Stakeholder Comments

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No.	**Stakeholder**	**Comment (justification for change)**	**Response / implemented changes**
151	VDMA Bekleidungs- und Ledertechnik	Ich habe in Ihren Report Task 1 DG ENTR Lot 5 "Machine tools and related machineries" eingesehen und habe die darin enthaltenen Restriktionen, dass Maschinen für den Bereich der Ver- und Bearbeitung von "soften und textilen" Materialien (Restiction Nr. 3, sowie Seite 26 "cleaning and joining fabrics and textiles processing"), als auch Maschinen für die Ver- und Bearbeitung von humanen und oder tierischen Materialien (vgl Seite 30 erster Absatz) von Lot 5 ausgeschlossen sind Infolge dieser Formulierungen ist der Bereich Bekleidungs- und Ledertechnik nicht von Ihrer Studie betroffen bzw. ausgeschlossen, da es sich in unserem Bereich um die Ver- und/oder Bearbeitung von Material handelt, welches in Ihrem Task 1, sowohl in Formulierung als auch in den beschriebenen Eigenschaften, ausgeschlossen ist. Wir sind mit diesem Ausschluss einverstanden	Statement does not require changes of the report
152	VDMA Bekleidungs- und Ledertechnik	Jedoch sind wegen des modularen Ansatzes einige unserer Maschinen aus dem textilen Bereich in Ihrer Tabelle 1-13 "Non-exhaustive list of affected industries for related machinery" enthalten. Das ist für mich unverständlich und nicht nachvollziehbar. Zusätzlich erwähnen Sie hier mitunter Produktgruppen, die bereits von EUP Verordnungen oder Durchführungsmaßnahmen betroffen sind.	Remark: Observe the distinction of „machine tools“ definition, and the scope, which covers also modules which are similar to those used in machine tools, but might be used in other machines
153	VDMA Fluidtechnik	**4.1.1** The break down of the bill of materials should be comparable between the different kinds of machines. For example in some cases copper is listed in others not.	Harmonised, where possible; depends on data availability, BOMs are structured differently among different manufacturers
154	VDMA Fluidtechnik	**4.1.3** Tools and hydraulic oil are mentioned as consumables. Hydraulic oil is not a consumable in the closer sense compared to others (e. g. lube oil) because it is used in a closed system for power transmission. Consumables as air or grease are not listed. The use of the data of the McManus et al. study for hydraulic oil in mobile systems is correct as long as it is used for the production related life cycle impacts of mineral oil production. But it cannot be used in respect of the lifetime of the hydraulic oil in stationary machines because the environmental stress conditions are not comparable, e. g. contamination, oil volume per kW, pressure levels or temperature changes.	“Consumables” is the sub-heading defined by the methodology, explanation will be added in the text. Lifetime estimate of hydraulic oil is not based on McManus, but on maintenance recommendations.
155	VDMA Fluidtechnik	**4.1.3.1** “Lube oil and hydraulic oil with an amount of 0.1 m3/year each (“Auxiliary Material 2”, approximated with a density 0.9 g/cm³) …”: Lube oil and hydraulic oil have to be distinguished. Usually, in machine tools the consume of lube oil is much higher than the consume of hydraulic oil. Furthermore, lube oil is used for example in electro-mechanical transmissions and has nothing to do with hydraulic systems. Delete “Life time of the auxiliary materials is one year.”: Lubrication is a continuous process and lube oil is in an open lubrication system consumed permanently. Hydraulic oil is used in a closed system. In modern systems condition monitoring is introduced. Thus, the hydraulic oil will be changed only when it is necessary. Usually, when the maintenance is well done, hydraulic oil will not be changed but only some new oil added over several years.	Hydraulic and lube oil listed separately. Data adapted.
156	VDMA Fluidtechnik	**Table 4-7, 4-8** Auxiliary material 2: Differentiate lubrication oil and hydraulic oil (also in the following clauses).	Done, where applicable.
157	VDMA Fluidtechnik	**4.2** “- Simple machine tools Non-numerically controlled horizontal lathes, for removing metal Non-hydraulic and non-numerically controlled presses for working metal”	Deleted to avoid misinterpretations; list was meant to reflect the PRODCOM nomenclature, not to label non-hydraulic as

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		Delete "Non-hydraulic and" The drive technology is no criteria for complexity. There exist also e.g. hydraulic nonnumerically controlled presses and other simple machinery.	"simple" per se.
158	VDMA Fluidtechnik	**4.2.2** "Hydraulic press brakes are typically applied where bending capacities of up to several thousand tonnes are required8, where electromechanical solutions are not an option." Delete ", where electromechanical solutions are not an option" Hydraulic presses are also used where high bending capacities are required **and** electromechanical presses are offered.	Text revised accordingly.
159	VDMA Fluidtechnik	**4.3.1, Page 35** "As the above calculations do not include hydraulic oil, this has to be assessed separately. Given an annual hydraulic oil consumption of 90 kg per year, total additional impacts are as listed in the table below for selected impact categories (those, which could be substantiated based on literature data). In all categories the hydraulic oil consumption is negligible in terms of life cycle impacts, except for one: The eutrophication potential raises by nearly 25% if hydraulic oil is taken into account. Lube oil and hydraulic oil have to be distinguished (see comments on 4.1.3.1 and table 4-7). The eutrophication potential raises mainly because of the lube oil.	The data provider for the Base Case stated 90 kg consumption per year for each, lube oil and hydraulic oil. Consequently the statement remains valid.
160	VDMA Fluidtechnik	**Task 5 In general:** The measures already realised should not be named by brand name in the study. If it is really necessary to mention them they should be in a footnote but not in the main text.	All brand names moved into footnotes.
161	VDMA Fluidtechnik	**Task 5 Executive Summary** "For example, hydraulics provide a high energy density while electromechanical systems are to be excellently controllable." Delete this sentence. The example is not necessary to support the content of the former sentence and can be misleading. Both technologies are under development.	Deleted
162	VDMA Fluidtechnik	**Figure 5-2** Separate pneumatic and other compressed air power consumption	No distinct data available.
163	VDMA Fluidtechnik	**Table 5-1** "Hydraulic and pneumatic Optimized systems" Column "Implications": "hydraulics and pneumatics are to be used in applications with fastly provided energy density" Replace by "Savings with adapted system design layout"	Done.
164	VDMA Fluidtechnik	**5.1.4.2, page 23** "Replacing inverter units: …" In the first (working) draft of ISO 14955 it's stated the other way around: 400 V technology saves energy in comparison to 200 V technology. To be checked!	Error in the report, corrected.
165	VDMA Fluidtechnik	**5.1.5.1** **"Electrical clamping devices:** Contrary to hydraulic clamping devices, electrical clamping tools require less maintenance, causing no efforts for cleaning and replacement of process fluids. Whereas the hydraulic system still runs during idle periods, the electrical one only consumes energy solely in specific situations (clamping and release). Other advantages are a higher degree of adjustability, leaner machine design due to the omission of the hydraulic unit, and reduced maintenance costs. There are several companies supporting electrical clamping devices, such as Röhm (E-Quipment34), Forkardt (iJaw35), and Hainbuch (electromechanical actuators36)."	Not deleted, but disclaimers added to address raised concerns.

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		Delete the whole item. The statements are provided by the mentioned companies and are not verified. Furthermore, the statements are partly wrong ("Whereas the hydraulic system still runs during idle periods" "reduced maintenance costs") and not energy saving relevant such as "leaner machine design due to the omission of the hydraulic unit".	
166	VDMA Fluidtechnik	„**Using non-pneumatic lubrication systems for spindles**: …" For HSC (High Speed Cutting) applications, oil-air lubrication is considered to be indispensable. The only way to reduce energy is to use oil with lower viscosity and reduce air pressure. The oil contamination of work pieces can be reduced or prevented by optimized seals.	Statement cited in the report.
167	VDMA Fluidtechnik	**5.1.6.1** Delete "piston" (to write: "conventional pump") The better energy efficiency is not dependent on the kind of pump (piston pump, gear pump and so on) but if the pump is controlled or not. "Besides providing additional flexibility for the user (e.g. by choosing application specific operating points regarding flow rate and pressure), savings compared with a conventional hydraulic system can be achieved in the range of 70%.45 1. In the referenced source it is said that savings can be achieved between 50 and 70 %. This is not "in the range of 70 %"! 2. The referenced source is a catalogue for screw spindle pumps. In machine tools these are usually applied for the lubrication systems. Insofar the improvement of 70 % cannot be assumed for hydraulic drive systems in general which are different from lubrication systems.	Done. Citation rephrased.
168	VDMA Fluidtechnik	**5.1.6.2** "Naturally, reducing the channels of supply significantly reduces pressure losses.47" The referenced source of this sentence is about centrifugal pumps. This has nothing to do with hydraulic systems. Insofar, the statement is not correct. Delete the sentence. Add a new sentence saying that it depends on the application if the mentioned measures can be used and which improvement can be achieved using them.	Done.
169	VDMA Fluidtechnik	**5.1.11.4** Regarding to the given example a description of the compared machine subsystem should be attached. For example the energy efficiency of a clamping unit depends significantly on the principle used for the clamping force generation and less on the drive technology.	No further details regarding the example available.
170	INEGI	We have realized that hydraulic oil was not considered as a relevant input on the Use phase of the Base Case 2, although this has been clearly stated in our reports. As also highlighted in this report, hydraulic oil is an important consumable to be considered when talking about machine-tools, and particularly for hydraulic press-brakes. The results related to the impact of this consumable to the overall environmental performance are explained as follows. The LCA analysis was followed with Simapro SW and EcoInvent databases. The EcoInvent datasets for the hydraulic used in the press-brakes LCA study are depicted in Figure 1. The oil source considered was a standard crude oil, and incineration was the end-of-life scenario associated. (...) **Figure 1: EcoInvent datasets' network associated to the hydraulic oil considered as input to the use-phase**	Comment and data cited.

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		of the press-brakes study. Based on this, it was expected that the use of no-renewable resources would determine the environmental impact profile related to the oil consumption. This is indeed confirmed from Figure 2. The results show both (a) the relative contributions and (b) the absolute Eco-indicator99 values of the impact of the Assembly-phase and Use-phase (Electricity and Oil) to the different middle-point impact categories. From these results, the following is to be highlighted: - The relative contribution of the oil consumption to the global environmental impact of the machine is higher than 20%, in 4 of the 11 impact categories analyzed; - The main impact of the oil consumption, in absolute value of the indicator, is on the depletion of fossil fuels, and, in this category, the impact is similar to that of the assembly resources; - The significant relative contributions of the oil consumption in other categories correspond only to minor impact values (such as in ecotoxicity or respiratory organics) or are even negligible (such as the effect on ozone layer). This contradicts the results reported for Base Case 1, where the main and only impact of the hydraulic oil was on eutrophication category (25%), although a different methodology has been used. This leads to evident conclusions, such as: 1- The contribution of the hydraulic oil used to the environmental impact of such machines should not be neglected. However, it is important to define the related datasets methodology to be considered for this study, even if the analysis is to be followed in parallel to the MEEuP assessment. 2- The impact assessment per impact categories should be followed in absolute values, and the relative contribution analysis should here be avoided, as this does not inform on the real extent of the impact and might mislead to wrong conclusions.	
171	INEGI	**Environmental profile of hydraulic vs electromechanical press-brakes** It is to be highlighted that although the full environmental impact of the all-electric machine was still not assessed, a compromise result is expected due to the following inverse contributions: - The increase on the content of electric and electronical components in the inventory, as source of hazardous substances with detrimental contribution to the environmental profile; - The absence of hydraulic oil and the reduction on the total energy consumption during use. The study followed by Santos et al. (see JCLEPRO paper) indicates to energy savings between 67%a and 90% are possible, for similar loading capacities installed.	The relevancy of this particular example is acknowledged and taken into account for the further analysis, but it will not be referenced as a general approach, as the inherent savings potential of hydraulic presses is not properly reflected with such a comparison.
172	INEGI	**Application range (bending capacity) of hydraulic and electromechanical press-brakes** The study followed by Santos et al. (see JCLEPRO paper) also included a benchmark on the commercially solutions of press-brakes, including the identification of the technologies predominant on different segments. From this study, it was concluded that for the lower loading range (<100 ton), all electric models are indeed quite used, in the intermediate range of 100-200 ton, some all electric models start to gain significant market share and, for higher loading capacities, only hydraulic systems are technically and mostly economically feasible. Although this does not contradicts the statement on section 4.2.2. that 'the range of 100-170 t bending capacity is a market segment where electromechanical presses are common', it must be emphasized that the hydraulic technology also dominates in this range.	Statement does not require changes of the report, no evidence provided.

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173	INEGI	**Referring to figure4-4** From this it was concluded that the power consumption in the use phase is not the only relevant life cycle aspect for bending machine tools, as the resources used to construct the bending machine tool significantly affect several impact categories, such as: Non-hazardous waste to landfill; Acidification; VOCs; POPs; HM emitted to air and water and Particulate matter. The following pictures present a closer look to the energy consumption during use and the assembly phase of the machine only, and compare the MEEuP results with those obtained with the Eco-Indicator methodology. The absolute Eco-Indicator value of the impacts is also shown. (...) **Figure 4: Life-cycle impacts per impact category for the Base-Case CNC Bending machine tools (1-shift), as included in the Lot5/Task4 report.** As discussed for the oil contribution, the comparative analysis of these charts makes evident that: - The relative contributions values seem to be valid for the analysis of the contribution of each life cycle stage to the overall environmental impact; - Absolute impact values should be used for the identification of the most affected environmental impact categories. As presented in our work from Azevedo at al (see LCE2011 paper), for the purpose of the analysis of the contribution of the different life-cycle to the overall environmental impact, a 100% stacked single column chart would be more appropriate, while the detailed analysis per impact category should consider stacked absolute values, in order to reveal those categories to which the machine is potentially more detrimental and which life-cycle contributes mostly to it. In terms of relative contributions of the 2 life-cycle stages, the results obtained with both methodologies are indeed comparable, as, from both charts (a) and (b) one can retain that the the 2 life-cycle stages analyzed indeed share more or less equally the full environmental impact. However, the analysis per impact categories is quite difficult to evaluate, even in cases where the correspondence is easier, such as Acidification and Eutrophication. However, if the analysis includes the absolute values of the impacts (only possible with the normalized indicator), one could guess that the Acidification indeed has a higher weight in the Acidification/Eutrophication indicator, as suggested by the MEEuP.	Comment and data cited.
174	EUROMAP	We appreciate the Commission acknowledges, that plastics and rubber machines are no machine tools and have to be dealt with separately. Therefore it would be consequent to have a straight forward process for machine tools only and dealing with plastics machines independently. Every attempt of mixing both technologies in one approach will lead to confusion and misunderstandings. As clearly pointed out in the 2nd Stakeholder meeting by Claudio Celata (ASSOCOMAPLAST) and Jan Horvat (VDMA) plastics and rubber processing machines will have to be excluded from the study. So far there are still references to plastics a rubber machines in the study.	The case of plastics and rubber machinery is discussed in detail in task 1.
175	EUROMAP	Apart from the process itself we have substantial doubts about the content of the study. The presented material of Fraunhofer in the 1st and 2nd Stakeholder meeting could neither convince us from a technical nor from a market point of view.	Statement does not require changes of the report, as no evidence is provided.

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176	EUROMAP	Our industry is deeply concerned about this process and the conclusions which might be drawn. EUROMAP therefore has installed an analytic process and conveyed a separate study. The study will be carried out by independent experts of our industry touching the European plastics and rubber machine side as well as the converting industry with reference to renown Universities too. On the ground of those solid findings EUROMAP will outline a realistic view on energy consumption of our industry including potentials as well an idea how to carry on with the ERP-Process regarding plastic and rubber machines. We expect to be ready to provide a proposal this summer.	Statement does not require changes of the report.
177	VDMA Construction Equipment and Building Material Machinery	We appreciate the limitation of the scope which now covers only machine tools including metal cutting and metal forming machine tools, wood working machine tools as well as soldering, welding and brazing equipment. This should be emphasized in the definition of the scope (Task 1).	Remark: “metal cutting and metal forming machine tools, wood working machine tools as well as soldering, welding and brazing equipment” are a non-exhaustive list of machine tools covered. The definition covers more than these.
178	VDMA Construction Equipment and Building Material Machinery	As related machinery is not part of the scope but might be indirectly affected, we still see the risk of further confusion and false conclusions. With the "modular approach", various machines used in various industries will be concerned. In order to follow a scientific way of work, all these different sectors shall be involved in the study. It seems not to be the case, even though the study started more than 15 months ago. From our point of view, including the "modular approach" in this study goes far beyond what was the content of the tender regarding machine tools in Lot 5 (CALL FOR TENDERS No ENTR/2009/035, 1.1).	Statement does not require changes of the report.
179	VDMA Construction Equipment and Building Material Machinery	Furthermore, there are different expressions regarding "related machinery" within the provided documents (e.g. Task 1, clause 1.1.3.4 and 1.1.4). Are "other machine Tools" and "related machinery" two terms for the same group of machines? If not, both expressions should be defined. Otherwise, only one single expression should be used.	Remark: Other machine tools are those, which are not “metal cutting and metal forming machine tools, wood working machine tools as well as soldering, welding and brazing equipment”. “Related machinery” is defined through modules.
180	VDMA Construction Equipment and Building Material Machinery	We also see a lack of consistency in Task 1 to 3 at the moment. In some cases information on "other machine tools" is given (e.g., Task 1, clause 1.1.3.4, 4.4 and 6.4, Task 2, clause 2.1.4. and Task 3, clause 3.2.4). In other cases, there is no information on "other machine tools" (see Task 2, clause 2.2, 2.3 and Task 3, clause 3.1).	Market estimates added for stone and ceramics working machine tools. Paragraphs in task 3 added.
181	VDMA Construction Equipment and Building Material Machinery	You state that no dedicated analysis is provided in Task 2 for “Related Machinery” and that the effects of later findings on “related machinery” will be estimated on a case-by-case basis where relevant (presentation on Task 2, p. 2). Why, then, do you already include information about some related machines in Tasks 1 and 2 if this is not part of the agenda? By including some scattered details about related machinery more confusion for the stakeholders is created.	Remark: Related machinery is part of the study, but a comprehensive coverage of all related machinery throughout all tasks is not feasible, which is a limitation of the study, but without alternative.
182	VDMA Construction Equipment and	If Building Material Machinery shall be part of the study as related machinery, an assessment according to article 15 of the Eco-design Directive 2009/125/EC for this type of machinery is necessary. Will this be part of the above	“Machine tools” as such are subject to the study, but simplifications and focus on most relevant sub-segments required. Therefore

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	Building Material Machinery	mentioned case-bycase estimation? When this will be done?	focus is on metal working as first priority, on wood working and welding with second priority, all other machine tools third priority.
183	VDMA Construction Equipment and Building Material Machinery	In Task 1, clause 1.1.5.1.3 (pages 53 and 54) it is stated that according to the EPTA 2001 Working Plan Study machines for treatment of stone, ceramics, concrete,… (Prodcom 28.49) these machines have a minor relevancy compared to other energy using-products. So why did you undertake a screening for these types of machines? What are the sources of the figures in Table 1-18?	No changes of the report. It was decided by the EC (and communicated at stakeholder meetings), that a broad scope of machine tools should be addressed in the study, regardless of the initial results of the Working Plan study. Figures are based on a Fraunhofer screening in absence of any detailed data at that point of the study.
184	VDMA Construction Equipment and Building Material Machinery	Although machines for treatment of stone, ceramics, concrete,… are not in the scope of the study, figures are given in one clause together with the three machines types which are in the scope (e.g. Task 2, clause 2.4.2). Machines for treatment of stone, ceramics, concrete,… shall be removed to another clause "other machine tools" consistently like all other machine types which are not in the scope.	Remark: machines for treatment of stone, ceramics, concrete,… are in the scope as long as they meet the definition provided in task 1 and thus are listed as (other) machine tools
185	VDMA Elektrische Automation	Definition "module" not sufficient. What are the borders to this definition? The examples on "Modular approach" (spindle, work piece table, drive unit, operator panel, machine base) are focussed only to machine tools and not transferable to other machines.	No unambiguous definition for ‘modules’ in existing literature. Comparable descriptions of modules added and discussed (ISO 14955, CECIMO SRI). The concept of modules in the frame of this study has been specified.
186	VDMA Elektrische Automation	Die Definition "Modul", oder wie an manchen Stellen genannt "funktionsfähige Einheit", ist nach wie vor nicht ausreichend. Wo fängt ein Modul an (z.B. bei einem Werkzeugspeicher), wo hört es auf (z.B. bei einem Sensor)? Die von FhG / CECIMO /VDW in einer Präsentation vom 6.2.2011 auf Seite 6 und 12 genannten Beispiele zum "Modular approach" (spindle, work piece table, drive unit, operator panel, machine base) sind auf die Funktion der Werkzeugmaschine bezogen, aber nicht auf andere Maschinen übertragbar.	See response above. (No. 185)
187	UBA	The criteria for the selection of the base cases should be made more transparent.	(Multiple) criteria applied and rational for base cases already explained in task 4.
188	UBA	The study indicates that machine tools consume a huge amount of energy during use. A large variety of improvement options seems to exist that allow a very high improvement potential. The presented results thus suggest that improvements are highly economic. The study indicates that energy efficiency only recently gains relevance for purchasers of machine tools. Given the high electricity costs this surprises. We hope that the study will investigate more on the barriers to implementation of (individual) BATs.	Will be partly addressed in task 7, but the basic analysis in task 3 already provides the essential barriers.
189	UBA	Energy consumption during use phase is indicated as the overwhelming environmental impact and used as filter for the restriction of the scope in Task 1. While there is little doubt on the importance of energy consumption in the use phase, other life cycle phases than the use-phase should be dealt with systematically (in Task 1 p. 63 reference to an LCA is given where the assembly and the consumption of oils is quiet relevant, too.). Furthermore, non-energy aspects are dealt with only in a very scattered way. Covering all life-cycle phases in a structured way in dedicated chapters would be appreciated.	Environmental (life cycle) assessment is provided in task 4. Relevant findings guide the later parts of the study (tasks 5-7).

