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Vietnamese-German "Programme Reform of TVET in Viet Nam"

CATALOGUE OF LEARNING OUTCOMES FOR "GREEN TVET"

derived from Viet Nam's Green Growth Strategy & National Action Plan on Green Growth

Imprint

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Abbreviations

- **BMUB** Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit [Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety]
- **BMZ** Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung [Federal Ministry for Economic Cooperation and Development]
- **CNC** Computerized Numerical Control
- **GDVT** General Directorate of Vocational Training
- **GGAP** National Action Plan on Green Growth for the period 2014 2020
- **GHG** Greenhouse gas
- **GIZ** Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
- HVCT Ho Chi Minh Vocational College of Technology
- HRD Human Resource Development
- **INEST** Institute for Environmental Science and Technology of Hanoi University of Science and Technology
- MOLISA Ministry of Labour, Invalids and Social Affairs
- **NIVT** National Institute for Vocational Training
- TC Technical Cooperation
- **TVET** Technical and Vocational Education and Training
- **UNEP** United Nations Environmental Programme
- **UNIDO** United Nations Industrial Development Organization
- VCMI Vocational College of Machinery and Irrigation
- VGGS National Green Growth Strategy for the period 2011 to 2020 and vision to 2050
- VNCPC Vietnam Cleaner Production Centre

Preliminary remarks

In Viet Nam, Technical and Vocational Education and Training (TVET) is high on the political agenda, because it is recognized that the development step from a low-wage country to an industrialized country is not possible without the appropriate availability of a skilled and competent workforce for the modern industrial sector. In addition, vocational training through the promotion of employability as well as the holistic development of individuals is an important factor for social development and stability in the country. At the same time, vocational training should become more closely oriented to the needs of a green economy. The implementation of the National Green Growth Strategy for the period 2011 to 2020 and vision to 2050 (VGGS), approved by the Prime Minister in September 2012, as well as the National Action Plan on Green Growth (GGAP) for the period 2014 – 2020, finally approved in March 2014, give a key role to the sustainable economic development of Viet Nam and address the following key points:

- reduction of the intensity of greenhouse gas emissions and promotion of the use of clean and renewable energy;
- greening production;
- greening lifestyle and promotion of sustainable consumption.

To achieve the objectives, the development of human resources is crucial. Qualified professionals are required, among others, to implement adapted sustainable production processes and to install, use and maintain new technologies.

Referring to the VGGS, the country strategy of BMZ in Viet Nam provides the framework for the development cooperation between the two countries: *"Human Resource Development (HRD) is considered a key factor for the further development of Viet Nam. Technical and voca-tional education and training plays a central role, which is reflected in the TVET strategy 2011-2020 with the objective of reaching the quality breakthrough in TVET. Furthermore, the adoption of the Green Growth Strategy put the importance of vocational training for a green economic development on the political agenda of the authorities and actors in charge (Ministry of Labour, Invalids and Social Affairs (MOLISA) and General Directorate of Vocational Training (GDVT)). The National Institute for Vocational Training (NIVT) of GDVT developed essential objectives and activities for the training of skilled workers for green growth, which was anchored in the action plan."*

In order to support the development of competent workforce capable of meeting the requirements of a "green" economy in Viet Nam, a catalogue of learning objectives for green skills development derived from the targets set in the VGGS and related GGAP, which includes HRD/TVET as an important cross-cutting issue, has been compiled. The learning outcomes describe requirements of a "green" economy for TVET which are then to be integrated in the occupational standards and the training programmes of all occupations supported by the Vietnamese-German Technical Cooperation (Metal Cutting / CNC Technician, Construction Mechanics Technician, Industrial Electronics Technician, Mechatronics Technician and Sewage Engineering Technician) at the TVET institutes LILAMA 2 Technical and Technology College, Ho Chi Minh Vocational College of Technology (HVCT) and Vocational College of Machinery and Irrigation (VCMI). The developed list of learning outcomes shall serve as a basis for measuring the alignment of the training offers with the demands of a "green" and sustainable economy.¹

¹ Module objective indicator 1 of the Vietnamese-German "Programme Reform of TVET in Viet Nam": "10 requirements derived from the Green Growth Strategy are integrated into the supported initial and further training programmes, especially at the new Centre of Excellence for Green TVET."

