# ANNEX E: DRAFT IMPACT ASSESSMENT ENERGY SAVINGS MODELLING PER MT SECTOR

## 1. OVERALL SCOPE AND POLICY OPTIONS

The overall scope of products covered in this project is represented by the Base Cases listed in Table 1. The Lot 5 preparatory study reviewed several types of classification resulting in a selection of 9 base cases that give a good representation of the great majority of different types and applications of MT (Machine Tools) found in practice. Additionally, a 10th base case was included in this project to represent stone and ceramics working MT.

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 |

It should be noted that although the base cases do not account for all the energy used by MT, this error is thought to be quite small in this overall product group, as previously described in the Final Report (August 2012) of the Lot 5 Preparatory Study (available at: http://www.ecomachinetools.eu/typo/reports.html).

### 1.1 Overview of policy options

There are four policy options (POs) that are appraised, and compared to "Business As Usual" (BAU). It should be noted that some of these are inter-related, and so 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 5-9*). It is assumed to be implemented in 2016 (tier 1).
- PO-2: Mandatory point scheme – covering metal-working as well as stone and ceramics working MT (*Base Cases 1-4 and 10*). The first tier for this PO will be implemented in 2016, and tier 2 and tier 3 will be implemented in 2019 and 2022 respectively.
- 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.

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

# 2. OVERVIEW OF ELECTRICITY CONSUMPTION UNDER DIFFERENT SCENARIOS

## 2.1 Overview of different scenarios

There are different scenarios discussed for different MT base-cases and are shown below:

- **Business as Usual (BAU)**: in this scenario, it is assumed that there will be no intervention of any energy saving technology until 2040 (the considered time horizon is 2012-2040). Hence, there will be no variation in unit MT energy consumption.
- **Mandatory Ecodesign Requirements (MER):** this scenario is a combination of different policy options, which are assumed to be implemented in 2016. The following energy savings potentials were considered for different base cases:
  - Metal-working MT - 5% (PO2+PO4)
  - Wood working MT - 5% (PO1+PO4)
  - Welding equipment - 5% (PO1+PO4)
  - Stone and ceramics working MT - it has been covered under PO2, but no quantification of possible energy savings is available yet. However, we would analyse this base-case by assuming 5% electricity savings under MER scenario (PO2+PO4), since its processes and operations are similar to metal-working MT.
- **Self-Regulatory Initiatives (SRI):** this scenario has been discussed as Policy Option 3 and is assumed to be implemented in 2016 in this analysis. The achievable (expected) energy saving potential considered for this scenario is 10% as discussed in Task 6 report of the Lot 5 preparatory study. This scenario has only been studied for metal-working MT (Base Cases 1-4).
- **Best Available Technology (BAT):** in this scenario, it is assumed that the best technology is available (starting from 2016) making possible the largest possible energy savings. The following considerations were made for different base cases:

  Metal-working MT
  - Base Case 1[2] – 23% possible electricity savings
  - Base Case 2[3] – 5% possible energy savings
  - Base Case 3[4] – 23% possible energy savings
  - Base Case 4[5] – 2.2% possible energy savings

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[2] BC1-8: the BAT savings are estimated on a modular basis. BC1: 23% savings are achievable by taking in to account factors such as: minimisation of non-productive time, 400V inverter systems to substitute 200V systems, regenerative feedback of inverter system (servo motor/spindle), controlled peripheral devices like mist extraction, and chip conveyer, single master switch-off, combination of several power electronics related measures, combination of several cooling lubrication system related measures, combination of several overall machine related measures, combination of several hydraulic system related measures, combination of several drive units related measures, optimised compressed air system with minimal losses, individual switched-off capability for specific modules and multi spindle-/ multi workpieces machining.

