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WORKING DOCUMENT FOR THE ECODESIGN CONSULTATION FORUM ON MACHINE TOOLS AND RELATED MACHINERY (ENTR LOT 5), 6 MAY 2014

This Working Document is not a Draft Ecodesign Regulation for the product group "Machine Tools and Related Machinery" (metal-working machine tools, wood-working machine tools, stone and ceramics machine tools, and welding equipment). Rather, it is a discussion note: (1) explaining the state of play; (2) introducing the proposed four policy options under consideration, for different sub-sectors of the overall product group, including an industry Self-Regulatory Initiative (SRI) proposal for the metal-working machine tools sector; (3) communicating the present draft modelled final energy electricity savings associated with each policy option.

This discussion note outlines within the text various questions and issues for the Consultation Forum to consider. The Commission invites members of the Consultation Forum and observers to submit comments in writing in answer to the issues raised, or with regard to other general or specific observations on the policy options being considered. These written comments may be submitted before or subsequent to the Consultation Forum.

The Consultation Forum is also invited to contribute to the ongoing Impact Assessment study.

1. STATE OF PLAY

Background: The Ecodesign Directive 2009/125/EC establishes the framework for the setting of ecodesign requirements for energy-related products. The first Working Plan of the Ecodesign Directive adopted on 21 October 2008 listed the product groups which were considered as a priority for implementing measures in 2009-2011, including 'machine tools and related machinery'. A preparatory study for this product group was launched in November 2009. The final report of the study was published in August 2012 on the dedicated Project Webpage: http://www.ecomachinetools.eu/typo/reports.html . The study concluded that machine tools and related machinery meet the criteria of Article 15 (2) of the Ecodesign directive, i.e., that the overall product group presents a significant volume of sales on the market, has a significant environmental impact and energy consumption, and presents a significant potential for improvement. The preparatory study identified at that time estimated final energy electricity saving potentials of between around 3 TWh and 8 TWh per year in 2025, for all product sub-groups within the overall product group. On average, over 95% of the energy required by machine tools (MT) is in the "use" phase of the products (the remainder mostly comprises the "embedded energy" in the materials used and the construction of the MT).

Commission européenne/Europese Commissie, 1049 Bruxelles/Brussel, BELGIQUE/BELGIË - Tel. +32 22991111
Office: BREY 7/029 - Tel. direct line +32 229-75552 – E-mail : michael-john.bennett@ec.europa.eu

It must also be emphasised that the other elements of Article 15 of the Ecodesign directive must also be adhered to, in particular Article 15 (4) and (5), where there is clear reference to a requirement for proposed ecodesign measures not to impose significant impacts on either the competitiveness of the manufacturers concerned - particularly SMEs - or on the functionality of the products made. For the very heterogeneous range of business-to-business (B2B) products which comprise "machine tools and related machinery", and the wide range of uses to which they are put, this balance between the requirements of Article 15 (2) and Article 15 (4 and 5) is very challenging. This is especially so, taking into account the high proportion of SMEs involved (in some sectors, up to around 80%) in machine tools manufacturing in the EU, and the customisation and adaptability of the solutions that these manufacturers need to offer to their B2B clients, within dynamic supply/ value chains (inter alia, automotive, aerospace, medical and other machinery sectors).

Overview - Product Group Characteristics (Preparatory Study findings): For the more expensive, intricate computer numerically-controlled (CNC) machining centres and tools, professional users of machine tools in the end-user sectors decide on the type, and detailed specification requirements, of the machine tool being purchased via its capacity to be able to manufacture sometimes very specialised components and complete products. The demands on such tools include often high precision, and flexibility for use in a variety of processes, using several materials. Alternatively, for some end-use professional clients, the ability of the machine tool to rapidly perform the same repetitive task may be required. Overall efficiency depends on the heterogeneity of the batches of end-product required, and small production runs versus large production runs. Where there are several end-products required, there is associated "downtime" required for changing tool parts, and for altering other configurations of the machine tool. Variations on "standby", "off" and "ready" modes are common, but there are trade-offs between energy efficiency and complexity/ downtime/ variety of product runs.

Regarding Life Cycle Costs (LCC) for the most sophisticated, expensive machine tools (purchase price often over 300 000 Euros, up to several millions of Euros), energy costs comprise c. 20%-25% of the LCC. Purchase price is some 70% of the total LCC. For non-NC machine tools (purchase price typically 5 000 Euros to 60 000 Euros), which are used where single tasks are required (e.g., sawing, drilling/boring, grinding), energy may comprise up to 70% of total LCC, whereas purchase price may only be c. 25% of LCC. These above proportions also depend on how many hours per day the machine tool, or welding equipment, is used; some professional equipment is used almost continuously, and on a two-shift pattern per day, whereas other, e.g., light stationary woodworking tools (purchase price typically c. 500 Euros) are used briefly twice per day in workshops.

Sources of Market Failure: For all machine tools and related equipment, the following financial considerations may hinder optimal energy efficient design, constituting market failures: (i) a lack of capital available for investment; (ii) a desire to limit the size of a company’s debt burden; (iii) uncertainty over long-term future sales of products made by the machine tool, or a perceived need for flexibility in the solutions offered by the machine tool.

Market failure also stems from a lack of reliable, standardised information on energy efficiency (and related environmental) performance of machine tool products. This prevents business customers from being able to compare different manufacturers' machine tool products, via universally-accepted measurement standards.

Ecodesign Self-Regulatory Initiatives (SRIs): Since the finalisation of the preparatory study, the Commission has followed developments in other B2B product groups subject to ecodesign measures, and also the several ecodesign Self-Regulatory Initiatives which have now been recognised by the Commission, or which are progressing towards this goal. In addition, the Commission's Guidelines

for Ecodesign Self-Regulatory Initiatives have been revised in draft, and are planned to be discussed again within the Ecodesign Consultation Forum during 2014, i.e., partly proceeding in parallel with the draft ecodesign proposals for Machine Tools and Related Machinery.

Impact Assessment Study: Regarding Machine Tools and Related Machinery, the Commission launched an Impact Assessment Study in November 2012 to support the preparation of its Impact Assessment, which is mandatory for all Commission proposals. One task of this study is also to reassess the findings and the product sub-groups of the preparatory study, and to consult on, and possibly revise, the indicated policy options via seeking additional information and feedback from stakeholders. The work is ongoing; the final report of the study will be delivered by August 2014.