Accordingly, the following tasks have been completed:

- Analysing the VGGS and the GGAP as well as other related documents by the Vietnamese government on Green Growth;Deriving a list of learning outcomes describing the requirements of a "green" economy for TVET which are to be integrated into the occupational standards and the training programmes at the TVET institutes LILAMA 2, HVCT and VCMI;
- Elaborating recommendations on the usage of the list of learning outcomes.

1 Green skills requirements in the National Green Growth Strategy as well as in the National Action Plan on Green Growth

1.1 National Green Growth Strategy

Viet Nam's National Green Growth Strategy for the period 2011 to 2020 and vision to 2050 (VGGS), issued on 25 September 2012, is an important framework for sustainable development of the country. The VGGS aims at more efficient usage of energy and resources, reducing greenhouse gas emissions and other air pollutants, creating new jobs in green economic sectors as well as promoting a green lifestyle in order to improve the living conditions of the people.

In detail three strategic tasks are addressed:

- 1. Reduction of the intensity of greenhouse gas emissions and promotion of the use of clean and renewable energy;
- 2. Greening of production;
- 3. Greening of lifestyle and promotion of sustainable consumption.

These tasks are accompanied by a catalogue of 17 so-called *solutions* and respective activities.

Solution 15 is on "Human resource training and development" and comprises the following activities:

- "Provide training, knowledge enhancement as well as governance and management skills on green economy, green production sectors for government staff and enterprise staff, starting with leaders, policy makers and those involved in the formulation process of socio-economic development strategies, master plans and plans.
- Develop human resources for green growth based on research to identify and select the contents of green growth, green technologies, sustainable exploitation of natural resources ... and mainstream these into education and vocational training at all levels.
- Formulate guidance for enterprises to access finance and technology options to shift towards green industry and green agriculture."²

Besides, most of the other *solutions* and activities of the VGGS have an implicit skills development component in the sense that implementing these measures will require a well trained workforce. However, the particular potential of Human Capacity Development (HCD) and Technical and Vocational Education and Training to support the green growth strategy is not specified.

² VGGS 2012, p. 11

1.2 National Action Plan on Green Growth

Based on the VGGS, the National Action Plan on Green Growth (GGAP) for the period 2014 – 2020 has been developed and discussed with various stakeholders in several consultation meetings in 2013. The GGAP, approved on 20th March 2014, contains 4 main themes, 12 groups of activities and 66 specific activities:³

- Theme 1: Setting up institutions and formulating green growth action plans at the local level (8 activities in 2 groups)
 - Institutional set-up
 - Formulating of local GGAPs
- Theme 2: Reducing the intensity of greenhouse gas (GHG) emissions and promoting the use of clean and renewable sources of energy (20 activities in 4 groups)
 - Implementing efficient and effective use of energy and reducing GHG emission in some energy consuming industrial sectors
 - Implementing efficient and effective use of energy and reducing GHG emission in the transportation sector
 - Changing cultivation techniques and improving management to reduce GHG emission in agro-forestry and aquaculture
 - Developing clean and renewable sources of energy

Theme 3: Greening production (25 activities in 4 groups)

- Reviewing and recommending revisions of development strategies, master plans, plans and formulating the program to restructure the economy towards green growth
- Using natural resources efficiently and sustainably and developing green economic sectors
- Developing sustainable infrastructure
- Promoting campaigns on "Enterprises for Sustainable Development", improving capacity and markets to provide green technical and management services for green growth
- Theme 4: Greening lifestyle and promoting sustainable consumption (13 activities in 2 groups)
 - Developing green and sustainable urban areas
 - Promoting green lifestyle

The period of 2014 to 2020 shall focus on 23 prioritized activities, among others

