# WORKING DOCUMENT ON

Potential Ecodesign Requirements for Welding Equipment and Machine Tool products

## EXPLANATORY NOTES

# 1. CONTEXT OF THE PROPOSAL

## 1.1. Legal framework

The Ecodesign Directive 2009/125/EC establishes a framework for laying down ecodesign requirements for energy-related products. It is a key instrument of EU policy for improving the energy efficiency and other aspects of the environmental performance of products in the internal market. As part of the intentions outlined in the Ecodesign Working Plan 2009-2011[1], as reinforced by the current Ecodesign Working Plan 2016-2019[2], welding equipment and machine tool products are under analysis for potential legislative proposals, namely an Ecodesign regulation, concerning their environmental impact.

The focus for both welding equipment and machine tool products is on those products typically used for industrial purposes, i.e., these are "Business-to-Business" (B2B) products. Concerning welding equipment, the scope refers solely to arc welding and allied processes designed for industrial and professional use[3]. Concerning machine tools, the scope refers solely to computer numerically-controlled machine tools including laser machine tools, of which multi-functional machining centres have a growing importance. Computer numerically-controlled (CNC) machine tools comprise the majority of industrial purposes machine tool products, and whilst they consume the largest proportion of energy in machine tools products, they also offer the largest possibilities for potential energy and resource savings.

Improved energy efficiency of welding equipment and machine tools products are in the framework of the initiatives which contribute to reach the 27 % energy savings potential by the year 2030[4]. Promotion of market uptake of energy- and resource-efficient welding equipment and machine tools products complies with the Lisbon and renewed Sustainable Development Strategy[5], as it would encourage investment in R&D and provide for a level playing field in the EU internal market.

In late 2015, the European Commission adopted the Circular Economy Package[6]; this includes revised legislative proposals on waste to stimulate Europe's transition towards a circular economy. The proposed ecodesign requirements on (among others) material efficiency will contribute to the targets proposed in the package, which has been emphasised in the aforementioned current Ecodesign Working Plan 2016-2019.

## 1.2. Grounds for and objectives of the proposal

Machine tool products are large energy consumers, and welding equipment energy consumption is considerable. Overall, the energy consumption of these devices is slightly increasing, because more services need to be delivered particularly with machine tools, as product quality standard stringency and speed of output are emphasised. As such, the products are more reliant on the information technology and CNC drivers, which consumer energy, but at the same time may save energy, through smarter, more efficient operations, and the facility of enhanced monitoring systems. These effects are felt to a lesser degree by the

[1] COM/2008/0660 final
[2] COM(2016)773 final, 30.11.2016
[3] As defined in IEC 60974-1: Arc welding equipment – Part 1: Welding power sources. Specifically excluded from the scope of this regulation are arc welding and cutting equipment designed for limited duty operation by laymen, designed in accordance with IEC 60974-6: Arc welding equipment – Part 6: Limited duty equipment.

[4] http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm
[5] OJ L 242, 10.9.2002, and Council document 109 17/06 of 26.6.2006
[6] http://ec.europa.eu/environment/circular-economy/index_en.htm

welding equipment market in terms of IT-related energy consumption growth. For welding equipment, the important relatively new advances are that, via enhanced programming of welding cycles - as controlled by sophisticated electronics in the products - the range of welding work that used to require possibly three welding machines may sometimes now be handled by one machine, but operating in different modes.

The scope of the proposed working document on potential Ecodesign requirements for welding equipment and machine tools products includes the following types of products:

1) Industrial welding equipment, comprising arc welding plus laser welding and cutting, and hybrid arc-laser welding;
2) CNC machine tools, comprising multi-functional machining centres, plus products which are designed primarily for one of the following functions: "material removal" operations, such as milling, grinding, cutting, drilling etc, and "material deformation" operations, such as pressing or bending. These products are mostly orientated for use in the metal-working sector, but there is a small percentage of wood-working CNC machine tools, in addition.

The products covered by this working document were analysed in the preparatory study for ENTR Lot 5[7].

Typically, over 80% of the electricity consumption related to welding equipment is due to energy consumption during use, from the power source used. The remaining electricity use is from "idle state" electricity use, and indirect electricity consumption stemming from the production of industrial gases such as argon, or mixtures of several gases, used as "shielding gases" during some welding processes. The technology shift to achieve energy reductions will be to eliminate transformer power sources from the market, and to move the market completely to inverter sources, which are considerably more efficient (at least for the size that is required onsite and in workshops for welding activities).

