledge and clear understanding of the sustainability concept
- to provide trainees with state of the art knowledge on sustainable technologies and sustainable pharmaceutical and cosmetic industry.

COURSE CONTENTS

The course covers the following topics:

1. The zero emission concept
2. Environmental sustainability and industry
3. Legislation
4. Sustainable technologies
5. Renewable energy resources
6. Energy efficiency of the technology processes
7. Sustainable development
8. The influence of international corporations on the environment
9. Pharmaceutical compliance with international standard requirements
10. Guidelines for Good Manufacturing Practice in Serbia
11. Medical wastes and chemicals management
12. Conventions on the control of hazardous wastes and their disposal
13. Toxic waste from industry
14. Household waste high-risk
15. Hazardous waste
16. Destruction of hazardous waste
17. Responsibilities and obligations
18. Organization of waste management
19. Medical and pharmaceutical waste
20. Methodology for analysis of case study

ECTS credits

6

COURSE TEACHING METHODS/COURSE ASSESSMENTS

The teaching methods will largely recline on student directed learning based on team work and peer to peer learning. This principle will be applied in creating the courses and in defining the pedagogical methodology. The principle of good practice exchange and Peer learning will also be adopted.

The teaching methods will largely recline on student directed learning and – considering the targeted composition of the student population consisting of candidates who already acquired extensive professional experience – will be based on peer-to-peer learning, including the application of benchmarking and exchange of best practices.

These principles will be put forward from the start of the course and have been applied in creating the course materials and course activities in defining the pedagogical methods.

Teaching methods:	lectures, assignments and team-work
Practice:	permanent evaluation of students' work outcomes, students' atttudes and behaviour
Examination methods:	students' presentations of assignment outcomes, written exams.

STUDY LOAD

1 ECTS credit = 25 hours of study load;
6 ECTS x 25 hours = 150 hours

Study load breakdown

Study load (in hours) attributed to theoretical lectures, practical classes, self-conducted learning, case studies and examination

Lectures	33	hours
Practice	33	hours
Case studies	6	hours
Reworking lectures & Self-directed learning	75	hours
Exams	4	hours
Total	**150**	**hours**

1 hour Lecture = 2 hours	Reworking lectures & Self-directed learning
1 hour Case study = 1,5 hours	Reworking lectures & Self-directed learning
1 hour Practice = 0 hours	Self-directed learning

COURSE PLANNING

Activities	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Course contents														
	1	2	3	4	5	6	6	7	8	9	10	11	12		
	Trainees workload in hours														All
Lectures	3	3	3	3	3	3	3	3	1	3	3	1	1		33
Practice		3	3	3	3	3	3	3	3	3	3	2			32
Case studies	-	-	-	-	-	-	-	-	-			2	4		6
Reworking lectures & Self-directed learning	6	6	6	6	6	6	6	6	2	6	6	5	8		75
Exams (covers previous 2 weeks of course content)	-		1			1			1						3
Final exam														1	1
Total	9	12	13	12	12	13	12	12	13	12	9	10	10	1	150

COURSE TITLE

Sustainable technologies and Chemical engineering

COURSE OUTCOMES

At the end of this course “**Sustainable technologies and Chemical engineering**“ trainees will have a general knowledge of sustainability and will have specialised knowledge on sustainable technology and sustainability related to Chemical engineering.

The trainees will be able to handle specific problems concerning sustainability in Chemical engineering

COURSE EDUCATIONAL AIMS

The course is part of lifelong learning programme and aims at recruiting staff from **Chemical industry,** involved in dealing with sustainability. Newly graduated students are also welcome. The course starts with general knowledge on sustainability, proceeds with sustainable technologies and finally ends with specific sustainability problems and chemical engineering. The general aim is to provide the students with the ability to implement the acquired knowledge and attitudes in industrial practice in order to establish a sustainable chemical engineering practice. The educational general aims of the course are:

- to provide trainees with thorough knowledge and clear understanding of the sustainability concept
- to provide trainees with state of the art knowledge on sustainable technologies and sustainable chemical industry.

COURSE CONTENTS

The course covers the following topics:

1. The zero emission concept
2. Environmental sustainability and industry
3. Legislation
4. Sustainable technologies
5. Renewable energy resources
6. Energy efficiency of the technology processes
7. Sustainable development – a challenge for chemical industry
8. Pollution prevention in chemical industry
9. Sustainable design and manufacture
10. Design and modelling of sustainable industrial processes
11. Combustion process as a source of air pollution
12. Zero emission concept of mass and energy in chemical industry
13. Treatment of textile wastes
14. Case studies

ECTS credits

6

COURSE TEACHING METHODS/COURSE ASSESSMENTS

The teaching methods will largely recline on student directed learning are based on team work and peer to peer learning. This principle will be applied in creating the courses and in defining the pedagogical methodology. The principle of good practice exchange and Peer learning will also be adopted.

The teaching methods will largely recline on student directed learning and – considering the targeted composition of the student population consisting of candidates who already acquired extensive professional experience – will be based on peer-to-peer learning, including the application of benchmarking and exchange of best practices.

These principles will be put forward from the start of the course and have been applied in creating the course materials and course activities in defining the pedagogical methods.

Teaching methods:	lectures, assignments and team-work
Practice:	permanent evaluation of students' work outcomes, students' attitudes and behaviour
Examination methods:	students' presentations of assignment outcomes, written exams.

STUDY LOAD

1 ECTS credit = 25 hours of study load;
6 ECTS x 25 hours = 150 hours

Study load breakdown

Study load (in hours) attributed to theoretical lectures, practical classes, self-conducted learning, case studies and examination

Lectures	30	hours
Practice	31	hours
Case studies	10	hours
Reworking lectures & Self-directed learning	75	hours
Exams	4	hours
Total	**150**	**hours**

1 hour Lecture = 2 hours	Reworking lectures & Self-directed learning
1 hour Case study = 1,5 hours	Reworking lectures & Self-directed learning
1 hour Practice = 0 hours	Self-directed learning

COURSE PLANNING

Activities	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Course contents														
	1	2	3	4	5	6	6	7, 8	9, 10	11, 12	11	11	12		
	Trainees workload in hours														All
Lectures	3	3	3	3	3	3	3	3	3	3					30
Practice		3	3	3	3	3	3	3	3	3	4				31
Case studies	-	-	-	-	-	-	-	-	-		2	4	4		10
Reworking lectures & Self-directed learning	6	6	6	6	6	6	6	6	6	6	3	6	6		75
Exams (covers previous 2 weeks of course content)	-		1			1			1						3
Final exam														1	1
Total	9	12	13	12	12	13	12	12	13	12	9	10	10	1	150

COURSE TITLE

Sustainable technologies and Materials engineering

COURSE OUTCOMES

At the end of this course "**Sustainable technologies and Materials engineering**" trainees will have a general knowledge of sustainability and will have specialised knowledge on sustainable technology and sustainability related to Material engineering.

The trainees will be able to handle specific problems concerning sustainability and Material engineering

COURSE EDUCATIONAL AIMS

The course is a part of lifelong learning programme and aims at recruiting staff from **Industry dealing with materials (ceramic, metals, polymers and composites)**. Newly graduated students are also welcome. The course starts with general knowledge on sustainability, proceeds with sustainable technologies and finally ends with specific sustainability problems and Material engineering. The general aim is to provide the students with the ability to implement the acquired knowledge and attitudes in industrial practice in order to establish a sustainable Material engineering practice. The educational general aims of the course are:

- to provide trainees with thorough knowledge and clear understanding of the sustainability concept
- to provide trainees with state of the art knowledge on sustainable technologies and sustainable materials engineering.

COURSE CONTENTS

The course covers the following topics:

1. The zero emission concept
2. Environmental sustainability and industry
3. Legislation
4. Sustainable technologies
5. Renewable energy resources
6. Energy efficiency of the technology processes
7. Materials Engineering
8. Polymer materials
9. Metals and alloys
10. Ceramic materials
11. Glass
12. Polymer eco-composite materials
13. Modern electrode materials in the hydrogen economy
14. Waste treatment in materials engineering
15. Case studies

ECTS credits

6

COURSE TEACHING METHODS/COURSE ASSESSMENTS

The teaching methods will largely recline on student directed learning are based on team work and peer to peer learning. This principle will be applied in creating the courses and in defining the pedagogical methodology. The principle of good practice exchange and Peer learning will also be adopted.

The teaching methods will largely recline on student directed learning and – considering the targeted composition of the student population consisting of candidates who already acquired extensive professional experience – will be based on peer-to-peer learning, including the application of benchmarking and exchange of best practices.

These principles will be put forward from the start of the course and have been applied in creating the course materials and course activities in defining the pedagogical methods.

Teaching methods:	lectures, assignments and team-work
Practice:	permanent evaluation of students' work outcomes, students' attitudes and behaviour
Examination methods:	students' presentations of assignment outcomes, written exams.