- Raising awareness and involving wide participation of all the people in VGGS implementation (no. 4)
 - Organizing communication and awareness raising activities on green growth in organizations, public agencies and civil societies representing communities.
 - Mainstreaming green growth into on-the-job training curricula for officials at all levels.
 - Promoting community campaigns in greening production and greening lifestyle.
 - Orienting and supporting the network development of technical consulting organizations and NGOs working to promote green growth.
- Improving energy management capacity in industries and constructions (no. 16)
- Providing training and awarding certificates on energy management and auditing for workers/ managers in industrial production sectors as well as managing and using construction works.
- Formulating and implementing policies that give priority to the development of clean energy sources (no. 26)

³ GGAP 2014, p. 1

- Reviewing and recommending revisions of the master plan for hydropower plants development.
- Establishing policies of investment, tax and price as well as market economic instruments to encourage exploiting and using natural gases.
- Issuing and monitoring the operation of economic policies to promote producing and consuming new energy sources (solar, wind, biomass, thermal and biofuel).

"The Government gives priorities and allocates sufficient budget from central and local sources to implement the GGAP, especially to improve efficient use of energy and development of renewable energy."⁴ As a consequence, the efficient use of energy and the use of renewable energy sources can be seen as the priority topics in the GGAP.

TVET is explicitly addressed in activity 38 "Support to develop human resources for green jobs(s)" which is a non-prioritized activity. It is specified as: "Support to develop technical human resources in sectors of green economy and issue policies to encourage the generation of green jobs".⁵

Besides, TVET is implicitly addressed in the following prioritized activities of the GGAP, but without specifying further details:

- Raising awareness and involving wide participation of all the people in VGGS implementation (no. 14).
- Improving energy management capacity in industries and constructions (no. 16).

1.3 Other concepts

Within the VGGS and the GGAP the concept of the Green Economy as well as the Cleaner Production initiative are used as concepts of reference. Thus, these concepts are shortly introduced and analysed in respect to hints for learning outcomes of Green TVET.

Green Economy

The concept of a green economy is promoted by the Green Economy Initiative of the United Nations Environmental Programme (UNEP) and emerged onto the global agenda in the runup to the UN Rio+20 Conference in 2012. Since then it has established itself as the new environmental guiding principle and plays an increasingly important role in strategic development processes on the national and international levels.⁶ The concept refers to an economy that is oriented towards ecological sustainability, economic profitability and social inclusion. Green Economy is characterised as an innovative economic approach, which meets the following requirements:⁷

- avoidance of harmful substances and emissions in all environmental media (air, soil, wa-ter);
- further development of the circular economy, that means avoiding of waste, reusing and recycling of waste materials as well as closing of regional material circles as far as possible;
- absolute reduction of usage of non-renewable resources, particularly by means of efficient use of energy, raw materials and other natural resources;
- continuous substitution of non-renewable resources by sustainably produced renewable resources;
- long-term switch to an energy system based on renewable energies;
- conservation or restoration of biodiversity as well as eco-systems and their performances.

⁴ GGAP 2014, p. 3

⁵ GGAP 2014, p. 22

⁶ See GIZ 2013, p. 19

⁷ See BMUB 2015, p. 5

Cleaner Production

Cleaner Production is a preventive, company-specific environmental protection initiative. The concept, developed as a programme of the United Nations Environmental Programme (UNEP) and the United Nations Industrial Development Organization (UNIDO), aims at resource-efficient and low-carbon industrial production. It is intended to increase the productive use of energy, water and other natural resources, minimize generation of waste and emissions and foster safe and responsible production in order to create a win-win-situation: saving energy and resources as well as reducing emissions on the on hand side and saving money due to cost reductions on the other.⁸ In Viet Nam the Vietnam Cleaner Production Centre (VNCPC) is promoting this concept. It is located at the Institute for Environmental Science and Technology (INEST) of Hanoi University of Science and Technology.