[3] BC2 : 5% savings are achievable by taking into account more efficient chiller units

[4] BC3: 23% savings are achievable by taking in to account factors such as: provide customer information to reduce consumption of resources, energy efficient pulse valves, optimisation of work piece processing by die tryout, avoid internal leakage, choice of the pump systems which match the requirement profile, controlled peripheral devices like mist extraction, scrap conveyer, etc, directed switch off of not needed branches, low flow rate for lubrication pump, apply the simultaneity factor when designing the power system, minimisation of moved masses, optimization of the overall machine design, use of energy efficient motors, match the pressure level to the load cycle and to the different actuators on the machine, combination of several control related measures, combination of several pneumatic system related measures, energy efficient valve connectors, use of pressure intensifiers for individual actuators which require higher pressure, lubrication flow depending on demand, intelligent drive management, pressure adjustment using pressure-controlled drive systems, displacement control systems, use of multi-pressure accumulator system for main axis.

Wood working MT

- Base Case 5[6] – 5% possible energy savings
- Base Case 6-8[7] – 26.5% possible energy savings

Welding equipment

- Base Case 9 – 12.2% possible energy savings (derivation explained in welding equipment section)

Stone and ceramics working MT

- Base Case 10 – no BAT identified yet

It is assumed that all policy options are implemented in 2016. The impact of different scenarios on electricity consumption of EU MT sector is discussed in the following subsections.

## 2.2 Scenarios for final electricity consumption over time of EU metal-working MT sector

Figure 1 presents the impact of different scenarios, which consist of one or a combination of several policy options. The policy impact scenarios are compared with business as usual scenario as shown below. Different BAT savings were assumed for each base-case (BC1-4), as shown in Figure 2.

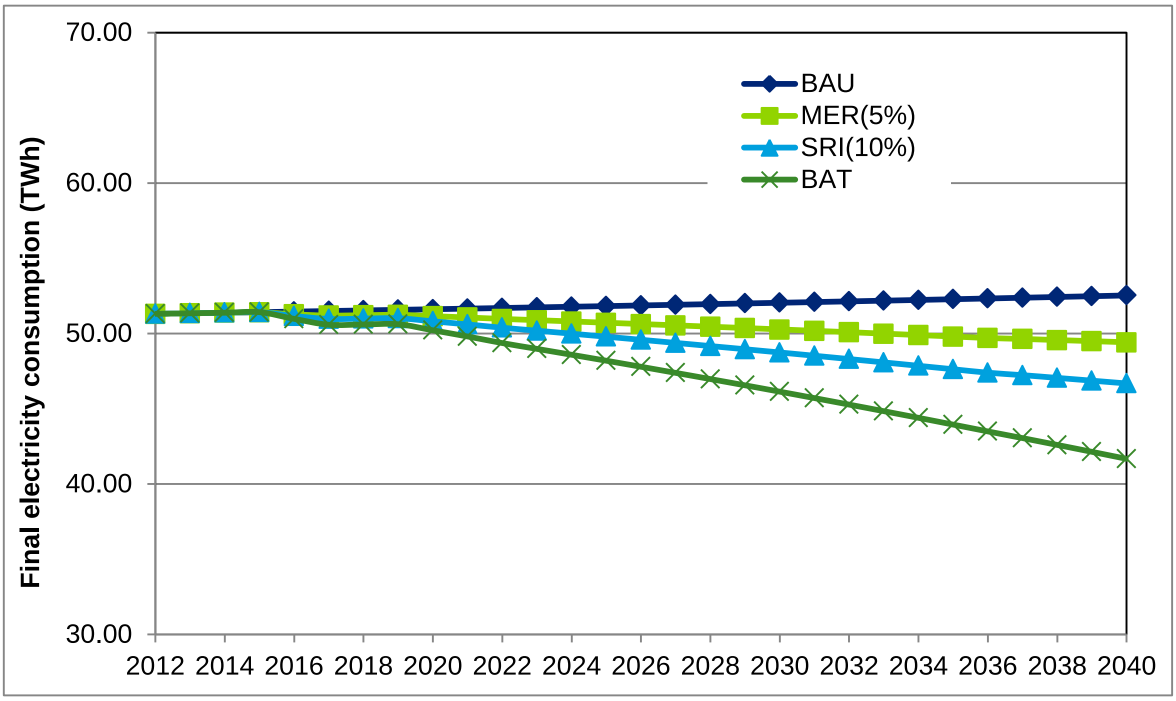


Figure 1: Final Electricity consumption over time under different scenarios for metal-working MT

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[5] BC4: 2.2% savings are achievable by taking into account a more efficient motor such as: IE3 motor instead of IE2.

