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Preliminairy Study on Tertiary Hot Beverage Equipment

Standards, Energy Consumption and Effective Measures for Exploiting Saving Potentials






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EVA	European Vending Association
Ecodesign WP3	Preparatory Study to establish the Ecodesign Working Plan 2015-2017 implementing Directive 2009/125/EC

Abstract

In 2016, the European Commission has formally dropped tertiary hot beverage equipment from the Ecodesign Working Plan 3 (2015–2017). On three levels the decision is incomprehensible. Firstly, with 1.8 TWh of energy saving potential in 2030 the underlying preparatory study (2014) presented an unreasonable low figure. Secondly, similar products groups such as household coffee machines or refrigerated vending machines are in the regulation process further advanced. Thirdly, various voluntary measurement norms for different types of the tertiary hot beverage equipment are already available. This paper therefore revised the corresponding preparatory study (2014) and shows that with an energy consumption of more than 10 TWh per year (in EU-27 for 2030) and a saving potential of 4 TWh per year immediate measures are now needed. Especially high standby power values up to 190 W (!) and energy losses of more than 3 kWh a day per machine should be tackled by ecodesign requirement first. In the long run an energy label is most effective.

Since the next Ecodesign Working Plan 4 is not being expected before 2019/20, this paper wants to prepare the basis to exploit energy saving potentials of these machines in Switzerland and become a role model for the next Working Plan. Short-term measures include online product lists (based on EVA EMP 3.1b or DIN 18873-2) of the most energy-efficient models which can be used for (public) procurement. To motivate the purchase of energy-efficient machines, they should be supported by a financial support program such as ProKilowatt. In order to include all types of tertiary hot beverage equipment in these measures, independent test series of professional espresso machines (porta filter) are needed, since energy consumption figures are de facto missing. This is especially bad since these machines are assumed to have the highest energy consumption within the tertiary hot beverage equipment. Mid- and long-term measures comprise a harmonized measurement norm, a requirement for a maximum stanbdy power (incl. auto-off function) and a Swiss energy label such as the one for household coffee machines. If in Switzerland only energy-efficient tertiary hot beverage equipment was in use, we estimate that 1.3 TWh of energy could be saved over their entire lifetime, thus saving more than 200 million Swiss francs.

Zusammenfassung

Im Jahr 2016 hat die Europäische Kommission gewerbliche Heissgetränkebereiter vom Ecodesign Working Plan 3 (2015–2017) ausgeschlossen. Auf drei Ebenen ist die Entscheidung nicht nachvollziehbar. (1) Mit 1.8 TWh im Jahr 2030 an Einsparpotential für diese Gerätekategorie hat die zugehörige Vorstudie (2014) eine viel zu niedrige Zahl veranschlagt. (2) Ähnliche Produktekategorien wie Haushaltskaffeemaschinen oder Kaltgetränkeautomaten sind im Regulierungsprozess viel weiter fortgeschritten. (3) Schliesslich sind Messnormen für gewisse Unterkategorien der gewerblichen Heissgetränkebereiter bereits heute verfügbar. Dieser Bericht hat deshalb die entsprechende Vorstudie der EU von 2014 nochmals durchleuchtet und zeigt, dass diese Gerätekategorie eher rund 10 TWh pro Jahr (EU-27 für das Jahr 2030) an Strom verbraucht und von einem Einsparpotential von 4 TWh pro Jahr auszugehen ist. Sofortige Massnahmen für gewerbliche Heissgetränkebereiter sind somit angebracht. Insbesondere die enormen Standby-Werte von bis zu 190 W (!) und tägliche Energieverluste von mehr als 3 kWh pro Gerät sollten im Rahmen einer Ecodesign Anforderung als erstes angegangen werden. Langfristig ist ein Energielabel am effektivsten.

Da der Ecodesign Working Plan 4 nicht vor 2019/20 zu erwarten ist, will dieser Bericht die Energiesparpotentiale der gewerblichen Heissgetränkebereiter in der Schweiz ausschöpfen und somit als Vorbild für den nächsten Working Plan der Europäischen Kommission dienen. Kurzfristige Massnahmen umfassen online Produktelisten mit den energiesparendsten Modellen (Kriterien basierend auf EVA EMP 3.1b oder DIN 18873-2), welche für die (öffentliche) Beschaffung genutzt werden können. Um den Kauf von energieefffizienten Maschinen anzukurbeln, sind Förderprogramme wie z. B. ProKilowatt zu begrüssen, welche finanzielle Anreize schaffen. Um alle Unterkategorien der gewerblichen Heissgetränkebereiter in den Effizienzmassnahmen anzugehen sind unabhängige Testserien von professionellen Gastrokaffeemaschinen (Siebträger) erforderlich, da die Energieverbrauchszahlen von diesen Geräten de facto fehlen. Dies ist insbesondere problematisch, weil diese Geräte innerhalb der gewerblichen Heissgetränkebereiter den höchsten Energieverbrauch aufweisen. Mittel- und langfristige Massnahmen beinhalten eine harmonisierte Messnorm, Mindestanforderungen für einen maximalen Standbyverbrauch (inkl. Auto-off Funktion) und ein Schweizer Energielabel analog dem Label für Haushaltskaffeemaschinen. Wenn in der Schweiz energieeffizientere gewerbliche Heissgetränkebereiter in Gebrauch sein würden, kann rund 1.3 TWh an Energie über deren Lebensdauer eingspart werden – dies einspricht einer Einsparung von mehr als 200 Millionen Schweizer Franken.

Résumé

En 2016, la Commission Européenne a retiré les préparateurs de boisson chaude du Working Plan 3 d'Ecodesign (2015–2017). Pour différentes raisons cette décision n'est pas fondée. Premièrement, avec une économie d'énergie de 1,8 TWh en 2030 le Preparatory Study présente une valeur d'économie d'énergie extrêmement basse. Deuxièmement, des produits similaires telles que les cafetières pour usage privé ou les distributeurs automatiques réfrigérée sont dans le processus législatif ils sont en train d'avancer. Troisièmement, il existe déjà plusieurs normes de mesures volontaires pour différents types de préparateur de boisson chaude. Cette étude revoit les résultats de l'étude préparatoire Européene et montre qu'avec une consommation de 10 TWh par année et un potentiel d'économie d'énergie de 4 TWh par années, des mesures immédiates sont nécessaires. En particulier pour le taux de stand-by qui peut arriver jusqu'à 190 Watt (!) et qui représente une perte de plus de 3 kWh par jour et par machine, il est important d'imposer des critères Ecodesign. Sur le long terme une étiquette énergétique a le plus d'impact.

