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Greening Technical VET
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Lifelong Learning

GT VET
Greening Technical VET
Sustainable Training Module for the European Steel Industry

European Framework Module

Green Skills for Mechanical/Industrial and Electrical Technicians

Training Handbook

D8

http://www.gt-vet.com/

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1. Background of GT VET

The European Steel Industry

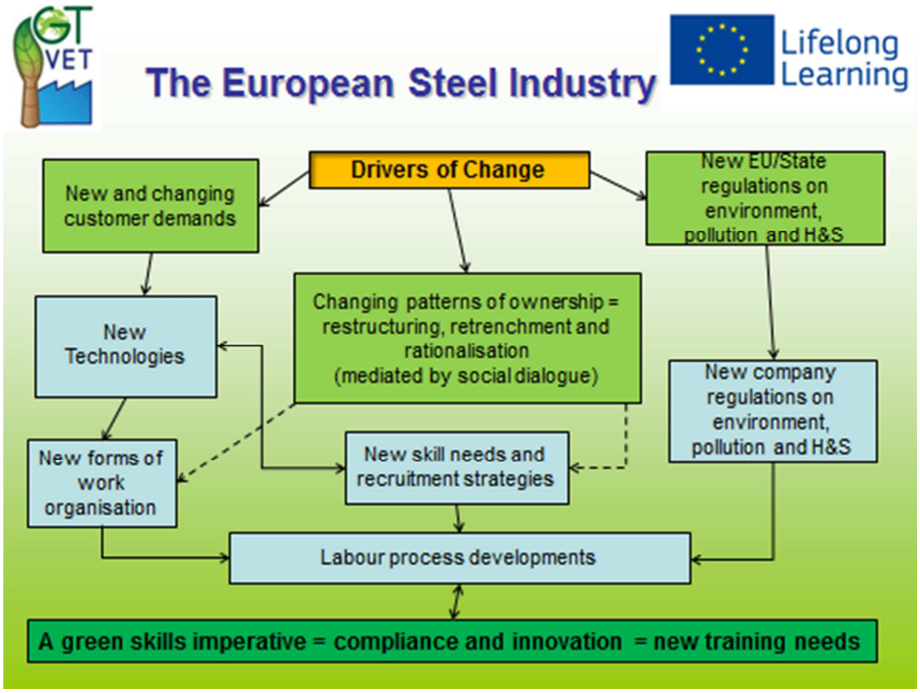
The European Steel Industry has been marked by many structural and economic changes in the recent decades:

- Changing patterns of ownership (from state-owned to private, greater concentration of ownership) and economical / market driven changes etc. led to restructuring, retrenchment, and rationalisation.
- New, more complex and sophisticated customer requirements
- New regulations on environment, pollution and health and safety (supra-national, national and company levels,external and internal).

This indicated also a changing labour process underscored by:

- New technologies (e.g. ULCOS)
- New forms of work organisation (e.g. Team working)
- New skills needs and recruitment strategies (e.g. up-skilling, more highly qualified workers).

This is exactly the background of the project GT VET and for the improvement of green skills: new training needs based on compliance and innovation (a green skills imperative).



Compared to many other industries, the European steel industry is energy intensive and has a high emission intensity of production. Whilst there are huge investments in breakthrough technologies (such as ULCOS: Ultra Low CO_2 Steel)[1] to reduce emissions, its skilled technical workforces also need to be provided with the appropriate green awareness and technical skills (e.g. ecological, health and safety related) to 'green' industry labour processes.

Critical to the global competitiveness of European industries is a timely response to demands for new mandatory skills. The European Steel Technology Platform (ESTEP) has focused its agenda around education and training to ensure skills needs are met and the long term competitiveness of the EU steel industry is secured. In parallel, since 2006, special attention has been paid to the anticipation of skills needs in the steel industry in the framework of the Sectoral Social Dialogue Committee on steel by both European social partners (industriALL and EUROFER).

The *Greening Technical Vocational Education and Training* (**GT VET**) project has explored how vocational education and training (VET) pathways meet *environment* and *health and safety* skill needs, which are key for the global competitiveness and sustainability of all European industries. As a model, the project has developed an industry driven European sustainable training module in correspondence with national VET systems. A partnership of steel companies and research institutes from four European member states (Germany, Poland, UK, Italy), has identified and anticipated the impacts of environmental legislation on the everyday work of mechanical/industrial technicians and electrical technicians. Independent of the different VET systems of the member states, VET practices and learning outcomes needed to be evaluated with respect to environmental skills, expertise and awareness. Based on these insights a European training module has been developed to obtain identical European learning outcomes in the field of green skills and sustainable awareness (for example, focusing on preventing pollution and securing occupational health and safety), complementing current technical VET programmes in this area. The module was tested in all four participating steel companies (ThyssenKrupp Steel, Tata Steel, Acciai Speciali Terni, Arcelor Mittal). Adjustments for each national system of VET have been made and learning outcomes were evaluated with transferable credit points (ECVET).

The main GT VET objectives

Using the example of the steel industry and the VET of industrial, mechanical, electrical and electronic technicians, the module and its implementation process can also be adapted and transferred to other technical VET professions and production industries. The initial promise for the module and the tested implementation processes to become a blueprint for the updating and implementation of training for new skills into the VET system was kept; they are focused on meeting industry driven requirements for environmental sustainability in an immediate and responsive way.

The main objectives of GT VET were:

- The timely and responsive **implementation** of new mandatory skills within VET systems (national and industry related);
- To investigate the scope for the development of ongoing and responsive training pathways by **focusing on skills for environmental sustainability;**
- To develop a model of an **industry driven and run European sustainable training module** and to match the demands of industry with the VET system;

[1] For more information: http://www.ulcos.org/en/.

- To identify and to anticipate **impacts of environmental legislation in everyday work** of skilled workers, both for today and future;
- To develop a **European training module** to obtain identical European learning outcomes in the field of green skills and sustainable awareness within technical VET (focusing on preventing pollution and securing occupational health and safety);
- **To adapt and to test the module** within four steel companies and member states (United Kingdom, Poland, Italy and Germany);
- To use the example of the steel industry and the VET of industrial mechanics, electrical and electronic technicians for **adaptation and transfer to other technical VET professions and production industries;**
- To produce a **blueprint** for the implementation (process) of new skills for the industry sector and the appropriate VET systems.

The GT VET Partnership: steel companies and research institutes supported by the social partners

The partnership was including and using different competences and perspectives: the research institutes with their scientific knowledge, the steel companies with their practical knowhow, the European associations with their dissemination and exploitation possibilities, and the associated partners with their national and regional relevance for VET. Together, these partners were composing a partnership that guaranteed high quality performance in relation to practicability and a cumulative sectoral, national and European added value for the benefit of all participating and further interested institutions, organisations and stakeholders.

The four participating steel companies directly benefit from the developed training module: managers and trainers of training departments, managers of technical, safety and health departments, apprentices and workers (industrial mechanics and electronic technicians). The participating steel companies become aware of future requirements in green issues and the necessity of and possibility of short term implementation of new skills.

Furthermore, European representatives of other steel companies and social partners have been informed at the regular meetings of ESTEP and SSDSC. Representatives of European (e.g. CEDEFOP) and national (e.g. BIBB Germany) VET agencies as well as national steel industry associations (e.g. National Steel Platforms of Poland and Germany) were informed about the project results and invited to European workshops and conferences. On a regional level, stakeholders of VET (vocational schools, chambers of industry and training departments of steel companies) were involved in the module development and the VET system related research and dissemination activities.

The steel companies (and their training departments) were directly involved in the research and development process of the project; being represented in the project partnership, participating in workshops and interviews, in the development and pilot testing of the training module.

In the development and pilot testing of the training module, the regional VET partners (steel company and VET institutions) worked closely together.

National VET stakeholders will continue to be integrated in the exploitation and exchange on the further definition and development of common European standards of learning outcomes concerning green issues in technical VET. National institutions and agencies dealing with VET as well as unions and employers organizations will continuously be invited to give advice on the project progress and the concrete outcomes and results.

The strong industry related partnership formed in GT VET is the guarantee for the continuous implementation of the GT VET European Framework Module after the project lifetime: ESTEP will be the basis for the future dissemination, exploitation and much more: the continuous development and improvement of the module – run and driven by industry demands.

The GT VET Partners:

Research institutions and steel companies ("tandem approach"):

1. **Germany**:
   - Technische Universität Dortmund – sfs Sozialforschungsstelle (Coordinator)
   - ThyssenKruppSteel Europe AG, Duisburg

2. **Poland**:
   - Instytut Metalurgii Żelaza IMZ, Gliwice
   - ArcelorMittal Poland S.A., Dabrowa Górnicza

3. **Italy**:
   - Istituto per la Cultura e la Storia d'Impresa ICSIM, Terni
   - Acciai Speciali Terni S.p.A. AST, Terni

4. **UK/Wales**:
   - Cardiff School of Social Sciences, Cardiff University
   - Tata Steel UK, Port Talbot

Strategic Partners (Dissemination and Valorisation):

- European Confederation of Iron and Steel Industries – EUROFER, Brussels
- industriALL – European Trade Union, Brussels

External Evaluation:

- VFA – Development and Innovation Consultants, Athens
- Jean-Claude Charbonnier (Consultant)

Associated Partners

ESTEP - European Steel Technology Platform, Brussels
…..

Stahl-Zentrum Deutschland, National Producers Association, Düsseldorf
…..

Polish Steel Technology Platform, National Producers Association, Gliwice
…..

Polish Association of Metallurgical Employers, National Employers Association, Katowice
…..

Bundesinstitut für Berufsbildung BIBB - Federal Institute for Vocational Education and Training, Bonn
…..

Comune di Terni, Terni Municipality
…..

Istituto Istruzione Superiore Tecnico Industriale e Professionale “ALLIEVI-PERTINI” - I.I.S. "Allievi-Pertini"; Vocational School Terni
…..

Tata Centre of Excellence, Cardiff School of Engineering, Cardiff.
…..

Jean-Claude Charbonnier (Consultant).
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2. The Project GT VET: Greening Technical VET
Sustainable Training Module for the European Steel Industry

Work Programme and Work Packages

The work programme was carried out by research institutions and a strong involvement of steel companies, accompanied by the European social partners and the involvement of VET system relevant associated partners. The programme was organised on a decentralised and work sharing basis, with main responsibilities attributed to organisations that are best suitable and have the expertise to undertake specific pieces of work. Research institutions were responsible for the research driven work packages, assisted and supported by the practical knowledge of the steel companies. The training departments of the steel companies developed and tested the training sub-modules, assisted by the research institutions. The social partners shared the responsibility of valorisation (dissemination and exploitation), supported by the steel companies and research institutions.

Beneath management and coordination, evaluation and quality assurance as well as dissemination and exploitation five consecutive work packages were carried out. With the described partnership we identified and anticipated in work package 2 (WP2) the impacts of ecological legislation in everyday work of skilled workers both for today and future. Independent of the different VET system of the member states, VET practices and learning outcomes needed to be evaluated with respect to ecological skills, expertise and awareness. In WP2, the consortium has conducted an industry driven analysis of current and future job requirements concerning green aspects (ecological sustainability, health and safety) of technically skilled workers in the steel industry in each of the four represented member states. On the basis of desktop research, interviews and workshops with the environmental and health and safety departments of the steel companies, comprehensive national reports have been delivered which are the bases of the WP2 summary report.

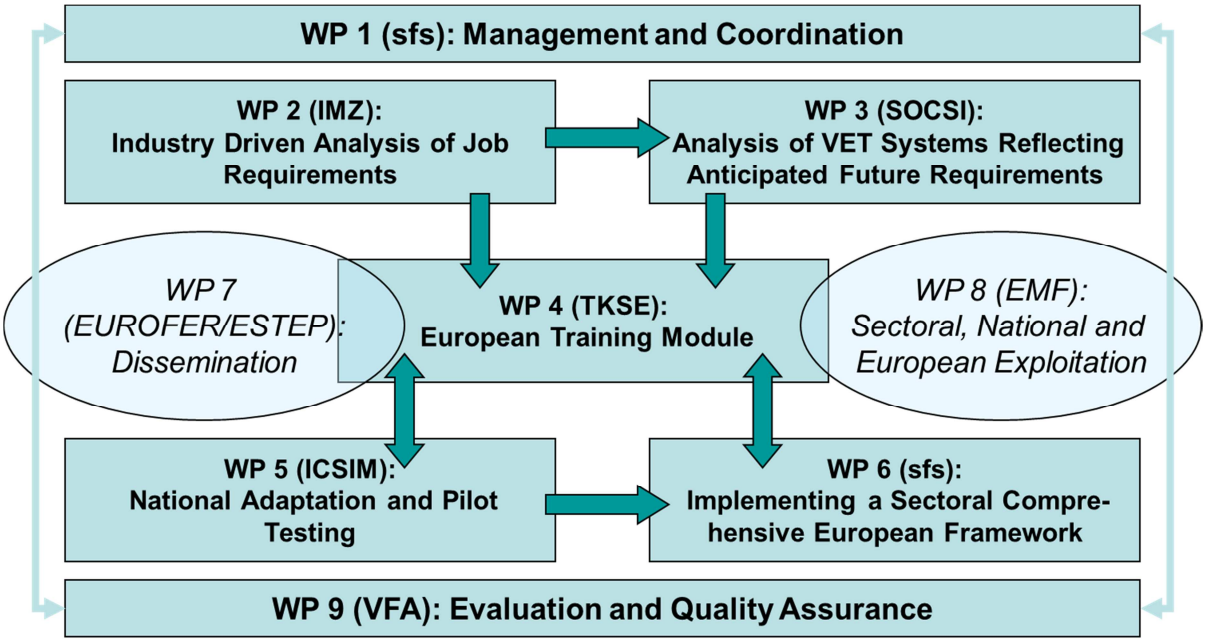
In WP3, each national VET system of the participating member states has been analysed with regard to its future industry needs (of WP2). With each VET system having different regulations and institutional frameworks, an analysis of the existing curricula of two main apprenticeships and regulated professions (industrial mechanics and electrical technicians) and its implementation possibilities for the identified skills has been done. The concrete realisation of VET in the different training venues has also been investigated – interviews and workshops with the training department in steel companies (target group: trainers), environment and other technical departments, e.g. health and safety (target group: managers), recently graduated apprentices, vocational schools (target group: teachers), the chambers of industry (representatives of VET), other VET relevant institutions at regional level provided this information. Again, a summary report has been delivered on the basis of national reports.

The next key step of the project was the development of the European training module for “greening” technical professions of the steel industry (WP4). This European training module has been developed as a comprehensive “continuous progressing training module” of all participating and further interested steel companies. It helps to keep the qualification of the (future) technicians up-to-date and up-to-future and to stimulate the short term implementation in the national VET systems. Based on the results of WP2 und 3 and a first definition of a European standard concerning green skills and green awareness in technical profession, a training module (consisting of different work related cases or smaller modules and a handbook) has been developed as a blueprint for each member state. The training departments of the steel companies have developed the four sub-modules, assisted by the research institutions.

This training module was then piloted in all participating steel companies and related VET institutions on regional level (WP5). Every company tested the sub-module they had

previously developed. As a second step in WP5, the other sub-modules were cross-tested. In accordance with testing feedback, the product was adapted and modified to fit the requirements of both the companies and member states as well as possible.

A central methodological approach was to discuss the results of the respective work packages promptly on a common sectoral and European level, taking feedback from external experts for the project proceeding and product development into account (WP6). All in all four European workshops have taken place, each one focusing on the results of a distinct work package, from 2 to 5. The workshops have concentrated on defining a European standard of the expected learning outcomes and have provided input for the subsequent work packages. Participants of these workshops on European level were representatives of the involved steel companies, the social partners (EUROFER, industriALL), national and European VET experts.



The main result of these efforts is a European Framework Module on Green Skills, its sectoral integration, which will be run continuously by ESTEP (the European Steel Technology Platform), with an ECVET approach, as a basis for continuous adjusting of the existing module against the background of new green skills demands.

In the following chapters, the main results and outcomes of content-related work packages in GT VET will be summarized.

Initial Research: Industry Driven Requirements (WP2)

Environmental (and related health and safety) Legislation and Company Implementation

Knowledge centers for environmental issues could be found in all major steel companies. They have European contact points or bureaus and they are engaged in “environmental networking” in Brussels. A “translation” of legal requirements into procedural instructions and handbooks and good practice examples for “application-oriented diffusion” of environmental legislation have been developed (“every employee has to understand the message”). Strict corporate targets (“no accidents”) are exceeding legal requirements to some extent (from complying to improving) and there is a steering approach through highly diversified target

figures on company, plant and department level, ensuring a high influence of environment-related instructions on everyday work.

Responsibility for environmental (and related health and safety) issues

Responsibility is taken by distinct departments for environmental issues and occupational health and safety. Hybrid working groups meet and define implementation pathways (1) to comply with new legal directives and (2) to integrate new requirements into training (VET, further training). But different levels of autonomy of plants could be found, e.g.: ThyssenKruppSteel Europe (TKSE) plants have recently installed their own environmental representative. A common "culture" of shared responsibility regarding environmental issues is aimed at as well as skilled workers are more and more considered as responsible for "green performance".

Environmental/green aspects of skilled work within the plant (Electrical Technicians and Mechanical Technicians)

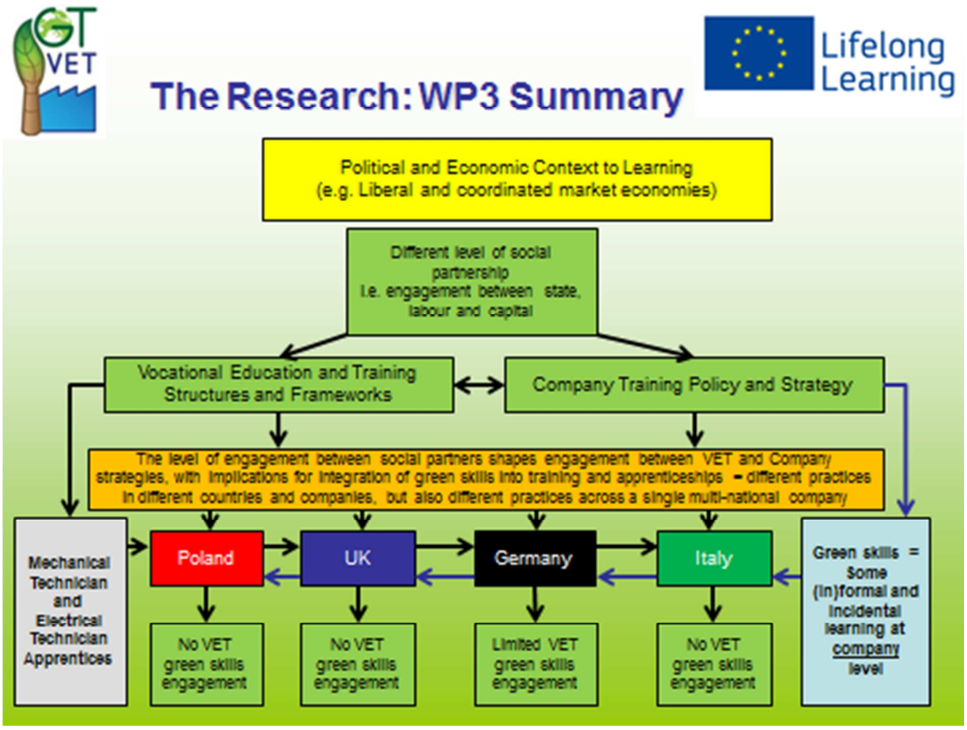
Environmental regulations influence basically every maintenance routine; they are extensively integrated in VET and further training, plant protocols and operational instructions. In addition "green projects" to improve environmental performance are undertaken. Training more and more resembles everyday work (integrative learning approach, autonomous problem solving and reflection as pedagogic concepts gaining importance).

Initial Research: VET Reflection on Industry Driven Requirements (WP3)

Clearly, there are a varied set of curricula, policies and practices, which is indicative of different levels of skills, competence and knowledge across the case study countries. Within the companies varied practice was evident and given the lack of centralised guidance/policy, it can be inferred that the emphasis accorded to environmental matters differs, based on the importance placed on such issues by section heads. The GT-VET project required a clear definition of green skills from which to work; this definition was formulated bottom-up to reflect the specificity of the steel sector and top-down to incorporate wider 'green' policy imperatives (such as those deriving from EU 2020 strategies).

Wider recommendations, common to a number of cases, were that there should be greater co-operation between companies and schools/colleges on (green) skills development, so as to ensure a clear, coherent and consistent message. More particularly, school content must be relevant, specific and applied to company practice. Further, it is important that in-company training programmes are reinforced by wider campaigns and information distribution.

In terms of module delivery, a series of smaller modules was postulated to be run over the course of the apprenticeship training. The focus of the introductory module should be basis knowledge like relevant environmental legislation and its impact upon and application to the steel industry. Modules on specific practice could then ensue. The main consideration was that such training should be applied and role-specific, with numerous examples of concrete learning provided, and supplemented by the use of projects and applications of tools, such as life cycle or productions process assessment. It was also suggested that critical incidents could be documented and form the basis for analysis – students could work out what went wrong in a situation and how it could have been prevented through the identification of the appropriate actions at each stage. These are deemed to be essential for effective learning by the trainees themselves. An emphasis on consequences of behaviour – the 'why' as well as the 'what' – and the implications for individuals, the organization and society should be included.



Training Module Develeopment (WP4)

Based on the background of the industry requirements (WP2) and their reflection within different VET frameworks (WP3), a first definition of European standards concerning green skills and awareness in technical professions was made, as well as a new framework for the development of the first pilot training module.

Instead of developing the planned pure e-learning tool, with limited practicability for and adaptability to the currently existing training programs of the participating steel companies and the national vet systems, the consortium produced a comprehensive training module on green skills, including parts of digital elements (CDs, videos). The new version

- raises more awareness of the workers on environmental and related health and safety issues;
- allows the companies to offer their apprentices and employees the “green skills” training module in a more flexible way, including face-to-face learning situations and self-conducted projects;
- is structured in such a way that it can be simply and flexibly integrated into each national system of VET or used in addition to the existing system of VET (by matching the demands of industry with the VET system).

The change was necessary because of the results of the workshops and interviews within work package 3: the training departments of the companies, representatives from vocational schools and not at least the trainers, teachers trainees themselves (in every involved member state) strongly advised the consortium to produce not an e-learning tool (which is of no interest for the target group) but a training module with concrete relevance to the workplace, not only giving information and inputs but setting activating tasks to the trainees. Furthermore, following the results of WP 3 research, the European training module

- was more thematically differentiated than foreseen in the original project planning: it consists of four different thematic sub-modules (energy, raw material, waste, noise)

- and address learners on different, subsequently following learning levels (basic information, background and coherences, professional practical knowledge/ competencies, process know-how).

The training module itself was produced as a digital and printable handbook, involving didactical tools such as theoretic inputs and practical work, self-organising work, questionnaires, and digital media (video). Therefore, not the training module as such was changed, but a new target group oriented and targeted format was chosen, enriched by different sub-modules (more concrete themes) and a stronger workplace and more flexible VET system implementation. This is why the way the training is delivered to the apprentices, workers, and students as well as to the trainers and teachers had to be adapted as well.

The advantages of this kind of comprehensive training module instead of an e-learning are obvious: the training module (and parts of it) could be more easily implemented and adopted to the companies and VET institutions training programs and to different training frameworks and arrangements, it is more user friendly in the sense of raising awareness of the trainees by encouraging trainers and trainees to self-organised and workplace near activities, the learning level “process know-how” is conceptualised as a self-organised activity on creative workplace innovation on “green effects”, ECVET credit points could be given in relation to the VET system related national curricula. These effects could not be given by a pure e-learning tool, which especially does not ensure the relation of the training to the workplace and the awareness of green issues to this extent.

National Adaptation and Pilot Testing (WP5)

Each sub-module was evaluated during **national and cross national testing**:

- First, the developed sub-modules were tested by integrating them in the existing VET activities of the involved companies and countries in which the specific sub-module was developed (national testing).
- After the national evaluation a cross national testing of all the sub-modules was carried out in all the participating companies and countries by interviews, group discussions and workshops with the already involved stakeholders (of WP2, 3, and 4) (cross national testing).

In the national in-depth tests under real conditions the learning level/modules were integrated in the normal education and training program of the companies and schools, by using given leeway and (depending on the “cultural” background of the companies) more or less oriented at the following structure:

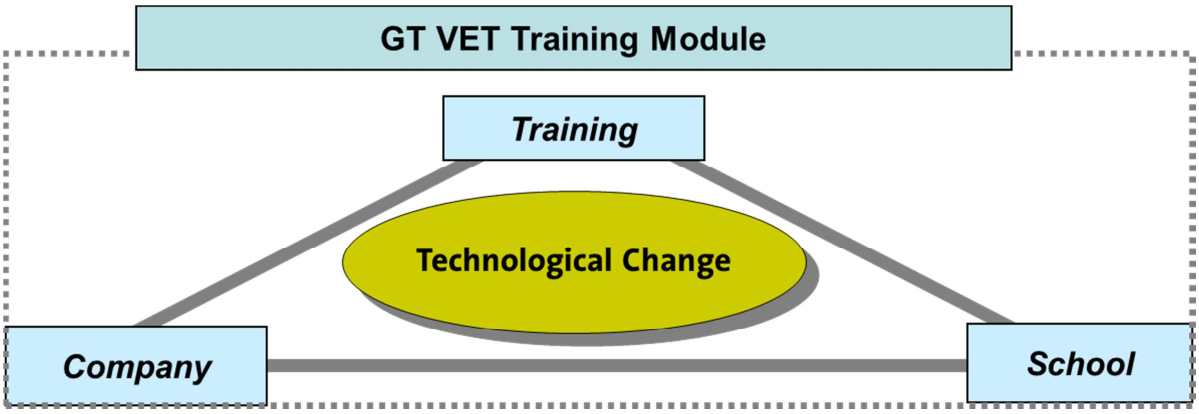
- Level 1 and 2: background and context information for the electrical and mechanical technicians in a more “class room” atmosphere
- Level 3: different tasks for electrical and mechanical technicians
- Level 4: project work if possible in cooperation with the workers and management of production areas

Teachers of middle, technical or vocational schools were integrated or informed and asked to create additional and deepening theoretical and practical background inputs.

The results of both tests showed that the sub-modules fit to the training program of the companies and schools and create a clear added value:

- The module (and its sub-modules) improves through its work place relevant practical knowledge and the activity based approach the awareness and skills for environmental awareness through self-reliant work, reduction of resources and saving of money.

- The teaching and learning model or profile could be a good image for new teaching and learning profiles encouraging “green” activity and responsibility of the learners/trainees/workers.
- By stressing explicitly this background the trainees and the trainers voted for an integration of these kinds of modules in the traineeship.
- The trainers (steel company) and teachers (vocational and secondary schools) will use (relevant parts of) the training module in their regular training program (even for continuous training).
- The developed GT VET training module is seen as a link for short-termed reaction to technological changes and responsive integration of work place related new skills demands in vocational education and training in both company training and VET system.
- Therefore, a (much more) close cooperation between companies and vocational schools in Initial VET is necessary.



The GT VET training module on green skills and its learning methods fit to the other learning contents, methods and phases of the general training program:

- Of the company: Could be implemented in the regular apprentices programme of the sites
- And the vocational school: could be used as a practical example of the steel industry for the education of other technicians and production industries.

The sub-modules energy, waste and noise can be introduced easily into schools as well (that came out of the school tests in Poland). From a (vocational) school perspective (dual system in Germany), the module is particularly appropriate since in the final exams (for instance of the chambers of commerce and *industry* in Germany) environmental awareness of students has become an important evaluation criterion (e.g. economic use of materials). This was supplemented by the operational, company related side (dual systems). Although many trainees attend various courses they aren’t aware of issues of environmental awareness in context of the subject (electrical/mechanical technician) because it is not explicitly mentioned in the descriptions.

The main findings of the test phase show that the GT VET module is a link for short-termed reaction to technological changes. The topics and didactic methods are approved, effective and attractive – also in a sense of increasing ecological awareness and green behaviour both at workplace and in private life. The practical knowledge obtained in the module was evaluated very highly, the content is important for the professional work of trainees. The module offers valuable exercises as well as methodological teaching solutions (variety of individual and group work, presentation of results obtained during group work to the rest of the group), even the interactivity of the theoretical inputs could be improved by media based

inputs (video, animations, etc.). The module is deemed necessary to train the partial lack of green awareness and will increase in the future "green" awareness of production processes and work processes in the company by giving a greater emphasis on the steel industry.

The flexibility of the module (different sub-modules, learning/knowledge levels) is shown by its possible combination with and integration in different learning arrangements, time schedule and content arrangement – for both educational and training programs / curricula of companies and the VET system.

The detailed assessments of the cross-national tests have been used to improve the sub-modules and their integration in the European Framework Module and the companies' activities and VET systems as well as new themes and sub-modules beyond the lifespan of the project:

Energy (Germany): This sub-module can easily be incorporated into company training programs and VET institutions (for initial and continuous VET as well). It provides ample examples of delivery methods with examples and templates that could be used at individual and group levels. Furthermore, the approach is conducive to behavioural and overarching cultural change as the module requires trainees to consider energy savings within the work environment, with society, the home and for encouraging their colleagues. It also encourages trainees to calculate energy consumption and savings thus allowing allocation of responsibility which in turn increases understanding. Knowledge and awareness of the target group about environmental issues of the steel industry is improved by the training: high engagement, awareness raising, enthusiasm was risen especially by finding more efficient solutions on the work place (saving money, work place innovation), a new view on the production process, and change of conscience and behavior (including correction of behaviour of others). The added value of the training module was seen by trainers and trainees because of

- Focus on the workplace experience, implications
- Own responsibility, own project planning and conducting
- Improvement of context knowledge, comprehensive approach for learning and training, generic understanding, identification of parameters for change
- Fostering workplace innovation (bottom-up)
- Improvement of the existing cooperation between company and vocational school (on the regular basis of cooperation: meetings twice a year, bilateral contacts).

Concerning the teaching and learning methods it was accentuated:

- Improvement of self-responsibility, the profession of the trainees in general
- The way teaching took place was relevant to improve awareness for green skills: theoretical inputs (small) and extensive self-organised learning, group and project work
- High engagement and enthusiasm was important (challenge: to keep this at everyday work)
- Fostering key qualifications, ability to critically check existing situations, planning and management of project, presentations
- Subsequent concept, increasing perspective of the workplace, easy start, increasing demands, challenges: basic information → deepening background → practical implications → production process relevance
- Trainees learn much more about the workplace and the related production process,
- Win-win situation with the management and the workers of the production site,
- New perspective on existing structures, breaking up existing of existing processes.

The module energy fits very well to the education and training program; energy is connected to the other modules as well (waste could be used for energy production, noise reduction through energy reduction, etc.). A “Learn-learn-learn” situation for trainees, trainers/teachers, workers/management of involved production sites was created, which was one of the best appreciated impulses during the project because it brought together actors from different systems with different interests.

Raw Materials (Italy): The sub-module is focused around operational practice and activities, thus does seem to be suitable for the target group specified i.e. individuals responsible for operation at workshop level. The information provided in the module is quite theoretical and as such the basic information content is adequate and it is backed by substantial information about best practice relating to specific processes. However, active learning elements are missing as well as a closer orientation at the contents of the targeted workers (electric/electronical and mechanic technicians). Especially metallurgy itself stands in focus, meaning the actual steel production process, which is relevant background knowledge but only marginally concerning the industrial mechanics and maintenance. Anyway, it was said by the trainees, that raw materials are only marginally an issue that could be integrated and illustrated within the other sub-modules.

Nevertheless, an indirect reference was made to the training: the transfer of knowledge about *steel* production could help the trainees to classify their work in the production process and lead to more understanding. Further, it highlights the work in the company as well as their own share/part within the production process. All in all the sub-module has to be improved in the direction an understanding of impact to encourage cultural change in the work place.

Noise (Poland): The approach for the sub-module is, again, a bit different because it addresses secondary and middle/technical school student (level 1 and 2), while level 3 and 4 are company related trainings. However, the contents of level 1 and 2 could be easily transferred to in-company trainings as well. Overall, the participants confirmed that noise hardly constitutes a conscious perceived issue with the trainees in the company. This was due mainly to the lack of awareness; even though such noise protection areas in the works are clearly marked and strict noise, health and safety regulations are applied. In addition, the responsibility to act environmentally conscious is as lower than with waste and energy conservation. But overall, it became clear that a greater awareness must be created regarding to the issue of noise in an environmental context.

The module was considered appropriate because noise is a commonplace tangible measure (e.g. decibels, vibration of equipment), so that project work/exercises would be possible (e.g. strategy development to reduce noise). But it was pointed out that the module could be shortened in time (if needed) and connected stronger to the production process as well as other issues (e.g. energy).

Waste (UK): This sub-module was rated as ‘very good’, with highly relevant content and a sound range of learning methods deployed, logical fit with other modules, covered at college (induction) as well as onsite, some of the content – Level 4 – deemed to be set at too high a level for apprentices’ needs/role requirements. Compared with the legal situation of waste legislation in other countries a modification to the national situation is necessary, but an implementation of the UK-version is not considered as problematic. For instructors/trainers two primary goals were important: creating a first awareness of trainees in order to mediate in-depth knowledge, even if they are trained in different disciplines or will work in various fields after their apprenticeship. It is not just a matter to impart knowledge, but also to achieve a change of mentality.

A critical remark was made to the term “waste”. Ultimately, the whole production process is a cycle in which *all* substances discharged and must be recycled. Taking this into consideration, there are no “waste” anymore but materials to be recycled. Consequently, this term is outdated or misleading in terms of new technologies and legislation.

The module was deemed necessary to train the partial lack of awareness of waste materials by trainees through practical projects. To integrate the module into the apprenticeship various training structures are possible. One suggestion was to start with the basics in the first year, to impart the next two levels in the course of the training and at the end of the training to carry out a project work. This is to ensure the principle "from simple to complex content", the general “philosophy” of GT VET. Furthermore, it is also possible to complete the first two levels in vocational schools and anything else on the operational stage. In addition, during the fourth level new company related project tasks should be set to cope with current operational problems.

In this context tangible measurement and documentation of changes are non-negligible elements. As a result it helps to show trainees in a transparent way how their behaviour may affect the production maintenance process e.g. within a project. This causes – as not only the experience of GT VET shows - a greater awareness as a purely theoretical training.

Implementing a Sectoral Comprehensive European Framework (WP6)

The development of a common sectoral and European view and the implementation of a framework for the continuous development of the training module beyond the project lifespan were initiated from the beginning of the project. A sustainable implementation and further development of the training module of GT VET and the continuous integration of industry demands for green skills on the background of a European future standard of green awareness and skills for the steel industry was the main objective.

This was mainly done by four European workshops discussing and comparing the results of work packages 2, 3, 4 and 5 and as well on the final conference guaranteeing a common sectoral and European level:

- WP 2 and 3 concentrated on defining a European background and standard of the expected learning outcomes
- WP 4 and 5 aimed at a framework for an on-going European module development and implementation in the regular VET activities of the European steel companies
- At the final conference the relevance, transfer and further development of the GT VET module was discussed from different European perspectives and stakeholders.

The *main result* of this work package was not only a discussion of the different cultural VET systems but also of the different company “cultures”. It seemed that the training of the companies is very much related to the different VET approaches and national systems:

- In Germany the dual system is dominating the education and training of the companies very much, even there is a strong emphasis on a closer integration or consideration of company related skills demands and practical orientation at the workplace (combining practical company related training with secondary vocational education) within the curricula of the vocational schools.
- In the UK a strong training approach / orientation done by special sectoral skills councils and training institutions is visible (focus on vocational training).
- In Poland a school related basic learning (with a focus on theoretical input) is visible for the first two levels of the training module (basic learning, context understanding) followed by practical experience related inputs within the company and tasks at level 3 and 4 of the module.

- In Italy a strong knowledge hierarchy is evident; each level is oriented at a higher worker level. This depends on the strong influence of the company, even in the development of the module.

The different “cultural frameworks” should not be seen as differences and constraints to integrate the related sub-modules in other national or company VET frameworks. In the contrary: These different approaches show the wide variety of integrating possibilities (verified through the test results in the other countries). Even the management orientation of the original Italian sub-module “raw material” shows that the managers have to be integrated in the development of green skills as well, e.g. taking the right decisions on the best available techniques (BAT) for a greener production process.

However, the main product of the project and this work package is the European Framework Module, integrating as a first basis four sub-modules with related ECVET points. Anyway, the four sub-modules and the general framework have to and will be developed continuously, coordinated within the activities of the Working Group “People” of the European Steel Technology Platform ESTEP (related to ESTEP´s other Working Groups, esp. “Planet”, and projects like “Ultra–Low Carbon dioxide (CO_2) Steelmaking – ULCOS”: www.ulcos.org). ESTEP - as almost the only European Technology Platform with a human resources oriented working group - will take care of the continuous implementation of this sectoral comprehensive European Framework Module and use its European platforms with other European industries for the dissemination and exploitation of GT VET to other industries and the worldsteel association.

3. European Framework for Green Skills

3.1 Relevance of green skills - General European framework for greening technical skills

3.1.1 EU VET strategy and green skills policy

Strategies - Lisbon and Europe 2020

The Lisbon Strategy, formulated by the European Council in 2000, articulated the EU's strategic intent to "become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth." To these ends, a ten-year programme, aimed at revitalising growth and sustainable development across the EU, was established and this underpinned EU policy formulation within the last decade (ETUC, 2006).

EU education and training policies gained impetus with the adoption of the Strategy (Europa, 2011). The main objectives were, essentially, to raise the quality and effectiveness of education and training systems in the EU to the highest levels and to ease access of all to education and training. To these ends, the European Commission initiated the Education and Training 2010 work programme (Council of the EU, 2002), with specific education and training benchmarks set for attainment by 2010.