The ongoing Impact Assessment Study comprises data taken from the ENTR Lot 5 Preparatory Study, which has been updated and consolidated, supplemented by additional data from stakeholders, and draft modelling exercises, which are discussed in the following sections. The interim results to date of the Impact Assessment study support the Policy Options being considered, as relevant to each of the four sectoral sub-groups (Metal-working Machine Tools, Wood-working Machine Tools, Welding Equipment, and Stone and Ceramics working Machine Tools).

Section 2 presents a "mapping" overview of which Policy Options are relevant to which sectoral sub-groups.

Annex E (separate document) presents the *draft* Impact Assessment final electricity energy savings modelled for the various Policy Options considered.

1.1 Machine Tools - Base Cases

Table 1 presents the 10 base cases considered, which include a tenth base case (Stone and Ceramics working Machine Tools) added since the 2012 ENTR Lot 5 Preparatory Study.

Table 1: Overall Machine Tool Base Cases

Base Case reference	Base Case description
BC1	MT for metal-working: Numerically controlled machining centre
BC2	MT for metal-working: Numerically controlled deep drawing or bending MT
BC3	MT for metal-working: Laser cutting MT
BC4	Non-numerically controlled metal-working drilling MT
BC5	MT for wood working: light stationary table saw
BC6	MT for wood working: horizontal panel saw
BC7	MT for wood working: through feed edge bending machine
BC8	MT for wood working: CNC machining centre
BC9	Welding equipment
BC10	Stone and ceramics working MT

Table 2 presents an estimate of annual EU-wide final electricity use by base case, updated to include 2012 data where available. The total estimated EU final electricity consumption associated with Machine Tools is approximately 67 TWh per year.

The metal-working machine tool sector is the dominant energy-using sector, comprising around 76% (51.2 TWh p.a.) of the total EU final electricity consumption attributed to Machine Tools. The complex multi-tasking, multi-tool Base Case 1 Metal-working Machine Centres dominate the share of the total electricity consumption, followed by the more traditional, more mono-purpose Base Case 4 machine tools.

It can be observed that the Base Case 10 Stone and Ceramic working Machine Tools also represent a significant electricity-using category (7.5 TWh p.a., 11.2%), followed by the Base Case 9 Welding Equipment (4.0 TWh p.a., 6.0%), and finally Wood Working Machine Tools (BCs 5-8), representing a total of 4.3 TWh p.a. (6.3%) of final electricity consumption.

Table 2: Final Electricity use by Base Case

Base Case	General design area	Annual Est. of Electricity consumption (TWh)	Share in total electricity consumption
BC1	CNC MT: metal-working machine centres	38.4	57.3%
BC2	CNC draw/bend tool: metal-working	0.8	1.2%
BC3	Laser cutting: metal-working	3.0	4.5%
BC4	Non-numerically controlled metal-working machine	9.0	13.4%
BC5	Wood table saw	1.1	1.6%
BC6	Wood panel saw	0.3	0.4%
BC7	Wood bender	2.2	3.3%
BC8	Wood CNC	0.7	1.0%
BC9	Welding	4.0	6.0%
BC10	Stone and ceramic working MT	7.5	11.2%

Table 3 shows policy analysis market inputs regarding annual sales, stocks and indicative lifetimes of the machine tool and related machinery base cases considered. These data have been updated from the ENTR Lot 5 Preparatory Study, where such data were available.

Baseline scenarios have been taken up to the year 2040, to allow policy measures sufficient time to take effect, for these products, some of which have lifetimes up to 20 years.

Industry feedback has indicated that most new machine tool sales are for replacement purposes; hence, the growth in the overall stock of machine tools up to 2040 is predicted to be on average fairly static. For the metal-working machine tools, the EU metal-working machine tools industry association has estimated that the sales growth would be between 1.0% p.a. and 1.5% p.a.; hence, an average sales growth of 1.25% p.a. for the metal-working machine tools sector has been assumed in the Impact Assessment study.

Table 3: Policy analysis market inputs (sales, stock and lifetime) – latest available data

Base Case	2009		Lifetime
	Sales (units)	Stock (units)	(years)
BC1: Metal-working Numerically controlled machining centre	11 085	288 845	12
BC2: Metal-working Laser cutting MT	1 500	15 000	12
BC3: Metal-working Numerically controlled deep drawing or bending MT	31 676	201 579	17
BC4: Metal-working Non-numerically controlled metal-working drilling machine	38 000	690 000	18
BC5: MT for wood working: light stationary table saw	220 000	4 400 000	20
BC6: MT for wood working: horizontal panel saw	1 300	25 000	20
BC7: MT for wood working: through feed edge bending machine	10 400	207 000	20
BC8: MT for wood working: CNC machining centre	670	13 494	20
BC9: Transportable welding equipment	180 000	1 270 000	7
BC10: Stone and ceramics working MT	59 140	945 919	20

1.2 Environmental Impacts

The Lot 5 Ecodesign Preparatory Study showed that energy consumption in the use phase of MT has the most significant environmental impact, but that there are other factors as well. One such aspect is the use of coolant fluids, but as coolant use is very costly it is normally reused and recycled. In addition, a reasonable assumption was made that once disposal becomes necessary, it is done so in accordance with environmental regulations in force. It should be noted that reducing coolant would both slow down machining operations, and accelerate tool wear. Therefore, reducing the

environmental impact associated with the coolant would be a complex and possibly counter-productive measure, with the potential to seriously affect the machine tool's functionality. Note that coolant is used only in metal and ceramic or stone cutting, and not for woodworking. In certain applications such as grinding and deep drilling, lubrication is an essential part of the process.

Wood dust and chips: Their emission in the workplace atmosphere can cause respiratory problems, but in the EU these levels are limited under existing health and safety regulations, and managed in a centralised way at plant level. Therefore, it has been deemed not to be an issue that needs further consideration within the impact assessment study.

Noise: The issue of MT-related noise is important to end-users, and MT which produce lower levels of noise tend to have a premium on their price. However, there is no evidence that making machinery more energy-efficient will increase noise levels, and it is likely that the opposite is usually likely to be true (for example, reduction in speed or automatic turning off of fans or other accessories will reduce noise levels). Therefore, in general there should be no environmental "trade-off" issues present between noise and energy efficiency. Noise per se may have to be addressed, but only if it is feasible to do so with regard to such heterogeneous Base Cases, or via consideration on a Base Case by Base Case level.