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190	UBA	Covering all relevant environmental impacts in a structured way in dedicated chapters would be appreciated. Task 1 in Table 1-27 provides info on non-energy aspects that seem worth to be dealt with in more detail. At the beginning of chapter 1.1.5.5.2 criteria are listed for the environmental screening (energy consumption, compressed air consumption, consumption of cooling lubricants, cooling water consumption, exhaust air from suction, workspace related air conditioning, and noise pollution). These criteria or those aspects identified in Table 1-27 having moderate relevance should be systematically screened for in the base cases and given dedicated chapters.	Aspects are covered by the Base Cases, where relevant (remark: noise is already regulated and therefore not considered in the Base Cases), but no additional chapters are included.
191	UBA	Task 5 describes BATs. It remains however unclear to which extent they are already or could be in the future placed on the market. Reference to Task 2 – Economic and Market Analysis should be made.	Task 5 revised accordingly, based on indications by industry regarding market shares of improvement options.
192	UBA	**Summary p 2** Headline Task 1 to be amended (not only definition, but also legislation and standards)	No change , according to the tender specification this task is called “Definition” only
193	UBA	**Summary p 3** “and intended for professional use”: wording does not make clear that this refers to the product, not the machine	Statement does not require changes of the report; the energy-using product is the machine
194	UBA	**Summary p 3** We support the wide approach of the study.	Statement does not require changes of the report
195	UBA	**Summary p 3** “moderate relevancy” may be interpreted in two different ways: 1. Only limited relevance – not worth further efforts and 2. Less relevant than energy consumption in use, but still important factors. If it is intended to express the latter we suggest a wording or amendment that emphasises these impacts.	Executive summary revised.
196	UBA	**Summary p 4** List of factors relevant other than energy in use phase: should the production phase be named (see summary page 7: “… for some impact categories also the production of the machine tools matter.” or Task 1 p. 63)	Done
197	UBA	**Summary p 6** 0,11 Euro/kWh for metal working machines and 0,14 Euro/kWh for wood working machines. Differing assumptions made in the preparatory studies makes comparisons between product groups difficult. Trade-off between product specific as close to reality as possible versus horizontal assumptions. What is the Commission’s pre-setting?	Remark: Official statistical data should be taken – which is the case here.
198	UBA	**Summary p 6** “no broad demand for and implementation of energy efficient modules in machine tools. Logic conclusion could be that an ecodesign regulation is needed. Is this in line with the perception of the contractors?	Statement does not require changes of the report; no speculation about regulations.
199	UBA	**Task 4 p 5** The criteria for the selection of the base cases should be given. In Task 1 already a pre-selection of product groups has been done in order to narrow the (wide) scope. Task 4 should refer to this. It should become more clear to which extent the base cases reflect the scope of the study and where a focus is set by this selection. The explanation should take market developments into account (not focusing only on current stock, but on development in future market of machine tools).	Logic for choosing base cases in explained in the report, with the intention to cover the market of machine tools broadly (but inevitably not being in the position to cover the market completely). Future market developments (as outlined in revised task 2) taken into account.
200	UBA	**Task 4 p 18** The fact that the Ecoreport does not provide a data set for hydraulic oil should – in parallel to the prep study – be reported to the Commission and vhk (in the light of the current revision of the MEEuP Ecoreport tool). It would be helpful to add info not only on the quantity, but also the quality (i.e. the potential environmental impact) of the oils.	Environmental impacts of hydraulic oil stated.
201	UBA	**Task 4 p 18** A separate chapter or at least paragraph on cooling would be helpful.	Environmental impacts of oil products

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		Task 2 suggests that cooling lubricants at least economically may play a role. ("Consumption of cooling lubricants constitutes a major share of life cycle costs of many machine tools.") As for the oils it would be helpful to add info not only on the quantity, but also the quality (i.e. the potential environmental impact) of the cooling fluids.	covered in 4.1.3, but no explicit information on cooling lubricants
202	UBA	**Task 4 p 19** It is appreciated that data are given on lubricants and cooling fluids. Is any information on the quality available?	Information added, where available.
203	UBA	**Task 5 p 5** in the summary one might get the impression, that the study only examined energy aspects.	Summary revised.
204	UBA	**Task 5 p 7** The consultants state that the same manufacturing task could be realised with different technologies. Choosing one or the other may have a fundamental impact on the environmental costs of the manufacturing. Comparing technologies for same tasks, however, is explicitly excluded. It would be desirable to include such comparisons as far as possible. The service of a machine tool is to e.g. change the shape of a metal piece. Ideally, one would set the performance of this service (precision, speed, etc.) in relation to the environmental impact of the process (consumption of energy and consumables, etc.). To do so a clear and narrow definition of the functional unit is needed. Given the wide scope and the individuality of the machine tools the problem of such an approach is obvious – as described in Task 1. Nevertheless the consultants should check whether comparisons overarching different technologies are feasible (e.g. via defining functional units within the individual base bases or in a more descriptive manner).	A comparison of technologies is beyond the scope of the study, as ecodesign of machine tools should be addressed, not the choice of technologies.
205	UBA	**Task 5 p 8** In chapter 5.1. second sentence again only energy during use phase is mentioned. Earlier non-energy aspects had been mentioned as considerable as well.	Report gave a misleading impression and is revised accordingly.
206	UBA	**Task 5 p 12** Bearing the overall consumptions in mind Table 5-1 shows an impressive savings potential of "simple" solutions.	Statement does not require changes of the report
207	UBA	**Task 5 p 39** The chapter describes methods for reduction of lubricants, but again only focuses on energy.	Statement not correct: 5.1.7.1 addresses lubricant and water consumption as well.
208	CECIMO	CECIMO recognises that the definition of machine tools for the purpose of the study has been modified taking into account CECIMO's official definition. However it was broadened in order to include other machines in the scope (welding machinery, machine tools for working plastic, rubber, glass, wood working machinery).	Statement does not require changes of the report
209	CECIMO	CECIMO also agrees with the division in of the study dedicated to machine tools for metalworking on one hand and other machinery on second hand.	Statement does not require changes of the report
210	CECIMO	CECIMO supports Fraunhofer Institute to follow the modular approach but disagrees with characterising the modular approach though physical components.	Later discussion of technical improvement potentials requires a correlation with physical components. Module definition remains as is, but technical analysis thoroughly has to care for a fair assessment of competing technologies. See response to comment 185
211	CECIMO	**Page 97** CECIMO cannot support the statement that the whole machine tool should be understood as a functional unit*:* "for practical reasons this study has to refer to one machine tool as a general functional unit".	Discussion on "functional unit" is provided in Task 1 since the 1st revision.
212	CECIMO	As machine tools for working metal are investigated closely, it is essential that Fraunhofer Institute takes over the experience of the industry sector and divides the modules into functional ones as proposed in previous communications. The concept of physical modules could put at risk market accessibility to some technologies if	See no. 185, 210

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		recognised as not favourable. The complexity of machine tools shows the variety of environmental impact level depending on the conditions of use and type of machine tools.	
213	CECIMO	**Page 110 "Gaps in standardisation"** The study states that there is a need for regulation in the area of power consumption, modes, and management as well as on consumption of lubricants, compressed air, water, and waste procedures. With the view on ongoing work on the standard ISO/WD 14955-1 CECIMO recommends looking closely at the development of the standard. Currently the standard has been setting up a process for integrating environmental aspects into product design and development and evaluating the integration of eco-design. However the extension of the scope is possible to such areas like power modes and power management. Yet, more concrete information could be possibly clarified after publication of the committee draft .	ISO/WD 14955 is referenced, but as long as the standard is not adopted, the gap regarding standards being in place remains.
214	CECIMO	Moreover the standard already tackles for the moment some aspects like lubricants, compressed air, power consumption and modes (Table A.1, ,B1 and B2 of the standard — Well tried mechanical and electrical components for metal cutting machine tools of the standard ISO/WD 14955-1). CECIMO believes that a standard on technical specification of the consumption of lubricants and consumption of compressed air is not necessary. The subject/topic of process waste generation measurements relates to other European Directive already in place, namely WEEE, and as such should not be included in the study. The Fraunhofer study should not investigate related labeling issues either. Moreover, we strongly underline that the role of the study should not be the establishment of a standard for machine tools as this would be a by-pass of the international standardisation organisation on-going work. We emphasize that machine tool industry recognises the standardisation activities as the competence of ISO Committees. We would like to emphasize that Fraunhofer Institute is welcome to provide comments to the ISO TC39 Technical Committee. Annex II Operating scenario according to the ISO/WD 14955-1 […]	Statement does not require changes of the report: aspects already covered by legislation need to be stated (to map the remaining gaps), and it is not the intention of the study to develop measurement standards. Definitions of modes taken into consideration in Task 7.
215	CECIMO	CECIMO appreciates that Fraunhofer Institute reworked the database and included a lot of CECIMO comments and methodological proposals. The study and the results are now much more realistic than in the first draft version. Nevertheless several aspects still need further clarification.	Statement does not require changes of the report
216	CECIMO	**Task 2** 1. CECIMO strongly recommends **to focus on the numerically controlled (NC-type) machines**. Most conclusions based on the examination of NC-type of machine tools in terms of energy usage will not be, in most cases, applicable to non-NC machine tools and vice versa. NC-type machines are the essence of the industrial use of machine tools. Inclusion of any other type of machines makes the picture unnecessarily distorted (see point 10.)	Statement does not require changes of the report, as there is no evidence, that non-NC machine tools are irrelevant
217	CECIMO	**Task 2** 2. The estimated stock of NC-machines of 850 thousand units appears to be realistic. The **total number of 4.5 million metalworking machine tools** (NC and non-NC) in EU27 **appears to be too high.** It is remarkable that a significant share of the total metalworking stock in Europe is made up by old and simple machines being out of industrial use. Both too high stock and assigning the use patterns specific for the industrial applications to the whole European stock may lead to wrong conclusions (see point 10.)	Uncertainty of the figure 4.5 million metalworking machine tools is stated in the report.
218	CECIMO	**Task 2** 3. [Page 37] Inclusion of French data only to calculate the machine tool stock in Europe is unjustified. **There were other studies supplied, for instance from Germany and Italy.**	Lifetime data / estimates from all three countries cordially provided by CECIMO where taken into consideration for stock calculations. French study cited on p. 37 is the only one stating installed numbers and is referenced here to confirm plausibility of our

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			own estimates.
219	CECIMO	**Task 2** 4. The total number of 372 thousand machines in France is correct but it **does not match the definition applied in the study**. The French stock of metalworking machine tools falling within the scope of the Task 2 **should be 232 thousand units**. The difference may be used for the calculations in the other subchapters of your study. Please refer to the document (Recensement du parc français de machines outils) CECIMO sent to Fraunhofer on 29 Novembre 2010.	Report has been corrected accordingly, plus a critical statement regarding the stock model.
220	CECIMO	**Task 2** 5. The **estimated machine tool stock in Europe based on 3 direct market surveys** (weighted by the share in apparent consumption) **is about 2,4 million units** (please refer to the enclosed spreadsheet for the methodology applied). As the primary source of data, the direct market surveys are the strongest available information on the machine tool stock. Therefore any other, correct methodology should not lead to substantially different result.	Data is included now in the report, including also a critical discussion of data plausibility.
221	CECIMO	**Task 2** 6. [Page 61] The forecast for the stable stock of machine tools by 2025 appears to be realistic. However, **the proportion to NC machines should increase** by that time. Apart from the arguments quoted in the study, which are correct, it should be noted **that more and more non-NC machines will be replaced by NC machines**. The current replacement model assumes that machines are always replaced by machines of the same type. In order to achieve the cross replacement of machines, the model should be adjusted accordingly.	Stock model revised, based on historic growth rates per category
222	CECIMO	**Task 2** 7. [Page 61] Having the model altered according to point 6, the **increase of the stock between 1995 and 2009 should not take place**. The assumption on not growing machine tools stock over time should be applied to the whole considered period. The observations mentioned in point 6 are no new phenomenon. The number indicated in point 5 should be therefore representative for the whole period of analysis. The results of the market surveys depicted in points 3-5 confirm gradual decrease of the total stock of machine tools. In Germany the stock decreased by 16% from 1985 to 1995. In Italy the number of installed machine tools lowered by 41% between 1985 and 2005.	Footnote added, but adjustment of the stock model not possible: The EuroStat data, even after a plausibility check, did not confirm this trend (although we acknowledge that CECIMO's claims are most likely correct). As there is no (other) robust data on the EU-27 level including historic figures, the stock model cannot be adjusted.
223	CECIMO	**Task 2** 8. [Page 61] Having the model altered according to the point 6, the **decrease of the share of NC machines** in total stock **should not take place**. The growing share of NC machine tools is confirmed by the surveys depicted in points 3-5. . The results show gradual increase of NC share in the total stock. In Germany the share increased from almost 6% in 1985 to over 21% in 1995. In Italy the share of NC machines increased from about 4% in 1985 to almost 27% in 2005.	Stock model revised
224	CECIMO	**Task 2** 9. [Page 33-35]: **Unrealistically low** (for example: 0 [zero] units for example of Hydraulic presses for working metal in 1995) **or high** (for example: 604,6 thousand units of riverting, swaging machines…in 2009) **estimation of machine tool stock** for metalworking machine types. Table is also affected by the overestimated total stock of the machine tool (see previous points).	Figures for hydraulic presses due to changes in PRODCOM codes (explanation provided now in a footnote to the table), riverting, swaging machines presumably include also smaller units, but data could not be verified in detail (footnote added to the table)
225	CECIMO	**Task 2** 10. [Page 50-51]: Table 1-14: Please note, that almost **entire consumption of metalworking machine tools takes place in "Engineering and other metal sectors"** (NACE rev. 1.1.: 28; 29; 30; 31; 32; 34; 35). According to the Eurostat data, **these sectors consumed overall 164 TWh of electricity in 2008** (out of 1145 TWh consumed by the whole industry in EU27 in 2008). In the study the electricity consumption assigned to metalworking machine tools **is calculated at 210-320 TWh/year for the stock of 2-3 million units**. Any estimation of energy consumption by metalworking machine tools for 2008 exceeding the total level of 164 TWh is difficult to explain. Although the 2009 electricity consumption values are not yet available, the industrial production	Plausibility check added, data corrected.

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		along with the machine tool consumption shrunk drastically in that year against 2008.	
226	CECIMO	**Task 2** 1. [Page 7] There is written: "*For example, a plant may use 100 machine tools and replace 5% of them in a typical year. If this firm anticipates a 5% increase in sales, it may plan to buy 10 machine tools this period; 5 new and 5 replacements. Thus, a 5% surge in expected sales at one level becomes a 50% surge for the supplier.*" Since there are no other assumptions given, the growth from 5 to 10 for the supplier means 100% increase. If so, the last sentence should read: *—Thus, a 5% surge in expected sales at one level becomes a **100%** surge for the supplier.*	Corrected.
227	CECIMO	**Task 2** 2. Table or figure out of date; please update the following: a) [Page 8]: Table 2-1 contains 2008 values. Data of 2010 available: http://www.gardnerweb.com/consump/produce.html Please note that the production data in the above mentioned table for Czech Republic is not correct. The actual Czech production values for 2009 and 2010 are 433 million EUR and 359 million EUR accordingly (EUR/USD exchange rate applied in the Gardner's study is 0,7192 for 2009 and 0,7549 for 2010) The statistics does not include Poland with the estimated production at 235 million EUR (2009) and 223 million EUR (2010). b) [Page 9]: Table 2-2 contains 2008 values: Data of 2010 available: http://www.gardnerweb.com/consump/consume.html Please note that the consumption data in the above mentioned table for Czech Republic is not correct. The actual Czech consumption values for 2009 and 2010 are 226 million EUR and 148 million EUR accordingly (EUR/USD exchange rate applied in the Gardner's study is 0,7192 for 2009 and 0,7549 for 2010) The statistics does not include Poland with the estimated consumption at 387 million EUR (2009) and 412 million EUR (2010). c) [Page 8]: Figure 2-2: Please update the charts with CECIMO 2009 and 2010 data, which are as follows: | | 2008 | 2009 | 2010 | | **Production (million EUR)** | 24425 | 16867 | 16638 | | **Apparent consumption (million EUR)** | 17798 | 10283 | 9719 | d) [Page 62]: Figure 2-9:	Corrected.
228	CECIMO	**Task 3 User behaviour** CECIMO disagrees with the conclusion that the user does not consider important the energy efficiency characteristic of a machine tool and that the environmental aspect does not impact purchase decisions. The energy efficiency is one of the cost criteria's factors. A machine tool characteristic including energy efficiency is scanned by the end user and precise requirements are set up in the cost of ownership specifications. Also the productivity is directly linked to the energy efficiency. We propose to include these statements in the study. Therefore the results of the Fraunhofer inquiry ranking sales information as indicated on page 7/8 are misleading. Since energy consumption is part of productivity, quality and life cycle costs, it is not correct to ask for energy consumption on top of those other factors. The methodology did not allow the responders to rank the energy aspects as very important, because they are already included in those other factors (which are rated as very important). The industry's definition and understanding of what —quality‖ is, is also	CECIMO statement referenced in the report.