STUDY LOAD

1 ECTS credit = 25 hours of study load;
6 ECTS x 25 hours = 150 hours

Study load breakdown

Study load (in hours) attributed to theoretical lectures, practical classes, self-conducted learning, case studies and examination

Lectures	30	hours
Practice	31	hours
Case studies	10	hours
Reworking lectures & Self-directed learning	75	hours
Exams	4	hours
Total	**150**	**hours**

1 hour Lecture = 2 hours	Reworking lectures & Self-directed learning
1 hour Case study = 1,5 hours	Reworking lectures & Self-directed learning
1 hour Practice = 0 hours	Self-directed learning

COURSE PLANNING

Activities	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Course contents														
	1	2	3	4	5	6	6	7	8-10	11-13	14	15	15		
	Trainees workload in hours														All
Lectures	3	3	3	3	3	3	3	3	3	3					30
Practice		3	3	3	3	3	3	3	3	3	4				31
Case studies	-	-	-	-	-	-	-	-	-		2	4	4		10
Reworking lectures & Self-directed learning	6	6	6	6	6	6	6	6	6	6	3	6	6		75
Exams (covers previous 2 weeks of course content)	-		1			1			1						3
Final exam														1	1
Total	9	12	13	12	12	13	12	12	13	12	9	10	10	1	150

4.4 Held courses and evaluations

SERBIA

Course organizer: University of Novi Sad, Faculty of technology, Novi Sad

A. Number and structure of trainees

Structure	Name of the company	Number of trainees
Industry	Alltech Serbia, Senta	22
	TE-TO Senta	21
Public service		0
Student		0
Other		0
Total		43

B. Position/occupation of trainees

Position/occupation	Number of trainees
Managers	
Engineers	
Administration	
Technicians	
Student	
Unemployed	
Total	43

C. Course attendance per topics

Topic/course	Number of trainees
Sustainable technologies	
Sustainable technologies in Food industry	
Sustainable technologies in Pharmaceutical and cosmetic industry	
Sustainable technologies and Chemical engineering	
Sustainable technologies and Materials engineering	

D. Course teachers

University of Novi Sad, Faculty of technology, Novi Sad

1. Zoltan Zavargo
2. Mile Klašnja
3. Slobodan Sokolović

University of Niš, Faculty of technology, Leskovac

4. Goran Nikolić
5. Olivera Stamenković

University of East Sarajevo, Faculty of technology, Zvornik

6. Radoslav Grujić

Tuzla University, Faculty of technology, Tuzla

7. Midhat Jašić

University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy, Skopje

8. Emilija Fidančevska

University Goce Delcev, Faculty of Technology, Štip

9. Vineta Srebrenkoska

E. Exam results and course evaluations

Exam results		
Passed the exam %	100	
Course evaluations		
Question	Options	%
Are you satisfied with the curriculum of the course?	**Yes**	76.47
	Partly	17.65
	No	11.76
Are you satisfied with the literature for the course?	Yes	76,47
	Partly	23,53
	No	0,00
Are you satisfied with the course lecturer?	**Yes**	82.35
	Partly	17.65
	No	0,00

SERBIA

Course organizer: University of Niš, Faculty of technology, Leskovac

A. Number and structure of trainees

Structure	Name of the company	Number of trainees
Industry	DCP Hemigal	3
	FHI Zdravlje-Actavis	2
	Biohem. Leskovac	1
	Interlemind	2
Public service	Municipality of Leskovac	1
Student		14
Other		3
Total		26

B. Position/occupation of trainees

Position/occupation	Number of trainees
Managers	1
Engineers	9
Administration	0
Technicians	1
Student	14
Unemployed	1
Total	26

C. Course attendance per topics

Topic/course	Number of trainees
Sustainable technologies	26
Sustainable technologies in Food industry	26
Sustainable technologies in Pharmaceutical and cosmetic industry	26
Sustainable technologies and Chemical engineering	26
Sustainable technologies and Materials engineering	26

D. Course teachers

University of Niš, Faculty of technology, Leskovac

1. Milorad Cakić
2. Goran Nikolić
3. Olivera Stamenković
4. Vlada Veljković
5. Zoran Todorović
6. Dragiša Savić

University of Novi Sad, Faculty of technology, Novi Sad

7. Zoltan Zavargo
8. Mile Klašnja

University of East Sarajevo, Faculty of technology, Zvornik

9. Radoslav Grujić

Tuzla University, Faculty of technology, Tuzla

10. Midhat Jašić

University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy, Skopje

11. Emilija Fidančevska

University Goce Delcev, Faculty of Technology, Štip

12. Vineta Srebrenkoska

E. Exam results and course evaluations

Exam results		
Passed the exam %	100	
Course evaluations		
Question	Options	%
Are you satisfied with the curriculum of the course?	Yes	100%
	Partly	0%
	No	0%
Are you satisfied with the literature for the course?	Yes	96%
	Partly	4%
	No	0%
Are you satisfied with the course lecturer?	Yes	100%
	Partly	0%
	No	0%

Bosnia and Herzegovina

Course organizer: University of East Sarajevo, Faculty of technology, Zvornik

A. Number and structure of trainees

Structure	Name of the company	Number of trainees
Industry	Birač	3
	Novohem	1
	Modriča	1
	“GROSS” SASE	3
	Bakery “Dijana”	1
	Bimal	2
Public service		2
Student		13
Other		1
Total		27

B. Position/occupation of trainees

Position/occupation	Number of trainees
Managers	2
Engineers	15
Administration	3
Technicians	3
Student	3
Unemployed	1
Total	27

C. Course attendance per topics

Topic/course	Number of trainees
Sustainable technologies	9
Sustainable technologies in Food industry	9
Sustainable technologies in Pharmaceutical and cosmetic industry	2
Sustainable technologies and Chemical engineering	7
Sustainable technologies and Materials engineering	3

D. Course teachers

University of East Sarajevo, Faculty of technology, Zvornik

1. Radoslav Grujić
2. Vladan Mićić
3. Milovan Jotanović
4. Milorad Tomić
5. Vojislav Aleksić
6. Branko Pejović
7. Dragica Lazić
8. Goran Tadić
9. Mitar Perušić
10. Miomir Pavlović
11. Pero Dugic
12. Miladin Gligorić
13. Branko Đukić
14. Dragan Vujadinović
15. Zoran Petrović
16. Jasna Mastilović
17. Slavica Grujić

Tuzla University, Faculty of technology, Tuzla

18. Midhat Jašić

University of Novi Sad, Faculty of technology, Novi Sad

19. Zoltan Zavargo
20. Mile Klašnja

University of Niš, Faculty of technology, Leskovac

21. Milorad Cakić
22. Goran Nikolić

University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy, Skopje

23. Emilija Fidančevska
24. Kiril Lisičkov

University Goce Delcev, Faculty of Technology, Štip

25. Vineta Srebrenkoska

E. Exam result and course evaluations

Exam results		
Passed the exam %	100	
Course evaluations		
Question	Options	%
Content of the course?	Excellent	96
	Good	4
	Bad	**0**
	Very bad	0
Applicability in practice	Excellent	**89**
	Good	**7**
	Bad	**4**
	Very bad	**0**
Quality of the lectures	Excellent	95
	Good	**5**
	Bad	**0**
	Very bad	**0**

Bosnia and Herzegovina

Course organizer: Tuzla University, Faculty of technology, Tuzla

A. Number and structure of trainees

Structure	Name of the company	Number of trainees
Industry	GLOBAL ISPAT Koksna industrija d.o.o. Lukavac	3
	Solana DD Tuzla	3
	SISECAM SODA LUKAVAC	6
	CIMOS „TMD Ai“ Gradačac	1
	Fabrika deterdženata „Dita“ Tuzla	2
	DUKAT Mlin Jelah	1
	Inmer d.o.o. Gradacac	1
	Fana d.o.o. Srebrenik	1
	‘’Voćar’’ Brčko	1
	BONY DOO Tuzla	1
	‘’DRAMAR ING’’ Tuzla	1
Public service	JKP “Komunalac” Tuzla	1
	CEE Centar za ekologiju i energiju Centre for Ecology and Energy	1
	KEMOKOP d.o.o.	1
	Mješovita srednja hemijska škola u Tuzli Secondary chemical school, Tuzla	13
	Agencija za certificiranje halal kvalitete Tuzla Agency for halal quality certification	1
	AgroLife d.o.o	1
	Faculty of Technology	2
	Organization Bosper	1
	Blagoleks d.o.o.	3
Student	Faculty of Technology	19
Other		16
Total		80

B. Position/occupation of trainees

Position/occupation	Number of trainees
Managers	3
Engineers	35
Administration	4
Technicians	6
Student	18
Unemployed	14
Total	80