Another challenge for welding equipment is to reduce the quantities of shielding gases used, and also the quantities of welding wire or filler material (these are fed into the welding machine and extruded to make the weld joint *per se*).

For machine tools, the electricity consumption of the products may be dominated by the actual primary process, or processes that the machine tool is undertaking (e.g., cutting, milling, etc). However, owing to changes during operations of the multiple tools used, the spindles and the rotation of the axes, in addition to the various types of peripheral equipment necessary (lubricating and cooling circuits, hydraulics and pneumatics, extraction fans and ventilation, etc), for some periods of operation ("duty cycles"), over 50% of the energy and other resources (e.g., compressed air) consumed may come from "off", "standby" or "warm up" operations.

During the period of the preparatory study for machine tools and welding equipment (2010-2012), and the subsequent external Impact Assessment study (2012-2014), industry stakeholders have emphasised that the machine tool product group is very diverse, and the uses to which the products are put is very heterogeneous. For this reason, it is notoriously difficult to establish a "typical use cycle", duty cycle, or so-called Functional Unit (i.e., a basis on which "apples may be compared with apples, and not with pears"). It is for this reason that concentrating at least initial efforts to reduce the energy used during "off", "idle" or "standby" periods is attractive, and more credible and manageable than the strict imposition of energy limits during the use phase.

[7] Ecodesign preparatory study on machine tools and related products ENTR Lot 5, available at: http://www.ecomachinetools.eu/typo/reports.html

For the products covered by the working document, the preparatory study has shown that:

- The quantities of welding equipment and machine tool products placed on the internal market are significant enough for EU action.
- Considerable energy- and resource-saving potentials exist for welding equipment and machine tool products, which could be achieved with cost-effective solutions. China (for welding equipment) and Japan (for machine tools) already have standards in place to push energy efficiency and "standby" energy use for these product groups.
- Owing to the impetus given by a pending Ecodesign measure regarding these two product groups, standardisation actions at international level have already taken place. For welding equipment, this consists of an updated revision of IEC 60974-1: Arc welding equipment – Part 1: Welding power sources. A standardisation request has already been issued to the European Standardisation Organisations (ESOs) to address energy and material efficiency aspects of welding equipment, the scope of which has been aligned to the requirements of the potential ecodesign measures presented in the working documents associated with this Explanatory Note. Regarding machine tools, work has been ongoing for several years on the five-part energy and resource efficiency standard, ISO 14955, which has now resulted in two finalised documents, with the remaining parts expected within the next two years.
- European manufacturers are arguably presently still in the vanguard of the design and functionality regarding both product groups. However, there is no room for complacency regarding the present and increased potential for competitiveness of the products offered by third countries.
- Both product groups have significant export markets to third countries, as well as inter-Member State trade.
- Energy consumption in the use phase, including "off", "idle" and various "standby" states normally constitutes over 80 % of the total environmental impacts of welding equipment and machine tool products.
- For machine tool products, the various "standby" states may comprise up to 50% of the energy used, when ancillary cooling, lubrication, ventilation etc systems are included, depending on the type of tool, the particular process and the type and quantity of end-product being manufactured.
- For welding equipment products, any reductions in excess use of shielding gases, or the welding wire/ filler material to actually make the welding joint would be economically and environmentally beneficial to end-users. Hence, "real-time" measuring devices would be advantageous to incorporate into products, and as such will be made mandatory.
- Both product groups have important knock-on effects regarding industrial and environmental sophistication of the end-user client groups, regarding the EU's competitiveness and innovation potential along the supply chain (e.g., automotive, maritime, wind energy, medical products sectors).
- The manufacturers associated with both product groups are dominated by SMEs in the EU.
- For both welding equipment and machine tool products, in addition to energy efficiency, there is room for improvement in material efficiency, and the management of reparability and upgradability.

### 1.3. General context

On the basis of the data presented in the preparatory study and in the impact assessment, it is estimated that the total final electricity consumption of welding equipment and machine tool products in the EU amounts to

ca. 65 TWh in 2013, of which ca. 47 TWh comprises products within the scope of the proposed regulation, This corresponds to Greenhouse Gas emissions of ca. 1.5 % of the total electricity consumption in the EU. The associated $CO_2$ eq. emissions are estimated at ca. 17 Mt per year in 2013. Over the next two decades, the "Business as Usual" predicted energy consumptions owing to the two product groups are only anticipated to increase slightly. This is because of the relative assumed stability in the end-client markets regarding demand (i.e., that rapid growth at least is not expected). The rate of renewal of equipment for both sectors is such that although efficiency gains are expected per piece of equipment and per use, the amount of use per product is expected to increase, and although the overall sales per year are expected to increase, the overall stock in the EU is anticipated to remain fairly stable.