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		ambiguous. Therefore it is recommendable to include a clear definition of such concept. The endogenous variables in this equation are not independent from one another, so the results are biased. The results of the inquiry represent opinion of only 9 companies study; this number is not representative. The Fraunhofer study mentioned several times the importance of the energy efficiency as regards the end user E.g.: (page 17) Increasing share of energy costs relative to total costs (share increase until 2013 by 76% from 4.3% to 7.6%).This is in contradiction to the results of the inquiry. Therefore the conclusion of the summary (page 3) "Growing interest (…) do not result in a broad demand for and implementation of energy efficiency modules in machine tools" has to be put into perspective.	
229	CECIMO	**Task 3 Measuring environmental use parameters** The study emphasizes that there are no standards in place to support the action of comparable measurements. CECIMO disagrees with the implication that power consumption can be measured based on noise emission measurements methodology of ISO 8525:2008 – Airborne noise emitted by machine tools – Operating conditions for metal-cutting machineries. The noise emissions methodology was set up for the purpose of measuring noise emissions and as such the conditions to achieve appropriate values are different from those expected to give values on energy consumption. The noise measurements have fixed threshold differentiating the measurements from the energy consumption measurements. The standard therefore as stated previously does not apply to energy consumption measurements.	Deleted. For clarification: The study does not suggest using the ISO 8525 methodology to measure energy consumption. In fact, it should be demonstrated that it is generally possible to define test parameters for assessments (in this case noise) on machine tools in order to gain comparable results. This point is stressed in 1.2.7 Gaps in standardization.
230	CECIMO	**Task 4 4.1.3 Use phase** CECIMO disagrees with the statement that reduced processing velocity might result in a lower total energy consumption. The high share of base load in a shorter processing time increases energy efficiency.	Statement refers to a literature citation. Footnote added in the text to clarify CECIMO's opposing
231	CECIMO	**Task 4** According to a research performed by Agie Charmilles SA, to prove the CECIMO statement, **faster machining saves up to 30% of energy. The measurements were taken on SodickA500** and **Robofil310** machines, which are widespread in use; **FI440ccs** is in full production, but is an older concept than **CUT20** which is the most advanced design. The results show that an older machine under standard conditions (**SodickA500 std.**), uses **3.86 times the energy** of the newer machine with optimized parameters (**CUT20 opt.**). It means that optimized machine **saves 74% of the energy** of an old one, not optimized machine, by performing the same work with the same quality output. The measurements show that typical savings between **standard** and **optimized** (maximized Cutting Rate) are **27%** to **45%** for all four machines[Ernst R. Bühler & Orio Sargenti, Agie Charmilles SA] Annex I Research data provide by Agie Charmilles 0.25mm brass in 60mm steel	Data cited in Task 5.
232	CECIMO	**Task 4** However CECIMO needs to emphasize that also other studies provide with similar results to mention just few : - Strategies for Minimum Energy Operation for Precision Machining[Strategies for Minimum Energy Operation for Precision Machining Nancy Diaz, Moneer Helu, Andrew Jarvis, Stefan Tönissen, David Dornfeld, Ralf Schlosser Laboratory for Manufacturing and Sustainability, University of California, Berkeley WZL, RWTH Aachen],	Referenced

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		- Temperatures in High Efficiency Deep Grinding (HEDG) - Rowea and T. Jin [CIRP Annals - Manufacturing Technology Volume 50, Issue 1, 2001, Pages 205-208)] - Low carbon scenario up to 2050 for China‖ by Liu Qiang and Jiang Kejun [http://www.climateanddevelopment.org/ap-net/docs/18th_seminar/0-3_ERI_Mr.LiuQiang.pdf] We would like to draw your attention to fact that the Rajemi's reference does not represent a typical case as it is based only on dry turning process.	
233	CECIMO	**Task 4 Operating states** CECIMO recommends using operating states for metal-cutting machine tools as described in the ISO/WD 14955-1[ANNEXII] However we emphasize fact that the standard is still in the draft version and some modification can occur. Consolidated draft will be discussed in September 2011. Results of several sources as indicated in the study are, indicating the improvement potential in percentage values going up to 95% in some cases. However there is no information clarifying if the improvement level is achieved on the component / subassembly / assembly in respect of total system, or on system level. CECIMO recommends providing relative values instead of absolute values.	Definition of modes follows ISO 14955 where possible and where data is available with this distinction. Absolute values (estimates) required by the methodology followed.
234	CECIMO	**Task 5** Task 5 lists several closed and ongoing research projects. Yet the task does not give any conclusion in terms of priorities for research or implementation of the results over the coming years. CECIMO recommends including such analysis.	Need for such analysis is acknowledged, but is beyond the scope of the study (with respect to BAT and BNAT the study has to identify solely the status, but is not meant to formulate future research strategies).
235	CECIMO	**Task 5** Task 5 should include a table illustrating the planned timeframe for past and for ongoing research projects. We also propose to divide BAT between solutions on component and solutions on design level, as this has an impact on the implementation cost.	Duration added.
236	CECIMO	**Task 5 Final conclusion** CECIMO opposes any attempt of creating a parallel to the on-going work of ISO activity (namely ISO/WD 14955-1) methodology on energy consumption measurements for machine tools. The industry launched itself the work on this subject within the framework of ISO activities. Industry experts are fully committed to this task and actively participate and contribute to the ISO activity. The ISO working group consist of experts in machine tool technologies. A parallel methodology on energy consumption should not be evaluated. In order to facilitate the work of the Fraunhofer Institute the draft of the ISO/WD 14955-1 can be made available in May 2011.	It is not the intention of the study to develop measurement standards.
237	Ana Reis (expert appointed by ECOS - the European Environmental Citizen's Organization for Standardisation - to follow the preparatory study)	Background …From this, and supported by the results of others, it can be concluded that the most significant environmental impacts of a machine tool are mainly affected by 3 types of factors: • The full set of resources used to obtain the machine 'as-is', accounted as input-output substances associated to the component production and assembly stage of the MT (materials and manufacturing processes-related); • The electricity consumption required by the MT during operation, accounted as the specific process energy (SPE) related to the main functionality of the machine during its use stage; • Other process- or operation-related resources, apart from electricity, accounted as input-output substances associated to the use stage of the MT (consumed directly in the process, by the auxiliary systems during operation or in maintenance operations	Statement does not require changes of the report

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238	Ana Reis / ECOS	**Overview and additional Comments on Task 4 Draft Report** Table 1 presents the positioning of these Base cases regarding the 3 main contributors focused above. **Table 1 – Conditions used in the assessment of the Base-Cases selected, regarding the main contributors to the environmental impact of machine-tools, as here proposed.** The data collected until this stage appears limited, and mostly there seems to be still room for improvement on the Base Case selection and assessment methodology to adopt. Base-Case 2 results were provided by INEGI. Real SPE results obtained from a comparative analysis between press-brakes technologies and usage modes are also available. Similar comparative studies have been followed for Laser cutting machines. These studies suggest that: • Technology should be used as a Base-Case selection criterion for such MT investigations, as it determines all the set-up regarding the 3 types of detrimental factors to the environmental profile of the machines. Hydraulic and all-electric press-brakes, as well as CO2-laser and Fiber Laser cutters, have been compared regarding SPE, but quite interesting results should be expected from other machine-groups, such as welding equipments, and in the other contributing categories such as the non-energy-related consumables during use stage. Among the Base-Cases used, this criteria is only clear for the press-brake (hydraulic), as for metal working machines only CNC (Base-Case 1, milling and turning only) and non-CNC (Base Case 3) are distinguished, while for the other Base Cases this is totally lacking. Note that a press-brake is also a metal working machine which could fit in the Base-Case 3 generic category. • The discussion on the overall vs sub-systemic (energy-consuming or not) approach still seems to be relevant. On the one hand, while in the standard heavy-weight machines the massive structure dominates the machine assembly contribution, the trend to more efficient power technologies, modular design, electronic and electromagnetic components (particularly non-ferrous metals, such as the detrimental Cu) and structural light weight materials might justify the sub-system approach. On the SPE side this approach, covering the energy-consuming sub-systems only, is definitely the one to adopt targeting the identification of main contributors, even if the total SPE value is the one to be 3 finally accounted in the MT ranking as followed for the production stage's input. Although for Base-Case 2 this was not followed, this was the approach used on the later Laser cutter study, and the benefits for the identification of main energy-consuming factors became evident. Besides, it must be noted that as the Base-Case data was provided by different sources, different data collection and accounting methods have been used, i.e., results are not comparable and the individual contributions are determined by the methodologies used. (Moreover, the limitations of the non-standardized MEEuP methodology and their impact on the assessment results were previously addressed in a separate letter.)	Descriptive analysis is taken into account for the revision of task 4.
239	Ana Reis / ECOS	**Overview and comments on draft Task 5 'Technical Analysis'** The draft is an interesting document supporting the discussion on improvement potential and presenting several technical solutions for the main factors contributing to the environmental impact of MTs, mainly energy-related but not-only. The technical analysis followed presents solutions for the 3 types of factors listed above, namely the assembly resources (S1, S5), the energy consumption during use (S2, S3, S4, S5, S7, S9) and the other consumables related to machine operation (S6, S7). Besides, several important comments regarding technological and market trends, sector future needs and other relevant topics to consider for MTs are included and support an integrated perspective of the proposals. Among these, references to the need of combination of measures,	Statement does not require changes of the report

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		productivity and functionality as conditions of application, cost implications of the individual measures/options, operating modes, configurations of process parameters, maintenance needs and process chain shortening are to be highlighted. Some of the sub-systems and solutions had also been included in the previous voluntary initiative (SRI) proposed by CECIMO/PE-International in 2009, which participation here is properly referred to. The statement that the BAT/BNAT approach (also advanced in the SRI proposal) for MTs should be followed on the individual component/sub-system level seems reasonable. Here, CECIMO SRI goes even further by weighing the sub-systems contributions and this could be discussed.	
240	Ana Reis / ECOS	**The role of the technology choice** In the Introduction section (end of page 7), the importance of the 'proper technology choice' is mentioned as being determinant to the environmental profile of a MT for a specific manufacturing task, as well as its potential for improving environmental aspects. However, this was considered not a design issue and, in the framework of the components level BAT approach, this was not further developed. As explained above, Technology is considered most relevant as categorization criterion for MT grouping, environmental assessment, SPE analysis and any other environmental performance related aspects. This categorization is even obviously implicit in such a sub-system BAT analysis, although this is based on energy-efficiency targets only. Thus, the option of omitting MT Technology as an optimization criterion is not fully understood, in the sense that pushing for the Best Available Technologies for a specific manufacturing task/application could trigger substantial environmental benefits. The full implications of technology selection to the environmental profile of the machine on the contributing factors have to be better analysed, and not only for the energy consumption during the 4 use stage of the machine. Particularly on the production stage level, and for the sub-system approach, it was also demonstrated by INEGI [Pereira 2010] that 'even small volume components may have significant contributions and result in huge differences on the environmental impact indicators, as those observed for a shaft bushing when changing from a non-ferrous material to a 50- 50%wt (~80-20%vol) steel-graphite composite, when compared to the ferrous-based components. While the significant impact of the housing material was more evident from the volumetric contribution of the component, the determinant impact of such a small volume component could be missed.' Furthermore, the trend for all electronic or electromagnetic versions should push for more complete LCA analysis, as this includes additional electrical and electronic components, which typically include an higher amount of hazardous materials [Santos 2011] as referred for Base-Case 2.	Relevancy is acknowledged, but study authors disagree with ECOS: the aspect of technology choice goes beyond the core scope of the study, which has to deal with the machine tool as a product, the product is not the technology.
241	Ana Reis / ECOS	On the use stage, it is important to highlight the interesting work followed by the CO2PE initiative [1], which has been working on the definition of a methodology for systematic analysis and improvement of manufacturing unit process life cycle inventory (UPLCI), i.e. on the deep analysis and quantification of the environmental impacts of manufacturing processes. As resumed in their last report [Kellens 2010], this methodology 'comprises two approaches with different levels of detail: the screening approach and the in-depth approach. The screening approach relies on representative general data and theoretical calculations for energy use, material loss, and identification of variables for improvement. The in-depth approach is subdivided into four modules, including a time study, a power consumption study, a consumables study and an emissions study, in which all relevant process in- and outputs are measured and analyzed in detail. To ensure optimal reproducibility and applicability, documentation guidelines for data and metadata are included in both approaches. Guidance on definition of functional unit and reference flow as well as on determination of system boundaries specifies the generic goal and scope definition requirements of ISO 14040 and ISO 14044'. Developed with the purpose of providing high-quality life-cycle inventory (LCI) data for manufacturing unit processes, this work seems also to fit the needs of methodology standardization for	Will be taken into account in task 7.

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		the MT use stage analysis in this preparatory study and subsequent work. As discussed in several forums, the definition of a standard job to use for comparative studies of relevant technologies available, and for pre-defined application ranges (material, shape, process quality,…) is required. Relevant technologies and application ranges should be selected from the manufacturers or their associations, considering the respective technology/application market shares.	
242	Ana Reis / ECOS	**Mass reduction of moving parts** The issue of the cost of alternative materials and the technical mastery on the MT manufacturer side is important, although this can be seen as a positive factor pushing for new dynamics to the sector. The achievements of the ECO-fit project on the replacement of main materials is referred and described later (section 5.1.11.3) in more details. Although the validation of the total life-cycle benefits is mentioned, the introduction of reinforced polymer based composites or light-weight metals should be carefully analyzed, particularly regarding the lifetime and end-of-life disposition of such components/materials (although a lot of work is going on regarding innovative end-of-life strategies for these materials, which should be closely followed). Still on this topic, INEGI has been involved in a project focusing on the replacement of the steel welded MT main structure by an innovative polymer concrete solution (also referred as 'mineral 5 casting'). Although this indirectly contributes to both measures proposed (i.e. replacement of current materials by lightweight alternatives and general material reduction), the introduction of high performance materials should be considered as an additional measure considering its significant environmental, technical and cost impacts. The potential use of polymer concrete and its advantages are mentioned in a later stage of the task report (BNAT section 5.2.3) regarding solutions for modularisation, versatility and optimisation of energy consumption. This solution is seen to satisfy and overcome the static and dynamic stiffness and vibration damping requirements also referred to in this section. The environmental and cost impacts of this alternative was analysed in a preliminary study by the MT manufacturer involved in the project (Figueira 2010). Part of the report on this is presented below.	Referenced and cited in the report.
243	Ana Reis / ECOS	**Steel *vs* polymer concrete: market opportunity** Steel pricing is undergoing a revolution as the steel prices rise. The change in steel pricing policy and current steel cost indicates that current overheads will be directly affected, and some MT manufacturers have already raised their prices. Although the need for alternative materials, less subjected to such market variations, became more evident, this is a complex task as MTs often have specific requirements for high stiffness, dimensional stability, ease of manufacturing, good dampening properties and high mass to avoid rigid body movements. If any of these features isn't met, process quality might be compromised. Several studies have been conducted in order to find alternatives to welded steel structures dominating in MTs production. Here, polymer concrete structures appear has a very promising alternative due to several technical advantages: better dampening, non or less machining requirements, lower lead times, capability to integrate functions due to moulding process and low heat conductivity allowing for better overall dimensional stability, ideal for precision machines. Currently, polymer concrete shows a versatile application within the range of tooling machines, measuring technique, machine racks, energy machines as well as machine parts. (...) **Figure 1 - Material comparison regarding vibration dampening (based on Anocast solution [2] data).** Polymer concrete is produced with mineral aggregates, which are crushed to meet specific grain size, then washed and dried, before mixing with an epoxy resin at ambient temperature. Resin degassing and vibratory compaction	Referenced and cited in the report.

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		during the moulding process allows for a more homogeneous, compact and air pockets free casting. There are several recipes for epoxy polymer concrete, each one with different properties and customized for specific applications. Table 2 compares polymer concrete against cast iron and steel welded base, including the environmental aspects. As it can be seen, polymer concrete presents several advantages over conventional metal structures. (...) **Table 2 - Process comparison for 3 different structural materials available for machine-tools.** The environmental aspects to be looked at include: • Embedded Energy: The energy requirements to produce a polymer concrete structure is previewed as about 25% of that needed to produce an equivalent welded steel structure. • Process steps/Production time reduction: Since mineral casted structures can be produced in a single-step, they are substantially faster available than traditional casting or steel welded parts. Normally the curing process can take up to 24 h. The cold casting process has no need for additional heat introduction, thus allowing saving energy. • Lifetime/Chemical Resistance: Polymer concrete is chemically inert against aggressive materials such as oils, caustic solutions, acids and liquid-coolants. • Recyclability: It can be deposited and potentially recycled. If crushed it can be re-used as a mineral casting filler. The results of the LCA study followed (based on Eco-Indicator99) for comparison of the current steel welded structure and the polymer concrete alternative are presented in Figure 2, and clearly confirm polymer concrete MT as a far more eco-friendly solution than the current welded-steel solution. (...) **Figure 2: LCA results of the comparison between machines with steel welded and polymer concrete (mineral casting) structures per: (a) end-points and (b) middle-points environmental impact categories.** Potential limitations to the use of polymer concrete include: • Resistance to flaming combustion: Direct incidence of the thermal beams into the structure should be avoided. • Shrinkage: Might represent a problem in thick bodies; high contraction leads to internal cracking appearance. • Extra thermal processes: Although curing typically takes place at room temperature, some resin systems are heat treated for added strength and stability. • Raw-material Cost: Aggregates exist in abundance and there are several companies which can supply mineral products where composition, granulometry and quality are certified. Unfortunately they represent less than 1% of the cost, although they are about 90% of the weight. There are some ready to use grout in the market. These products have the advantage of being market proven, allowing to reduce risk and time-to-market; the drawback is their higher cost. Resins cost represents approximately 84% of the final cost. In	

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		general, epoxy resins are about four times more expensive than polyester resins. Depending on the quality requirements, polyester could be a preferable choice.	
244	Ana Reis / ECOS	**Role of the MT user in energy management options** Although widely discussed in different areas, this is a topic that MT end-users tend to neglect, as confirmed in many of the questionnaires where INEGI was involved. The importance of enabling 'the user to provide detailed insights into the energy consumption of the production process' is essential to accomplish the optimization of the MT environmental profile during the use stage, as the user is most actively involved in this process. Independently of the many possible solutions targeting the control of the MT, the user's insight is surely determinant for this optimization. Further parallel actions on this should be encouraged. Regarding the stand-by management discussion, it is important to highlight the importance of the overall approach besides the sub-system approach. As concluded from the Laser cutter study, although the sub-system dimensioning and energy-consumption could be individually optimized for a specific application condition range, these are quite technology dependent. Besides, considering that MTs typically operate in very distinct operating modes, it is important to ensure that all sub-systems are properly synchronized in each operating condition and the respective power consumption profiles should be matched. This is expected to contribute significantly for the reduction of the power demand and improved efficiency of auxiliary main-systems against the main energy source sub-system, as shown.	Statement does not require changes of the report
245	Ana Reis / ECOS	**Best non-available technologies (BNAT)** The BNAT section consists in the presentation of a wide set of on-going projects running in Germany. The reference to the NEXT and PROLIMA EU projects is highly appreciated, although the compilation presented in the CECIMO's draft SRI should also be referred to. The solutions proposed in these compilations would also fit perfectly as BAT identification sources.	Statement does not require changes of the report; CECIMO's compilation was already taken into account for the BAT listings.
246	Ana Reis / ECOS	Conclusion At this stage, the work led by Fraunhofer IZM to draft the preparatory study resulted in a quite extended and detailed overview of the improvement potential of the environmental profile of machine tools. The compilation of data and projects running on this subject shows the high interest and efforts devoted by the European MT manufacturers and their associations, research institutes and academia on finding added-value and effective solutions, which is essential for the success, sustainability and continuous improvement of the Ecodesign measure to be adopted. Regarding the environmental profile definition and classification, the main factors seem to have been identified, however the environmental assessment methodology and machine tool categorization still requires improvement and fine-tuning. To accomplish this more effectively, consideration of the experience and results of other parallel research teams is suggested, such as the CO2PE! initiative on the environmental characterization methodology of manufacturing processes. In addition, the ongoing preparation of the revision of the MEEuP methodology could also contribute to improving this categorization-characterization-improvement strategy, and should be closely followed. This is essential for the proper assessment of any characterization result and for the future development of key-performance indicators, classification system or any other standards.	Statement does not require changes of the report; revision of MEEuP will not feed into this study, but targets at future studies.
247	EPTA	**Energy** Generally light stationary woodworking products use minimal energy. Typical annual use phase energy consumption is approximately €40. Overall, using realistic industry assumptions, products of this type currently in use in the EU 27 countries consume approximately 0.550 TWh per annum. Hypothetically, using optimistic life and usage assumptions, this figure would not exceed 0.825 TWh per annum. (See table 1 below)	Data taken into account for additional Base Case calculation
248	EPTA	**Improvement Potential**	To be addressed in task 6.