1.4 Conclusions

Both the VGGS and the GGAP contain only implicit skills development components; however, the potential of HCD and TVET to support the green growth strategy and action plan is stated as topics to be considered. On the other hand, relevant issues for TVET can be deduced from the objectives, themes and activities of VGGS and GGAP as well as from the relevant reference concepts Green Economy and Cleaner Production.

Accordingly, the following topics can be deduced from VGGS and GGAP as relevant for greening TVET:

- effective and efficient use of energy including energy management;
- reduction of the intensity of greenhouse gas emissions;
- efficient use of natural resources (e.g. water);
- use of renewable energies (solar, wind, biomass, geo thermal and biofuel);
- awareness raising on green growth.

The concepts of Green Economy and Cleaner Production contain these issues relevant for TVET:

- avoidance of harmful substances and emissions in all environmental media (air, soil, water);
- avoidance of waste, reusing and recycling of waste materials;
- absolute reduction of usage of non-renewable resources, particularly by means of efficient use of energy, raw materials and other natural resources;
- continuous substitution of non-renewable resources by sustainably produced renewable resources;
- safe and responsible production.

2 Catalogue of learning outcomes for Green TVET

The following catalogue of learning outcomes is based on the results of

- the analysis of the Green Growth Strategy, the Action Plan and the corresponding concept of Green Economy and Cleaner Production
- the analysis of relevant German training regulations and framework curricula for vocational schools as well as
- the analysis of occupational standards of the selected occupational fields supported by the Vietnamese-German TVET programme.

The catalogue consists of cross-occupational and occupation-specific criteria.

The learning outcomes for Green TVET of the occupations "Metal Cutting/CNC Technician (Milling Machine Operator)" and "Construction Mechanics Technician (Construction Mechanic)" are identical due to the great similarities between the two occupations. On the other

⁸ See UNEP 2016

hand, the "Mechatronics (Mechatronics Fitter)" combines elements of both metal working and electronics occupations. Consequently, this list contains learning outcomes of the selected metal working and electronics occupations, but focussed on mechatronics systems.

2.1 Cross-occupational learning outcomes for Green TVET

At the end of the training the student is able to⁹

- 1. explain the relevance of the VGGS and the GGAP for his/her college and partner company and his/her occupation using examples
- 2. apply relevant environmental protection regulations at the workplace
- 3. give examples of organisational, technical and behavioural measures for environmental protection/efficient use of energy and resources in the college and the partner company
- 4. describe possible environmental risks at his/her workplace and how he/she can minimize these risks by correct occupational behaviour
- 5. use energy effectively and efficiently
- 6. use natural resources and materials effectively and efficiently
- 7. apply the "3 Rs" of the so-called waste hierarchy (reduce, reuse, recycle)
- 8. store and handle hazardous substances as well as hazardous waste in an environmentally friendly manner
- 9. advise customers on energy efficient and effective utilizations

2.2 Occupation-specific learning outcomes for Green TVET

2.2.1 Metal Cutting/CNC Technician (Milling Machine Operator)¹⁰

At the end of the training the student is able to

- 1. evaluate the ecological impacts of different joining and separation techniques
- 2. avoid unnecessary energy consumption by correct planning, processing and maintaining of manufacturing processes
- 3. avoid scrap and high rate of material consumption by correct planning, processing and maintaining of manufacturing processes
- 4. handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, fuels and anticorrosive) in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)
- 5. separate and dispose unusable components as well as scrap metals and plastics according to the requirements of the waste management system of the college and the partner company

2.2.2 Construction Mechanics Technician (Construction Mechanic)¹¹

At the end of the training the student is able to

- 1. evaluate the ecological impacts of different joining and separation techniques
- 2. avoid unnecessary energy consumption by correct planning, processing and maintaining of manufacturing processes
- 3. avoid scrap and high rate of material consumption by correct planning, processing and maintaining of manufacturing processes
- 4. handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, fuels and anticorrosive) in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)
- 5. separate and dispose unusable components as well as scrap metals and plastics according to the requirements of the waste management system of the college and the partner company

⁹ The use of renewable energies is not considered, because it is not part of the ordinary training in the five occupations.