The Lisbon Strategy was updated through the EU2020 strategy. This latter maintains the themes of 'growth and jobs' and places the period 2010-20 in the context of recovery from the economic crisis and the urgent need for sustainable economic development. The EU 2020 strategy articulates three main priorities: smart growth, sustainable growth and inclusive growth (European Commission, 2011). Of course, for the purposes of this project, sustainable growth is of most interest. It is envisaged that the EU will stimulate sustainable growth through two flagship initiatives: 'Resource-efficient Europe', which aims to decouple economic growth from resource and energy use by reducing carbon emissions, promoting greater energy security and reducing the resource intensity of production and consumption; and 'An industrial policy for the globalisation era', which aims to support businesses as they respond to globalisation, the economic crisis and the shift to a low-carbon economy.

The Copenhagen Process

The Copenhagen Process was launched in 2002, in order to strengthen pan-European co-operation in VET and concomitantly, the alignment of European and national-level practice. Member states have committed themselves to a set of common priorities and therefore, several universal European principles and instruments have been developed, so as to support lifelong learning, ensure enhanced quality of VET provision and facilitate educational and job mobility within and between member states. Principally, the instruments focus on the improved quality of VET provision at national level through the development of a European quality assurance system (EQAVET); the facilitation of comparisons of qualifications across Europe through the creation of the European Qualifications Framework (EQF) with which national qualification frameworks must align; and the development of a credit system (ECVET), so that work experience and qualifications gained in one member country can be validated and recognised in another.

The Bruges Communique

In December 2010, the European Ministers for Vocational Training, the European Social Partners and the European Commission met in Bruges to set the priorities of the Copenhagen Process, and thus the common objectives for vocational training, for 2011-2020 (Europa, 2010.). In light of the challenges currently facing the EU, the need for responsive, flexible, high quality education and training systems is emphasised. The Communique states that the capacity of VET to respond to the changing requirements of the labour market must be enhanced, and that these changing labour market needs must be integrated into VET provision (content, infrastructure and methods) over the long-term. The transition to a green economy is also identified as a 'mega trend', which impacts on skill needs across many different jobs and sectors. The Communique establishes that the labour market requires a balance between developing generic green skills (e.g. reducing waste, improving energy efficiency) and more specific skills (e.g. the development and utilisation of green technology).

The EU and 'Green Skills' Policy

The EU's Sustainable Development Strategy (SDS) was launched under the auspices of the Lisbon Treaty in 2000 and this overarching policy goal was renewed in 2006. The 2009 Review of the SDS outlines progress made, in addition to identifying areas for further action. The Review states that whilst the EU has mainstreamed SD into its policies, the economic crisis of 2008-09 served to highlight that sustainability is a key factor for member states' financial systems and the economy as a whole (European Commission, 2009). It refers to the Recovery Plan for jobs and growth (a fiscal stimulus of EUR 200 billion) launched by the Commission in 2008 (which focused investment on clean technologies and infrastructure) and emphasises how crucial it is that measures to support the economy and reduce the social impact of the financial crisis are compatible with long-term sustainability goals. The Review emphasises that the EU must turn the crisis into an opportunity to address financial and ecological sustainability, and develop a dynamic low-carbon and resource-efficient, knowledge-based, socially inclusive society. This building of a green economy is increasingly vaunted as a vehicle for job creation at European and national levels (e.g. European Commission, 2009; Cedefop, 2009; Innovas, 2009; Levy, 2010). The EU has also explicitly recognised that green jobs require green skills, and that these play a critical role in supporting a low-carbon economy (Environment DG, 2011). EU policy documents in this area clearly advocate government intervention at national level through, for example, subsidising research and early stage deployment into new green technologies. This is seen as being crucial in supporting such job creation.

However, despite the fact that education and training have been identified as the critical foundation in attaining sustainable development and the creation of a green economy (European Commission, 2009; see also GHK, 2008), research by ECORYS (2010) for the European Commission highlighted the existence of a 'green skills gap'.

3.1.2 The Sectoral Level – Strategies for the European Steel Industry

The green skills strategies, policies and practices of a number of influential sectoral bodies that operate at the European level were reviewed in GT VET. The bodies were the European Metalworkers' Federation (EMF, which during the GT VET project merged into industriALL), the European Confederation of Iron and Steel Industries (EUROFER) and the European Steel Platform, aimed at maintaining the global competitiveness and sustainable future of the European steel industry. In essence, the review found that whilst each of these institutions has issued policy statements on the subjects of climate change, environmental protection and sustainability, as well as on training, development and lifelong learning, there is currently very little explicit emphasis on a green skills agenda.

EUROFER exists to represent all steel producers operating within the EU. Its members are therefore steel companies and national steel federations. It represents the common interests of its members vis-à-vis third parties, notably the European institutions and other international organisations, and thus, aims to influence policy. Its general environmental position was outlined in WP2. Of particular salience is that in a number of policy documents, EUROFER has highlighted the growing challenge posed to the European steel sector by EU environmental and climate change regulation (Eurofer, 2010). Indeed, the very future of Europe's steel industry is identified as being dependent on the European internal regulatory framework.

Training and lifelong learning policy are formulated through the process of social dialogue, with the other party being industriALL. industriALL is the representative body defending the interests of workers in the European metal industry. It has a mandate for the external representation and coordination of the metalworkers' unions as well as to engage in bargaining at European level. A specific objective of the social dialogue process in this case is the anticipation of the skills needed in the sector, as well as concomitant workforce development. In furtherance of this aim, EUROFER and industriALL submitted a joint proposal to the European Commission at the end of August 2010, regarding the establishment of a European Sector Council on Jobs and Employment for the Steel Industry. In terms of the role and functions of such a Council, the body would coordinate the monitoring, forecasting, analysis (professional and training requirements) and proposals for European and national legislation (in terms of compliance) concerning proficiency, training and the development of skills and job descriptions in the steel industry. Of particular salience here is that the proposal specifically identifies that such functions would encompass the provision of support for steel workforces in the transition toward more environmentally sustainable production technologies and products.

In addition to its participation in Social Dialogue, industriALL (at that time still EMF) has launched two relevant initiatives in the area of education and training. These are the EMF Qualification Initiative of 2001 (EMF, 2001) and more recently, its 'Education, Training and Lifelong Learning – A Must for Sustainable Development' position (EMF, 2010). The former aims essentially to develop collective bargaining on training whilst the latter highlights the crucial role of education and training for sustainable development. In this latter, industriALL argues that the Commission's emphasis on education and initial training systems (basic school education and university) for the creation of new skills that fit with the requirements of new 'green' jobs is somewhat misplaced. industriALL's position is that the emphasis should be on continuing education, as it is through such mechanisms that effective responses to the cyclical requirements of competence needs can be made. To this end, industriALL argues that the EU and the Member States must mobilise substantial financial means in order to allow new green jobs to emerge, facilitate the transformation of those that already exist and engage in the adaptation and reconversion of existing competence mainly via vocational training (although a role for initial training is also envisaged). Thus, industriALL states that educational and training systems must be more responsive to the challenges of fast-moving, disruptive technological change (ICT, green jobs and energy constraints, nanotechnologies, etc.

Both industriALL and EUROFER work in close co-operation with the European Steel Technology Platform (ESTEP) in order to promote training and lifelong learning in the steel industry.

ESTEP is a European-wide research network, which brings together the whole European steel industry, research centres, universities, the European Commission and Member States, as well as the other European institutions and trade unions, in order to create a coherent response to the challenges that impact on the European steel industry namely, the growing impact of globalisation, the matching of steel supply and demand and the climate change issue. In so doing, it aims to strengthen the EU-27 partnerships. More than 120 experts meet several times a year so as to implement and update the body's Strategic Research Agenda (SRA). The SRA is a key part of a sustainable development policy aimed at

maintaining the global leadership of the European steel industry. Skills development of the workforce in line with technological advance is one of the anticipated outcomes of the research agenda.

3.1.3 Conclusions: The need for a European framework

Research conducted within work package 3 “Analysis of VET Systems - Reflecting Anticipated Future Requirements” of GT VET in all four participating EU member states has shown that there are a varied set of curricula, policies and practices, which is indicative of different levels of skills, competence and knowledge across the case study countries. Within the companies varied practice was evident and given the lack of centralised guidance/policy, it can be inferred that the emphasis accorded to environmental matters differs, based on the importance placed on such issues by section heads.

A central recommendation is that there should be greater co-operation between companies and schools/colleges on (green) skills development, so as to ensure a clear, coherent and consistent message. More particularly, school content must be relevant, specific and applied to company practice. Furthermore, it is important that in-company training programmes are reinforced by wider campaigns and information distribution.

In terms of module delivery, one opposite proposal is that a series of smaller modules be run over the course of the apprenticeship training. The focus of the introductory module could be on relevant environmental legislation and its impact upon and application to the steel industry. Modules on specific practice could then ensue. The main consideration is that such training should be applied and role-specific, with numerous examples of concrete learning provided, and supplemented by the use of projects and applications of tools, such as Life Cycle Assessment. It was also suggested that critical incidents could be documented and form the basis for analysis – students could work out what went wrong in a situation and how it could have been prevented through the identification of the appropriate actions at each stage. These are deemed to be essential for effective learning by the trainees themselves. An emphasis on consequences of behaviour – the ‘why’ as well as the ‘what’ – and the implications for individuals, the organization and society should be included.

3.2 Introduction: Environmental Responsibility

3.2.1 Green Skills as a Management Task[2]

Germany

Concerning environmental protection issues, a central contact point is located on parent company level. The parent company also maintains corresponding offices in Brussels. Additionally, there are links to associations (Eurofer, World Steel Ass) covering topics such as environmental and climate protection across sectors. On company level contacts to national authorities are considered important because these are implementing legislation and carry out company inspections. In addition, the company is constantly in contact with the plant operators to discuss environment-related decisions and to keep the Board constantly

[2] Germany = ThyssenKrupp Steel, Italy = Acciai Speciali Terni, Poland = Arcelor Mittal, UK = Tata Steel.

informed (including the case of larger investments). At organizational level important changes are displayed in the work instructions.

Important Legislation

For the Department of Environment and Climate Change as well as for the engi-neers, especially CO2 is an important legislative issue which involves lobbying efforts and for which legislation is continually updated. Maybe this dynamics lead to a situation in which the engineers of the company inadequately prepared for their prospective management tasks by the universities. The TEHG Amendment (Greenhouse Gas Immission Trading Act) constitutes an important law through which an energy management system will be established. In this context the EEG (Renewable Energy Sources Act) is relevant. For the division of hazardous substances the program REACH and the Compliance Program (CLP) are important, especially for the hazardous material labeling and work safety.

Another important area, especially in education, is the issue of hazardous sub-stances (storage, recycling and substitutes). Therefore, important laws have to be “translated” into practical instructions. The high pace of hazardous substances definition and re-definition also requires a permanent operational adaptation. In vocational education the ordinance of disposal rules (e.g. container and waste management, prevention of fires) as well as the handling of hazardous materials is important. Currently a comprehensive ‘white education’ without contact to hazardous substances is available only to a minor extent.

Italy

AST allocate responsibilities on both the environmental and H&S issues to the same single department to underline the strict connections between the two fields in the concrete production and service activities and the external context (territory, city, local community)

Regulation and Legislation

Compliance with environmental legislation is sought in the areas of waste, air, water, land and groundwater contamination, as well as carbon dioxide emissions under the ETS scheme.

In some cases the legislation is implemented extensively while in other cases only specific parts of it are applied, particularly where risks of internal and external pollution or contamination are higher.

The geographic location of the steelwork within the Terni’s urban area contribut-ed to rise the level of awareness together with the positive effect of the correct environment management on costs and economic results.

Workforce engagement is seen as an essential element in securing such compliance. Although the company is positively willing to implement the EU and national legislation, the burden of bureaucratic procedures is considered by the company too much time consuming and costly.

Company Strategy

The company aim is however to move from compliance to improvement, with regulation seen as the baseline from which to progress.

Environmental protection and producer waste responsibility are and will increas-ingly be a challenge and a critical aspect in the neat future for the survival of in-dustries.

Levers should be used to set up the basis for future development such as:

- Collective awareness campaigns on environmental protection (improve-ment groups; awards)
- General information on company-produced wastes and handling tech-niques;
- Location of waste disposal areas serving individual working areas;
- Incentives of eco-friendly behaviours

Workplace Culture and Practice

Changing behaviours and culture are an important aspect of a strategy.

A complete reversal in taking care also the environmental issues and not only production cycle, need time and an everyday effort in changing many behaviours kept for a long time.

AST has already point out several target to reach in a short time and strengthen with a continuous specific training:

- To develop/increase the awareness of how maintenance may impact the environment
- To develop and/or spread environmentally friendly behaviours
- To know the distinction between ordinary and special wastes, the related handling methods and the location of storage and disposal places
- To be aware of industrial waste disposal systems and waste reduction practices

Occupational/Job Requirements

As stated in a former chapter, the environmental aspects of the work of mechani-cal and electrical technicians were identified.

AST clearly identified the need to develop, increase the awareness of how maintenance may impact the environment. The main point of this strategy is de-veloping and spreading environmentally friendly behaviours

To this purpose, it is of paramount importance to know the distinction between ordinary and special wastes, the related handling methods and the location of storage and disposal places, as far as to be aware of industrial waste disposal systems and waste reduction practices.

Poland

In Arcelor Mittal, green skills as a management task can be summarized under the following quality criteria and development goals:

- pro-awareness and pro-motivation activities among employees to care for the environment and safety work
- constant increasing the awareness of employees and environmental culture and observance of safety rules
- increasing the number of internal environmental controls, in particular for installations with a significant impact on the environment
- introduction of motivational elements into salary system
- conducting environmental education: ecological picnics and awareness action through fun / entertainment, eco-mails, ecological contests, describing the current environmental problems related to individual departments
- increasing financial investments for environmental investment, modernization and renovation

United Kingdom

The Environmental Department was established in the mid-1990s. It is comprised of twelve staff and undertakes both compliance work (ie ensuring that legislation and regulation is adhered to) and improvement work (through step-change projects e.g. capital expenditure on air quality, waste management and recycling projects). The Environmental Manager reports directly to Director level, which shows the increased significance of the role.

Regulation and Legislation

Compliance with environmental legislation is sought in the areas of waste, air, water, land and groundwater contamination, as well as carbon dioxide emissions under the ETS scheme. One interviewee stated that ‘The Port Talbot plant has struggled to meet

compliance targets.' Workforce engagement is seen as an essential element in securing such compliance, although the environmental department has 'limited resources to communicate with the workforce.'

Environmental regulation emanating from the EU was described as having 'a good underpinning logic' but as being highly inflexible and prescriptive. Moreover, it was described as counterproductive at times and as 'driving behaviour in the wrong way'. An example was given, where waste oil from process was being collected, in order to recycle it through the spraying of coal prior to coking. However, this was a breach of the Waste Incineration Directive, despite the 'waste' oil being purer than oil bought in for such purposes. Moreover, the ETS was described as highly bureaucratic, with a vast amount of time and money having to be spent on monitoring, assessment, calibration as opposed to trying to reduce. This is seen as proliferating jobs for bureaucrats and the private accreditation firms.

Company Strategy

The company aim is however to move from compliance to improvement, with regulation seen as the baseline from which to progress. Improvement activities, which are comprised of capital investment in key areas of the business, are based on cost-benefit analysis and auditing. There is a pre-allocated 'pot' of £5 billion and applications have to be made for that funding for schemes identified within the department. Improvement is seen as coming from the changing of be-haviours/culture, as well as the implementation of current technology and the identification of new technologies (these latter through capital expenditure and collaboration with R&D).

The Tata takeover is seen as being influential in moving 'environmental issues up the agenda', with more emphasis placed on such aspects in the last two years than 'over the past twelve.' Tata is said to have a different approach to capital expenditure and is spending the money required 'to get the facility to a world-class level.

Changing behaviours and culture are an important aspect of strategy.

Workplace Culture and Practice

Participants referred to 'The Journey', the on-going culture change programme being implemented at the plant. Fundamentally, the 'Journey' aims to change attitudes to work and therefore, behaviours, instilling a sense of pride in work and ensuring that all see 'continuous improvement' as an essential and habitual part of their work.

Behaviour and attitude change are seen as interchangeable and thus, there are a raft of practical measures in place, designed to change behaviours and reinforce attitudinal change. Work protocols/standard operating procedures are explicitly specified – and accessible – for all tasks. Environmental and safety aspects are incorporated within these protocols. For example, the procedures for dealing with acid leaks, oil spills or preventing gas emissions are documented within the protocols. Such behaviours are reinforced by 'environmental/health and safety walkovers', conducted by staff from the respective departments (these supplement more formal 'Lead Safe Audits'). Walkovers essentially involve staff asking those carrying out tasks about what they're doing and questioning them as to the environmental/safety aspects of the work being undertaken. Workers might be asked to explain correct procedures in the event of spillage, for example, or how waste should be disposed of. There are occasions where a task/job has changed/evolved, but the safety/environmental aspects have not been incorporated into procedures; the right adjustments do not get made. Moreover, respondents identified that walkovers take time and there are a limited number of staff available.

Behaviours are also reinforced through target-setting and appraisals which incorporate measurement against such goals.

The key role of management 'buy-in' to the environmental agenda was empha-sised – if the area has a 'good' manager, this is reflected down the hierarchy. Heavy-end areas, with the

greatest potential for environmental risk, were de-scribed as those requiring most improvement.

3.2.2 Integration in company internal training programs

Germany

The Environmental Management Handbook is the key instrument to communi-cate objectives and regulations of the company concerning environmental protection. It contains all requirements and principles decided upon by the management board, described in practical and applicable guidelines to make it understandable for the whole workforce. The higher the corporate level, the more theoretical is the reference to the Handbook.

The Occupational Safety Handbook contains the essential corporate guidelines and all the institutions, programs and processes which are involved in occupa-tional safety. For further development of the handbook, a risk assessment of every workplace is supplied, including corresponding health and safety measures in a very complex procedure. Finally, the staff receives a set of behavioral related core rules and procedures only for its operating areas. In training sessions the employees are regularly instructed concerning these measures. This risk assessment and instruction is required by law; the design of the training is left to the company.

With regard to environmental standards the company moves simultaneously be-tween exercising their duties (‘working rules off’) and individual initiative to be better than legally necessary. On the one hand, the company has to enforce the regulations; on the other hand internal processes have to be analyzed continu-ously to improve performance independently from legal requirements. A focus was set i.e. on the issue of resource efficiency through an in-depth analysis of the process flow. In this area seminars have been offered to the workforce. On the operational level an internal or external benchmarking (among companies) is considered important (amount of energy consumption and steel production).

Although the legislature does not require accident-free operations TKSE has set the guideline ‘zero accidents’ and focuses ‘behavioral occupational safety’. In this context the internal ‘ADAM program’ ("safety through attentive workers") was developed on the premise that ‘everyone takes responsibility for everyone’ in order to avoid misconduct. Without these extensive guidelines TKSE would not be competitive because this policy is an international ‘State of the Art’.

Targets in environmental protection

Targets concerning environmental protection are collected annually from every division. Approximately 150 targets are set per year and are divided into five to six categories (e.g. energy saving). For the year 2009/2010 there were about 146 measures and about 88 (60%) were completed (result of the monitoring). In turn, individual goals (e.g. reduction of emissions), the corresponding action (installa-tion of a water spray) and the required investment are derived from this point. The compliance rate of TKSE in general is 60% and only less than 5% are stopped completely (e.g. not conducive anymore; changing targets; target is identified as unreachable). The remaining measures will be transferred to subsequent years.

The companies define ‘its contribution to environmental protection’ on their own initiative and have no guidelines imposed from the management level. Only if a company formulates no targets the management will take measures. Then, the figures for environmental protection (operation phase; data from measuring de-vices, e.g. emissions) will be awarded. Although TKSE is ‘at the top’ of the com-petition in environmental protection, it is not the only company worldwide that takes into account environmental issues. It is exposed to a greater competitive pressure and relies more on the initiative of the departments to implement vari-

ous internal company guidelines. In the context of occupational safety, ‘reactive targets’ like accident rates are in the centre of attention. These are also relevant for bonus payments.

Trainees and work instructions

The info-point project has recently been implemented in order to provide the trainees with information on health and safety lines (mind map), a safety manual, and facts about environmental protection, documentation and information about accidents and responsibilities of various persons in the company. The info-point is a clearly visible element of the everyday workplace and therefore easily accessible. This is supposed to encourage everyday learning and interest of the trainees. The project was launched by the personnel department together with the trainees two years ago. According to the workshop participants, it reflects massive changes in the educational approach in the German dual training which started with the new design of the technical training occupations in 2003. The key phrase ‘holistic” or “integrated” training refers to the ‘business or process orientated provision of training content’.

Cooperation of departments

If a department has a concrete problem (e.g. hazardous substances) and is not able to find a solution on its own, the occupational health and safety department (OHS) will be contacted. Together with the working group the problem is dis-cussed on the basis of operational instructions and procedures. The OHS contacts the responsible hazardous substance officer to further discuss solutions. This happens several times a year. On top of this there is regular communication between the officer and the hazardous substance department. There is also a working group composed of the hazardous substance division, the hazardous substance officer and the company medical officers. Since the beginning of 2011 the working group ‘safety at work’ is part of the education centre Duisburg. Once a month the security officers meet (approximately 15 participants, including the security officer of the trainees) and talk about current events in the education center such as accidents, hazardous substances or environmental issues and formulate action targets promptly. The working group follows the top OHS premise of ‘zero fires, zero accidents’ derived from the corporate targets. In this context the focus is the learning experience of new trainees.

Conflicts between departments arise more at the level of legislation if European and German law is incompatible. Then the departments need different instruc-tions to react to these requirements. Thus the legislation for the corporate level must ‘be practical as possible’ and provide alternate instructions for action. Otherwise this will lead to rule violations (e.g. replacement of banned substances). Meanwhile the motivation of employees to use prohibited substances has de-creased significantly during the past years.

Increasing competence requirements in the field of environmental and climate protection

At TKSE the competences of the workforce in the fields of climate and environ-mental protection have increased. This is a common observation of all workshop participants. Management officers for climate and environmental protection have been installed as contact partners for the parent company at operational level. They are supposed to do daily inspections checking and discussing safety is-sues, and they are responsible for the training and internal audits of employees. The audit was introduced in the course of the “decentralized restructuring” (e.g. reducing the number to five auditors). The management representatives are regularly trained and subject to disciplinary action of the local management. But they complete the audits independently. This system has proven to be very effi-cient.

Italy

At AST training is worked out and administered at the internal Training Cen-tre, an entity recognized as a training agency and qualified to issue certificates and qualifications. On-the-job technical training is developed by AST’s own technicians.

Safety training is provided by contract agencies in compliance with the Italian safety regulation. Training includes a base refresher course on the fundamental principles of electricity, mechanics and electronics and courses on the operation of specific plants (e.g.: operating practices).

Concerning the environmental aspects, for the time being, training on the job is the only existing way to train new employees in strict cooperation with more ex-perienced colleagues.

Specific training for operators on issues as reference laws and regulations, waste types, classifications and volumes, environmental impact, storage and disposal methods and waste minimization techniques is still missing.

Future Developments

In the recent past, production/operational issues were the priorities, with other issues (including environmental aspects) perceived as secondary. This is now felt to be changing – environmental aspects are 'moving up the agenda' and will ultimately become as central as health and safety actually is.

However, greater environmental awareness and workforce engagement is seen as essential to the progress of such an agenda. Environmental protection and producer waste responsibility are and will increasingly be a challenge and a critical aspect in the neat future for the survival of industries.

Levers should be used to set up the basis for future development such as collective awareness campaigns on environmental protection (improvement groups; awards), general information on company-produced wastes and handling techniques; location of waste disposal areas serving individual working areas, incentives of eco-friendly behaviours.

Poland

The Company has an annual training plan. Scope of training depends on the realized tasks; training proposals to the plan are reported by individual organizational units. The Company does not have a formal training program only in environmental protection. Environmental aspects are discussed both in health and safety training and training management systems and training by their direct superior.

Examples of training packages: Health and safety periodically for persons employed in blue-collar workers, environmental protection, waste management, industrial serious breakdowns.

Training takes place officially, usually during working hours and are funded by employer. Obligatory training is conducted in health and safety: the initial, periodic, etc.

There are conducted also formal and informal training for people whose responsibility is related to EU directives and regulations (e.g. in the field of integrated permits IPPC, Emissions Trading Scheme ETS, REACH) / National legislation / regulations at Com-pany level. Each employee has access to the intranet „studnia" („well"), where he can become familiar witch legal requirements: in integrated permits IPPC, Emissions Trading Scheme ETS, REACH / National legislation / regulations at Company level and other in-formation on the environment. In addition, in part of plants are conducted environmental training project implemented within the framework of WCM. Additionally, the employee may be aimed at training by the supervisor after the acceptance of training depart-ment. Staff familiarity with the requirements of the directives and regulations is carried out mainly by familiarizing employees with the internal normative acts (circulars letters, Directives of the General Director, etc.) system procedures and instructions which these requirements are fully reflected.

Directives and regulations shape the training for analyzed occupations, because workers should be aware of the rules in order to perform his professional activity properly.

United Kingdom

The formal induction for employees, including apprentices, includes a section on environmental issues, which is delivered by staff from the Environmental Department. There are also specific environmental training packages, which will be tailored by occupation and section. How frequently such training is delivered was unclear, as were the reasons that prompt delivery. Environmental staff will attend departmental meetings, held every month for managers. In such meetings, any environmental breaches will be discussed, with a view to implementing appropriate action. Moreover, updates and briefings on any new environmental developments will be delivered in such forums.

For the workforce in general, there is an emphasis on task-based learning, or learning by doing. Protocols and procedures, which specify correct and safe ways of working, are aimed at shaping behaviour and work performance. How-ever, there was acknowledgement that procedures might change, but practice does not always keep pace. Moreover, novel safety and environmental issues that evolve out of changes to work practice are not always recognised and incor-porated into procedure or practice. It was also recognised that the 'worst offenders' (contractors and sub-contractors) might be missed.

In terms of more formal training, the workforce attends Journey Days, where en-vironmental aspects might be discussed; has 'Toolbox Talks' with section man-agement; and might attend 'Industrial Forums', where speakers from the Envi-ronment Agency or the Welsh Assembly might speak about the broader implications of environmental breaches.

Future Developments

Interviewees were unanimous in the view that previously, production/operational issues would be the priority, with other issues (including environmental aspects) perceived as secondary. This is now felt to be changing – environmental aspects are 'moving up the agenda' and will ultimately become as central as health and safety has. However, greater environmental awareness and workforce engagement is seen as essential to the progress of such an agenda. Training is acknowledged to be a central plank in any such programme – so as to move away from the "current fire-fighting, reactive approach of the Environment Department" - but gaps in current provision were recognised.

Possible recommendations were the use of 'Training Champions' located within sections (following the model of the new Energy Optimisation department, who are based in sections, working on specific projects), who would disseminate and reinforce good practice and ongoing education in correct protocols. Another idea was to incorporate and emphasise environmental perspectives into training and practice on risk assessments. All workers are trained in the process of risk as-sessment and are encouraged to conduct an on-the-spot, two-minute risk as-sessment for all jobs (alongside the written, formal risk assessments that are lo-cated in, and can be accessed from, a computerised database). The Safety manager proposed that the identification of any potential environmental hazards and associated protective and preventative measures should be emphasised, alongside the assessment of personal safety hazards.

4. Methodology of the Training Module

Based on a precise definition of green skills being relevant for GT VET in the steel industry an activity based learning approach with four thematic sub-modules was generated, each consisting of four subsequent and increasing learning levels.

The training module is defined by learning outcomes, including non-formal and informal learning oriented at knowledge, skills and competences (EQF), with the main focus on competences (ability to use knowledge and skills with self-responsibility and autonomy).

Definition of green skills

Related to the three differentiations for green skills (O*NET Classification) GT VET is dealing with the increase of green skills for existing occupations[3] (embedding both generic and technical skills)[4]. When using the term green skills GT-VET focuses more on environmental sustainability. But there are clear benefits in terms of social and economic sustainability, too. As skills are acquired and then applied by individuals in different contexts, skills become green when they are applied in green contexts. Our point of reference is with respect to the context of the European steel industry and its green requirements concerning legislation, innovation and stakeholders perspectives – both for now and the foreseeable future. In addition to the analysis of relevant documents the following definition is also a result of interviews and workshops with steel and VET experts within the framework of the GT-VET project.

Green skills for technical VET in the European steel industry are technical skills and appropriate awareness to prevent and reduce negative impacts on the individual and environment (neighbourhood, employees, air, water and ground) caused or initiated by operations and work in and around steel production. Green skills aim to equip skilled workers with competencies for ecologically and environmentally sustainable behaviour whilst maintaining high health and safety standards.

This comprises knowledge, abilities and attitudes:

- to save and reduce input of resources, particularly energy and raw materials.

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[3] The other two are: green enhanced skills occupations (green skills that significantly change the work and worker requirements) and new and emerging green occupations (unique work and worker requirements, resulting in the generation of new occupations, entirely novel or 'born' from an existing occupation). (Source: Green Skills Agreement Implementation Plan 2010-2011. Ministerial council for tertiary education and employment. June 2010, page 3. For a comprehensive definition of occupational categories on green skills see also: Dierdorff, E., Norton, J., Drewes, D., Kroustalis.C., Rivkin, D. and Lewis, P. (2009) Greening of the World of Work: Implications for O*NET®-SOC and New and Emerging Occupations. A Report for U.S. Department of Labor Employment and Training Administration Office of Workforce Investment Division of Workforce System Support Washington, DC. The National Center for O*NET Development, February 12, 2009).

[4] Generic skills - the possession by an individual of the qualities and competencies required to meet the changing needs of employers and customers and thereby help to realise his or her aspirations and potential at work (CBI, Qualified to compete. Creating a world class qualifications framework, CBI, London,1998).
Technical skills - the skills needed to perform the tasks required to produce a good or service, often involving analysis, evaluation or the application of machines or technological systems. Examples of technical /specific green skills include knowledge of sustainable materials, carbon 'foot printing' and environmental impact assessment skills (Cedefop (2010), Skills for green jobs, developing a low-carbon economy depends on improving existing skills rather than specialised green skills, Briefing Note, July 2010 - http://www.cedefop.europa.eu/EN/Files/9024_en.pdf).

- to prevent and reduce emissions, pollution and noise.
- to utilize, store and dispose waste materials in a manner that conforms with best practice environmental procedures and understands the consequences of nonconformity.
- to understand the value, impact and lifecycle of resources and materials.
- to keep track of current standards and best available techniques.

Activity based learning approach

Based on the results of the industry requirements and its reflection on the VET systems, an activity oriented learning approach the European training module was developed as a workplace and activity based learning sequence (with smaller sub-modules and action-oriented green skills projects) supported by digital media (e.g. power point-presentation for teachers, videos). For the pilot version principal environmental concerns that derive from the steel production process were identified as sub-modules (energy, raw materials, waste, and noise) and developed in new or enriched existing projects with green aspects. The module shapes knowledge, abilities and attitudes in broadly understood green awareness. Learning outcomes were defined to be tangible and raise awareness. The content is workplace related and relevant for steel production and its further processing. Cognitive and manual learning as well as learning by doing were combined, useful work pieces which foster sustainable learning were created and learning is action oriented. A set of didactic methods were incorporated in the module to facilitate the knowledge transfer and spice up learning process. The more complex didactics are they were oriented towards activities. Learning impact was based on critical events (including which kind of misconduct led to negative impacts). Beneath practical parts all contents are convenient to be used at different learning facilities (school, company work place, training areas). The module promotes cooperation between all learning venues (vocational school, training centre, production site).

Matrix of learning areas and levels

The main topics (energy, raw materials, noise and waste) deriving from the actual demands of the involved companies were developed in sub-modules of four different learning or knowledge levels (see the following matrix). These levels are subsequently following each other, improving the level of self-learning and learning outcomes step-by-step. The specific learning contents and activities are oriented at typical situations and matters close to the workplace and company requirements. Each level of each sub-module develops knowledge to a deeper (and more industry relevant) level. While level 1 and 2 are more input oriented (with self-learning and group work as well), especially level 3 and 4 are based on own activities, tasks and projects of the trainees.

Level 1: basic information

- General introduction into the issue taken account of examples form the steel industry (between 5 to 15 pages)
  - definitions
  - using examples
  - e.g. to use for self-learning
  - technical background is not needed
- Easy exercises for singular or group work
  - related to personal experiences
  - to reflect surrounding world
  - to scrutinize everyday occurrences
  - to exchange personal experiences in a learning group
  - to show that this issues is relevant for everybody
  - discussion of results could be a starting point for a wider discussion

Level 2: understand background and coherences

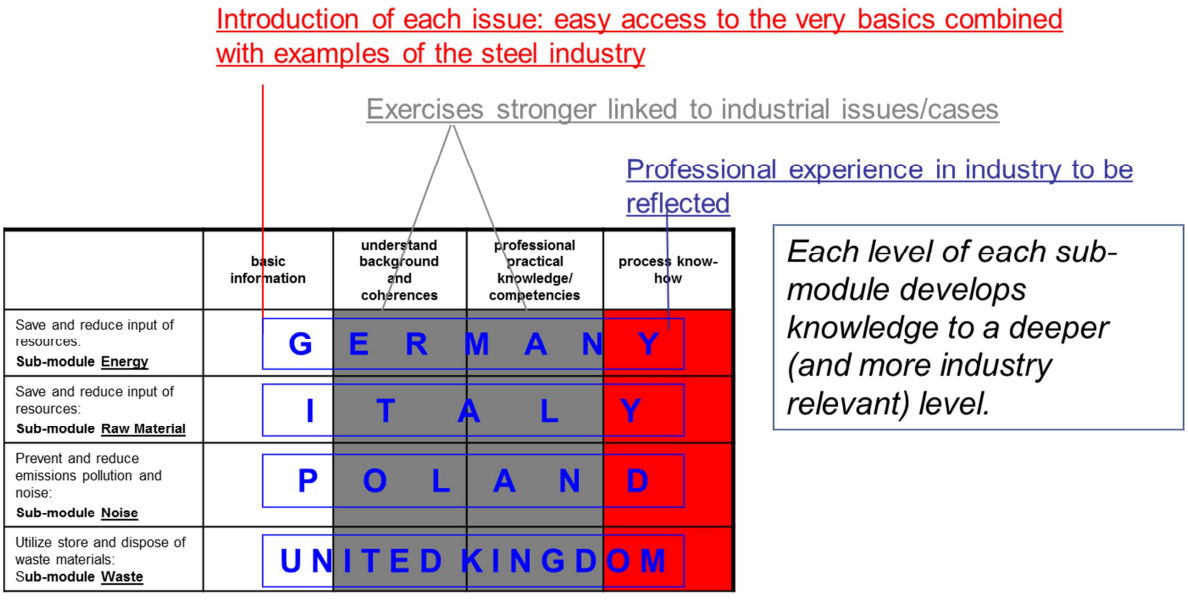
- Exercises are more complex than in 1st level
- Needed information are to be self searched (papers, document, internet etc.) not presented
- Results have to presented and explained by learners
- Exercises are linked to industry
- Exercises should work out in group
- Encourage to discuss the results

Level 3: Professional practical knowledge/competencies

- Practical exercise for technical apprentices in a industrial workshop or technical training centre
- Exercise should cover a short but complete work process (from planning to evaluating the process)
- Get in contact and understand needed industrial guidelines for the exercise
- Understand how the exercise is linked to the GT-VET issue
- Intensify search-work and presenting work

Level 4: process know-how

- Reflection of a practical phase of skilled work in a steel company
- Understand green aspects of production (What do they do for environmental protection in the plant part where I am working)
- Reflect environmental guidelines, instructions relevant for a specific working process
- Knowledge about specialized contact persons in a plant part (environmental protection officer, safety protection officer, hazardous substances officer etc.) and their essential functions



Matrix of learning areas and levels

Industry related main topics	**Level 1:** Basic information	**Level 2:** Understand background and coherences	**Level 3:** Professional practical knowledge/ competencies	**Level 4:** Process know-how
Save and reduce input of resources: **Sub-module Energy**	Introduction of each issue: Easy access to the very basics combined with examples of the steel industry	Exercises stronger linked to industrial issues/cases		Professional experience in industry to be reflected
Save and reduce input of resources: **Sub-module Raw Materials**				
Prevent and reduce emissions pollution and noise: **Sub-module: Noise**				
Utilize store and dispose of waste materials: **Sub-module Waste**				

The development was based on the different demands and priorities for green skills in the involved steel companies and the related national VET systems. Therefore the pilot sub-modules show some European relevant similarities as well as national relevant specifications:

Target groups

While the sub-modules “Energy” (Germany, TKSE) and “Waste” (UK, TataSteel) are quite similar in the target group and learning place orientation and straight in line with the GT VET targeted professions electronic and mechanical technicians, the sub-module “Noise” (Poland, ArcelorMittal Poland) was at level 1 and 2 targeted at students of middle and technical schools, but the contents are easily transferrable to training with apprentices and workers (see results of the cross-national test - work package 5). The sub-module “Raw Materials” (Italy, AST) is quite different, because the qualification level is rising from level 1 (unskilled workers) continuously to top managers (level 4). Therefore this training sub-module could not be transferred to the other countries and companies and had to be improved basically for the European Framework Module (see results of the cross-national test - work package 5 – and the outcomes of work package 6).

Target Group Level within the Sub-modules

Industry related main topics	**Level 1:** Basic information	**Level 2:** Understand background and coherences	**Level 3:** Professional practical knowledge/ competencies	**Level 4:** Process know-how
Save and reduce input of resources: **Sub-module Energy**	pupils / starting apprentices	apprentices (lower level)	apprentices (higher level)	professionals
Save and reduce input of resources: **Sub-module Raw Materials**	no previous knowledge	professionals	middle managers revised: professional workers	(top managers) revised: professional workers
Prevent and reduce emissions pollution and noise: **Sub-module: Noise**	middle school students	technical school students (higher than middle school)	workers	specialised workers
Utilize store and dispose of waste materials: **Sub-module Waste**	apprentices / students	apprentices / students	apprentices / students	apprentices / students

Methodological / pedagogical mix learning activities

The module (represented by different sub-modules) aims to improve the knowledge and awareness of the target group on environmental issues of the steel industry. Evidence suggests that there is little awareness and interest in 'green' issues. The objective is for the training to increase engagement and motivation in this area.