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		The main improvement area for these products relates to the motor. Typically induction motors fitted to these products are already more efficient than the universal motors fitted to portable hand held tools. Efficiency can be improved by optimising the lamination quality, optimising the airflow for motor cooling, choosing the best raw material for the winding, optimising the winding process and increasing the motor surface to increase the heat absorption. All these improvement areas carry cost / weight / size implications. Overall, it is considered that an energy improvement potential of between 5% and 7% could be achieved with an increased manufacturing cost of between €20 and €25 per unit. Thus far these changes have not been commercially viable due to the on-cost for consumers in relation to the overall product price. In any case, it can be seen from the table below that energy improvement potential is neutralised by the requirement for additional manufacturing energy usage and also there would be increased consumption of raw materials. Table 1 (see spreadsheet for detailed assumptions and calculations) **Data collected for the Light Stationary Tool Category in the EU27 Member States shows the following:** **Realistic** **2009 Sales Volume** | **Products Currently in Use** | **TWh per annum Energy Consumption** | **TWh Energy Improvement Potential** | **TWh Additional Manufacturing Energy** | **TWh per annum Net Energy Consumption** **TOTAL** | **220,000** | **2,200,000** | **0.550** | **-0.028** | **0.064** | **0.586** **Optimistic** **2009 Sales Volume** | **Products Currently in Use** | **TWh per annum Energy Consumption** | **TWh Energy Improvement Potential** | **TWh Additional Manufacturing Energy** | **TWh per annum Net Energy Consumption** **TOTAL** | **220,000** | **3,300,000** | **0.825** | **-0.058** | **0.077** | **0.844**	
249	CLASP	CLASP does however feel that the study as a whole suffers from a lack of clarity on the approach that should be adopted. Although we appreciate that this is normal at this stage, we feel that the collection of data would strongly benefit from a clearer articulation of views on this issue. We are currently developing a position paper in which we discuss a range of possible approaches and identify a few options that hold considerable promise, which we hope can make a useful contribution to the study.	Statement does not require changes of the report
250	CLASP	Scope: CLASP is very disappointed by the exclusion of some categories of machine tools that represent very significant energy consumption in Europe and suggest that the Preparatory study include these to allow the Commission to take a view as to whether these products should be analysed and covered. We believe that more attention should be given to the possible overlaps with other ecodesign studies: for example servo motors are probably in scope of the imminent motor call.	The scope covers all types of machine tools in a very broad sense; the scope is already extended to "related machinery" on the modular level. Further broadening of the scope is not feasible for capacity reasons and would be in conflict with other stakeholder comments, which state the risk of a too general approach, which does not allow for a thorough consideration of specific machinery aspects in certain segments.
251	CLASP	Economic and market analysis: Further to the lack of robust information, which we hope will be addressed shortly, this section suffers from the vagueness of the definitions picked up in chapter 1. We would also like to see more information in the study about which are the most and least important products for each category of product.	Statement does not require changes of the report; most and least important categories in terms of market figures can be seen in the detailed market figure tables (on the

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			PRODCOM level)
252	CLASP	User requirements: Despite the result of the survey showing that energy use is considered the least important factor when purchasing a machine, CLASP is reassured to see that large users are very conscious of the importance of this issue – enough to make considerable efforts to characterize machine tool energy use. The results of the survey strengthens our conviction that setting ambitious ecodesign requirements for machine tools is of great importance, and that it could only strengthen the competitiveness of the European industry.	Statement does not require changes of the report
253	CLASP	Technical analysis of BAT and BNAT: To make the proposals of energy saving options more useful and more salient, there needs to be a clear explanation of the applicability of each measure, its penetration to date, barriers to market and ultimate realization of potential. Possible interactions between improvement options will also have to be clarified, as there will necessarily be overlap between measures.	Applicability, barriers are addressed in the revised version, based on stakeholder survey.
254	CLASP	As mentioned above, one of the main issues of importance to the study is the definition and choices of basecases. Creating basecases that are correct for all phases of the life cycle is potentially difficult and time consuming. But if from a quick exercise we can determine that it is energy consumption that is the critical factor, then we have to worry less that other factors, such as material composition, may not be accurate. This would save time as you take the study forward.	Taken into account.
255	CLASP	At the simplest level basecases are representative of a defined group of products. But could they also be extended to cover products with different functions that had the same energy use and savings potential characteristics? Many simpler machine tools are in energy terms just a motor on a lump of metal. If the measure is to use a more efficient motor, and they have similar duties, then a virtual basecase machine can be defined that represents several simple machine tools which functionally have no relation to each other. Such a basecase could not be identifiable as a real product, but would be suitable for the purposes of the MEEUP method. In this case it would be something like "Simple machine tool with power drive motor and no other significant modules".	Partly addressed with the generic Base Cases on non-NC machine tools and light-stationary tools
256	CLASP	The use of parameterised basecase models: To reduce the numbers of models, particularly where there are different distinct sizes or duties, the basecase could be for one size or duty range. The impact on machines with different sizes or duties could then be identified in the section on sensitivity analysis. This is, or should be, the case for all products that may have different duties. For example in the EuP Circulator study the same product has different distinct duties in different regions, and so the cost benefit analysis of measures in these different regions was checked. This used the same basecase model and results, just doing a quick check on the impact of energy use and savings if the duty was altered. In the example described in point 1, the basecase may have parameterised values of (11kW, 500 hours pa). Other groups of machines with different values could quickly be checked by altering lifetime energy costs in proportion to their actual (power, duty) values. Conceptually this could also be done for different sizes of machines where the factor impacting energy use is size rather than duty.	Taken into account in the sensitivity analysis.
257	CLASP	A focus on common energy saving measures for products with apparently different components and functionality: This approach is only valid where there are a small number of identifiable BAT options. For example, TIG and MIG welders and even plasma cutters are "An electrical machine for metal-working where the principle BAT is a change from standard to inverter transformer." MMA welders would arguably be excluded from this definition as their standby power consumption is of much greater significance than this other group of similar products.	No such differentiation possible for welding equipment due to resource limitations

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		CLASP appreciates that this probably doesn't fit with how the selection process is described in the MEEUP description, but we think that these approaches are all very much in the spirit of things, are probably what has implicitly been done in other studies, and should yield the results that we are all wanting.	
258	CLASP	**Chapter 1: Definition and Scope** (…) What would be extremely useful at this stage is more information on the products in question, as it would make the discussions easier to follow. The limited information provided prevents us from making a firm judgement on the product categories suggested. Many stakeholders will only have an in-depth understanding of some of the covered machine types. With more information on the machine types, you will find the selection of basecases easier to justify.	A thorough description of all relevant types of machine tools and related machinery is far beyond the scope of the study; it is recommended to consult instead the extensive published literature on machine tools
259	CLASP	We would also like to see more attention given to understanding for each product type both what the most common products are (especially in terms of energy use), and which are not so important. While all should be considered in the study, this will give a more transparent basis for verifying techno-economic data ascribed to each.	Energy use is analysed in Task 4.
260	CLASP	Welding equipment is an important machine tool category, and CLASP is pleased that it is being included in the study scope. CLASP is concerned, however, at the lack of information in Chapter 1 for welding equipment. We would have expected to find a much more detailed overview of the market and technology than is currently presented.	Market analysis is covered in Task 2.
261	CLASP	CLASP is very disappointed by the decision to exclude plastics machinery from the study. We find this decision to be unreasonable as these are common machines that consume energy and resources and have an impact on the environment. There is scope for better/more environmentally sound equipment, and thus the Preparatory Study should include these machines to enable the Commission to take a view as to whether these products should be analysed and covered.	Extensive rationale is provided in task 1, what are the characteristic of plastics and rubber machinery, and why they are different from machine tools.
262	CLASP	1.1.1.1 CLASP agrees DIN 8580 is a process description only, and is not useful for categorising machines for our purposes. Relating to the scope of the study, welding, soldering and brazing equipment IS shown here as a process, but is not what we would consider a machine tool. However, given the energy used by welding equipment, CLASP strongly supports its inclusion in the study.	Statement does not require changes of the report
263	CLASP	1.1.1.2 Ostensibly it sounds reasonable that environmental impact increases with machine complexity. This is because there will be a higher total power of equipment to service all the additional functionality. But conversely, more automation means greater speed, as it is likely to be faster than less automated machinery. So there may be more power but possibly less energy per part. By contrast, a low tech machine tool left switched on for all of a shift, but only used for occasional jobs, will show very high energy consumption over the shift, but only a low power during operation. As you say, relating energy to product output then becomes important. CLASP believes that standby/idle time power consumption for these machines should be included in the scope of the Preparatory Study, as this can have a significant impact on the overall life-cycle energy consumption. And, by looking into this issue, it would provide the Commission with information and data relating to the magnitude of this issue and consider appropriate remedial measures. It is suggested that there is a good link between electricity use and heat evolution. We need to be careful with the link between electricity use and heat, as much of the electricity will be used for motion control, and so it will not all end up as heat. While this idea is reasonable in a general sense, the relationship between the two will alter according to all sorts of machine and duty specific factors in such a way that we believe that it is too imprecise to be used as the basis of regulation.	All these arguments are already addressed throughout the study.

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		CLASP supports the 5 levels of automation depicted in Figure 1.2. We believe that if the stakeholders can endorse this categorization, this is a good building block for the study.	
264	CLASP	1.1.1.3 DIN 69651 is definitely more relevant than DIN8580, but it still is by machine type rather than what the machine is trying to achieve, i.e. many of the machines could be used for several processes. This issue is something that will be critical later on to avoid confusion, ensuring that a machine is classified in only one category. In CLASP's view, the best categorisation of these machines would be based around the PRODCOM structure with the enhancements discussed earlier.	DIN 69651 deals with metal working machine tools, whereas DIN 8580 also considers all kinds of production machinery which is in line with the scope of the study. Both standards are valuable in the course of finding a definition for machine tools. Double counts are avoided as the PRODCOM structure is applied for the classification of the product scope.
265	CLASP	1.1.1.5 Table 1.2: There is always a problem with discontinuities in standards and we wonder whether a graduated MEPS level would be more appropriate than relying on just two categories. As it stands, machines in the border area are likely to be sized to best regulatory advantage, removing a size range of machines from the market. Given that picking the correct size of machine is a contributor to best energy efficiency, this would have the unwanted effect of reducing energy efficiency in some cases. CLASP would therefore recommend that at this early stage of the analysis a sliding scale should be used, such that the MEPS targets represent an equal techno-economic challenge to manufacturers for every size and type. Once these curves have been agreed by stakeholders, they will provide the technical evidence on which to consider the option of replacing the curves with two (or more) categories. By way of reference, all EUP motor, pump, fan and circulator MEPS are based on such sliding scales. Given the large contribution of motors to the total energy use of machine tools, where large motors are progressively more efficient that smaller ones, and are regulated on a size by size basis, this implies that this approach is a very good starting point. (In terms of product analysis, in particular for identifying basecases, splitting the product group up into sizes is useful, but we would like to note that this is a different consideration from the need to make robust regulations.)	This chapter is about documenting existing standards, not about proposing MEPS. Policy analysis will follow in task 7.
266	CLASP	1.1.2.1 Preliminary restrictions Please note that the broader scope of products we are suggesting should be considered will mean modifications to the current definition of machine tools. A key issue is that we are suggesting that the scope is broadened to ensure that account is taken of machines currently out of scope that perform operations similar to those in scope. (Note that an impact of the possible modular approach discussed later would mean that other applications of the modules used in machine tools will need analysing, although these out of scope products would not be subjected directly to machine tool regulations.)	Definition of "related machinery" is based on the "similar modules approach", a "similar operations approach" (which in fact is largely covered by the "machine tools" definition already) would not add value, but complexity to the definition part.
267	CLASP	Restriction 1 – Technology Casting (and other primary shaping processes) of components is regarded by component manufacturers as another alternative to primary shaping. For example, there will sometimes be a decision whether to mill or to cast a complex metal part. For low volumes milling may be chosen, but for high volumes the high cost of the tooling for casting can be justified. While it may be excluded from the Machinery Directive, by virtue of the similarly of goods that it produces, CLASP does therefore not see that it follows that these processes should be excluded from this study on Machine tools. CLASP would therefore like to see an analysis of casting and other primary shaping processes which can compete with machining operations. We do not accept the argument that a non-solid feedstock means that a process should be excluded, as	Machinery for primary shaping has been excluded from the "machine tools" definition for several reasons as stated in task 1 and as discussed at the 1st Stakeholder Meeting already (similarity of machines, common understanding of machine tools, feasibility etc.) It is not the scope of the study to analyse technologies as such, but machines (i.e.

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		in terms of application this is arbitrary. We agree that surface acting processes for cleaning should not be in scope. However, altering surface properties of materials can enable light-weighting and extensions of lifetime, both of which have impacts on the lifecycle energy use of the produced product. So while it will not significantly change the geometric shape of the workpiece in the terms of the current definition of machine tools, it does enable much more significant benefits overall. CLASP believes that it would be a mistake to overlook such beneficial technologies, and so such technologies should be in scope.	energy-using-products)
268	CLASP	Restriction 2 – Product with reproducible geometry A shredder may be distant from the precision nature of the products that are characteristic of those made by the machine tool industry. But it still cuts up metal, and so using this much broader definition should be considered as a machine tool product. CLASP would therefore like to see this category of products included in the study.	Shredder could be covered as "related machinery" on the modular level. Definition has been discussed at the 1st Stakeholder Meeting already.
269	CLASP	DIY tools. We agree that these should be excluded on the basis that they have exceptionally low running hours. CLASP, however, feels very strongly that there must be a clear technical definition of a DIY product, to eliminate the risk that unscrupulous manufacturers will claim their products are for the DIY market, when in reality they may not be. From initial research, this definition of DIY and professional uses is not simple; - The informed consumer will be aware of the relative quality of different brands, with the performance and in particular durability of DIY goods being far less than those intended for professional use. But rarely is this made explicit, with a couple of exceptions proving the rule: - www.axminister.co.uk is a retailer of machinery aimed at the smaller professional or serious amateur market. They grade bigger power equipment into the following categories: Hobby, Light trade, Trade, Industrial, and Production. For each, an expected number of annual maximum operating hours is given. This is obviously discretionary, and relates to build quality, durability, serviceability etc, but there is no technical description of how this process works. - Bosch is explicit in having green power tools for the consumer market, and blue for the professional market. We do not yet have a suggested solution to this problem.	No suitable definition of DIY tool available beyond the descriptive differentiation now introduced to the report: Opposite to machine tools, DIY tools are consumer goods and thus have to meet other requirement than in the B2B market. Machine tools, on the other hand, are investment goods made for professional use. (1.1.2.1 Preliminary restrictions → restriction 4)
270	CLASP	Restriction 3 - Strength of shape Strength of shape is given as a criterion, but what about e.g. pressed rubber components which are on the limit of your definitions? The phrase "at the very least resist human or gravitational forces" would not stand up in law, and so CLASP suggests that this is defined in terms that are unambiguous. This definition should be tested to ensure that the results are acceptable to stakeholders.	Scientific definition added.
271	CLASP	Restriction 4 – No hand tools Hand tools need to be clearly defined, as products such as chop saws are portable, but not held during operation. CLASP disagrees with the assertion that hand tools used by professionals are only used for a few minutes a day. This is true of the DIY market and the light trade market alluded to, but in factories there are hand tools being used on assembly and finishing lines with much higher duties. In many cases there will be a choice between compressed air driven or electric hand tools, with the former being lighter and safer, but also more costly in terms of energy. CLASP therefore suggests that this restriction is lifted, with the "No DIY" tools restriction allowing the focus on industrial hand tools. Pneurop should be very helpful regarding compressed air tools.	"Portable by hand" is unambiguously defined in 1.1.2.2, clearly distinct from "transportable" equipment. Thus, a workable definition is provided, which would not be the case, if the major distinction (of portable by hand units) would be "DIY" and "professional".
272	CLASP	Fig 1.5 item 3.4 shows non-mechanical removal operations, and seemingly contradicts the exclusion of surface treatments in restriction 1. These do not fit into some definitions of machine tools in that there are no moving parts.	3.4 falls under cutting

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		We would like to understand more about these operations and the reasons for their inclusion, (an example of more descriptions needed of the equipment).	
273	CLASP	Restriction 5 –Components and sub-assemblies excluded We agree that a module is not a machine tool. We also agree that you are right to include them for later analysis so as to understand how improved modules can improve machine tool performance.	Statement does not require changes of the report
274	CLASP	Restriction 6 – No supply or disposal systems There should be a distinction drawn between centralised systems and those local peripheral systems where they are, or are capable of, being controlled in some way by the machine tool to which they are attached. For example, a central compressed air system will be left on all the time, but a downdraft table, wood dust extract fan, heat extract fan or chip conveyor could be interfaced to a machine tool. Furthermore, for these products, where the machine tool could to some extent controls them, and are connected solely to that machine, then they can be thought of as a module belonging to that machine, and so CLASP's view is that they should be in scope. The fact that an integrated product is physically separate from the machine tool is not a valid reason for excluding them. Chip removal systems are a good example, but there may also be others.	No changes; an unambiguous definition requires a clear distinction: If peripheral systems are included, these need to be defined as well, facing the difficulty of differentiating peripheral systems serving one, two, several machine tools up to centralised systems.
275	CLASP	1.1.2.2 Generic Definition. There are some good features to this but we have the following comments, which refer partly to our comments on the exclusions: We need to be careful when defining the movement criteria - for example if a machine is considered "mobile", no matter how difficult this is to move, it would then escape the regulations. CLASP is concerned that the link between transportability and energy consumption has not been proven, with for example some welding equipment with high duty factors designed to be mobile so that they can be moved between processes. Therefore we insist that this criterion is removed at this stage of the analysis. (If it can be proved, for example, that the typical running hours of a class of machine are so low that energy is not an important concern, then, such an exclusion would be reasonable, but it would need to be considered on a product by product basis).	Definition states: Only those machinery with a motor-driven system for re-locating is out of scope, not any movable machinery. Welding equipment falls under "transportable", but not "mobile" as the power source is always floor standing, thus welding equipment is covered by this definition already.
276	CLASP	The "linked parts" criterion needs to be removed because electric welding equipment has no moving parts. CLASP suggests that Welding Equipment, Soldering and Brazing equipment is subject to a different generic definition, as the operating action of the equipment is manifestly very different from that of machine tools with moving parts.	No changes: Welding equipment typically has got moving parts, which might be moved by hand, but still moving.
277	CLASP	Shredding machinery is built on similar basic principles – big frame, motor(s) and controls, and it processes metal. CLASP cannot see that there is the reason for their exclusion (the condition "product of defined reproducible geometry") is sufficient.	See above.
278	CLASP	CLASP is concerned about the "intended for professional use" criterion because it is imprecise and would not provide sufficient assurances that equipment not intended for professional use (and presumably not regulated) is in fact used for professional applications. This is a similar point to that of distinguishing DIY and Professional use. CLASP is concerned that the definition of "Professional" use is imprecise and could not be testable in law, and so should either be removed or defined in a way that is precise and enforceable by law.	Removing the "professional use" criterion would broaden the scope to DIY tools, which is not intended, due to their limited environmental significance. Although professional products typically feature a higher robustness / reliability, there is no suitable, verifiable technical indicator to define precisely the difference between DIY and professional equipment.
279	CLASP	CLASP would like to see formal definitions of all of the process terms written down in a way suitable for publication in the final WD. This will enable the definitions to be tested to check their robustness, only after which it will be	A definition of all process terms is beyond the scope of this study and as the processes are