C. Course attendance per topics

Topic/course	Number of trainees
Sustainable technologies	80
Sustainable technologies in Food industry	37
Sustainable technologies in Pharmaceutical and cosmetic industry	37
Sustainable technologies and Chemical engineering	43
Sustainable technologies and Materials engineering	37

D. Course teachers

Tuzla University, Faculty of technology, Tuzla

1. Midhat Jašić

University of East Sarajevo, Faculty of technology, Zvornik

2. Radoslav Grujić

University of Novi Sad, Faculty of technology, Novi Sad

3. Zoltan Zavargo
4. Mile Klašnja

University of Niš, Faculty of technology, Leskovac

5. Milorad Cakić
6. Goran Nikolić

University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy, Skopje

7. Emilija Fidančevska
8. Kiril Lisičkov

University Goce Delcev, Faculty of Technology, Štip

9. Vineta Srebrenkoska

E. Exam results and course evaluations

Exam results		
Passed the exam %	100	
Course evaluations		
Question	Options	%
How are you satisfied with the overall course?	5	35,29
	4	33,33
	3	25,5
	2	5,85
	1	0
How do you assess the readiness of lectures and news topics?	5	31,37
	4	39,22
	3	25,49
	2	**3,92**
	1	**0**
Lectures connect well theory and practice?	yes	92,16
	no	7,34
Do you think that such courses should be continuously organized?	yes	98,04
	no	1,96

The Former Yugoslav Republic of Macedonia

Course organizer: University Goce Delcev, Faculty of Technology, Stip

A. Number and structure of trainees

Structure	Name of the company	Number of trainees
Industry	11 Oktomvri Eurokompozit – Prilep	17
Public service		0
Student		3
Other		0
Total		20

B. Position/occupation of trainees

Position/occupation	Number of trainees
Managers	6
Engineers	11
Administration	0
Technicians	0
Student	3
Unemployed	0
Total	20

C. Course attendance per topics

Topic/course	Number of trainees
Sustainable technologies	20
Sustainable technologies in Food industry	20
Sustainable technologies in Pharmaceutical and cosmetic industry	20
Sustainable technologies and Chemical engineering	20
Sustainable technologies and Materials engineering	20

D. Course teachers

University Goce Delcev, Faculty of Technology, Štip

1. Vineta Srebrenkoska
2. Dimko Dimeski

University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy, Skopje

3. Emilija Fidančevska
4. Jadranka Blaževska Gilev
5. Kiril Lisičkov

University of Niš, Faculty of Technology, Leskovac

6. Milorad Cakić
7. Goran Nikolić

University of Novi Sad, Faculty of technology, Novi Sad

8. Zoltan Zavargo
9. Mile Klašnja

University of East Sarajevo, Faculty of technology, Zvornik

10. Radoslav Grujić

Tuzla University, Faculty of technology, Tuzla

11. Midhat Jašić

E. Exam results and course evaluations

Exam results		
Passed the exam %	100	
Course evaluations		
Question	Options	%
Are you satisfied with the curriculum of the course?	Yes	97
	Partly	0
	No	7
Are you satisfied with the literature for the course?	Yes	94%
	Partly	6%
	No	0%
Are you satisfied with the course lecturer?	Yes	100%
	Partly	0
	No	0

The Former Yugoslav Republic of Macedonia

Course organizer: University Ss Cyril and Methodius in Skopje
Faculty of Technology and Metallurgy, Skopje

A. Number and structure of trainees

Structure	Name of the company	Number of trainees
Industry	Bomex Refractory – Pehčevo	17
Public service		0
Student		3
Other		0
Total		20

B. Position/occupation of trainees

Position/occupation	Number of trainees
Managers	9
Engineers	8
Administration	0
Technicians	0
Student	3
Unemployed	0
Total	20

C. Course attendance per topics

Topic/course	Number of trainees
Sustainable technologies	20
Sustainable technologies in Food industry	20
Sustainable technologies in Pharmaceutical and cosmetic industry	20
Sustainable technologies and Chemical engineering	20
Sustainable technologies and Materials engineering	20

D. Course teachers

University Ss Cyril and Methodius in Skopje, Faculty of Technology and Metallurgy, Skopje

1. Emilija Fidančevska
2. Jadranka Blaževska Gilev
3. Kiril Lisičkov
4. Sveto Cvetkovski
5. Biljana Anguševa

University Goce Delcev, Faculty of Technology, Štip

6. Vineta Srebrenkoska
7. Dimko Dimeski

University of Niš, Faculty of Technology, Leskovac

8. Milorad Cakić
9. Goran Nikolić

University of Novi Sad, Faculty of Technology, Novi Sad

10. Zoltan Zavargo
11. Mile Klašnja

University of East Sarajevo, Faculty of Technology, Zvornik

12. Radoslav Grujić

Tuzla University, Faculty of Technology, Tuzla

13. Midhat Jašić

E. Exam results and course evaluations

Exam results		
Passed the exam %	95	
Course evaluations		
Question	Options	%
Are you satisfied with the curriculum of the course?	Yes	95
	Partly	5
	No	0
Are you satisfied with the literature for the course?	Yes	95
	Partly	5
	No	0
Are you satisfied with the course lecturer?	Yes	95
	Partly	5
	No	0

Summary

Number and structure of trainees

Structure	Number of trainees
Industry	117
Public service	27
Student	52
Other	20
Total	216

Position/occupation	Number of trainees
Managers	40
Engineers	95
Administration	7
Technicians	17
Student	41
Unemployed	16
Total	216

Suggestions/comments

1. Content of some topics should be more detailed
2. More on renewable energies and practical examples
3. Separate training for engineers and technicians
4. Tailored courses: combination of topics by specific needs
5. Courses to be continued
6. Cooperation with same teachers to be continued
7. Involve new teachers – experts in specific topics

Common course evaluation sheet

The common course evaluation sheet is proposed for the future work.

Course: Sustainable technologies **Course evaluation sheet**		
Questions		**Answer**
1.	Are the topics of the course interesting/contemporary?	Yes
		Partly
		No
2.	Is the content of the course topics in line with course aim?	Yes
		Partly
		No
3.	Are you satisfied with the Literature for the course?	Yes
		Partly
		No
4.	Have your expectations been realized?	Yes
		Partly
		No
5.	Are you satisfied with the readiness of the lectures?	Yes
		Partly
		No
6.	Rapport	Yes
		Partly
		No
7.	Lectures were performed in a stimulating and innovative way?	Yes
		Partly
		No
8.	Attending the lectures significantly enrich your knowledge on sustainable technologies?	Yes
		Partly
		No

9.	Will knowledge gained in the course be used readily in your company or study?	Yes
		Partly
		No
10.	During the classes were you actively involved?	Yes
		Partly
		No
11.	During the course/break you asked a question or spoke to the teachers?	Yes
		Partly
		No
12.	Such courses should be organized in the future?	Yes
		Partly
		No
13.	Do you want to be kept informed with similar activities?	Yes
		Partly
		No
Comments/suggestions		

SWOT Analysis

Strength	**Weakness**
Established network of universities and enterprises and universities in Balkan region	Macedonian language is the least similar to others
Knowledge and experience	Distance between partner universities
Common education origin	
Except Macedonian, languages are almost the same	
Competent teaching staff	
Appropriate teaching written material and equipment	
Opportunities	**Threats**
Great interest from trainees for the courses	Lack of financial support by government and universities
Connections with industry	Not fully developed network with industry
Experience gained from industry	Lack of interest by potential trainees
	Undeveloped industry with low production

4.5 Network

Network members

Serbia
University of Novi Sad
Faculty of Technology, Novi Sad
Zoltan Zavargo
Expertise concerning the topic of the courses
- Energy efficiency
- Zero emisson concept
- Environmental risk assessment

Mile Klašnja
Expertise concerning the topic of the courses
- Legislation
- Waste water treatment
- Waste minimization
- Biogas

Slobodan Sokolović
Expertise concerning the topic of the courses
- Environmental sustainability and industry
- Life cycle assessment
- Management of human resources
- Environmental risk assessment

Aleksandar Jokić
Expertise concerning the topic of the courses
- Zero emisson concept

Bojana Ikonić
- Sugar industry – case study

Jovana Grahovac
- Yeast industry – case study

Serbia
University of Nis
Faculty of Technology, Leskovac
Milorad Cakić
Expertise concerning the topic of the courses
- Renewable energy resources

Goran Nikolić
Expertise concerning the topic of the courses
- Sustainable technologies in Pharmaceutical and cosmetic industry

Vlada Veljković
Expertise concerning the topic of the courses
- Concept of sustainability related to society, and especially industry

Olivera Stamenković
Expertise concerning the topic of the courses
- Renewable energy resources

Zoran Todorović
Expertise concerning the topic of the courses
- Sustaibale technologies
- Pollution from food industry