Consumption of shielding gases in welding, with their high embedded energy from air separation: Please see Section 2.1.2 for consideration of this issue.

1.3 Improvement Potential – Energy & Environmental Mitigation Approaches

Component-based/ Modular Approach: For each Base Case, various scenarios of combinations of individual design improvement options were suggested in the Lot 5 Ecodesign Preparatory Study. The total energy consumption savings for these scenarios were calculated as the gross summation of all of the relevant improvement options. However, it is recognised that not all scenarios will be applicable in every Base Case, and so the maximum values cited in the ENTR Lot 5 Preparatory Study should be seen as the most optimistic values. Also the gross summation of individual savings can lead to implausibly high efficiencies, since as energy savings rise, there may be increasingly less potential for future energy efficiency measures.

The subsequent section on policy options details specific measures at the components level, as used in MT. There is a necessary compromise required between basing the analysis on a finite number of base cases, and the actual result via the application of horizontal measures. The components-based, or modular, approach to the overall energy savings policy options fit as far as is feasible with respect to the draft methodology defined within the International Standard being developed for the Environmental Evaluation of Machine Tools, ISO 14955 Part 1 (status: "under publication"), and subsequent Parts 2, 3 and 4 (work being carried out by ISO/ TC39). *It is important to note that methods to measure energy efficiency in MT are being developed in ISO 14955 Part 2 (in progress).*

When considering the magnitude of energy savings that are possible to achieve in MT, the functional relationship between modules should be considered, as should the type of work done by the end-user, as stated in ISO 14955 Part 1 (and from information received regarding Part 2).

Welding equipment is a specific sub-group of products. Please see Section 2.1.2 for observations and proposals for welding equipment.

1.4 Existing Legislation and Relevant Initiatives

Machine tools per se are not the subject of energy efficiency regulation within the EU, or elsewhere globally. However, a number of the modules used in MT are either already covered, or considered for future energy efficiency regulations in the EU.

For example, induction motors that are currently used within MT are already included within the Lot 11 motor Regulation 640/2009. This regulation covers common designs of induction motor in the 0.75 – 375 kW 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 will usually be powered by specialist servo motors that are not within the scope of Regulation 640/2009. It has been noted that in situations where an induction motor frequently changes its speed during utilisation, during the acceleration phase the higher inertia of some higher efficiency motors may mean that more energy is required for the motor to reach its desired speed. However, this effect will in normal applications be greatly outweighed by steady-state energy savings.

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

Noise: ISO 11204:1997 is the primary standard concerning noise emissions from machinery. There are other related standards also dealing with noise emissions from specific types of machinery.

2. POLICY OPTIONS CONSIDERED

In addition to the "Business As Usual" (BAU) scenario, four policy options (POs) have been considered, variously applied to the MT Base Cases, depending on whether the policy option was deemed to be appropriate. It should be noted that some of these are inter-related, and so the final definition of the measures should be reviewed in light of the final set of policy options selected.

- **PO-1: Mandatory ecodesign requirements - covering wood working and welding equipment** (*Base Cases 5-8, and 9*). It is assumed to be implemented in 2016 (Tier 1).
- **PO-2: Mandatory ecodesign "points" scheme – covering metal-working as well as stone and ceramics working MT** (*Base Cases 1-4 and 10*). This PO is assumed to be implemented in 2016 for stone and ceramics working MT; for metal-working MT it will be considered for implementation if the draft industry SRI (PO-3) is not ultimately approved by the European Commission.
- **PO-3: Self-Regulatory Initiative (supported by CECIMO[1]) – covering metal-working MT only** (*Base Cases 1-4*). It is assumed to be implemented in 2016.
- **PO-4: Good Design Practice Checklist – covering all MT** (*Base Cases 1-10*). It is assumed to be implemented in 2016.

The Policy Options must be viewed from the perspective of sectoral product groups, to understand which Policy Options are appropriate for which products, as explained below.

[1] The European Association of the Machine Tool Industries (http://www.cecimo.eu/site/)

The "No action" policy option must always be considered, and is applicable to all sectors and Base Cases.

In addition, Policy Option 4 is applicable to all sectors and Base Cases, as an over-arching additional "information requirements" measure to be taken into account, over and above other Policy Options.

Sectoral Product Grouping	Relevant Policy Options Considered (in addition to "No Action")
• **Metal-working MT (BCs 1-4)**	PO-2 Mandatory "Points" scheme **OR** PO-3 Industry SRI Proposal – CECIMO **AND** PO-4 Good Design Practice Checklist
• **Wood working MT (BCs 5-8)**	PO-1 Mandatory Ecodesign requirements **AND** PO-4 Good Design Practice Checklist
• **Welding Equipment (BC 9)**	PO-1Mandatory Ecodesign requirements **AND** PO-4 Good Design Practice Checklist
• **Stone & Ceramics working MT (BC 10)**	PO-2 Mandatory "Points" scheme **AND** PO-4 Good Design Practice Checklist

Figure 1: Sectoral Product Groups Mapped to Relevant Policy Options

2.1 PO-1: Summary Description of Mandatory Ecodesign Regulation Requirements - Wood Working (*Base Cases 5-8*) and Welding Equipment (*Base Case 9*)

Scope and Coverage

Mandatory ecodesign measures considered in this policy option aim to reduce the amount of electricity used both in the machinery itself and the essential ancillary equipment servicing the machine tool. In most of the base cases, applying only one measure is not sufficient to achieve significantly large energy and related environmental savings. This policy option therefore examines combinations of several mandatory ecodesign measures and their resulting energy and environmental savings. This policy option considers only possible **mandatory ecodesign measures** that apply to **Wood Working MT (Base Cases 5-8)** and **Welding Equipment (Base Case 9)**.

Table 4 below presents an overview and description of the potential ecodesign strategies relevant to BCs 5-9, including summarised information on coverage, restrictions and exclusions. (More detailed information on these technical design strategies is given in **Annex A**).

Feasible mandatory ecodesign implementing measure requirements have been selected from the wider list of potential ecodesign options and strategies for MT described in Table 4, and are subsequently presented as follows:

- Table 5 (proposed Ecodesign Implementing Measures - Wood working MTs: BCs 5-8);
- Table 6 (proposed Ecodesign Implementing Measures - Welding Equipment: BC 9).