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		reasonable to accept any of the definitions suggested.	not part of the generic definition this is not needed.
280	CLASP	1.1.2.3 / .4 Metalworking definition Cecimo states that the products are generally produced for sophisticated end uses, and yet many are for lower tech products such as domestic goods and car parts. Our comment is that machine tools are also used extensively for less high tech applications.	No changes: Chapter cites CECIMO's definition
281	CLASP	We agree that the bulk of the market is B2B, but it should be noted that there is also some B2C sales of smaller machines. As previously, this cannot work without a clear definition of B2B and B2C. (There is also some confusion concerning this definition in that this clause is not included within the italicized definition.)	Remark: B2B is covered by "professional use"
282	CLASP	Forming is a slightly vague term, which could be interpreted as including casting (which is currently excluded). The revised EUP definition reads well, as does that for woodworking machinery.	In engineering terms "forming" is different from "primary shaping" (i.e. casting etc.), so no further definition required.
283	CLASP	1.12.5 Welding , soldering and brazing machine definition CLASP would like clarification concerning whether all welding equipment where the torch or electrode is moved by hand are in scope. Given the large numbers of these, it is important that they are in scope. The definition of welding machine is weak – do you currently mean a fixed machine that is fully or semi-automatic in that it moves the torch or electrode without human direction? These definitions need resolving before we can make full comment. But in terms of energy use, CLASP insists that all welding machinery, whatever its mobility, is included in this.	Welding equipment where the torch or electrode is moved by hand is within the scope.
284	CLASP	1.1.3.1/2 Moulded metal powders and sintering is a growing area and competes with other technologies – should we really be excluding it? We currently have no numerical data on this, but as it is a growth area we would like the consultants to review this sector in order to better inform this decision. The other 3 criteria relate to system components, but we should be careful here as we may well end up regulating these, in which case these will need including. Note that some machines can be used for both metal and wood working, and indeed other materials. CLASP notes that the exhaustive list is in need of some editing – e.g., is there a difference between drill and drilling machines? CLASP requests that before this list is finalised, stakeholders be given an opportunity to review the full definitions to clarify points like this and enable us to determine whether we agree with the list as it is presented. This is a long list, but for each type it will need splitting further into different sizes, key features, etc. This is critical to provide a level playing field for any resulting regulations. Your Fig 1.2 is a good starter in this regard. To take just one example of welding equipment. For the family of MIG welders (for which it is not currently clear which Prodcom code they sit under), there is a family of products: - Battery powered MIG welders, (typically 2 car batteries) for off-grid use - Small DIY MIG welders (<13A supply 1 phase) suitable for domestic use. - Small MIG welders (<16A supply 1 phase) suitable for professional use, (similar to above but with much higher maximum operating duties). - Medium MIG welders (3 phase supply, medium power) for lower power industrial applications. - Large MIG welders (3 phase supply, high power) for heavy fabrication. - (The same category will also be available with separate wire feed units.) - Fixed MIG machinery integrated into production equipment.	No changes: The lists are for orientation only and not part of the definition; sub-categorising further would not add value as the later analysis (Base Cases) cannot follow a similar level of granularity.

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		- Engine powered MIG welding machinery. Most of these will be available in both mains frequency and compact high frequency designs. For the study to yield useful results, CLASP asks that the lists should be expanded to this next level of detail such that it is much easier for stakeholders to relate to particular items of equipment.	
285	CLASP	1.1.3.3 By volume, sales of static welding equipment are small, but by energy use it may be a large proportion. This is because most manual welding sets only have low duties, whereas e.g. MIG or spot welders on automated machinery will have much higher duties. More data on this market is required in order that judgements can be made. From our knowledge of this market, (electric) brazing is only a very small sub-set of welding use. Does this include gas brazing? Soldering includes hand operated equipment where at a guess is in total a very small consumer – perhaps 25W thermostatically controlled on average, (although Prodcom explicitly excludes this). But there is also flow soldering machinery for soldering circuit boards and solder "pots" – they use much more power, but are comparatively rare. Again, does it include gas soldering? Table 1-9 needs modifying to be explicit about where different key processes fit, for example; MIG, MIG, MMA, laser, stir, spot, electron beam, friction welding etc. As with woodworking and metalworking machines, a full list of apparatus is needed.	All mentioned welding (and soldering) equipment is within the scope, but observe the overlap with the oven study (lot 4). All available market data is listed in task 2 (with a reflection, which kind of equipment falls likely under which PRODCOM category). A complete list of covered equipment cannot be stated, and is not intended, as the scope definition reflects joint technical characteristics, but is not defined through the numerous individual technologies.
286	CLASP	1.1.3.4 Table 1-10. This list of other products impacted is useful. Can you be sure that the specifications will adequately differentiate the same generic products intended for different markets?	The broad variety of markets covered by these products is obvious. A detailed analysis of these markets is beyond scope. Limitations of this broad approach will be addressed in task 7.
287	CLASP	Table 1-11 is concerning, as it acknowledges weaknesses in Prodcom. If Prodcom is to be used, or a version of it, it needs to be justified firstly by reference to market statistics, secondly to considerations of the basis on which products are going to be regulated, and then on the way in which market surveillance will operate with an emphasis on removing any loopholes. We do not so far see this information and so are unable to comment whether what is being proposed is useful.	Usage of PRODCOM is required by the tender specification and MEEuP. Pros and cons of this approach are discussed in task 2. Complementary statistical data is taken into account in task 2. PRODCOM categorization is not part of the scope definition and serves only for a rough classification.
288	CLASP	1.1.3.5 The text says 76 categories, but table 1-11 shows 84. Please correct and/or explain the difference.	Corrected.
289	CLASP	1.1.4 This states that the study will also follow a modular approach, which we welcome. This being the case, we would like to see these modules defined precisely here and subjected to MEEuP analysis so that the benefits and negative impacts of each can be understood. Lighting, displays and cooling fans could usefully be included here. We agree that the modular approach gives the opportunity for machine independent findings. CLASP is aware that this approach has trade-offs, and as mentioned in our introduction we will be submitting a short discussion paper that lists the pros and cons of this approach compared to that of regulating the whole machine tool product. The two big incentives for this approach are that it greatly reduces the burden of trying to classify and regulate the performance of the huge range of machine tools. It also makes compliance checking much simpler, greatly reducing the test burden on the manufacturer and removing the need to develop lots of technical standards and accompanying test workpieces.	Statement does not require changes of the report

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		While the modular approach is good, how they are controlled to operate together will also be very important. It will also not be able to take account of advances in framework design. An unintended side effect will be that where these modules are used in out of scope machines, these other machines will also be indirectly impacted. CLASP looks forward keenly to seeing the results of this work.	
290	CLASP	1.1.4.3 You mention that modules that are of very different dimensions to those in scope of this study will not be impacted. In this case, clear size limits will need specifying.	This specification inevitably has to follow the analysis of improvement options.
291	CLASP	A comment is made that the Motors Directive excludes food, beverages and tobacco products (presumably because these are special wash-down duties), but this is not written in the EuP regulations on motors.	Comment mis-interpreted by CLASP.
292	CLASP	1.1.5.1 This cross-check with the working plan study is good; your comments are reasonable but better data on which to base further analysis will hopefully emerge as the study progresses. CLASP would like to provide motor energy use data as a cross check. The following is a rough estimate only to indicate the methodology. This indicates that, even allowing for the exclusion of welding equipment, your estimate is too large by up to 100%. This highlights the importance of reviewing the different product categories in more detail. From the EUP motors regulations, current EU motor energy use is roughly 1100TWh pa. Studies vary due to the vagueness in definitions, but as an indication 5-10% of this would be for process equipment. Of this, most would be machine tools, and using the cited figure in your report of 90% of machine tool energy use being for motors within machine tools, there is an upper figure of c120TWh pa for all machine tools (excluding welding equipment).	Further plausibility checks added to the report.
293	CLASP	1.1.5.1.2 We agree with your comments regarding the EPTA data – your data is much more reasonable. We note that soldering (yet alone brazing) equipment is not included in the discussion, which could distort things. We would like to understand more about the split between fixed and mobile welding equipment, as this is key to understanding the energy consumption. Separately, given that there are so many portable welders, should this category be included as a new category? Although the welding time may be very small, where they are left on all the time, the standby power consumption can be considerable, and can be greatly reduced with better technology	"Transportable" welding units are included, there are no fully hand-held ("portable by hand" according to the definition) units
294	CLASP	1.1.5.1.3 We would like to see more data here to support these figures for stone and ceramics usage. However, it does seem reasonable to accept that metalworking machinery dominates in terms of energy consumption.	Market figures are provided in task 2, confirming the minor relevancy compared to metalworking machine tools.
295	CLASP	1.1.5.2 This distribution of machine tools by size is useful. However, it relates to available products, not those produced, and so is not indicative of actual sales and so cannot be used to give statistical averages. You make a good point regarding the huge distribution of machine tools by size. Generally manufacturer surveys can be problematic as they are only from a relatively small and maybe biased sample (as you seem to acknowledge), and so if it is later seen to conflict with other data, it should not be a concern. A survey of users would be useful in order to give a broader spread of views. If that is not possible within the timeframe of the study, then we would suggest at the least talking to NGOs and other organisations who are actively engaged in promoting energy efficiency to the end user.	(Industrial) users of machine tools have been invited to participate in a survey on user behavior, with very limited response (see task 3).
296	CLASP	Cecimo LCA: We think this is reasonable. So that you can confirm that it is energy that should be focused on in the study, are you able to take this and define the minimum annual running hours and lifetime that make energy consumption the most important factor?	Distinct analysis and discussion, also taking into account again the CECIMO LCA, is provided in task 4
297	CLASP	1.1.5.3 Junila: Does this data on a welding machine refer to a conventional or inverter welder? Also does it include the MIG wire – this is quite costly and will impact the in-use environmental impact. This is potentially very useful	No further information available (even upon request).

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		information, but it needs more detail to be usable.	
298	CLASP	1.1.5.4 Screening for the plastics and rubber industries P 67: On p 67 it is stated that plastic machinery will only be included if the modules are also relevant. In effect, most plastics machinery will therefore be impacted to a greater or lesser extent. As you have indicated, it is unwise to rely on Eurostats for sales data. Where does your assumed 2/3 smaller industry: 1/3 large intensive user split come from? It seems to contradict the similar figure in the next paragraph of 2/3 being in intensively used industries.	The 2/3 : 1/3 split is an industry estimate, which could not be verified further. The 2/3 in the next paragraph refer to the plastics processing enterprises, not the number of plastics processing machines.
299	CLASP	P 82: We note the Euromap 60 method for categorising the performance of plastic injection moulding machinery. It shows average power, specific energy consumption, and cycle time. This could be an interesting approach for other products. Does the standard offer values on which performance can be assessed relative to the rest of the market?	No
300	CLASP	(And yet on P 84 you explicitly rule out the use of material weight as a measure for non-plastics machinery – presumably you are referring to the weight of the workpiece rather than of the material removed. The weight of material removed could in theory be a measure for other machines, and so should not be excluded at this stage without further exploration).	Confirmed.
301	CLASP	P 83: CLASP objects to the decision to exclude plastics machinery simply on the basis that heating and cooling are particularly important features. They are widely used in industry and offer a way to make parts that may be alternatives to those made out of other materials by other machines that are in scope. We understand that there is a large energy consumption of plastic injection moulding machinery, there is an impressive and accessible energy savings potential, an availability of standards, and the machines are functionally very similar. CLASP feels strongly that for these reasons these machines should be included in the Preparatory Study.	No doubt about the energy consumption impact, but the intention of this chapter is to identify, whether there are sufficient similarities with machine tools to justify a similar approach. A multitude of approaches just cannot be dealt with in such a study.
302	CLASP	1.1.5.5.1 Environmental parameters. A: You state here that the manufacturing phase is of low importance. But the contribution by Ana Reis contradicts this, where for a press the materials are shown to be important. More evidence is needed on this to understand in which machines/applications the material the machine it made of is a significant issue. You correctly state the case in 1.1.5.7.	At this point it is a screening only, details follow in task 4.
303	CLASP	C: Soldering and welding equipment do operate at elevated temperatures, but it does not follow that they use high amounts of energy, certainly not in comparison to other types of machine tools. It would be useful to clarify this comment that you have made, as it is not clear what point is being made.	Explanation added.
304	CLASP	You rightly state that power consumption is very dependent on the workpiece, and so not dependent on machine related improvement options. We also strongly urge you to expand on this point, as it implies that the selection of workpieces will be critical.	Addressed in later tasks.
305	CLASP	Furthermore, we would also find it useful if you could confirm that the performance of a machine with a standard workpiece will be representative of its performance with different workpieces. If regulations are going to be based on a whole machine, then it is essential that this is true.	Statement does not require changes of the report. It is unlikely, that the performance of a machine with a standard workpiece is representative of its performance with different workpieces.
306	CLASP	D: We agree that soldering is a health hazard, but if there is no solution for an alternative, then there can be no improvement potential and so it is not an issue for this study. We believe you are saying that most components are RoHS compliant and so this is not an issue, but this is not clear. We kindly ask that you clarify this statement.	Statement does not require changes of the report. There is no evidence, whether “most” components are RoHS compliant, only observed trends as stated.
307	CLASP	E: It is an interesting point that reduced use of fluids can lead to increased machining energy consumption. Care needs to be taken in any regulations to ensure that this issue is addressed directly, as a move to slower cutting to	Statement does not require changes of the report.

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		reduce power consumption in order to reduce fluid use could increase energy consumption. This point should be revisited when you come to make recommendations on possible regulations.	
308	CLASP	F: This is probably a typing error relating to the point regarding easy maintenance and accessibility – "access to key components ... usually is critical".	Design typically facilitates maintenance, thus access to components is usually considered in machinery design and thus non-critical.
309	CLASP	J: Waste produced during processing. A key question is whether the waste is something that should accounted for in regulations. Different machines used to make the same product will have different amounts of waste. But will different models of a type of machine have different waste quantities? Issues include margins needed for gripping (for example with lathes), size of working area (which impacts scope for laying out patterns in the most advantageous way), kerf width (probably thicker for heavier duty machines?), etc. A firm idea of the impacts of these parameters is needed in order that this issue can be understood and taken account of at this early stage of the study.	Relevancy of stated parameters is confirmed, but there is no generic evidence whatsoever regarding the actual impact, as this is highly dependent on the later application
310	CLASP	1.1.5.5.2 This states that the major environmental impact is in the in use phase. From the evidence presented, this is true on average, but it also appears that there are some cases where this is not true, for instance the press tool example presented by Ana Reis. It is therefore important that each class of product is considered in order that further examples are identified. This is necessary so that any non-energy negative impacts of measures do not inadvertently increase the total environmental lifecycle impact of a product. Like you, CLASP is also not comfortable with the suggested 30-60kW indicative operating power. It really does need to be considered on a product by product basis – it is likely that many products in the intended classification were not included in this analysis.	Statement does not require changes of the report as it is not possible to address the multitude of machine tools individually. Side effects on other environmental impacts are taken into account later in the study (task 6).
311	CLASP	1.1.5.6 Prioritising machine tool categories The concept of using price as a measure of complexity is new. Table 1-28 uses this as one criterion, but it is not related to size of machine. Can you quote the source for this, as it needs much more explanation – it is not convincing at present. We agree with you that there are problems with some classes of data, see later comments on the annexes.	Statement does not require changes of the report: Plausibility check of PRODCOM data lead to the rather obvious conclusion, that very complex machines (e.g. machining centers) show up in the statistics with high unit values. Vice versa, this criterion then is applied to categorise the EuroStat data for machine tools.
312	CLASP	1.1.5.7 Can you explain better the sentence "Depending on the scale of the machine tool, the extent of connection power of machine tools is rather heterogeneous."	The study reveals that weight and connection power among machine tools is heterogeneous, meaning that machine tools (also those which share the same PRODCOM category) have very specific and individual ecological impacts and improvement potentials.
313	CLASP	You state that highly intensive energy using machines should be the focus. We ask that you please reconsider this, as even non-intensive energy using machines collectively can have a big impact.	See Base Case assessments.
314	CLASP	1.1.6 Functional unit. This is a very useful discussion, well done! The conclusion is that for practical reasons, the focus must be on the machine tool, with productivity only being taken account of in assessing the outcomes. We note that Cecimo focuses on the machine only, not production. This is an easier approach in analytical terms, but we question whether it is valid in terms of what the EuP is trying to	Statement does not require changes of the report

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		achieve, and whether it really reflects user choices. We will expand on this point in our later paper.	
315	CLASP	1.2.1.1 As mentioned during the Preparatory study meeting, CLASP agrees that the existence of reference work processes for noise regulations could in principle be used also for energy consumption.	Statement does not require changes of the report
316	CLASP	1.3.1 P 122: Exemptions from RoHS and WEEE are often the subject of debate. We would appreciate if you could clarify the distinction in the machine tools environment between integrated and independent products. More detailed discussion on this point is needed to demonstrate whether the component is physically different or if it is simply a case of where it is fitted. This may have implications later where an independent product can also become an integrated product, which might mean it escaping regulation.	No changes. Discussion on possible RoHS / WEEE exemptions is beyond the scope of this study.
317	CLASP	1.3.3 Do you have any comments to make on the Japanese idea of regulating Power factor? We think it relates to electrical networks etc, not energy consumption, but would welcome confirmation of this.	Power factor is relevant for energy consumption. Task 1 is about compiling legal approaches in place, not commenting these.
318	CLASP	This comment just refers to an offer of further information as it becomes available – there are no changes required at present. P 128: If necessary, CLASP can update you on motor regulations, in particular likely changes in EuP regulations. For example, the maximum motor size will increase. However, the EuP regulations you mention is the most important.	Statement does not require changes of the report
319	CLASP	Annex 4.1 More evidence is needed to show that this Prodcom list works. As with the earlier example of MIG welders, the family of each category should be broken down further into groups of recognisable products on which analysis can be undertaken. Without this there cannot be confidence that this classification scheme will work. 4.2 Some specific comments on woodworking machinery: 4.3 Table 4-2 Woodworking: .12.10 and .20 “Multi-purpose” machine is a poor category for regulatory purposes. Here it focuses on the transfer between machine issues, ignoring what the machines actually are. This makes this category impossible to describe in adequate detail. Sawing machines. If it is not a band saw or circular saw, please define or describe what it is- Planing, milling and (spindle) moulding are completely different processes, and so cannot be categorised together. Similarly 28.49.12.63 – 28.49.12.75 include different types of machinery within them. Again, all these categories need further breaking down into sub-categories in order for them to be useful Table 4.3 Welding, soldering and brazing machines Generally more description is needed of these products, as some of them are very obscure, and so it is impossible to make judgement. .70.90 and 31.18 are not easy to distinguish .31.99 Key categories of MIG and TIG are included in this “catch all” category. It is however unacceptable to merge them like this. There are also combined MMA/TIG units available, and it is not clear where these would fit. See earlier example on MIG categories. Would welding apparatus include remote MIG wire feed units? A distinction should be made between self contained units and those with central transformers. Also portable welding equipment powered by diesel engines or possibly batteries. We would like to know how you have made the important distinction between electric and gas processes. Please elaborate.	Statement does not require changes of the report as the annex is for information only and relates directly to the PRODCOM classification. It is not the intention to interprete, which individual machine tools might have been reported by the companies under which category. Mentioned shortcomings of the PRODCOM classification are confirmed. It is not the intention, that the PRODCOM classification is part of the “machine tools” definition. Further description of the categories is partly considered in task 2, where relevant for the market analysis.
320	CLASP	6.1 Prodcom sales data. This is problematic for several reasons; There is a numeric bias towards smaller product, which distorts any averages derived from this. Where do sales of spares fit into this? 6.2-0 automation. No comments shown in right hand column	See Task 2 for a more detailed analysis of PRODCOM figures.