The training improves awareness for green skills:

- Theoretical inputs and self-organised learning, group and project work, ability to critically check existing situations, planning and management of project, presentations
- Focus on the workplace experience, implications.
- Self-directed learning
- Improvement of context knowledge, comprehensive approach for learning and training, generic understanding, identification of parameters for change.

There is potential for the programme (as a whole, or individual sub-modules) to fit with company delivered programmes or wider VET frameworks. One aspect under consideration is for the module programme to be accredited through the European Credit system for VET (ECVET).

The sub-modules fit together very much: E.g. the "Waste" sub-module is of direct importance for the sub-modules on "Energy", "Raw Materials" and "Noise". Each level of each sub-module develops knowledge to a deaper (and more industry relevant) level.

Duration of the (sub-) modules and ECVET Credit Points

The proposed formal integration in **national VET systems** could be a complicated and lengthy process. But as declared during piloting and testing the GT VET sub-modules (or parts of it) in its recent state could be easily and flexible integrated in the national and companies related VET systems:

- In **Germany** it is done by given leeway of the existing curricula and the given learning targets of the analysed professions. The Dual System provides also the possibility of a close cooperation between vocational schools and companies.
- In **Italy** all sub-modules can be integrated in the curricula of the schools due to their autonomy. According to the law, schools are allowed to modify up to 35% of their Education Plan to upgrade contents and methodology in the perspective to respond to new training needs coming from territory, companies and stakeholders.
- In **Poland** integration with the national VET system could take place by including into school programs, as part of ecological education and training. Also a strong cooperation between the steel company and the region encourages schools and pupils to implement industry related topics in the learning paths.
- In the **UK** this would require the engagement of the sector skills council (SEMTA) and the involvement of the appropriate standards authorities.

However, the pilot test in the different steel companies and member states showed that sub-modules or parts of it could be easily integrated in the companies training program and the national VET activities by given leeway or responsibilities. This includes the allocation of credit points within the European ECVET system or approach, based on the time scale and the learning level of the different sub-modules. Each sub-module has a time scale between 2 hours and about 20 days depending on the learning level.

Overview training module: duration of learning units

Topics from GT-VET definition	**Derived contents**	**Level 1:** Basic information	**Level 2:** Understand background and coherences	**Level 3:** Professional practical knowledge/ competencies	**Level 4:** Process know-how	**total learning hours**
Save and reduce input of resources	**energy**	*2 hours*	*2 hours*	*3 days*	*15 days*	*about 20 days*
	raw materials	*2 hours*	*2 hours*	*2 days*	*10-15 days*	*about 20 days*
Prevent and reduce emissions, pollution and noise	**Noise**	*2 hours*	*2 hours*	*3 days*	*15 days*	*about 20 days*
Utilize store and dispose of waste materials	**waste**	*2 hours*	*2 hours*	*3 days*	*15 days*	*about 20 days*

Due to the flexibility of the European Training Module and its sub-modules this kind of distribution allows the flexible integration of credit points into every VET arrangement, even within a two or three years apprenticeship of initial (IVET) or a continuous vocational education and training (CVET) programs.

Based on this time timetable and on the calculation of the ECVET framework and other ECVET pilot projects for the GT VET sub-modules the following distribution of credit points were developed:

European Framework Module: ECVET Credit Points

Topics form GT-VET definition	**Derived contents**	**basic information**	**understand background and coherences**	**professional practical knowledge/ competencies**	**process know-how**	
Save and reduce input of resources	energy	*10%*	*20%*	*30%*	*40%*	***100%***
		0,5	1	2	3	***6,5***
	raw materials	*10%*	*20%*	*30%*	*40%*	***100%***
		0,5	1	2	3	***6,5***
Prevent and reduce emissions pollution and noise	noise	*10%*	*20%*	*30%*	*40%*	***100%***
		0,5	1	2	3	***6,5***
Utilize store and dispose of waste materials	waste	*10%*	*20%*	*30%*	*40%*	***100%***
		0,5	1	2	3	***6,5***
Total ECVET Points	***%***	***10%***	***20%***	***30%***	***40%***	***100%***
		2	***4***	***8***	***12***	***26***

Calculation Basis:

200 training days a year = 60 credit points
about 20 training days for each sub-module are foreseen. That makes about 10% of a whole training year or about 6 credit points per sub-module.

The credit points could be inserted in the two or three years lasting general/formal education and training program for apprentices.

The next step concerning ECVET is a learning agreement in form of a "Memorandum of Understanding" within an international partnership (ESTEP, Eurofer, industriAll), to acknowledge the learning outcomes of GT VET within the European Steel Industry, especially to foster transnational and trans-professional mobility.

5. GT VET Training Module

5.1 Submodule 1: Save and reduce input of resources

5.1.1 Theoretical input: Saving and reducing utilisation of resources, particularly energy and raw materials[5]

Consumption of non-renewable resources

Finiteness of raw materials

For millennia, the economic and social success of man has been dependent on the utilisation of the resources available in nature, such as plants, minerals and seemingly unlimited supplies of water and air. If one chooses a small enough biotope to look at, one becomes aware of the limited nature of resources. When using non-renewable resources, these are not lost, strictly speaking, but the overall quantity available is reduced.

Resource

Resource: Source of raw materials and energy that is useful to us, as a result of high local concentration in accordance with Carnot's Principle (extraction is only economical above a certain concentration).

Non-renewable

Non-renewable: Through the utilisation of resources, the resultant dilution (global distribution) or transformation (e.g. combustion) makes the resource unusable in its original form. Nature is unable to regenerate these resources from the end products of our utilisation within a time period that is manageable for us.

Finite resources

Examples of the finite availability of resources include the following:

- Utilisation of water resources as an industrial one-way street leads to its local destruction: If ground water is disposed of untreated into the environment after use in the production process, or if residues remain in dumps after waste water treatment, water resources become increasingly polluted, i.e. used up in their original quality.
- Woodland as a supplier of timber does not regenerate in the short term, as many examples now demonstrate. Fast-growing newly planted species of tree may regenerate the economic, but not the natural function.

Raw material balance

Technologies for the utilisation of raw materials

The raw material balances of the last 150 years demonstrate that the consumption of raw materials has on average doubled every 35 years. New technologies have led to more effective extraction of raw materials, and the seemingly unlimited supply of raw materials in turn produced wasteful technologies:

More prosperity = more waste

The outdated notion of unlimited raw materials being available led to a spiral of prosperity, consumption and waste.

It is now becoming apparent that our high level of consumption can no longer be maintained, because

- An increasing scarcity of resources is anticipated in the coming years

[5] Source: Internal Handbook for environmental protection of TKSE: Umweltschutz in der ThyssenKrupp Berufsbildung (Draft 2012).

- The volume of waste and pollutants produced by the consumption of resources is producing significant consequences locally.

Saved energy performance	Energy type/ Mode of loss	Typical relative loss
100%	Primary energy	
	Extraction, refining	30 %
70 %	Secondary energy	
	Transport	10 %
63 %	Net energy	
	Utilisation process	80 %
14%	Energy performance	

Saved raw material performance	Raw material type/ Mode of loss	Typical relative use / loss
100%	Primary raw material	
	Extraction / reprocessing, waste	20%
80%	Secondary raw material	
	Transport	10%
72%	Charge material	
	Original transformation, waste	25%
54%	Intermediate product	
	Target transformation	10%

The requirement resulting from this situation is as follows:

Requirements

- Use raw materials and energy sparingly, and
- Use alternatives wherever possible.

This should entail turning away from the attitude

- Greater prosperity through greater consumption of resources, towards
- Maintaining the same level of prosperity using the lowest possible volume of resources.

This objective can be achieved through improvements in resource performance.

Resource performance: Benefit obtained from a resource in proportion to the volume of the resource used.

Resource performance

Technological objectives in relation to an optimised resource performance:

Technological objectives

- Introduction of technologies that save and recycle energy and raw materials, i.e. reducing the technical limits for energy and raw material requirements,
- Extending the service life of consumer goods,
- Easier options for replacement and repair,
- Moving towards information-intensive and team-oriented production,
- Multiplying the resource performance with the same throughput of material and energy,

- Reducing the throughput of material and energy for the same resource performance.

Many of the resulting alterations may not change our day-to-day life in any immediately visible ways, but they give our descendants a real chance to living conditions as good as those we enjoy.

Sustainable activity

Sensible use of materials

A sensible and conscientious use of materials results in two different advantages:

The point of sensible use of materials

- Making use of nature's ability to provide us with resources through evolutionary concepts, without destroying this ability,
- Taking advantage of the economic benefit that automatically results from using lower volumes of material.

The many different terms for describing materials make it necessary to differentiate what we mean, particularly in this environmentally oriented context:

Material: Depending upon the value creation process in which a material is involved, we generally differentiate between the following classifications:

Differentiating between types of material

- Raw material, recyclable material: Substantial materials incorporated into the product.
- Auxiliary material, operating material: Material required for the manufacturing of the products, which undergoes transformation but is not or is only partially incorporated into the product.
- Pollutant, hazardous material: Material that has a harmful effect on the environment.
- Residual material: Material that cannot be used further in any appropriate process at the plant.
- Waste: All moveable things that an owner disposes of, wishes to or must dispose of.

But: A residual material that is produced in one plant as waste may be a recyclable material in another plant. If it is used accordingly in that other plant, it loses its status as waste.

Basic formula: Waste = recyc-lable material

Material resources are considered not to be infinite if nature or we are incapable of regenerating them within a manageable time period (e.g. 50-100 years). All utilisation of resources to date has resulted in severe interference with nature. In some cases, this has led to the destruction of its capability to regenerate. Furthermore, many of the waste materials produced destroy the equilibrium of nature in the long term.

Limited resources

When we consider the sensible utilisation of materials, the focus should be on four distinct areas:

Avoidance - Reduction - Recycling - Disposal

Priorities for the utilisation of materials

As these terms conceal considerable expense in technology and costs, it is sensible also to discuss the economic aspects:

Any avoidance or reduction of pollutants/hazardous materials reduces the future costs for disposal under the 'polluter pays' principle. This allows future displaced costs to be avoided.

The 'polluter pays' principle

Any reduction of materials used, and any recycling of recyclable materials, will reduce the production costs and improve competitiveness.

An environmentally friendly production process, and the perception of product responsibility, can generally also strengthen the acceptance of the company by an increasingly green market, in addition to improving sales.

Acceptance of the company

Every task performed in accordance with sensible utilisation of materials must follow the chronology of the four points listed above, which will be described as follows.

Avoidance

Materials that have been identified as potentially hazardous materials or their precursors must be removed from the production process. Accomplishing this requires either

Avoidance

- Searching for a substitute material, or
- Redesigning the production process.

If neither of these alternatives is possible for technical reasons, every attempt must be made to reduce the quantity of the material used.

Example: Methylene chloride is one of the materials used as a degreasing and cleaning agent for steel plates. This material is considered to be carcinogenic, and can damage the ozone layer in the atmosphere. Methylene chloride is certainly one of the best alternatives for cleaning plate surfaces. If the substitute material ethanol is used, this does show a considerably lower degree of effectiveness, but it also has much lower potential hazards.

Methylene chloride

Reduction

Reduction strategies incorporate not only pollutants and hazardous materials, but also charge materials (raw, auxiliary and operating materials). Every reduction in charge materials reduces the consumption of resources, the energy requirements for processing and handling, and the expense of recycling and disposal. This process requires the development of green products and technologies with the following objectives:

Reduction

- Increasing the service life of the product,
- Improving suitability for recycling,
- Reducing the use of materials and energy.

Example: In integrated steelworks, large quantities of water are required for cooling purposes. The specific requirement stands at around 3.2 cubic metres of water per tonne of steel. Every year, the Duisburg steelworks of TKSE would require around 800 million cubic metres of water. This is more than is used by the entire population of the German state of Bavaria in a whole year. This is why closed water cycles have been developed in which the water is continually reused, cleaned and treated. Only very limited quantities, less than 3%, need to be added as a result of losses.

Technological innovations: closed cooling water cycle

Example: As a result of the innovative development of new quality classes for thin steel sheet, the automotive industry is able to build lighter and hence energy-saving vehicles while achieving the same or often even improved material properties. At the same time, the use of lower quantities of raw materials reduces energy consumption during the manufacturing process.

Technological innovation: new steel grades

Recycling

Recycling

When the potential for avoidance and reduction has been exhausted, the search for recycling processes can lead to an improvement in the environmental balance. Recycling distinguishes between four basic strategies:

a) Recycling through reuse:
If a product or a component of it can be used more than once, the consumption of energy and material for the production process is reduced accordingly: products with long service lives are worthwhile.

PC housing

Example: The housing of a PC can often be retained over several technical development stages of the actual system; the same applies for the hardware, which obtains greater utilisation potential from improved software.

b) Recycling through further use:
The product that is no longer useful for its original purpose can be put to a new final use.

Old tyres

Example: Shredded old tyres can be turned into floor coverings.

c) Recycling through reprocessing:
If a product has become unusable after having been used once or many times, its material can be fed back into the production process.

Steel scrap

Example: Scrap steel from cars can be melted down and turned into new products. This type of recycling relies heavily on the recyclable material being uncontaminated, in order to avoid impairment of the product quality.

d) Recycling through further processing:
Many waste materials often retain significant energy content. High-performance combustion processes can often utilise pollutants, considerably reducing their potential hazards.

Recycling in the shaft furnace

Example: Residual materials and waste from operations at an iron and steel plant, e.g. sludge from rolling mills and coating plants or dust from the sinter plant, are subjected to further processing at TKSE in Duisburg using the only shaft furnace of its kind in the world. From the approx. 200,000 tonnes of residual material collected in Duisburg each year, up to 170,000 tonnes of pig iron is produced, saving approx. 250,000 tonnes of iron ore, and ensuring that the dust and sludge no longer need to be disposed of.

Example: The blast furnace gas produced during the blast furnace process.

Disposal

Disposal

Terminal dump

All products and materials that at the end of their planned utilisation phase cannot be used for anything at all must be disposed of. The only means of disposal currently available is off-site dumping. This means that large-scale sealed areas must be created in order to prevent damage to the surrounding nature. This process increasingly reduces the available living space.

Disposal must necessarily be viewed as a last resort, where every effort has been made and no other alternatives can be found.

Personal tasks

What strategy does this observation suggest?

1. Awareness in using of operational charge materials.

2. Support of material cycles and disposal concepts.

Sensible use of energy

Fossil energy sources

A large proportion of the energy we use is derived from work previously performed by nature, which made use of solar energy. The resultant energy sources such as coal, mineral oil and natural gas are called fossil fuels, because they were created over millions of years. During the last century, the increasing extraction of these fossil energy sources has resulted in our steadily increasing prosperity. Today, however, the end of this increase is anticipated as a result of the exhaustion of the sources of raw materials. A transition to sensible utilisation of energy has therefore been taking place since around 1970. This means that a stable level of prosperity is to be guaranteed while using progressively lower volumes of energy.

The foundation of our prosperity

The discussion of energy consumption and utilisation potential requires the following terms to be defined:

Energy: Energy is the product of capacity (quantity factor) and intensity (potential factor)

Energy types by field

Depending on type, distinctions are made between:

Mechanical energy [Nm]:	E_P= weight * height difference (lifting a rock) E_K= accelerated mass * acceleration distance/2 (accelerating a bicycle)
Electrical energy [Ws]:	E_E= electric charge * potential difference (operating a lamp or an electric motor from a battery)
Radiant energy [J]:	E_S= quantity of light * frequency (radiant energy from the sun)
Chemical energy [J]:	EC= material volume * reactivity (heat energy from the combustion of natural gas)
Thermal energy [J]:	ET= thermal capacity * temperature (geothermal energy from hot springs)

Energy types by availability

Depending on their availability, distinctions are made between:

- Primary energy: Energy before transformation in power plants, refineries, etc.
- Secondary energy: Energy after transformation
- Final energy: Energy that reaches the end users
- Net energy: Energy that the consumer derives from the device.

Coal and crude oil

As examples, we will use coal and crude oil:

Primary energy	**Coal / crude oil**	
	Coal-fired power plant / refinery	**Transformation**
Secondary energy	**Electricity / petrol**	
	Overland cables / transport	**Transport**
Final energy	**Socket outlet / fuel pump**	
	Lamp / vehicle	**Transformation**
Net energy	**Light / kinetic energy**	

Efficiency

There are two criteria for evaluating the benefits of different energy types of Efficiency □ (relative to the respective transformation process):

□ = T_{out}/T_{in} (Temperature)

□ = $(T_O-T_U)/T_O$ (acc. to Carnot) for thermal power plants
T_O: heat energy taken from the high temperature system
T_U: heat energy delivered to the cold temperature system

Carnot's equation shows that an energy gradient is always required for the utilisation of energy.

Exergy and anergy

The degree of efficiency breaks energy down into two further kinds:

- Exergy,

  as the useful fraction W_{out} on the total energy volume W_{in}
- Anergy,

  as the non-useful fraction (W_{in}-W_{out}) of the total energy volume W_{in}.

By reference to the concept of residual material, anergy can also be described as the residual energy that cannot be used by any other appropriate process. In most cases, this residual energy is disposed of into the environment as waste heat.

But: The residual energy loses its status as waste if it can be used as final or net energy in another process. As residual energy generally only has a low energy gradient, special technology is required for its utilisation.

Energy performance

Energy performance (relative to the specific benefit): Performance value that the consumer derives through the utilisation of a specific volume of (net) energy.

Objectives for the utilisation of energy

Two objectives of equal importance can be formulated on the basis of these observations:

- Increasing the energy performance of an energy type
- Transition from non-renewable to renewable energies.

Plant hall

Example: Heating a plant hall of 150m^2 to 20℃ using natural gas during a year, with:

- Poor insulation and ventilation through open windows:
  8.000m^3 => 0.019m^2/m^3 gas
- Poor insulation and altered ventilation practices:
  6.000m^3 => 0.025m^2/m^3 gas => + 33% increased energy performance
- Improved thermal insulation and altered ventilation practices:
  2.500m^3 => 0.060m^2/m^3 gas => +220% increased energy performance
- Optimised thermal insulation, passive solar form of construction and ventilation via heat exchange:
  500 m^3 => 0.300 m^2/ m^3 gas => +1.500% increased energy performance.

Personal transport

Example: If one person travels a distance of 100 km using:

- Aeroplane: 138 kWh => 00.725 km/kWh
- Car: 064 kWh => 01.563 km/kWh => + 116%
- Train: 048 kWh => 02.083 km/ kWh => + 187%
- Coach: 022 kWh => 04.762 km/ kWh => + 557%
- Electric car: 006 kWh => 16.700 km/ kWh => +2.199%
- Solar-powered car: 2 kWh => 50.0 km/ kWh => +6.797%

Both examples demonstrate that putting in the same volume of energy can lead to achieving considerable increases in useful energy (= increasing the energy performance).

Alongside these objectives, it is possible to formulate many derivative tasks:

- Conscientious utilisation of energy, i.e. consumers should be switched off when they are not required,
- Replacing old, energy-intensive technologies with modern, energy-saving ones,
- Changing energy-intensive life habits.

Standby

Example: The standby mode of many devices still uses considerable quantities of electricity. The standby time of a device does not represent any benefit, meaning that the energy performance here is zero. For extended periods of non-use, it makes more sense to switch devices off.

Energy-saving lamp

Example: Using energy-saving lamps instead of conventional electric bulbs: The higher initial outlay is justified by the reduction of electricity consumption by 80% and an extension of the service life by a factor of 4. Overall, the lighting performance is increased by a factor of 20.

5.1.2 Learning Unit: Energy

The sub-module “Energy” was developed in the way that its four learning levels could be integrated in the regular education and training program of the company and the vocational school within the German Dual System. Given leeway within the official curricula (green skills are already part of the formal curriculum, but not enough considered, esp. from the perspective of company needs) were used for this integration.

Level 1 and 2: both professions (electrical and mechanical technicians) were taught together in a “class room”

Level 3 and 4: different tasks were conducted for electrical and mechanical technicians (but within mixed groups of 4 to 5 persons with electrical and mechanical technicians)

Level 4: took place in cooperation with the workers and management of a specific production area (rolling mill).

The sub-module contents and didactics were developed by the TKSE training departments. Teachers of the vocational school (dual system) were informed and created additional and deepening theoretical and practical background inputs.

Trainees: electrical and mechanic technicians (apprentices of TKSE)

Trainers: trainers of TKSE, teachers of the vocational school (dual system)

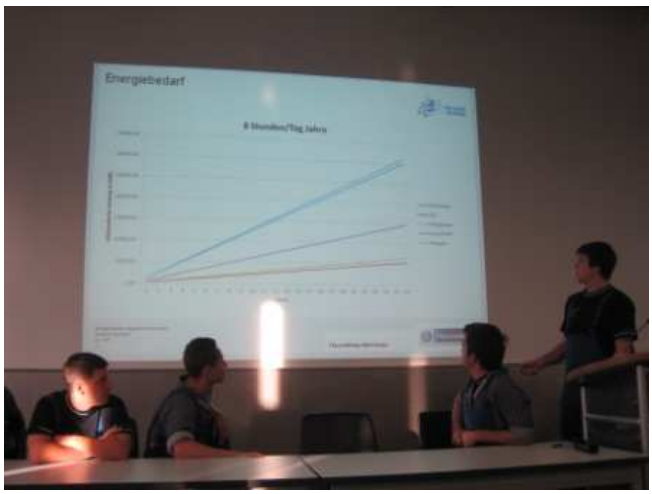
The didactics reflect working conditions of skilled workers: such as decide independently, prepare and evaluate own working processes, working in a teams.

Although issues and contents worth for steel industry were identified primary, some exercises were not concentrated on the steel industry cases. However this is the German system of VET. Apprentices are not trained for a company or a specific branch.

Knowledge and awareness of the target group about environmental issues of the steel industry have to be improved. Because there was no awareness, no interest and motivation before the training, engagement and motivation was increased by the trainers and the concept of the training module (interesting tasks and own activities of the trainees).

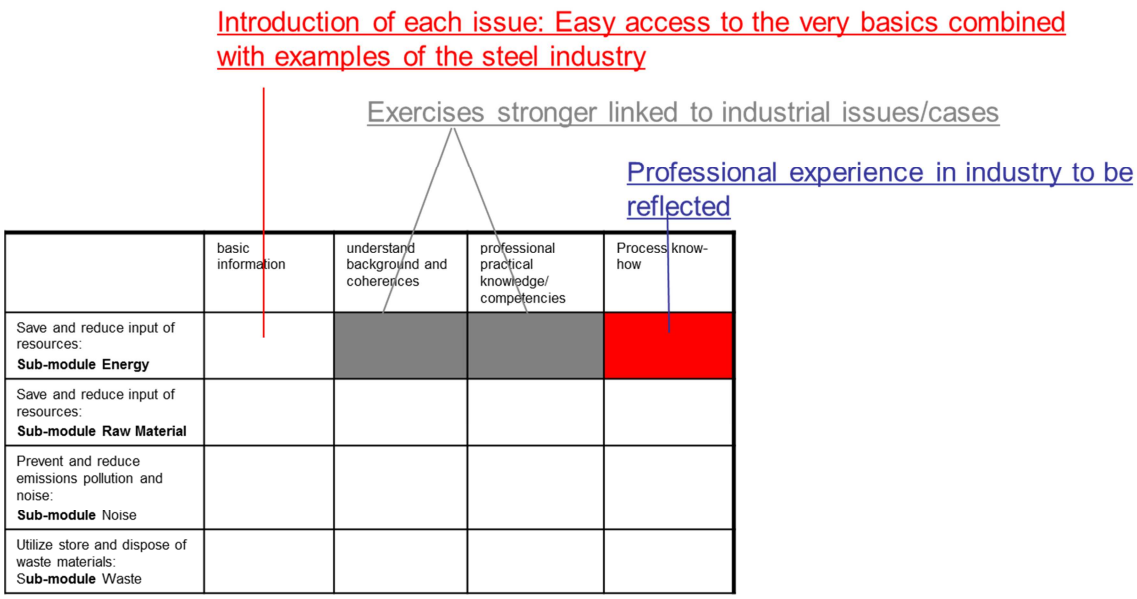
The way teaching took place was relevant to improve awareness for green skills:

- Theoretical inputs (small) and extensive self-organised learning, group and project work, fostering key qualifications, ability to critically check existing situations, planning and management of project, presentations
- Focus on the workplace experience, implications.
- Own responsibility, own project planning and conducting.
- Improvement of context knowledge, comprehensive approach for learning and training, generic understanding, identification of parameters for change.



The subsequent concept of the learning levels and the related increasing perspective of the workplace is a relevant aspect of improving awareness for green skills:

1. easy start, increasing demands, challenges: basic information (level 1)
2. deepening background (level 2)
3. practical implications (level 3)
4. relevance for production process (level 4).



Level 4 was created in a way that trainees learned much more about the workplace and the related production process and a win-win situation with the management and the workers of the production site was produced by getting a new perspective on existing structures through de-constructing and analysing existing processes.

The sub-module “energy” and its learning methods fit to the other learning contents, methods and phases of the general training program:

- of the company: to be implemented in the regular apprentices program of the site
- and the vocational school: to be used for the education of other technicians and production industries.

The sub-module “Energy” could be easily connected to the other sub-modules of GT VET as well (waste could be used for energy production, noise reduction through energy reduction, etc.).

The following description of the training units are following the distinction of the four levels, first showing the actual unit within the whole training program and giving on overview of the learning contents and didactics. Then specific tasks are described.

Overview Sub-module Energy

	L.1: Basic information	L.2: understand background and coherences	L.3:professional practical knowledge/ competencies	L.4: process know-how
Title of the training unit	Forms and sources of energy	Energy sources, efficiency and saving	Calculate and measure energy consumption in a defined area and justify an economic solution	Saving energy at your workplace
Learning outcome	The apprentices/pupils distinguish between different forms of energy, esp. renewable and non-renewable sources, can explain their efficiency independently with a variety of presentation media	The trainees know different levels of energy and sort them to energy sources as well as they know possibilities to save energy	Apprentices could build a laboratory situation to measure several kinds of light, their energy consumption, their costs and the efficient way to use them. They could calculate capacity, efficiency and cost for a specific energy solution.	The apprentices / pupils could check possibilities to save energy at their workplace.
Background information required	No information required	Basic understanding of energy sources	Knowledge how to calculate and measure electricity.	Data sheets, company directives, practical industry experience
Approximate duration	90 minutes	90 minutes	3 Days	Depending on duration of internship/employment
Target group profiles	Pupils / starting apprentices	Apprentices	Apprentices	Professionals, professional apprentices
Learning process (didactical procedure)	Brainstorming, group discussion, group-work, individual work, own presentations	Raising awareness of use and saving energy	Complete work order: plan, realize, evaluate a project	Presentation reflecting industrial experience

Content and Didactical Measures

Level	Content	Didactical measures
L.1.	Definition of energy, energy conversion (with examples), sources of energy, renewable and non renewable energies, efficiency	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, conclude agreements, team work, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, results presentation 4. **Exercises**: look up, work out, explain and present main notions; match the energy sources to pictures; what is energy conversion for you
L.2.	Different forms of energy and distinction of them, renewable and non renewable energies	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, conclude agreements, team work, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, results presentation 4. **Exercises**: sorting levels of energy to energy sources; look up, work out, explain and present which energy sources are used where and for what purpose; saving resources – responsibility of trainees, politics, society and company
L.3.	Calculations of power, efficiency and costs	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, implementation of the task, conclude agreements, team work, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, results presentation 4. **Exercises**: housing lighting installation with regard to the most economic solution (electrical technicians); optimize a hydraulic system with a pressure-controlled vane-type pump (mechanical technicians)
L.4.	Experience-related competences, examples of energy savings in the plant	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, conclude agreements, to deliver and present information 3. **Methods**: tutor presentation; tutor led discussion, individual work, results presentation 4. **Exercises**: completing the form

L4. Examples and strategies where energy is saved and could be saved at the workplace (working area) have to be examined and presented. A worksheet helps to structure and prepare the presentation.

Energy Level 1: Basic Information

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Curriculum / Course Instruction (Overview Level1)

Use of energy, reducing and saving

Level 1:	**Basic information**
Level 2:	**Understand background and coherence**
Level 3:	**Professional practical knowlegde**
Level 4:	**Process know-how**

Topic: **Level 1: Basic information**
Target audience: Apprentices 1st year / pupils class 11 (16-20 years old) without prior knowledge (16 people)

Learning outcome: The apprentices/ pupils could work out the different forms of energy, can appoint and distinguish energy sources /forms and explain their efficiency independently on the basis of a variety of media.
Time: 90 minutes

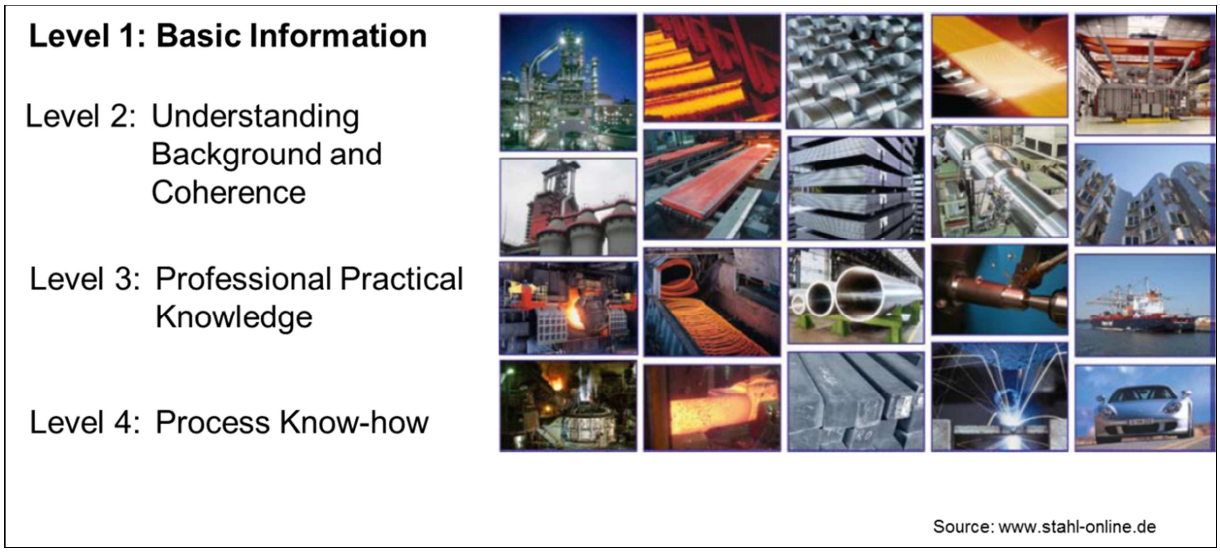
Trainer Input	Expected behaviour of participants	Purpose of content	Method	Media	Time	Remarks / notes
Welcome	Listening	Stimulate attention	Presentation	ppt: slide L1/1, L1/2 Welcome & energy	10 Min.	Booking room, place chairs, provide materials
Introduce topic: Use of energy, reducing and saving Exercise: What is energy conversion for you?	Active participation	To activate, to motivate, to give cause for considerations, to check knowlegde	Tutor led discussion	ppt: slide L1/3 energy conversion	15 Min.	Writing answers onto the interactive WB
Exercise: Look up, work out, explain and present Question: Designate, distinguish energy sources / forms, declare efficiency 4 groups of 4 trainees	Looking up, collecting and filtering information, conclude agreements	Concentration, thinking Dealing with media	Exercise: Group work of 4 trainees	ppt: slide 1/4 technical book, technical data manual, Intranet, Internet	30 Min.	different working rooms, at least 4 technical data manuals, 4 technical books, 4 connected computers, 4 pin boards, 4 media kit
Presentation on pin board	Presenting	Practice of public speaking	Group work of 4 traininees or individual work	4 pin boards, 4 media kit	4x5 Min. ⇕ 20 Min.	Prepare room for presentation: darken the room
Summarize the results, distribute handouts	Listening	Deepening of knowledge	Presentation	ppt: slide 1/5	15 Min.	Distribute handouts

Methods: P => Presentation
TD => Trainer led discussion
IW => Individual work
GW => Group work

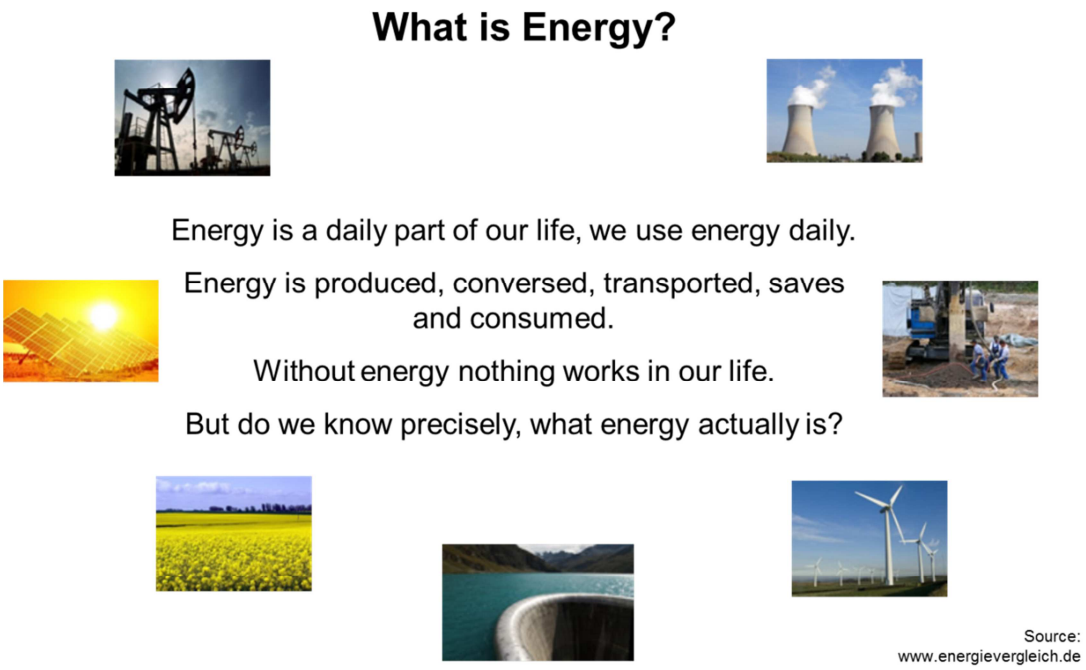
ppt => Powerpoint Präsentation -> Use of energy, reducing and saving
WB => Whiteboard

Slides/Exercises (Level 1)

Slide L1/1: Welcome



Slide L1/2: What is Energy?



Slide L1/3: Energy conversion

Energy conversion

The different forms of energy could be conversed in each other, without changing the amount of energy. Within this process the degree of efficiency during the conversion has to be 100%.

Energy could not be generated but conversed.

Example:

Motor = electric/chemical energy is conversed in kinetic energy

Generator = kinetic energy is conversed in electric energy

Battery = electric energy is conversed in electric energy

Immersion heater = electric energy is conversed in thermal energy

Thermal element = thermal energy is conversed in electric energy

Brake = kinetic energy is conversed in thermal energy

Slide L1/4: Energy Sources, Conversion and Efficiency (exercise, group work)

Look up, work out, explain and present

- What sources of energy do you know?
- What is the difference between renewable and not renewable energies?
- Explain the law of conversation of energy by using examples?
- What is the meaning of efficiency in this context?

Slide L1/5: Energy Sources (questionnaire, individual work)

Match the energy sources to pictures

1 fossil fuels

2 nuclear power

3 water energy

4 solar energy

5 wind energy

6 bioenergy

7 geothermics

Source:
www.energievergleich.de

Energy Level 2: Understand background and coherences

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Curriculum / Course Instruction (Overview Level 2)

Use of energy, reducing and saving

Level 1:	**Basic information**
Level 2:	**Understand background and coherence**
Level 3:	**Professional practical knowlegde**
Level 4:	**Process know-how**

Topic: **Level 2: Understand background and coherence**
Target audience: Apprentices 1st year / pupils class 11 (16-20 years old) some prior knowledge (16 people)

Learning outcome: The apprentices / pupils work out different levels of energy and sort them to energy sources independently taking into consideration a variety of media.
Time: 90 min.

Trainer Input	expected behaviour of participants	Purpose of content	Method	Media	Time	Remarks / notes
Welcome	Listening	Stimulate attention	Presentation	ppt: slide 2/1	10 Min.	Booking of room, place chairs, provide materials
Feedback previous topic: Basic information New topic: Exercise: Sorting levels of energy to energy sources.	Active participation	To activate, to motivate, to give cause for considerations, to controll knowlegde	Tutor led discussion	ppt: slide 2/2, 2/3, 2/4	10 Min.	Writing answers onto the interactive whiteboard (WB)
Exercise: Look up, work out, explain Question: Which energy sources are used where and for what purpose? Saving resources, Responsibility politics, society, company 4 groups of 4	Looking up, collecting and filtering information, conclude agreements	Concentration, considering Dealing with media	Exercise: Group work of 4 trainees	Intranet, Internet, www. Energievergleich. de www.Bine.Info/…	30 Min.	different working rooms, 4 connected computers, 4 pin boards, 4 media kit
Presentation	Presenting	Practice of public speaking	Group work of 4 trainees	4 pin boards, 4 media kit	30 Min.	Prepare room for presentation: darken the room
Summarize the results, distribute handouts	Listening	Deepen of knowledge	Presentation	ppt: slide 2/5, 2/6	10 Min.	Distribute handouts

Methods: P => Presentation
TD => Trainer led discussion
IW => Individual work
GW => Group work

ppt => Powerpoint Präsentation -> Use of energy, reducing and saving
WB => Whiteboard

Slides/Exercises (Level 2)

Slide L2/1: Welcome

Level 1: Basic Information

Level 2: Understanding Background and Coherence

Level 3: Professional Practical Knowledge

Level 4: Process Know-how

Source: www.stahl-online.de

Slide L2/2: Energy Levels

Energy is existing in different forms and there are different possibilities to its distinction.