Table 4: Overview of general ecodesign aspects for consideration for Wood Working MT and Welding Equipment (details given in Annex A): NB information only–not mandatory measures

Technical measure	Market	Base Case scope	Exclusions	Technical Constraints
Overall machine mass reduction	Wood working machinery	Base Cases 5-8		In some small equipment, the workpiece is moved relative to the tool, and so the only spinning mass savings are in the tool clamp.
Software-based energy management	Wood working machinery	Base Cases 5-8		Only CNC machines will be running software, and no other types of machine can have this technical measure. Savings are less than with metal-working equipment, as there is no cooling lubricant.
Drive units (energy regeneration)	Wood working machinery	Base Case 8 only	Machines where there are too few stop-starts per hour to justify this.[2]	Those machines that have no requirement for speed control should not be made to fit them solely to obtain this modest energy saving. Most wood working machinery needs to work at high speed for best effectiveness; there is thus little scope for speed reduction in most BC8 MT.
Hydraulic systems (tool handling and clamping)	Wood working machinery	Base Cases 7 and 8	Machines that do not include hydraulic handling (Base Cases 5,6)	Savings cannot be achieved on a machine that does not use a hydraulic system (this option refers to improvements in hydraulic systems, not the use of hydraulic systems in preference to other systems).
Optimised Pneumatic Systems	Wood working machinery	Base Cases 7 and 8	Machines that do not include pneumatic handling (Base Cases 5,6)	Savings cannot be achieved on a machine that does not use a pneumatic system that is not used.

[2] The economic criteria for this will vary with the inertia (a function of mass and rotational speed), and size (and hence cost) of the machine.

Technical measure	Market	Base Case scope	Exclusions	Technical Constraints
Electric systems	Wood working machinery	Base Cases 5 - 8	Machines that do not include electric systems (other than power drive motors)	This includes other electrical systems such as lighting, fans, and valves. Savings cannot be achieved on a system that is not used.
Cooling systems and use of waste heat	Wood working machinery	Base Cases 6 - 8	Machines that do not include cooling systems, other than ports designed for connection of an external wood chip/dust extractor system	Savings cannot be achieved on a system that is not used.
Peripheral systems	Wood working machinery	Base Cases 5 - 8		Interlock signal for external extract systems to allow automatic switch off when machine is not operating.
Guidance for energy efficient use	Wood working machinery	Base Cases 5 - 9		This will vary in scope by type of machine.
Control systems	Wood working machinery	Base Cases 5 - 9	Machines that do not have automatic control systems	Most machines have only rudimentary control systems (tool cutting span and/or speed), which offers little scope for saving. More advanced control systems might include multiple tools.
Productivity and processing time	Wood working machinery	Base Cases 5 - 9	Does not apply to products other than highly automated machinery where there is the option for advances in this area	
More efficient welding power sources	Welding machinery	Base Case 9	Does not apply to hobby type welding equipment (which has very	The cost of moving from transformer to inverter topology is disproportionate for the hobby type welding equipment sector, where equipment will only be

Technical measure	Market	Base Case scope	Exclusions	Technical Constraints
			low duties)	used for a very short time.
Limits on idling power consumption	Welding machinery	Base Case 9	Does not apply to hobby type MMA [3] welding equipment.	The cost of moving from transformer to inverter topology is disproportionate for this sector, where equipment will only be used very briefly per year.

2.1.1 Wood Working MTs – Proposed Ecodesign Mandatory Implementing Measures

Table 5 proposes technical features that wood working machine tools (Base Cases 5-8) should be subjected to as mandatory ecodesign requirements as a part of this policy option. The mandatory ecodesign requirements for welding equipment (Base Case 9) are presented separately afterwards.

Table 5: Proposed Ecodesign Implementing Measures – Wood Working MTs (BCs 5-8)

Instrument	Tier 1 (2016)	Tier 2 (Date TBC)
Software-based energy management	Software to reduce idling energy consumption	Software to track and record energy use
Regenerative Variable Speed Drives (VSDs)		Use of regenerative VSDs
Hydraulic and pneumatic optimised system	Maximum speed for fluid in pipework	Vary fluid flow to suit demand

The following points summarise the performance criteria for Tier 1 and 2 mandatory ecodesign requirements for Base Cases 5-8:

- **Software to reduce idling energy consumption:** the end-user shall be able to set automatic turn off for ancillaries such as lights, extractor fan, cooling lubricant and hydraulic power pack during the period of time when a machine tool is not cutting.

- **Software to track and record energy use:** software that shows and records energy use in sufficient detail should be included so as to allow the user to fully understand how the machine consumes energy. This software may then be used to iteratively optimise processes and to virtually model optimal combinations of options for machining.

[3] MMA (Manual Metal Arc) welders using conventional transformers have permanently energised transformers, and therefore limiting the standby current consumption would be difficult.

- **Use of regenerative Variable Speed Drives (VSDs)**: where a VSD is specified and the motor being controlled has on/off cycles of less than two minutes for a minimum of 4,000 hours per year, operating time PAM (Pulse Amplitude Modulation), then a regenerative VSD shall be used.

- **Maximum speed for fluid in pipework:** the maximum allowable fluid speed in pipework shall be 3.0 m/s.[4]

- **Vary fluid flow to suit demand:** the fluid flow shall be controlled by any means so as to avoid maximum flow continuously. Examples of eligible methods include variable speed and automatic on/off control.

Issues for the Consultation Forum to consider regarding PO-1, Table 4 (Wood working MT) Ecodesign Implementing Measures:

1. ***Numerous ecodesign options from Table 4 have been discarded, because they are more qualitative, and/ or less auditable for Market Surveillance Authorities. Does the Consultation Forum consider that any other ecodesign options from Table 4 might be feasibly incorporated into the mandatory Ecodesign Implementing Measures?***

2. ***Comments on the feasibility of the mandatory proposals, proposed scope, ambition and timelines.***

2.1.2 Welding Equipment (Base Case 9) – Proposed Ecodesign Implementing Measures

Table 6 proposes technical features that welding equipment (Base Case 9) should be subjected to as mandatory ecodesign requirements for this policy option.