Dragiša Savić
Expertise concerning the topic of the courses
- Sustainable technologies in Food industry

Bosnia and Herzegovina
University of East Sarajevo
Faculty of Technology, Zvornik
Radoslav Grujić
Expertise concerning the topic of the courses
- Concept of sustainability related to society, and especially industry
- Sustainable technologies in Food industry
- Pollution from food industry
- Food industry – case studies

Vladan Mićić
Expertise concerning the topic of the courses
- Zero emisson concept

Milovan Jotanović
Expertise concerning the topic of the courses
- Pollution prevention in chemical industry
- Chemical industry – case studies

Milorad Tomić
Expertise concerning the topic of the courses
- Environmental sustainability and industry
- Sustainable development – challenge for chemical industry

Vojislav Aleksić
Expertise concerning the topic of the courses
- Sustainable technologies in Food industry

Branko Pejović
Expertise concerning the topic of the courses
- Pollution prevention in chemical industry

Dragica Lazić
Expertise concerning the topic of the courses
- Environmental risk assessment
- Chemical industry – case studies

Goran Tadić
Expertise concerning the topic of the courses
- Sustainable Design and Manufacture

Mitar Perušić
Expertise concerning the topic of the courses
Environmental management
Miomir Pavlović
Expertise concerning the topic of the courses
Sustainable technologies in Food industry
Chemical industry – case studies
Pero Dugic
Expertise concerning the topic of the courses
Sustainable technologies in Food industry
Food industry – case studies
Miladin Gligorić
Expertise concerning the topic of the courses
Sustainable technologies in Food industry
Safe management of hazardous waste
Branko Đukić
Expertise concerning the topic of the courses
Pollution from food industry
Safe management of medical waste
Dragan Vujadinović
Expertise concerning the topic of the courses
Sustainable technologies in Food industry
Zoran Petrović
Expertise concerning the topic of the courses
Sustainable technologies in Food industry – Case studies

Bosnia and Herzegovina
Tuzla University
Faculty of Technology, Tuzla

Midhat Jašić
Expertise concerning the topic of the courses
Hazardous substances from environment in food
Pollution from food industry
Mustafa Burgić
Expertise concerning the topic of the courses
The concept of sustainable development with a focus on the industry
Midhat Suljkanović
Expertise concerning the topic of the courses
Energy efficiency of technological processes
Design and modeling of sustainable industrial processes
Zoran Iličković
Expertise concerning the topic of the courses
Sustainable development – a challenge for the chemical industry
Jasminka Sadadinović
Expertise concerning the topic of the courses
Chemical industry as a source of pollution
Vahida Selimbašić
Expertise concerning the topic of the courses
Combustion process as a source of air pollution
Disposal of waste products from the food industry
Blatnik Stanko
Expertise concerning the topic of the courses
Solving environmental problems in Saleška Dolina – Case study
Abdulah Ahmetović
Expertise concerning the topic of the courses
Salt production – Case study
Nihad Akeljić
Expertise concerning the topic of the courses
Production of soda – case study
Zehrudin Osmanović
Expertise concerning the topic of the courses
Alternative fuels in the cement industry – Case study
Meho Bašić
Expertise concerning the topic of the courses
Meat industry – Case study
Ramzija Cvrk
Expertise concerning the topic of the courses
Fruit and vegetable – Case study
Emilija Spaseska
Expertise concerning the topic of the courses
Pharmaceutical industry – Case study
Nevres Hurić
Expertise concerning the topic of the courses
Management of medical waste – case study

The former Yugoslav Republic of Macedonia
University Ss Cyril and Methodius in Skopje
Faculty of Technology and Metallurgy, Skopje

Emilija Fidančevska
Expertise concerning the topic of the courses
Materials engineering
Ceramic materials
Ceramic products from waste materials
Recycling of refractories
Waste treatment in materials engineering
Zero emission concept
Jadranka Blaževska Gilev
Expertise concerning the topic of the courses
Concept of sustainability related to society, and especially industry
Polymer materials
Zero emission concept

Kiril Lisičkov
Expertise concerning the topic of the courses
- Green chemistry and clean technologies
- Application of the zero emission concept for the production process of Magnetite refractories – case study

Sveto Cvetkovski
Expertise concerning the topic of the courses
- Metals and alloys
- Recycling of metal scrap

Perica Paunović
Expertise concerning the topic of the courses
- Modern electrode materials in the hydrogen economy
- Environmental electrochemistry within the environmental engineering

Dijana Spaseska
Expertise concerning the topic of the courses
- Recycling
- Polymer recycling

Gordana Bogoeva Gaceva
Expertise concerning the topic of the courses
- Composite materials
- Polymer eco-composite materials

Aleksandar Dimitrov
Expertise concerning the topic of the courses
- Best available techniques

Milosav Miloševski
Expertise concerning the topic of the courses
- Waste water treatment

Gordana Ruseska
Expertise concerning the topic of the courses
- Glass and glass recycling

Biljana Anguševa
Expertise concerning the topic of the courses
- Ceramic products from waste materials

The former Yugoslav Republic of Macedonia
University Goce Delcev
Faculty of Technology, Štip

Vineta Srebrenkoska
Expertise concerning the topic of the courses
- Environmental sustainability and industry
- Air protection
- Solid waste management
- Treatment of textile wastes
- Materials Engineering
- Composite materials
- Polymer eco-composite materials
- Waste treatment in materials engineering
- End of life treatment of polymer composite materials
- Recycling and recovery of energy from waste polymer composites (case study)

Dimko Dimeski
Expertise concerning the topic of the courses
- Composite materials
- Polymer eco-composite materials
- End of life treatment of polymer composite materials
- Recycling and recovery of energy from waste polymer composites

Books for the courses

Sustainable technologies

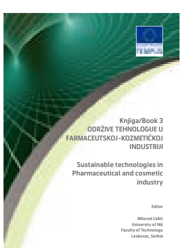
Content

1. The zero emission concept
2. Environmental sustainability and industry
3. Legislation
4. Sustainable technologies
5. Renewable energy resources
6. Energy efficiency of the technology processes

Sustainable technologies in Food industry

Content

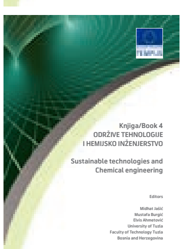
1. Sustainability in the food sector
2. Food processing and generation of waste
3. Zero emission in the food industry
4. Hazardous substances from environment in food
5. Pollution caused by food industry
6. Wastewater treatment
7. Case studies



Sustainable technologies in Pharmaceutical and cosmetic industry

Content

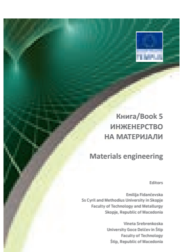
1. Sustainable development
2. Guidelines for Good Manufacturing Practice in Serbia
3. Medical wastes and chemicals management
4. Toxic waste from industry
5. Organization of waste management
6. Methodology for analysis of case study



Sustainable technologies and Chemical engineering

Content

1. Pollution prevention in chemical industry
2. Sustainable design and manufacture
3. Design and modelling of sustainable industrial processes
4. Combustion process as a source of air pollution
5. Zero emission concept of mass and energy in chemical industry
6. Treatment of textile wastes
7. Case studies



Materials engineering

Content

1. Materials Engineering
2. Polymer materials
3. Metals and alloys
4. Ceramic materials
5. Glass
6. Polymer eco-composite materials
7. Modern electrode materials in the hydrogen economy
8. Waste treatment in materials engineering
9. Case studies

5. Summary of the conducted activities

1st year

March 2010.

1st Coordination meeting, Gent, Belgium
Main decisions:
Accepted Project's Web site structure and design
Accepted scheme of retraining of the staff from WB partner universities in BE, GE and AT
Accepted Plan for Dissemination activities

March – April 2010.
Development of the project website
www.techno-sus.com

April 2010.
Workshop, Novi Sad, Serbia
Review and analyze the existing knowledge of the staff from industry on sustainable industry
Main decision:
Accepted the Test content and the way of testing and analysing the results **on existing knowledge of the staff from industry on sustainable industry**

May 2010.
The existing knowledge of the staff from industry on sustainable industry was tested in RS, BA and MK.

May – July 2010.
Short visit of EU experts to WB partner universities
&
Workshop and Dissemination conference
Screening and analyzing knowledge transfer from university to industry and formulation of the course scheme
31st May – 05th June 2010.
Zvornik, Bosnia and Herzegovina
03rd – 05th June 2010.
Tuzla, Bosnia and Herzegovina
21st – 25th June 2010.
Skopje, The Former Yugoslav Republic of Macedonia

24th – 25th June 2010.
Stip, The Former Yugoslav Republic of Macedonia
04th – 08th July 2010.
Leskovac, Serbia
04th – 06th July 2010.
Novi Sad, Serbia

July 2010.