Analysis showed market failures which prevent the full realisation of the identified energy savings and material efficiency potential include:

- Lack of functional information: there is a lack of reliable parameters for measuring the energy efficiency and material efficiency of machine tools. Although there have been a number of R&D initiatives funded by the EU, and although there has been interest in developing an Ecodesign Voluntary Agreement (or Self-Regulation Instrument) by the main EU machine tools trade association, CECIMO, since ca. 2009-10, these initiatives have still not produced anything that can be utilised, concretely. During the same timescale, progress has been difficult, and reaching consensus has proved a relatively slow process, in the relevant ISO Working Group, Technical Committee TC39, which has been working on a five-part ISO series addressing the environmental and energy-related impacts of machine tools (ISO 14955). Currently there are a number of different types of information and performance tests available, but they cannot offer objective comparison since there is no standardisation in the methods, apart from a Japanese "Standard Workpiece" approach which addressed machine tools which remove material (via cutting, grinding, milling, etc). Bending and pressing machine tools are not covered by the Japanese standardisation approach. The Japanese method, which seems to have initially been favoured by ISO Technical Committee TC39, and a number of academics working the field, has more lately been viewed less favourably. For welding equipment, the relevant IEC standard on arc welding equipment power sources, IEC 60974-1, has had for a number of years an informative annex dealing with efficiency; this has now been formalised as a normative annex, as a result of the Ecodesign-inspired work, but which still needs to be employed on the market to see the results[8].
- “Myopic environmental/ energy use behaviour” of the buyers: energy-efficient products are already available on the EU market today. However, many customers (mainly professional customers) prioritise productivity and finish accuracy, together with lower purchasing costs, over the Life Cycle Costs (also known as the Total Cost of Ownership) of the products. As such, these end-users do not necessarily demand and/ or purchase best-practice energy efficient products, as the majority of end-consumers, although they state an interest, when interviewed, in improving the energy efficiency of these products - and their associated utilities costs - tend to relegate lifetime electricity and maintenance costs to a lower area of concern when choosing one product over another. That is, in comparison to the task of meeting their in-house or clients' short- and medium-term contractual needs regarding production volumes and level of the finished items, environmental savings over the lifetime of the machine tool or welding products suffer from a relatively low priority ranking.

[8] Chinese regulations/ standards have leapt ahead of ISO standards since 2010, at least on two levels of voluntary minimum efficiency limits, but there are doubts amongst the European welding community that these are being widely employed.

- There are a lack of incentives for Least Life Cycle Cost repair, refurbishment, reuse and recycling. Although reuse and upgrading of machine tools is frequent, the optimisation of components at refurbishment is unclear, and often comprises a “closed loop” service provided solely by the OEM (Original Equipment Manufacturer) provider. If a machine tool is sold either directly or indirectly (i.e., via a specialised second-hand dealer/broker) by its first owner to a second owner, any refurbishment deemed necessary may not, however, be carried out with a Least Life Cycle Cost approach for the "second-life" owner, and it would be desirable to address this. (Machine tools have historically been reported with overall lifetimes of ca. 20 years, but for the contemporary additionally sophisticated electronic CNC multi-function machine centre types, this may become significantly less, unless periodic refurbishment is carried out, e.g., at 10 years.) Welding equipment has a shorter lifetime (e.g., with a common “first” life of around seven years). Upgrades are quite frequently carried out as part of "Total Cost of Ownership" contracts[9]. IT software intergenerational compatibility is becoming an increasing issue for both product groups, and data deletion at end-of-life is becoming important.

The first two market failures for realising energy saving potential (i.e. the lack of functional information and the possible “myopic behaviour” of the buyers) are mutually supportive and feed each other, in the sense that the continued low level of interest from large sectors of B2B customers allows a lack of functional information to be perpetuated. These aspects, together, result in an environment that does not – overall – sufficiently stimulate investment or efforts towards designing more energy-efficient products. However, there are exceptions: for example, in markets such as the automotive sector, which has more repetitive mass volume product runs, upwards pressure is being exerted on manufacturers of machine tools and welding equipment to improve energy and resource efficiency, at the same time as productivity, reliability and fulfilling strict product specifications, and speed of production.