Étant donné que le prochain Working Plan 4 Ecodesign n'est pas attendu avant 2019-2020, la présente étude souhaite préparer le terrain pour atteindre des économies d'énergie pour ces machines en Suisse et devenir un modèle pour le prochain Working Plan. Les mesures à court-terme inclues une liste de produits (basé sur EVA EMP 3.1b ou DIN 18873-2) des produits les plus efficient qui peut être utilisé pour l'achat (publique) à grande échelle. Afin d'inciter l'achat des produits à basse consommation énergétique, c'est derniers devraient être soutenus par un programme de subventions tel que le programme ProKilowatt. Pour inclure tout type d'équipements de préparation de boisson chaude dans ses mesures, il est nécessaire d'organiser une série de tests indépendants de machines professionnelles à expresso, étant donné que les données concernant la consommation énergétique manquent. Les mesures à moyen et long terme comprennent une norme de mesure harmonisante, une limitation de la consommation en mode stand-by et une étiquette énergétique Suisse similaire à l'étiquette énergétique pour les machines à café à usage privé. Si en Suisse il n'existait que des préparateurs de boissons chaudes efficients, nous estimons que 1,3 TWh pourrait être sauvegardé sur la durée de vie du produit économisant plus de 200 millions CHF.

Riassunto

Nel 2016 la Commissione Europea ha deciso di escludere dall'Ecodesign Working Plan 3 (2015 – 2017) gli apparecchi professionali per la preparazione di bevande calde. Questa decisione è incomprensibile per tre ragioni. Innanzitutto, assumendo per questi apparecchi un potenziale di risparmio energetico di 1.8 TWh nel 2030, lo studio preparatorio stima un valore di risparmio energetico troppo basso. In secondo luogo prodotti simili come le macchine da caffè per uso privato o i distributori automatici refrigerati sono in una fase avanzata del processo di regolamentazione. Infine per diversi tipi di preparatori professionali di bevande calde esistono già ora norme di misurazione volontarie. Questo studio corregge i risultati dello studio preparatorio europeo dimostrando che, con un consumo energetico di più di 10 TWh per anno (EU-27 in 2030) e un potenziale di risparmio di 4TWh per anno, è opportuno che vengano prese delle misure immediate. In particolare, siccome l'alto consumo in stand-by può arrivare fino a 190 W (!) e risultare in una perdita di energia di più di 3 kWh per giorno per macchina, è importante che questi prodotti vengano sottomessi a criteri di Ecodesign. Nel lungo termine un'etichetta energetica avrà l'impatto più marcato.

Siccome il prossimo Ecodesign Working Plan 4 non apparirà prima del 2019-2020, questo studio vuole preparare il terreno per sfruttare il potenziale di risparmio energetico di questi apparecchi in Svizzera e rappresentare un esempio pratico per il prossimo Working Plan. Le misure di intervento a breve termine comprendono una lista di prodotti a basso consumo energetico (basata su EVA EMP 3.1b o DIN 18873-2), il cui acquisto viene incentivato nell'ambito di progetti pubblici. L'acquisto di apparecchi efficienti può venir favorito da misure di sostegno finanziario come nel caso del programma Prokilowatt. Per includere tutti i tipi di apparechi professionali di preparazione di bevande calde in un tale programma sono necessari test indipendenti, in particolare sulle macchine professionali da caffè siccome le informazioni sul consumo energetico a loro riguardo sono carenti. Ciò è molto importante perché si suppone che queste macchine presentino il consumo energetico più elevato fra tutti gli apparecchi per bevande calde. Misure da adottare sul medio e lungo termine comprendono norme di misurazione armonizzate, una limitazione del consumo energetico in stand-by e un'etichetta energetica svizzera simile a quella per le macchine da caffè per uso privato. Se in Svizzera si utilizzassero apparecchi professionali per bevande calde più efficienti stimiamo che si potrebbero risparmiare 1.3 TWh di elettricità durante la durata di vita degli apparecchi, ciò significa un risparmio di più di 200 milioni CHF.

Introduction

After the announcement that the European Commission has abandoned tertiary hot beverage equipment from the Ecodesign Working Plan 3 (2015–2017), Topten International has conducted a brief plausibility check of the underlying preparatory study [1]/ [2]. The estimated energy saving potential of 1.8 TWh per year (in 2030 in the EU) seems far too low and is rather twice the figure. Since on the European level no new regulations are expected before the next Working Plan 4 (2019/2020), this paper wants to prepare the basis to exploit the energy saving potential of these machines in Switzerland and set an example for the next European Working Plan 4.

Chapter 1 begins with the terminology and typology of the tertiary hot beverage equipment. It will then present the current state of the EU regulations of similar products. This chapter also gives insights into the Swiss market with its rather high machine base. To compare tertiary hot beverage equipment in terms of energy consumption there is a need for measurements standards and declarations; Chapter 2 will present the current situation and briefly compare these. Chapter 3 then revises the energy consumptions and saving potentials on the European level of the Ecodesign WP3. Additionally, it will estimate these figures for Switzerland. Finally, chapter 4 will highlight the findings of this paper and present effective measures that need to be taken.

1. Current Situation: Regulations & Market

1.1 Typology

The Ecodesign WP3 categorizes the tertiary hot beverage equipment into three groups [3]. (1) Free-standing hot beverage machines, (2) table-top hot beverage machines, and (3) professional espresso machines.