2nd Coordination Meeting, Novi Sad, Serbia

Main decisions:

Accepted Remarks and Recommendation of the Tempus Serbia Monitoring team
Accepted internal evaluator

September 2010.

Retraining and updating of PC universities staff in BE

Main retraining topics/activities

Chamber of Commerce East Flanders
Laboratory of environmental technology
Efficient energy use at the Campus
Sustainable building at KaHo Sint-Lieven
Lifelong learning/Trainings about renewable energy
Company visits

October 2010.

Retraining and updating of PC universities staff in GE

Main retraining topics/activities

Zero emission concept
Material Flow Management
Circular Economy
Industrial Material Flow Management
Experience with enterprise-university cooperation
Company visits

November 2010.

Retraining and updating of PC universities staff in AT

Main retraining topics/activities

Environmental Protection
Dust separation from air and gases
Separation of gaseous pollutants from air and gases
Zero energy emission technologies
Advanced energy conversion
Company visits

2nd year

January 2011.

Course development workshop 1
Ohrid, The Former Yugoslav Republic Macedonia

Main decisions:

Accepted curriculum structure and common content
Accepted specific topics tailored for the need of the industry

February 2011.

3rd Coordination Meeting, Birkenfeld, Germany

Main decisions:

Accepted Annual report

Accepted Dissemination activities

Accepted Plan of the activities for the 2nd year

June 2011.

Course development workshop 2, Tuzla, Bosnia and Herzegovina

Main topics/decisions:

Presentation of the status of the course material

Accepted the content of the specific topics tailored for the need of the industry

Accepted internal and external review of the course written material

July 2011.

4th Coordination Meeting, Vienna, Austria

Main decisions:

Elaboration of internal quality report

Elaboration of external quality evaluation reports

Accepted Intermediate Report on implementation of the project

July 2011.

Submitted Intermediate Report on implementation of the project

August 2011.

The Intermediate Report Evaluation of EACEA

The EACEA found that results and activities that have been produced so far are very positive.

The EACEA also gave some suggestions.

February – December 2011.

Course development

3rd year

January 2012.

3rd Course Development Workshop

&

2nd Dissemination conference

Novi Sad, Serbia

Main topics/decisions

Presentation of the Project

Short presentation of the courses

Course written materials presentations

January 2012.

5th Coordination meeting, Novi Sad, Serbia

Main topics/decisions

Accepted suggestions of EACEA's gave in the Intermediate report evaluation
Accepted the final extent and outlook of courses written material
Accepted the courses holding time table

April – June 2012.

Course holding

Courses were held at all WB partner universities.

May – June 2012.

Teacher's exchange

During this period the all teachers had lectured all partner universities.

June 2012.

3rd Dissemination conference, Tuzla, Bosnia and Herzegovina

Main topics/decisions

Presentations of the activities of WB partner universities
Presentation Evaluation of the courses by the trainees
Certificates distribution to the participants and teachers

June 2012.

6th Coordination meeting

Main topics/decisions

Elaboration of external quality evaluation reports for the 2nd year
Accepted activities on definition of the Document ***Creation the Strategic Plan for education on sustainable industry in cooperation with Chambers of commerce***
Accepted Course books, flyers and Certificates design

September 2012.

4th Dissemination conference

Ohrid, The Former Yugoslav Republic Macedonia

Main topics/decisions

Presentations of the activities of WB partner universities
Presentation Evaluation of the courses by the trainees
Certificates distribution to the participants and teachers

September 2012.

7th Coordination meeting

Main topics/decisions

Accepted the titles of the written course books
Accepted the unique titles of the courses
Accepted ECTS files contents
Accepted Dissemination booklet structure and content
Accepted contents of the Certificates and flyers

October 2012.

5th Dissemination conference, Leskovac, Serbia

Main topics/decisions

- Presentation Evaluation of the courses by the trainees held in RS, BA and MK
- Award of Certificate
- Accepted the final course book written material
- Distributed Common certificates to all partners
- Presentation of the Academic cooperation agreement and Agreement on intellectual property documents
- Accepted Strategic Plan for education on sustainable industry and Strategic plan for sustainability of the project

October 2012.

6th Dissemination conference

Alltech Serbia, Senta, Serbia

Main topics/decisions

- Presentation of Alltech-Serbia Company
- Presentation of the project
- Award of Certificate

October 2012.

8th Coordination meeting

Novi Sad, Serbia

Main topics/decisions

- Accepted the final content of Academic cooperation agreement and Agreement on intellectual property documents
- Accepted the final content of the Document Strategic plan for sustainability of the project
- Accepted the common Evaluation sheet content
- Flyers distribution to partner universities
- Presentation the first version of Dissemination booklet

December 2012. – January 2013.

Signed Cooperation agreement with companies

Signed Cooperation agreement and Agreement on intellectual property documents

Signed Academic chambers of cooperation agreement

Signed Agreement with chambers of commerce

January 2013.

9th Coordination meeting

Skopje, The Former Yugoslav Republic Macedonia

Main topics/decisions

- Evaluation reports for the 3rd year were accepted
- Tasks to be done till the end of the project

March 2013.

Printed course books

Printed Dissemination booklet

March – April 2013.

Writing the Final report

March 2013.

Closing Coordination meeting

Gent, Belgium

Conclusions

Final report

6. Dissemination activities

Project's website

www.techno-sus.com

Partners' website

Serbia

University of Novi Sad
Faculty of technology, Novi Sad
www.uns.ac.rs

University of Niš
Faculty of technology, Leskovac
www.tf.ni.ac.rs

Bosnia and Herzegovina

University of East Sarajevo
Faculty of technology, Zvornik
http://www.tfzv.org

Tuzla university
Faculty of technology, Tuzla
www.tf.untz.ba

The former Yugoslav Republic of Macedonia
University Ss Cyril and Methodius in Skopje
Faculty of technology and metallurgy
http://www.tmf.ukim.edu.mk

University Goce Delcev, Štip
Faculty of technology
http://www.ugd.edu.mk/index.php/mk/fakulteti/ttf

Dissemination conferences

1st Dissemination conference
Screening and analyzing knowledge transfer from university to industry and formulation of the course scheme
Held at Each WB Partner University
Number of conferences: 6
Intermediate Dissemination conference
After the Coordination meeting in Vienna
At each partner university/Chamber of commerce
Number of conferences: 6
2nd Dissemination conference
Presentation of the created course

Held in Novi Sad, Serbia	
Number of conferences:	1
3rd Dissemination conference	
Presentation of the courses	
Held at each WB Partner country	
Number of conferences:	4
Total number of Dissemination conferences	17
Dissemination of the results by articles	
Number of articles	12
Dissemination of the results by lectures	
Number of Lectures	12
Dissemination through media	
Number of text in newspapers	17
Report and interview on radio and television	26
Total number of disseminations	**84**

7. Sustainsability

Strategy plan for sustainability of the project outcomes

The project partners recognized the importance of sustainable development, especially related to industry. The sustainable concept of zero emission seems to be an answer to both industry and society. The aim of zero emissions is maximum resource productivity and virtually no waste. Creating zero emission industry is a great challenge for both EU and WB partner countries.

General aims of the project

The general aim of the project is to introduce the concept of sustainable industrial production in the surrounding area of the participating universities, to foster LLL and to improve the university-enterprise cooperation.

Operational aims

To achieve these goals special courses on sustainable industry have been created and held to industry. In this way industry employees have been made susceptible to the sustainability concepts and accordingly trained in the use of sustainable technologies in specified industrial sectors.

Work plan

The following Work plan has been pursued
Year 1. Training of university staff
Year 2. Course development
Year 3. Course development and implementation for industry staff members

Strategic aims of the project

In the future, after the life of the Project, each WB partner university will continue to spread knowledge on sustainable technologies, spread the idea on zero emission concept and strength the link between university and enterprises and WB universities.

In this process the primary trainees will be staff from industry as well as other trainees like graduated students, public services, local administration, etc. The WB partners will provide this value to the trainees by holding courses on sustainable technologies. The trainees can also be involved in the training process with specific tasks in order to improve the level of the courses as well as to foster mutual cooperation on sustainable industry issue.

Strategic Plan for education on sustainable industry

The WB partners’ core purpose is to help building an environmentally friendly industry enhance LLL and continuously improve the related courses at their universities. To achieve this WB partners will:

1. Propagate effectively the course offer in Serbia, Macedonia and Bosnia-Herzegovina;
2. Continue with the same industry partner/trainees;
3. Have annual recruitment of app. 20 students, most of them from industry;
4. Involve as much as possible of teaching staff from partner universities in teaching and updating the courses;
5. Involve the trainees in teaching;
6. Involve the management level and teaching staff of all participating universities dissemination of the course offer;

7. Build an Inter-university network for maintaining a common course offer, sharing the work load and benchmarking "sustainable technology" propagating activities;
8. Build a University-Enterprise network;
9. Build a "University-sector organizations" and "university-chamber of commerce" network.