¹⁰ In brackets (...) you find the official translation of the BIBB; German term: Zerspanungsmechaniker/in.

¹¹ In brackets (...) you find the official translation of the BIBB; German term: Konstruktionsmechaniker/in.

2.2.3 Industrial Electronics Technician¹²

At the end of the training the student is able to

- 1. evaluate the ecological impacts of different types of power supply
- 2. avoid unnecessary energy consumption by correct planning, implementing and maintaining of electrical/electronic installations
- 3. avoid scrap and high rate of material consumption by correct planning, processing and maintaining of electrical/electronic installations
- 4. evaluate the ecological impacts of different electrical drives and pneumatic actuators
- 5. handle frequency converters with electronic rotation speed control in order to optimize the engine output of electric drives
- 6. separate and dispose unusable components and electric/electronic waste as well as used batteries and other waste containing hazardous substances according to the requirements of the waste management system of the college and the partner company

2.2.4 Mechatronics (Mechatronics Fitter)¹³

At the end of the training the student is able to

- 1. evaluate the ecological impacts of different joining and separation techniques and different types of power supply
- 2. avoid unnecessary energy consumption by correct planning, implementing and maintaining of mechatronics systems
- 3. avoid scrap and high rate of material consumption by correct planning, processing and maintaining of mechatronics systems
- 4. evaluate the ecological impacts of different electrical drives and pneumatic and hydraulic actuators
- 5. handle frequency converters with electronic rotation speed control in order to optimize the engine output of electric drives
- 6. handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, fuels and anticorrosive) in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)
- separate and dispose unusable components, scrap metals and plastics as well as electric / electronic waste and used batteries and other waste containing hazardous substances according to the requirements of the waste management system of the college and the partner company

2.2.5 Sewage Engineering Technician¹⁴

At the end of the training the student is able to

- 1. evaluate and minimize the ecological impacts of sewage treatment plants and corresponding drainage systems
- 2. avoid unnecessary energy consumption by correct planning, processing and maintaining of electrical/electronic installations
- 3. handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, grease and fuels) as well as environmental chemicals in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)
- 4. dispose wastes from sewage treatment plants in an environmentally friendly manner
- 5. separate and dispose residues, unusable components, scrap metals and plastics as well as electric/electronic waste, used batteries and other waste containing hazardous substances according to the requirements of the waste management system of the college and the partner company

¹² German term: Industrieelektroniker/in; since August 2003 replaced by Electronics Technician for Automation Technology (German term: Elektroniker/in für Automatisierungstechnik).

¹³ In brackets (...) you find the official translation of the BIBB; German term: Mechatroniker/in.

¹⁴ German term: Fachkraft für Abwassertechnik

3 Recommendations

In this chapter, recommendations on the usage of the list of learning outcomes for Green TVET are given. In the tables the reader finds – if necessary – a clarification of each learning outcome ("explanations") as well as hints on how to include the learning outcomes for Green TVET in the draft occupational standards developed jointly by the TVET institutes LILAMA 2, HVCT and VCMI and the business sector with support of the Programme Reform of TVET in Viet Nam (GIZ) and explicit or implicit references to specific duties and tasks which are already described in the draft occupational standards for the supported occupations ("implementation").