(1) Free-Standing Hot Beverage Machine	**(2) Table-Top Hot Beverage Machine**	**(3) Professional Espresso Machine**
		
Coffeetek NEO	Franke FCS4026	Reneka LIFE

Table 1: Typologies of Tertiary Hot Beverage Equipment

Free-standing hot beverage machines and table-top hot beverage machines are fully-automatic which means that the user presses a button and the coffee is prepared. Professional espresso machines on the other hand need to be prepared manually with a porta filter. These machines are therefore only

used in restaurants, bars and hotels with the according staff. Furthermore, professional espresso machines don't have a built-in grinder.

In terms of coffee type, free-standing as well as table-top hot beverage machines are available for instant, ground and bean coffee which means that some have a built-in grinder. Both machine types offer a broad range of hot drinks such as coffee, tea, chocolate and some dispense foamed milk. Free-standing hot beverage machines are designated for busy places and include a vending function. In the table-top category there are vending and non-vending machines available. Table-top hot beverage machines are designated for offices and gastronomy; they have an average throughput of 5 to 50 litres/day.

A more detailed classification can be found on the Energy Star website in their Product Specification for Commercial Coffee Brewers (Version 1.0, Oct. 2016), see Table 2 [4].

	Type I: Single Serving Commercial Coffee Brewer	**Type II: Batch Commercial Coffee Brewer**	**Type III: Bulk Commercial Coffee Brewer**
Standard Brew Volume	6 to 24oz.	>24 to 384oz.	>384oz.
Type of Machines	– Bean-to-Cup – Liquid Coffee Dispensers – Powdered Drink Dispensers – Espresso Machines	– Re-usable or Single-use Coffee Filter Machines (with loose, ground coffee)	– Urn Coffee Brewers – Satellite Coffee Brewers

Table 2: Typologies of Commercial Coffee Brewer Products According to Energy Star

The product specification of Energy Star also includes types of coffee machines which are not considered in the Ecodesign WP3 such as batch and bulk commercial coffee brewers which seem to be more popular in the United States[1], see Table 3. Batch commercial coffee brewers have a brew volume capacity of 24oz. – 384oz. which is about 0.7 – 11.5 litres. Bulk commercial coffee brewers have a brew volume capacity larger than 11.5 litres [4].

[1] See also the press release of Energy Star "Commercial Coffee Brewers Now Eligible" from July 27th 2016 at https://www.energystar.gov/about/content/commercial_coffee_brewers_now_eligible

Batch Commercial Coffee Brewer	Bulk Commercial Coffee Brewer: Satellite Coffee Brewer	Bulk Commercial Coffee Brewer: Urn Coffee Brewer
		
Bloomfield Koffee King 3	Bloomfield Pourover Airpot	West Bend Coffee Urn

Table 3: Examples of Batch and Bulk Commercial Coffee Brewers

1.2 EU Regulations

After dropping the tertiary hot beverage equipment from the Ecodesign WP3 no regulations regarding the energy consumption for tertiary hot beverage equipment will be in place in the near future. Other, similar product groups are in the regulation process further advanced.

Tertiary hot beverage equipment comprises hot vending beverage machines (for offices and public spaces) and professional espresso machines (used in restaurants and bars). Refrigerated vending machines for example are covered in the EuP Lot 12: Commercial Refrigerators and Freezers [5]. The ecodesign requirements and an energy label are in planning [1]. The European Committee for Standardisation (CEN) and the European Committee for Electrotechnical Standardisation (CENELEC) will ratify the measurement of energy consumption of vending machines in 2018 in the norm EN 50597:2017 [6].

Non-tertiary coffee machines (excluding commercial use) are included in the Commission Regulation No 801/2013 which covers requirements on standby for coffee machines [7]. Since 2015 an ecodesign requirement regulates the delay time after which the coffee machine switches automatically into standby and off-mode [7]. Currently the maximum standby consumption is 0.5 W (1 W for products with a display), this is regulated by the Commission Regulation No 1275/2008 [8]. However, the final report on the review study of the Standby Regulation (2017) proposes to lower the maximum standby to 0.2 W [9]. Still, an energy label for coffee machines in the EU is missing.

In Switzerland, there is a mandatory energy label since 2017 effective for coffee machines which is regulated by the Swiss Federal Energy Ordinance SR 730.01 [10]. The methods for measuring the performance of electric household coffee makers are defined in the norm EN 60661 [11]. Energy efficiency classes range from A+++ to D. The allocation depends on the absolute power consumption thus measuring not only the cooling and reheating of water but also the standby consumption.

The advanced regulative situation for similar product groups and the energy label for household coffee machines in Switzerland indicate how a regulation for the energy consumption of tertiary hot beverage equipment could look like.

1.3 Market & Segmentation

According to the European Vending Association (EVA) Switzerland has a total machine base of 102'000 vending machines [12]. Compared to Europe (62%), Switzerland has a higher share of hot vending machines (71%); resulting in about 72'000 machines for 2015. 43% of all hot beverage vending machines in Switzerland are free-standing (31'000) and 57% are table-top types (41'000).

For table-top non-vending machines we follow the Ecodesign WP3 assumption that these types "*represent about 5% of the market of hot vending machines*" [3], which results in 3'500 machines for Switzerland. Finally, we assume that there is at least one professional espresso machine in each restaurant, café and bar in Switzerland, we rely on the figures from the Swiss Federal Statistical Office which lists 32'000 gastronomic enterprises in 2011 [13].

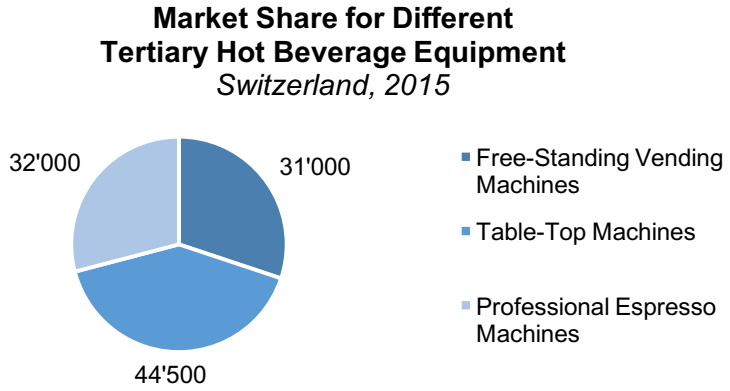

Figure 1: Market Share for Different Tertiary Hot Beverage Equipment (Switzerland, 2015)

The total machine base for tertiary hot beverage equipment is estimated in Switzerland at about 110'000 whereas each type represents roughly about 1/3 of the market (see Figure 1).