The following courses are planned to be offered:

1. Course 1
   Sustainable technologies in Food industry
2. Course 2
   Sustainable technologies in Pharmaceutical and cosmetic industry
3. Course 3
   Sustainable technologies and Chemical engineering
4. Course 4
   Sustainable technologies and Materials engineering
5. Course 5
   Specific course going deeper in certain topics
6. Course 6
   Courses tailored to the specific needs of industry from the existing topics.

The offered courses are covered with the written material given in five (5) course books:

1. Course book 1
   Sustainable technologies
2. Course book 2
   Sustainable technologies in Food industry
3. Course book 3
   Sustainable technologies in Pharmaceutical and cosmetic industry
4. Course book 4
   Sustainable technologies and Chemical engineering
5. Course book 5
   Materials engineering

In the future new courses should also be offered which will originate from the experience gained from cooperation with industry.

The Chambers of commerce should be the link between university and industry, the source of necessary data on industry in the region and should point out industry needs.

Strategic plan for sustainability of the project

Internal activities in partner universities:

1. General approval by WB university authorities;
2. Signing of Cooperation agreement between all WB partners;
3. Signing of Agreement on intellectual property rights;
4. Development of a joint certificate for all participants;
5. Organization of dissemination conferences;
6. Intra-university information campaign on available course offer and course materials,

7. Drawing up a list (per university) of possible lecturers and cooperators for offering the course modules to industry;
8. Making an inventory of developed course elements/chapters that could be built into the regular courses offer in all participating universities
9. Internships in companies;
10. Staff exchange between universities and companies;
11. Enlisting all dissemination activities;
12. Development of a permanent evaluation form;
13. Building data base of alumni.

External activities

1. Website updating and maintenance;
2. Publication of project leaflet including practical info;
3. Publication of project booklet;
4. Publishing of course materials;
5. Publishing of course abstracts on website;
6. Course overview and course planning on home website of each university + link to the official project website, including possibility to follow tailor-made courses;
7. Communication of course offer and outcomes via journal publication and communication on field related congresses and/or symposia;
8. Personal invitation letter to potential partner industries;
9. Signing of cooperation agreements with industry or/and chambers of commerce;
10. Approval on agreement on creation of university-enterprise networks for education on sustainable technologies from all partner institutions.

Each 6 WB partner universities should have a sustainability plan. Each Sustainability plan can have different accents according to the local situation.

Actions performed during the life of the Project

Internal

1. General approval by WB university authorities;
2. Agreement on continued joint cooperation between 6 WB universities;
3. Agreement on intellectual property rights;
4. Development of a joint certificate for all participants;
5. Organization of dissemination conferences;
6. Intra-university information campaign on available course offer and course materials;
7. List (per university) of possible lecturers and cooperators for offering the course modules to industry;
8. Inventory of developed course elements/chapters that could be build into the regular courses offer in all participating universities;
9. Internships in companies;
10. Staff exchange between universities and companies;
11. Enlist of all dissemination activities;
12. Development of a permanent evaluation form;
13. Building data base of alumni.

External activities

1. Website updating and maintenance;
2. Publication of project leaflet including practical info;
3. Publication of project booklet;
4. Publishing of course materials;
5. Publishing of course abstracts on website;
6. Course overview and course planning on home website of each university + link to the official project website, including possibility to follow tailor-made courses;
7. Communication of course offer and outcomes via journal publication and communication on field related congresses and/or symposia;
8. Personal invitation letter to potential partner industries;
9. Signing of cooperation agreements with industry or/and chambers of commerce;
10. Approval on agreement on creation of university-enterprise networks for education on sustainable technologies from all partner institutions.

Actions to be performed after the life of the Project

Internal

1. Organization of dissemination conferences;
2. Intra-university information campaign on available course offer and course materials;
3. Internships in companies;
4. Staff exchange between universities and companies;
5. Enlist of all dissemination activities;
6. Alumni data base updating and maintenance;

External activities:

1. Website updating and maintenance;
2. Spreading of project leaflet including practical info;
3. Course overview and course planning on home website of each university + link to the official project website, including possibility to follow tailor-made courses;
4. Communication of course offer and outcomes via journal publication and communication on field related congresses and/or symposia;
5. Personal invitation letter to potential partner industries;

8. Evaluations

Internal evaluations

Katrin Müller-Hansen

University of Applied Sciences Trier, Birkenfeld, Germany

1st year

The rate of using resources and the incurred costs as compared to the outcome of each activity

The rate of using resources was done according to the outcome of each activity. There was a small delay at the beginning of the project. The starting meeting was postponed and the 1st Dissemination conference was held in July 2010 instead in June 2010. The other activities were done on time.

All the project partners have been involved in the project activities.

The cooperation between University partners and Industry/Chambers of commerce is at high level. The non-university partners show great interest for cooperation.

The cooperation between WB university partners and WB and EU partners is also at a very high level.

The extent of the outcome of each activity and how it will contribute to the purposes of the project

The extent of the outcome of each activity is done due to schedule. All activities have been done.

The eventual changes in the environment of the project (target groups, target sectors and potential beneficiaries)

Although, originally not planned, the project will involve students for practical placement in the non-partner institutions. Some of the placement was done during 1st year; the other will be done during 2nd and 3rd year (Recommendation of EACEA. Evaluation report of the project's Application).

In the Activity I***nventorying and analyzing the status of knowledge in industry regarding the topics of the courses***, more industry partners was involved than it was originally planned.

Success of the communication flow and project coordination

The Project Management Board was set up at the Staring meeting in Gent, and its meetings are held regularly. All the meetings were prepared with Agenda sent to all participants. All Minutes of meetings (who attended, what papers were prepared, timetable established) can be found on the project's website.

The project teams have also been set up at each partner university.

Cost efficiency evaluated through internal procedures

The planned costs are compared to realized costs. The staff costs for the 1st year will be paid during April. The costs for External expert visits are reduced. Instead of three visits there will be only two visits.

2nd year

The rate of using resources and the incurred costs as compared to the outcome of each activity

The rate of using resources was done according to the outcome of each activity. The activities were done according to schedule.

All the project partners have been involved in the project activities.

The cooperation between University partners and Industry/Chambers of commerce is at high level. The non-university partners show great interest for cooperation.

The cooperation between WB university partners and WB and EU partners is also at a very high level.

The extent of the outcome of each activity and how it will contribute to the purposes of the project

The extent of the outcome of each activity is done due to schedule. All activities have been done.

The eventual changes in the environment of the project (target groups, target sectors and potential beneficiaries)

No changes.

Success of the communication flow and project coordination

The Project Management Board was set up at the Starting meeting in Gent, and its meetings are held regularly. All the meetings were prepared with Agenda sent to all participants. All Minutes of meetings (who attended, what papers were prepared, timetable established) can be found on the project's website.

Cost efficiency evaluated through internal procedures

The planned costs are compared to realized costs. The staff costs for the 2nd year were paid during May and June.

3rd year

The rate of using resources and the incurred costs as compared to the outcome of each activity

The extent of the outcome of each activity and how it will contribute to the purposes of the project

The rate of using resources was done according to the outcome of each activity. The activities were done according to schedule. The written course materials were presented in January 2012 in Novi Sad. According to suggestions given at the meeting in Novi Sad, it was corrected and presented in Tuzla, June 2012. The final version was presented and accepted at Dissemination meeting in Leskovac, October 2012.

The Dissemination booklet writing was finished by December 2012 and sent to all participants. After corrections it will be printed.

All the project partners have been involved in the project activities.

The cooperation between University partners and Industry/Chambers of commerce is at high level. The non-university partners show great interest for cooperation.

The cooperation between WB university partners and WB and EU partners is also at a very high level.

The extent of the outcome of each activity is done due to schedule. All activities have been completed.

The extent of the outcome of each activity is at schedule. All activities have been done. Outcome 4 Implement the new developed curricula for the staff from industry

There were no changes in the environment of the project (target groups, target sectors and potential beneficiaries)

Success of the communication flow and project coordination

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Cost efficiency evaluated through internal procedures

The planned costs are compared to realized costs. The staff costs for the 3rd year will be paid till the end of the project.

External evaluations

Gyula Vatai
Corvinus University of Budapest
Faculty of Food Science

1st year

Recommendations and possible difficulties

As a result of expert visit and above made report the next recommendations can be made. Some possible difficulties can be predicted.

In the first year of the project a great job on monitoring and analysis of the existing knowledge of the staff from industry on sustainable issue is the basis for further activities in the companies involved in this Tempus project focused on companies in Serbia, Bosnia and Herzegovina and The Former Yugoslav Republic Macedonia. In this period of the project the level of knowledge of the staff from industry has been analyzed in 13 companies in Serbia, Bosnia and Herzegovina and The Former Yugoslav Republic of Macedonia.