[6] BC5: 5% savings are achievable by taking into account higher motor efficiency.

[7] BC6-8: 26.5% savings are achievable by taking into account factors such as: application specific design of drives, machine stand-by management, less parts to be moved, electrical clamping devices, optimised blowing nozzles, minimized pre-heated glue volume, combination of measures for improved electronics / power supply, load-dependent air table control, energy monitoring, efficient motors also <750 W, line controlled blow-off device to adapt air consumption to actual needs.

NB Regarding Figure 1 and metal-working MT, it should be note that the energy consumption figure presented here (and which is being used in the draft Impact Assessment study) has been calculated based on the actual data for year 2010 (as presented in the Lot 5 Preparatory Study), but updated for the year 2012, based on the latest statistics reported for year 2012, from CECIMO (2013).

The figures differ from the energy consumption statistics for 2012 in the Task 7 report of the Lot 5 Preparatory Study, which were based on estimates available at the time.

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All the scenarios were assumed to be implemented in 2016. The energy savings potential for BAT is the same as discussed in section 2.1. Figure 2 shows the BAT scenario electricity consumption for selected base cases, separately.

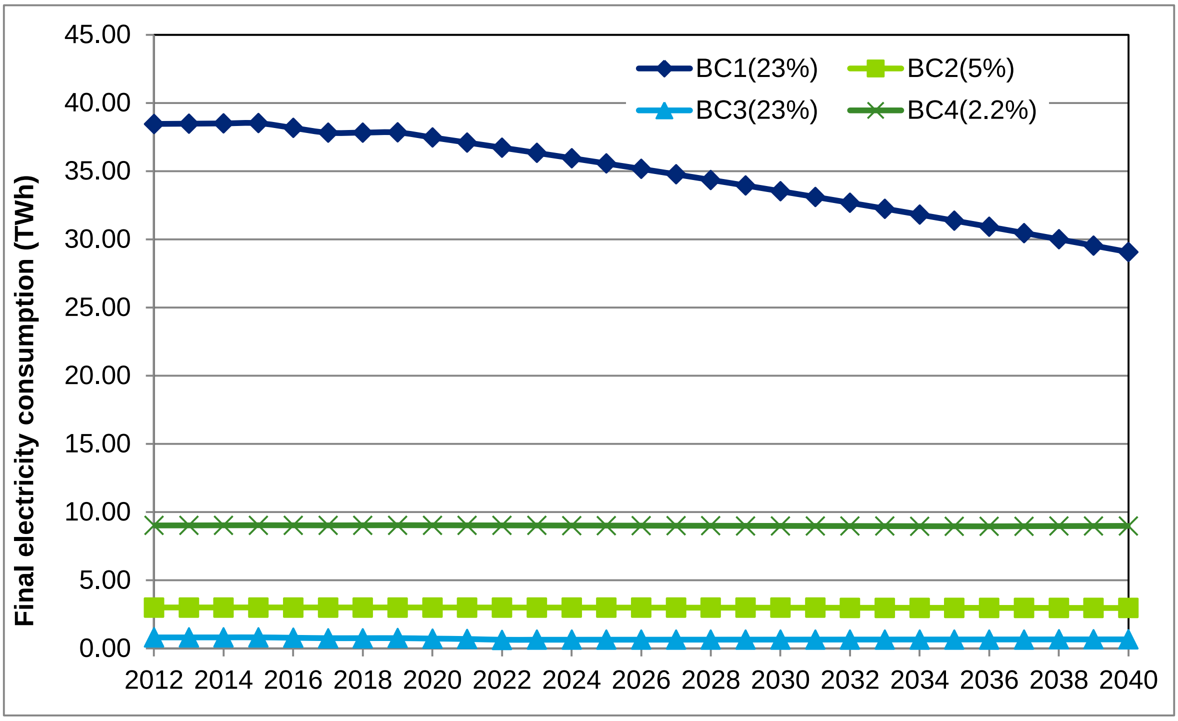


Figure 2: Final Electricity consumption over time under BAT scenario for selected metal-working MT base cases

Table 2 below presents the final electricity consumption under different scenarios for the overall EU metal-working MT sector for some key years.

| Scenario | Table 2: Metal-working MT – Final Electricity consumption (in TWh) under different scenarios over time | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2012 | 2016 | 2019 | 2022 | 2025 | 2030 | 2040 |
| **Business as Usual (BAU)** | 51.3 | 51.45 | 51.57 | 51.69 | 51.82 | 52.04 | 52.53 |
| **Mandatory Ecodesign Requirements (MER)** | 51.3 | 51.27 | 51.24 | 50.97 | 50.72 | 50.27 | 49.42 |
| **SRI** | 51.3 | 51.16 | 51.01 | 50.38 | 49.79 | 48.74 | 46.68 |
| **Best Available Technology (BAT)** | 51.3 | 50.97 | 50.62 | 49.36 | 48.19 | 46.13 | 41.67 |

## 2.3 Scenarios for electricity consumption over time of EU wood working MT sector

Figure 3 shows the impact of different scenarios, which consist of one or a combination of several policy options. The policy impact scenarios are compared with business as usual scenario as shown below.