3.1	Recommendations on the usage of the cross-occupational learning
	outcomes

No.	Learning outcome	Explanation	Implementation
1	Explain the relevance of the VGGS and the GGAP for his/her college and partner company and his/her occupation using examples	In order to develop environmental awareness every student should know the concerns, objectives and main activities of the VGGS and the GGAP. Students should be able to give exam- ples on how they can contribute to achieving the goals of the VGGS and the GGAP.	New issue. Should be considered in conjunction with learning outcome no. 3. In order to raise awareness/contribute to achieving the goals of the VGGS and the GGAP with regard to the occupation, the college and the partner company (project work; experts discussions with senior management & exploration of the training company).
2	Apply relevant environmen- tal protection regulations at the workplace		Already part of occupational standards in the fields of metal working and elec- trical engineering: D2.
3	Give examples of organisa- tional, technical and behav- ioural measures for envi- ronmental protection/ effi- cient use of energy and resources in the college and the partner company	Learning outcome 3 is more detailed than the task in the current draft occu- pational standards of metal working and electrical engineering and includes efficient use of energy and resources.	Partly considered in occupational stand- ards in the fields of metal working and electrical engineering: D1.
4	Describe possible environ- mental risks at his/her work- place and how he/she can minimize these risks by correct occupational behav- iour	Learning outcome 4 is focussed on the workplace and the student's occupa- tional behaviour.	Partly considered in occupational stand- ards in the fields of metal working and electrical engineering: D1.
5	Use energy effectively and efficiently	Besides efficient usage of energy (effi- ciency: to do things correctly) students should be able to assess if a technical solution is appropriate to achieve a goal (effectively: to do the right things).	New issue. Should be highlighted in the occupa- tional standards or training plans.
6	Use natural resources and materials effectively and efficiently	See above	Partly considered in occupational stand- ards in the fields of metal working and electrical engineering: D4.
7	Apply the "3 Rs" of the so- called waste hierarchy (re- duce, reuse, recycle)	This learning outcome is more detailed than the phrase "avoid waste and han- dle resources thoroughly" in the current draft occupational standards of metal working and electrical engineering.	Partly considered in occupational stand- ards in the fields of metal working and electrical engineering: D4.
8	Store and handle hazardous substances as well as haz- ardous waste in an envi- ronmentally friendly manner	Correct storage of hazardous sub- stances is an important issue. General- ly, catch basins are required, which could be manufactured by students in terms of project work.	Partly considered in occupational stand- ards in the fields of metal working and electrical engineering: G1/G2
9	Advise customers on energy efficient and effective utilizations	Issues on how to use technology/ tech- nologies or procedure/s energy effi- ciently and effectively should be con- sidered in technical advice to costum- ers.	New issue.

3.2 Recommendations on the usage of the occupation-specific learning outcomes

No.	Learning outcome	Explanation	Implementation
1	Evaluate the ecological impacts of different joining and separation techniques	This is a concrete occupation- specific application of the cross- occupational learning outcome 4.	New issue. To be considered in duties O and Q.
2	Avoid unnecessary energy con- sumption by correct planning, pro- cessing and maintaining of manu- facturing processes	This is a concrete occupation- specific application of cross- occupational Learning outcome 5. Students should be able to avoid unnecessary energy consumption in complex working contexts.	New issue. Effective and efficient energy con- sumption is currently not considered in the occupational standard.
3	Avoid scrap and high rate of materi- al consumption by correct planning, processing and maintaining of man- ufacturing processes	This is a concrete occupation- specific application of the cross- occupational learning outcome 6. Students should be able to avoid scrap and high rate of material consumption in complex working contexts.	New issue. Besides duty D ("Contribute to the avoidance of operational caused environmental pollution") avoiding scrap and high rate of material consumption is currently not con- sidered in the technical duties and tasks of the draft occupational standard
4	Handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, fuels and anticorro- sive) in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)	This is a concrete occupation- specific application of the cross- occupational learning outcome 8. Auxiliary and operating materials are often hazardous and should be handled and stored with care	Partly considered in draft occupa- tional standard: G2, I3 In order to reduce their environmen- tal impacts a management of cool- ing lubricants should be introduced. Its goals are not only to avoid health risks but to extend the operating life of these substances while enhanc- ing taking on student's responsibility at the same time.
5	Separate and dispose unusable components as well as scrap metals and plastics according to the re- quirements of the waste manage- ment system of the college and the partner company	This is a concrete occupation- specific application of the cross- occupational learning outcome 7. In the field of metal working there is a wide range of different waste materials to be considered in waste management.	Partly considered in the draft occupational standard: G2