EVA estimates that about 80% of all vending machines are located in the workplace [12]. This results in about 58'000 hot beverage vending machines in Swiss workplaces. The Swiss Vending Association estimates that the machine base of non-private equipment (renting and operating) is at 24'000 hot beverage vending machines (see Annex A). Thus, 48'000 hot beverage vending machines are privately-owned in Switzerland.

1.4 Actors

According to the Swiss Vending Association, only one company still produces free-standing vending machines (Braumann AG) in Switzerland. For table-top and professional espresso machines there are several more manufactures. Especially for fully automatic machines, Swiss manufacturers seem to be world leaders [14]. The largest manufacturers are [15]:

– Cafina (Melitta)

– Franke Coffee Systems AG

– Schaerer AG

– Thermoplan AG

– Egro Coffee Systems AG

– HGZ Maschinenbau Zurich

These manufacturers also have their own regional showrooms and sell their machines directly usually with yearly service contracts for maintenance and repair. Besides these Swiss manufacturers and suppliers also the Italian company La Cimbali is an important market player for professional espresso machines in Switzerland. Further smaller retailers with online shops are GastroHeld, Leomat AG or IntroGastro GmBH.

Table-top and professional espresso machines are mainly found in restaurants and hotels. The largest restaurant operators can be found in the GastroSuisse report [13]:

Group	Number of Branches	Total Revenue in Mio. CHF
McDonald's	150	718
Migros	219	666
SV Group AG	299	436
Groupe DSR	256	286
Coop Genossenschaft	202	254
Compass Group AG	300	240
ZFV-Unternehmungen	134	204

Table 4: Largest Restaurant Operators in Switzerland (2012)

Companies also have the possibilities to rent or let the vending machine be operated by vending operators. Largest operators in Switzerland are selecta AG, Dallmayer and Nurissa. Areas for vending services are typically office spaces, petrol stations, airports or public places incl. railway stations, universities, schools or hospitals.

2. Measurement & Declaration Standards

Due to the very diverse product types of the tertiary hot beverage equipment it is not surprising that there are different measurement standards for these machines. This chapter will present five different standards and briefly compare them.

2.1 EVA EMP 3.1b

The European Vending Association (EVA) is an industry organisation for the coffee service and vending machine industry. The association has developed the measurement protocol EVA EMP 3.1a & 3.1b for the energy consumption in vending and dispensing machines [2] [3]. The measurement standard is also the basis for their voluntary, self-declared energy label with a consumption scale from

[2] The latest version (Oct. 2016) of the EVA energy measurement protocol can be requested on their website http://www.vending-europe.eu/en/standards_protocols/

A++ to G (see Figure 2). EVA EMP 3.1a is the measurement standard mainly for commercial refrigerators and freezers whereas EVA EMP 3.1b is targeted at hot vending machines (incl. machines which provide hot and cold drinks at the same time). Since refrigerated vending machines are covered in the EuP Lot 12 the EVA EMP 3.1a will be fully replaced by the official European energy measurement standard EN 50597 in the course of 2018 [6]. A similar approach for hot vending machines is not planned by the EU in the near future.

In contrast to EVA EMP 3.1a the measurement standard EVA EMP 3.1b not only comprises the energy consumption in idle mode but also measures the energy consumption for preparing and delivering a drink. The test in fact measures seven different phases (e.g. heat-up and vending phase). The energy rating class is based on the productive energy for preparing one litre of the vending drink and the energy use during idle mode (over 24h) divided by the daily output amount in litres. These two figures yield to the total energy consumption (in Wh/l) for the tested vending machine (see Figure 2). For a class rating A++ the machine must have a total energy consumption of less than 100 Wh/l and for A+ less than 140 Wh/l. The energy class limits can be found in the Annex B.

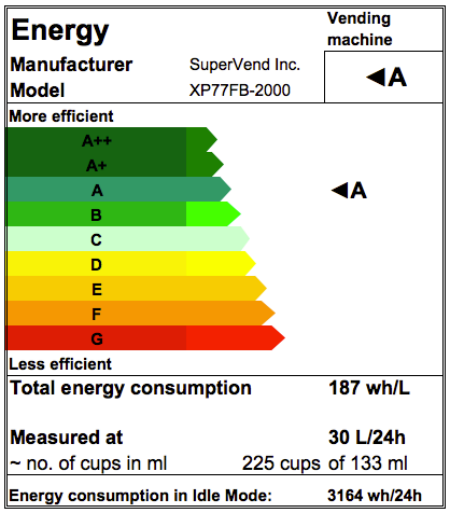

Figure 2: Energy Label According to EVA EMP 3.1b

2.2 DIN 18873-2

The German Institute for Standardisation provides the measurement standard DIN 18873-2 “Methods For Measuring Of The Energy Use From Equipment For Commercial Kitchens - Part 2: Commercial Coffee Machines”. It targets fully automatic table-top machines and professional espresso machines (porta filter). The norm measures the energy losses per day (kWh) which includes the energy for cleaning and rinsing. It separately measures the energy loss (idle mode) of the refrigerator systems for milk [16]. The productive energy for producing the drink (e.g. coffee) is not considered [3]. The DIN standard does not have an energy efficiency scale nor is it used for any energy labelling.

The DIN 18873-2 is mainly used by the German Industrial Association of House, Heating and Kitchen Technology (HKI). HKI lists the energy consumption data for around 75 professional table-top coffee machines on their website [3], see Annex E. Values for professional espresso machines are still missing.

2.3 Energy Star 1.0 Commercial Coffee Makers

In July 2016 the US Environmental Protection Agency (EPA) finalized the Energy Star specification for commercial coffee brewers [17]. At the moment of writing, only the Program Requirements Product Specification for Commercial Coffee Brewers are available. As a first step, Energy Star will focus on batch commercial coffee brewers (see Table 3). As soon as the data of their energy use becomes available further types will come into scope. Currently, Energy Star only provides energy efficiency requirements for batch commercial brewers with a brew volume capacity of 0.7 – 11.5 litres, see Table 5.