Another good work was that the retraining courses were organized for 18 – 24 participants from WB PC in Belgium, Austria and Germany. All of the participant countries, faculties and Chamber of Commerce/Economy and/or Industry had 1-2 representatives, as well. My opinion is that the organization and management of the project in the former 1 year period was excellent, as well as this retraining event.

The task for the next two-year of the project is to keep the interest of the companies included into the project for learning about sustainable technologies, tools for improvement of the exploited technology. For these purposes powerful activities of the Chamber of Commerce or Economy are needed for changing the regulations related to retraining of the practicing engineers every certain period related to environmental issues, sustainable development, etc.

2nd year

Recommendations and possible difficulties

As a result of expert visit and above made report the next recommendations can be made. Some possible difficulties can be predicted.

The second year of the project was devoted to the courses development and teaching material writing. It is obvious that the retraining performed in the first year of the project, in BE, DE and AT helps the partner as well as communication with industry.

The task for the next year of the project is to keep the interest of the companies included into the project for learning about sustainable technologies, tools for improvement of the exploited technology. For these purposes powerful activities of the Chamber of Commerce or Economy is needed for changing the regulations related to retraining of the practicing engineers every certain period related to environmental issues, sustainable development, etc.

3rd year

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External evaluations

Adam Pawełczyk
Wroclaw University of Technology
Faculty of Chemistry

1st year

Difficulties and Recommendations

No threads and obstacles had been observed during the first year of the project that could affect its completion negatively. There were some minor problems that occurred in this period but they did not influence the performance of the consortium. Here below, we are giving some related remarks:

1. Some doubts related to financial issues and refunds aroused during the first year which was immediately cleared by the coordinator
2. Some problems emerged with the volume of the course materials, which actually started to be very extensive, and in some parts too detailed. The problem was solved after a discussion with participation of the consortium members. Uniform shape of all chapters was agreed.
3. The course materials and their contents had to be reviewed and adapted to the project assumptions, which were accomplished during subsequent meetings and sessions.
4. Solution of some problems related to equipment supply was needed.
5. The project website should be updated and completed with key documents produced during
6. The first year of project run.
7. It would be recommended to mention dissemination events on the website.

General remarks and opinion

It is my pleasure to be an external expert in the Tempus JPHS–159989-1-2009-1-BE project entitled “Creation of university-enterprise cooperation networks for education on sustainable technologies”. I appreciate the involvement of a great number of university staff members and industry representatives who showed big interests in facilitating and establishing contacts between both stakeholders. The results from the project are certainly leadership’s contribution, who were able to motivate all colleagues to work hard and put a lot of effort into the project. The course materials, which are recently under preparation process, are of great value as they help to be aware of the environmental threads and to get more familiar with the zero emission concept, developed in and supported by the European Commission. The project will certainly be an example of sustainable process helping the involved people in future activities in their international cooperation within network of the European Higher Education Area.

2nd year

Recommendations and possible difficulties

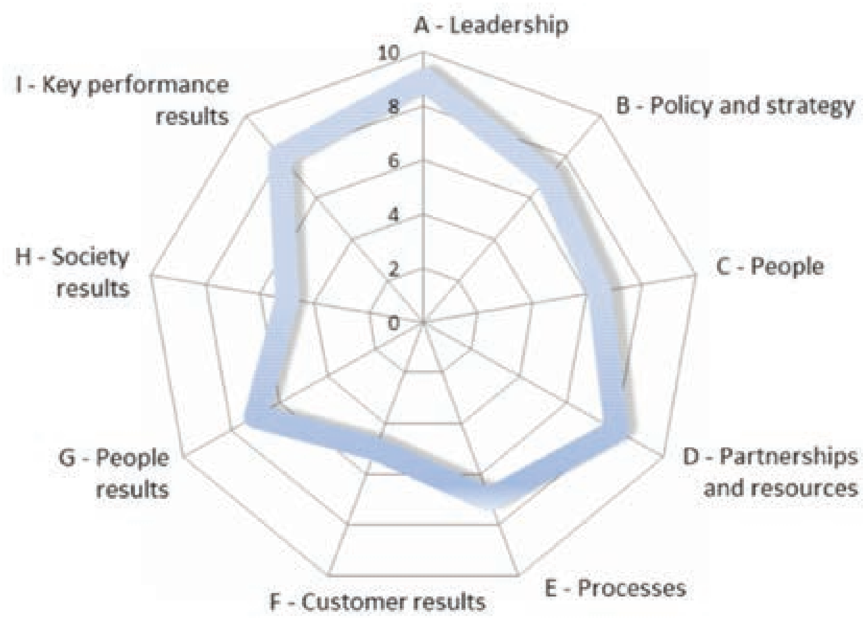
As a result of expert visit and above made report the next recommendations can be proposed. Some possible difficulties can be predicted.

The second year of the project was devoted to the courses development and teaching material writing. It is obvious that the retraining performed in the first year of the project, in BE, DE and AT helps the partner as well as communication with industry.

The task for the next year of the project is to keep the interest of the companies included into the project for learning about sustainable technologies, tools for improvement of the exploited technology. For these purposes powerful activities of the Chamber of Commerce or Economy are needed for changing the regulations related to retraining of the practicing engineers every certain period related to environmental issues, sustainable development, etc.

Final remarks and conclusion

The obtained results from the evaluation of the project can be expressed graphically in the form of radar diagram. The values assigned to particular criteria in the EFQM model of excellence have just tentative meaning and are based on an expert's subjective judgment. When analyzing the diagram one can notice that some of the criteria have higher values, while some others are lower. The general shape of the diagram shows a very satisfactory performance achieved by the project consortium, as a whole. Leadership, policy & strategy, partnerships & resources and people's results have been highly rated. This was an effect of the management as well as all the participant's commitment and contribution to the project. Other criteria were rated not as highly as the above mentioned, they were however not crucial for the project success.



Additionally, there was a very tough task to reach higher values, especially in the case of society or customer results. It would take more time to involve societies into the whole process, which actually was dedicated to the industry. Hopefully the project enablers and results will be sustained after the project end affecting society in a positive way. I am sure it will happen as the courses developed and offered by the WB universities aroused big interest among not just the industry people but even among students, unemployed and clerks.

It is worth to mention that the project produced a high added value on the European level. It consists in establishing contacts between European universities, WB universities and the WB industry. The contacts will be used in the future for development of new ideas and projects. Realization of the project enlightened the new partners on necessity of building the stronger links with the industry, extend their knowledge on modern, environmental friendly technologies and international cooperation in this matter. Participation in the project gave the partners and companies a chance for new projects and for enjoying a prestige derive that the results achieved are very impressive. The project consortium did huge work, which I admire very much.

The course materials have been already developed, the website is functioning, and first courses came from the international cooperation.

The project affected attitude of the industry people who began to be aware of profits derived from the university – industry cooperation in the creation of appropriate labor market structure. The project clearly demonstrated that nowadays, in the current economical crisis, a joint industry-university consultancy and problem solving could be the best way of the crisis mitigation.

In conclusion, I just want to present some of my observations and remarks. It was my great pleasure to say that the achieved results are very impressive. The project consortium did huge work which I admire very much.

Usefulness of the EFQM model was proven after analyzing a feedback from the project stakeholders that is from the students and industry representatives participating in the courses. I appreciate the results of my discussions with them and results of questionnaires. The EFQM model applied composes an almost closed loop reflecting the full relations between enablers and customers.

I think the project goals are not threaten and we are approaching a successful project finish. I highly appreciate what was done during the last year, particularly organization of the meetings in Tuzla meetings in Ohrid, Birkenfeld and Vienna. The big interest among people invited to the conference in Tuzla proves that this project is very important and needed for representatives of the industry and new links between universities and industry are expected.

These are examples of the good job done by the universities in Novi Sad, Tuzla, Leskovac, Zvornik, Stip and Skopje. There are no outsiders among the partnership as it is acting as one team. In my opinion, everybody contributed to the project achievements equally.

3rd year

Recommendations and possible difficulties

As a result of expert visit and above made report, the next recommendations can be proposed. Some possible difficulties can be predicted.

The third project year was devoted to finishing and completing the course materials as well as to adjustment of all the project products to the final shape, consistent with the assumptions set in the application form. Paramount part of activity in this period were the courses carried out, dissemination actions such as dissemination conferences, meetings, interviews, website updating, industry visits etc.

To these purposes many external institutions were involved which had sent their staff interested in environmental issues, sustainable development, etc, for the offered courses.

As recommended during the coordination meetings, the activities in this period were also focused on development and keeping the interest of the companies and other external entities, in sustainable technologies and tools for improvement of the exploited technologies.