Table 6: Suggested Minimum Performance Criteria for Welding Equipment Ecodesign Implementing Measures[5]

Measure	Tier 1 (2017)	Tier 2 (2019)	Tier 3 (2021)
Minimum inverter efficiency of machinery (3 phase)	75%	80%	85%
Minimum inverter efficiency of machinery (1 phase)	70%	75%	80%
Maximum idling power	150W	70W	50W

[4] This is a commonly used figure for maximum fluid velocity in industrial and commercial water movement systems.

[5] Efficiency being defined as the ratio of output power to input power, expressed as a percentage. These values reflect data received from the European Welding Association, subsequent to the completion of the ENTR Lot 5 Ecodesign Preparatory Study.

Types of welding equipment which are proposed to be excluded from the scope of the above Ecodesign Implementing Measures comprise the following:

- Submerged Arc equipment (arc > 600A): this equipment has a very low sales volume (less than 800 units p.a.[6])
- Machines covered by EN 60974-6 (so-called "hobby" welding equipment, on the grounds that it is low duty cycle, is used for only a few hours per year, and would require a technology change to reach Tier 3 aims (change to inverter technology)[7]

Alternative "One Tier" Ecodesign Implementing Measures solution, for non-inverter welding technology covered by EN 60974-1: An alternative possible solution for this equipment might be to proceed to the Tier 3 requirements, with no Tier 1 and Tier 2 staged requirements, over the 6 year timeline. Such a potential solution requires further discussion with the stakeholders concerned, and any decision needs to be informed by full Impact Assessment parameters (cost, competitiveness, relative advantages of one "step change" versus three "steps", etc), not solely energy considerations.

Standardization Progress: It should be noted that in preparation for possible Ecodesign Implementing Measures, a draft standard is already available [IEC/EN60974-1 (improved Annex M)], which may be used to measure the above mandatory ecodesign measures (standby consumption and inverter energy efficiency) proposed here as mandatory Ecodesign measures. The first Committee Draft has already been shared with all National Committees.

Other environmental issues are proposed to be covered by "good practice" guidelines, including:

- Optimising welding shield gas supply, via:
  - Using adjustable flow devices
  - Optimising system pressure settings
  - Careful calibration of flow meters
  - Minimising the volume between flow device and torch tip (at the wire feeder)
  - Use of a welding gas regulator, to provide a consistent gas flow from arc-on to arc-off, allowing welders to set a lower gas flow rate
- Maintenance requirements regarding gas circuits, to prevent damage and leakage.
- Availability of spare parts: at least longer than 5 years
- Durability and longer product life: software updates are incorporated; recommendations on preventive maintenance are already included in relevant EN standards.
- Dismantling/ End of Life aspects: As well as WEEE marking, current design practice is to optimize assembly methods to allow easy disassembly (e.g., easy access to electronics and batteries utilized).

The Consultation Forum is invited to consider the above welding equipment (Base Case 9) proposals and to give comments and feedback, regarding the mandatory proposals, proposed scope and equipment exclusions, timelines and also the guideline aspects.

[6] Source; European Welding Association (EWA), letter dated 15.10.2013.

[7] The ENTR Lot 5 Preparatory Study (2012) discusses special welding processes (Task 5, Table 4-93, note 61), which could or should be considered for exclusion from the proposed mandatory Ecodesign Implementing Measure for Welding Equipment.

2.2 PO-2: Summary Description of Mandatory Point Scheme – for Metal-working MT (BCs 1-4), and Stone and Ceramics working MT (BC 10)

2.2.1 Scope and Coverage

The mandatory Ecodesign Point Scheme measure in PO-2 is designed to apply to metal-working as well as to stone and ceramics MT manufacturers. PO-2 has been compiled for both Stone and Ceramics working MT as well as Metal-working MT, as many of the manufacturing processes and components used are similar.

NB For **Metal-working MT**, PO-2 is **mutually exclusive** to the industry SRI Proposal (PO-3), which is described in Section 2.3 and enclosed as **Annex D**.

The conceptual detail of this scheme is based on the internationally-recognised scheme for building performance, BREEAM, where designers have to achieve a certain numbers of points related to concepts and efficiency/ design factors, in order to claim certain design levels (www.breeam.org). BREEAM certification, and the allocation of points justified and verified, by site inspections from independent inspectors, who must be qualified via training as auditors within the BREEAM scheme.

2.2.2 Requirement for compliance

Under the mandatory Ecodesign proposals of this Policy Option, MT manufacturers will have to reach a certain level of expected energy savings in order to demonstrate their compliance. The underlying principle is that MT manufacturers are free to use any mix of measures to reach the specified level of energy savings, and that the energy savings percentage achieved is denoted by a certain amount of equivalent points.

It should be noted that, in its present state of refinement, PO-2 takes the approach that all manufacturers' MT models must achieve these mandatory savings, without any regard to the level of energy savings measures that their MTs already incorporate. Thus, "early energy saving adoption measures" are at present not taken into account or rewarded, i.e., PO-2 adopts an average state of the market "blanket approach", taking into account the total population of metal-working MT. Therefore, the Mandatory Ecodesign "Points" PO-2 lacks the sophistication that a truly dynamic Policy Option might be able to take advantage of, namely where successive generations of MT from the same manufacturer can be compared, allowing design elements to keep pace with technical developments both at the overall machine level, and at a modular components level.

As a reference guide to Best Available Technologies (BAT) savings possible for BCs 1-9, **Annex B** presents the summary findings from the ENTR Lot 5 Ecodesign Preparatory Study.

Annex C compares energy saving estimates for specific and definable measures, taken from three sources:

- ISO/DIS 14955-1 MT (draft, 2014) - Environmental evaluation of MT - Part 1: Design methodology for energy-efficient MT
- ENTR Lot 5 Ecodesign Preparatory Study estimates (2012)
- Energy savings analysis model provided by CECIMO during ENTR Lot 5 discussions.

Annex C shows a *draft* list of best practice measures listed in the ENTR Lot 5 Ecodesign Preparatory Study report and the draft ISO 14955-1 standard, which (whilst some are not directly measureable) are recommended, where feasible. Please note that the CECIMO estimates apply to

gains in energy efficiency in the sub-system per se, not at Machine Tool level (as elsewhere in Annex C).

The values in the "suggested machine energy savings %" column have been derived by the experts from the Impact Assessment consultancy team, from BIO and Atkins.

Further input and feedback from Consultation Forum Member States and stakeholders would be very welcome, in order to refine these draft suggested values and tables within Annexes B and C.