[3] Online database of HKI can be found at http://grosskuechen.cert.hki-online.de/de/geraete-nach-typ/liste?typ=Heissgetraenkebereiter

Normalized Ready-to-Brew Idle Energy Rate	Normalized Heavy-Use Brew Energy Rate
≤ 65 watts/gal [4]	≤ 280 watt-hrs/gal [3]

Table 5: Energy Efficiency Requirements of Energy Star for Type II Commercial Coffee Brewers

The Energy Star test method is based on the ASTM F-2990-1 “Standard Test Method for Commercial Coffee Brewers”. The test method only covers Type I and Type II coffee brewers (see chapter 1.1). Type III and espresso machines are excluded.

2.4 ENAK Measurement Standard for Fully Automatic Professional Coffee Machines

ENAK is a Swiss association for the promotion of energy-efficient commercial equipment within the hotel industry, gastronomy and community catering. The association is supported by the Swiss Federal Office of Energy. ENAK develops uniform methods to measure the energy consumption of commercial catering equipment and provide a database for their members. Each member is invited to test its machine according to their test method and upload the data.

ENAK has also a measurement standard for fully automatic professional coffee machines (table-top non-vending machines)[5]. Four energy consumption measurements are defined which are tested in a row:

– Energy consumption for heating up (until ready-to-operate) [kWh]

– Energy consumption for staying one hour in standby mode [kWh]

– Energy consumption for preparing 60 coffees [kWh]

– Energy consumption for cleaning [kWh]

2.5 EN 60661

The Swiss energy label for coffee machines is based on the norm EN 60661 “The methods for measuring the performance of electric household coffee makers” [11]. The label indicates the energy class which is calculated on the yearly total energy consumption. The measurement standard is separately defined for pressure coffee makers (incl. capsule/pad machines) and filter coffee machines. A test procedure for pressure coffee makers includes not only the coffee period but also the steam function, standby mode, off mode, rinsing and grinding. The procedure for filter coffee machines includes besides the energy consumption for the coffee period also the consumption in standby and off mode. Thanks to the idle phases in the test procedure also the insulation quality of the tank is integrated.

[4] 1 gallon corresponds to 3.79 litres

[5] Measurement standards are available for members at http://www.enak.ch/de-ch/downloadsdeutsch/downloadberich.aspx

2.6 Comparing Measurement and Declaration Standards

Five different measurement methods have briefly been presented. Unfortunately, none of them have been applied to all types of the tertiary hot beverage equipment so far. Since all test methods use different parameters (e.g. productive vs. idle energy use) it is also difficult to compare the figures. A further flaw is the heterogeneous use of terminologies. Some measurement standards use *idle* and *standby mode* (EVA EMP, DIN 18873-2), Energy Star only refers to *idle mode* and the EN 60661 operates with *standby* and *off mode*.

If the goal is to have one energy label as soon as possible for all machines types of the tertiary hot beverage equipment, then using EVA EMP 3.1b or DIN 18873-2 as underlying measurement standards seems one possible option. EVA EMP 3.1b is already widely adopted for free-standing vending machines and DIN 18873-2 for table-top machines.

DIN 18873-2 has the advantage that as of 2016, its measurement standard includes also professional espresso machines (porta filter), therefore it would cover all machine types. Nevertheless, measurement figures for professional espresso machines and free-standing machines are not yet found. Furthermore, the test procedure seems easier since the actual preparing (and vending) functions don't need to be tested. Testing only the energy loss is especially easier for professional espresso machines where replacing the porta filter 60 times in a row and testing additional features (touch displays, vending options, built-in grinders etc.) are complicated. It is debatable if the productive energy – which is especially relevant for high-use machines (see for example the different efficiency requirements for normal and heavy-use machines of Energy Star in Table 5) – should to be included in the norm.

On the other side, EVA EMP 3.1b measures the productive energy and has already a voluntary energy label. A major current drawback is that it is only targeted at vending machines. In order to cover all types of tertiary hot beverage equipment it needs a revision for professional espresso machines. It is questionable if a revision that would include non-vending machines is of interest to the European Vending Association. For revising EVA EMP 3.1b or for creating a new measurement standard, the EN 60661 serves as a good example. It covers the different phases of a machine (productive and idle modes), defines according to different types of machines the appropriate test procedures and provides one single energy rating value for each type – independent of their maximum output capacity.

3. Energy Consumption & Saving Potentials

To evaluate the total energy consumption and saving potential of tertiary hot beverage equipment this chapter will calculate the energy consumption per year per typology (individual level), the energy consumption of each typology taking the machine base in to account (aggregated level) and the saving potentials for each typology. The estimates will be given separately for the EU and Switzerland.

3.1 Energy Consumption in EU & Switzerland

Since data on free-standing, table-top vending and professional espresso machines is very scarce, we must partly rely on the data provided by the Ecodesign WP3 [3]. We rely fully on their stocks and sales data for EU but the energy consumption figures have been revised (see Table 6).

The figures of the Ecodesign WP3 for free-standing vending machines seem reasonable [6]. For table-top vending machines however we added a 150 kWh/year per machine since the standby power during weekends wasn't included[7]. For professional espresso machines, we added 200 kWh/year per machine since the standby power on Sundays wasn't included[8]. Finally, the energy consumption for table-top non-vending machines seems too low. The study relies on an average of 300 kWh/year of energy losses. This is just a fraction of the very similar table-top vending machines which are at 950 kWh/year. Consulting the ENAK list of table-top non-vending machine (see Annex C), we rather estimate also a 950 kWh/year for these machine types. Multiplying the average final energy consumption in use phase of each machine type with the stock data, tertiary hot beverage equipment will use a total of 10.3 TWh a year in 2030 (which is 7% more than the Ecodesign WP3 estimates).