3.2.1 Metal Cutting / CNC Technician (Milling Machine Operator)

3.2.2 Construction Mechanics Technician (Construction Mechanic)

No.	Learning outcome	Explanation	Implementation
1	Evaluate the ecological impacts of different joining and separation techniques	This is a concrete occupation- specific application of the cross- occupational learning outcome 4.	New issue. To be considered in duties O and Q.
2	Avoid unnecessary energy con- sumption by correct planning, pro- cessing and maintaining of manu- facturing processes	This is a concrete occupation- specific application of the cross- occupational learning outcome 5. Students should be able to avoid unnecessary energy consumption in complex working contexts.	New issue. Effective and efficient energy con- sumption is currently not considered in the draft occupational standard.
3	Avoid scrap and high rate of materi- al consumption by correct planning, processing and maintaining of man- ufacturing processes	This is a concrete occupation- specific application of the cross- occupational learning outcome 6. Students should be able to avoid scrap and high rate of material consumption in complex working contexts.	New issue. Besides duty D ("Contribute to the avoidance of operational caused environmental pollution") avoiding scrap and high rate of material consumption is currently not con- sidered in the technical duties and tasks of the draft occupational standard.

4	Handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, fuels and anticorro- sive) in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)	This is a concrete occupation- specific application of the cross- occupational learning outcome 8. Auxiliary and operating materials are often hazardous and should be handled and stored with care.	Partly considered in occupational standard: G2, I3 In order to reduce their environmen- tal impacts a management of cool- ing lubricants should be introduced. Its goals are not only to avoid health risks but to extend the operating life of these substances while enhanc- ing taking on student's responsibility at the same time.
5	Separate and dispose unusable components as well as scrap metals and plastics according to the re- quirements of the waste manage- ment system of the college and the partner company	This is a concrete occupation- specific application of the cross- occupational learning outcome 7. In the field of metal working there is a wide range of different waste materials to be considered in waste management.	Partly considered in the draft occupational standard: G2

3.2.3 Industrial Electronics Technician

No.	Learning outcome	Explanation	Implementation
1	Evaluate the ecological impacts of different types of power supply	This skill is part of learning field 5 of the occupation's framework curricula in Germany.	New issue
2	Avoid unnecessary energy con- sumption by correct planning, pro- cessing and maintaining of electri- cal/electronic installations	This is a concrete occupation- specific application of the cross- occupational learning outcome 5.	New issue. Effective and efficient energy con- sumption is currently not considered in the draft occupational standard.
3	Avoid scrap and high rate of materi- al consumption by correct planning, processing and maintaining of elec- trical/electronic installations	This is a concrete occupation- specific application of the cross- occupational learning outcome 6. Students should be able to avoid scrap and high rate of material consumption in complex working contexts.	Partly considered in the draft occupational standard: G9
4	Evaluate the ecological impacts of different electrical and pneumatic drives	According to learning field 8 of the occupation's framework curricula in Germany, technical and economic impacts of different electrical and pneumatic drives have to be assessed. Ecological impacts should be integrated.	New issue.
5	Handle frequency converters with electronic rotation speed control in order to optimize the engine output of electric drives	Electrical drives (including pumps, ventilators and compressors, ex- hausters etc.) are among the big- gest electricity consumers. The use of electric drives with a high degree of efficiency yield considerable savings. Moreover, available tech- nology today enables an electronic rotation speed control of drives. This improves the process control, reduc- es wear and tear and keeps down the noise level. Altogether the elec- tricity consumption of electrical drives can be reduced by about a quarter by using electronic rotation speed control.	New issue.
6	Separate and dispose unusable components and electric/electronic waste as well as used batteries and other waste containing hazardous substances according to the re- quirements of the waste manage- ment system of the college and the partner company	This is a concrete occupation- specific application of the cross- occupational learning outcome 7.	Partly considered in the draft occupational standard: G9