[9] Information provided by the European Welding Association.

## 2. MARKET SIGNIFICANCE

Table 1 illustrates the sales, estimated EU-wide stock and range of prices of the 9 "Base Cases" that were considered during the Preparatory Study and external Impact Assessment report work. With regard to the scope of the present measures, it is suggested to restrict the scope to the Computer Numerically-Controlled (CNC) and laser machine tools (Base Cases 1, 2, 3 and 8), together with Base Case 9 (welding equipment).

The CNC machine tools (Base Cases 1, 2, 3 and 8) comprise the more complex machine tools, which perform more intricate operations, and therefore have become ever more intertwined with IT controls, pre-machining simulations on "virtual workpieces" and "real workpieces", and also optimised engineering/ design/ functionalities. With regard to existing stock from the data cited in Table 1, solely 519,000 units out of 5.8 million units (**9%**) of machine tools were CNC units (i.e., Base Cases 1, 2, 3 and 8). The **annual sales** comprised 46,000 units of CNC machine tools p.a., compared to overall machine tools sales of 315,000 (i.e., **15%**). Unit sales (and monetary sales, by an even larger rate) of CNC machine tools are expected to carry on increasing with time as a proportion of the total, because operations and final client requirements are becoming ever more sophisticated. Increasing energy demand will accompany the increased machine tool sophistication, with hand-in-hand additional opportunities for energy-saving opportunities, when proportionately applied (also related to "smart manufacturing", and increased IT connectedness). Hence the CNC machine tools offer the greatest opportunities for well-designed Least Life Cycle Cost savings and repair, refurbishment and IT-product intergenerational compatibility measures, and information requirements via Ecodesign.

The non-CNC machine tools (Base Cases 4, 5, 6 and 7) are <u>not</u> affected by the measures as drafted. It is not anticipated that there will be any so-called "substitution effects", that is, via end-users moving away from CNC devices towards more manual products in order to avoid Ecodesign requirements. This is because the advantages of the CNC products, via enhanced production efficiency and end-product quality control, far outweigh any perceived disadvantages which may be induced by legislation, if producers were to contemplate returning to using manually-controlled products.

Industrial welding equipment is a more "mass market" group of products compared to machine tools, with greater numbers of products sold annually, and less specialised individually-specified models, or model options, compared to machine tools. IT control of welding equipment within the devices *per se* is also of increasing importance, as are the client technical specifications of welding operations per individual welding job, which may be introduced to many products' on-board mini-IT systems via a USB stick, or equivalent.

Table 3 illustrates that the typical lifetime of welding equipment products is presently considerably shorter than the majority of machine tools, with a related more constant turnover of products and sales. Greater durability of welding equipment, and intergenerational product-IT compatibility issues, are therefore worth exploring via Ecodesign options.

**Table 1: Sales, Stock and Price of products within scope**
***(Source: Impact Assessment Final report, March 2015)***

| Base Case | Base Case description | 2009[4] | | Average price |
|---|---|---|---|---|
| | | Sales (units) | Stock (units) | (€/unit) |
| **BC 1** | CNC 4-axis multifunctional milling centre: metal-working MT | 11,085 | 288,845 | 480,000 |
| **BC 2** | Laser cutting: metal-working MT | 1,500 | 15,000 | 400,000 |
| **BC 3** | CNC bending: metal-working MT | 31,676 | 201,579 | 100,000 |
| **BC 4** | Non-numerically controlled: metal-working MT | 38,000 | 690,000 | 5,000 |
| **BC 5** | Table saw: wood-working MT | 220,000 | 4,400,000 | 610 |
| **BC 6** | Horizontal panel saw: wood-working MT | 1,300 | 25,000 | 60,000 |
| **BC 7** | Throughfeed edge banding: wood-working MT | 10,400 | 207,000 | 60,000 |
| **BC 8** | CNC machining centre: wood-working MT | 670 | 13,494 | 300,000 |
| **BC 9** | Welding equipment | 180,000 | 1,270,000 | 1,200 |

Table 2 shows the previously-mentioned trend of increasing annual sales for machine tools, but with the stock and the annual final energy consumption predicted to remain fairly constant.