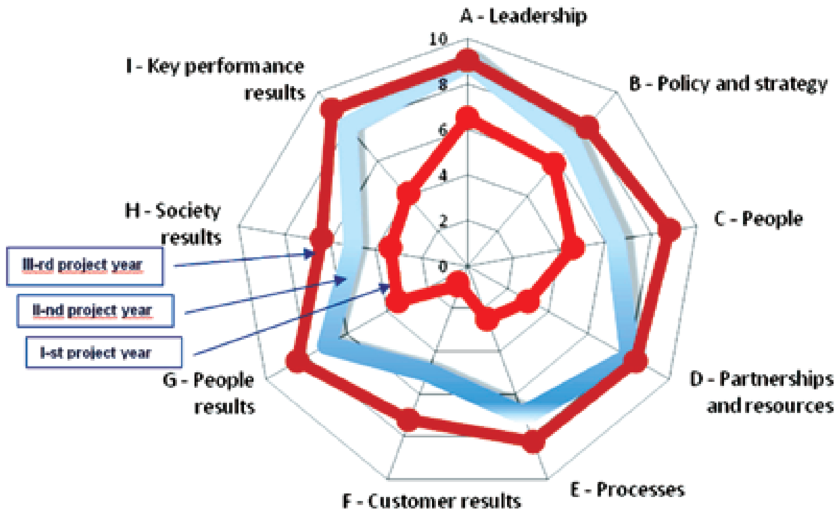
Despite the fact that many enterprises were in bad condition caused by the economical crisis, the project consortium managed to attract to the participation in the above mentioned activities, representatives of the industry, provincial secretariats for education, administration and national communities, environmental protection departments, local economic development offices, municipalities etc. The economical obstacles, the external entities were facing had not affected negatively the project outcomes during the third project year.

The courses which attracted numerous participants were successfully accomplished, as it was planned, and certificates were awarded during the dissemination conferences in all participating WB universities.

Final remarks and conclusion

In the conclusion, one can state that the third year was the crucial period for the successful project completion. After the intensive second year, feedbacks could be gathered from the stakeholders, that is from all the targeted entities. In that way the applied EFQM model of excellence composed a close loop, enabling to adjust and improve project processes during the third year.

Based on the project enablers and results it was possible to perform full evaluation of the outcomes related to the nine criteria recommended by the EFQM model. This evaluation can be expressed graphically in form of radar diagram, presenting the changes of the particular criteria within the 3-year period (diagram below).



The values, assigned to particular criteria, have a tentative meaning and are based on an expert's subjective judgment and evaluation based on the expert's visits as well as registered activities performed within three project years, such as:

- new cooperation initiatives established and old industry contacts restored
- dozens of factories involved and visited
- hundreds of course participants
- number of lecture lessons given

- course materials developed
- numerous information and dissemination activities performed
- dozens of visits and re-trainings at the EU institutions
- Meetings, workshops, conferences, discussions, studies etc.
- trips in Europe and within a country
- equipment purchased
- reviews of the staff knowledge
- coordination meetings
- preparation of the curricula
- finance management
- quality control

The diagram shows that the increase of particular criteria was not equal although it reached rather high values. At the end of the third year all criteria reached very satisfactory level. Criterion A (leadership) was appraised highest. This was doubtlessly the most important factor conditioning good project performance and final results.

The great added value of this project and its features in the educational context achieved in the third year is the fact that it contributes to the construction and of new environments and to restoration of the old ones, extinct some years ago.

These environments consist of enablers being in fact a university side (university teachers) and customers (and industry representatives), on the other side.

The both sides compose now a network of stakeholders who can benefit the communication between teachers and students and they can benefit among themselves, as well. Thus, they can create new opportunities for the industry to participate more actively in the process of construction of its own learning. All this is, in my opinion, a principle for sustainable development in the future, when the project is finished.

9. Summary

The aim of this project was to improve the university-enterprise cooperation in the process of creating a sustainable industry in Serbia, Bosnia and Herzegovina and the Former Yugoslav Republic of Macedonia.

The specific objectives of the project were:

1. To bring new curricula on sustainable industry for the staff from industries involved in the project
2. To adopt experience from EU partners on sustainable industry in the newly developed curricula
3. To bring the knowledge of staff from industry closer to standards in EU partner countries
4. To propose strategy for education for the staff from industry on sustainable industrial production

Objective 1

To bring new curricula on sustainable industry for the staff from industries involved in the project

During the 2nd year of the Project four courses were created:

Course 1: Sustainable technologies in Food industry
Course 2: Sustainable technologies in Pharmaceutical and cosmetic industry
Course 3: Sustainable technologies and Chemical engineering
Course 4: Sustainable technologies and Materials engineering

And five course books were written:

Book 1: Sustainable technologies
Book 2: Sustainable technologies in Food industry
Book 3: Sustainable technologies in Pharmaceutical and cosmetic industry
Book 4: Sustainable technologies and Chemical engineering
Book 5: Materials engineering

All course books were revised and published. The courses were held at each WB partner universities to 226 trainees. Originally, in the Application 70 trainees are planned.

Objective 2

To adopt experience from EU partners on sustainable industry in the newly developed curricula

During the 1st year of the Project teachers from all WB partner universities had a retraining and updating of one week at each EU partner universities. The representatives of WB chambers of commerce and industry were also involved. The gained knowledge was incorporated in the courses. During the 2nd year on the workshops the EU and WB partners actively cooperated on courses creation.

Objective 3

To bring the knowledge of staff from industry closer to standards in EU partner countries

During the 3rd year of the project the courses were held to the staff from industry. Through the courses, the knowledge based on EU standards and experience was brought to staff from the industry. The staff from industry had the opportunity to have the latest knowledge on sustainable industry issue.

Objective 4

To propose strategy for education for the staff from industry on sustainable industrial production

The goal of the WB partners was to continuously educate the staff from industry and to strengthen the partnership with industry. In order to achieve this The Strategic plan for sustainability of the project was accepted.

Two another important documents were accepted and signed: Cooperation agreement among WB partner institutions and Agreement on intellectual property among WB partners.

The cooperation agreements between WB PU and industry partners as well as chambers of commerce were also signed.

During the life of the project the partners have gained a very worth knowledge from EU partners, transferred it to local industry, strengthen the link with industry, partner universities and EU partners. The partners are devoted to spread knowledge on sustainable technologies in the future, as stated in Mission statement and to be recognized as a valuable partner in providing courses on sustainable technology and in the process of building a sustainable industry as stated in Vision statement..

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DISSEMINATION BOOKLET

Glavni i odgovorni urednik:
Dr Zoltan Zavargo, redovni profesor

Autori:
Dr Zoltan Zavargo, redovni profesor, Univerzitet u Novom Sadu, Tehnološki fakultet Novi Sad, Srbija
Dr Vineta Srebrenkoska, vanredni profesor, Univerzitet Goce Delčev, Tehnološko-tehnički fakultet, Štip, Makedonija
Dr Emilija Fidančevska, vanredni profesor, Univerzitet „Sv. Kiril i Metodij" u Skoplju, Tehnološko-metalurški fakultet, Skopje, Makedonija
Dr sc. Midhat Jašić, redovni profesor, Univerzitet u Tuzli, Tehnološki fakultet, Tuzla, Bosna i Hercegovina
Dr Milorad Cakić, redovni profesor, Univerzitet u Nišu, Tehnološki fakultet, Leskovac, Srbija
Dr Radoslav Grujić, redovni profesor, Univerzitet Istočno Sarajevo, Tehnološki fakultet, Zvornik, Bosna i Hercegovina

Izdavač
Univerzitet u Novom Sadu, Tehnološki fakultet Novi Sad
Bulevar cara Lazara 1, Novi Sad, Srbija

Tiraž
150 primeraka

Recenzija engleskog jezika
Jelena Jerković, viši predavač, Tehnološki fakultet Novi Sad

Prelom
Addiction, Slobodana Bajića 37, Sremska Kamenica, Srbija

Dizajn
Ksenija Čobanović

Štampa
Futura, Mažuranićeva 46, Petrovaradin, Srbija

CIP – Каталогизација у публикацији
Библиотека Матице српске, Нови Сад

378.6:66(497.113 Нови Сад)

DISSEMINATION Booklet : Tempus 158989-Tempus-1-2009-1-BE-Tempus-JPHES Creation of university-enterprise cooperation networks for education on sustainable technologies / Zoltan Zavargo ... [et all.]. – Novi Sad : Tehnološki fakultet, 2013 (Petrovaradin : Futura). – 105 str. : ilustr. ; 27 cm

Tiraž 150. – Bibliografija.

ISBN 978-86-6253-016-5
1. Zavargo, Zoltan [аутор]
а) Технолошки факултет (Нови Сад) – Tempus
158989-Tempus-1-2009-1-BE-Tempus-JPHES
COBISS.SR-ID 277769223

TU WIEN

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