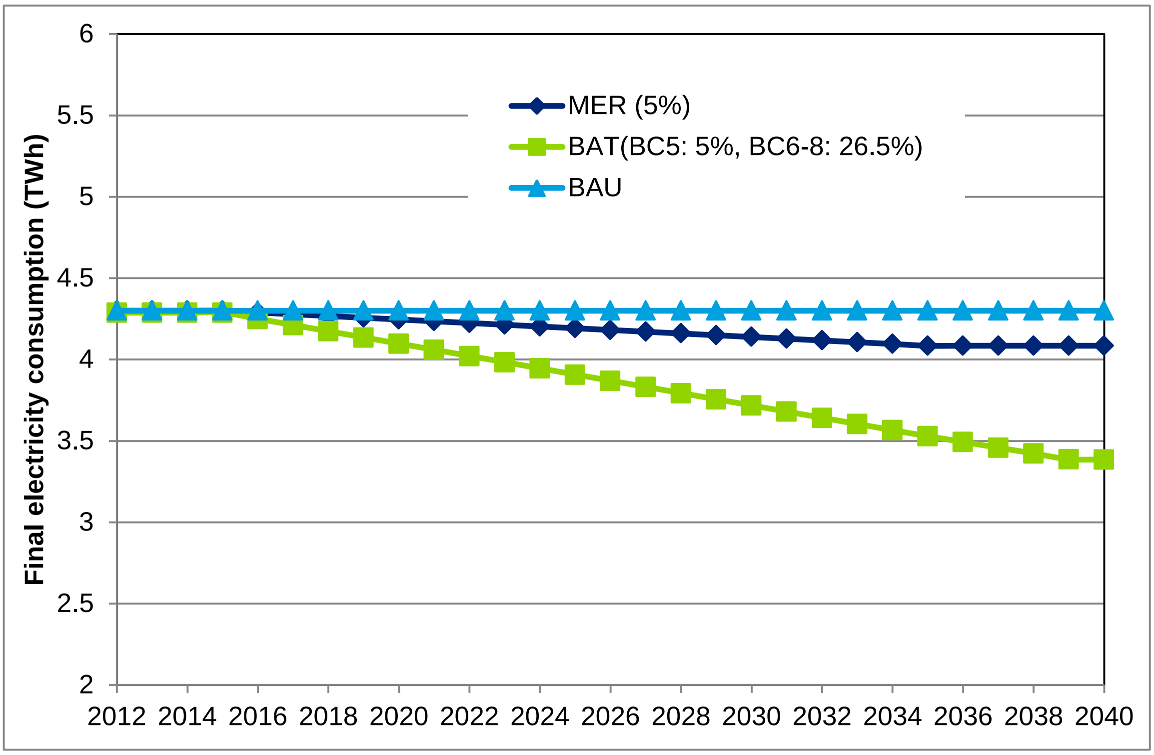


Figure 3: Final Electricity consumption over time under different scenarios for wood working MT

All the scenarios studied for wood working MT were assumed to have policy options implemented in 2016. The electricity consumption scenario (BAU) would be constant over the period 2016-2040 because there is no change in the wood working MT stock. All the sales that happen will be replacement of units in the stock, thus the electricity consumption is reduced from the year of implementation of the policy option.

Table 3 below presents the final electricity consumption under different scenarios for the overall EU wood working MT sector for some key years.

| Scenario | Table 3: Wood Working MT – Final Electricity consumption (in TWh) under different scenarios over time | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2012 | 2016 | 2019 | 2022 | 2025 | 2030 | 2040 |
| **Business as Usual (BAU)** | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 | 4.30 |
| **Mandatory ecodesign requirements (MER)** | 4.30 | 4.29 | 4.26 | 4.22 | 4.19 | 4.14 | 4.08 |
| **Best Available Technology (BAT)** | 4.30 | 4.25 | 4.14 | 4.02 | 3.91 | 3.72 | 3.39 |

## 2.4 Scenarios for electricity consumption over time of EU welding equipment sector

Figure 4 shows the impact of different scenarios, which consist of one or a combination of several policy options. The policy impact scenarios are compared with the business as usual scenario as shown below. The BAT (12.2%) scenario for welding equipment has been taken to be the same as discussed in Task 6 of the Lot 5 preparatory study[8], i.e. improvement potential for welding equipment using the combination of three options, such as:

- Option 1: Arc welding DC Power source efficiency 85% instead of an average 75%
- Option 2: 10% gas saving through a combination of state-of-the-art measures
- Option 3: Idle power consumption of less than 10 W