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		6.3 Welding. As previously discussed, the lack of clarity on products means that this table is inadequate for the detail of analysis that is needed.	
321	CLASP	**Chapter 2: Economic and Market Analysis** This study should consider carefully whether modules are best considered within this or other Lots – for example servo motors are probably in scope of the imminent new motors call and so it would be unwise to attempt to regulate something so complex within this Lot.	Unless the results of other lots are available modules cannot be excluded per se from this study.
322	CLASP	A double check on the statistics should be made based on total energy consumption (which should be fairly robust from the work in chapter 1. Here Number of units x annual energy consumption = total energy consumption, where No. units = annual sales x lifetime – the later assumption which is approximately valid with the static stock assumption made in the study. Where data is uncertain, the impact on regulations of under/over estimating energy costs should be estimated so as to properly focus on any sensitive factors.	Statement does not require changes of the report, such a screening is provided in Task 1.
323	CLASP	2 Although "related machinery" is difficult to identify, it is potentially huge for some products. For example, if this Lot was to regulate some motor components, such as inverters, then the impact on products outside of scope would be much bigger than that of products in scope. Care must be taken to identify the total markets for each module identified in this study. In some cases these modules will already be regulated, in others they may be better regulated via other product regulations, (e.g. currently unregulated motors within upcoming EUP motor studies). Identification of these wider markets should be a core part of work, not just on a case by case basis, as there is a danger that it will be over-looked.	It is not feasible to analyse all potential "related machinery" and related modules in detail as this is far beyond the scope of the study. Core part has to be "machine tools".
324	CLASP	2.1.1 The study should be focussed on EU consumption, not production. However, CLASP appreciates the difficulty with getting data on consumption. We kindly urge you to clearly state in the report that this is a source of error, and also suggest you speak to Cecimo to get an idea of the impact of this in the different categories of products. We have no view on the best scenario to adopt, but in the absence of other data then we would have thought that simply extrapolating the average over the time series would be best, i.e. a new line mid-way between the two top scenarios would be the least controversial option. It is a good point that the average cost of machine tools is increasing with increasing complexity.	Whole chapter 2.2.1 deals with a consumption based stock model.
325	CLASP	P.10 Market units estimate. Prodcom is a very weak source. Again, we encourage you to check that this is consistent with Cecimo data. A double check is that No of units x Average energy = total energy of all machine tools. (This will involve consideration of lifetimes to get the stock, as you generate later in this chapter). Given that this total will ultimately be confirmed by 2 (3 inc motors) methods, this should be robust, and so you can then trade stock and average energy to get the best fit of all your information. To be safe, it is suggested that table 2-3 is expanded to include average energy etc for each, with the total energy consumption then cross-checked with the total in Task 1. Without this double check with total energy (which is perhaps the most robust number you have), there is no obvious way to corroborate the estimates in Table 2-3.	As explained in the report, figures where subject to a plausibility check, assisted by CECIMO. The approach of "average energy" (which is pretty weak in itself) was followed already in task 1. It is not intended to update with each task this screening. Energy consumption is subject of task 4.
326	CLASP	2.1.2 The comments regarding estimates of stock, sales and energy consumption apply as with metal-working machinery. As a comment only, on average the EPTA differentiation of light and heavy machinery looks reasonable. This split by kW, capacity and duty may be useful for other products too. The price data also looks very reasonable. However, when looking at specific products the split will be at different values It is noted that EPTA only accounts for 30% of sales – it implies much of the balance is from Asian imports. Care must be taken in extrapolating, as Asian imports are possibly the lower value products.	Statement does not require changes of the report, see above.

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327	CLASP	2.1.3 We wonder if all stakeholders agree that MIG wire-fed machinery is "partly automatic", it would have seemed more reasonable to consider this a manual process, as the torch is guided by hand. Generally we need much more precise definitions of the products, as for this Prodcom does not appear adequate to describe the variety of products. Table 2-6 27903118. "Likely to be" is not convincing. It could range from solder pots to flow solder machines – clarity needed. Brazing is completely different to flow solder machines, so this is not a useful way of splitting things, and hence getting the basecase will not be possible. 27903152. We are surprised that 25% of MIG or other automatic machines are over 20000 euros. Again, this needs splitting between static automated or robotic machines and the huge consumer market of MIG welders <300euros. 27903163. This recalculated value sounds about right. But what about central welding transformers with multiple torches? 27903172. Unclear what "other shielded arc welding" means – presumably its TIG welding judging by the unit price – but this is not really thought of as arc welding. Please clarify. 27903181. We don't know what this is, thus some explanation would be useful. 27903199. This seems to be a catch all, and presumably includes friction welding and stir welding amongst others. Please clarify. 28297090. It is not clear to us that this includes cutting equipment, (such as plasma or oxy-acetylene). Please clarify. It would be good if the Lot 4 Preparatory Study on ovens can be used as a reference for flow solder machines. Also there is no reference made to portable welding sources, in particular those run by diesel generators. There are also battery powered MIG welders, which you can Google for examples.	Footnote added. Data was discussed with industry representatives, which is the best approximation and interpretation available. Data is reported anonymously, and cannot be tracked back to individual manufacturers. Further clarifications or distinctions are not possible on the level of PRODCOM codes, any further distinction would require a broad survey and investigation, which is not feasible for this kind of study. It is agreed, that PRODCOM is a weak basis for a distinction of welding equipment and the like, but the only available source, which allows an assessment on a per-unit-basis.
328	CLASP	2.1.4 Other machine tools There seems to be little information on these. It would be good to understand in more detail about the market. Is there a relevant trade association or key manufacturers who could be consulted?	Report revised. "Other machine tools" covered now more coherently throughout task 2, but given the nature of "other", this is a catch-all category, for which there is no dedicated association
329	CLASP	Fig 2-3 …. Age of machines. Is this year of design or year of manufacture? Metalworking tools The use of second hand markets to gauge lifetime is innovative and seems to deliver good results – congratulations on an elegant way around this data problem! Please cite the source of Table 2-10. Are there any trends – e.g. does more basic equipment last longer?	See footnote 13 of the draft report
330	CLASP	2.2.1.2 Woodworking tools Light machinery only has a very small proportion of total usage, and so the life of this should not be used in calculating the average of the whole group. Instead, it is important to further sub-divide the market into product types in order that each can be analysed separately. As stated, there is uncertainty on the lifetime of this category, which needs firming up. But the working figure quoted is reasonable until such time as better information is required.	No better data available.
331	CLASP	Table 2-11 The point is made that lower cost products do not last as long as higher cost products. A counter argument is that surely lower cost products, such as used for maintenance and occasional work, are used more rarely and so last longer?	Data was estimated by one company and then confirmed at an association meeting. This is considered robust enough as an

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		We need more information than one manufacturer's estimate for this.	estimate.
332	CLASP	2.2.2.1 CLASP supports the assumption of no growth in stock for the installed base calculation. Tables 2.14/15. What is the purpose of these tables – is it just stretching the dataset beyond the known Eurostat reporting years? The same question applies to subsequent tables for other products.	Year to year data might become relevant when discussing effective dates of any policy measure later on (in task 7)
333	CLASP	2.2.3 While these stock summaries are interesting, they are ultimately not that useful in that the different product categories are so diverse and so it is misleading to just add them together.	There is no other way for a summary, which always has some shortcomings and essentially is a simplification of the complex analysis.
334	CLASP	Table 2.26 Interesting to see that parts, accessories and services are worth 30% of the new product market. The profit from this in most industries is usually much higher than that of new machines. This point may be useful at a later stage in the study.	Statement does not require changes of the report
335	CLASP	2.3.1.2 We would appreciate if you could please define "UV Production lines."	Done, source does not define
336	CLASP	Fig 2-15 We suggest that this would make the point better if the areas on the pie charts were proportional to the total consumption of products by these companies, as the key automobile sector for example looks rather insignificant – but only do this if the data is easily to hand as it is only a presentational issue.	No such data at hand, economic relevancy of the automotive sector is stated in the report
337	CLASP	2.3.3.1 P 75: An interesting comment is made here regarding the customisation of metal-working machinery, which will have implications for design of regulations. On page 76 it is also stated that standard machines are becoming more flexible.	Statement does not require changes of the report
338	CLASP	2.3.3.2 We kindly ask that you give an indication of the growth of the laser market. Furthermore, we also ask that you clarify whether Nano technology applies only to the cutting pieces or also to the machines themselves.	Added.
339	CLASP	Fig 2.19 Machine tools are only one of many applications for PLCs, and so if they are regulated, their use in other products should also be taken into account.	Statement is not in conflict with what is stated in the report.
340	CLASP	P 83 Example of LCC. Here compressed air also has a direct energy value. This shows how energy and lubricant costs are very similar, and so in theory there may be trade-offs between them. No operator costs are shown – unless it is "occupancy" costs, which was assumed to be the cost of the building etc. The loss of production from unplanned downtime does not appear to be shown – this is a strange omission. Information on condition monitoring would be very interesting, as this is a growing market.	Statement does not require changes of the report, data is directly taken from the referenced source
341	CLASP	2.4.2 Prices. These are of little real value given the variation in sizes and complexity of machines; the categories really do need sub-dividing further such that representative prices of each sub-group can be identified.	No statistical data available on the sub-PRODCOM level (see referenced tables).
342	CLASP	2.4.3.2 Good to see the point made about consumables for welding etc exceeding that of the equipment itself.	Statement does not require changes of the report
343	CLASP	2.4.4 Not very clear what Tools, Work holders and spare parts includes.	See table 2-32.
344	CLASP	Table 2-32 These categories are so diverse that total values are not very useful.	Agreed, but this is the only available statistical source.
345	CLASP	**Chapter 3: User Requirements** 3.1.1 We wonder what the basis was for this selection. It seems as if whole families of machinery are left out, for example welding, laser or press machinery. We would like to know what effort was made to ensure that these are really the basecase average for the categories they represent.	Facts presented where dependent on research findings and feedback received from stakeholders.

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346	CLASP	These products are all CNC. Will it be possible to use these examples to generate non-CNC basecases by stripping out the CNC functionality?	No.
347	CLASP	P 6: But for automobile manufacturers energy is something that we read earlier in the report is of interest, so presumably it is also of interest to some other major users. It is hard to believe that energy is not of interest, could it be that it is of less interest than other factors to the factory staff, but still important to the company as a whole? However, given the value of the output of the machinery, the energy consumption is understandably a much lower consideration wit intensively used machines.	Describes correctly our findings and impressions, but no further evidence provided.
348	CLASP	Fig 3.1 is useful in that it shows how energy is far from being “not very important”, and also lists the other understandably very important factors when choosing a machine. Fig 3-3 gives an indication of the value of throughput compared to energy and amortisation (which is taken to include machinery costs). In the absence of any data, if we assume that a typical material cost: selling price multiplier of say x5, then the ratio of output value (46% x 5) to energy (1.8%) is 130:1. Although very rude, this illustrates the over-riding importance of throughput compared to energy consumption. P 10: The estimates of the savings potentials will be superseded by later data found in this study.	Confirmed.
349	CLASP	P 12 Measuring energy consumption. It is stated that there is no common way to assess the energy performance of a machine tool. CLASP agrees with this finding, and we would support more work being done in this Preparatory Study and by testing organisations and CECIMO to develop appropriate, accurate and repeatable energy measurement methods for this equipment.	See task 1: description of standards
350	CLASP	Fig 3.5 summarises the thermodynamic method suggested by Gutowski, and shows the dominance of indirect (as opposed to machining) energy use. This is very interesting. The unit of measurement here is kJ.cm3, i.e. it measures volume of material removed. This is plausible for some processes, but puts the focus on kerf width – which will introduce its own distortions, such as pressing have zero removed material	Statement does not require changes of the report
351	CLASP	Fig 3.6 shows SEC as a function of feed rate for various processes, showing how faster feed rates give lower energy consumption, due to the auxiliary equipment energy use being spread over a higher machining energy consumption. We would appreciate if you could please cite the source of this graph as it would be interesting to better understand what this is showing.	See footnote 18
352	CLASP	We would very much welcome information on the methodology being developed by the ISO/TC39/WG12 group, as there will be great benefits from an exchange of information and data. There is currently a concern that if both studies use a different approach, it will be hard to resolve later on.	See presentations made at stakeholder meetings, and status description in task 1
353	CLASP	We agree that in principle a test pattern for noise could also be used as the basis of a test pattern for energy consumption at no load.	See contrary comment by CECIMO
354	CLASP	3.1.3 Welding, soldering and brazing equipment There is a reference to robotics improving welding efficiency. We kindly ask that you clarify whether for a given power source the rate of deposition is determined by the current or if it is actually down to weld design. CLASP would like to see more information provided to support this statement.	No change as it is not related to this task. Efficiency is related to faster processing and better control.
355	CLASP	3.2 The figure of 15% for machine tool consumption as a proportion of total German electricity consumption sounds high. We would like to see the data that supports this claim included or referenced in the study.	Source is referenced in the study: Kuttkat
356	CLASP	Fig 3.7 We wonder whether this energy includes transport to the consumer, which is significant in mining and related	No further clarification available: Original data

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		processing. Please clarify.	refers to energy consumption of the "German economy"
357	CLASP	P 19: Please explain what the reproduction industry is. We would like to know whether you in this section imply that the proportion of energy that can be saved in HVAC etc in the production industry is smaller because of the energy intensive nature of the machining and kindly ask that you either confirm or refute this point.	"Reproduction" changed to "publishing"
358	CLASP	P 23: Despite advances in efficiency, it would appear that the improvement in performance will lead to an overall increase in energy use – please confirm or repudiate this inference. The key point is made here that because of advances in performance, the energy consumption of a machine has increased over time, but the increase in output means that the SEC has come down considerably.	(1) In principle higher "performance" results in higher energy consumption per single machine tool BUT lower energy consumption per workpiece! (2) Yes.
359	CLASP	P 24: This is an interesting discussion about complex machines being run hard compared to simple machines having low running hours, and the impact this has on SEC. Table 3.4 illustrates this nicely.	Statement does not require changes of the report
360	CLASP	3.2.3 Welding, soldering and brazing equipment Table 3-7 needs further sub-division, and the estimates need to be based on more comprehensive information based on these sub-divisions	Structure follows PRODCOM to allow for later calculations based on these statistics. No other appropriate statistical data available, hence further sub-division is not useful.
361	CLASP	3.3 End of life behaviour. Please clarify what fig 3-11 is showing. Please explain what is meant by renewal/replacement measures.	Explanation given in text above figure 3-11. "Renewal and extension measures" changed to "renewal and extension"; Term "replacement measures" not used in text.
362	CLASP	**Chapter 4: Assessment of Basecases** CLASP feels strongly that it is important that all types of machine are included – so for example laser cutting machines need to be included.	Done
363	CLASP	The basecases must all be a statistical average of all products within their respective group, otherwise the total impacts will differ from the totals already calculated.	Base cases are "conscious abstraction of reality", not statistical average
364	CLASP	4.1 You have referred to 6 different schemes for the product-specific inputs. We would like to know how you decided on the basecases and ask that you please show your thought process behind the decision/s. Providing clarity on this issue should alleviate stakeholder concerns over the selection of basecases. The description of the different approaches is a useful basis for later discussion; Machine tools system (kinematics), modules, application, complexity, operation to be performed by the machine tool, Cecimo functional module approach. Please clarify if the kinematic method is the same as the thermodynamic method discussed earlier.	Done.
365	CLASP	4.1.1.1.1 CLASP is pleased to learn that these basecases were constructed from several BOMs supplied by Cecimo. But even for this range of machines, the variation in size of 5- 100 tonnes seems too big to have one basecase. We would suggest that it is subdivided into 2 or 3 size categories. How it is split is a good question – should it be on the basis of kW rated, a function of the property of the machine (size of workpiece it can handle), weight, or some other parameter? As a preference, any categorisation should be on the basis of output or performance, as input power includes any machine inefficiencies, where for a given rating a less efficient machine cannot actually do the same job. So, a press may be on rated tons, a lathe on the maximum	The Base Case is not based on BOMs provided by CECIMO, CECIMO data is referenced to verify our base case data. Only limited number of base cases feasible.