Note: The 2014 draft ISO 14955 standard has been followed as far as possible, as the basis of this scheme. In addition, in order to give confidence that the measures shown are being broadly applied, this has been extended to allocate points for specific energy-saving measures. The draft proposals outlined in Table 7 propose that a one percentage point of energy saving is set as equal to four "points"; thus, two percentage points of energy saving would be equal to eight points, and so on. Only those measures which are clearly demonstrable (quantifiable) can be included in this system, giving some degree of robustness to the energy savings ascribed.

Issues for consideration and feedback from the Consultation Forum:

1. Alternatively, other "points" could be allocated per 1% of energy savings than the draft relationship presently chosen. The draft ratio of "1% energy saving = 4 points" has been chosen, to retain and improve the degree of sensitivity, as the system is adopted, refined and then goes forward, regarding information on benchmarked energy savings for technology types, baseline of installed stock, awaited ISO standard developments regarding energy measurement, etc.

2. Points allocations could vary via a non-linear relationship to the % energy savings, e.g., points being progressively reduced the higher the theoretical cumulative energy savings claimed. Such an approach might realistically reflect that various component-level savings are not directly additive. (Note that this is already partly incorporated into Table 7, via the 20 points maximum setting, i.e., there is no regard as to how far in excess of 4% the highest performance savings are, for a single measure.)

Table 7: Description of indicative draft proposed point scheme

Ascribed % of energy savings for measure	Allocated points
<1%	4
1% - 2%	8
2% - 3%	12
3% - 4%	16
>4%	20

It might occur that a MT has no relevant parts that can be attributed in some category groups, i.e., where the feature/ technology is not applicable, or where it is absent on the product model concerned. In this case, the points allocated to that group of technology/ features is deemed to be the

average of all other category groups' points[8] relevant to, and present in the MT under consideration. *Please see worked example below. It must be emphasised that this example is illustrative only, taking a perhaps "slightly better than average" Machine Tool, and is for explanatory purposes only. It does not purport to represent a real, or average Machine Tool, etc.*

- **Worked illustrative-only example: application of the points methodology for a hypothetical metal-working MT**

Table 8 shows the measures (taken from **Annex C**) selected by the MT manufacturer, plus the points allocated to the feature groups (far left column). The "Grand Total" gives the overall points gained by the MT in question, e.g., in the "Electric Systems" section, a converter with power factor correction was fitted, scoring 2 out of a maximum 4 points for this category. An important aspect of the "points" system to note is illustrated by the points allocated to "Pneumatic Systems". As there is no pneumatic system on the particular machine tool being examined, the average score of the relevant categories was allocated to the non-relevant "Pneumatic System". In this way, the phenomenon of being marked down for an irrelevant feature is avoided, which is an aspect taken from the BREEAM certification scheme. (The measures applied to the machine have allocated to it 35 points (i.e., 8.75% energy savings indicated) out of a total possible of 90 points. This relatively high score shows that it is quite an energy efficient machine. (Note that the actual energy saving seen in practice may not exactly attain this figure, but this approach is indicative, and iterative).

Table 8: Example calculation of points to be allocated to a metal-working MT

Ascribed % energy savings for measure	Maximum possible allocated points by category	Points achieved by example machine	Allocation for those systems not present on the machine (the average of the other scores)
Overall Machine	19	7	
Drive Units	16	4	
Hydraulic System	5	4	
Pneumatic System	20		8 (=27/70 x 20)
Electric Systems	4	2	
Cooling lubricant	7	3	
Cooling	3	1	
Power Electronics	6	2	

[8] This approach is as used in the BREEAM building design scheme.

Ascribed % energy savings for measure	Maximum possible allocated points by category	Points achieved by example machine	Allocation for those systems not present on the machine (the average of the other scores)
Overall machine	4	2	
Peripheral	2	0	
Control	4	2	
Grand Total	**90**	**35 Points**	

2.2.3 Possible Timescale for full implementation of PO 2

It is recognised that time will be needed to collect further data in order to refine the technologies and energy improvements allocated to them. CECIMO (the European Association of the Metal Working Machine Tool Industries) is funding work on collecting and aggregating energy efficiency improvements; the tests and resulting data are estimated to be completed within 3 years (see SRI Policy Option 3, below). In parallel, preparation could start to be made to cope with the administrative procedures associated with the point scheme under this policy option.

A further 18 months is suggested as being reasonable in order to give adequate notice of introduction of this scheme to manufacturers and stakeholders. This represents a total lead time of 4.5 years from a start time of indicatively mid-2014, giving 1 January 2019 as the starting date for implementation. Subsequently, either a "dynamic learning", iterative approach could be set for subsequent energy savings ambitions, based on progress in technologies, standard energy measurement methodology (via ISO) and building up a reliable database of information to feed into the draft Annex C tabular quantities, or a more traditional, typical ecodesign tiered approach might be attempted, for the post-2019 period.

For the average final energy savings expected, a conservative, pragmatic 5% savings over the 10-year period 2015-2025 has been utilised in the comparative energy savings exercise of **Annex E**, as conservatively realistic figure, in line with the findings of the ENTR Lot 5 Preparatory Study.

Comments from the Consultation Forum regarding the above timing and energy saving expectations issues are invited.

2.3 PO-3: Metal-working Machine Tools Industry Proposal for a Self-Regulatory Initiative (SRI), or Self-Regulatory Mechanism (SRM) – for Metal-working MT (BCs 1-4) Only

The metal-working MT industry (BCs 1-4) Self-Regulation Measure (SRM) Proposal from CECIMO[9] is included as **Annex D.** The contents and mechanisms proposed in this SRM Proposal have been preliminarily discussed with the European Commission and the Impact Assessment consultants, and have been prepared by CECIMO taking into account both Annex VIII regarding

[9] Latest version, Draft 4, dated 09/04/2014.

Self-Regulatory Initiatives from the Ecodesign Directive and the European Commission's draft 'Guidelines on self-regulation measures under the Ecodesign Directive 2009/125/EC'[10].

2.3.1 Introduction to the CECIMO SRM Proposal

CECIMO[11] originally filed an application to the European Commission to commit themselves on behalf of their member companies for a Self-Regulatory Initiative in 2009, as an alternative to mandatory Ecodesign Regulation for metal-working MT (Machine Tools).