One possibility is to differentiate the following three energy levels.

1. Primary energy:

- Raw energy like sun, wind, wood, etc.

2. Technical energy:

- Processed energy like electricity, fuel, steam, etc.

3. Effective energy:

- Useful energy like light, transport, heat, etc.

Within and in between the different energy forms there are natural and technical ways of energy conversion**.**

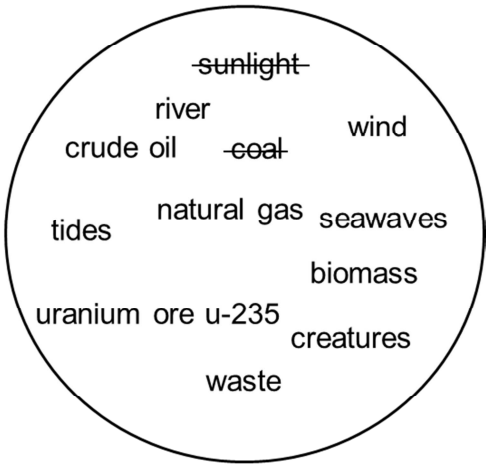
Source: www.energie.ch/energieformen

Slide L2/3: Primary energy (questionnaire, individual work)

Energy sources can be divided in renewable and non-renewable ones.

Please match the energy sources!

not renewable energy sources	renewable energy sources
coal …	sunlight …



Slide L2/4: Technical and Effective Energy

Technical energy

Technical energy is the kind of energy after the conversion from primary to effective or useful energy, e.g. from crude oil to gasoline.

- This conversion is mostly done by industry.

Effective energy

Effective or useful energy is the kind of energy that is used by the end-consumer.

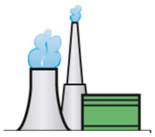
- This could be heat, electricity, light but also transport energy (kinetic energy).

Slide L2/5: Usage of Different Energy Sources (group work)

Where and for what reason do we use the different energy sources?

Energy sources are used for …?

Household



Power station

steelworks

Traffic

natural gas - heating …	water – energy …	coke - heat …	gas - motion …

Present your results!

Slide L2/6: Usage of Different Energy Sources (group work)

Group Work:

Please present your results and give examples for each question!

How can you safe energy in your private life?

What can politics do to save energy?

What can society do to save energy?

What can your company do to save energy?

Energy Level 3: Professional practical knowledge

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Curriculum / Course Instruction (Overview Level 3)

Use of energy, reducing and saving

Level 1:	**Basic information**
Level 2:	**Understand background and coherence**
Level 3:	**Professional practical knowlegde**
Level 4:	**Process know-how**

Topic: **Level 3: Professional practical knowlegde**
Target audience: Apprentices ET 1st year / pupils cl. 11 (16-20 years old) good knowledge (16 people)

Learning outcome: The apprentices / pupils work out the different light sources using the example of a housing lightning installation taking into consideration the most econimic solution.
Time: 22 h

Trainer Input	expected behaviour of participants	Purpose of content	Method	Media	Time	Remarks / notes
Welcome	Listening	Stimulate attention	Presentation	ppt: slide 3/1 Introduction of topic	10 Min.	Booking room, place chairs, provide materials
Feedback previous topic: Understand background and coherence New topic: Different tasks for electrical and mechanical trainees: Housing lightning installation Optimize a hydraulic system	Active participation	To activate, to motivate, to give cause for thought, to controll knowlegde	Tutor led discussion	ppt: slide 3/2, 3/3 slide 3/4, 3/5 task	25 Min.	Writing answers onto the interactive Whiteboard (WB)
Task: **Electric Technicians:** Housing lightning installation with regard to the most economic solution. **Mechanical Technicians:** Optimize a hydraulic system with a pressure-controlled vane-type pump. 4 groups of 4 trainees Implementation	Looking up, collecting and filtering information, implementation of the task, hand over conversation, conclude agreements	Concentration, planning, organisation, retrieve knowledge Dealing with technical and functional specifications Practice of public speaking	Group work of 4 trainees	Technical book, technical data manual, Internet, Intranet selfmade materials racks, tools and instruments	Information: 3 h. Planning: 4 h Implementation: 11 h control: 3 h	Prepare room for handing over conversation, Planning a plant for task implementation different working rooms, min. 4 technical data manuals, 4 technical books, 4 connected pc, 4 pin boards, 4 media kit
Summarize the results, distribute handouts	Presenting / Listening	Deepen of knowledge	Presentation	ppt: slide 3/3, 3/5	25 Min.	Prepare handouts & assessments

Methods: P => Presentation
TD => Trainer led discussion
IW => Individual work
GW => Group work

ppt => Powerpoint Präsentation -> Use of energy, reducing and saving
WB => Whiteboard

Slides/Exercises (Level 3)

Slide L3/1: Welcome

Level 1: Basic Information

Level 2: Understanding Background and Coherence

Level 3: Professional Practical Knowledge

Level 4: Process Know-how

Source: www.stahl-online.de

Slide L3/2:
Power Calculation, Efficiency and Costs (Electrical Technician Apprentices)

Power Calculation, Efficiency and Costs (Electrical Technician Apprentices)

In a workshop/laboratory experiment, create the lighting for a living area (see the work assignment, slide L3/3).

Calculate and measure through the useof different sources of illumination - e.g.:

bulb, fluorescent lamp, energy-saving lamp)

the values required for determining the power, efficiency and costs.

Taking energy saving and operating costs into consideration, which is the most economical solution?

Slide L3/3:
Work assignment: lighting installation for a living area
(Electrical Technician Apprentices)

Work assignment (2):
lighting installation for a living area
(Electrical Technician Apprentices)

In a living area measuring 4 x 5 metres, a two-way connection with 5 lighting outlets is to be installed. For this, there are 3 junction boxes, 2 switches and 1 lamp available (simulation of the 5 lighting outlets). This circuit is to be simulated on a grid sheet. This is to be produced in accordance with the relevant regulations. All safety devices must be prepared independently.

This assignment is individual work planned by a group.

The frames must be of a standardised structure.

Furthermore, they should alternately use a **light bulb, a fluorescent lamp, an energy saving lamp, halogen lamp and an LED lamp.**

On the basis of a current measurement, a power calculation, a lighting calculation and a specification of costs, please determine the savings potential of the respective source of illumination.

The necessary documents for this system are to be compiled independently.

The maximum time allowed for this work assignment is 3 working days, i.e. 21 hours.

The results are then to be presented.

Slide L3/4:
Work Assignment: Power Calculation, Efficiency and Costs
(Mechanical Technician Apprentices)

Work assignment:
Power Calculation, Efficiency and Costs
(Mechanical Technician Apprentices)

Optimise a hydraulic system with a pressure-controlled vane-type pump

In a workshop experiment, optimise the volume flow supply of a hydraulic system (see the work assignment of slide 3/5).

Perform calculations and measurements for different system situations.

Identify the required values for the determination of:

power, efficiency and costs.

Taking energy saving and operating costs into consideration, which is the most economical solution?

Slide L3/5:
Work Assignment: Power Calculation, Efficiency and Costs
(Mechanical Technician Apprentices) (doppelt mit L3/4?

Work assignment:
Power Calculation, Efficiency and Costs
(Mechanical Technician Apprentices)

Optimise a hydraulic system with a pressure-controlled vane-type pump

Determine the actual effective power of the hydraulic system on the basis of a current measurement, volume flow measurement and a pressure measurement.

Perform measurements before and after optimisation.

Provide proof mathematically.

The necessary documents for this system are to be compiled independently.

The maximum time allowed for this work assignment is 2 working days, i.e. 16 hours. The results are then to be presented.

Energy Level 4: Process Know-how

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Description of the Training Unit "Process Know-how"

Title of the training unit	Saving energy at your workplace
Learning outcome	The apprentices / pupils could check possibilities to save energy at their workplace.
Background information required	Data sheets, company directives, practical industry experience
Approximate duration	Depending on duration of internship/employment. Within this example: about 4 weeks
Target group profiles	Professionals, professional apprentices
Required materials	Worksheet
Learning Process (didactical procedure)	Presentation reflecting industrial experience
Clear description of the unit/exercise for learners	Examples and strategies where energy is saved and could be saved at the workplace (working area) have to be examined and presented. A worksheet helps to structure and prepare the presentation.

Curriculum / Course Instruction (Overview Level 4)

Use of energy, reducing and saving						
Level 1:	**Basic information**					
Level 2:	**Understand background and coherence**					
Level 3:	**Professional practical knowlegde**					
Level 4:	**Process know-how**					

Topic: **Level 4: Process know-how**
Target audience: Apprentices 1st year / pupils class 11 (16-20 years old) very good knowledge (16 people)

Learning outcome: The apprentices / pupils work out the inexhaustible "energy source" and transfer the process of saving energy and resouces by a sensitive, self-responsible acting into the outdoor oerations.
Time: 4 weeks (5 days - 1-2 vocational school) ==> approx. 15 days

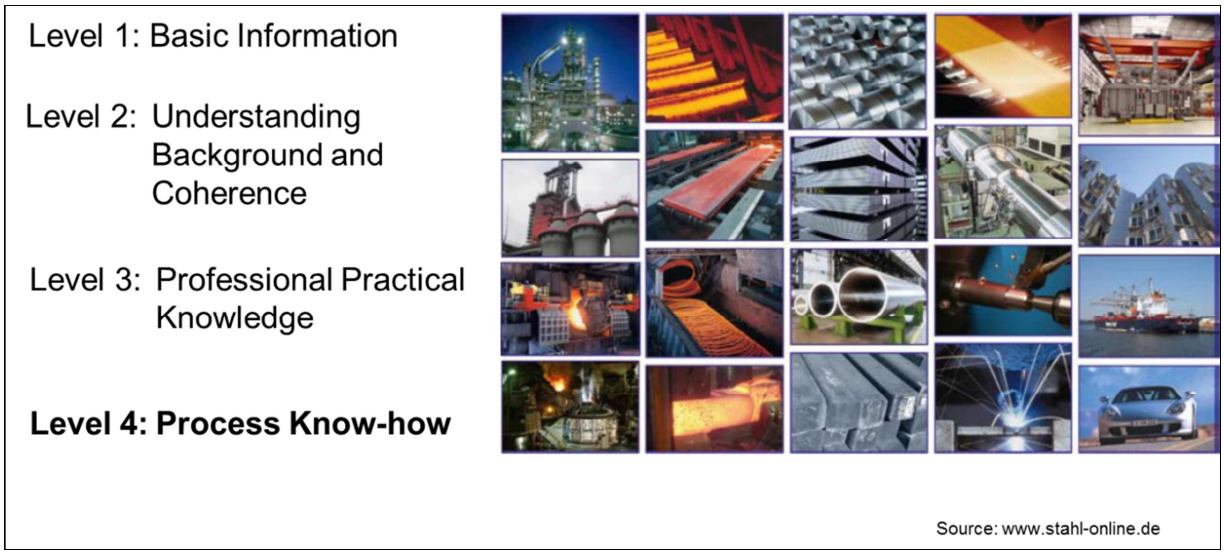
Trainer Input	expected behaviour of participants	Purpose of content	Method	Media	Time	Remarks / notes
Welcome	Listening	Stimulate attention	Presentation	ppt: slide 4/1 Welcome	5 Min.	Booking room, place chairs, provide materials
Feedback previous topic: experience-related competences Comment: inexhaustible "energy source"	Active participation	To activate, to motivate, to give cause for considerations, to check knowlegde	Presentation	ppt: slide 4/2 Energy	10 Min.	Writing answers onto the interactive Whiteborad (WB)
Introduction and preparation in and for the outdoor operation (Introduction and safety instructions)						
Task: Potential of savinf energy in the plant Task exploration phase: Examples of energy savings in the plant.	To collect and filter information, to conclude agreements, to deliver and present informations	Concentration, considering, sensitize / raise awareness Dealing with media	Realisation of the task	Technical book, Technical data manual, Intranet, Internet, colleagues in the plant	4 weeks	Outdoor operation
Presentation	Presenting	Practice of public speaking	Individual Work	selfmade ppt with pictures and concrete examples of saving resources	16x 10 Min. ⇕ 3 h	Prepare room for presentation: darken the room
Summarize the results, evaluation of results, distribute handouts	Listening	Deepen of knowledge	Presentation	Collecting information	15 Min.	Prepare handouts & assessments

Methods: P => Presentation
TD => Trainer led discussion
IW => Individual work
GW => Group work

ppt => Powerpoint Präsentation -> Use of energy, reducing and saving
WB => Whiteboard

Slides/Exercises (Level 4)

Slide L4/1: Welcome



Slide L4/2: Check list to reflect work experience

Check list to reflect work experience

Working area:	

Measures/activities to fulfil environmental protection in specific working area

1.
2.
3.
4.

Ask your colleagues and supervisor!

GTVET major tasks

Save and reduce resources	Prevent and reduce emissions, pollution and noise	Utilize, store and waste of materials
□	□	□

Sub-theme (e.g. Energy, Raw Materials, Noise, Waste):

Contact person:		Essential functions?
Environmental protection officer	□	
Safety protection officer	□	
Hazardous substance officer	□	
Radiation protection officer	□	
...	□	

Get in contact with relevant contact persons of the company!

Professional Knowledge required to perform "green" activities/work (e.g. work directives, operating instructions)

Professional Knowledge	*Content of work*

Identify relevant work directives, operating instructions and required knowledge!

5.1.3 Learning Unit: Raw Materials

The sub-module “Raw Material” was developed by AST within a new greening technical VET training programme of the company. Its general goal is to strengthen the environmental awareness of employees (from apprentices to middle managers) and to widen their horizons with new suggestions. The Green Skills Training Program was a new issue in the company’s training plans and had been designed and delivered with reference to the participation of the company in the GT VET project. In AST, it is possible to say that ecological awareness is quite well known, thanks to the presence of a corporate function complying with national and European environmental legislation. Environmental awareness, however, is mostly found amongst those people who work on plants subject to the law, or with those who pursue it for personal conviction or because they emulate a virtuous behaviour of their leaders.

The training course had the advantage of making clear the attention that the company pays on ecological issues which have now become a specific goal that the company intends to pursue by developing new technologies and specific training courses. The first version of the GT VET sub-module was not only addressed to blue collar workers but (due to the decision of the company) also to engineers and the middle management (mainly level 3 and 4). It was therefore quite theoretical with only a few practical exercises. At the end of each level, except for the one dedicated to the „Process Know-how“, a final learning test was foreseen.

This decision was made because the AST workforce, nowadays, has a low number of apprentices and, in most of the situations, they are not included in maintenance activities; because of this, it was not possible to fully comply with the established project‘s initial target groups. Therefore, AST has chosen a higher qualified target group level than the supposed electrical and mechanical technicians:

- Workers and employees of the production areas whose activities impact on the environment, and who have responsibility for the job training of other operators,
- Employees of the production and staff functions who are responsible for the choices and the study of new technologies and methods that can be able to suggest new plans and new technologies,
- Personnel with decision-making skills and responsibilities, who have the abilities to evaluate the selection of new technologies.

The company’s experts and external consultants coming from the most important research centres (CSM; Tenova Group) have contributed to the delivery of the training courses.

General objective of the sub-module was to develop and strengthen the awareness of the impact of a steel company on the environment, and how to limit this impact through the levers of principal business processes.

The concrete objective for the Raw Materials sub-module was to get a general idea of the steel production stages which have a greater environmental impact and to help saving and reusing raw materials.

LEVEL	GOALS	TARGET GROUPS
Basic Information: Steel production cycle The raw materials used Products and re-use The melting of scrap	Propose initial suggestions for the creation of environmental awareness such that, in a possible introduction inside the company, young people can already count on a shared vocabulary with operators and on a culture that has equal foundation.	Technical industrial students blue collar workers involved in maintenance process
Understanding background and coherences: Main description of electric furnace production process Raw material's description Intelligent use of by-product to limit harm to the environment	To develop and to strengthen the awareness of the impact of a steel company on the environment, and how to limit this impact through the levers of the principal business processes.	White collars involved in maintenance process: Shift Foremen
Professional Practical knowledge Competencies: Correct behavior for the reduction of raw material consumption	To get stronger knowledge about the acquisition on the use of criteria for the evaluation of new technologies; evaluation of the impact of their implementation in the company and proposal of new solutions. To suggest and encourage a correct behavior through the knowledge of new technologies in the fields of energy and waste.	White collars employed in departments where techniques and new technologies are studied and evaluated
Process Know – how: best available technologies	Knowledge of the new technological frontiers and possible future scenarios. Process lines and finishing strips: environment as a target for the evolution of technologies.	Middle management authorised to take decision on new technologies.

After the cross-national tests of this sub-module - saying that the module is too theoretical and ambitious for the defined target group of electronic/electric and mechanical technicians - the GT VET consortium decided to modify the developed module in a more mainstreaming way. However, it was not possible to develop the sub-module anew, the final sub-module "Raw Material" is still more theoretical than the others, but heavily improved by more practical tasks and tests. It is about the sustainable usage of raw materials in the steel industry, focused on the handling of scrap and slag and, above all, its recycling in order to reduce the environmental impact. The optimised use of raw materials for the production of stainless steel is explained at the **Electric-Arc Furnace (EAF)** process of Acciai Speciali Terni (AST). A close relation to the sub-module "Waste" and the European Waste Directive (1975, Nr. 442) has to be mentioned.

Objective of this sub-module is to show how an optimised use of raw materials could be a basic condition for the steelmaking process to be both cost-efficient and eco-friendly.

On level 1 the reduction of environmental impact in the steel production and the role of raw materials and energy are described. Level 2 illustrates the stainless steel production with the EAF process and the use and reuse of scrap. The use and reuse of steelmaking byproducts (mainly slag) and scrap and life cycle aspects are the main topic of level 3, level 4 is dedicated to the analysis of the learners of the identification and the use and reuse of raw materials in the production process of the company subjects.

Overview Sub-module Raw Materials

	L.1: Basic information	L.2: understand background and coherences	L.3:professional practical knowledge/ competencies	L.4: process know-how
Title of the training unit	Raw Materials in the Steel Production	Steel Production Process (in relation to raw materials reuse)	Steel Production Process (in relation to raw materials reuse)	Identification of raw materials and their reuse
Learning outcome	Initial understanding of raw material and its usage in the production process	Knowing how electric furnace production process works and raw materials are used within this process	Knowing how slag and scrape is (re)used in the production process, describing a life cycle of raw material	Be familiar with production cycle in the steel plant, ability to the (re-)use of raw material in the company
Background information required	No information required	Information from L.1.	Information from L.2.	Information from L.3.
Approximate duration	90 minutes	90 minutes	2 days	5-15 days depending on the complexity
Target group profiles	Students or apprentices with vocational school degree and no work experience	Professional degree, max. two years of practice in the company	Professional degree, max. two years of practice in the company	Professional degree, more than two years of practice in the company
Learning process (didactical procedure)	Lecture, group discussion exercises, test	Lecture, group discussion / work, test	Group/team work, undertaking a given task	Conducting an on project analysing the production process in the company under the perspective of the use and reuse of raw material

Content and Didactical Measures

Level	Content	Didactical measures
L.1.	Raw Materials in the Steel Production	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, conclude agreements, team work, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, results presentation 4. **Exercises**: look up, work out, explain and present main notions; what are raw materials, listing raw materials;
L.2.	Steel Production Process (in relation to raw materials reuse)	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, conclude agreements, team work, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, results presentation 4. **Exercises**: look up, work out, explain and present which raw materials are used where and for what purpose; saving resources – raw materials
L.3.	Steel Production Process (in relation to raw materials reuse)	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, implementation of the task, conclude agreements, team work, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team work, results presentation 4. **Exercises**: Raw materials and their life cycle: the hammer tool example
L.4.	Identification of raw materials and their reuse in the workplace	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises, looking up, collecting and filtering information, conclude agreements, to deliver and present information 3. **Methods**: tutor presentation; tutor led discussion, individual work, results presentation 4. **Exercises**: completing the form, checklist

Raw Material Level 1 - Basic Information: Raw Materials in the Steel Production

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Steel Companies and Environment

Steel Companies are often located in the city centre because - starting from the end of the XIX century - cities developed around the industrial areas (e.g. AST in Terni, Italy).

In general and for this reason it is the duty of steel companies, also from the ethical point of view, to take care of the environment and also of the permitted obligations.

Reducing the environmental impact of steel making is therefore the most important economic, social and ecological task of the steel industry.

Energy and raw material efficiency are also relevant because of its high volume used within the steel making process. Resource efficiency could be reached by two ways:

Acciai Speciali Terni (placed within the city centre of Terni)

1. Optimizing the usage of resources for steel making
2. Optimizing the steel production and usage.

Because of complicated and limited possibilities for further improving the production process, the main attention is paid to an optimisation of the usage of raw material.

REDUCING THE ENVIRONMENTAL IMPACT OF STEELMAKING

Reducing the environmental impact of the steelmaking process cannot only be limited to a passive end-of-pipe control of emissions (off-gases, dusts etc.).

Environmental impact can be reduced more efficiently through the prevention of atmospheric emissions with an optimized use of resources, including raw materials and energy.

Actually, an optimized usage of raw materials is a basic condition for the steelmaking process to be both costs efficient and eco-friendly.

Minimizing the consumption of resources as a function of the regenerating capacity of the planet is therefore the most important requisite for a sustainable development that is also respectful of our future generations.

Steelmaking resources are best preserved when:

- the use of raw materials for steelmaking provides the highest possible yield
- the reactors used are those that best suit the individual process steps
- reactors are operated as efficiently as possible
- energy is delivered only when necessary
- both raw materials and the amount of energy that is inevitably dispersed can be recovered.

In relation to the economic production requirements, the environmental impact of the production process is reduced to its minimum by …

- An integrated power system
- Water circulation system
- Reducement and reuse of „waste“, raw materials.

PRIMARY AND SECONDARY RAW MATERIAL

primary raw material (examples):

- Water
- Iron ore
- Coal
- Crude oil

secondary raw material (examples):

- scrap (usable waste of ferrous metals)
- spent lubricants;
- rejected material from components;
- discontinued articles made of polyethylene;
- and worn out tire treads,
- spent sulfuric acid,
- and waste paper.

Secondary raw material also includes machines, equipment, and their components that have fallen out of service because of wear; metal parts obtained in the demolition of buildings and

old ships; ferrous and nonferrous metals contained in everyday articles and articles of general consumption unfit for use; and end waste products of production that constitute an irrevocable loss for a given enterprise (for example, ashes in electrical power plants).

Most important for the national economy, both in terms of the magnitude of the resource and its value, are the various secondary metals that are formed in the shape of depreciated scrap and industrial waste.

(Source: http://encyclopedia2.thefreedictionary.com/Secondary+Raw+Material">Secondary Raw Material)

Main raw material in the steel production

- Iron ore
- Coke
- Scrap
- Slag
- Oxygen
- Scorifyers/Flux (minerals used to collect impurities during iron and steelmaking, e.g. limestone and dolomite).

However: Steel itself is a 100% recyclable raw material.

"Scrap" as a steel based raw material and "Slag" as a byproduct of the steel production process are examples of raw material in the stainless steel production. Scrap and slag could be seen as "waste" or "raw materials".

RAW MATERIALS FOR STAINLESS STEEL PRODUCTION

Raw materials (and energy) are the most common resources for stainless steel production.

These resources can be roughly divided into four categories:

- Scrap (of stainless and carbon steel)
- Scorifyers: limestone, fluorine and (indirectly) magnesic or aluminous refractory materials
- Ferroalloys and alloys (manganese, aluminium and nickel)
- Process gases: oxygen, nitrogen and argon

TEST / QUESTIONS

The following questions should be answered in group work.
The results have to be presented to the whole class.

QUESTION/GROUP WORK (1)

1. Which are the environmental impacts of your steel company for the region nearby?
   Look up, work out, explain and present main notions.

2. What is done by your company to reduce the amount of raw materials?

QUESTION/GROUP WORK (2)

3. What kind of raw materials do you know?
   Used in your private life or in your steel company.
   Please list them up. Try to differentiate in primary and secondary raw material.

Raw Material	Used in private life	Used in our company	Primary raw material	Secondary raw material
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐

QUESTION/GROUP WORK (3)

4. Please have a look at the following advantages of primary and secondary raw materials. Which advantage has to be related to primary or secondary raw materials?

Advantages	Primary raw material	Secondary raw material	Comments
Purity	☐ (x)	☐	_____
Availability	☐ (x)	☐ (x)	_____ (The availability of primary raw materials is reduced more and more (crude oil), secondary raw material use is dependend from its economic profit.)
Price	☐	☐(x)	
Regional availability	☐	☐(x)	_____ (The extraction of primary raw materials concentrated in specific regions of the world, secondary raw material is available and transportable from more reachable different places.)
Process engineering	☐(x)	☐	_____ (For the process integration of secondary raw material there is still more research and development necessary.)
Production process	☐(x)	☐	_____ (For the integration of secondary raw material in the production process more expenditure has to be done (e.g. energy, water).)

Raw Material Level 2 - Understand background and coherences: Raw Materials in the Stainless Steel Production

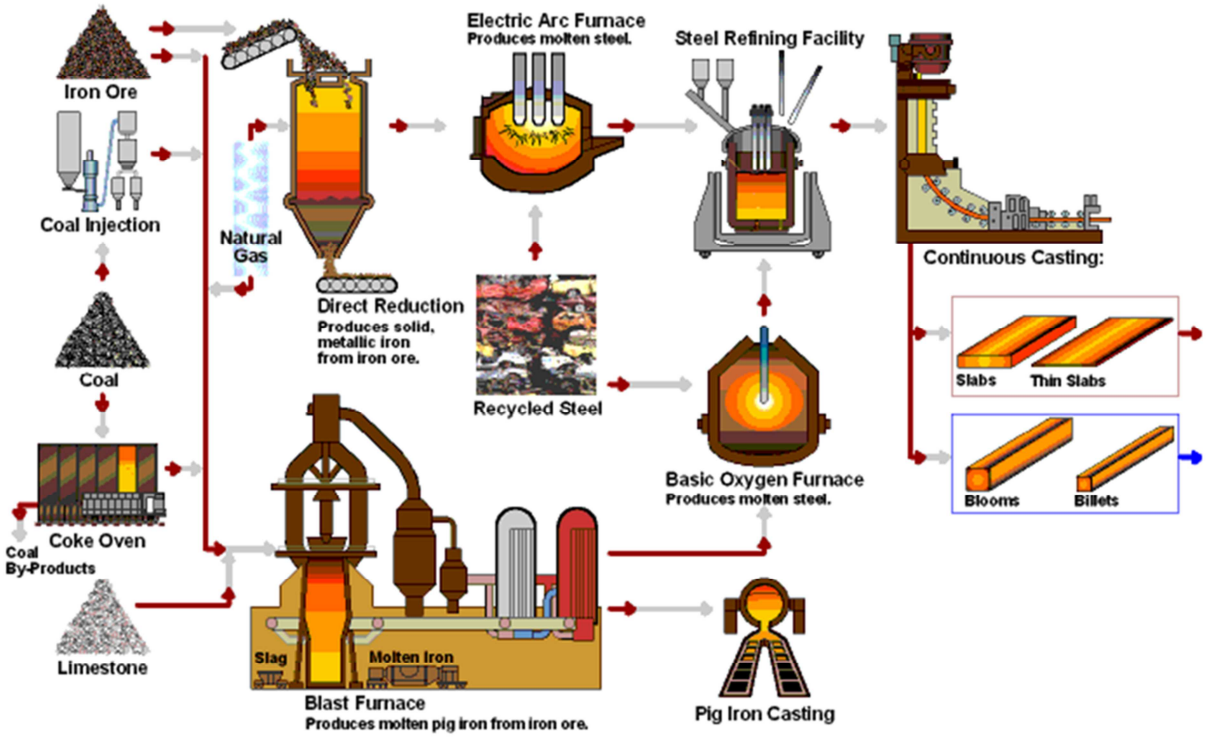
You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

STEEL PRODUCTION CYCLES

Knowing steel processes allows to get a more comprehensive idea of those steps where steel production is most impactful and to avoid any unnecessary dispersion of harmful materials and energy to the environment.

Steel is normally produced in two ways, the **integrated cycle** – which starts from iron ore (oxides and/or sulfides) and the mineral form of alloying elements (oxides and others), which for stainless steel are basically chromium, nickel, titanium and molybdenum – and the **electric-arc furnace cycle**.



Electric-Arc Furnace

The most common production cycle for stainless steel is the electric-arc furnace process.

In this case, the basic raw material is stainless *steel scrap*, which can be added with carbon steel scrap and especially ferroalloys. Ferroalloys are the elements required to obtain the desired steel composition, i.e. Cr, Ni, Mo and Ti, alloyed with iron (Fe). Unalloyed elements are used only in special cases. The role of alloying elements (mainly chromium) is to provide iron, which is the basic component of steel, with corrosion resistance properties.

THE PRODUCTION UNITS OF AN EAF CYCLE

Stainless steel production is based on the following units or shops:

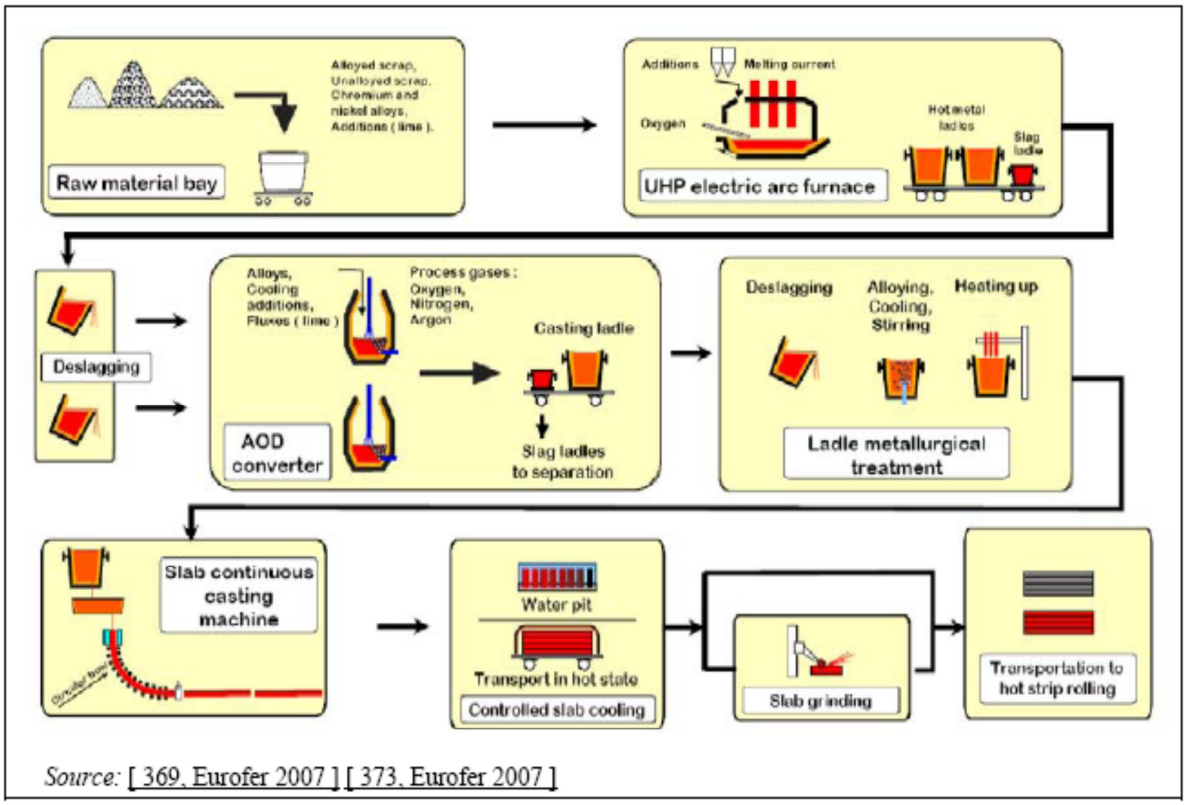
The raw materials yard, including:

- ***the scrap yard*** composed of gathering pits and separation boxes
- ***the ferroalloys yard*** including silos and boxes.

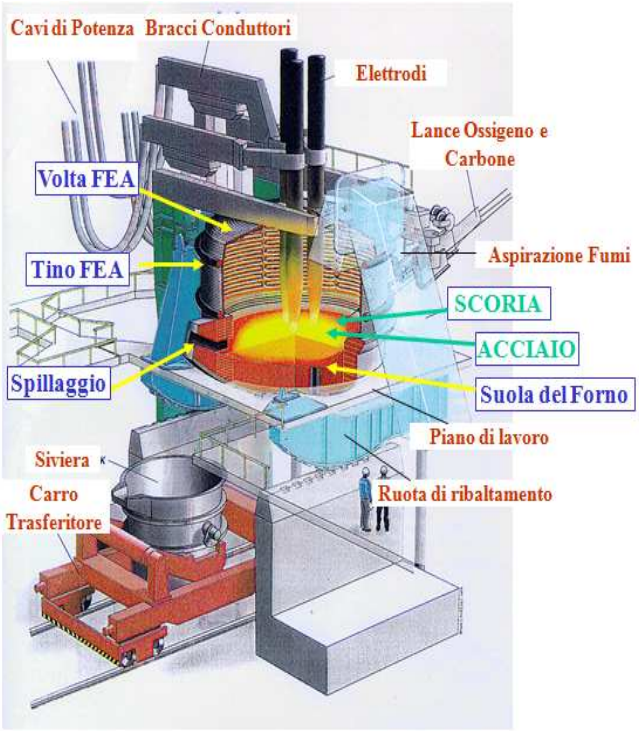
The meltshop, including:

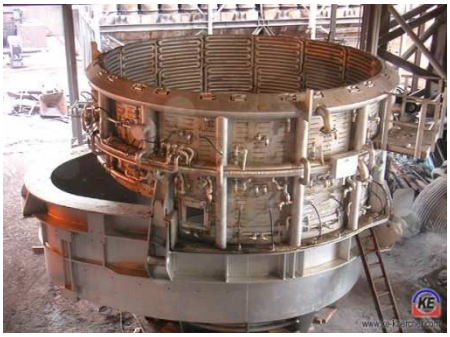
- ***the melting (or primary metallurgy) area:*** where electric-arc furnaces are located
- ***the refining (or secondary metallurgy) area*****:** including reactors such as the **AOD** (Argon Oxygen Decarburization) and/or **VOD** (Vacuum Oxygen Decarburization) for stainless steel refining. Other Ladle Furnace (**LF**) reactors are located downstream these plants.
- **the steel casting and solidifying shop:** steel from the secondary metallurgy area is processed by continuous casters and solidified into slabs, blooms or billets.

The electrical steel production is based on the *use of scrap as basic raw material*.



Electric-Arc Furnace (EAF)





TEST / QUESTIONS

The following questions should be answered in group work by making interviews with the relevant workers or responsibles of the steel company.
Two Groups:

- one group describes and answer from the perspective of **oxygen** steel production process
- another group describes and answer from the perspective of **electric** steel production process.

The results have to be presented to the whole class, the advantages and disadvantages of each production process have to be discussed on the background of the use of raw material.

QUESTION/GROUP WORK (1)

1. In which way is an electric / oxygen steel production process reducing the impact on the environment?

Advantages and Disadvantages of oxygen and electric steel production

Production Process	Advantages	Disadvantages	Comments
Oxygen	_____	_____	_____
Electric	_____	_____	_____

QUESTION/GROUP WORK (2)

2. What kind of raw materials are used in an electric / oxygen steel production process?

Raw materials used in oxygen and electric steel production

Raw material	*Oxygen*	*Electric*	*Comments*
Chromit	☐	☐	_____
Coal	☐	☐	_____
Coke	☐	☐	_____
Iron ore	☐	☐	_____
Nickel	☐	☐	_____
Oxygen	☐	☐	_____
Scrap	☐	☐	_____
Slag	☐	☐	_____
Water	☐	☐	_____
Zinc	☐	☐	_____
	☐	☐	_____
	☐	☐	_____
	☐	☐	_____
	☐	☐	_____
	☐	☐	_____

QUESTION/GROUP WORK (3)

3. What kind of raw materials are used in the steel production of your company? Please make a list and try to rate their portion (in total or in per cent of all used raw materials)?
   (e.g. by visiting the raw materials yard and the melting shop)

Material	Raw Material no	Raw Material yes	Used in the steel industry	Used in our company	Volume, used in the production process (estimated consumption)
Bauxite	☐	☐	☐	☐	_____
Chromite	☐	☐	☐	☐	_____
Coal	☐	☐	☐	☐	_____
Coke	☐	☐	☐	☐	_____
Copper	☐	☐	☐	☐	_____
Crushed rock	☐	☐	☐	☐	_____
Gas	☐	☐	☐	☐	_____
Gold	☐	☐	☐	☐	_____
Iron ore	☐	☐	☐	☐	_____
Nickel	☐	☐	☐	☐	_____
Oxygen	☐	☐	☐	☐	_____
Paper	☐	☐	☐	☐	_____
Plastic	☐	☐	☐	☐	_____
Sand	☐	☐	☐	☐	_____
Scrap	☐	☐	☐	☐	_____
Slag	☐	☐	☐	☐	_____
Steel	☐	☐	☐	☐	_____
Tin	☐	☐	☐	☐	_____
Water	☐	☐	☐	☐	_____
Wood	☐	☐	☐	☐	_____
Zinc	☐	☐	☐	☐	_____

Background information: The main steelmaking raw materials, their properties, and usage in steel and other applications
(Directorate for Science, Technology and Industry – Steel Committee: Steelmaking Raw Materials: Market and Policy Developments 2012, p. 9)

Raw material	Properties in steel	Steel industry's share of use, %	Other applications
Iron ore	Provides the ferrous content in the steel	98%	Metallurgy, medicine, paints
Coking coal	Produces coke, heat source and reducing agent in BF	>80%	Energy generation
Ferrous scrap	Main elements for EAF-steel, combined with iron in BOF to reduce levels of heat	100%	
Manganese	Desulpherises and as alloying element for strength	90%	Batteries
Silicon	Used to de-oxidise steel	60%	Construction materials and glass
Nickel	Anti-corrosion (nickel content in stainless steel 8-10%)	60%	Aerospace and batteries
Chromium	Anti-corrosion (in stainless steel, average content 18%)	75%	Aerospace, iron castings
Zinc	Used to galvanise steel (enhances corrosion resistance)	60%	Die-casting, brass and bronze
Tin	Brings protective coating to steel (food and drink cans)	20%	Solder
Molybdenum	Resistance to heat, corrosion (high-end steel). Brings weldability to steel (construction steel)	60%	Aircraft engine parts, chemicals and alloys
Vanadium	Brings extreme hardness to steel (high-strength steel)	85%	Longer-range electric car batteries
Tungsten	Brings extreme hardness to steel (high-speed steel)	20%	Abrasives, knives and armaments, and in fluorescent lighting

See also: Communicaton papers oft he EU: CCMI/078 Secondary raw materials

Raw Material Level 3: Professional practical knowledge: Scrap and Slag as Raw Materials

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Introduction:

In the following "Scrap" as steel based raw material and "Slag" as a byproduct of the steel production process will be chosen as examples of raw material in the stainless steel production. Scrap and slag could be seen as "waste" or "raw materials".