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		dimensions it can handle, a MMA welder on maximum output current etc.	
366	CLASP	CLASP understands that this life-cycle assessment study is a simplified LCA, and thus some of the materials in the database do not match the actual material used in the equipment BOM. Where the LCA material and the BOM material do not match, please comment on the potential impact of these mismatches on the results.	Minor impacts assumed, but in absence of LCA data for relevant material, such claim cannot be further substantiated.
367	CLASP	4.1.1.1.2 This CNC centre is only based on one specific model, and so there can be no confidence of how typical it is of this family of machines. It may have been chosen carefully, in which case it would give much more credence if you could describe the basis on which this was selected, and reference the Prodcom code(s) it represents. The same comment about material mismatches applies too.	Appropriateness confirmed through comparison with CECIMO LCA data. Represented PRODCOM codes stated in table 4-20 of the first draft.
368	CLASP	4.1.1.2 Hydraulic press brake. Similarly, CLASP is concerned that there is no reason given for the selection of this as a basecase example. This is essential in order that there can be confidence in this basecase model.	Justification added.
369	CLASP	4.1.1.3 We await the example of the non-CNC machine.	See revised report
370	CLASP	4.1.1.4 Woodworking machinery – example also awaited.	See revised report
371	CLASP	4.1.1.5 Welding equipment – example also awaited. As a suggestion, a 120A MIG welder (not fan cooled) would be representative of DIY welders. BATs would then be fan-cooled versions and inverter welders, both of which are available in similar ratings – although the markets are then Professional. Given that the improvements that can be made are believed by CLASP to relate to the transformer only, this could also be representative of similar sized domestic TIG and MMA welders. This same argument could probably extend to plasma cutters too. Subject to consultation with EWA, CLASP believes that these findings could be generalised for larger welding equipment too.	DIY market is not in the scope of the study (although overlaps have to be acknowledged), 200A welder taken for Base Case calculation
372	CLASP	4.1.1.6 For this general category, no basecase examples are sought. The correctness of this in terms of the EuP process needs to be checked, because even if the products are not regulated as a whole but instead in terms of e.g. modules, do you legally need to attempt basecase models to avoid later arguments that these products were not properly studied?	Has to be checked by EC.
373	CLASP	4.1.3 Tools are mentioned here. We kindly ask that you explain whether these are in or out of scope of the study, including how inclusion/exclusion is justified. We note the point that higher speed wears the tools faster, which should be considered when making recommendations on MEPS regulations for the machine. Please confirm whether external services such as heat extract and compressed air are included in the in-use analysis. Please explain the footnote reference to “induced dislocations of the drives” and clarify whether it refers to thermal expansion.	Tools are part of the machine and therefore included.
374	CLASP	4.1.3.2 It is noted here that press brakes are characterised by bending capacity in tonnes, which might therefore be a good way to classify them. Again, a better understanding of the whole market of press brakes is needed in order to understand how typical this example is of all of this class of machine.	No data for a sound statistical distinction beyond the PRODCOM codes as provided in task 2 available.
375	CLASP	4.2 Definition of base cases It would be useful to explain here the link between the information supplied by manufacturers in 4.1 and the way in which it is then used as the basis of these base-cases. (Specifically, the product specific information in 4.1 was for particular products, but it is only in 4.2 that there is a discussion on basecase categorisation. Is it the case that in practice the 4.2 discussion was considered first, and then the product specific information sought accordingly? This would be more logical.)	Headings follow MEEuP, which is the explanation for the logic followed in 4.1/4.2

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376	CLASP	Comments on basecase definition: Given the variety of machines, basecase identification is one of the most challenging aspects of this study. Fundamentally a clear understanding of what the different products are is an essential starting point – as mentioned in our comments on Chapters 1 and 2, we do not believe the report has reached this stage yet. It is therefore very hard to proceed with any confidence to group different products such that they can each be represented by a single basecase model. What we would suggest is that for each of the product types listed in the finally developed categorisation scheme, at the very least a picture, sales by size rating, typical duties, etc. is given. This way we can start to understand the relative importance of different products in terms of energy consumption. This will be invaluable in that if a particular machine dominates a proposed grouping, then the basecase can be biased heavily towards that machine type. Understanding the energy use of each group of products, as represented by the basecase model, is essential. If the basecase is not also a statistical average (as in the basecase has the average annual energy consumption of all products that it represents), then the total energy consumption of each basecase group of products will be wrong. As Table 4-26 develops, this will become more important, as the total energy consumption of all machine tools much equal the sum of that of each basecase type. Pragmatically some iteration of basecase average energy consumptions is likely to be needed, but the first estimate should be based on a bottom-up estimate of the average energy consumption of each group of products. For many groups of products this is made more complex by the big size range, and the sheer variety of types of products in some categories. This is why we earlier suggested breaking down product categories into power ranges. This allows the idea of “weighted averages” to become clearer, with most products dominated numerically by the smallest of products, and hence the average needing to be biased towards the smaller sizes, even within size categories. Even if the eco design improvements for both small and large products of a particular type are similar, this splitting of the categories is very useful in order to understand better the composition of the market. For many modules, sensors and controls have identical or similar prices irrespective of machine power, and so will be much more cost effective for higher energy using products. It is likely that sales are biased towards a few major types of machinery, and so efforts should be focussed on these. But equally, other minority types all need identifying so that they can be taken account of. The challenge to get data on these will undoubtedly be harder, and will involve perhaps tracking down relatively small suppliers. As an example of product variation, woodworking sanders come in several types; for example belt, disc, spindle, edge, drum or pad sanders. Even if they are all considered as one product category, this needs to be justified by reference to their detailed operation. As an example, we have suggested elsewhere how we selected a basecase for a small welder. Because we had split the market into sizes, and sub-classes of machine, and in particular were able to guess where the energy saving can be made, we were able to construct a basecase that was actually representative of several products that are in different prodcom categories.	Although we agree with most comments raised here, the statistical basis (e.g. power rating classes of sold equipment on the sub-PRODCOM level) to follow this approach is almost completely missing, thus the approach is not feasible.
377	CLASP	Commenting specifically on your planned approach: Application scenarios This is good, as it gives the basis for understanding the energy consumption of each type of machine, but to complete the picture you also need information on the size and duty. (By Manufacturing method, do you mean the type of machine?) Complexity Here the list has shrunk from the original 5 to now just 3 levels. Please explain why. The final list of 5 basecases is stated without any commentary. It is therefore impossible to prove that this is correct.	List of base cases extended.

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		To make life easier, are you able from pre-screening to state that energy is of primary importance, and so spend less effort on other factors for some products? This will make data collection and processing easier. The energy efficiency of the selected basecase is important. It should represent the typical product in service, giving a good baseline against which improvements can be made. Accordingly, the best performing products should not be considered when devising basecases. (But this is a good time to also be asking for examples of best in class and future developments from manufacturers) The potential for improvements is another useful guide as to the grouping of products. The implication here is that in some of the currently diverse product categories, they may need further splitting according to their improvement potential.	
378	CLASP	Complete products or modules? An issue that is fundamental to this study is whether to consider regulating at the level of complete machine tool products or modules component parts. From the work completed to date, it seems as if many of the improvements are in the modules, with others in the frame and how the machine is all controlled and configured. In order to understand the benefits of improvements in the modules, we suggest that the modules are also evaluated by using the MEEuP method. The outcome of this will be parameterised models of each, allowing a quick assessment of the energy savings and wider eco-impact from use of improved modules as a function of annual running hours, duty variation, power rating (or rating of the controlled product in the case of a controller). At the bottom of page 28, you list modules to analyse – will these be analysed separately? Section 4.5.6.2 hints at this, but nowhere else is this mentioned. Have module suppliers been asked to provide information on which you can start to categorise each type of module by size, specification etc and hence derive a basecase example? This will enable the easy identification of the cost effectiveness of the different modules in all machine tool applications where they are or could be used. (This would also mean that in the event that it is decided to regulate on the basis of modules, the information would be readily available). Given that the burden of making any improvements to modules will fall on module suppliers rather than machine tool manufacturers, this module focus will enable a much clearer dialogue with them. It is disappointing that few module suppliers are so far engaged in the process, as they have much to offer and will understand the wider markets for their products. If regulations apply to modules irrespective of where they are used, then this study needs to also understand the cost effectiveness of their use in out of scope applications. The potential impact of many other industries is huge if this approach is adopted, and so is likely to meet considerable opposition. It may be that regulations only apply when modules are used on in scope products, but this is a critical point that needs discussion and resolution very quickly.	Modules considered more in detail in the revised report, but abstraction from machines to individual modules rarely possible.
379	CLASP	**Chapter 5: BAT and BNAT** More engagement from module suppliers will be important in order to understand the opportunities in detail, as the response so far disappointing. The questionnaires need some considerable work to enable them to return results that are comparable, with the primary suggestion being that questions are more specific.	No revision of the questionnaires planned, questionnaires considered a good compromise between detailed questions and rough estimates to be stated.
380	CLASP	To ensure that energy saving measures do not inadvertently have negative impacts in other phases of use, we would suggest subjecting the selected measure to the MEEuP, even in only a simplistic way, so as to check for other emissions. Although unlikely to be a problem, it would be useful to have this information to hand in case there are complaints from stakeholders. For example, they might complain about the additional end of life semiconductor waste in inverter welders.	To be done in Task 6.
381	CLASP	There needs to be a clear explanation of the applicability of each measure, its penetration to date, barriers to market,	This exactly is the purpose of the stakeholder

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		and ultimate potential. With this information, it is then possible to suggest which measures are applicable for each type of machine tool product. Some of the final outputs will be two sets of graphs of cost effectiveness of technologies: 1) Cost effectiveness of improvements of modules (with parameterised loading conditions) 2) Cost effectiveness of different module options when applied to different machine tools. As mentioned in the report, there will be considerable overlap of measures, and so the interrelatedness of the measures needs explaining. There will need to be a method designed such that where there are options, there is a rationale for the final choice made for the modelling. The descriptions of R&D work are impressive, but to be really useful they need to be developed such that the information can be used to inform specific BAT and BNAT measures.	assessment matrix (and further research); report amended accordingly.
382	CLASP	P 7 We would appreciate if you could explain more about heat exchangers for preheating components.	Done.
383	CLASP	A key point is that whereas some technologies are better than others for undertaking the same operation, this consideration is outside of the scope of this study, as it is a user choice. This does though underline the importance of giving the user more information on which to base their decisions.	Statement does not require changes of the report
384	CLASP	P 9 Good to see the issue of idling and auxiliary functions again brought to attention, as this seems to be where the easier savings can be found. Interestingly, much of this will be down to better control, which a focus on simply improving efficiency of modules will not achieve. The issues of combined machines, higher tool wear from higher speed machines, and light-weighting of frames are well made. The list of options offered so far by stakeholders is disappointing (standby mode, improved spindle drives, high efficiency motors), more efforts are needed in order to get inputs from a wider range of module suppliers.	Statement does not require changes of the report beyond the scheduled revision
385	CLASP	Table 5.1 This list of energy saving options is really good, interested to see how this develops as the energy saving estimates are refined.	Statement does not require changes of the report
386	CLASP	5.1.2.3 Light-weighting (of rotating parts only?). This reduces acceleration times, and so improves throughput. It would be good to see some numbers on this in terms of energy savings – for example how much more energy is needed to get the heavier clamping device up to speed? And how much of this additional energy will be recovered through a 4-quadrant VSD? It may be that the net energy saving is not huge, but the increase in 30 productivity is a boon, and reduces the impact of other constant auxiliary energy using loads.	Energy saving potential added.
387	CLASP	5.1.2.4 Structural optimisation How much energy does this save? Does this relate to workpiece and toolpositioning machinery only?	See stakeholder assessments.
388	CLASP	5.1.2.5 Questionnaire To be useful, the questionnaire must pose very specific questions, otherwise it will be impossible to interpret the responses, as respondents may be thinking about different products. Thinking of this in terms of a “basecase” module with energy saving, it may be that a specific chuck is cited, with the chuck chosen as a basecase representative of all high speed rotating parts that are to be lightweighted. Hence the selection of the part to be considered needs to be developed using a similar approach as in Task 4 for the complete machines.	No revision of the questionnaires planned, questionnaires considered a good compromise between detailed questions and rough estimates to be stated.
389	CLASP	5.1.3.3 Questionnaire on monitoring and controls We believe that the software and controllers are a similar price irrespective of size. If this is the case, then suggest	No revision of the questionnaires planned, questionnaires considered a good

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		asking for absolute prices rather than percentage increases. Generally it is questionable whether the options should be so proscribed. For example, stand-by management savings may be much more than 5%, but as the highest saving category is ">5%", we will never know by how much. We suggest instead a questionnaire including open-ended questions.	compromise between detailed questions and rough estimates to be stated.
390	CLASP	5.1.4.1 From our experience, motor over-sizing is often over-stated, with induction motors having a similar efficiency at 50% to their performance at 100%. Since bigger motors are inherently more efficient, optimum sizing isn't that critical except for applications where there will be widely varying loads with greater time at low power levels. We encourage you to check the typical loading of motors with manufacturers to verify this point about over-sizing. Speed control is only really relevant to auxiliary processes such as the air compressor mentioned. Many items on a machine tool have to be speed controlled anyway for their functionality, and so there is no further potential. It would be interesting to get breakdowns of typical motors used on a machine tool so that a sense of their relative importance can be understood.	Statements referenced in the report. Evidence on motors used in smaller (wood working) machine tools provided in task 4.
391	CLASP	The use of higher voltage VSDs is interesting, and it would be good to see more information on this so that its general applicability to machine tools can be better understood.	See stakeholder assessments.
392	CLASP	Please define "voltage-proof" converter.	No definition available, stems from ISO 14955.
393	CLASP	Please explain "automated wattles current compensation".	changed to the more popular term "power factor correction"
394	CLASP	IGBTs. It is not clear how much design detail of modules we should go into, as this is not something that we can influence. In practical terms, does the user really have an option – surely the market very quickly moves to all use similar IGBTs? It may be a difficult question for people to answer, and so would end up with misleading results. Switched reluctance drives have improved enormously, and now have far less of the problems described.	No changes of the report required.
395	CLASP	Again, the questionnaire is weak. In addition to the previous comments, there needs to be a sense of the penetration of each, and barriers to implementation, so that the potential can be evaluated. It needs to be made clear which options are linked, either as alternatives, or have an impact on each other. This is essential so that the total of all the opportunities can be assessed. For each item, it needs to be made clear whether the cost and benefits relate to a single product or the whole machine.	See above. Actually, the questionnaire already addressed most of these aspects.
396	CLASP	Increasing acceleration time to avoid going into the service region of the motor avoids the small increase in motor losses, but this is possibly offset by the increase in production time.	No change to the report, statement could not be verified.
397	CLASP	5.1.6.1 The savings from this Daikin pump are impressive and greater than we would have thought reasonable. It would be most helpful if you could comment on whether the savings estimates have been independently verified, and also provide further data on this important energy efficiency measure/option, for example how similar pumps without the idle facility have a saving, according to Daikin, of 50%, and also elaborate on the important comment to the effect that the saving depends very much on the duty. The EUP regulations on Motors do not have a big impact on hydraulic pump energy consumption, as they only impact the motor and not the critical speed controls.	No independent verification available.
398	CLASP	5.1.6.2 Using smaller motors by cooling them is questionable, as a smaller motor is inherently less efficient. Please verify with the source of this information the actual efficiency of the motor compared to if a larger one in the open air was used.	As this is a general option, no dedicated efficiency comparison is available. See stakeholder assessment for estimates.
399	CLASP	5.1.6.3 We kindly ask that you justify your statement that the centralised production of compressed air gives better	Text amended.

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		air quality, as there is no obvious reason why this should be so. (In fact, locally treated compressed air can give the quality needed in the quantities required.)	
400	CLASP	Using exhaust air to capture waste energy from pneumatics is an interesting idea. Please clarify and state whether piezo or air turbines are available commercially.	Text amended.
401	CLASP	Fig 5.9 Pneumatics We wonder how this information fits into this study. The bigger question is how many machines have in-built compressors, and how many rely on external or centralised compressed air systems. The same general comments apply to this questionnaire as to the previous ones.	Text amended for clarification.
402	CLASP	5.1.7 Lubricants If reduced (or no) fluid use results in increased machining times, then the auxiliary energy consumption will increase per workpiece. Cryogenic machining sounds like a big subject, are these applications sufficiently common to warrant more investigation, as it sounds like it offers a big energy saving potential?	Statement not confirmed. Cryogenic machining is related to a basic change in machining technology, detailed analysis goes beyond the scope of the study.
403	CLASP	5.1.8 Cooling systems and cabinet heat More information on this is required. What is special about the Rittal technology, are they really the only ones with this sort of performance? The title mentions the use of cabinet heat, but is this ever used for anything positively?	Text amended. Use of waste heat depends on machinery-external factors and conditions.
404	CLASP	5.1.9 Is product pre-heating within the scope of machine tool improvements?	If performed machinery internal: yes.
405	CLASP	5.1.10 The key energy issue with these products is that the no load losses of conventional welding transformers is far greater than that of inverter welders. From our understanding of inverter design, we imagine that there is little difference in the performance of different inverter welders, but would welcome confirmation of this point. A useful discussion on the energy consumption of arc welders is at http://oee.nrcan.gc.ca/industrial/equipment/arc-welding/index.cfm?attr=24. MIG welders are also very popular, but their transformers are only energized during actual welding, and so the critical standby losses are not so important. The argument hinges on the assumption that arc welders are left energized between welds, but this is questionable.	Analysis provided.
406	CLASP	5.1.11 System approach This section is full of good examples of how machine operations can be integrated to save energy, but it is hard to synthesise this into data that can be used for this Task. We kindly ask that you attempt to make some general quantitative statements about the benefits of integration as described here. This is important so that these bigger system issues are not over-looked when regulating individual machine tools.	Unfortunately “general” and “quantitative” exclude each other for such application specific aspects. No changes in the report.
407	CLASP	5.1.11.2 The mega-trend of increased modularisation and reconfiguration to allow for rapid changes is interesting, and is another reason for focussing on modules rather than machines.	Statement does not require changes of the report
408	CLASP	5.1.11.3 The energy saving claims for light-weighting need to be parameterised so that their universal applicability can be understood.	To our knowledge no parameterization possible; feasibility and effect have to be judged on a case by case basis.
409	CLASP	5.1.11.4 This is an interesting note regarding the limited applicability of all-electric solutions where high clamping forces are needed, or for some safety applications.	Statement does not require changes of the report
410	CLASP	5.2.1 This is an excellent listing of ongoing R&D work. For key activities, we would be interested to see if information can be used to inform BNAT options.	See Task 2 for technology trends (processes, materials, machinery concepts), which is the

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		At the very least, we feel that a qualitative summary of other changes in the developments of newer materials and processing technologies would be useful.	more relevant summary of mid-term trends. Generalisation of R&D projects is hardly possible.
411	CLASP	5.2.2 / 3 Summary of more research work. There is clearly a lot of interesting activity – it would be useful if this could be placed in the context of this EuP study. As it is, it is hard to understand how it can impact the study. It will be interesting to see how the collected data matches with the data in these chapters.	As for most of the projects no transparent data or robust prognosis is available, there is not much more, that can be directly extracted for the study besides the general research topics currently addressed by R&D.
412	VDMA European Office	**1. Scope of the Preparatory Study** We would like to stress again our concerns regarding the wide scope of the study. The extension of the scope is based upon an artificial definition of the product group "machine tools" that ignores existing and over a long period of time well-established and industrially applied sectoral product definitions. This new definition, combining metal-working machine tools, woodworking machinery, as well as rubber and plastic machinery etc., into a single product group neglects significant differences in technology, market structures, customer requirements and application scenarios. Extending the scope by including related machinery would mean to assess and compare technologies with completely different environmental footprints, albeit they might contain similar physical components.	Rationale for scope definition is given in the report and was discussed at 1st and 2nd stakeholder meeting; limitations are acknowledged, and are addressed throughout the report
413	VDMA European Office	In this context we would also like to object to the approach of the study to define the whole machine tool as a "functional unit" as defined in EN ISO 14040 for the following reasons: In principle, VDMA strongly favours the extended product approach that takes into consideration the operating conditions and use patterns of the product involved. By doing so, usually a fixed unit will have to be studied, taking into consideration the actual product, composed of a motor and the control unit. In marketing this unit the manufacturer assumes "overall responsibility".[1] In exceptional cases, however, it may happen that complex machinery – which in fact preferably should not be regarded as an ErP-product – may only be regulated under ErP if the product is split into modules. This is the case for machine tools. Metal processing machine tools are complex systems and are marketed as an asset to companies who actively influence the technical characteristics, performance data and equipment characteristics of the machine tool. Therefore, these products are highly unique, influenced by the customer's requirements with regard to the end product as well as by the organisational and manufacturing involvement in the customer's production technical environment. In addition, metal processing machine tools encompass an extremely wide range of different processing technologies, with approximately 400 machine groups and around 2000 different types of machines, meaning that any technical/technological comparability between them is extremely difficult. The requirement of EN ISO 14040, to use a "functional unit" for a Life Cycle , is not applicable to a machine tool due to its various application scenarios. [1] For further explanation please refer to the VDMA Position Paper „The Ecodesign Directive 2009/125/EC – challenges and implementation limitations for capital goods" (April 2011).	Limitations are acknowledged, are addressed throughout the report, and will be taken into account for the policy discussion in task 7. VDMA statement cited in Task 1.
414	VDMA European Office	The approach of the study Lot 5 is a very simplified procedure just to cover a wide range of different products that in our view will not achieve optimum results for the environmental evaluation and fails to meet the sense of the concept to provide a comparable unit process. Since machine tools are complex systems consisting of different subsystems and elements (some of which are rather functional units themselves) we are convinced that this course of action will not provide generally applicable measures with respect to the objectives of the Eco-design Directive.	Limitations are acknowledged, are addressed throughout the report, and will be taken into account for the policy discussion in task 7
415	VDMA European	We acknowledge the challenge to perform a study based on scientific evidence on complex machinery in a relatively short period of time. Even with the prolongation of the study by six months, the task remains highly ambitious. But	As clarified with VDMA bilaterally, comments partly referred to the 1st draft; plausibility

