Course description

Energy Efficiency in Production

Difficulty	Intermediate
Learning time	7,5 h
Additionally recommended learning media	Basics of Energy Efficiency (Evaluation), Commissioning Package Energy Efficiency (User Guide), Integration of the Air Saving Circuit (User Guide), Integration of the Vacuum Nozzle (User Guide), Energy Efficiency - Explained in 5 Minutes (Video)
Course type	eLab
Theme category	IIoT and Industry 4.0

After completing the training, the learners will know the basic terms relating to energy efficiency and the associated ecological aspect. They can derive various measures for increasing energy efficiency in production. They are familiar with common forms of representation such as the Sankey diagram. Using various key figures, the learners are able to carry out an economic efficiency analysis of the overall system.

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
Learning unit 1 : Fundamentals of energy efficiency, energy flows and cognition numbers							
1	Basics of energy efficiency	Guidance text supported Method	Apply	▪ Basic terms ▪ Productivity and efficiency ▪ Energy efficiency in production systems ▪ Data acquisition and measurement ▪ Analysis ▪ Rating ▪ Identification of improvement measures ▪ Implementation/ investigation of measures ▪ Sankey diagram	▪ Know the term energy efficiency and the ecological aspect. ▪ Can classify the scope of efficient measures for production. ▪ Know the physical quantities and basic concepts such as electrical energy, active and reactive power. ▪ Calculate the productivity and efficiency of a system. ▪ Know measures to increase energy efficiency. ▪ Know the basic concepts for mapping a system from the point of view of material and energy flows. ▪ Know material and energy flows of a system ▪ Know the difference between moment load and load profile measurement. ▪ Can visualize the energy demand in a system. ▪ Know the Sankey diagram and its advantages. ▪ Know and are familiar with the various metrics of a system. ▪ Can interpret the various metrics using a performance-time chart. ▪ Can derive measures to optimize energy demand. ▪ Can compare the improvement measures mathematically, taking into account defined framework conditions. ▪ Know procedural steps of the continuous improvement process to increase the energy efficiency of production processes	60 min.	No

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW depen-dent
2	Energy flows, process chains, key figures of a system	Technical analysis	Rate	▪ Process chain ▪ Process times ▪ Cycle times (single process) ▪ Cycle time (process chain) ▪ Continuous improvement process ▪ Material and energy flows ▪ Measuring system - Factory Views ▪ Load profiles ▪ Operational responsibility ▪ Energy demand ▪ Energy costs ▪ Cycle time diagram ▪ Single. and process chain view	▪ Know the basic concepts of process chains in the context of energy efficient operation. ▪ Can classify and express the concept of cycle time. ▪ Can reproduce the cycle times using HW as an example. ▪ Can allocate the energy and material flows of a plant. ▪ Know the measuring system and its functionalities. ▪ Can accommodate the electrical/pneumatic (compressed air) load profile of the process chain of an overall system. ▪ Can interpret the measured values and calculate the energy demand as well as the resulting costs. ▪ Can interpret load profiles. ▪ Can formulate specific recommendations for action to reduce energy use. ▪ Can calculate energy costs under given conditions for an overall system at the workpiece level. ▪ Can derive improvement measures to reduce energy demand at the system and station level ▪ Know the common strategies for the energetic optimization of technical systems ▪ Can describe the product manufacturing process at the MPS facility.	60 min.	Both with and without