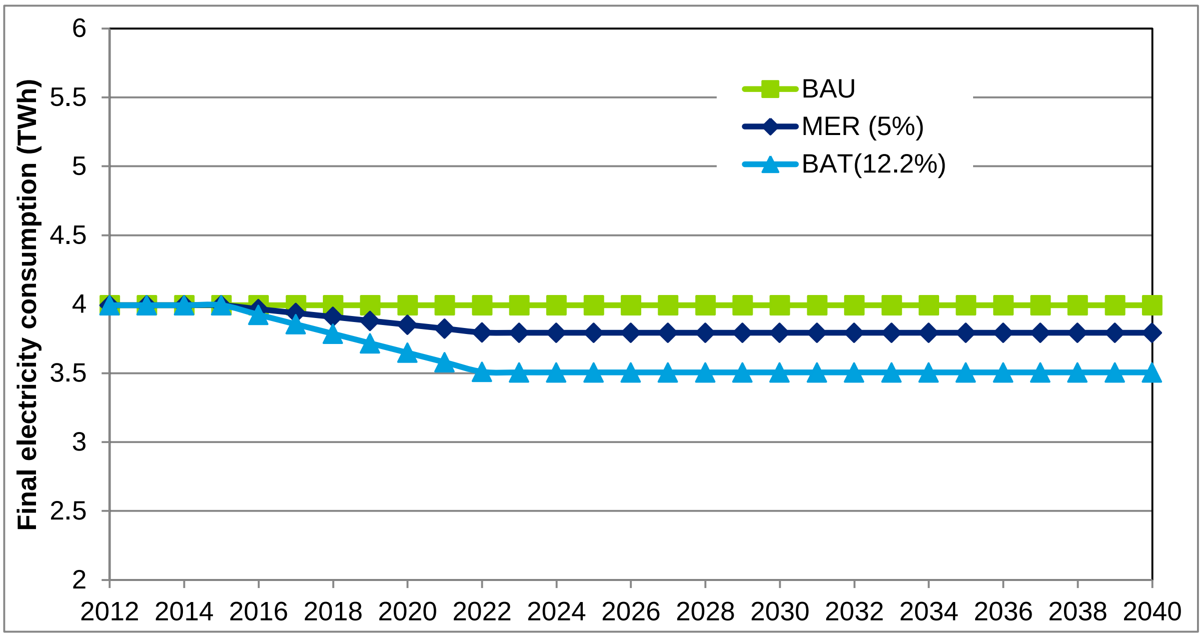


Figure 4: Final Electricity consumption over time under different scenarios - EU welding equipment sector

All the scenarios studied for welding equipment were assumed to have policy options implemented in 2016. The electricity consumption scenario (BAU) would be constant over the period 2016-2040 because there is no change in the welding equipment stock. All the sales that happen will be for replacement of units in the stock, thus the electricity consumption is reduced from the year of implementation of the policy option.

Table 4 below presents the final electricity consumption under different scenarios for the overall EU welding sector for some key years.

| Scenario | Table 4: Welding Equipment – Final Electricity consumption (in TWh) under different scenarios over time | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2012 | 2016 | 2019 | 2022 | 2025 | 2030 | 2040 |
| **Business as Usual (BAU)** | 3.99 | 3.99 | 3.99 | 3.99 | 3.99 | 3.99 | 3.99 |
| **Mandatory ecodesign requirements (MER)** | 3.99 | 3.96 | 3.88 | 3.79 | 3.79 | 3.79 | 3.79 |
| **Best Available Technology (BAT)** | 3.99 | 3.92 | 3.72 | 3.51 | 3.51 | 3.51 | 3.51 |

[8] Please refer to page 23 and 45 of Task 6 report, Lot 5 preparatory study

## 2.5 Scenarios for electricity consumption over time of EU stone and ceramics working MT sector

Figure 5 shows the impact of the minimum ecodesign requirement (MER) scenario, which is a combination of PO2 and PO4. The policy impact scenario is compared with the business as usual scenario as shown below.