According to the Ecodesign Directive, and the draft 'Guidelines on self-regulation measures under the Ecodesign Directive 2009/125/EC'[12], an ecodesign self-regulation measure that meets all the conditions specified in the Directive can be considered as a valid alternative to an ecodesign mandatory implementing measure. Consequently, as long as such a self-regulation measure meets its objectives and complies with the requirements of the Ecodesign Directive, the Commission will give it priority and will refrain from adopting an Ecodesign Regulation for the product group concerned. However, if the monitoring and reporting performed under the self-regulation measure indicate deficiencies in the functioning of such a measure, the Commission will consider proposing a mandatory Ecodesign Regulation (in this case, Policy Option 2) for the product groups concerned.

Concerning the drafting of self-regulation measures, the current draft Ecodesign SRI Guidelines recommend a specific structure to ensure coherence between all self-regulation measures adopted under the Directive, with the aim that this will contribute to facilitating their interpretation and application. This structure consists of 16 different elements, which serve as rules for any ecodesign self-regulation measure concluded by the relevant industry sector(s) that will participate in the SRI, and which will regulate its operation. These rules must respect the principles specified in the Ecodesign Directive 2009 (principally, but not exclusively, the criteria specified in its Annex VIII) and in the Guidelines.

The SRI framework proposed by CECIMO, and provided to the European Commission (latest version is Draft 4, dated 09/04/2014) is discussed in the following sections, bearing in mind that these are only initial comments, owing to the short time available to review the draft SRI. Below, comments are given on certain criteria aspects, but these are not exhaustive.

2.3.2 CECIMO SRI Scope and Coverage

The Self-Regulatory Initiative (SRI) proposed by CECIMO will apply to metal-working MT manufacturers who are members of the EU trade association CECIMO, and - if possible - to other non-CECIMO metal-working MT manufacturers as well. CECIMO covers more than 98% of total metal-working MT production in Europe and more than one-third worldwide, thus representing approximately 1 500 industrial enterprises in Europe, over 80% of which are SMEs. This concerns almost 150 000 employees and corresponds to an annual turnover of nearly €22 Billion (in 2012).[13]

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[10] European Commission, Draft of Guidelines on the self-regulation measures concluded by industry under the Ecodesign Directive 2009/125/EC, September 2013

[11] European Association of the metal working machine tool industries

[12] European Commission, Draft of Guidelines on the self-regulation measures concluded by industry under the Ecodesign Directive 2009/125/EC, September 2013

[13] CECIMO website (accessed 26th Feb 2014): http://www.cecimo.eu/site/about-us/

According to a recent inquiry conducted by CECIMO, at least 40% of their members would certainly be willing to be involved in the SRI and contribute experts in standardisation to the process; and at least another 40% of the members would participate in the SRI, depending on conditions introduced.[14]

The SRI Guidelines set a minimum market coverage share of 80% of the products placed on the market and/ or put into service for a self-regulation measure to be considered as a valid ecodesign measure. The SRI Guidelines requirement on scope requires the self-regulation measure to apply to at least 90% of all product models placed on the market and/ or put into service by each signatory of the SRI. CECIMO has stated that these conditions can be met.

2.3.3 Requirements for compliance

CECIMO's concept SRI framework is based on the principle of allowing metal-working MT manufacturers to identify and realise suitable energy savings potentials for their specific products through selective measures.

ISO-DIS 14955-1 identifies the use phase of processes performed by metal-working MT as the main target for energy savings, and CECIMO has considered this as the starting point for its SRI. Consequently, the metal-working MT manufacturers will be provided with a list of energy efficiency improvements based on Appendix A and B of ISO 14955-1. The SRI is designed such that the metal-working MT manufacturers' actions and efforts towards energy efficient measures will be documented and compiled in a timely manner. The aggregated information will lead to insights into best practice measures, in order to define the overall state-of-the-art. This consists of the following three phases:

- **Mandatory evaluation of machine tools design –** In this phase, the feasibility of possible measures similar to those listed in Appendix A and B of ISO 14955-1 will be assessed. The impact of any specific measure will be based on information available from one of several sources: from catalogues, via the values indicated by suppliers (if available), via qualified estimates (calculation/simulation/measurement), or also via a reference value, provided by a **dynamic** checklist.[15] The increase in productivity, if applicable, is suggested to be considered as well. These factors will lead to determination of energy- saving potentials.
- **Optional evaluation of operations and environmental conditions –** This phase consists of analysis and optimisation of processes and factory resources. Although these measures are customer-specific, they can often be realised, and, where possible, greatly improve energy efficiency; therefore, they must be taken into account. As this is not possible for all metal-working MT manufacturers, especially those catering for more universal applications, this phase is optional, for those who can make use of it.
- **Additional continuous improvement by service, maintenance and training** – Involvement of the metal-working MT user and maintenance of MT to continuously improve the energy efficiency of the use phase.

From the implementation of the above, CECIMO estimates that a 12% energy efficiency improvement for the metal-working MT sector could be achieved in the first 10 years of the SRI application (indicatively 2015-2025), which is approximately in line with the 10% modelled findings

[14] CECIMO, SRI Inquiry Report, June 2013.

[15] The SRI administration will, over time, identify the most suitable measures for different machine types, and will provide average figures for their effectiveness, adding them to the checklist

of the ENTR Lot 5 Preparatory Study. Thereafter, as the "lower-hanging fruit" energy efficiency gains diminish, CECIMO has estimated that the period from 2025-2035 could attain an average energy efficiency improvement of 6%, i.e., cumulatively 18% energy efficiency gains by 2035 (q.v., Figure 3, p9, CECIMO SRM Draft 4). **Annex E** models in draft these energy savings over time.

2.3.4 CECIMO SRI Administrative Mechanism

The SRI framework features a self-assessment and documentation mechanism, where metal-working MT manufacturers will evaluate the energy efficiency implementations in their products, following a procedure defined by the SRI administration. The self-assessment and documentation will follow the concept of assessment and reporting of machinery safety (viz. Machinery Directive 2006/42/EC), leading to CE conformity. This mechanism provides the entrepreneurial freedom for companies to react to market demands, whilst leading to effective increases in energy efficiency.