**Table 2: Outlook for Base Cases 1-4 Machine Tools: 2010-2050**
***(Source: Impact Assessment Final report, March 2015) (***

| Year | 2018 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| **Sales (units)** | 88,747 | 91,342 | 104,314 | 117,287 | 130,260 |
| **Installed stock (units)** | 1,200,788 | 1,203,382 | 1,216,355 | 1,229,328 | 1,242,300 |
| **Annual final (electricity) energy consumption (TWh)** | 59.2 | 59.3 | 59.8 | 60.2 | 60.6 |

Table 3 summarises the final energy consumption trends per Base Case, and shows the expected lifetimes for the products. It should be noted that for Base Cases 1 and 2, with increasing CNC complexity and reliance on software as well as electro-mechanical components, the expected lifetimes are already lower than the other machine tools Base Cases; it might be supposed that this trend might be exacerbated in the future, unless measures are taken to support longer lifetimes for these increasingly complex products. Welding equipment has a typically shorter product life, at 7 years.

**Table 3: EU Final Energy consumption per year and Lifetime Estimates of Machine Tools and Welding Equipment** *(Source: Impact Assessment Final report, March 2015)*

| Base Case | Base Case description | Final energy consumption (KWh/unit/year) | Lifetime (years) |
|---|---|---|---|
| BC 1 | CNC 4-axis multifunctional milling centre: metal-working MT | 132,741 | 12 |
| BC 2 | Laser cutting: metal-working MT | 195,600 | 12 |
| BC 3 | CNC bending: metal-working MT | 3,515 | 17 |
| BC 4 | Non-numerically controlled: metal-working MT | 10,300 | 18 |
| BC 5 | Table saw: wood-working MT | 250 | 20 |
| BC 6 | Horizontal panel saw: wood-working MT | 13,031 | 20 |
| BC 7 | Throughfeed edge banding: wood-working MT | 10,425 | 20 |
| BC 8 | CNC machining centre: wood-working MT | 52,800 | 20 |
| BC 9 | Welding equipment | 53,993 | 7 |

## 3. ECONOMIC SIGNIFICANCE

The total revenue from sales of machine tools and welding equipment is ca. €10.5 bn, p.a. (figures derived from Table 1), of which the product groups within the suggested "CNC machine tools plus welding equipment" scope amount to €9.5 bn p.a.

With regard to welding equipment, significant revenue results from the sales of consumables (industrial gases for use as shielding gases, and welding wire/ filler material), i.e., the soldering metal which we actually observe when examining a welding joint. It is estimated that welding equipment maintenance and service amounts to revenue of ca. €7bn p.a. overall, whilst the consumables account for sales of ca. €12 bn p.a.

## 4. ENVIRONMENTAL SIGNIFICANCE

The preparatory study has shown that slightly more than 80% of the electricity consumption related to machine tools and welding equipment is due to direct energy consumption during use. The energy efficiency of machine tools and welding equipment during use, and during various states of "off", "idle" and "standby" is also very important, and is crucial to overall reduction of energy consumption in these two product groups.

The impact assessment shows that the estimated annual final electricity consumption of machine tools and welding equipment (from 2009 data) is as illustrated in Table 4. The products in scope account for ca. 1.5 % of the total EU electricity consumption currently. The total final electricity consumption of the products in

scope (Base Cases 1, 2, 3, 8 and 9) was ca. 47 TWh, equivalent to Greenhouse Gas emissions of approximately 17 Mt of $CO_2$ eq.

## 5. EXISTING LEGISLATION IN EUROPE AND THIRD COUNTRIES

### 5.1 Energy Efficiency regarding Machine tools

Concerning existing legislation at EU level, **machine tools** per se are not the subject of energy efficiency regulation within the EU, or elsewhere globally. However, many of the modules used in machine tools are either already covered, or are being considered for energy efficiency regulations in EU.

For example, induction motors that are currently used within machine tools are already included within the existing Ecodesign Motor Regulation (EC No 640/2009). This regulation covers common designs of induction motor in the 0.75kW – 375kW power range. These motors are used, for example, to power the work tool itself (drill, saw blade, etc.) or the hydraulic power pack. Precision positioning of the machine tool components and tools will usually be powered by specialist servo motors that are not within the scope of this regulation. Brake motors are a special category of induction motors that have a shaft brake, which is fitted either on the inside or on the outside of the motor frame. These brake motors are included within motor regulations in the USA; there is a degree of resistance to include them within the Ecodesign regulations because of the additional losses during start-up of high efficiency motors due to their higher inertia. This is a particular concern in some machine tool operations where the motor needs to provide frequent stop-start motion. However, motors that have such regular cycling duty where this may be a problem will not be continuous ("S1") rated, and as such, are excluded from the Motor Regulation (EC No 640/2009).