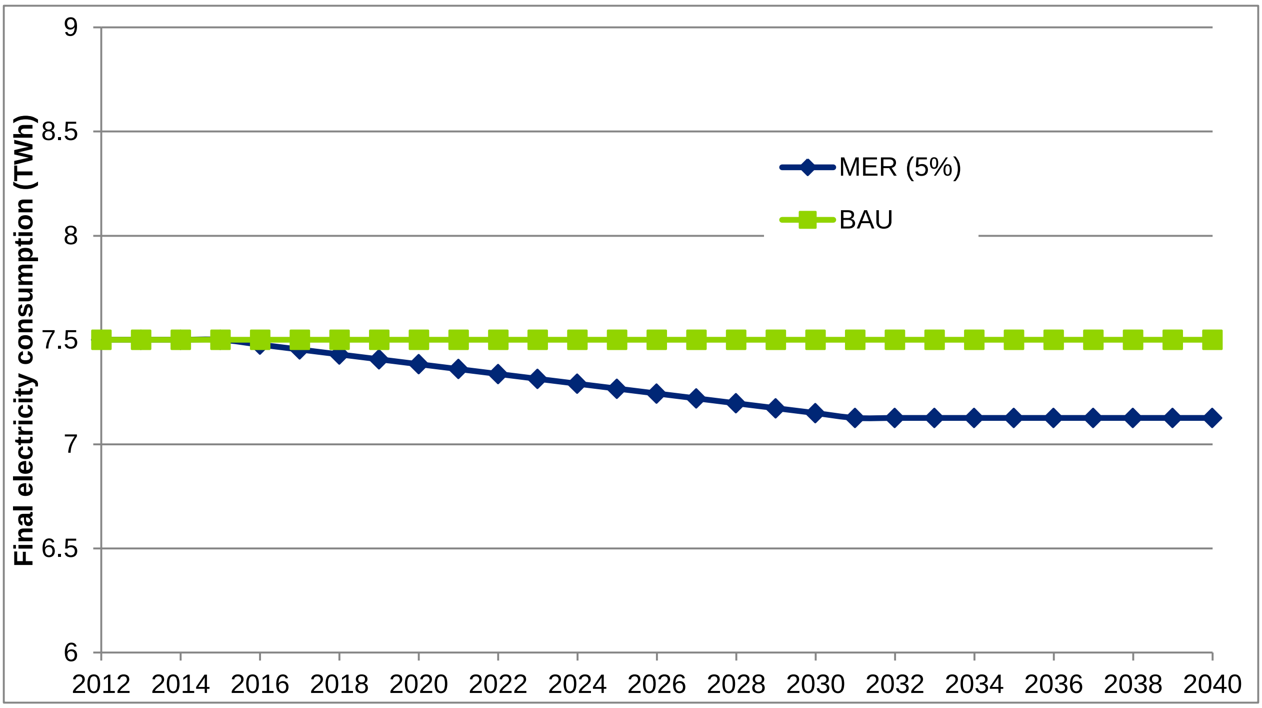


Figure 5: Final Electricity consumption over time under different scenarios for the Overall EU stone and ceramics working MT sector

The scenario (MER) shown above for the stone and ceramics working MT was assumed to be implemented in 2016. The electricity consumption (in BAU) would be constant over the period 2016-2040 because there is no change in the stone and ceramics MT stock. All the sales that happen will be for replacement of units in the stock, thus the electricity consumption starts to reduce from the year of implementation of the policy option.

No potential energy saving best available technologies (BAT) were identified for stone and ceramics working MT in the Lot 5 preparatory study. Owing to the similarities of the stone and ceramics working MT to some of the base cases within the metal-working MT, energy savings of 5% have been estimated. This figure may be refined if further data comes to light from stakeholders.

Table 5 below presents the final electricity consumption under different scenarios for the overall EU stone and ceramics working MT sector for some key years.