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Learning unit 2: Energy efficiency measures in production							
3	Electrical power consumption	Guidance text supported Method	Rate	▪ Process times ▪ Cycle times (single process) ▪ Continuous improvement process ▪ Material and energy flows ▪ Measurement system (Factory Views) ▪ Load profiles ▪ Operational responsibility ▪ Energy demand ▪ Energy costs ▪ Cycle time diagram ▪ Single view	▪ Can accommodate the electrical/pneumatic (compressed air) load profile of a subsystem's process chain. ▪ Can accommodate load profiles at the component level. ▪ Can interpret the measured values and calculate the energy demand and the costs involved. ▪ Can interpret load profiles at the station / component level. ▪ Can formulate specific recommendations for action to reduce energy use. ▪ Can calculate energy costs at the workpiece level under given conditions. ▪ Can derive improvement measures to reduce energy demand at the station level and present them (dimensioning / shutdown of components). ▪ Can compare the improvement measures mathematically, taking into account defined framework conditions. ▪ Know the common stratagems for energy optimization of technical systems.	90 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
4	Compressed air generation and distribution	Guidance text supported Method	Apply	▪ Pressurized air generation and distribution ▪ Material and energy flows ▪ Measuring system (Factory View) ▪ Load profiles ▪ Key figures ▪ Optimization/improvement measures ▪ Energy demand ▪ Energy costs ▪ Results presentation	▪ Know the basics of compressed air generation and distribution. ▪ Can reflect the types of industrial compressed air use. ▪ Can classify energy demand using different nations as examples. ▪ Know the efficiency potential of a forced air system. ▪ Know the individual steps of the continuous improvement process. ▪ Can allocate the energy and material flows to a station. ▪ Know the measuring system and its functionalities. ▪ Can accommodate the turn-on load profile for the compressed air at a station. ▪ Can analyze the recorded switch-on load profile. ▪ Can calculate the energy requirements and energy costs of manufacturing individual workpieces. ▪ Can derive improvement measures to reduce energy demand. ▪ Can compare the improvement measures mathematically, taking into account defined framework conditions. ▪ Can prepare results using common software tools (e.g. ppt).	60 min.	Yes
5	Air-saving circuit	Case study	Rate	▪ MES ▪ Vacuum generator with air saving circuit ▪ Factory View ▪ Energy efficiency ▪ Energy optimization ▪ Presentation & Communication ▪ Technical documentation	▪ Can perform an analysis on a subsystem in the context of air consumption/electrical energy. ▪ Can identify the problem/cause of excessive air consumption using software tools. ▪ Can interpret charts and typical ratios. ▪ Can describe the cause of high air consumption. ▪ Can derive and implement concrete solution measures. ▪ Can use the technical documentation for assembly/disassembly. ▪ Can present the results created ▪ Can evaluate learning actions and outcomes.	60 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
6	Reduce pressure level	Case study	Apply	▪ Energy consumption ▪ Compressed air consumption ▪ Manufacturing/production costs ▪ Optimization measures ▪ Presentation & Communication	▪ Can perform an analysis on a subsystem in the context of normal/reduced operating pressure. ▪ Can highlight the potential challenges of error-free operation. ▪ Can derive and implement consistent measures to ensure error-free operation. ▪ Can present your findings. ▪ Can evaluate the procedure and the results.	60 min.	Yes
7	Reduce leakage	Case study	Develop	▪ MES4 ▪ Leakage ▪ Troubleshooting ▪ Volume flow ▪ Compressed air consumption ▪ Energy consumption ▪ Energy costs ▪ Troubleshooting	▪ Can interpret charts and typical ratios. ▪ Can name different types of leaks. ▪ Can derive and implement concrete solution measures. ▪ Can calculate energy costs and potential savings and derive environmental impacts. ▪ Know methods to identify compressed air leaks in production. ▪ Can present your findings.	60 min.	Yes

No.	Task	Method	Competency level	Content	Competencies	Learning time	HW/ SW dependent
8	Economic efficiency analysis	Case study	Rate	▪ Economic efficiency ▪ Cost optimization ▪ Dimensioning ▪ Hose length ▪ Friction ▪ Components ▪ Weight ▪ Energy shutdown	▪ Can look at a system from a cost effectiveness perspective. ▪ Can name important factors in the context of energy efficiency and cost-effectiveness. ▪ Can mathematically compare the factors learned to increase energy efficiency. ▪ Can represent the costs of the optmization measures mathematically. ▪ Can present costs/benefits given specific framework. ▪ Can consider a cost effectiveness analysis in the context of an industrial scale energy efficiency measure. ▪ Can present your findings.	45 min	No