Many machine tools will include lighting and/or a display screen, which could be subject to regulations influenced by the lighting regulation (EC 245/2009 and EC 1194/2012) and standby regulation (EC 1275/2008).

### 5.2 Energy Efficiency regarding Welding Equipment

China has an energy efficiency regulation for arc welding equipment. This regulation is based on the Chinese standard GB 26736-2012 (Minimum allowable values of energy efficiency and energy efficiency grades for arc welding machines). This standard is valid only for professional use of arc welding equipment (thus excluding hobby equipment, resistant welding and stud welding). The Chinese regulation includes both voluntary and mandatory requirements as grades listed hereunder:

- Grade 3 (includes efficiency values limits) the lowest, is compulsory;
- Grade 2 (includes efficiency and power factor limits) is *voluntary*;
- Grade 1 (includes efficiency, power factor and idle power limits) is *voluntary*.

The limit values for the grades in the potential Chinese regulation, just like the potential ecodesign requirements for welding equipment in EU, also depend on the type of welding current used (AC or DC).

### 5.3 Other EU Legislation possibly relevant to machine tools or welding equipment

EU Directives for health, safety, and performance apply to machine tools. The following listed standards are selected as being the most pertinent[10]:

[10] Environmental regulations that have an impact on aspects of Machine tool use were listed in detail in the Task 2 Report of the ENTR Lot 5 Preparatory Study

- Machinery Directive (2006/42/EC): Explicitly tackles aspects which are intended to limit environmental impacts (such as safety integration, materials and products and related design measures must not endanger persons safety or health, airborne noise and other emissions, such as vibrations, radiation has to be minimised, and emissions of hazardous materials and substances have to be reduced through design and construction).
- Waste Electrical and Electronic Equipment (WEEE) Directive (Directive 2012/19/EU): Requires manufacturers to finance collection, treatment, recovery and environmentally sound disposal costs. Manufacturers have to offer take-back of obsolete equipment, conditions of which can be fixed in any sales contract.
- RoHS Directive (2011/65/EU): Restricts the use of lead, mercury, cadmium, chromium-IV, PBB and PBDE in welding equipment. It should be noted that machine tools are currently out of scope from the RoHS Directive. Exemptions from RoHS bans for certain applications apply, such as lead as used in solder for welding, and exemptions also for lead up to a certain level in steel, aluminium and copper alloys (which allows better workability of these alloys).
- Electromagnetic Compatibility (EMC) Directive (2004/108/EC): Lays down requirements in order to prevent electrical and electronic equipment from generating or being affected by electromagnetic disturbances. This is important for both product groups, but its provisions do not overlap with the working document.
- The Low Voltage Directive (LVD) [11] regulates health and safety aspects including e.g. mechanical, chemical, noise related or ergonomic aspects.
- Pressure Equipment Directive (97/23/EC): Rather atypical for most machine tools, but applicable to some.
- ATEX[12] Directive (94/9/EC): Is only relevant for those machine tools intended to operate in certain production environments, e.g. use in the chemical industry could be affected.

## 6. IMPROVEMENT POTENTIAL

The preparatory study and Impact Assessment report identified various improvement options that would result in lower overall energy consumption and related emissions realisable at no excessive life cycle costs for the products within scope, as well as material efficiency requirements.

The proposed ecodesign requirements presented in this document combine the improvement options of energy efficiency from the preparatory study and the Impact Assessment report, but updated to take into account the additional material efficiency emphasis placed on Ecodesign to deliver in the policy area of the Circular Economy, since late 2015.

The other element for which the proposed regulatory specific Ecodesign requirements, and information requirements attempt to compensate, is the collapse of the Self-Regulation Initiative (SRI) of the European machine tools association, CECIMO, from 2015 onwards. This is due partly to the high number of CECIMO's members (in excess of 1 000), which makes the logistics difficult with respect to managing an Ecodesign SRI (this is because the European Commission insists on at least 80% of an association's members remaining members of the SRI, for it to be formally acknowledged in lieu of a regulation).

[11] Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits. OJ L 374, 27.12.2006

[12] ATEX derives its name from the French title of the 94/9/EC Directive: Appareils destinés à être utilisés en ATmosphères EXplosives.