| **Scenario** | **Table 5: Stone & Ceramics working MT – Final Electricity consumption (in TWh) under different scenarios over time** | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2012 | 2016 | 2019 | 2022 | 2025 | 2030 | 2040 |
| **Business as Usual (BAU)** | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| **Mandatory ecodesign requirements (MER)** | 7.50 | 7.48 | 7.41 | 7.34 | 7.27 | 7.15 | 7.13 |

Table 6 below presents a summary of the total modelled final electricity consumption for all base cases, under different scenarios over time.

| Scenario | Table 6: Final Electricity consumption (in TWh) of EU MT sector under different scenarios over time | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2012 | 2016 | 2019 | 2022 | 2025 | 2030 | 2040 |
| **Business as Usual (BAU) for all base cases** | 67.09 | 67.25 | 67.36 | 67.49 | 67.60 | 67.84 | 68.32 |
| **Mandatory ecodesign requirements (MER) for all base cases** | 67.09 | 67.00 | 66.78 | 66.33 | 65.97 | 65.35 | 64.42 |
| **Self-regulatory initiatives (SRI: only for metal-working MT: BC1-4)** | 51.3 | 51.16 | 51.01 | 50.38 | 49.79 | 48.74 | 46.68 |
| **Best available technology (BAT, only for base cases 1-9)** | 59.58 | 59.14 | 58.47 | 56.90 | 55.60 | 53.36 | 48.56 |