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	Office	with the preparatory study being the blueprint for a possible subsequent Commission implementing measure, we see the necessity to be adamant and to highlight methodological or technical deficits. a. We are concerned by the way market and trade data are assessed (e.g. completely false stock estimation), and we miss plausibility checks for elaborated statements, e.g. for the estimation of energy consumption. Furthermore, statistical data appear to be treated incorrectly (e.g. calculation of mean value and standard deviation for ordinally scaled characteristics).	check provided in the revised version
416	VDMA European Office	b. The complex cause-effect relationship seems to be underestimated or over-simplified: For instance, user requirements are not addressed as a multi-variable problem in the survey and data assessment.	Noted, but simplifications required given the broad scope, and justified given the purpose of the analysis.
417	VDMA European Office	c. We would expect a better structure of the study results: For example, BAT- and BNAT-chapters often appear to be only a salmagundi of commercially available technological options or a pure listing of research activities rather than a structured technological assessment.	Chapters follow the pre-defined structure of the MEEuP methodology. Assessment of BATs is newly introduced in the revised task 5 report and evaluation follows in task 6.
418	VDMA European Office	d. Individual improvement measures already realised by the sector should not be named by brand name in the study. If it is necessary to mention the source of information it should be given in a footnote but not in the main text. e. Advertising messages from individual companies such as in 5.1.5.1 for electrical clamping devices should not be introduced in the reports, at least as long as the statements are not verified by the contractor.	Company names moved into footnotes. Claims by companies / manufacturers were marked as such in the revised version (detailed verification of the claims made by manufacturers is not feasible, in particular as it frequently refers to a certain machinery configuration, to which the sudy authors do not have access – no own measurement campaigns).
419	CETOP	4.1.1 The break down of the bill of materials should be comparable between the different kinds of machines. For example in some cases copper is listed, in others not.	Harmonised, where possible; depends on data availability, BOMs are structured differently among different manufacturers
420	CETOP	4.1.3 Tools and hydraulic oil are mentioned as consumables. Hydraulic oil is not a consumable in the closer sense compared to others (e. g. lube oil) because it is used in a closed system for power transmission.	Usage in a closed system is acknowledged; labeling as “consumable” follows the structure of MEEuP
421	CETOP	Consumables as air or grease are not listed.	Done, where appropriate
422	CETOP	The use of the data of the McManus et al. study for hydraulic oil in mobile systems is correct as long as it is used for the production related life cycle impacts of mineral oil production. But it cannot be used in respect of the lifetime of the hydraulic oil in stationary machines because the environmental stress conditions are not comparable, e. g. contamination, oil volume per kW, pressure levels or temperature changes.	McManus data was solely used to calculate upstream impacts (production of hydraulic oil), not the lifetime
423	CETOP	4.1.3.1 “Lube oil and hydraulic oil with an amount of 0.1 m3/year each (“Auxiliary Material 2”, approximated with a density 0.9 g/cm³) …” Lube oil and hydraulic oil have to be distinguished. Usually, in machine tools the consume of lube oil is much higher than the consume of hydraulic oil. Furthermore, lube oil is used for example in electro-mechanical transmissions and	Hydraulic and lube oil listed separately. Data adapted.

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		has nothing to do with hydraulic systems. Delete “Life time of the auxiliary materials is one year.” Lubrication is a continuous process and lube oil is in an open lubrication system consumed permanently. Hydraulic oil is used in a closed system. In modern systems condition monitoring is introduced. Thus, the hydraulic oil will be changed only when it is necessary. Usually, when the maintenance is well done, hydraulic oil will not be changed but only some new oil added over several years.	
424	CETOP	Table 4.7, Table 4.8 Auxiliary material 2: Differentiate lubrication oil and hydraulic oil (also in the following clauses).	Done, where applicable.
425	CETOP	4.2 “- Simple machine tools Non-numerically controlled horizontal lathes, for removing metal Non-hydraulic and non-numerically controlled presses for working metal” Delete “Non-hydraulic and” The drive technology is no criteria for complexity. There exist e.g. also hydraulic non-numerically controlled presses and other simple machinery.	Deleted to avoid misinterpretations; list was meant to reflect the PRODCOM nomenclature, not to label non-hydraulic as “simple” per se.
426	CETOP	4.2.2 “Hydraulic press brakes are typically applied where bending capacities of up to several thousand tonnes are required[8], where electromechanical solutions are not an option.” Delete “,where electromechanical solutions are not an option” Hydraulic presses are also used where high bending capacities are required **and** electro-mechanical presses are offered.	Wording adapted
427	CETOP	4.3.1. “As the above calculations do not include hydraulic oil, this has to be assessed separately. Given an annual hydraulic oil consumption of 90 kg per year, total additional impacts are as listed in the table below for selected impact categories (those, which could be substantiated based on literature data). In all categories the hydraulic oil consumption is negligible in terms of life cycle impacts, except for one: The eutrophication potential raises by nearly 25% if hydraulic oil is taken into account. Lube oil and hydraulic oil have to be distinguished (see comments on 4.1.3.1 and table 4-7). The eutrophication potential raises mainly because of the lube oil.	The data provider for the Base Case stated 90 kg consumption per year for each, lube oil and hydraulic oil. Consequently the statement remains valid.
428	CETOP	TASK 5 In general: The measures already realised should not be named by brand name in the study. If it is really necessary to mention them they should be in a footnote but not in the main text.	Revised accordingly
429	CETOP	All Do not mention particular manufacturer Only CETOP mentioned in the body of the text upon hydraulics and pneumatics.	See above
430	CETOP	Executive Summary “For example, hydraulics provide a high energy density while electromechanical systems are to be excellently controllable.” Delete this sentence. The example is not necessary to support the content of the former sentence and can be misleading. Both technologies are under development.	Deleted.
431	CETOP	Figure 5.2	No distinct data available.

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		Separate pneumatic and other compressed air power consumption	
432	CETOP	Table 5.1 “Hydraulic and pneumatic Optimized systems” Column “Implications”: “hydraulics and pneumatics are to be used in applications with fastly provided energy density” Replace by “Savings with adapted system design layout”	Done.
433	CETOP	5.1.4.2 “Replacing inverter units: …” In the first (working) draft of ISO 14955 it’s stated the other way around: 400 V technology saves energy in comparison to 200 V technology. To be checked!	Error in the report, corrected.
434	CETOP	5.1.5.1 **“Electrical clamping devices:** Contrary to hydraulic clamping devices, electrical clamping tools require less maintenance, causing no efforts for cleaning and replacement of process fluids. Whereas the hydraulic system still runs during idle periods, the electrical one only consumes energy solely in specific situations (clamping and release). Other advantages are a higher degree of adjustability, leaner machine design due to the omission of the hydraulic unit, and reduced maintenance costs. There are several companies supporting electrical clamping devices, such as Röhm (E-Quipment[34]), Forkardt (iJaw[35]), and Hainbuch (electromechanical actuators[36]).” „**Using non - pneumatic lubrication systems for spindles**: …” Delete the whole item. The statements are provided by the mentioned companies and are not verified. Furthermore, the statements are partly wrong (“Whereas the hydraulic system still runs during idle periods” “reduced maintenance costs”) and not energy saving relevant such as “leaner machine design due to the omission of the hydraulic unit”. For HSC (High Speed Cutting) applications, oil - air lubrication is considered to be indispensable. The only way to reduce energy is to use oil with lower viscosity and reduce air pressure. The oil contamination of work pieces can be reduced or prevented by optimized seals.	Not deleted, but disclaimers added to address raised concerns. Statement regarding HSC cited in the report.
435	CETOP	5.1.6.1 Delete “piston” (to write: “conventional pump”) The better energy efficiency is not dependent on the kind of pump (piston pump, gear pump and so on) but if the pump is controlled or not.	Done.
436	CETOP	“Besides providing additional flexibility for the user (e.g. by choosing application specific operating points regarding flow rate and pressure), savings compared with a conventional hydraulic system can be achieved in the range of 70%.[45] 1. In the referenced source it is said that savings can be achieved between 50 and 70 %. This is not “in the range of 70 %”! 2. The referenced source is a catalogue for screw spindle pumps. In machine tools these are usually applied for the lubrication systems. Insofar the improvement of 70 % cannot be assumed for hydraulic drive systems in general which are different from lubrication systems.	Citation rephrased.
437	CETOP	5.1.6.2 “Naturally, reducing the channels of supply significantly reduces pressure losses.[47]“ The referenced source of this sentence is about centrifugal pumps. This has nothing to do with hydraulic systems.	Done.

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		Insofar, the statement is not correct. Delete the sentence. Add a new sentence saying that it depends on the application if the mentioned measures can be used and which improvement can be achieved using them.	
438	CETOP	5.1.6.2 **Adaptable levels of pressure**: Using pressure control valves, process related pressure adjustment can be achieved. To write: **Adaptable levels of pressure:** Pressure adjustment using adjustable pressure valves or zero-pressure circulation (In ISO 5598: pressure relief valve = clapet de décharge de pression)	Done
439	CETOP	5.1.6.2 Use of hydraulic accumulators: Hydraulic accumulators can be used to cover peak loads and to support adjustments to the load cycle of the process**.** To write: **Use of hydraulic accumulators:** Hydraulic accumulators can be used for temporary storage of hydraulic energy to achieve the best possible match between the pump drive (accumulator charging circuits) and the load cycle, and to compensate for demand peaks (so that drives and pumps with a lower output rating can be used).	Done
440	CETOP	5.1.6.2 **Substitution of technologies**: The use of throttle control for a hydraulic system leads to throttle and bypass losses. These terms vanish, if the control system is replaced by displacement control. Alternatively, the volume flow can be controlled by means of variation speed drives. To write: **Adaptable levels of flow rate:** The use of throttle control …	Done
441	CETOP	5.1.6.2 Reducing inner leakages: E.g. by using seat valves during charging the hydraulic accumulators, leading to rarer reload intervals and thus less use of the motor To write: **Reducing inner leakages:** E.g. by the use of poppet valves in the accumulator charging circuit leading to rarer reload intervals and thus less use of the motor or leakage optimised spool valves	Done
442	CETOP	5.1.6.2 Use of hydraulic clamping tools: Hydraulic clamping tools which consist of cylinder and seat valves are almost completely closed, meaning that nearly no further energy is needed during clamping. Replace "seat valves" by "poppet valves" (see ISO 5598 "Fluid power systems and components — Vocabulary")	Done
443	CETOP	5.1.6.2 Prevention of nipple collapse: Flexible hydraulic line systems have a bottleneck at the connection point between the fitting and line owing to their design, which causes considerable shortfalls in efficiency in hydraulic systems. The pressing in of the hose and connecting fitting additionally aggravates the bottleneck situation as a result of the collapsing nipple. Using self-adjusting press-fit socket hoses, the bottleneck can be substantially relieved. (Fa. Voswinkel, UVOS-m Series) The description is focussed on one component and shows the solution of one manufacturer. This point should be more general as follows because there are many more energy saving potentials in the whole pipe and hose lines:	Done

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		Optimize the design of the hydraulic lines and reduce hydraulic resistance	
444	CETOP	5.1.6.3 A general statement is absent Accepted with the following modifications: The first step to achieve energy saving is to optimize the size of the pneumatic system (after the air compressor) by taking into account the flow characteristics of components and by using proprietary sizing software.	Done
445	CETOP	5.1.6.3 Add a new first item: **Energy optimised engineering of the machinery**: Drives are frequently overdimensioned, This leads to higher air demand and hence energy loss. As a consequence it is important to adjust the pneumatic system to the specific needs.	Done
446	CETOP	5.1.6.3 Add the new following item: **Housekeeping and maintenance:** [1] A well-maintained compressed air system needs less energy to deliver the required pressure and flow rate by adopting best practices. By optimising system design performance, this will achieve good energy efficient results. [1] Reference Carbon Trust www.carbontrust.co.uk	Done
447	CETOP	5.1.6.3 **Application specific compressed air quality**: To meet the demands of specific applications, the compressed air runs through a drying process and several filter stages. The number of filter stages significantly influences the energy demand of the system. Hence, centralized treatment of compressed air can be a beneficial option. Reducing impurities in the air taken in by the compressor can improve system efficiency, and can increase the life and performance of end-use equipment. Efficiency can be improved by: • Treating air to the minimum required standard • Correctly installing and maintaining the treatment system, and making sure it is adjusted following any change in demand. • In all filter bowls use an automatic drain function to increase filter efficency and reduce air loss • On Compressors ensure timed solenoid condensate drains are set correctly, or using more efficient no-loss type electric condensate drains instead	Done
448	CETOP	5.1.6.3 Change the second item as follows: Reducing *tube length and diameter*/dead volume: If the distance between valve and cylinder increases, longer connecting tubes are needed. For each switching procedure, the pressured air within the tubes is accounted as dead volume and cannot be used for operation. By minimizing the length and diameter of tubelines within the pneumatic system, energy losses due to dead volume will be reduced to a minimum.	Done
449	CETOP	5.1.6.3 **Minimizing losses due to leakages:** Leakages are commonly appearing drains which can lead to a significant over-consumption of energy. Possible measures would be the use of volume flow monitoring systems, which indicatively provide information about the existence of leakages. Direct investigation of leaks can be carried out e.g. by the aid of ultrasonic acoustic detectors.	Done

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		Change the §: **Minimizing losses due to leakages:** Leakages can lead to a significant over-consumption of energy. Possible measures would be the use of volume flow monitoring systems, which indicatively provide information about the existence of leakages and to remove or close off unneeded compressed air lines. Direct investigation of leaks can be carried out e.g. by the aid of ultrasonic acoustic detectors.	
450	CETOP	5.1.6.3 **Pneumatic Cylinder with optimized drive surface:** For applications, in which the maximal driving force is solely needed for one direction, the surface for the return stroke can be downsized so that the secondary valve can be left out. Subsequently, the return stroke chamber will be permanently under pressure. For the return motion, the extension movement of the cylinder no longer requires pneumatic energy. Proposal to change: **Pneumatic Cylinder with optimized drive surface:** Ensure that pneumatic cylinders are sized to produce the force that is required. Oversizing cylinders will lead to increased consumption of compressed air which is then wasted.	This improvement option aims at examining the role of constructive adjustment of the piston surface for the back stroke as a mean to improve the energy efficiency. The proposal by CETOP added as a new BAT in the list.
451	CETOP	5.1.6.3 Page 33 The following wording is not clear : "**Pneumatic Cylinder with optimized drive surface:** For applications, in which the maximal driving force is solely needed for one direction, the surface for the return stroke can be downsized so that the secondary valve can be left out. Subsequently, the return stroke chamber will be permanently under pressure. For the return motion, the extension movement of the cylinder no longer requires pneumatic energy. A new statement must be provided by the authors.	Wording revised.
452	CETOP	5.1.6.3 Page 33-34 The following wording is not clear: **"Pneumatic Cylinder with multiple chambers**: Multiple chambers in pneumatic cylinders are useful if multi-propose processes are at hand. In the regard, the adequate chamber will be selected according to how much lifting force is required for the operation. " Delete the proposal because it requires not state of the art equipment.	Disclaimer regarding this option added.
453	CETOP	5.1.6.3 Page 34 The following wording is not clear: **"Use of multiple valves**: using several different valves for a single pneumatic....short notice." Delete the proposal because it requires not state of the art equipment.	Disclaimer regarding this option added.
454	CETOP	5.1.6.3 Write the revised item "Pressure reduction" between the item "Single acting pneumatic cylinder" and "Targeted cut-off from air supply" as follows: **Single acting pneumatic cylinder:** If only one drive chamber is needed, springs can be deployed for power absorption during the stroke motion. Thus, the return stroke is realized without the use of further air supply, but it has to be considered, that additional driving force is needed to compensate the spring force. **Pressure reduction (system):** Depending on the application, a reduction of the system air pressure level by e.g. 1 bar can reduce air consumption without unwanted performance losses.	Done

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		T**argeted cut-off from air supply:** If no retention forces are needed, as soon as the drive reached the end position, the air supply can be cut-off by the valve to avoid unnecessary pressure build-up within the drive chamber.	
455	CETOP	5.1.6.3 Page 34 To add: - **Blow Guns:** Blow Guns are versatile in their usage and commonly used to clean components and surfaces. Having the Blow Gun fitted with a venturi-type nozzle delivers the same performance with up to 30 per cent less air. **Air ejectors:** Air ejectors with a venturi-type nozzle deliver the same performance with up to 30 per cent less air.	Done
456	CETOP	5.1.6.3 Page 34 **Using exhaust air**: Due to...be pressurized. The proposal is not suitable in the industry. The increase of the level of the exhaust back pressure is not taken into account if micro turbines are used. Delete the proposal.	Adapted, disclaimer regarding this option added.
457	CETOP	**Optimized valve switching:** As the driving of valves requires electrical energy, it should be examined if an energy-oriented switching strategy significantly contributes to a decrease in energy consumption. To change: **Optimized valve switching:** As the driving of valves requires electrical energy, it should be examined if an energy-oriented switching strategy utilising low wattage coils would significantly contribute to a decrease in energy consumption.	Text revised.
458	CETOP	5.1.7.2 **Vegetable oils as lubricants and hydraulic fluids:** Under the reformulation of additives, chemical and genetic modification, vegetable oils (e.g. canola oil, coconut oil, olive oil, palm oil, soybean oil, etc.) may substantially substitute petroleum-based lubrication and hydraulic fluids in the long run.59 Vegetable oils are not suitable for hydraulic systems in machine tools. The oil will be hardened after a short time of use because of the high temperature. The source 59 is focussed on cutting fluids.	Disclaimer added
459	CETOP	5.1.11.4 Regarding to the given example a description of the compared machine subsystem should be attached. For example the energy efficiency of a clamping unit depends significantly on the principle used for the clamping force generation and less on the drive technology.	No further information regarding this example could be sourced.
460	CETOP	**Assessment matrix** The base for the estimations concerning hydraulic units is a machine tool equipped with a standard system with constant pressure and flow rate.	Noticed
461	CETOP	"Other environmental impacts of the approach: Hydraulic oil savings" As commented on 23.03.2011 on Task 4, clause 4.1.3.1, it has to be distinguished between lube oil and hydraulic oil. Insofar, significant oil savings are possible for lube oil but not for hydraulic oil. Hydraulic oil is used in a closed circuit!	See stakeholder assessment for the analysis of this aspect. Despite being used in a closed circuit, hydraulic oil is subject to maintenance (exchange, refill) and thus is consumed over the lifetime of the machine tool.
462	VDMA	**Task 5 Seite 34:** Die Idee, die benutzte Druckluft durch eine Mikroturbine zu entspannen, ist derartig unwirtschaftlich	Disclaimer added.

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	Fachverband Kompressoren, Druckluft- und Vakuumtechnik	(bei Gewinn von optimistisch geschätzten 100 Watt durchschnittlich an der Mikroturbine in 4000 Betriebs-h im Jahr ergeben sich bei 0,1 Euro/kWh und 4 Jahren Amortisationszeit 160 Euro als Einsparung; bei Kosten so einer Turbine von >> 500 Euro -> Kommentar fast überflüssig)	
463	VDMA Fachverband Kompressoren, Druckluft- und Vakuumtechnik	**Task 5 S 34:** Auch die Idee auf S. 34 mit dem "use of multiple valves" klingt eher nach der Förderung des Ventilverkaufs als nach realististischer Einsparmöglichkeit.	No change to the report as no further evidence is available.
464	VDMA Fachverband Kompressoren, Druckluft- und Vakuumtechnik	**Task 5.10 S. 38:** Zu "prevention of nipple collapse", Punkt 5.10 auf Seite 38 haben wir übrigens nur eine ungefähre Vorstellung. Bedeutet das so etwas wie "Abknicken der Druckluftleitung an der Anschlussstelle" ?	See extended description and reference under 5.1.6.2