THE SCRAP RESOURCE

The use of scrap is regulated by international and national rules (see deliverables of work package 2 of GT VET – www.gt-vet.com).

In order to be considered as ***"secondary raw material"*** and not as ***"waste"*** and be subject to disposal, scrap must be conforming to special standards (ECSC, AISI, CAEF, Uni, Euro).

Scrap is classified according to its origin as:

- ***In-house scrap:*** coming from melting, casting and rolling processes in the mill. These materials are never discarded and their chemical properties are known at any moment.
- ***New Scrap:*** coming from steel transforming industries.
- ***Old Scrap:*** composed of collectable scrap from end-of-life items.

SCRAP SEGREGATION

In order to direct scrap to the production of the appropriate steels, it is fundamental to separate and segregate scrap into pits and boxes where it can always be identified, so as to:

- preserve the alloy contents in steel scrap
- use first-melt alloys to a reasonable extent
- make sure that only the elements that are desired in the final product are charged in the steel preparation step.

When a mill produces a varied range of steel types, scrap classification according to alloy contents must be much more careful than for a mill producing one type of steel.

At least 300 scrap categories have been identified for a plant producing several steel grades using the basic process, including alloyed and stainless steels.

SCRAP RECYCLING IN THE EAF AND ENVIRONMENTAL IMPACT REDUCTION

There are more benefits in producing steel with recycled scrap (especially from the EAF) than in using an integrated process based on pure raw materials (iron ore and coal), because less energy and less natural resources are consumed.

Raw Material	Absolute Theoretical Minimum Energy as a Function of Tap Temperature (MJ/t)	
	1813 K	1873 K
Ore (Fe_2O_3)	8,620	8,673
Scrap (Fe)	1,274	1,327

Evidence of the lower environmental impact of scrap recycling is that energy consumption is only 20% of the amount required by the integrated process.

Besides lower energy consumption, the scrap-based cycle emits less greenhouse gases such as CO_2 than the integrated iron-ore cycle.

In addition to CO_2, the scrap-based cycle reduces all the other atmospheric pollutants, either gaseous (NOx, VOC, dioxins and furans) or solid (dusts and heavy metal oxides).

Raw Material	Temperature (degrees K)	Carbon Emissions (kg CO_2/tonne)		
		Fuel = Carbon	Fuel = Natural Gas	Fuel = Electricity
Ore (Fe_2O_3)	1813	960	475	1,494
	1873	966	478	1,503
Scrap (Fe)	1813	142	70	221
	1873	148	73	230

STEEL MELTING BYPRODUCTS ENVIRONMENTAL CONSIDERATIONS

A large amount of solid byproducts arise from steel melting.

They make up 30 to 40% of the steel output from the EAF and approximately the same quantity of the steel produced by the integrated cycle.

The most critical byproduct for the environment is **slag**, especially for the large quantity produced that exceeds 20% by weight (approx. 50% by volume) of the steel output.

With only rare exceptions, slag generation is essential for steel production, because it comes in contact with steel, the refractory lining and the atmosphere inside the reactor (furnace, converter, ladle or tundish).

The role of slag in steelmaking is to catch undesirable elements from the charge or arising in the reactor. Whenever necessary, some slag properties can be modified with the addition of appropriate scorifyers.

From an environmental point of view, slag helps to protect the refractory resource, increase scrap yield, save energy, enhance steel quality and therefore save the steel resource.

REMARKS ON THE SLAG RESOURCE

In agreement with the current regulation, slag can be considered as:

- a “product” (this is the case of blast furnace slag, that is used for cement clinker production);
- a “byproduct”;

- a “waste” which can be subject to an approved recovery process for reuse purposes.

Reuse of slag

Due to its varying composition and mechanical properties, slag can be reused in very different ways. In particular

- **slag from primary metallurgy** can generally be likened to natural effusive rocks of magmatic origin and it is provided with high mechanical strength and durability. Its characteristics are often better than those of pricy effusive inerts such as basalt, diabase and porphyry and it can be applied to road subgrades and the like;
- **slag from secondary metallurgy** is typically composed of dicalcium silicate which has pulverized on cooling down. Its main use depends on its chemical composition and can be an alternative choice to limestone. According to a well-established practice, ladle slag is reused in the electric-arc furnace instead of a typical scorifyer such as limestone.

Recovering metals from fines is much more efficient if fines are compacted (or agglomerated) into briquettes or pellets. This system can help to avoid the exposure of a large surface of fines to off-gases. As the density of agglomerated fines (in briquettes or pellets) may be bigger than that of slag, they can cross the slag layer and reach the underlying molten steel, where they solubilize quickly.

TASK 1:
INTEGRATION OF THE RAW MATERIALS SCRAP AND SLAG IN THE PRODUCTION PROCESS

Group work: Lifecycle of scrap and slag

Please describe where and when in the production process scrap and slag are used and produced? Please try to describe it from the perspective of production process or cycle: from raw material extraction through materials processing, manufacture, distribution, and disposal or recycling.

TASK 2: LIFECYCLE OF RAW MATERIALS: THE HAMMER TOOL

Duration: 45 minutes

Required materials: hammer tool, flipcharts, colour markers

Learning process: Team work

Introduction: A hammer tool is one of the most used “raw” materials, even for electrical and mechanical technicians.

Please define the raw materials of the hammer tool, what does it consists of.
Demonstrate your results in 5 minutes, in relation to the raw materials of the steel production.

By concentration of the origin of the basic elements (wooden handle and metal head) please discuss and present in a graphical slide the life cycle of a hammer.

Eample:

Wooden handle:

tree → cutting down a tree → wood processing → manufacturing the handle according to the project → assembling with other structural elements of hammer → distribution → sale → exploitation → waste formation → waste collection → waste disposal

Metal head:

mining of raw materials → steel production process → manufacturing the steel head according to the project → assembling with other structural elements of hammer → distribution → sale → exploitation → waste formation → waste collection → waste disposal (recycling)

Raw Material Level 4: Process Know-how

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Project: Analysis of raw materials and the re-use in the production process of the company

Please analyse the production cycle in the steel plant: From raw material to finished products to raw material (scrap and slag). Check the production process and the use and reuse of raw material in your company. What kinds of activities are done in your company for saving raw materials (saving resources)? Do you have own suggestions to optimise the use of raw materials?

Operational objective: the employee knows what and in what order the production processes in the steel plant takes place, knows what are the used and reused raw materials and products, and what the impact of the process on environment is.

Presentation: Results on basis of the checklist to the whole class/course.

Check list to reflect work experience

Check list to reflect work experience		
Working area:		
Measures/activities to fulfil environmental protection in specific working area		
1.		
2.		
3.		
4.		
GTVET major tasks		
Save and reduce resources	**Prevent and reduce emissions, pollution and noise**	**Utilize, store and waste of materials**
□	□	□
Sub-theme (e.g. Energy, Raw Materials, Noise, Waste):		
Contact person:		**Essential functions?**
Environmental protection officer	□	
Safety protection officer	□	
Hazardous substance officer	□	
Radiation protection officer	□	
...	□	
Professional Knowledge required to perform "green" activities/work (e.g. work directives, operating instructions)		
Professional Knowledge		***Content of work***

Ask your colleagues and supervisor!

Get in contact with relevant contact persons of the company!

Identify relevant work directives, operating instructions and required knowledge!

5.2 Sub-module 2: Prevent and reduce emissions pollution and noise

Overview Sub-module Noise

	L.1: Basic information	L.2: understand background and coherences	L.3:professional practical knowledge/ competencies	L.4: process know-how
Title of the training unit	What is the noise, key issues	Noise in general - to prevent and reduce	Noise nuisance	Rating industrial noise - practical aspects; acoustic protection and specialized issues of noise in the workplace
Learning outcome	The trainees distinguish between sound and noise, know noise effect and its harmfulness in general	The trainees know fundamentals of acoustic, understand the phenomena of hearing, know damages of hearing and how to protect the hearing	The trainees know the sources of industrial noise, esp. in steel plant, harmfulness of noise, law requirements for noise emissions, application of PPE (personal protective equipment)	The trainees know health and safety requirements for noise, noise measurement methods at workplace, occupational risk assessment, effects of exposure to noise, methods to reduce noise emissions
Background information required	No information required	Information from L.1.	Information from L.2.	Information from L.3.
Approximate duration	45 minutes	45 minutes	45 minutes	45 minutes
Target group profiles	middle school students	students of technical schools	workers admitted to the Company	specialists in the Company
Learning process (didactical procedure)	Lecture, group discussion exercises	Lecture, group discussion exercises	Lecture, group discussion exercises	Lecture, group discussion exercises

Content and Didactical Measures

Level	Content	Didactical measures
L.1.	Concept of sound and noise, noise and its effect on humans, evaluation of sounds: the intensity and an aesthetic feelings, harmfulness of noise, effects of noise	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises and discussions 3. **Methods**: tutor presentation; tutor led discussion, individual work 4. **Exercises**: measuring the noise intensity with sound level gauge , sound examples
L.2.	Fundamentals of acoustics: sound source, acoustic wave; phenomenon of hearing, construction of the ear, damages of hearing, how to protect the hearing, work in noise - impact on productivity and health of employees, acceptable levels of environmental noise	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises and discussions 3. **Methods**: tutor presentation; tutor led discussion, individual work 4. **Exercises**: matching the notion to the correct definition, measuring the noise intensity with sound level gauge, proper recognition of activities serve to protect against noise, searching in Internet some specific law regulations, presentation of PPE (e.g. earmuffs, ear-plugs)
L.3.	Industrial noise, main sources of noise in company, noise reduction. harmfulness of noise, H&S regulations and requirements for noise emissions, PPE - hearing protection and their application, environmental regulations for noise emissions, noise emissions from industrial plants	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises and discussions 3. **Methods**: tutor presentation; tutor led discussion, individual work 4. **Exercises**: test on admissible noise levels, presentation of PPE (e.g. earmuffs, ear-plugs)
L.4.	H&S requirements for noise, noise emission measurements at workplace, occupational risk assessment, effects of exposure to noise, reducing of noise emissions, medical exam	1. **Trainer input**: lecture, lead discussion 2. **Trainee behaviours**: listening, active participation in exercises and discussions 3. **Methods**: tutor presentation; tutor led discussion, individual work 4. **Exercises**: presentation of examples of use measurement devices, test on recognition the administrative and technical methods of noise reducing

Noise Level 1 - Basic Information: What is noise? - Key issues

You are here (actual unit of the training module)

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

SCOPE OF THE TRAINING (Level 1):

1. Concept of sound and noise
2. Noise and its effect on humans
3. Evaluation of sounds: the intensity and an aesthetic feelings
4. Harmfulness of noise
5. Effects of noise

1. CONCEPT OF SOUND AND NOISE

CONCEPT OF SOUND AND NOISE

- Signals from the environment, recorded by hear, are called **sound**s
- **The sounds**, the listening experience, differ not only in volume, height (frequency) and timbre - some are pleasant to the ear, others are not
- Sounds perceived as "undesirable, inconvenient, painful, unpleasant, annoying," usually too loud, are called **noise**
- Sound intensity level is described by the unit called decibel (dB)

The parameters characterizing the sound:

- intensity (loudness) (dB)
  (silent - loud)
- height (frequency)
  (low - high)
- timbre
  (characteristic of the sound source, which allows to distinguish between these sources,
  for example, allows you to recognize people by voice)

2. NOISE AND ITS EFFECT ON HUMANS

Noise levels:

Sound intensity	Effects on humans
0-20 dB	The impression of complete silence
20-35 dB	Noise level not harmful to health but can cause nervousness. Dissipates in activities requiring concentration, such as designing, writing, etc., especially when it takes a long time. This level of noise is caused by e.g. rush of water, dishes or interleaved clink of tools, the sound of the refrigerator or computer.
35-70 dB	The level of noise negatively affects the human nervous system. This causes tiredness and lost of productivity. May reduce the intelligibility of speech and delay sleep and rest.
70-85 dB	Permanent noise levels may cause a reduction in labor productivity, permanent hearing loss, headache, and a negative impact on the human nervous system.
85-130 dB	This level of noise causes hearing damage and various diseases such as cardiovascular disorders, neurological, balance, and others. This prevents speech intelligibility, even from a distance of 0.5 meters.
130-150 dB	It stimulates the vibration of some internal organs of the human body and can even cause the disease or permanent damage. Working in such a noise is associated with a high risk of widespread weakening of hearing, and even its severe and permanent damage.
> 150 dB	The noise of this intensity after 5 minutes completely paralyzes the action of the body, causes nausea and vertigo, unable to perform coordinated movements of limbs, changes the proportions of constituents in the blood. Among those working in such a noise up to 80% can be identified onset of the incurable disease, anxiety and depression and other symptoms of mental illness The noise level above 150 dB occurs: during a firecracker explosion (160 dB), at the start of the spacecraft (190 dB), during explosion of the atomic bomb (220 dB), at Krakatau eruption in Indonesia - probably the loudest sound in the history in the world (350 dB).

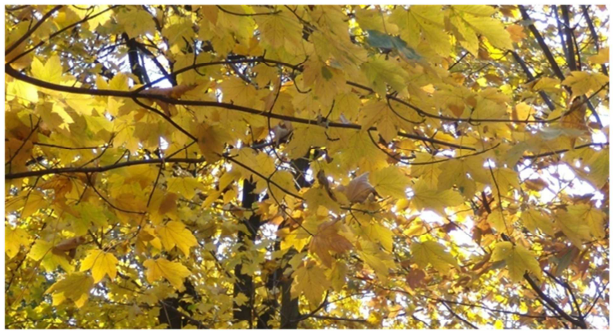
3. EVALUATION OF SOUNDS: INTENSITY AND ANAESTHETIC FEELINGS

Exercise 1: Individual feeling of sounds

(Instruction for the teachers/trainers: the sound has to be underlined at the speakers, use the powerpoint version of the module)

Exercise 1.
How do you feel listening to these sounds?
Check the appropriate box in the table.

1. Rustling leaves



pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

2. Tearing the paper

http://polandwatch.typepad.com

pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

3. Vacuum cleaner

www.gadzetolog.pl

pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

4. School corridor - pause

www.2sp.lublin.pl

pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

5. Opera singer

http://powiat.trzebnica.pl/

pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

6. Rock concert

www.2sp.lublin.pl

pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

7. Pneumatic hammer

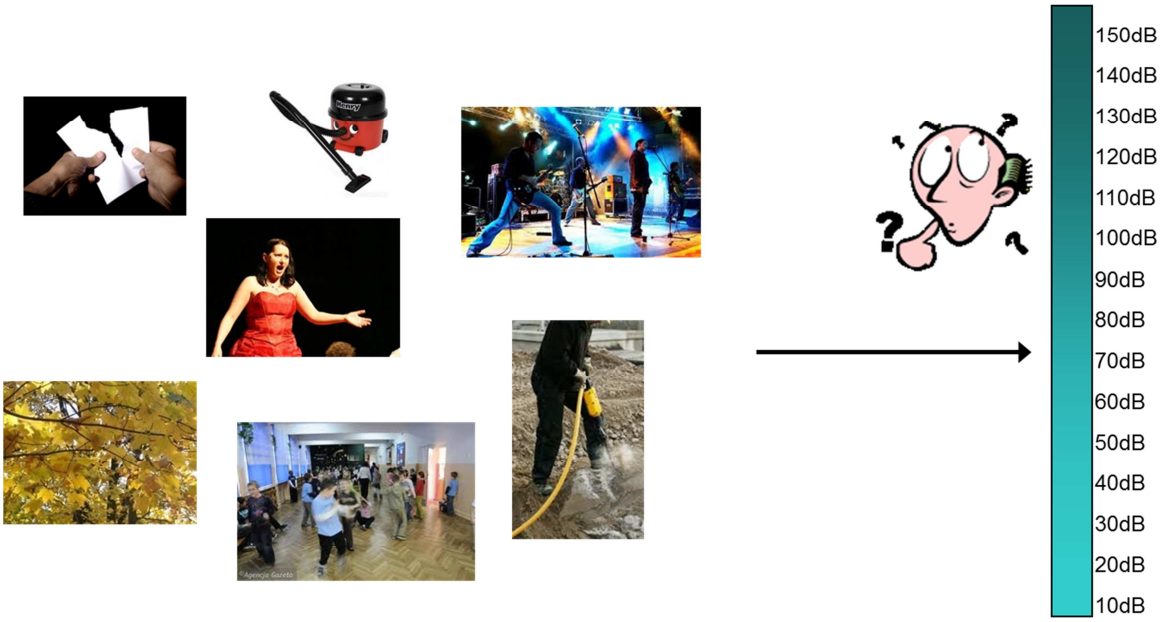
www.kurt-koenig.com.pl

pleasant to the ear	
neutral	
unpleasant	
inconvenient	
very irritating	

Exercise 2: Objective loudness of sounds

Exercise 2.

Try to arrange sounds from the quietest to the loudest.



The correct answer:

Rustling leaves	ok. 10 dB
Tearing the paper	ok. 40 dB
Vacuum cleaner	ok. 60 dB
Opera singer	70-110 dB
School pause	85-120 dB
Pneumatic hammer	ok.100 dB
Rock concert	ok. 120 dB

Exercise 3: Pleasentness of sounds

Exercise 3.

Arrange the sounds from the most unpleasent to the most pleasent.

unpleasant						pleasant







Exercise 4: Discussion of subjective pereception of souds

Discussion:

Subjective perception of sounds, their intensity, height and timbre
(based on the results of exercises1, 2 and 3).

4. The intensity of sound is individually received by various people - this applies in particular to the reaction to the above-mentioned levels of noise and feels the pain threshold.
5. Also, aesthetic experience sounds are subjective. This is particularly the music, singing and speech, which at the same intensity may be perceived as pleasant or unpleasant, e.g. such as a rock concert or opera singing by some is perceiveed as pleasant sounds, by others not. Noise during school break, industrial and transport noise to outside observers are usually unpleasant.

Exercise 5: Reducement of noise

Discussion: What can we do in school to reduce noise?
Sample solutions: • let's talk instead of shouting to each other • sit down in the reading room and read something interesting • walk instead of run • let's eat lunch in peace

4. HARMFULNESS OF NOISE

Is noise harmful?

The high level of noise reduces ability to concentrate, can cause sleep and metabolism disturbance.

Effects of prolonged exposure to noise on humans can be fatal nervous diseases of the neurotic background and damage to hearing.

The pain threshold is 130 dB.

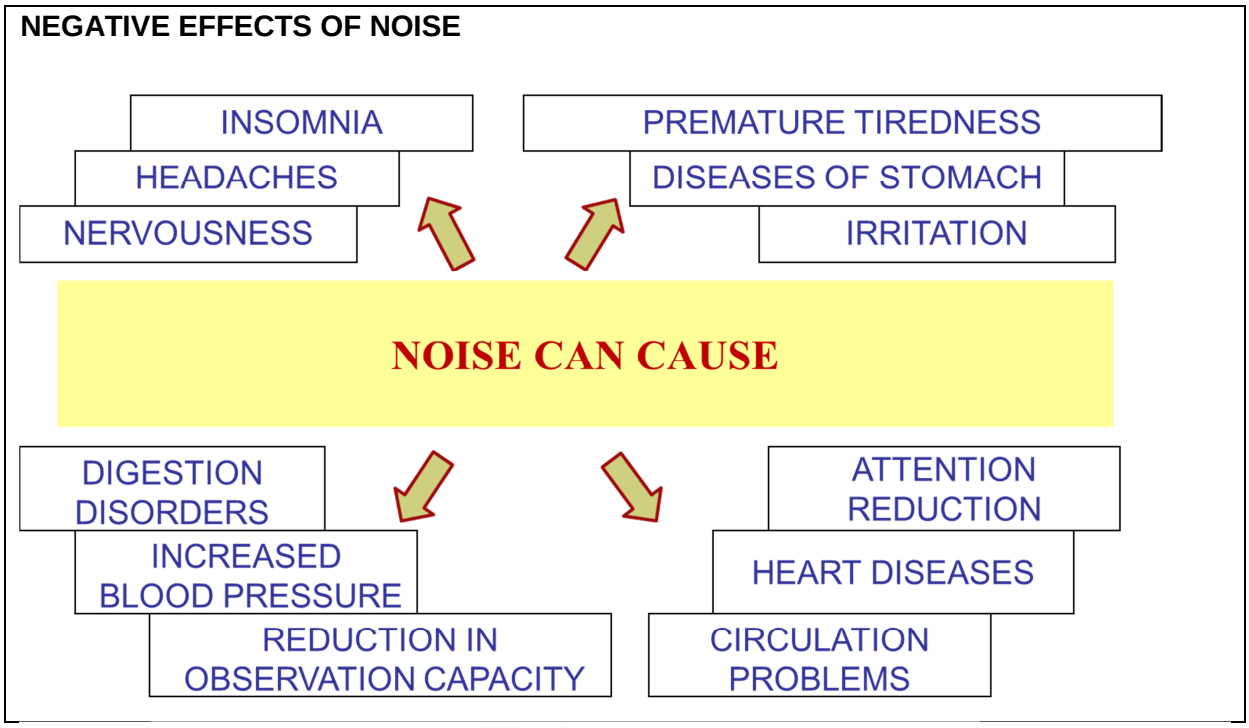
5. EFFECTS OF NOISE

Research shows that **about 20% of children and young people in Poland** are hearing impaired. One of the main reasons is long and loud litening to the music from the players what in the future may result in irreversible hearing loss.

This is a global problem. As it results from the EU reports, as many as 10 million young Europeans are threatened by serious hearing damage caused by lisening to too loud music (e.g. from MP3 players).

EFFECTS OF NOISE

- Approximately 450 million people in Europe (i.e. 65% of the population), are exposed to a noise intensity of 55 dB for 24 hours a day, which causes anxiety and negatively affects the health.
- Approximately 113 million people (17% of the population) are exposed to noise greater than 65 dB, which is above the level at which serious adverse health effects are observed.
- About 10 million people live in an environment where noise exceeds 75 dB for 24 hours a day, which is unacceptable.
- Although we are accustomed to different sounds accompanying us every day, every noise annoys us and tires us physically and mentally.
- Hearing loss, insomnia and constant state of nervous tension, also known as stress, are the symptoms of harmful effects that may be caused by noise.
- Sounds on intensity of 70 dB are hard to deal with for a longer time. Harmful noise intensity begins at the level of 90 dB and the pain occurs at 130 dB.


NEGATIVE EFFECTS OF NOISE
INSOMNIA
HEADACHES
NERVOUSNESS
PREMATURE TIREDNESS
DISEASES OF STOMACH
IRRITATION
NOISE CAN CAUSE
DIGESTION DISORDERS
INCREASED BLOOD PRESSURE
REDUCTION IN OBSERVATION CAPACITY
ATTENTION REDUCTION
HEART DISEASES
CIRCULATION PROBLEMS


Thank you very much for your attention!
http://www.gt-vet.com
http://www.arcelormittal.com/poland
http://www.imz.pl

Noise Level 2 - Understand background and coherences: Noise in general - to prevent and reduce

You are here (actual unit of the training module)

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

SCOPE OF THE TRAINING (Level 2):

1. Basic definitions
2. Fundamentals of acoustics: sound source, acoustic wave
3. The phenomenon of hearing, the construction of the ear
4. Damages of hearing
5. How to protect the hearing
6. Work in noise - impact on productivity and health of employees
7. Acceptable levels of environmental noise

1. BASIC DEFINITIONS

BASIC DEFINITIONS

- Signals from the environment, recorded by organ of hearing, are called **sounds**.
- The sounds, the listening experience, differ not only in volume, height (frequency) and timbre - some are pleasant to the ear, others do not.
- Sounds perceived as "undesirable, inconvenient, painful, unpleasant, annoying," usually too loud, called **noise**.
- Sound intensity level is described by the unit called decibel (dB)

2. FUNDAMENTALS OF ACOUSTICS: SOUND SOURCE, ACOUSTIC WAVE

Task 1: Match the notion to the correct definition:

UNIT OF SOUND INTENSITY, SOUND INTENSITY, NOISE, ACOUSTIC PRESSURE, FREQUENCY OF SOUND, ACOUSTIC WAVE, ACOUSTIC RESONANCE

Sound intensity

..... - the measure of the acoustic wave energy, which the unit is W/m^2. It is equal to the average value of the acoustic energy stream flowing in 1s by area of $1m^2$, oriented perpendicular to the direction of wave propagation.

Acoustic resonance

…….…….. - tendency of an acoustic system to absorb more energy when it is forced or driven at a frequency that matches one of its own natural frequencies of vibration than it does at other frequencies.

Frequency of sound

…… - informs about the received pitch, is expressed in Hertz [Hz]. Person hears sounds with frequencies from 20 Hz (low sounds, bass) to 20 kHz (high sounds). In this frequency range we are dealing with so-called. audible noise. Sounds, which humans can not hear with frequencies below 20 Hz are called infra sound, and with the frequencies above 20 kHz - ultrasound.

Noise

…….. any unwanted, unpleasant, annoying or harmful vibrations of elastic medium, acting on the organ of hearing and other senses and human body parts (simple: any unwanted sound).

Acoustic pressure

…… - small changes in air pressure in which the the sound propagates and is expressed in Pascals [Pa]. The most silent sounds heard by humans are of sound pressure level at 0.00002 Pa, and the sounds that cause ear pain more than 60 Pa pressure. Due to the very large range of sound pressures of sounds received by humans relative measure of sound pressure, which is the sound pressure level expressed in dB, instead of the sound pressure is used.

Unit of sound intensity

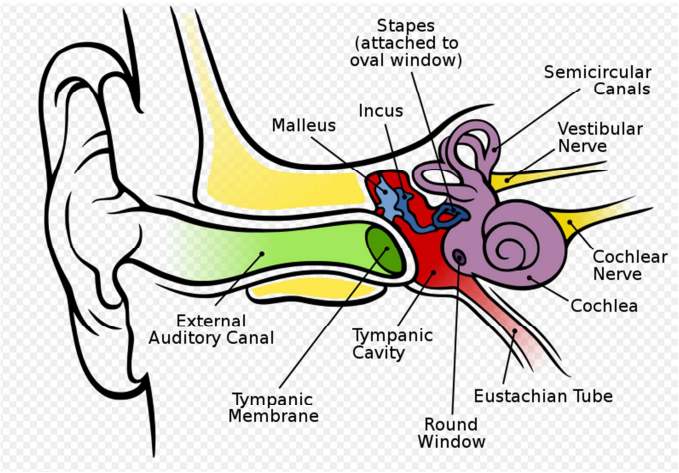
…….. - bel (1 B), 1 bel sound intensity corresponds to the sound of ten times greater intensity than the threshold of audibility, 2 bels - sound intensity a hundredfold greater than the threshold of audibility. In practice, the sound level, however, is expressed in decibels, decibel (1 dB) is a ten times

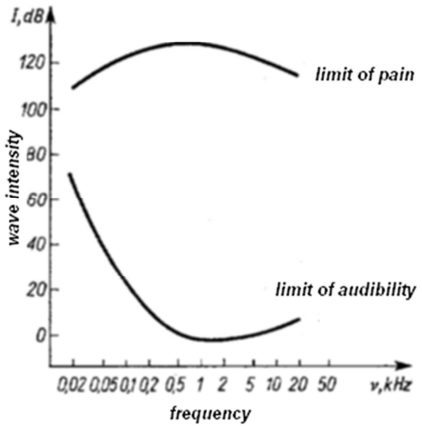
Acoustic wave

…….. - disorder of density (and pressure) propagates in medium causing the impression of auditory (sound)

3. THE PHENOMENON OF HEARING, THE CONSTRUCTION OF THE EAR

Ear - the organ responsible for receiving audio signals





A typical audiogram for a person with normal hearing

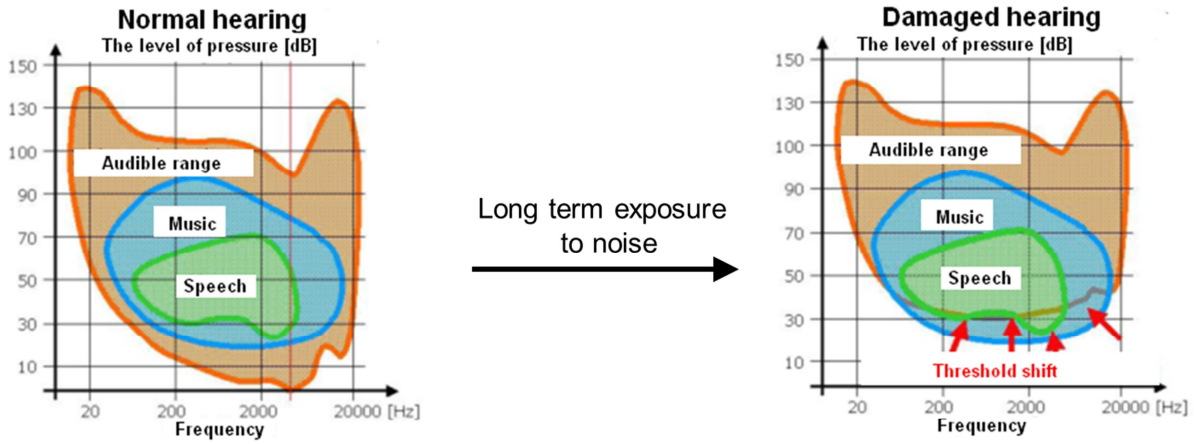
4. DAMAGES OF HEARING

Harmfulness of Noise

There are several types of noise, depending on its harmfulness:

- **Less than 35 dB** - is not harmful to health, but can be frustrating
- **From 35 to 70 dB** - can cause dizziness, weakness and reduced productivity at work
- **From 130 to 150 dB** - very harmful, may cause vibration of some human organs and those working in such noise are usually impaired hearing
- **More than 150 dB** - after a few minutes of being in such a noise paralysis and convulsions may occur, changes in the body are irreversible

Damages of hearing



Hearing damage - the effects of:

- auditory threshold shift and deterioration of speech understanding,
- problems in the evaluation of sound volume,
- loss of ability to differentiate pitch,
- limitation the capacities for determining the direction of a sound.

5. HOW TO PROTECT THE HEARING

independent antinoise earmuffs

Task 2:
What do you think which of these <u>activities not serve</u> to protect against noise?

a) Use ear muffs or ear inserts.

helmet mounted earmuffs

b) Wearing a helmet and protective clothing.

c) Use of acoustic safeguards in the devices - sources of noise.

ear-plugs

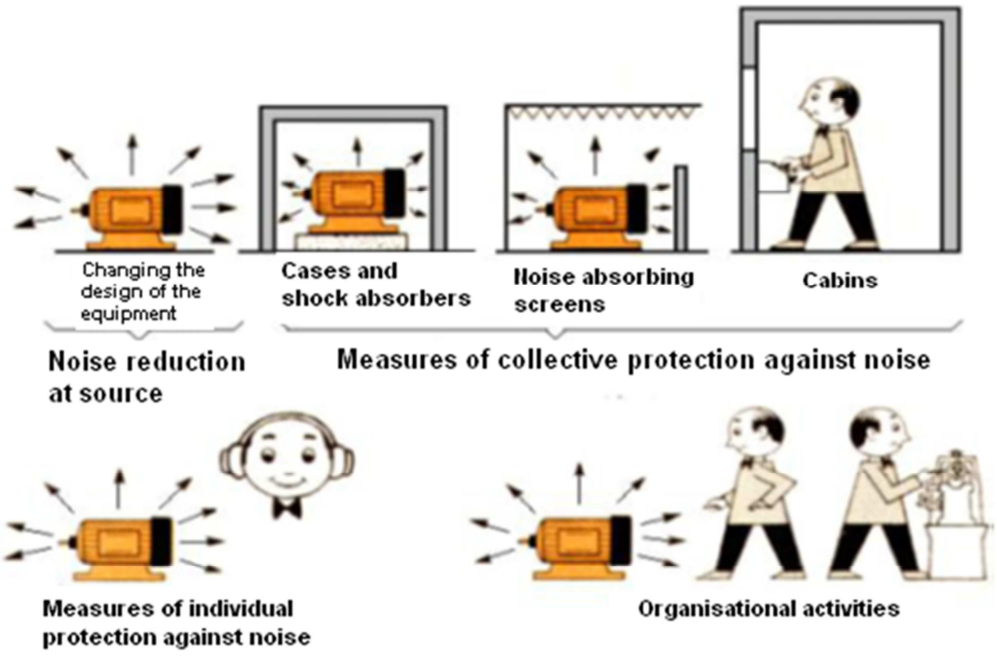
d) Such location of noise sources (devices) that noise is accumulated.

e) Rotation of the „noisy" work position.

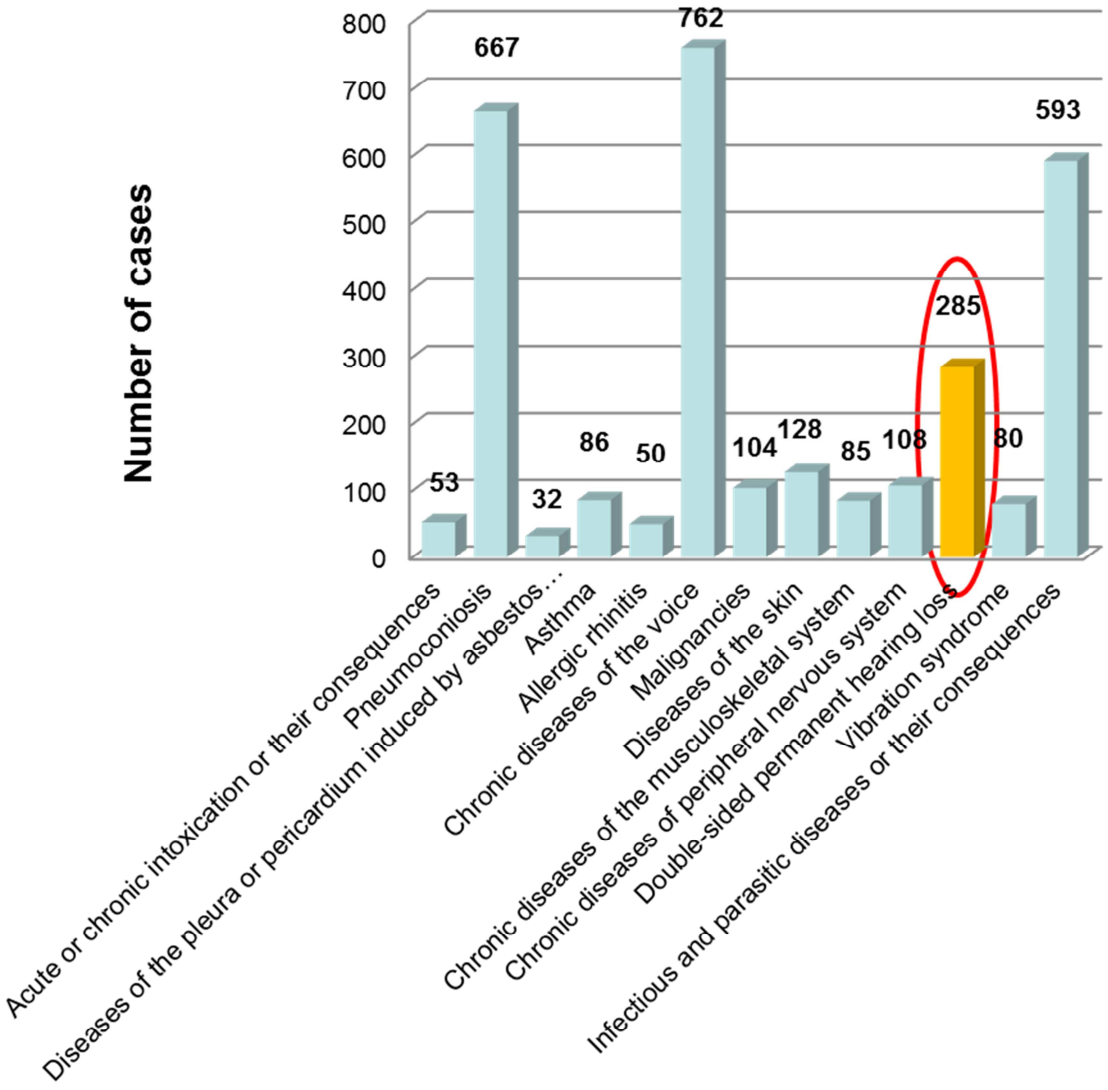
f) Stay away from noise sources.