The proposed measures in the draft regulation should reduce the above energy use by 0.65 TWh p.a. in the case of welding equipment, and possibly an additional c. 1 TWh p.a. in the case of in-scope machine tools, which amounts to a total reduction of 1.65 TWh, i.e.,. ca. 3.5% of the present total final energy use, by 2030. The additional indirect electricity savings from possible reduced use of industrial gases as shielding gases in welding is not accounted for in this total. Additionally, resource use reductions should accrue from the material efficiency requirements for disassembly, repair, upgrading, reuse and recycling, and the additional monitoring proposed for welding consumables' use.

The proposed 2023 "Tier 1" ecodesign requirements for welding equipment in EU are 5% more stringent than the highest mandatory limit value in the previously-mentioned Chinese regulation (Standard GB 26736, from 2012). The proposed 2028 "Tier 2" ecodesign requirements for welding equipment aim to maintain the EU's lead over the Chinese regulation, by going above the "Grade 2" Chinese (presently voluntary) limits[13].

## 7. PROPOSED MEASURES

The working document on potential ecodesign requirements for welding equipment and machine tools products proposes the following energy efficiency requirements:

### 7.1 Welding Equipment

- Minimum power supplies efficiency
- Maximum idle mode power state consumption
- Material efficiency requirements (see below).

Information requirements proposed include:

- Minimum power source efficiency
- Maximum idle power consumption at cold state
- Tabulated information on expected shielding gas utilisation for representative welding schedules and programmes
- Tabulated information on expected welding wire or filler material utilisation for representative welding schedules and programmes

### 7.2 Machine Tools

- Requirement for a leak detector and on-demand monitoring system, for hydraulic and pneumatic systems, where present
- Replacement of 200 Volt systems in drive units with higher voltage inverter systems

Information requirements proposed include:

- Reporting of Energy Efficiency Indicator
- Documentation of all motors used in the product, including the IEC Class notation, plus explanations of why Variable Speed Drives and/ or regenerative braking systems have not been used, where applicable.

[13] The proposed EU measures do not include a "power factor" requirement as per the Chinese standard/ regulation, since the European EMC Directive takes this into account (there is no equivalent of the EMC Directive in China).

- Declaration of energy consumption of the various 'off', 'standby' and 'idle' etc states, according to the Japanese standards from 2009-2010, in the current absence of ISO or CEN/ CNELEC methods.
- Voluntary reporting of "processing" phase energy consumption for either "Standard Workpieces" or particular, client- or machine-specific workpieces.

### 7.3 Material Efficiency Requirements for both Welding Equipment and Machine Tools Products

Material efficiency requirements proposed for both servers and data storage product in the working document include:

- Total weight per product of critical raw materials
- Latest software/ firmware version to be made available
- Use of reversible joining techniques (i.e. generally avoiding, but not specifically prohibiting welding of electronic/ electrical components, and firm methods of gluing) for components to be accessed, such as motors, circuit boards, fans, lubrication equipment, etc.
- Information on the disassembly operations needed to access the targeted components (as from the point above)
- Data deletion tool(s) to be compulsorily available with the product at the moment of its placing on the market.

Given that these provisions oblige manufacturers to disclose detailed information on the architecture of their products, it is proposed to only make available this information for professional recyclers.

Table 4 provides an overview of the parameters covered in the working document, by product group.

**Table 4 Table overview of parameters covered per product type**

| Parameter | Welding Equipment | Machine Tools |
|---|---|---|
| **Product information** | ✓ | ✓ |
| **Power source minimum efficiency** | ✓ | |
| **Maximum idle power** | ✓ | |
| **Material efficiency** | ✓ | ✓ |

The working document on potential Ecodesign requirements for machine tools and welding equipment products is part of the first wave of Ecodesign product groups to be proposed after the adoption of the Circular Economy package. As such, it envisages a number of requirements related to material efficiency, over and above those related to energy efficiency, whose nature is somewhat different.

The benefit of most of these material efficiency requirements is typically realised during repair, upgrading or refurbishment, or at the end-of-life stage of the product lifecycle, as opposed to energy savings taking place during the use phase. Additionally, material efficiency requirements tend to be more society-centric than user-centric, and techno-economic analyses on this aspect is still scarce. The proposed material efficiency requirements could represent the most suitable and balanced approach based on the currently-available data. The perspective of the Ecodesign Consultation Forum on these matters would be valuable, in line with the evolving measures on enterprise servers, data displays and the computers Ecodesign revision.