EU-27	Year	Free-Standing Vending Machine	Table-Top Vending Machine	Table-Top Non-Vending Machine	Professional Espresso Machine	Total
Stock (1'000)	2012 2020 2030	770 775 750	1'430 1'650 1'800	100 110 125	1'460 1'500 1'680	3'760 4'035 4'355
Average Final Energy Consumption in Use Phase (per Year)	-	2'350 kWh	950 kWh	950 kWh	3'950 kWh	-
Total Energy Consumption in Use Phase (per Year)	2012 2020 2030	1.8 TWh 1.8 TWh 1.8 TWh	1.4 TWh 1.6 TWh 1.7 TWh	0.1 TWh 0.1 TWh 0.1 TWh	5.8 TWh 5.9 TWh 6.6 TWh	**9.0 TWh** **9.4 TWh** **10.3 TWh**

Table 6: Total Energy Consumption for Tertiary Hot Beverage Equipment in EU-27

Using the market data from chapter 1.3 and assuming the same trends for 2020 and 2030 as in the EU, we can calculate the total energy consumption of tertiary hot beverage equipment in Switzerland. The total energy consumption is at 270 GWh per year (2030).

[6] They assume that vending machines have an average consumption of 215 Wh/l. Energy consumption for free-standing machines is calculated for 30 litres/day at 365 days.

[7] For table-top vending machines the WP3 study team also used average consumption of 215 Wh/l, calculated for 15litres/day at 250 days. We added 115 days at 50 Wh for the night-standby mode on weekends and during holidays.

[8] We included the night-time idle energy use of 3.9 kWh for each Sunday [21].

CH	Year	Free-Standing Vending Machine	Table-Top Vending Machine	Table-Top Non-Vending Machine	Professional Espresso Machine	Total
Stock (1'000)	2012 2020 2030	31 31 30	41 47 52	3.5 3.8 4.4	32 33 37	110 115 123
Average Final Energy Consumption in Use Phase (per Year)	-	2'350 kWh	950 kWh	950 kWh	3'950 kWh	-
Total Energy Consumption in Use Phase (per Year)	2012 2020 2030	72.9 GWh 72.9 GWh 70.5 GWh	39.0 GWh 45.0 GWh 49.0 GWh	3.3 GWh 3.6 GWh 4.2 GWh	126.3 GWh 130.0 GWh 146.0 GWh	**241.4 GWh** **251.4 GWh** **270.0 GWh**

Table 7: Total Energy Consumption for Tertiary Hot Beverage Equipment in Switzerland

3.2 Energy Savings in EU & Switzerland

Even if some energy consumptions in the Ecodesign WP3 were too low, overall estimates are rather accurate. The energy saving potentials on the other hand are set too low.

For free-standing and table-top vending machines Ecodesign WP3 estimates a saving potential of 35%. By contacting manufactures directly and checking their product sheets online, we calculated an average of 128 Wh/l for A+ machines (see Annex D). Compared to the average consumption of 215 Wh/l of the current machine base, the improvement potential is at least 40%.

For table-top non-vending machines the saving potential has been estimated only at 15%. This figure is not supported by actual data but is only based on cited statements from manufacturers [3]. When consulting the HKI database, which calculates the energy loss acccording to DIN 18873-2, it can be easily seen that huge differences between the table-top machines are apparent. Each dot in Figure 3 represents a table-top machine located at its capacity for preparing coffees within one hour. Not only do machines with a higher capacity have a higher energyloss (dotted trend line), but also there are large differences within the same product category (based on coffee output). The saving potential ranges from 35 – 87%, see Table 8. A similar figure can be obtained by comparing the ENAK database which reports the energy consumption (kWh) for preparing 60 cups of coffees (Annex C). We conclude therefore that an improvement potential of 40% is also a safe figure for table-top non-vending machines.

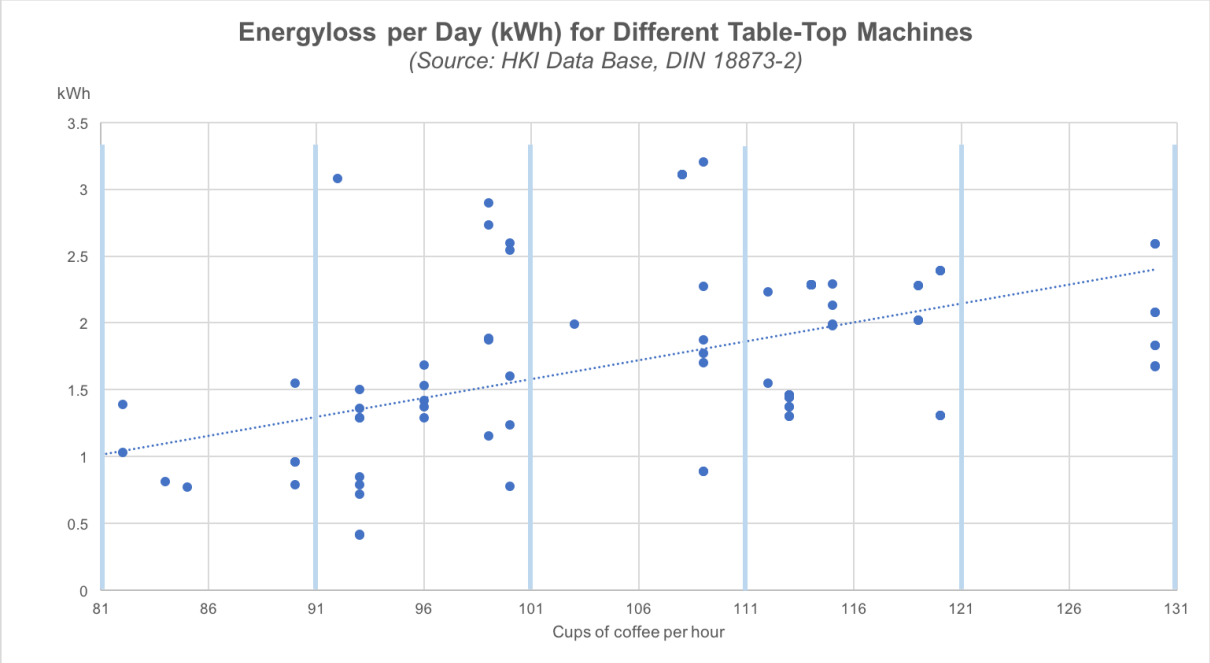

Figure 3: Energyloss per Day (kWh) for Different Table-Top Machines

Product Category	Saving Potential (Best vs Worst Model)
81 – 90 Coffee Cups / h	50%
91 – 100 Coffee Cups / h	87%
101 – 110 Coffee Cups / h	72%
111 – 120 Coffee Cups / h	46%
121 – 130 Coffee Cups / h	36%

