Improvement actions: General according to ISO/DIS 14955-1				
No.	**Requirements on**	**Description**	**Relevant for machine tool**	**Estimated Energy savings**
1	Minimization of moved masses	Moved masses have to be accelerated and the energy required for acceleration is depending on the mass ($E = 1/2*m*v^2$). Even if some part of the energy is recovered during braking, this recovery is with an efficiency factor below 1. The best way reducing energy needed for acceleration is mass reduction.	Metal cutting; Mechanical Press; Servo Press;	3,1 – 3,6%
2	Minimization of moved masses	Moved masses have to be accelerated and the energy required for acceleration is depending on the mass ($E = 1/2*m*v^2$). Even if some part of the energy is recovered during braking, this recovery is with an efficiency factor below 1. The best way reducing energy needed for acceleration is mass reduction.	Hydraulic Press	
3	Redundant axis	High acceleration with short-stroke axis reducing acceleration for long range, heavy axis.	Metal cutting	<=3%
4	Increase output	Without utilisation (production) or low output the efficiency will be degraded.	Metal cutting	4,6 – 5,5%
5	Provide customer interaction to reduce consumption of resources	Give the operator provisions to interact when he expects downtime.	Metal cutting	4,6 – 5,5%
7	Reduction of friction	Reduction of friction means less mechanical wear, higher quality and also should lead to energy reduction; various types of bearing possible (rolling bearing, sliding bearing, hydrostatic bearing, magnet bearing); ecological aspect has to be considered by choose of bearing as well.;Reduction of speed dependent friction must be optimized in respect to the characteristic of choosen drive technology.	Mechanical Press; Servo Press; Hydraulic Press, Metal cutting	<=3%
8	Optimization of the electrical design	Check, if the machine tool has been designed according to customer requirements; operational range been specified close to optimal working point; avoiding adding up spare capacities (avoid oversizing/over-engineering)	Metal cutting; Mechanical Press; Servo Press; Hydraulic Press	<=3%
9	Design for instant machining without warm-up	Provisions for automatic temperature compensation.	Metal cutting	4,6 – 5,5%
10	Counterbalance system for vertical axes	Counterbalancing systems reduces the potential energy in vertical moving systems. Additionaly reduction of accelerating and decellerating.	Mechanical Press; Servo Press; Hydraulic Press	
11	Work piece clamping and tool clamping	Use best efficient technology.	Metal cutting	3,7 – 4,5%
12	High efficient cushion	Cushions are needed for restraining material flow. Without energy efficiency means, the energy required is mostly transferred into heat.Use cushion control system with low energy consumption or regenerative feedback.	Mechanical Press; Servo Press; Hydraulic Press	
13	Multi spindle- / multi work pieces machining	*Explanation needed.*	Metal cutting	4,6 – 5,5%
14	Use regenerative circuit for differential cylinders	Reduction of pressure drop on control valves.	Hydraulic Press	
15	Die clamping	Choose clamping system with best efficient technology. Prefer passive clamping systems e. g. spring loaded clamping, electric clamping, magnetic clamping.	Mechanical Press; Servo Press; Hydraulic Press	3,7 – 4,5%

16	Complete machining all sides	*Explanation needed.*	Metal cutting	4,6 – 5,5%
18	Combination of various technologies (turning + milling + laser + grinding etc.)	Combination of technologies in one machine, one-time mounting and adjusting may result in higher quality and higher yield and so also causing less energy consumption.	Metal cutting	4,6 – 5,5%
19	Axis clamping	Usage of axis clamping instead of active motor break (see 1-5).	Metal cutting	
20	Optimization of work piece processing by simulation off-machine; avoidance of inefficient operating time	Work piece processing by simulation off-machine avoidance of inefficient operating time use also possible in conceptual phase of machine tool production.Non-productive time can be minimized if a simulation environment is provided for virtual setup allowing for simulative exclusion of possible collisions and simulative optimization of tool paths.	Metal cutting	3,7 – 4,5%
21	Optimisation of work piece processing by die tryout	Work piece processing by tryout off-machine; avoidance of inefficient operating time; use also possible in conceptual phase of machine tool production	Mechanical Press; Servo Press; Hydraulic Press	3,1 – 3,6%
22	Minimize non-productive time	Without utilisation (production) the efficiency will be degraded.Extended description by example required (information for user).	Metal cutting	4,6 – 5,5%
23	Provisions to reduce scrap production	Die monitoring, in-process control, optimised use of raw material - minimise waste, zero defect production	Mechanical Press; Servo Press; Hydraulic Press	3,7 – 4,5%
24	Provide customer information to reduce consumption of resources	Training of operators leads to energy-sensitive handling of the machine tool.	Mechanical Press; Servo Press; Hydraulic Press	3,7 – 4,5%
25	Information to user on energy efficient use of the machine e.g. on/off programming of auxiliary devices (users manual, instruction)	Give the operator information e. g. how to interact when he expects downtime.	Mechanical Press; Servo Press; Hydraulic Press	4,6 – 5,5%
26	Information to user on optimized movements of axis	Means for optimization of movements of multiple axis systems (feeders, robots) to follow energy optimized moving curves	Mechanical Press; Servo Press; Hydraulic Press	3,1 – 3,6%
27	Information to user on usable exergy	Provide information about type of exergy carrier (e. g. water) and temperature of medium to choose optimal means for recovery.	Mechanical Press; Servo Press; Hydraulic Press	
28	Minimize non-productive time	Without utilisation (production) or low output the efficiency will be degraded. Means of improving output may be automatic die change systems, condition monitoring to prevent component failures, good diagnostic for quick trouble shooting etc.	Mechanical Press; Servo Press; Hydraulic Press	3,7 – 4,5%
29	Optimize productivity by reducing cycle time per part	An improved productivity reduces the portion of required basic load per part.	Mechanical Press; Servo Press; Hydraulic Press	