## 7.4. Staged implementation and ecodesign requirements

There are two gradual stages of implementation for the welding equipment minimum power source efficiency requirements and maximum idle power state energy consumption. The time intervals between the hopeful adoption of the regulation in 2019 and the first efficiency requirement by 2023 allows SME welding manufacturers to adapt to the changing technology requirements in their product designs and manufacturing capabilities. Subsequently, a five-year gap is envisaged before the next "tier" of energy efficiency and maximum idle permitted level.

However, other requirements will be applicable already at the first stage of implementation, which comes into effect on 1st January 2021, as outlined below.

Ecodesign requirements shall apply in accordance with the following timetable:

(a) From 1 January 2021:

Welding equipment products shall comply with the requirements set out in points 2 and 3 of Annex III

Machine tools products shall comply with the requirements set out in points 1 and 2 of Annex IV

(b) From 1 January 2023:

Welding equipment products shall comply with the requirements set out in point 1.1. of Annex III

(c) From 1 January 2028 welding equipment products shall comply with the requirements set out in point 1.2 of Annex III.

## 8. MEASUREMENTS AND CALCULATIONS

Measurements and calculations of the relevant product parameters should be performed taking into account the generally recognised state-of-the-art calculation and measurement methods. In this context, manufacturers may apply reliable, accurate and reproducible measurement and calculation methods and harmonised standards set up in accordance with Article 10 of Directive 2009/125/EC, as soon as they are made available and published for that purpose in the Official Journal of the European Union. Requirements for calculation and measurement methods are specified in Annex III of the working document.

Concerning the material efficiency aspects, there is already a standardisation request for developing standards with regards to ecodesign requirements on material efficiency aspects of energy-related products[14]. Proposed material efficiency requirements for welding equipment and machine tools could be supported by the developed standards.

## 9. BENCHMARKS

For machine tools, it is difficult to cite concrete benchmarks at an overview level of performance, as there are many factors and trade-offs involved, and hence it may well be optimal to retain a high degree of flexibility in how product design improvements over time are realised. Hence, no "benchmarks" are presently cited.

[14] http://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=564#

For welding equipment, it has been claimed[15] that the welding power source should be capable of energy conversion factors (i.e., energy efficiency) of "close to 90%". The Chinese national welding standard GB 28736-2012 cites a voluntary ("grade 1") power source efficiency requirement of 91% for arc welding equipment.

For idle state power consumption in welding, the claimed "Best Available Technologies" cited[16] are 10 Watts; however, it is presently not clear if all the minor cumulative power contributions contained within the EU calculations of this figure are considered in the Canada-derived figure.

## 10. CONFORMITY ASSESSMENT

As required in Article 8 of Directive 2009/125/EC the working document specifies the applicable conformity assessment procedures, which should be based on an internal design control or a management system as described in Annexes IV and V of Directive 2009/125/EC. Other conformity assessment procedures of those described in Annex II of Decision 768/2008/EC[17] are considered not duly justified and proportionate to the risk. For the purposes of conformity assessment, the technical documentation shall contain the product information set out in the relevant Annexes.

## 11. VERIFICATION PROCEDURE FOR MARKET SURVEILLANCE PURPOSES

When performing the market surveillance checks referred to in Article 3 (2) of Directive 2009/125/EC, the authorities of the Member States shall apply the verification procedure for the requirements set out in Annexes II and IV of the Working Document. To this extent, the authorities of the Member States shall follow the procedure laid down in Annex VI of the working document. Annex VI also specifies the verification tolerances, which relate only to the verification of the measured parameters by Member State authorities and shall not be used by the manufacturer or importer as an allowed tolerance to establish the values in the technical documentation. The tolerance for power source efficiency is no more than 2 % deviation from the declared value, and 10% for the idle state power of welding equipment power sources.

## 12. DATE FOR EVALUATION AND POSSIBLE REVISION

The main issues for a possible revision (proposed for 2024) of the proposed working document are:

- the appropriateness to set specific ecodesign requirements on machine tools' efficiency levels, performance and power demand;
- the need to update the definitions or the scope;
- the appropriateness to set specific ecodesign requirements, possibly via a "points system" for machine tools;
- to check whether the power source efficiency minimum requirements and idle state maximum power consumption requirements are appropriate for welding equipment;
- the appropriateness of setting emissions limit values of emissions to air from welding equipment;
- the feasibility and appropriateness of setting limits on consumables utilised in welding equipment (shielding gases, welding wire or filler material) during welding operations.

[15] For example, National Resources Canada (2012): Arc-welding. Office of Energy Efficiency, National Resources Canada.
[16] Ibid.
[17] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:218:0082:0128:en:PDF