Solution: a, d

How to protect hearing: Technical and organisational methods



Damage of hearing is the fourth occupational disease in terms of number of cases



So be sure to do:

- preliminary examinations
- prophylactic examinations
- periodic examinations

6. WORK IN NOISE - IMPACT ON PRODUCTIVITY AND HEALTH OF EMPLOYEES

Noise can contribute to an accident at work, among others by:

- Deterioration of hearing commands and signals, and as a result of this incorrect understanding,
- Blocking of the warning signs of danger (e.g. beep or the sound of the approaching vehicle),
- Distraction of employees, for example, drivers and operators,
- Increasing the probability of making a mistake by persons tired by work done in noise.

7. ACCEPTABLE LEVELS OF ENVIRONMENTAL NOISE

NOISE IS DANGEROUS FOR THE ENVIRONMENT

Task 3:

Using internet resources find and read the contents of the existing regulation on the allowable noise levels in the environment (of 14 June 2007).

NOISE LIMITS IN THE ENVIRONMENT accordance with the Regulation of the Minister of Environment on the permissible noise levels in the environment

Type of area	Permissible noise level [dB] Industry factories			
	Roads or railways		**Other facilities and activities being a source of noise**	
	LAeq D - reference time interval equal to 16 hours	**LAeq N** - reference time interval equal to 8hours	**LAeq D** - reference time interval equal to 8 the least favorable hours of the day after the other following	**LAeq N** - reference time interval equal to one night hour of at the least favorable
The protection zone "A" spa The hospitals area outside the cities	**50**	**45**	**45**	**40**
Single-family housing areas Building areas associated with permanent or temporary stay of children and youth The area of social care homes -The hospitals area in the cities	**55**	**50**	**50**	**40**
- Multi-family residential areas and housing collective - Farm building areas - Recreation areas - Residential and service areas	**60**	**50**	**55**	**45**
The areas in the city center in the cities with over 100 thousand. residents	**65**	**55**	**55**	**45**

Noise Level 3 - Professional practical knowledge: Nuisance noise

You are here (actual unit of the training module)

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

SCOPE OF TRAINING

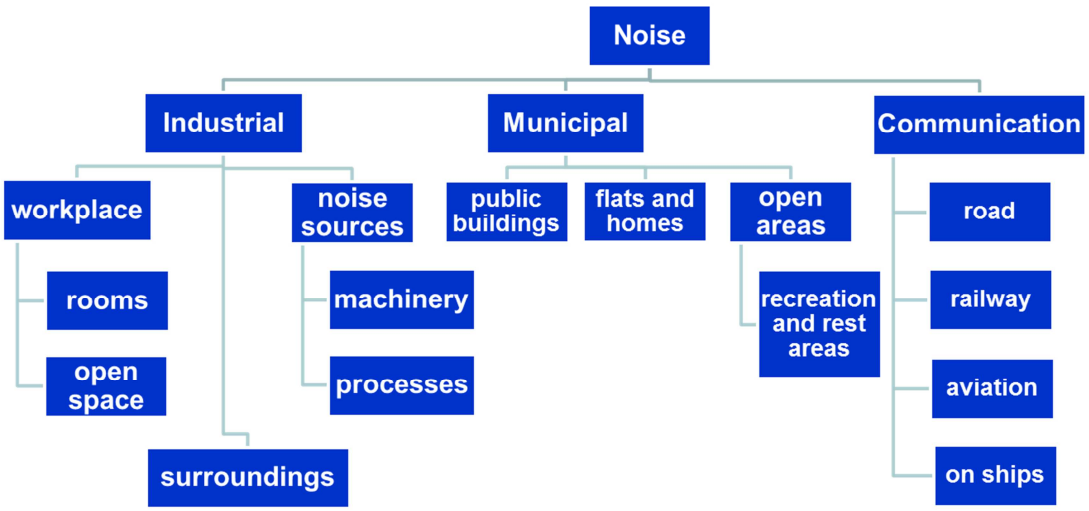
1. **Basic definitions**
2. **Industrial noise**
3. **The main sources of noise in ArcelorMittal Poland**
4. **Noise reduction**
5. **Harmfulness of noise**
6. **Health and safety regulations and requirements for noise emissions**
7. **Personal protective equipment - hearing protection and their application**
8. **Environmental regulations for noise emissions**
9. **Test: admissible noise levels**
10. **Noise emissions from industrial plants**
11. **Questionnaire on the test module**

1. BASIC DEFINITIONS

BASIC DEFINITIONS (repeating)

- Signals from the environment, recorded by organ of hearing, are called **sounds**.
- The sounds, the listening experience, differ not only in volume, height (frequency) and timbre - some are pleasant to the ear, others do not.
- Sounds perceived as "undesirable, inconvenient, painful, unpleasant, annoying," usually too loud, called **noise**.
- Sound intensity level is described by the unit called decibel (dB)

Types and Sources of Noise



source: http://akustyczna.mapa.lodz.pl

2. INDUSTRIAL NOISE

INDUSTRIAL NOISE – WHAT IS THIS?

Industrial noise includes both the sounds emitted by various types of machinery and equipment during the manufacturing processes, as well as equipment and installations of services, retail facilities, dining and entertainment objects.

Companies are especially burdensome local source of noise. Industrial noise is therefore not a significant effect on the acoustic climate in the whole of the city and is much less noticeable than, for example traffic noise.

Act "Environmental law" treats noise as one of the environmental pollution and subjected it to the same rules and restrictions as in the case of other pollutants.

3. THE MAIN SOURCES OF NOISE IN ARCELOR MITTAL POLAND (AMP)

THE MAIN SOURCES OF NOISE IN ARCELOR MITTAL POLAND (AMP)

- fans,
- industrial nodes,
- air intakes,
- discharge of media (e.g. steam)
- departures from the chimneys,
- dust collectors,
- conveyor belts,
- mixers,
- exhaust fans,
- screens,
- cooling towers,
- etc.

Sources of noise are characterised by parameters such as:

- sound power [dB],
- the height of the source [m],
- working time during the day and at night [h].

These parameters are integrated permits

EXAMPLES OF NOISE SOURCES IN ARCELOR MITTAL POLAND (AMP)

Air intake

Air intake in the picture, noise emission level 92.5 dB

Chimney

In the photo: waste gas exhaust in converter steel plant , height 80 m, noise emission level 128dB

Group of fans

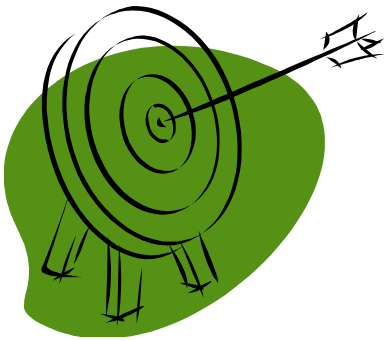
In the photo: system of 6 fans in sinter belt cooling , noise emission level 112dB

4. NOISE REDUCTION

NOISE REDUCTION

One of the main environmental objectives in ArcelorMittal Poland is to reduce noise.

In order to reduce the noise a variety of acoustic protection is applied, including sound absorbing and insulating enclosures, silencers, damping chambers, screens. It is possible to adjust the work time of the noise source at night, when the standards are stricter.



EXAMPLES OF METHODS USED TO SILENCE THE NOISE

Sound-insulating housing for returning fan exhaust system to the sinter belt in the sinter plant

Sound absorbing and insulating enclosures on fans in dust collector in cokery

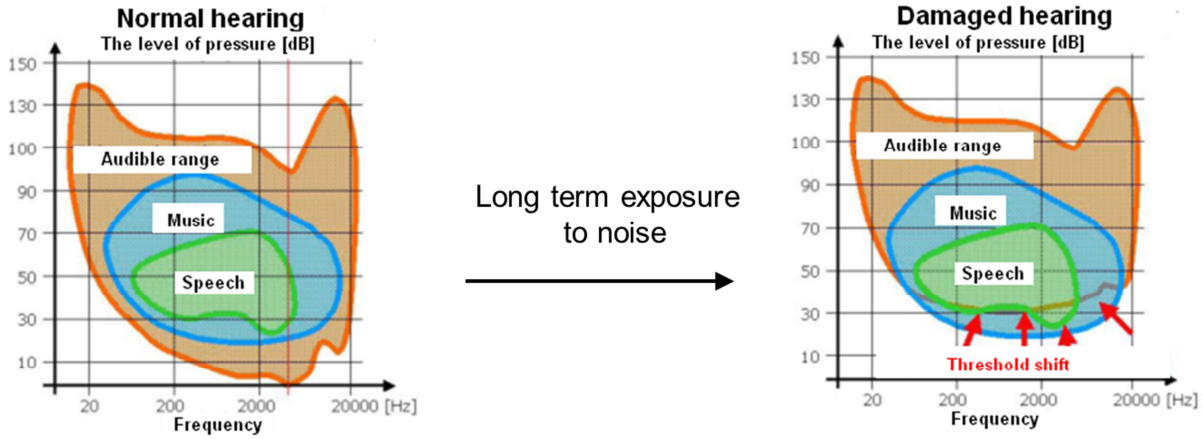
Acoustic screens for six skylights in cold rolling mill annealing plant

The project to build the acoustic screen (the western wall) in AMP Huta Królewska

5. HARMFULNESS OF NOISE

Noise is the most common factor in harmful working environment, the number of workers at risk from year to year increases.

The primary effect of noise on the ear is temporary or permanent hearing threshold shift.



REMEMBER !

Formation of hearing loss is usually a slow process, and hearing loss develop gradually and painlessly. For this reason, a person exposed to excessive noise are often not aware of the effect to the point where it appears that occurred in these severe hearing loss.

6. HEALTH AND SAFETY REGULATIONS AND REQUIREMENTS FOR NOISE EMISSIONS

Legal basis:

- ✓ REGULATION OF THE MINISTER OF ECONOMY AND LABOUR of 5 August 2005 on health and safety at work related to exposure to noise or vibration - Dz.U.05.157.1318
- ✓ REGULATION OF THE MINISTER OF LABOUR AND SOCIAL POLICY on the general safety and health at work of 26 September 1997 - Dz.U.03.169.1650
- ✓ REGULATION OF THE MINISTER OF ECONOMY of 21 December 2005 on essential requirements for personal protective equipment - Dz.U.05.259.2173
- ✓ REGULATION OF THE MINISTER OF LABOUR AND SOCIAL POLICY of 29 November 2002 on the maximum permissible concentrations and intensities of harmful factors in the work environment - Dz.U.02. 217.1833
- ✓ The European Directive 86/188/EEC on the protection of workers from risks related to exposure to noise at work

HEALTH AND SAFETY REGULATIONS AND REQUIREMENTS FOR NOISE EMISSIONS

I. The employer is obliged to ensure the protection of workers from risks related to exposure to noise, through **the use of technical and organizational solutions, reducing noise,** and in particular, ensure the use of:

- ➢ technological processes that do not cause excessive noise,
- ➢ machines and other technical equipment causing the least possible noise, not exceeding the limit values,
- ➢ solutions to reduce the noise level in the work processes.

II. In the workplaces, in which **in spite of the possible technical and organizational solutions, noise level exceeds the legal limits**, the employer is obliged to provide:

- ➢ determine the causes of exceeding the permissible sound level and the development and use of, the technical and organizational measures aimed at the most effective reducing the exposure of workers to noise,
- ➢ the supply of workers with individual ear protection, matched to the size of the noise and the characteristics of individual employees, and their application,
- ➢ limiting the time of exposure to noise, including the use of breaks,
- ➢ labeling of hazardous noise areas and, where this is justified due to the degree of risk and possible, to restrict access to these areas by their separation.

III. The employer shall ensure that workers employed in positions where noise levels exceed the permissible are:

- ➢ informed of the risks, in particular the risks against which they protect their personal protection, and information about these measures and conditions of use,
- ➢ informed of the results of the measurement noise and present health risks,
- ➢ informed of the results of risk assessment,
- ➢ trained in risk assessment results,
- ➢ informed of the action taken in connection with the appearing excess noise,
- ➢ equipped with appropriate personal protection hearing and informed on how to use them,
- ➢ medically examined periodically.

IV. It is the responsibility of the employee to use noise protection and informing the **employer** of any damage of protective measures and difficulties associated with their use.

7. PERSONAL PROTECTIVE EQUIPMENT - HEARING PROTECTION AND THEIR APPLICATION

In the event that avoid or eliminate occupational risks from exposure to noise is not possible by means of collective protection or labor organization, the employer:

- provides personal protection of hearing if the noise in the work environment exceeds the threshold,
- provides personal protection of hearing and monitor the accuracy of their use, if the noise in the work environment meets or exceeds the maximum intensity.

Noise limit values for the protection of hearing are:

- the level of noise exposure for an 8-hour or 40-hour of working time – 85 dB,
- maximum sound level *A* – 115 dB,
- peak sound level *C* – 135 dB.

PPE intended to prevent the harmful effects of noise should reduce noise in such a way that the maximum sound level A perceived by the user, does not exceed the limit values. Measures should bear labeling indicating the noise attenuation level and the value of the comfort index provided by the measure. Labels should be placed directly on the measure of hearing protection, and if this is not possible, on the packaging of the measure.

Provided to employees for use the personal protective equipment should:

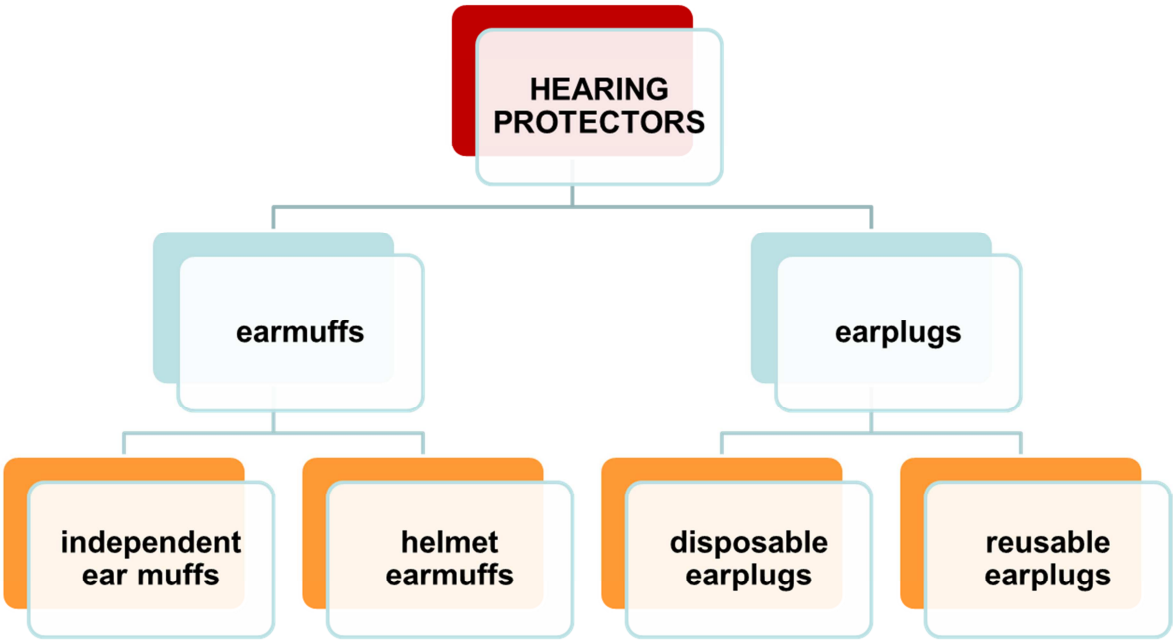
- be appropriate for the existing risk and do not in themselves cause an increased risk;
- take into account the conditions in the workplace;
- take account of ergonomic requirements and the state of health of the employee;
- be tailored to the user - after the necessary adjustments.

If there is more than one threat and the need for concomitant use of several personal protection measures - they should have to fit to each other without reducing their protective properties.

The employer shall inform employees of the risks, in particular the risks against which they protect their personal protection measures and provide information about these measures and rules for their use.

To personal protective equipment should be included instructions for use, developed in Polish.

TYPES OF HEARING PROTECTION MEASURES



TYPES OF HEARING PROTECTION MEASURES

- disposable earplugs 
- reusable earplugs   
- hearing protection ear muffs  

Ear-muffs attached to an industrial safety helmet


Additional features include: ear muffs with adjustable damping, ear muffs with active noise reduction, ear muffs with the signal source of input introduced electronically, earplugs with adjustable damping, electronic ear muffs with audio devices.

TEST

Which of the following signs is telling the employee that in a given area should use hearing protection?

1)

2)

3)

Solution: Nr. 2

When you <u>do not use</u> hearing protection

The work, in which the proper use of personal protective equipment of hearing all the time would cause a greater risk to the health and safety of workers, than not using such protectors, made in particular:

- by persons engaged in the rescue to protect human life or health, the protection of property or the environment, removal failure or natural disaster prevention,

- by drivers of motor vehicles, agricultural tractors and self-propelled machinery on public roads or road transportation and communication in the company,

- by artists - performers of music and entertainment shows.

8. ENVIRONMENTAL REGULATIONS FOR NOISE EMISSIONS

Allowable noise levels are varied depending on the:

- land use,
- type of facility or activity which is the source of noise,
- period, for which reference is made for noise levels as the reference time.

Defined in Annex 1 to

REGULATION OF THE MINISTER OF ENVIRONMENT of 14 June 2007 on the levels of environmental noise

9. TEST - ADMISSIBLE NOISE LEVELS

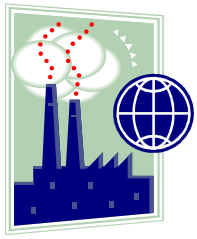
See the regulation on permissible noise levels in the environment and answer following questions:

1. What is the permissible level of industrial noise at night in the single-family housing? 50dB

2. What is the permissible level of industrial noise at night in residential areas and multi-family residence collective? 45dB

10. NOISE EMISSIONS FROM INDUSTRIAL PLANTS

For industrial plants and installations with the appropriate permits, noise emissions are determined and evaluated based on measurements of environmental noise.



Periodic measurements of environmental noise, including noise pulse is conducted every two years, including operating characteristics of noise sources (for systems with Integrated Permits)

In the case of environmental protection authority, based on their own measurements, measurements made by the provincial environmental protection inspector or measurements entity responsible for their conduct that the off-site as a result of its activities, are exceeded permissible noise levels, it shall issue a decision on an acceptable level noise.

Protection against noise in iron and steel industry is also subject to BAT

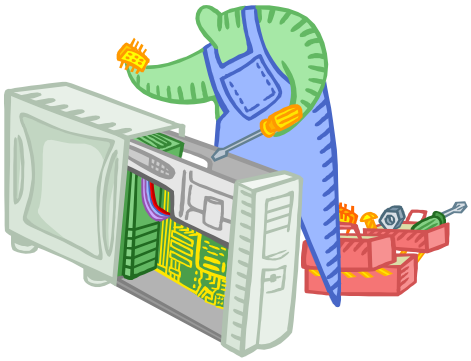
BAT is to reduce noise emissions from relevant sources in the iron and steel manufacturing processes by using one or more of the following techniques depending on and according to local conditions:

- implementation of a noise-reduction strategy,
- enclosure of the noisy operations/units,
- vibration insulation of operations/units,
- internal and external lining made of impact-absorbent material,
- soundproofing buildings to shelter any noisy operations involving material transformation equipment.
- building noise protection walls, e.g. the construction of buildings or natural barriers, such as growing trees and bushes between the protected area and the noisy activity,
- outlet silencers on exhaust stacks,
- lagging ducts and final blowers which are situated in soundproof buildings,
- closing doors and windows of covered areas.

YOU ALSO CAN REDUCE NOISE!

Each employee can help in reducing noise, every action is important, therefore, let us remember:

- Closing windows - where the air goes, "it takes" the noise with
- Closing doors, gates, enclosures devices that emit excessive noise
- Surveys and the ongoing monitoring of these devices
- Reporting and eliminating any leaks, holes, and the high volume of devices
- A quick response to defects which are the source of noise



PENALTIES FOR EXCEEDING NOISE EMISSION

298th Article of Environmental Protection Act says that the administrative fines are imposed by decision of the provincial environmental protection inspector, for among others:

- exceeding specified in the decision on the acceptable level of noise or license, noise levels.

Thank you very much for your attention!

http://www.gt-vet.com

http://www.arcelormittal.com/poland

http://www.imz.pl

Noise Level 4 - Process Know-how: Rating industrial noise

You are here (actual unit of the training module)

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

SCOPE OF TRAINING

1. **Basic definitions Basic definitions (reminder)**
2. **Health and safety requirements for noise**
3. **Noise emission measurements at workplaces**
4. **Occupational risk assessment**
5. **Effects of exposure to noise**
6. **Reducing of noise emissions**
7. **Medical examinations**
8. **Test: noise permitted levels**
9. **Questionnaire on the test module**

1. BASIC DEFINITIONS

BASIC DEFINITIONS (repeating)

- Signals from the environment, recorded by organ of hearing, are called **sounds**.
- The sounds, the listening experience, differ not only in volume, height (frequency) and timbre - some are pleasant to the ear, others do not.
- Sounds perceived as "undesirable, inconvenient, painful, unpleasant, annoying," usually too loud, called **noise**.
- Sound intensity level is described by the unit called decibel (dB)

2. HEALTH AND SAFETY REQUIREMENTS FOR NOISE

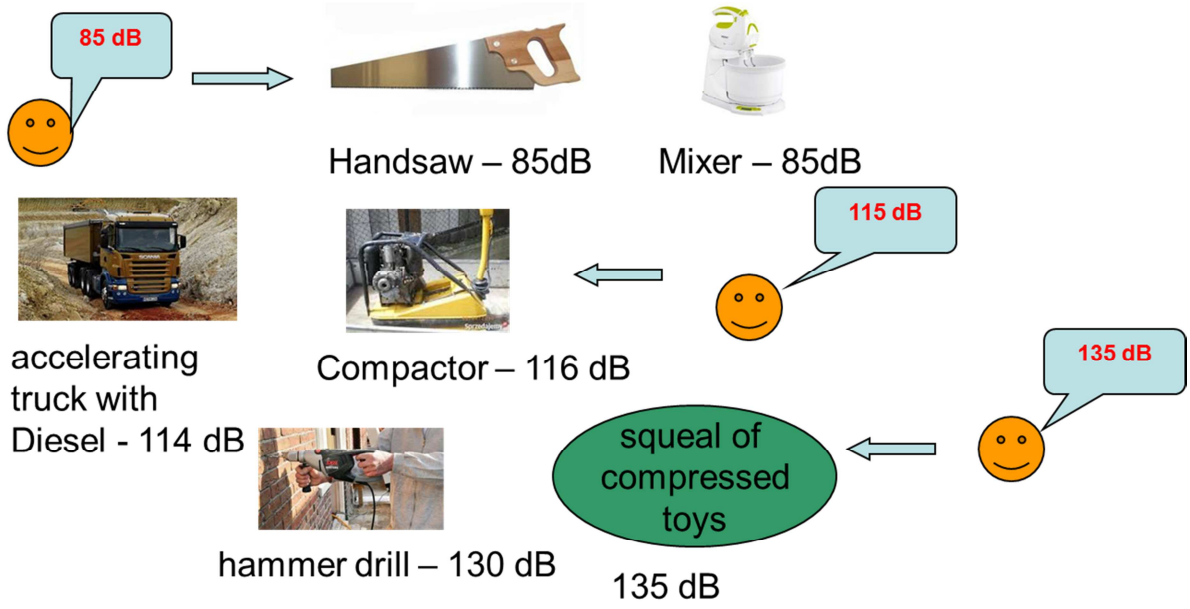
Threshold values for noise in the workplace:

1. The level of **exposure to noise** referenced to **8 hours daily working time** or level of exposure to noise referenced to the **work week** - the limit value is **80 dB**. For peak C sound level - as a threshold value of the MAI (Maximum Allowable Intensity) **135 dB** is taken.

2. The level of **noise exposure** referred for an **8-hour daily working time** - the limit value is **85 dB**.

   Maximum sound level A - **115 dB**

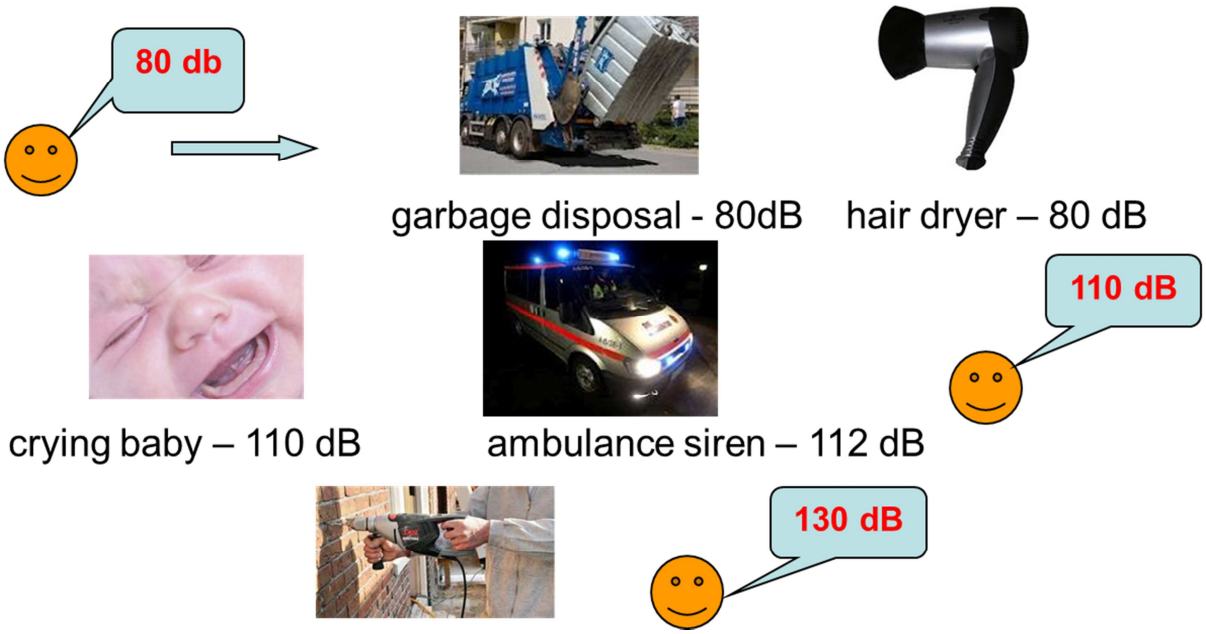
   Peak sound level C - **135 dB**



3. **Juveniles** - The level of **noise exposure** referred for an **8-hour daily working time** - the limit value is **80dB.**

   Maximum sound level A - **110dB**

   Peak sound level C - **130dB**



Legal basis:

REGULATION OF COUNCIL OF MINISTERS of 24 August 2004 on the list of work forbidden to the juvenile and conditions of their employment in some of these works (Dz. U. 2004, No. 200, item 2047 with amendments).

REGULATION OF THE MINISTER OF LABOUR AND SOCIAL POLICY of 29 November 2002 on the maximum permissible concentrations and intensities of harmful factors in the work environment (Dz. U. 2002, No. 217, item 1833 with amendments).

3. NOISE EMISSION MEASUREMENTS AT WORKPLACES

Effective combating of noise primarily requires the proper assessment.

Primary activity associated with the evaluation of the work environment is risk assessment in the workplace.

The obligation to risk assessment and its documentation results from § 39 para. 1 REGULATION OF THE MINISTER OF LABOUR AND SOCIAL POLICY of 26 September 1997 on the general safety and health at work (Dz.U. No.169, item 1650 from 2003) and art. 226 point 1 of the CODE OF LABOUR.

To conduct a risk assessment to carrying out the noise measurements is necessary. The employer shall measure the parameters which characterize the noise and compares the results of these measurements with the values of MAI and threshold values.

Mode, method, type and frequency of measurement, how to record and store the results and make them available to employees lay down rules on the test and measurement of harmful factors in the work environment.

In case of exceeding the thresholds employer plans and take action to reduce the occupational risk.

Individual employee exposure to noise can not exceed the value of the MAI. In the case of individual exposure to noise in excess of the value of the MAI, the employer:

- take immediate action to reduce exposure to an individual below the MAI,
- determine the cause of the excessive exposure of individual,
- selected protective measures and take preventive actions to avoid recurrence of individual exposure in excess of the value of MAI.

Measurements of noise in the work environment should be carried out:

- at least once a year, if the results of the recently carried out measurements reached the limit values above 0.5,
- at least once a year, if the results of the recently carried out measurements reached the limit values above 0.1, but did not exceed the limit values 0.5,
- in each case the change in the conditions of occurrence of noise.

Frequency of noise measurements is defined in MINISTER OF HEALTH REGULATION on the test and measurement of harmful factors in the work environment Dz.U. 2011 No. 33 item 166.

MEASUREMENT METHODS

- **Direct method of measurement of noise in the workplace** is a continuous measurement of employee exposure to noise and read directly from the gauge, such as of noise dosimeter or integrating sound level gauge. This is an easy method that requires perform complex calculations. The disadvantage of this method is its time-consuming (measured for one workplace takes a shift or more).
- **Indirect method** is to measure the noise in less than the time of exposure of a worker and use of appropriate mathematical relationships to determine the size describing the noise in the workplace.

When measuring, you should take into account the uncertainty of measurement errors resulting from using a particular measurement procedure, errors contributed by the measuring instrument and other reasons.

MEASUREMENT EQUIPMENT FOR NOISE EMISSION

To measure the parameters characterizing noise should be used noise dosimeters or integrating sound level gauges with accuracy class 2 or more.

noise dosimeter

integrating sound level gauge

4. OCCUPATIONAL RISK ASSESSMENT

Employer shall assess the occupational risk arising from the exposure of workers to noise or vibration, resulting from the features of the workplace and the use of the specific conditions or work processes.

Risk assessment of exposure to noise consists in at the same time to refer intended or measured parameters characterizing the noise to their limit values (daily or weekly noise exposure level; maximum sound level – A, Peak sound level – C).

Acceptable Risk - the risk of small or medium size

Unacceptable Risk - risk of large size

CAUTION: **Noise limits apply at the same time. If any of the values is greater than the MAI - occupational risk is high.**

SAFE LIMITS OF NOISE

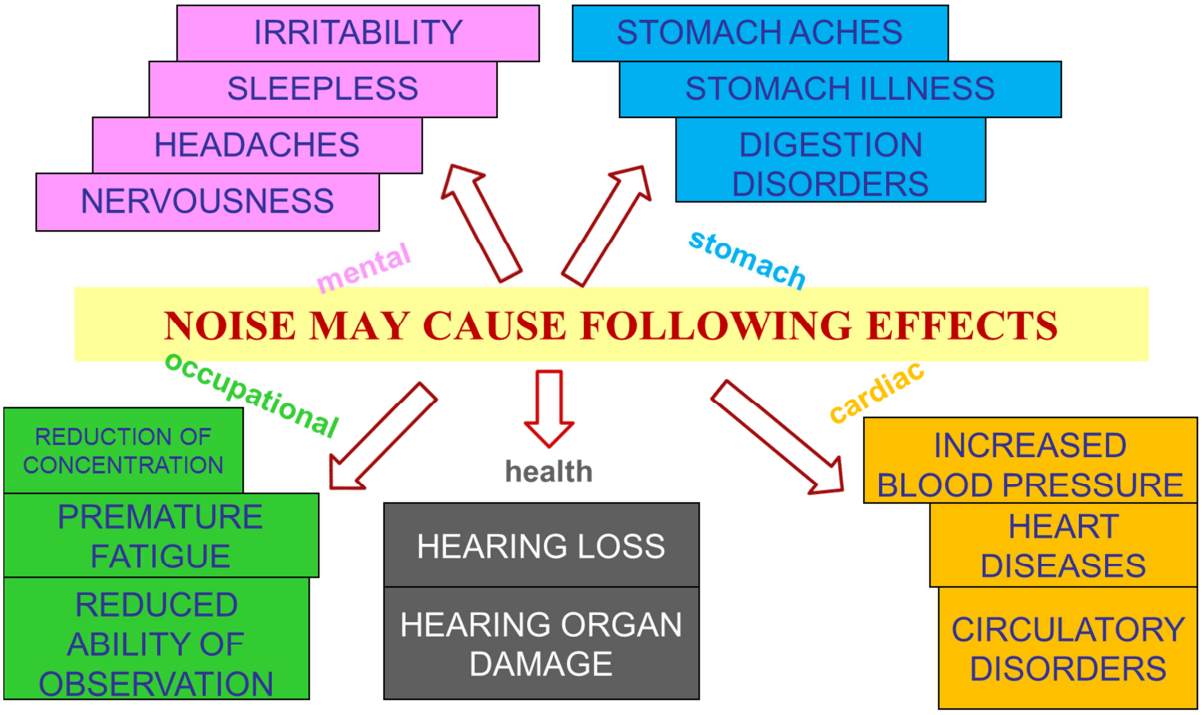
20 dB	**threshold of audibility**	**rustling leaves**
45 - 50 dB	**level of comfort**	**computer noise, modern car**
75 dB	**level not constituting a threat, but if the noise is not desired may harm your health**	**subway, loud conversation**
80 dB	**hearing protection recommended at 8 hour exposure to noise above the intensity of 80 dB**	**car klaxon, barking dog**
85 db	**hearing protection recommended at 8 hour exposure to noise above the intensity of 85 dB**	**truck**
100 db	**extremely loud**	**train, pneumatic hammer**
120 db	**even a short exposure can damage your hearing and a feeling of "ringing in the ears"**	**plane engine, a circular saw, a very loud rock music**
130 dB	**immediate pain threshold**	**firecracker explosion**
135 dB	**maximum exposure to noise by using ear protection**	**shot with a rifle, jet airplane**
160 dB	**immediate physical damage of hearing**	

5. NOISE IMPACT ON PRODUCTIVITY AND HEALTH

High noise level reduced ability to concentrate, can cause sleep disturbances and metabolic.

Long-term effects of noise on humans can be dangerous disorders nervous motivated and hearing damage.

The limit of pain - 130dB!

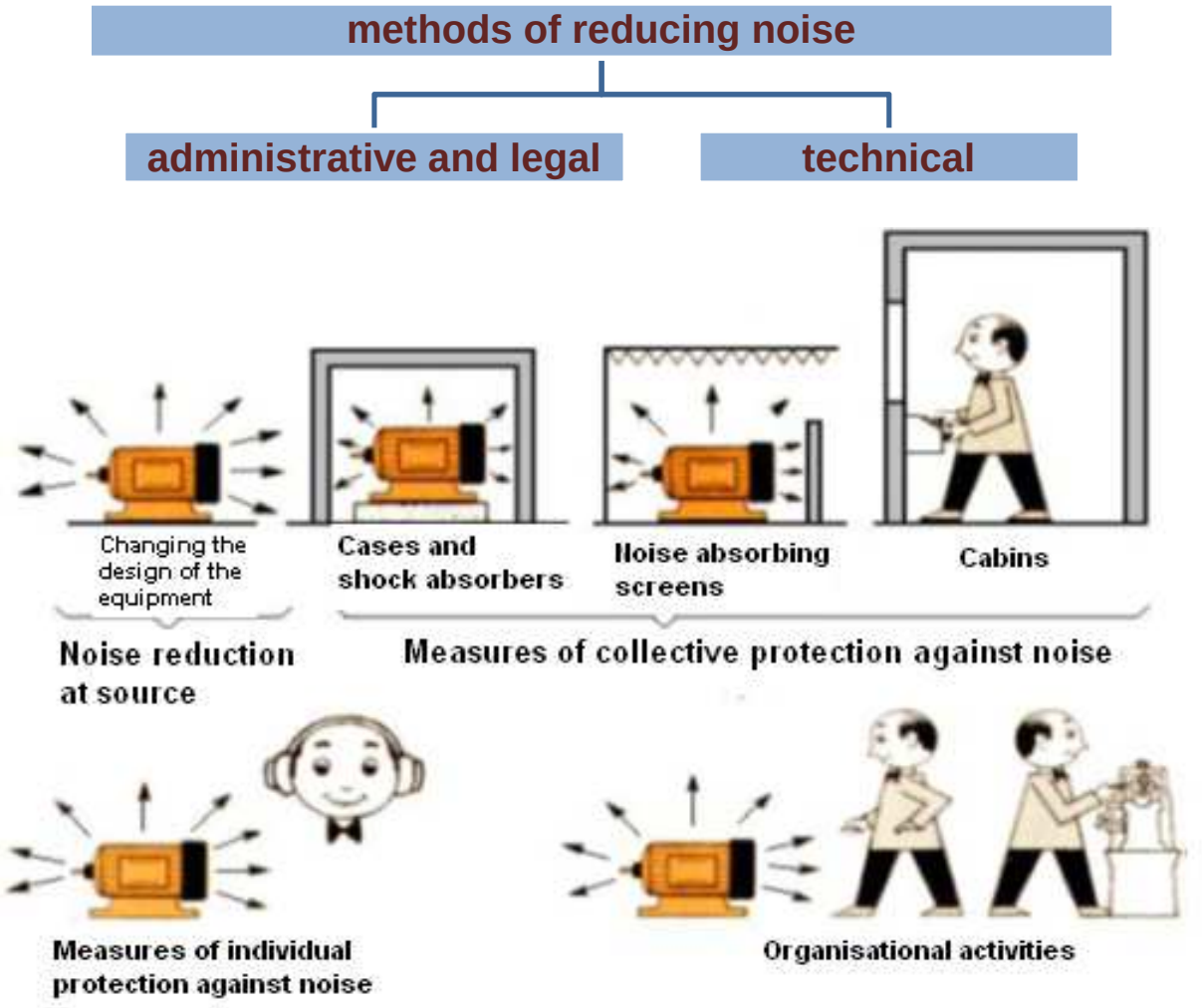


6. POSSIBILITIES OF NOISE EMISSION REDUCTION

Legal basis:

According to **§ 5 of the REGULATION OF THE MINISTER OF ECONOMY AND LABOUR of 5 August 2005 on health and safety at work related to exposure to noise or vibration** is the employer's duty to eliminate occupational risk at source related to exposure to noise or reduce the risk to the lowest level taking into account the available technology and scientific and technical progress.