Table 8: Energy Saving Potentials for Table-Top Non-Vending Machines

Finally, the saving potential for professional espresso machines in the Ecodesign WP3 is only estimated at 10%. A brief plausibility check of Topten International states that this figure is unreasonably low [2]. Unfortunately, no further data other than that of the Ecodesign WP3 on the consumption of these machines was found. Topten estimates – based on its experience with household coffee machines – that the saving potential is rather around 35% [18]/ [19]. Even if the potential of an introduction of standby power and auto-power down requirements is somewhat lower at professional espresso machines other options such as better insulation, smaller boilers or contionous-flow heaters can reduce energy consumption considerably. This assumption is also supported by the values from the ENAK database (Annex C). The energy consumption for preparing 60 cups of coffees differs by 45% between the best and the worst model. A 40% saving potential is considered as a fair estimate for professional espresso machines.

Applying these saving potential (40% for all categories) to the calculated energy consumption in Table 6 and Table 7, the overall energy saving is 4.0 TWh in 2030 – this is more than twice the figure as reported in the Ecodesign WP3. For Switzerland the energy saving is more than 100 GWh per year in 2030.

	Free-Standing Vending Machine	Table-Top Vending Machine	Table-Top Non-Vending Machine	Professional Espresso Machine	Total
EU-27 Energy Savings (Per Year in 2030)	0.7 TWh	0.7 TWh	0.04 TWh	2.6 TWh	**4.0 TWh**
CH Energy Savings (Per Year in 2030)	28.2 GWh	19.6 GWh	1.7 GWh	58.4 GWh	**107.9 GWh**

Table 9: Energy Saving Potential for Tertiary Hot Beverage Equipment in 2030

Energy saving potentials of approximatively 40% can also be found in other publications. Energy Star estimates that their label will result in 35% energy saving for commercial coffee brewers [17]. A test from the Swedisch Energy Agency found "*a difference of more than 50% in energy consumption between coffee machines tested*" [20].

3.3 Energy Savings in Switzerland over Machine Lifetime

Since high energy saving potentials were found, it is also valid to question how much energy a more energy-efficient machine saves over its lifetime. According to Ecodesign WP3 tertiary hot beverage equipment have an average lifetime of 7.5 to 15 years depending on the type, see Table 10. Multiplying the lifetime of each type with its energy saving potential (40%), we get a total saving 1.3 TWh over their lifetime if in 2030 in Switzerland only efficient models are used.

	Free-Standing Vending Machine	Table-Top Vending Machine	Table-Top Non-Vending Machine	Professional Espresso Machine	Total
Average Lifetime	7.5 years	7.5 years	10 years	15 years	**-**
CH Energy Savings (Per Year in 2030)	28.2 GWh	19.6 GWh	1.7 GWh	58.4 GWh	**107.9 GWh**
CH Energy Savings over Machine Lifetime	211.5 GWh	146.3 GWh	17 GWh	876 GWh	**1.3 TWh**

Table 10: Energy Savings over Machine Lifetime (Switzerland)

3.4 Energy Savings in Switzerland with Effective Measures

The above presented energy savings over the machines lifetime is the entire saving potential for the tertiary hot beverage equipment in Switzerland. What if a financial support program such as ProKilowatt, procurement guidelines or online product lists for energy-efficient appliances (e.g. topten.ch) were effectively implemented; how much savings per machine type can be expected? And what would be reasonable criteria?

For vending machines the case is rather simple thanks to the measurement standard EVA EMP 3.1b with its energy ratings. The best class at EVA EMP 3.1b is located at A++ with ≤ 100Wh/l. There seems to be no such machine at the market yet, however A+ machines can be found (see Annex D). For non-vending table-top machines we suggest to use the popular DIN 18873-2 measurement standard as a reference; with the hourly coffee output capacity and the daily energy loss an energy efficiency criterion can be created (see Annex E). Looking at the HKI database an average of 125 Wh/l energy loss for machines with an output of from 80–130 cups of coffees (125ml) is found [16]. Setting the criterion at 90 Wh/l of energy loss results in 30% more energy-efficient machines than the average. Since for professional espresso machines only data from a study of 2000 is available [21], setting criteria would be rather random. Therefore, test series for these machine types are strongly needed.

These criteria result in savings of 6'570 kWh for free-standing vending machines and 2'250 kWh for table-top vending machines over their average lifetime. For table-top non-vending machines the saving of 910 kWh over the average lifetime seems rather low – but it is to be noted, that this is only the saving of the energy loss. An energy-efficient machine clearly would also bring savings within it is productive phase.

	Free-Standing Vending Machine	**Table-Top Vending Machine**	**Table-Top Non-Vending Machine**	**Professional Espresso Machine**
Average Lifetime[9]	8 years	8 years	8 years	15 years
Average Energy Consumption in Use Phase (per Year)	2'350 kWh (215 Wh/l)	950 kWh (215 Wh/l)	545 kWh (Only Energy Losses, 125 Wh/l)	3'950 kWh
Efficiency Criteria	**A+ (≤ 140 Wh/l)**	**A+ (≤ 140 Wh/l)**	**≤ 90 Wh/l** for Energy Losses	-
Measurement Standard	EVA EMP 3.1b	EVA EMP 3.1b	DIN 18873-2	DIN 18873-2
Energy Consumption of Efficient Machine (per Year)	1'535 kWh	665 kWh	430 kWh (Only Energy Losses)	-
Savings per Machine (per Year)	820 kWh	280 kWh	115 kWh (Only Energy Losses)	-
Savings per Machine over Lifetime	**6'570 kWh**	**2'250 kWh**	**910 kWh** (Only Energy Losses)	-

Table 11: Energy Savings in Switzerland with Proposed Efficiency Criteria

[9] The ProKilowatt program usually uses 15 years of lifetime for appliances. Since lower lifetimes for some machines of the tertiary hot beverage equipment are expected, we set the lifetimes for free-standing vending machines and table-top machines to 8 years.