Compliance with the SRI will be monitored by an Independent Inspector, and the SRI Administration as an independent authority. This auditing arrangement would ensure the transparent operation of the SRI. The Independent Inspector will also serve as a link between signatory companies, the European Commission, and all other stakeholders. The SRI Administration will be responsible for providing guidelines to the signatories of the SRI (i.e. metal-working MT manufacturers) and validating the credibility of their self-declaration. It will also be responsible for aggregating the data received from its signatories in order to identify the most suitable measures, and will provide average figures for their effectiveness. Via this approach, measures which are entering saturation, or which have become de facto market standards can also be identified, to help to push forward visions and plans for future developments.

The Consultation Forum is invited to comment on the scope, the technical and administrative/ managerial content of the CECIMO SRM Proposal, taking into account above-referenced draft SRI Guidelines, and the state of play of evaluating such a heterogeneous, dynamically-evolving product group as metal-working MT, together with the acceptability, workability and the ambition of the SRI.

2.4 PO-4: Good Practice Design Checklist – Information Requirements/ Consideration - for All Machine Tools (BCs 1-10)

2.4.1 Scope and Coverage

Policy Option 4, comprising a "Good Practice Design Checklist", includes measures for energy savings going beyond the *de facto* minimum levels of performance specified in possible Mandatory Ecodesign measures (e.g., PO-1). The Checklist is an "information requirements" measure, intended to supplement other POs, and to support and encourage both manufacturers and end-users of MT to create a market for superior performing products. PO-4 is intended to cover **all** MT categories.

2.4.2 Guidelines for Use

Many of the measures described are solely qualitative, and so it may not always be possible to definitively prove that a particular option on the checklist has been implemented or considered. The Checklist should not, therefore, be used as the basis for compliance checking. Instead, the Checklist should rather serve as the record of a discussion between a supplier and a purchaser. This discussion and the understanding of how a decision on the inclusion or non-inclusion of an option or approach from the Checklist is made are the essential elements to make such a Checklist a valuable tool, and policy option. If a completed Checklist were to be regarded as simply another item of paperwork to

be included in the delivery package, its value would of course be greatly reduced. Therefore, the "burden of proof" (*s.lato*) when using the Checklist could be on the MT manufacturer justifying why more energy/ environmentally-efficient design elements were ***not*** incorporated, rather than vice versa, to maintain the ambition of the ecodesign process.

Table 9 establishes a proposed ***draft*** Checklist of good design measures. Every one of the measures per se described in the Checklist under this policy option cannot, by their nature, be mandatory as many of the measures listed are qualitative only, and secondly their application and use depends on the MT itself, and the context of use. That is, some of the measures will also be relevant only in some applications, with regard to either technical or financial feasibility.

It will be for the supplier and purchaser to agree on the details of how the checklist is to be used for the individual design briefs, contracts and transactions concerned. It is intended that the Checklist serves as a list of issues for both manufacturer and client to consider and discuss. In the case of the way in which wood-working MT are specified and purchased, this process of active consideration may mark a significant change in the way this is done compared to the present-day scenario, whereby it is often that only the more established measures are considered.

The existence of a list will act as a primer for purchasers to enquire about energy-saving features that they may not otherwise have been aware of. Similarly, being able to make available many of the measures on the Checklist will offer a useful marketing opportunity to more progressive suppliers.

Table 9: Suggested Checklist of Measures for Good Design Practice

Category of measures	Checklist measures
Mass reduction of moving parts[16]	Lightweighting of static parts by re-design and/or new materials.
	Reduction in weight of rotating parts by re-design and/or new materials.
Software-based energy management[17]	Standby management, allowing the end-user to set up idle periods, pauses, cycles, etc. to optimise the process without compromising the functionality and performance of the machine.
	Recording and tracking of the energy consumption allows the end-user to have full control and identification of energy peaks and waste, informing him/ her which measures can be taken to make best use of energy saving operating modes such as standby and idle.
	Energy optimised motion control.
Motor and drives controls	IE4 motors are becoming available for both fixed and variable speed application. They are more efficient than the IE3 motors required under existing Ecodesign legislation.

[16] For all of these important measures, it is acknowledged that the difficulty in establishing a baseline will make improvements hard to demonstrate.

[17] Note: This element is different from the use of software to optimise machining programmes.

Category of measures	Checklist measures
	Where Variable Speed Drives are used with frequent stop-start cycles, a regenerative model will be cost-effective.
	Localised Power Factor Correction will reduce losses in supply cable(s) to the MT.
	Synchronous belts are more efficient than the V belts usually supplied as a default.
	Optimise servo positioning system according to application.
	Helical gears instead of less efficient worm gears.
Tool handling and clamping	Full consideration given to the appropriate selection of pneumatic, hydraulic or electrical clamping systems, based on application.
Hydraulic and pneumatic optimised system	Variable pressure systems.
	Inclusion of hydraulic accumulator.
	Optimise efficiency via variable flow.
	Turn off when not required.
	Prevention of nipple collapse.
	Single action cylinders.
	System pressure reduction during inactive times.
	Minimise "dead volume" of tubes.
	System pressure reduction during active times.
	Isolation of unused channels during times of no operation.
Energy efficient cooling lubricant supply	Minimum Quantity lubrication
	Pressure control valves

2.4.5 Possible timescale for full implementation

Time will be required to write and publish checklists, although if this already began in 2014 it could be completed by 2015. Therefore, in 2015 PO-4 could be already in use.

The Consultation Forum is invited to comment on the technical content of the overarching additional Good Practice Design Checklist Policy Option, its feasibility and its added value.

3. DRAFT IMPACT ASSESSMENT FINDINGS – FINAL ELECTRICTY SAVINGS BY MACHINE TOOL SECTOR, TAKING INTO ACCOUNT APPLICABLE POLICY OPTIONS[18]

Annex E presents the draft modelling of final energy (electricity) consumption and savings, which has been undertaken analysing the appropriate Policy Options available for each overall sector within the remit of ENTR Lot 5 Machine Tools, i.e., Metal-working MT, Wood-working MT, Welding Equipment, and Stone and Ceramics-working MT.

It should be noted that wider economic and other factors have yet to be incorporated into the Impact Assessment Policy Options modelling and comparisons; hence, solely the relative final energy consumption figures are included.

Members of the Consultation Forum are invited to comment on the relevant advantages of the various Policy Options per particular sector within the overall product group of "Machine Tools". The Consultation Forum is also invited to contribute to the Impact Assessment study.

[18] Please note that these are draft energy consumption modelling considerations from the ongoing Impact Assessment.