POSSIBILITIES OF NOISE EMISSION REDUCTION



POSSIBILITIES OF NOISE EMISSION REDUCTION

Measures taken should be in accordance with the following schedule:

1. elimination of threat through its reduction at source

- use as the quietest technological processes
- use as the quietest of means of production (machinery, equipment)
- limiting noise sources

2. application of collective protection measures

- sound insulated and sound absorbing casings
- acoustic silencers
- acoustic screens
- industrial cabins sound insulated
- sound absorbing materials
- active noise reduction

3. use of personal protective equipment:

- hearing protectors: ear muffs and earplugs

4. use of organizational undertakings.

- breaks application and reducing time to noisy jobs, job rotation
- separate areas in which work is performed with low noise emissions from the areas in which work is performed with high noise
- grouping of sound sources depending on the level of sound acoustic pressure of emitted sound
- human withdrawal from the noisy processes (robotization and automation)
- appropriate location of noise sources to each other and the walls of the room.

7. MEDICAL EXAMINATIONS

Legal basis:

REGULATION OF MINISTER OF HEALTH AND SOCIAL WELFARE of 30 May 1996 on the medical examinations of employees, the scope of preventive health care workers and medical certificates issued for the purposes provided for in the Labour Code (Dz. U 1996, No. 69, item 332).

The employee is obliged to undergo preliminary, periodic and control medical check-ups, for which directs the employee.

The result of the prophylactic check-up is a medical certificate stating:

- no medical contraindications to work on a specific workplace, or
- medical contraindications to work on a specific workplace.

An employer can only hire such an employee who has a valid a medical certificate for absence of medical contraindications to perform the job.

Medical certificate is passed to both employer and employee.

Employee or the employer who does not agree with the content of the certificate may, subject to the conditions set out in the Regulation, to apply for re-examination.

Prophylactic medical examinations are carried out at the expense of the employer.

The employer shall also bear the other costs associated with preventive health care (including the costs of health monitoring and training of staff who works in the conditions of occurrence of maximum concentration and intensity of harmful factors).

Periodic and control testing shall be carried out as far as possible during working hours without loss of pay for the duration of the examination. Preliminary studies are mandatory for employees:

- newly admitted,
- juveniles transferred to other workplaces,
- transmitted to the workplacse on which occur factors harmful to health or nuisance conditions.

The scope of the periodic inspection and the frequency are determined by the physician, based on methodological guidance contained in Regulation.

Control medical examination is required in the case of an employee who was on sick leave lasting more than 30 days.

The employee is obliged to submit to the examination, in accordance with the referral issued by the employer.

Preventive examinations are carried out on the basis of referrals issued by the employer, which should include an identification of the prophylactic study, the position in which it is or is to be employed worker, and information on the occurrence of these position harmful or disruptive factors (including measurement data).

The scope and frequency of preventive examinations are set out in the annex to that Regulation.

Medical examinations for the noise examinations include:

- Preliminary examination:
  - medical examination - general and otolaryngology
  - ancillary tests - the tone audiometric 125-8000 Hz (air conduction and bone), and other studies, depending on the indications
- Periodic examination:
  - medical examination - general and otolaryngology
  - ancillary tests - the tone audiometric 125-8000 Hz (air conduction and bone)
- Last periodic examination :
  - medical examination - general and otolaryngology
  - ancillary tests - the tone audiometric 125-8000 Hz (air conduction and bone).

General examinations should be carried out every 4 years. Otolaryngologic and audiometric examinations should be performed for the first three years of work in noise - every year, and than every three years. In case of disclosure in periodic audiometric testing of loss hearing characterized by a large dynamic development, the frequency of audiometric testing should be increased, reducing the interval between successive tests up to 1 year or 6 months. In the event of exposure to impulsive noise or noise, the equivalent sound pressure level exceeding 110 dB continuously or frequently, audiometric testing should be performed at least once a year.

Physician performs preventiv examination can broaden the scope for additional specialized consulting tests and additional tests, as well as set a shorter deadline for the next test if he finds that it is necessary for a proper assessment of the state of health of the employee.

8. TEST - METHODS OF REDUCING NOISE

The following methods of noise reduction assign corresponding to methods of administration - legal and technical methods

- regulations, this is resolutions of the Council of Ministers, parliamentary Acts, regulations, ordinances and other regulations and technical standards
- reduction and minimization of noise emission from the source
- application breaks and reducing time to noisy jobs
- transfer of personnel sensitive to noise, and those diagnosed with the disorder, and especially hearing loss, to work in a less burdensome
- reduce noise transmission, i.e. the reduction of vibro-acoustic energy reduction on the roads their delivery
- use as the quietest the means of production
- the use of well-designed means of collective protection
- the use of sound absorbing and insulation enclosures, silencers, screens to loud equipment
- applying the medical prophylaxis, including medical examinations covering control of hearing for all newly admitted employees and periodic checks of all employees exposed to noise exceeding the limit values

TEST - METHODS OF REDUCING NOISE

Administrative and legal methods of noise abatement	Technical methods of noise abatement
• regulations, this is resolutions of the Council of Ministers, parliamentary Acts, regulations, ordinances and other regulations and technical standards • application breaks and reducing time to noisy jobs • transfer of personnel sensitive to noise, and those diagnosed with the disorder, and especially hearing loss, to work in a less burdensome • applying the medical prophylaxis, including medical examinations covering control of hearing for all newly admitted employees and periodic checks of all employees exposed to noise exceeding the limit values	• reduction and minimization of noise emission from the source reduce noise transmission, i.e. the reduction of vibro-acoustic energy reduction on the roads their delivery • use as the quietest the means of production • the use of well-designed means of collective protection • the use of sound absorbing and insulation enclosures, silencers, screens to loud equipment

NOISE IS ALSO THE POLLUTION FOR THE ENVIRONMENT

Noise is one of the major problems that reduce the quality of life in Europe. Environmental noise is all kinds of unwanted, unpleasant and annoying sounds in a given place and time.

For the environment is pollution characterized by a variety of sources and the widespread occurrence.

Noise, beyond harm to the human body, contributes to the deterioration of the natural environment, resulting in: loss of significant environmental value that is calm, decrease or therapeutic recreation areas, changing the behavior of birds and other animals.

Environmental objectives to be achieved concerning noise (Chief Inspectorate for Environmental Protection):

- elimination of the production of means of transport, machinery and equipment, the noisiness of which does not conform to the standards of the European Union, and the gradual elimination of the use of these devices;
- start action to reduce the noise in urban areas around airports, industrial areas and major roads and major railways to a level not exceeding the equivalent of 55 dB at night;
- introduction to the local development plans of records dedicated to the protection against noise.

NOISE LIMITS IN THE ENVIRONMENT (doppelt?! Ende Level 2) in accordance with the Regulation of the Minister of Environment on the permissible noise levels in the environment

Industry factories

Type of area	Permissible noise level [dB]			
	Roads or railways		Other facilities and activities being a source of noise	
	LAeq D -reference time interval equal to 16 hours	**LAeq N** - reference time interval equal to 8hours	**LAeq D** - reference time interval equal to 8 the least favorable hours of the day after the other following	**LAeq N** - reference time interval equal to one night hour of at the least favorable
- The protection zone "A" spa - The hospitals area outside the cities	**50**	**45**	**45**	**40**
- Single-family housing areas - Building areas associated with permanent or temporary stay of children and youth - The area of social care homes - The hospitals area in the cities	**55**	**50**	**50**	**40**
- Multi-family residential areas and housing collective - Farm building areas - Recreation areas - Residential and service areas	**60**	**50**	**55**	**45**
The areas in the city center in the cities with over 100 thousand. residents	**65**	**55**	**55**	**45**

WHICH NOISE SOURCES DO YOU KNOW IN THE STEEL PLANT?

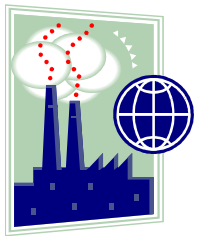
Discussion

The main sources of noise in ArcelorMittal Poland:

- **fans,**
- **industrial nodes,**
- **air intakes,**
- **discharge of media (eg. steam)**
- **departures from the chimneys,**
- **dust collectors,**
- **conveyor belts,**
- **mixers,**
- **exhaust fans,**
- **screens,**
- **cooling towers,**
- **etc.**

NOISE EMISSIONS FROM INDUSTRIAL PLANTS (repeating level 2?, doppelt)

For industrial plants and installations with the appropriate permits, noise emissions are determined and evaluated based on measurements of environmental noise.



Periodic measurements of environmental noise, including noise pulse is conducted every two years, including operating characteristics of noise sources (for systems with Integrated Permits)

In the case of environmental protection authority, based on their own measurements, measurements made by the provincial environmental protection inspector or measurements entity responsible for their conduct that the off-site as a result of its activities, are exceeded permissible noise levels, it shall issue a decision on an acceptable level noise.

DECISION ON PERMISSIBLE NOISE LEVEL

The decision shall specify the permissible noise levels outside the plant using noise indicators LAeq D and LAeq N with respect to the kinds of areas, which affects plant.

The decision can be determined:

- schedule of noise sources work for the entire day, along with the expected variations,
- the scope and method of measurement of the noise level and the transmission of results.

In an analogous manner the issue of noise from the system is defined in the integrated permit.

For exceeding the noise limits set out in the decision on the acceptable level of noise or in the integrated permit, the Regional Environmental Inspector may charge a penalty, and in special cases, stop the work plant / installation.

AS AN EMPLOYEE OF INDUSTRIAL COMPANY REMEMBER THAT:

1. Act "Environmental law" treats noise as one of the environmental pollution and subjected it to the same rules and restrictions as in the case of other pollutants.
2. Noise sources identified eithin the company have set out in the Integrated Permit sound power level [dB], the height of the source [m], working time at night and day [h].
3. For exceeding the permissible noise levels due to operation of equipment may be charged penalties, moreover Company must take steps to eliminate the excess.

5.3 Sub-module 3: Utilize store and dispose of waste materials

The module was developed by researchers and engineers from Tata Steel and Cardiff University.

It has four levels:

Level 1: What is Waste?

Level 2: Legal Requirements

Level 3: Waste produced in the workplace

Level 4: Auditing, Mapping and Minimisation

The levels work from elementary to more advanced and industry specific levels. Each level incorporates Theory and Activities, and in some cases Case Studies.

The learning is (mostly) self-directed, but also makes provision for trainer led training.

The “Waste” sub-module fits together with the sub-modules on “Energy”, “Raw Materials” and “Noise”. Each level of each sub-module develops knowledge to a deaper (and more industry relevant) level.

Overview Sub-module Waste

	L.1: Basic information	L.2: understand background and coherences	L.3:professional practical knowledge/ competencies	L.4: process know-how
Title of the training unit	What is waste	Waste – Legal Requirements	Waste produced in the workplace	Waste Auditing, Mapping & Minimisation
Learning outcome	Students will be able to: define waste and understand how waste is created; understand, define and use correctly basic waste terminology, understand categories of waste and waste hierarchies	Students will be able to: understand the impacts of Waste, understand how the impacts of waste are controlled – Duty of Care, understand how the impacts of waste are mitigated or reduced	Students will be able to: identify the types of waste that are generated through mechanical/electrical maintenance work, describe the disposal requirements for each type of waste and to understand processes of safely and accurately disposing of generated waste, understand how to accurately complete required records	Students will be able to: evaluate and understand how to apply, the principles of the waste hierarchy to the work area, understand how to make recommendations as to waste minimisation/improved management in work area, understand the steps involved in a waste audit
Background information required	No information required	L.1 – Basic Information	L.2 – Background and Coherence	L.3 – Professional Practical Knowledge
Approximate duration	120 minutes	110 minutes	60 minutes	Duration of the course
Target group profiles	Apprentices and students	Apprentices and students	Apprentices and students	Apprentices and students
Learning process (didactical procedure)	Lecture, team-work, individual activity, quiz to test knowledge	Lecture, team work	Lecture, practical exercises, case studies	Lecture, project work

Content and Didactical Measures

Level	Content	Didactical measures
L.1.	Definitions, commonly used terms (e.g. scrap), characteristic of waste, waste types, waste production statistics, how waste arises in the manufacturing process; how individual activities can influence waste generation	1. **Trainer input**: preparing Course Materials, lecture, lead training 2. **Trainee behaviours**: listening, active participation in team/individual work exercises, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, individual computer based tasks, results presentation, multiple choice quiz 4. **Exercises**: key steps in any manufacturing process with aim to identify places of waste producing
L.2.	Resource depletion, accidental or inappropriate waste release, ladfill impacts, incinearation impacts, measures for mitigation of these issues	1. **Trainer input**: preparing Course Materials, lecture, lead training 2. **Trainee behaviours**: listening, active participation in team/individual work exercises, presentation of the results 3. **Methods**: tutor presentation; tutor led discussion, team and/or individual work, individual computer based tasks, results presentation 4. **Exercises**: waste impacts activity
L.3.	Recap of sources of waste, assessment of whether a material is a substance or a waste, Duty of Care documentation	1. **Trainer input**: preparing Course Materials, lecture, lead training 2. **Trainee behaviours**: listening, active participation in individual work exercise, presentation of the results 3. **Methods**: tutor presentation; individual work, results presentation 4. **Exercises**: fill in example of obligatory waste document
L.4.	Introduction to the basics of waste mapping, use site map to plot: type of waste, location, quantity, disposal costs; consider all sources of waste; site walkabout and audit; identify sources, identify types and current stats	1. **Trainer input**: preparing Course Materials, lecture, lead training 2. **Trainee behaviours**: listening, active participation in individual work exercise, presentation of the results 3. **Methods**: tutor presentation; individual work, results presentation in written report 4. **Exercises**: student project

Waste Level 1 - Basic Information: What is Waste?

You are here (actual unit of the training module)

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Level 1: Part 1: Theory

Definitions and key terms:

- What is waste: Anything that is discarded - solid, liquid and gaseous materials.
- Essentially anything not wanted or thrown away:
  - Includes:
    - solid waste, contained liquid wastes, process wastes
    - end-of-life products/ materials
    - Process wastes, including those that can be recycled or recovered

Note! Some process by-products e.g. granulated slag are already sold to external markets and are therefore not generally classified as wastes.

- In *widest sense* can be anything that is *wasted* therefore *also*:
  - effluent discharges, atmospheric emissions, waste heat
- Overview of commonly used terms e.g.
  - Scrap: recyclable and other materials left over from product consumption.
  - Losses: product lost (i.e. unusable) from a process.
  - Overmake: when a greater quantity is made than needed.
  - Process Yield: the amount produced by a particular process.
  - Remake: Having to repeat a process or remake – it often requires additional material or energy resources in addition to wasting capacity

Characteristics of waste:

- Organic: Waste that contains carbon compounds; derived from animal and plant materials.
- Inorganic: Waste materials that do not contain carbon as the principal element, i.e. waste matter other than plant or animal
- Dirty water: Used water, or water that is not needed, which is permitted to escape, or unavoidably escapes for which the owners of the premises are legally responsible.
- Grey water: is wastewater generated from domestic activities such as laundry, dishwashing, and bathing, which can be recycled on-site for uses such as toilet flushing, landscape irrigation and constructed wetlands
- Putrescible: Solid waste that contains organic matter capable of being decomposed by microorganisms and of such a character and proportion as to cause obnoxious odours and to be capable of attracting or providing food for birds or animals.

Overview of common waste types

Example sources of waste:

- Raw materials & consumables
- Packaging
- Solid : off-cuts, defective products
- Liquid: Water, Effluent and other liquids
- Gaseous: Volatile Organic Compounds (e.g. paints, coatings, chlorofluorocarbons), combustion products
- Materials covered by Hazard Waste Regulations
- Lubricating Oils, Paints & Solvents
- Electrical Electrical & Electronic Equipment (WEEE)
- Energy production

May specifically include:

- Agricultural waste
- Animal waste
- Building waste
- Chemical waste
- Compostable waste
- Conveyor Belt waste
- Dredged material
- Filter cake
- Laboratory waste
- Liquid waste
- Metal waste
- Mineral waste
- Mining waste
- Municipal waste
- Oily Wastes
- Organic waste
- Packaging waste
- Plastic waste
- Radioactive waste
- Refractory waste
- Rubber waste
- Scrap material
- Sewage sludge
- Waste gas
- Waste glass
- Waste oil
- Waste paper
- Waste water
-

Different types e.g. domestic, commercial, industrial, agricultural

Statistics for waste production are available from the following websites:
UK Statistics:

http://www.defra.gov.uk/statistics/files/20110617-waste-data-overview.pdf

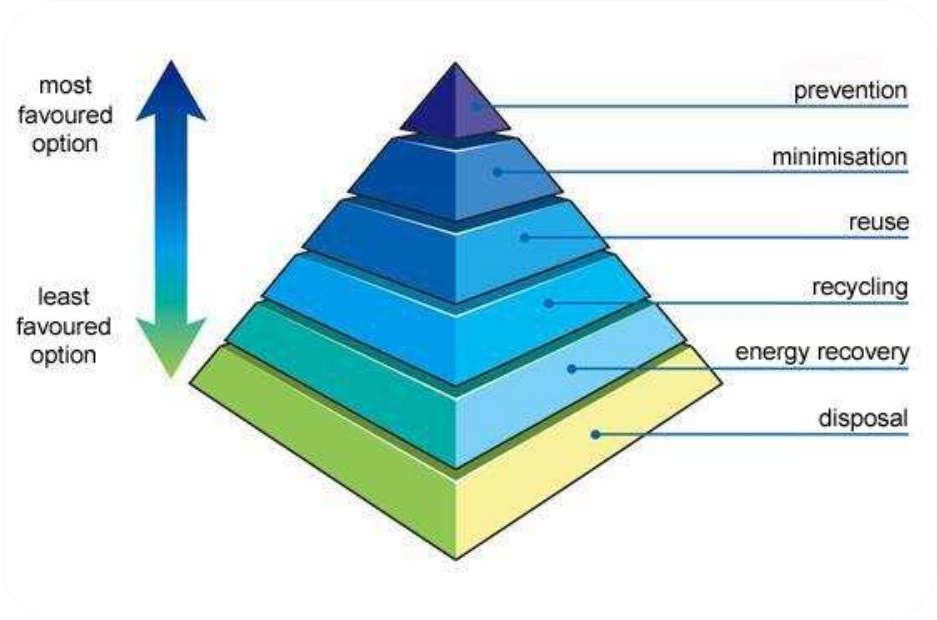
EU Statistics:

http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Waste_statistics

Level 1: Part 2: Waste Hierarchy

Definition for the Waste Hierarchy:

Waste Hierarchy: The Waste Hierarchy is a series of options for managing wastes. It gives top priority to preventing waste in the first place. When waste is created, it gives priority to preparing it for re-use, then recycling, then other recovery such as energy recovery, and last of all disposal (for example landfill).



Waste Hierarchy: The Theory

1) Eliminate: Eliminating waste entirely may not always be possible, but by not creating it in the first place reduces costs of raw materials.

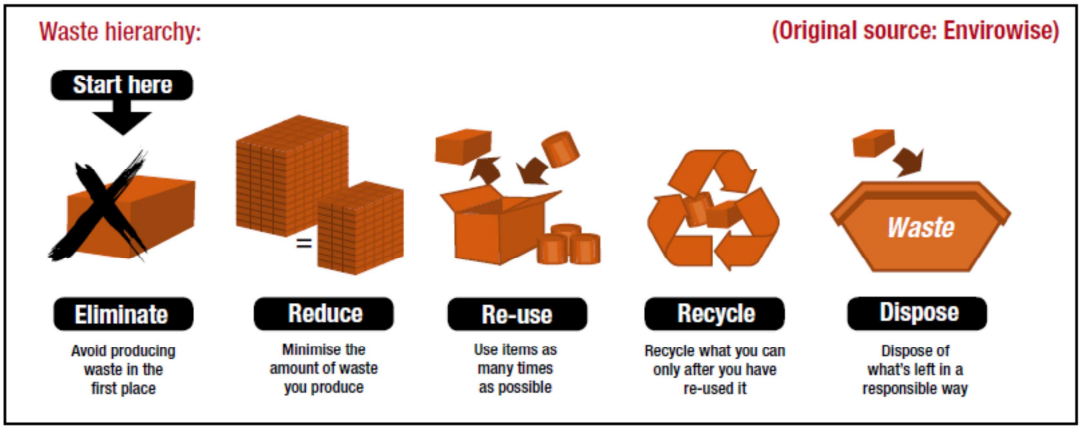
2) Reduce: Reducing the amount of waste you produce can be achieved in a number of ways, including the amount of packing used, reduce off-cuts and rejects, send information electronically, purchase material in bulk and use returnable containers.

3) Re-use: To limit extra spend of buying items in, many can be re-used to reduce waste:

- Packaging - boxes can be re-used many times.
- Paper - re-use paper from misprints and drafts as scrap paper in the office.
- Drums - many raw materials are delivered in drums that can be washed and returned to the supplier, or re-used on site as waste containers.
- Furniture and textiles - waste furniture and textiles may be of use to charities or to waste exchange groups.

4) Recycle: Recycling is an increasing requirement through legislation in order to reduce the impact on the environment.

5) Disposal: Disposal is the last resort when the other hierarchy options have been exhausted.



There is a tendency to work from the bottom of the hierarchy: disposal (landfill) costs rise and cost savings are sought by trying to recycle or re-use etc rather than looking to eliminate the cause of the waste in the first place. Significant attitude changes are required to encourage elimination at source.

Activity Schedule – Level 1

	Activity	*Materials*	*Method*	*Mode*	*Timing*
1	How can we influence waste generation?	Waste Resource Materials. Paper and pen. Flip chart or PPT	Student Led Group Work	Flip chart or PPT for feedback of student work	**40 minutes +** 30 minutes for task + 10 minutes for each group to feedback
2	Understanding producing and disposing of waste	Paper and pen	Individual Task	Discussion with students and/or tutor	**40 minutes** 20 minutes for task + 20 minutes for discussion
3	Multiple Choice Quiz (MCQ)	MCQ Internet	Individual Computer Based Task	Complete MCQ. Check against answers sheet.	**40 minutes** Approx 40 minutes to complete quiz and check answers

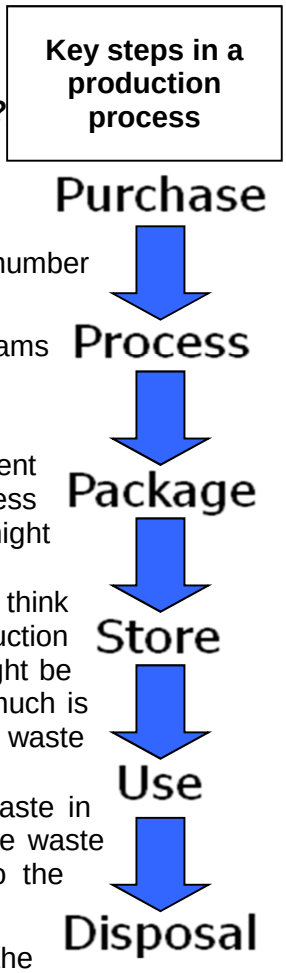
Activities: Level 1

Level 1: Activity 1: How can we influence waste generation?

- Student team activity: Based on Course Materials.

Tutor/Student Guidance

1) Students should be split into groups of an appropriate number (approximately 4 students per group)
2) Students should then discuss stage 3 in their respective teams and present their findings back to the class.
3) Students should consider:
   - The key steps in any manufacturing process – the student groups or tutor should choose a manufacturing process (e.g. making steel or any other product with which you might be familiar).
   - Where waste is typically produced in that process – think about what is involved in the manufacturing/production process and for each stage think about what waste might be involved (for example, energy might be wasted if too much is used or inaccurate measures of chemicals might lead to waste or substandard and wasted production)
   - How we could apply the waste hierarchy to reduce waste in each part of the production process – look back on the waste hierarchy materials and think about how it applies to the manufacturing process you have been discussing
4) The tutor and class should then offer feedback on the students' work.



Level 1: Activity 2: Understanding producing and disposing of waste

Tutor/Student Guidance

The students should consider in some detail the wastes that may be generated when making a cup of tea.

The exercise should be considered within the boundary of a kitchen at home etc and should not consider aspects directly outside the control of the person making the drink.

Consider the following as a minimum:

- Tea or teas bags
- Milk
- Water
- Energy
- Cups
- Packaging
- Washing of cups etc

Students should think about the process in terms of producing and disposing of waste. At each point of the process students must identify what waste is being produced, how wastage might be reduced (or eliminated) and how waste might be disposed of in a proper manner.

Level 1: Activity 3: Multiple Choice Quiz

- Multiple-choice quiz on course material content – see example.
- Test and understanding of basic waste concepts.
- Students to research answers on-line.

GT-VET WP4 Waste Training Example Quiz

No.	Question	Answer
1	How much waste is produced in the UK each year?	A: 400 million tonnes
2	Which industry produces the most waste in the UK?	A:Agriculture
3	How much waste is deposited in landfill sites every year?	A: 80 million tonnes
4	What usually happens to waste before it is transported?	A: It is compacted so that it takes up less space
5	What is another term for burning waste?	A: Incineration
6	What is a 'scrubber'?	A: Pollution control equipment fitted to incinerators
7	What are PCBs?	A: Polychlorinated biphenyls – persistent organic pollutants
8	What is the main gas produced by degrading organic waste?	A: Methane
9	What is the name for the contaminated water found in landfill sites?	A: Leachate
10	What is putrescible waste?	A: Waste that rots or can be broken down easily by bacteria
11	What is the illegal disposal of waste known as?	A: Fly-tipping
12	What material is often used to seal a landfill site?	A: Clay
13	What is the name for the process by which material is used again?	A: Recycling
14	Who issues and supervises licences to run landfill sites?	A: Environment A:gency
15	Where is most of the UK's waste disposed?	A: Landfill Sites
16	Why are 'paper nets' erected at landfill sites?	A: To stop light waste blowing into neighbouring premises
17	What is liquid waste, domestic sewage or waste from a manufacturing process that is put into water known as?	A: Effluent
18	How many aluminium cans are used in a year?	A: 2,000,000

Waste Level 2 - Understand background and coherences

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Level 2: Part 1: Waste Environmental Impacts

Resource depletion

Resource Depletion: Use of natural resources at a rate that exceeds its capacity for renewal, thereby removing its availability for future generations.

Accidental or inappropriate release:

Spillage: A discharge into the natural environment that is abnormal in quality or quantity in light of all the circumstances of the discharge. Therefore a spill can be a discharge of anything from a container or building which enters the natural environment (Air, Water & Land)

Leaking: A spillage that occurs from the ongoing loss of containment from a container such as a tank, vessel or pipe into the environment.

Fly-tipping: Fly-tipping is the illegal dumping of waste. It can vary in scale significantly from a bin bag of rubbish to large quantities of waste dumped from trucks. Fly-tipped waste may be found anywhere, such as roadsides, in lay-bys or on private land. A wide variety of wastes are fly-tipped.

Landfill impacts

Landfill Odour: Landfill sites may generate landfill gas by the decomposition of organic wastes. The gas consists of a mixture of gases and is colourless with an offensive odour. The gas is also highly dangerous as it contains methane at explosive concentrations.

Birds and flies: attracted to landfill by waste causing infestations and nuisance, and potential for spreading disease.

Methane production: Methane is a volatile gas produced in landfills by the decomposition of organic wastes. The gas is dangerous as it may be present at explosive concentrations. It must be vented or collected at all operational landfill sites accepting organic wastes, often it is incinerated (CO_2 is less harmful than methane) or burnt in a gas engine to generate electricity (considered a renewable energy).

Leachate and contamination of land / groundwater: Leachate (liquid run off) is any liquid that, in passing through matter, absorbs chemicals and solids from the material through which it has passed. In landfill sites water passing through the waste may contain environmentally harmful substances that may then enter the environment. To prevent contamination of land and groundwater, landfill leachate must be collected and treated to prevent pollution.

Incineration Impacts

Gaseous emissions: Incineration has a number of outputs such as the emission to the atmosphere of flue gas. Before the flue gas cleaning system, the flue gases may contain significant amounts of particulate matter, heavy metals, dioxins, furans, sulphur dioxide, and acid gases.

Disposal of ash: Incineration produces fly ash and bottom ash just as is the case when coal is combusted. The fly ash constitutes more of a potential health hazard than does the bottom ash because the fly ash often contains high concentrations of heavy metals such as lead, cadmium, copper and zinc as well as small amounts of dioxins and furans. The bottom ash seldom contains significant levels of heavy metals. The hazardous nature of the fly ash requires disposal at a licensed waste management facility such as a hazardous landfill site.

Level 2: Part 2: Landfill Concerns

Landfill Problems:

- The risk of contaminating groundwater with leachate
- The risk of contaminating land and making it unsuitable for some uses
- Landfill gas can be dangerous and its methane content is an important greenhouse gas
- Suitable disposal space is running short in some areas
- Public perception and nuisance issues

Mitigating Landfill Problems:

- Landfill liners and leachate (i.e. liquid material that drains from land or stockpiled material) collection systems: the purpose is to isolate landfill contents from the environment with lining (e.g. with clay or plastic membrane) or drainage system for treatment
- Minimising the working face: ensuring only small area of landfill is actively tipped at any one time
- Daily covering of wastes: covering of landfill to prevent escape of waste and scavenging by animals and birds
- Landfill capping: capping the landfill with vegetated soil, asphalt/concrete and other materials to prevent escape and rainwater ingress.
- Gas collection facilities: series of pipes entering landfill to extract gas (mostly methane and carbon-dioxide) and distribute it for incineration or energy recovery
- Greater control over what can be landfilled: restrictions on what can be landfilled, thus ensuring waste tipped in landfills is within the permitted wastes acceptable (European Waste Classification EWC) for a particular site (further explanation of EWC in level 3 part 5).

Level 2: Part 3: Incineration Concerns

Incinerator Problems

- Atmospheric pollutants – dioxins, furans, heavy metals, PCB's
- Solid waste – fly ash, incinerator bottom ash
- High initial investment
- Public perception

Mitigating Incinerator Problems

- Waste to energy technologies: technologies that convert waste (e.g. gasses) to energy.
- Combined heat and power (CHP) facilities: using the 'waste' heat from power (e.g. electricity) production to supply homes and industry.
- Waste segregation: dividing waste into wet (e.g. organic waste such as food) and dry waste (e.g. wood, metal, glass) or biodegradable and non- biodegradable. Thus ensuring materials suitable for recycling are removed.
- Management of gaseous emissions (scrubbers, filters etc): treatment of gaseous emissions through use of, for example, wet scrubbers that absorb the pollutants.
- Solid waste management: the collection, disposal and recycling of discarded material in a manner that is safe, efficient, environmentally sound and cost-effective. Careful use or disposal of fly and bottom ash.

Level 2: Part 4: Duty of Care

Duty of Care
Duty of Care applies to anyone who is the holder of controlled waste. A holder is any person who: • Produces; Imports; Carries; Keeps; Treats; Disposes of such waste; or is a waste broker • Breach of the duty of care is an offence with a penalty of an unlimited fine if convicted on indictment

Duty of Care Requirements
When you have waste you must: • contain it securely to avoid escape • transfer it only to someone with authority to take it (e.g. registered or exempt carrier/ licensed waste manager) • keep appropriate records using transfer notes (including description and information on any potential problems). When you take waste from someone else you must: • be sure you are allowed to take it • make sure the documentation is properly complete. Also, all waste holders should be alert to non-compliance of others. Holders or creators of waste have a cradle-to-grave responsibility for the waste they pass onto others.

Activity Schedule – Level 2

	Activity	*Materials*	*Method*	*Mode*	*Timing*
1	Waste impacts activity	Internet Access Paper (A3) and coloured pens.	Student Led Group Work. Computer Based Task	Internet search Poster design and feedback of student work.	**50 minutes+** 20 minutes internet search 20 minutes poster development + 10 minutes for each group to feedback
2	Duty of Care/Segregation Activity	Waste Resource Materials. Internet Access Paper and pen. Flip chart or PPT	Student Led Group Work Computer Based Task	Internet search Discussion with students and/or tutor	**1 hour** 20 minutes internet search 20 minutes analysis of search results 20 minutes discussion

Activities: Level 2 (Tutor/Student Guidance)

Level 2: Activity 1: Waste Impacts Activity

1) Students are split into groups and assigned either landfill or incineration as a disposal technique.
2) Using the internet, each pair will research the environmental issues associated with the technique and the methods for mitigation of the problems (e.g. landfill leachate treatment, landfill gas collection, incinerator scrubbing, energy recovery, emissions monitoring etc)
3) Pairs then produce information leaflet/poster summarising key points and feed back to the group

Level 2: Activity 2: Duty of Care/Segregation Activity

1) Students split into groups and analyse different images which relate to the waste Duty of Care requirements.
2) Students analyse images, discuss and relate to course documentation regarding the waste Duty of Care (DoC). Students asked to identify good/bad points in each image and any non-conformances with DoC
3) Feedback of findings to class and group discussion on how to follow duty of care and recommendations to implement.

Example Images **Model Answers**

Image 1

Non-conformances:
Co-mixing of waste streams
Poor segregation
Skip too full, risks spillage of waste materials
Health & Safety issue

Recommendation:
Segregate waste materials correctly
Don't overfill waste containers

Image 2

Non-conformances:
Waste barrels not stored correctly
Loss of containment causing contamination

Recommendation:
Relocate barrels onto hard standing
Ensure loss of containment (leakage) does not occur
Notify environment department so cleanup can be undertaken

Image 3

Non-conformances:
Use of un-licensed or untrustworthy waste contractor

Recommendation:
Check Carriers licence
Ensure paperwork is filled in correctly
Double check waste reaches its disposal destination (fly-tipping)

Image 4

Non-conformances:
Co-mixing of waste streams
Poor segregation

Recommendation:
Segregate waste materials correctly
Implement waste heirarchy

Image 5

Non-conformance:
None!
Good example of waste segregation in a workplace

Recommendation:
Ensure correct disposal by following colours on bins/containers

Image 6

Non-conformances:

Co-mixing of waste streams
Poor segregation
Skip too full - Inadequate storage of wate

Recommendation:
Segregate waste materials correctly
Implement waste hierarchy
Store less waste

Image 7

Non-conformances:
None!
Good example of good waste segregation and storage

Waste Level 3 - Professional practical knowledge: Waste produced in the workplace

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Level 3: Part 1: Waste Sources Theory Recap

Waste Classification and documentation

Essentially anything not wanted or thrown away:

Includes:

- solid waste, contained liquid wastes, process wastes
- end-of-life products/ materials

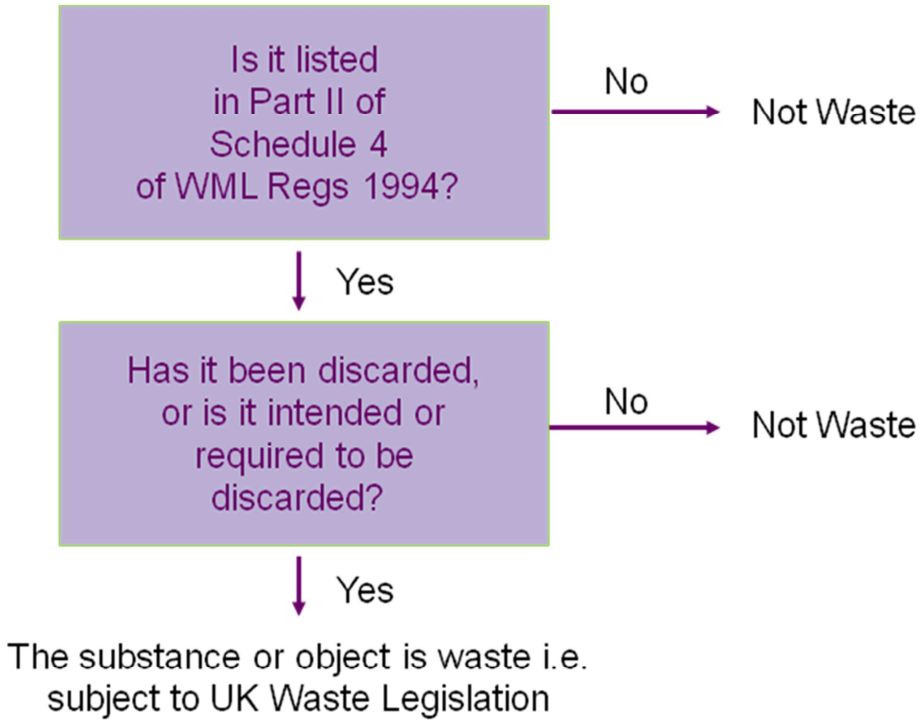
In *widest sense* can be anything that is *wasted* therefore *also*:

- effluent discharges, atmospheric emissions, waste heat

Further Examples:

- Raw materials & consumables
- Packaging
- Solid : offcuts, defective products
- Liquid: Effluent and other liquids
- Gaseous: VOC's, combustion products
- Materials covered by Hazard Waste Regulations
- Paints & Solvents
- Electrical Equipment (WEEE)
- Energy

Level 3: Part 2: Is a substance or object waste?