3.2.4 Mechatronics (Mechatronics Fitter)

No.	Learning outcome	Explanation	Implementation
1	Evaluate the ecological impacts of different joining and separation techniques	This is a concrete occupation-specific application of the cross-occupational learning outcome 4.	New issue. To be considered in duties I and K.
2	Avoid unnecessary energy con- sumption by correct planning, pro- cessing and maintaining of mecha- tronics systems	This is a concrete occupation-specific application of the cross-occupational learning outcome 5. Please note: Compressed air is, sec- ond to electricity, the most frequently used energy source in industry and crafts. Compressed air is one of the most expensive sources of energy of all: To produce 1 kWh of compressed air energy is 10 times as expensive as the production of 1 kWh of electricity, because from 100% of the applied energy only 10% are being transferred into compressed air. 90% are lost by waste heat. Careful and efficient han- dling of compressed air is mandatory.	New issue. Effective and efficient energy consumption is currently not considered in the draft occu- pational standard.
3	Avoid scrap and high rate of materi- al consumption by correct planning, processing and maintaining of mechatronics systems	This is a concrete occupation-specific application of the cross-occupational learning outcome 6. Students should be able to avoid scrap and high rate of material consumption in complex working contexts.	New issue.
4	Evaluate the ecological impacts of different electrical and pneumatic drives		New issue. To be considered in duty M.
5	Handle frequency converters with electronic rotation speed control in order to optimize the engine output of electric drives	Electrical drives (including pumps, ventilators and compressors, exhaust- ers etc.) are among the biggest elec- tricity consumers. The use of electric drives with a high degree of efficiency yield considerable savings. Moreover, available technology today enables an electronic rotation speed control of drives. This improves the process control, reduces wear and tear and keeps down the noise level. Altogether the electricity consumption of electrical drives can be reduced by about a quar- ter by using electronic rotation speed control.	New issue. To be considered in duty M.
6	Handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, fuels and anticorro- sive) in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)	This is a concrete occupation-specific application of the cross-occupational learning outcome 8. Auxiliary and operating materials are often hazardous and should be han- dled and stored with care.	Partly considered in occupa- tional standard: Q, T8. In order to reduce their envi- ronmental impacts a man- agement of cooling lubricants should be introduced. Its goals are not only to avoid health risks but to extend the operating life of these sub- stances while enhancing taking on student's responsi- bility at the same time.
7	Separate and dispose unusable components, scrap metals and plastics as well as electric / electron- ic waste and used batteries and other waste containing hazardous substances according to the re- quirements of the waste manage- ment system of the college and the partner company	This is a concrete occupation-specific application of the cross-occupational learning outcome 7.	New issue.

3.2.5 Sewage Engineering Technician

No.	Learning outcome	Explanation	Implementation
1	Evaluate and minimize the ecologi- cal impacts of sewage treatment plants and corresponding drainage systems	Students shall be able describing ecological circles as well as plan- ning a concept for operating a sew- age treatment plant, ecological issues to be considered.	New issue. To be considered in duties C - H
2	Avoid unnecessary energy con- sumption by correct planning, pro- cessing and maintaining of electri- cal/ electronic installations	This is a concrete occupation- specific application of the cross- occupational learning outcome 5.	Partly considered in the occupation- al standard: A-07, D-06, E-14, F-14
3	Handle auxiliary and operating materials (e.g. cooling lubricants, solvents, oils, grease and fuels) as well as environmental chemicals in an environmentally friendly manner (especially avoidance of emissions to air, soil or water)	This is a concrete occupation- specific application of the cross- occupational learning outcome 8. Auxiliary and operating materials are often hazardous and should be handled and stored with care.	Partly considered in the occupation- al standard: A-06.
4	Dispose wastes from sewage treat- ment plants in an environmentally friendly manner	This is a concrete occupation- specific application of the cross- occupational learning outcome 7.	Considered in the occupational standard: duty I.
5	Separate and dispose residues, unusable components, scrap metals and plastics as well as elec- tric/electronic waste, used batteries and other waste containing hazard- ous substances according to the requirements of the waste manage- ment system of the college and the partner company	This is a concrete occupation- specific application of the cross- occupational learning outcome 7.	Partly considered in the occupation- al standard: A-06.

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