Level 3: Part 3: Duty of Care Documentation

Transfer Note:

- Transfer Note: In accordance with the Duty of Care, a waste transfer note has to be produced when waste is transferred from one waste holder to another
- It must be kept for at least two years
- It must provide copies to agencies if requested

Season tickets

- One transfer note covering a series of transfers
- Series of transfers of the same waste between the same parties within 12 month period

Consignment note

- Fulfills requirements of transfer documentation for hazardous waste
- Companies or sites producing above small limits of hazardous waste must be registered with the Environment Agency

Waste Carriers Licence

- Companies are allowed to transport their own created waste (except building waste)
- Carrier’s licence is required to carry other peoples’ wastes

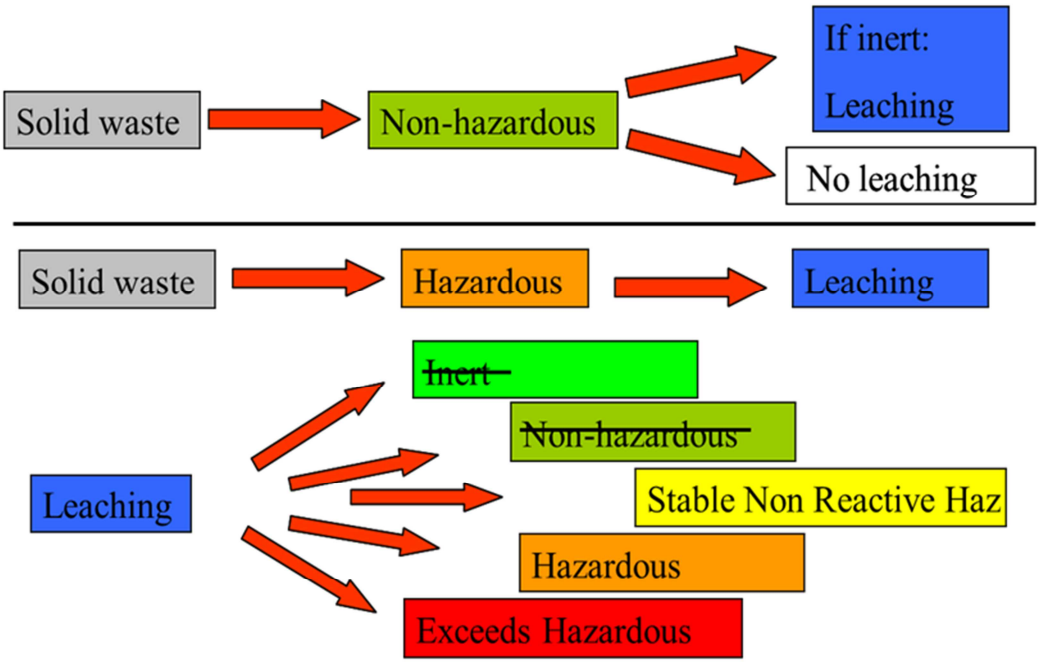
Level 3: Part 4: Hazardous and Non Hazardous Criteria (WAC)

Introduction on the classification of waste into: hazardous, non-hazardous, inert waste

Disposal locations for different waste streams (Landfill Directive)

Introduction to coding wastes under the European Waste Catalogue

Waste Acceptance Criteria (WAC): The introduction of the Waste Acceptance Criteria (WAC) aims to obtain greater control on the nature of the waste disposed of at landfills, so to minimise the impact of this form of disposal. Furthermore, the requirement to characterise all waste disposed of will make the producers more aware of the type of waste they produce, whilst improving the overall knowledge of the constitution of the waste landfilled.



This diagram gives a simplified overview of how to determine whether a leaching test is required when determining the disposal destination of solid wastes. If a chemical composition of the waste indicates that a waste in non-hazardous, no leaching test is required. If however the waste is being classified as inert (to achieve a lower rate of landfill tax) this requires a two stage leaching test. This is also the case for samples that indicate a waste is hazardous. The leaching part of the WAC test will determine the type of landfill that the material can be sent to. If non-hazardous wastes meet the leaching requirements for inert, they are allowed to be disposed of at an inert landfill. Hazardous wastes must meet limits for hazardous landfill sites and may in certain circumstanced exceed WAC and may not be disposed of in landfill, thus becoming a problematic ‘orphan’ waste.

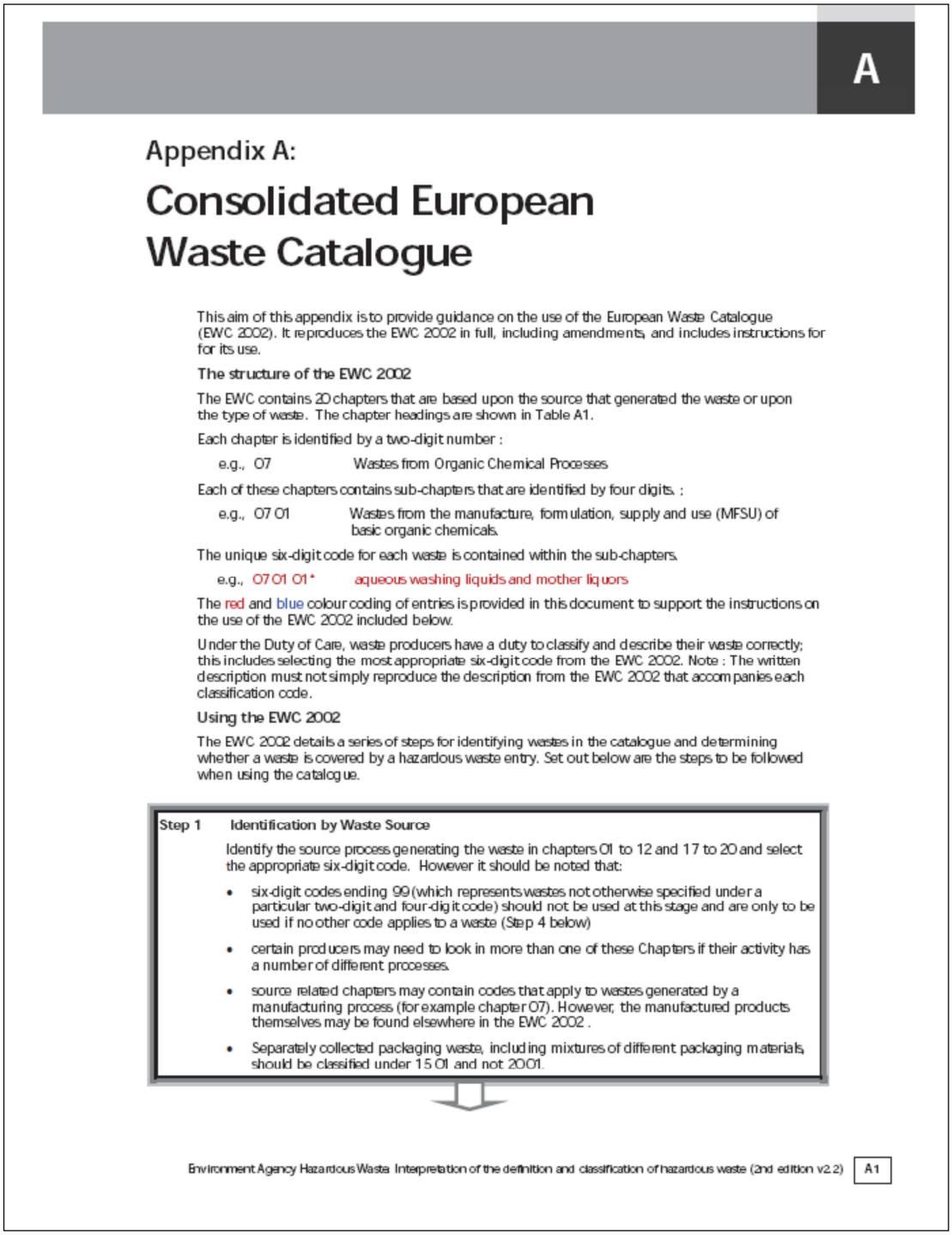
The EAF dust case study below is an example of this kind of waste, which however can be cold bonded and reused via the process, thereby pushing the waste up the waste hierarchy.

Level 3: Part 5: Landfill Directive & European Waste Catalogue

The tutor should consult:

- Landfill Directive
- European Waste Catalogue (list of wastes). Available here:

http://www.environment-agency.gov.uk/static/documents/GEHO1105BJVS-e-e.pdf



A

Appendix A:

Consolidated European Waste Catalogue

This aim of this appendix is to provide guidance on the use of the European Waste Catalogue (EWC 2002). It reproduces the EWC 2002 in full, including amendments, and includes instructions for for its use.

The structure of the EWC 2002

The EWC contains 20 chapters that are based upon the source that generated the waste or upon the type of waste. The chapter headings are shown in Table A1.

Each chapter is identified by a two-digit number :

e.g., 07 Wastes from Organic Chemical Processes

Each of these chapters contains sub-chapters that are identified by four digits. :

e.g., 07 01 Wastes from the manufacture, formulation, supply and use (MFSU) of basic organic chemicals.

The unique six-digit code for each waste is contained within the sub-chapters.

e.g., 07 01 01 * aqueous washing liquids and mother liquors

The red and blue colour coding of entries is provided in this document to support the instructions on the use of the EWC 2002 included below.

Under the Duty of Care, waste producers have a duty to classify and describe their waste correctly; this includes selecting the most appropriate six-digit code from the EWC 2002. Note : The written description must not simply reproduce the description from the EWC 2002 that accompanies each classification code.

Using the EWC 2002

The EWC 2002 details a series of steps for identifying wastes in the catalogue and determining whether a waste is covered by a hazardous waste entry. Set out below are the steps to be followed when using the catalogue.

Step 1 Identification by Waste Source

Identify the source process generating the waste in chapters 01 to 12 and 17 to 20 and select the appropriate six-digit code. However it should be noted that:

- six-digit codes ending 99 (which represents wastes not otherwise specified under a particular two-digit and four-digit code) should not be used at this stage and are only to be used if no other code applies to a waste (Step 4 below)
- certain producers may need to look in more than one of these Chapters if their activity has a number of different processes.
- source related chapters may contain codes that apply to wastes generated by a manufacturing process (for example chapter 07). However, the manufactured products themselves may be found elsewhere in the EWC 2002 .
- Separately collected packaging waste, including mixtures of different packaging materials, should be classified under 15 01 and not 20 01.

Activity Schedule

	Activity	*Materials*	*Method*	*Mode*	*Timing*
1	Practical Exercise: Controlled Waste Transfer Note	EWC document Waste Transfer and Consignment Notes Pen	Individual student exercise	Complete correctly Waste Transfer and Consignment Notes – tutor to check	**1 hour**

Level 3: Activity 1: Practical Exercise: Controlled Waste Transfer Note

Students will be required to use EWC list of wastes, permits, carriers licences etc (tutor should provide copies) and will have to fill in waste transfer and consignment notes for key wastes produced during mechanical and electrical maintenance operations.

Documents include EWC, Permits, and Carriers Licences

Examples of the required information:

- A description of the waste creation process
- Any processes the waste has been through
- How the waste is contained or packaged
- The quantity of the waste
- The place, date and time of transfer
- The name and address of both parties
- Details of the permit, licence or exemption of the person receiving the waste
- The appropriate European Waste Catalogue (EWC) code for the waste

Individual work is checked by the tutor.

Controlled Waste Transfer Note

Ref. No.

A Description of Waste

Description of waste:

Containment method bag ☐ drum ☐ skip ☐ loose ☐ other ☐ Please describe

Quantity (weight, number of containers, etc.) List of Wastes (EWC) code: ☐☐☐☐☐☐

B Current Holder of Waste *(Transferor)*

(BLOCK CAPITALS)

Full Name:

Company Name & Address:

Post Code:

Tick box(es) as appropriate

Which are you? Producer ☐ Importer ☐ WCA ☐ (Scotland Only) WDA ☐

Standard Industrial Classification Code:

Holder of an Environmental Permit ☐
Registered Waste Carrier ☐
Registered Waste Broker or Dealer ☐
Waste Disposal Authority ☐
Exemption from Permit/Registration ☐
Permit No./Reg. No.
Exemption No.
Reason for exemption

C Collector /Carrier of Waste

(BLOCK CAPITALS)

Full Name:

Company Name & Address:

Post Code:

Tick box(es) as appropriate

Which are you? Authorised for Transport ☐ WCA ☐ (Scotland Only) WDA ☐

Holder of an Environmental Permit ☐
Registered Waste Carrier ☐
Registered Waste Broker or Dealer ☐
Waste Disposal Authority ☐
Exemption from Permit/Registration ☐
Permit No./Reg. No.
Exemption No.
Reason for exemption

Transfer Details

For multiple loads or regular pick-up state date/time range

Address of Place of Transfer

Date of transfer: Time of transfer:

Current Holder of Waste *(Transferor)*
(BLOCK CAPITALS)
Full Name:
Signature:
On behalf of:

Carrier of Waste *(Carrier)*
(BLOCK CAPITALS)
Full Name:
Signature:
On behalf of:

D Receiver/Disposer of Waste *(Transferee)*

(BLOCK CAPITALS)

Full Name:

Company Name & Address:

Post Code:

Tick box(es) as appropriate

Which are you? Authorised for Transport ☐ WCA ☐ (Scotland Only) WDA ☐

Holder of an Environmental Permit ☐
Registered Waste Carrier ☐
Registered Waste Broker or Dealer ☐
Waste Disposal Authority ☐
Exemption from Permit/Registration ☐
Permit No./Reg. No.
Exemption No.
Reason for exemption

Transfer Details

For multiple loads or regular pick-up state date/time range

Address of Place of Transfer

Date of transfer: Time of transfer:

Carrier of Waste *(Carrier)*
(BLOCK CAPITALS)
Full Name:
Signature:
On behalf of:

Receiver/Disposer of Waste *(Transferee)*
(BLOCK CAPITALS)
Full Name:
Signature:
On behalf of:

E Broker Details (If applicable)

(BLOCK CAPITALS)

Full Name:

Company Name & Address:

Post Code: Broker Registration No.

SPECIMEN

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Level 3: Case Study 1: Reuse in the Steel Industry – EAF Dust

Reuse in the Steel Industry – EAF Dust

- Electric Arc Furnace (EAF) Dust
- Lead, zinc oxides content exceed relevant threshold limits for landfilling
- Hazardous, EWC 10 02 07*

Typical analysis:

This table provides the typical chemical analyses of Electric Arc Furnace flue dust that is characterised as a hazardous material and must therefore undergo leaching tests. This table shows the values that exceed the hazardous landfill leaching limits. This waste cannot therefore be landfilled in its current form and alternative recovery/disposal methods are required.

	Concentration (mg/kg) at L/S 10:1	
Analyte	EAF Dust Sample	Hazardous Landfill Acceptance Limit
As	0.0	25
Ba	3	300
Cd	0.0	5
Cl	8800	25000
Cr	8	70
Cu	2	100
F	60	500
Hg	0.01	2
Mo	200	30
Ni	0.1	40
Pb	1600	50
Sb	0.00	5
Se	0.14	7
SO_4	5750	50000
Zn	36	200

Level 3: Case Study 2: Resource Recovery example in the steel industry – EAF Dust

EAF dust cold bonded to form waste oxide briquettes (WOB's) and charged to the BOS plant. This example shows how the waste hierarchy can be applied in the context of a difficult problem waste.

Waste Level 4 - Process Know-how: Waste Auditing, Mapping and Minimisation

You are here (actual unit of the training module):

Topics from GT-VET definition	Derived contents	basic information	understand background and coherences	professional practical knowledge/ competencies	process know-how
Save and reduce input of resources	**Energy**				
	Raw materials				
Prevent and reduce emissions pollution and noise	**Noise**				
Utilize store and dispose of waste materials	**Waste**				

Level 4: Part 1: Waste Mapping

Waste Mapping

Introduction to the basics of waste mapping

Use site map to plot:

- Type of wastes created – are they gas, liquid, solid or mixture?
- Location of sources of waste and storage points – exhaust through chimneys, dust, scrap, water based to settling tanks etc. Site storage is important – all wastes are segregated when they are produced, it is poor practice and illegal to mix different wastes without a permit.
- Quantity (tonnes, kg, litres, pallets, bags etc as locally understood)
- Disposal Costs (consider breaking down into transport – internal and external, disposal, tax, other).
- Easy to view, consider drawing waste flow chart.

Consider all sources of waste, gaseous, liquid, solid including effluents and fugitive emissions

Ensure units are common

- Usually focus on disposal cost (consider future disposal costs/issues?)
- Consider the replacement cost of waste
- Try to normalise waste generation against production output
- Consider expressing wastes in weekly, monthly, annual rates.

Level 4: Part 2: Waste Mapping – How To

Site walkabout/audit

Identify sources:

- From each stage of process – what are the inputs, outputs, waste
- And each function
- Talk to employees
- Inputs and outputs at all levels – determine mass balance if practicable, make sure fugitive emissions are considered.

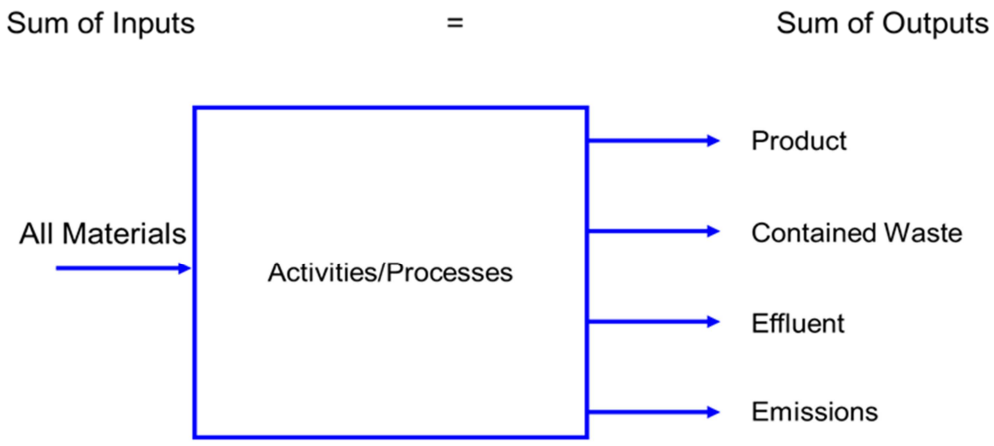
Identify types and current stats:

- Also perhaps try and normalise against production so can assess how quantities, types, nature may vary if output increases/decreases
- Consider wastes created abnormally (start up, shutdown, maintenance), normally (usual production) and emergency situations

Select/Priorities:

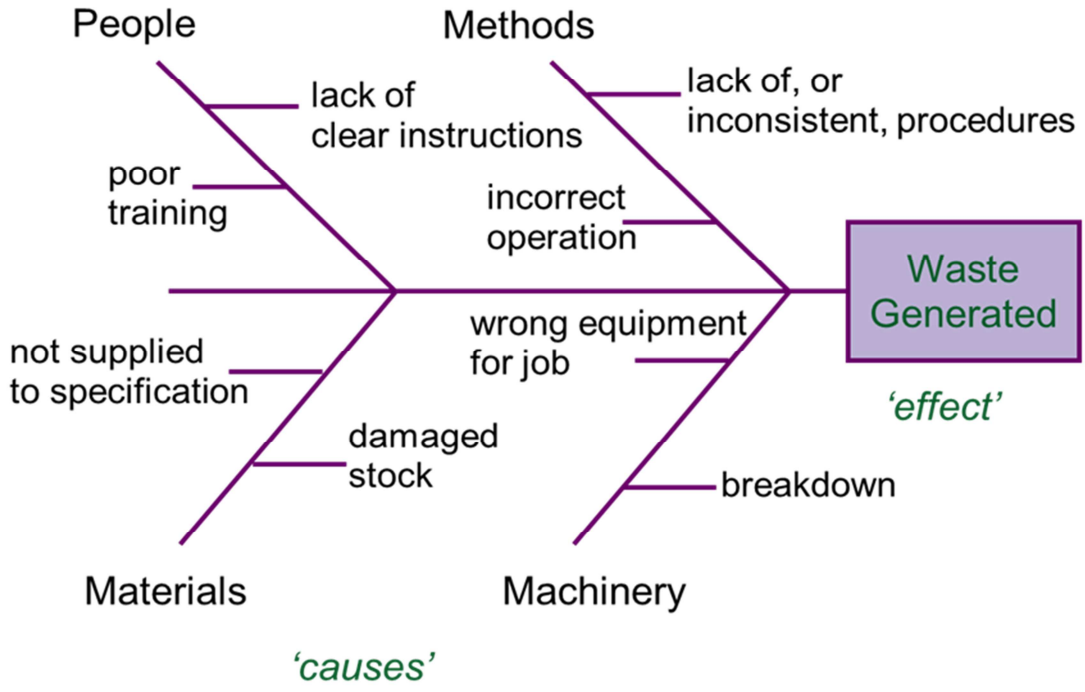
- Quick wins – easy returns, low or no cost to implement
- Major benefits: Cost, difficulty/ease of disposal
- Investment requirements
- Legal / Permit compliance

Level 4: Part 3: Waste Mapping Techniques: Mass Balance



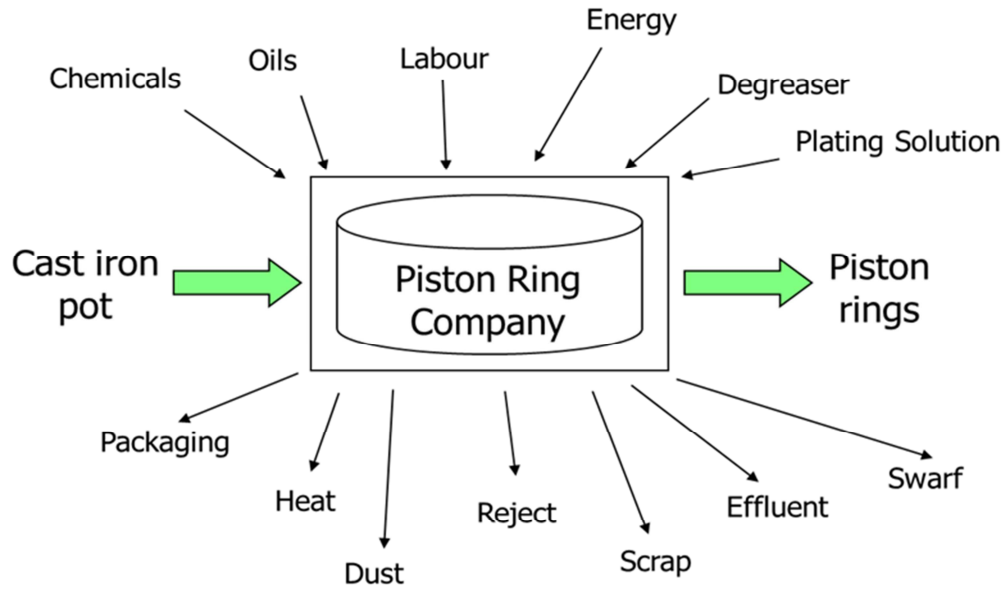
It is often difficult, over short production periods to balance masses. If it is not practicable consider over longer period, which may enable more accurate estimates to be determined for some wastes. Remember some wastes may not be routinely weighed or data captured. An important action from a waste audit might be to determine and accurate method of determining waste production rate.

Level 4: Part 4: Waste Mapping Techniques: Fishbone Diagram



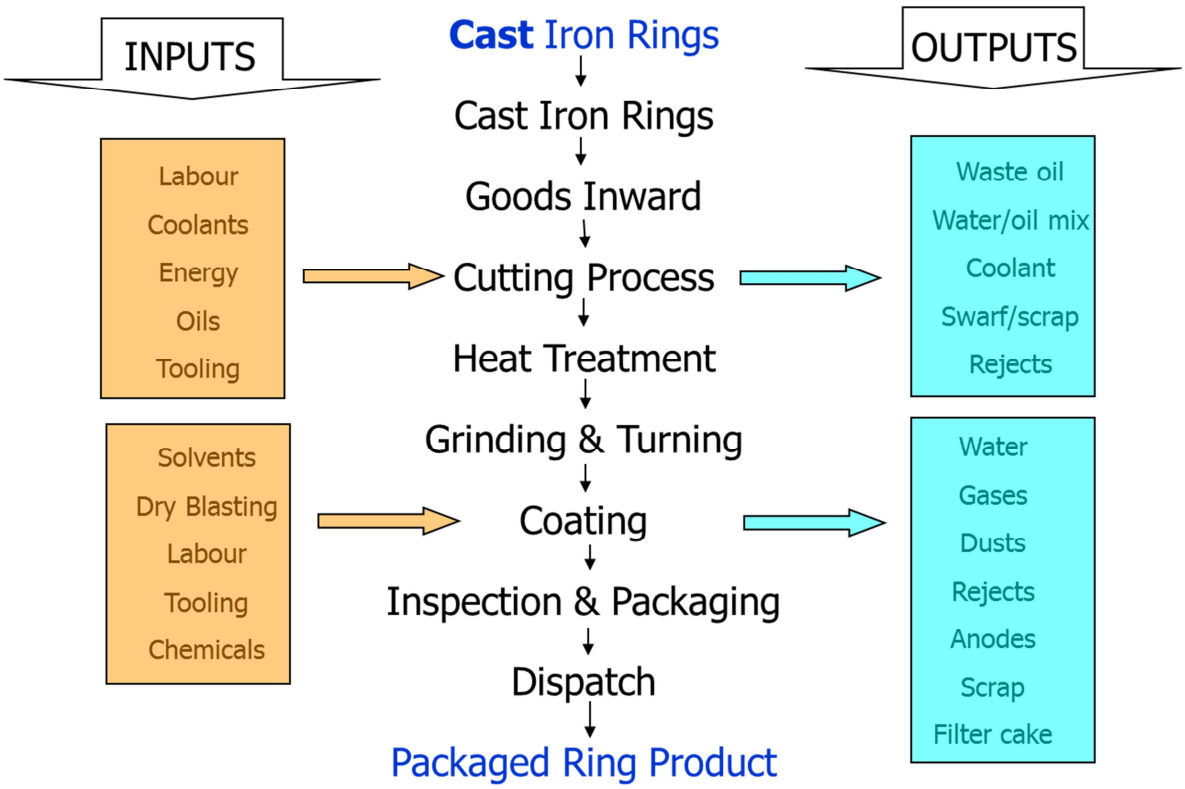
Collecting information in the above form is a useful way of considering contributory factors and potential identifying more important causes of waste and quick win opportunities. Talking to operators is an excellent method to understand what may typically happen (good practice and when things go wrong). Learn to use open questions (how and why), i.e. ones that require an explanation not just a yes / no answer.

Level 4: Part 5: Case Study Example: Stage 1 Site Level Waste Map



The above diagram is an overview of the main inputs and outputs.

Level 4: Part 6: Case Study Example: Stage 2 Detailed Level



Providing detailed information about the rate of waste generation, how the wastes are handled, their disposal routes and costs of disposal will provide valuable pointers in determining what actions may be taken to:

- Eliminate or prevent
- Minimise
- Re-use
- Recycle
- Energy recovery
- Disposal

For example:

- Centrifuging swarf / scrap to separate out cutting oils / coolant
- Filtering cutting oils and coolant to remove bacteria and extend life
- Examine heat treatment processes, can it be undertaken overnight using less expensive electrical energy or by an induction heating process

Activity Schedule

	Activity	*Materials*	*Method*	*Mode*	*Timing*
1	Student Project	Pen, paper and folder PPT	Individual student project work. Write report	Waste Mapping Exercise Feedback PPT to students and workplace colleagues	**To be completed during the duration of the course -** final submission at end of programme

Level 4: Activity 1: Student Project

Students are required to carry out a waste reduction study exercise in their workplace by applying the knowledge they have gained through the course

Objective: Carry out a waste mapping exercise to identify sources of waste, cost and legal implications for the business

Carry out an assessment on that waste to ensure the Duty of Care requirements are being fulfilled

Based on their findings, develop a strategy for

- Waste reduction (avoidance) or reuse
- Recovery/recycling of waste
- Ideas for reducing disposal costs

Students are required to report the findings in the form of a waste audit and mapping report

Presentation of key findings to the rest of the group and representatives from steel company

Video-Input (has to be distributed by TataSteel)

6. Further Development

The European Framework Module on Greening Technical VET (GT VET) will be further developed (adjustment of the existing sub-modules, adding new sub-modules like water recycling, VET system integration, etc.):

- Within the activities of the Working Group 5 “People” of the European Steel Technology Platform.
- Within transfer of innovation projects
  - for other industries (like automotive, cement, chemical industry)
  - for other occupations (like in the Italian LLP project EdilMap: green skills for the occupations of the construction sector)
  - to other steel and industry regions in Europe.
- Within the different national VET systems and ECVET.

Within the final European conference of GT VET (with VET stakeholders, social partners, the steel industry as a whole, and other relevant manufacturing industries attending) a high level round table panel discussed “Green Skills Relevance for the Competitiveness of the European Industry”. The panel participants from OECD/LEED, DG EAC, DG Employment, EUROFOUND, industriALL, ESTEP, and a Member of the European Parliament, Greens/European Free Alliance stated that the GT VET approach is the right concept for

- pushing green awareness with generic, specific, essential and transversal skills
- new ways of learning and training pathways off the classroom
- a flexible and easily integration in education and training programs, in schools/VET institutions and companies as well
- sectoral and cross-sectoral cooperation between companies
- and: a responsive and short-termed integration of new skills - coming from continuously and rapidly changing (production) technologies - into the workplace, the shop-floor.

Based on the GT VET concept as an outlook the following future oriented requirements or suggestions were made:

- more flexibility and practicability of VET and a focus on generic, specific and transversal skills
- looking much more on job transformation to ensure a smooth transition in the different member states, done by a closer cooperation between companies and VET institutions (esp. schools)
- getting VET closer to user needs and drive innovations processes by this
- using the GT VET concept for more innovation at the shop-floor, for the workforce, for improving productivity of resources: to improve work place innovation and platforms for exploring the idea of driving innovation.
- to bind all different actors from different fields to build up skills alliances (sector skills councils, sector alliances) oriented at different occupations and/or sectors, even as cross-sectoral
- encouraging a better sectoral and cross-sectoral cooperation between companies: green skills have to be extended for all industries and all kind of staff – white and blue collar as well as all levels of management: all have to have knowledge about green developments and technologies and the ability of greening their work

- pushing the development of the green skills approach further with proactive sector led proposals, focusing as well on the local and regional level because that is where the drives comes from
- to enlarge investment on skills development in general.

Other recommendations: The future perspective of a green skilled industry depends on three factors: recognition, enormous investment in finance and skills (governments, companies, etc.) and visions/illustrations/objectives (e.g. reports/papers from the European Commission, projects etc.). Ministries and authorisations have to be taken into account in order to deliver and anticipate skills. Green Deals (like in the UK) have to be made. Anticipation to offer demand related training is necessary. Green skills are transversal in covering all levels and all jobs, on the shop floor, but in management as well, posing future challenges for the companies with regard to the establishment of a common “mind set” for green awareness.

Plans for the Future

Based on the results of GT VET and the feedback of steel industry representatives and the high level round table participants it was decided that after the funding phase of the GT VET project by the European Lifelong Learning Programme, the *European Framework Module on Greening Technical VET will be run and developed continuously by the Working Group “People” of the European Steel Technology Platform ESTEP*. Since 2013 both (scientific and company related) co-ordinators of GT VET are as well the elected chairman (Veit Echterhoff from ThyssenKruppSteel Europe) and vice-chairman (Antonius Schröder, Technische Universität Dortmund – sfs) of this working group. The GT VET approach on greening technical VET and the steel industry became also part of the new Strategic Research Agenda of ESTEP, integrated into a social innovation perspective.

On this foundation and institutionalisation the European Framework Module will be continuously developed, disseminated and exploited:

- **Continuous management and coordination** in close cooperation with the members of the working group (steel companies, research institutes, steel universities, steel platforms and associations) and the social partners (EUROFER, industriALL, Sectoral Social Dialogue Committee Steel /Training), national and European VET experts, as well as organisations referring to green aspects in the steel industry.
- **Continuous development** of the European training module as a comprehensive “continuous progressing training module” driven by the demands of the steel industry, by integrated new qualification demands, new sub-modules and training methods.
- **Continuous efforts** for the short-termed and responsive integration of steel industry related qualification demands in the national VET systems, adapting the European training module in steel companies and in VET institutions on the regional level (in each relevant member state).
- **Development of a sectoral agreement** on the acknowledgement of ECVET within the steel industry: The further improvement of the European Framework Module will be interrelated with the elaboration of credit points and their acknowledgement. To ensure the mobility and transfer of approved learning outcomes the development of a sectoral agreement on ECVET will be an objective to be launched in WG5 of ESTEP, maybe done by a social dialogue project.
- **Continuous active dissemination** of the project within ESTEP, the Sectoral Social Dialogue Committee Steel /Training, at conferences on VET and / or HR development, to the scientific community and of course to the national VET responsible institutions of the member states.

- **Continuous proceeding and improvement of the GT VET website**, covering all the relevant information, activities and plans for the future, integrated more interactive elements like social media blogs and e-learning parts (if accepted and used by the target groups).
- **Continuous active exploitation** of the GT VET concept and module on the sectoral, national and European level within the steel industry and to other industry sectors:
  - Within the industry by transferring the module to other sites of the involved and other steel companies
  - using the dissemination platforms of ESTEP, EUROFER and industriALL as well as the activities of the research institutes
  - supporting existing and forthcoming skills development platforms like Skills Councils (as advised in the High-level Round Table on the future of the European Steel Industry, Draft 2013)
  - by already approved or advised projects on
    - transfer of this innovation (concept) to other sectors (GREEN STAR, *currently in evaluation*) and other occupations and continuous vocational training CVET (to be done),
    - social innovation (large scale FP7, Social Innovation: Driving Force of Social Change SI-DRIVE – policy area “education” and “sustainability”, *currently in negotiation phase, to start in 2014*) and workplace innovation (The European Workplace Innovation Network – euwin, *already started and funded*),
    - the development of sustainable innovations (public private partnership SPIRE Sustainable Process Industry through Resource and Energy Efficiency www.spire2030.eu, Ultra–Low Carbon dioxide (CO_2) Steelmaking ULCOS www.ulcos.org, CASI – Public participation in developing a common framework for assessment and management of sustainable innovation).

In all these activities and projects, members of the GT VET consortium (especially ThyssenKruppSteel and Technische Universität Dortmund – sfs) are already engaged or even play a leading part. For the listed objectives and activities, in addition to own resources of the involved members of ESTEP WG5, future funding schemes like “Erasmus for All” and “Horizon 2020” will be checked and used as well as the public-private-partnership “SPIRE 2030” to sustainable develop the European Framework Module GT VET.

Contribution to EU policies

The project is in line with the objectives of European lifelong learning policy by having created an innovative and updating VET module, improving the European VET system by sustainable, short term and industry driven pathways between industry and national VET systems, securing a correspondent exchange from a European level to the national VET systems, embedding an excellent basis for valorisation of the training module and its pathways / implementation procedures to other steel companies and production industries, to other member states and to other professional occupations.

On the other hand, the project refers to basic European strategies and guidelines: Implementing new skills for new job demands (new skills for new high-skilled workers in the steel industry), being complementary with the Lisbon strategy by taking the greening of the steel industry as a European competitive advantage and refocus the steel or production industry as a key industry of the European competitiveness (the EU 2020 strategy paper outlines ecological sustainability as crucial for the competitiveness of the European industries in global markets), the industry and job oriented implementation of the EU environmental directives (IPPC, GHS, REACH, etc.) and national guidelines and recommendations.

The third relevance area regards the steel industry itself, referring to the main challenges stated already at the Warsaw conference 2007 “recruitment and training”: recruitment and attracting of young employees by offering high-skilled, safe and healthy jobs to overcome the demographic change in an ecological oriented production industry, offering continuous developing training modules for future oriented skilled workers in correspondence with the VET system and stimulating a short term implementation of industry required qualifications, in relation to already existing or planned activities (e.g. the German Federal Institute of VET is stimulating and funding sectoral VET on sustainable development).

In order to overcome some limitation because of VET system imminent constraints (e.g. teachers have no time or interest of integrating the sub-modules, lack of financial resources) companies, industry association as well as public authorities (e.g. ministries, regional and local authorities) should be aware of integrating modules like GT VET not only in the training programs of metallurgical companies, but also in the national vocational training program. The idea of GT VET should be propagated and show the benefits of raising pro-environmental awareness in a systematic way, on the basis of the continuation and expansion of issues from foundations gained in schools till the professional career. The module should be integrated in existing VET systems both at national and steel companies’ levels. Wider recommendations were made upon a greater co-operation between companies and vocational schools in the way that school content must be relevant, specific and applied to company practice. Further, it is important that in-company training programs are reinforced by wider campaigns and information distribution.

In line with the objectives of lifelong learning, by creating an innovative and continually developing VET module, GT VET is improving the European VET system by

- developing sustainable, immediate and industry driven pathways that fit between industry and national VET systems,
- securing a correspondent exchange from a European level to the national VET systems,
- embedding valorisation possibilities to other steel companies and production industries, to other member states and to other professional occupations.

The European training module, which has Europe-wide application and is run by the European steel industry, with correspondent pathways to the national VET system, will anticipate actual and future industry needs (thus tackling a lack of short term implementation of industry required new skills, improving cooperation between industry and VET system, etc.). In terms of concrete skills the module aims at improving the green skills and awareness for technical professions in the steel industry. In line with the Lisbon agenda, the EU 2020 strategy and the European environmental directives GT VET aims to contribute to the European VET systems as a basis for lifelong learning pathways and industry competitiveness by making production and industry as a whole greener.

To foster this approach, the GT VET consortium formulates the following **key policy recommendations**:

1. The VET systems should be **flexible and give leeway to include modules** of VET with industry driven demands systematically and in immediate and responsive ways, to be integrated in different institutions (secondary and vocational schools, company oriented vocational education and training) for different reasons (general education, initial vocational education and training, further vocational training to adjust missing competences).
2. **Overarching European wide learning objectives** on green skills should be defined for all technical occupations to foster bindingly cognitive and empirical learning as well as awareness building in close relation to everyday work, the workplace challenges, in cooperation with national VET institutions and systems; based on an industry related **European definition of green skills**: reflecting the specificity of the industry sectors and

top-down to incorporate wider ‘green’ policy imperatives bottom-up (such as those deriving from EU 2020 strategies).

3. The European Credit System for Vocational Education and Training ECVET should be implemented as soon as possible providing the basis for a **European wide and accepted certification** of the training module contents, also giving leeway to integrate and acknowledge small modules like GT VET into formal education and training programmes.
4. The **cooperation and involvement** of enterprises and social partners as well as stakeholders of VET institutions like vocational schools and chambers of industry should be improved **at the regional level**, where people live, work and learn.
5. The New Skills for New Jobs initiative focused on 19 industries, but the European steel industry was not considered. However, this project follows the direction of this European flagship initiative. Not only the new economy, but also the “traditional” production industries like the steel industry with it high-technology based production processes and products should be considered in **European advanced manufacturing** activities to a much greater degree (because industry is still a backbone of European competitiveness).