3.5 Standby Power

Remarkable are the very high standby values which are found across all categories of the tertiary hot beverage equipment. Looking at Figure 3 for example, energy losses of table-top non-vending machines range from 400 Wh to 3200 Wh a day. This is about 16 to 130 W of standby power[10]. Similar figures are to be found in the ENAK database which shows standby power values from 30 to 190 W (see Annex C). For free-standing vending machines figures from 50 up to 170 W are found. For professional espresso machines again no data is provided except the US study from 2000 which states an idle energy rate of 550 W (!) [21].

4. Conclusions and Suggested Measures

With an energy consumption of 10 TWh per year (in EU-27 for 2030) and saving potential of 4 TWh per year (40%) for tertiary hot beverage equipment this study shows that more actions towards energy efficiency are strongly needed. In Switzerland, these machines have a yearly energy consumption of almost 240 GWh per year (2012). The saving potential of 110 GWh per year in Switzerland represents more than 20 million Swiss francs per year. If Switzerland had only energy-efficient tertiary hot beverage equipment in use, we estimate that 1.3 TWh of energy can be saved over their entire lifetime, thus saving more than 200 million Swiss francs. The lowest hanging fruits are the exceptionally high standby power values and energy losses of more than 3 kWh a day per machine.

4.1 Measurement Norms & Tests Needed

A harmonized measurement standard which covers all machines types within the tertiary hot beverage equipment is a first step towards a basis for comparison and further measures. The DIN 18873-2 norm seems to be a good starting point. The key question is if its figure for energy loss does represent accurately the energy use of heavy-use machines such as professional espresso machines (porta filter) or free-standing vending machines. Another option is to define a new measurement standard which follows the principles of EN 60661. Both options require test series of an independent lab.

4.2 Regulations for Standby Power & Energy Label

Besides a harmonized measurement norm, it is required to impose minimum energy performance standards (MEPS). The simplest measure in this case, is to follow the requirements of household coffee machines and require a standby regulation and auto-off function also for tertiary hot beverage equipment (which is technically very easy to implement). Similar solutions already exist on the market. VendSense for example switches off the vending machines when no motion is detected within its vicinity and it can also be programmed to for certain time slots – apparently saving up to 64% of energy [22]. Further technical measures to save energy are good isolation, smaller boiler tanks and the use of continuous-flow heaters instead of boiler tanks.

The most effective measure finally is to implement an energy label for tertiary hot beverage equipment. With the presented saving potentials and the advanced regulative situation for very similar product groups such as refrigerated vending machines an energy label seems feasible.

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[10] Note: This figure is according to DIN 18873-2 which not only includes standby power but also other energy losses such as the energy consumption for the cleaning function. However, the standby consumption is still the major part of this energy loss.

As with the household coffee machines the measure of an energy label in Switzerland could be highly effective since Swiss manufacturers of fully automatic professional machines (table-top types) are leading and exporting worldwide.

4.3 Short-Term Measures for Switzerland

As immediate national measures for Switzerland the following options are proposed. Since measurement figures for table-top and free-standing machines are available (which cover about 70% of the tertiary hot beverage equipment market), the information platform topten.ch can present the most energy-efficient appliances in online product lists. Criteria for the best appliances should be an A+ energy label (≤ 140 Wh/l) according to EVA EMP 3.1b or an energy loss of less than 90 Wh/l according to DIN 18873-2. These product lists then can be used for (public) procurement.

Experiences from other product groups show that financial support programs such as ProKilowatt are very helpful to motivate energy-efficient purchases and to start a collaboration with the industry. For free-standing vending machines such programs should target the procurement department of companies since 80% are located in the workplace according to EVA. For table-top machines not only workplaces are interesting but especially large restaurant groups such as McDonalds, Migros or SV Group should be of high interest (see Table 4).

For professional espresso machines (porta filter) the situation is currently more difficult since no energy consumption figures are available. Due to their large share of energy consumption within the tertiary hot beverage equipment (more than 50%), measures to get manufactures to publish the figures or start independent measurements of these professional espresso machines are now needed.

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Annex

A. Vending Market Switzerland 2015

Vending Verband Schweiz VVS
Vending Association Suisse VAS
Vending Associazione Svizzera VAS

STATISTIKZAHLEN VENDING MARKT SCHWEIZ 2015
HOCHRECHNUNG / OHNE GEWÄHR

► **Automatenbestand Ende 2015**
(nur Total Miete und Operating, ohne Kauf)

	Anzahl	**%**
Total Instant-Automaten	1'983	4.11
Total Bohnen-Automaten	21'746	45.07
Total Kaltgetränke-Automaten	12'266	25.43
Total Snack-Automaten	12'246	25.39
TOTAL AUTOMATEN	**48'241**	**100**

Schönbühl, Juni 2016

B. Calculation of the Energy Consumption Scale According to EVA EMP 3.1b

Values from EVA-EMP report			
Inlet water T		24.3	°C
Idle phase	**IM**	131.8	wh/h
Vending phase	**VM**	500.0	wh
Total drink volume	**DV**	4.000	litres
Avg. drink temp.	**DT**	87.0	°C
Energy saving mode	**ESM**	0.0	wh/h
Duration of **VM** in hours e.g.4.0		1.0	hrs
No. of drinks dispensed during **VM**		30.0	cups

Process energy consumption without IM					Cup volume (DV)	wh
wh	wh	wh			ml	IM / 24 hrs
Energy L/° ideal	Energy L/°	Energy / L @ 80°			133.3	3164.11
1.163	1.468	81.765				

	Liters	cups	wh	wh	30L/24h
	Liters/24h	number	Tot process	Tot energy / L	Energy class
OCS	5L/24h	38	408.824	714.587	G
Table Top	15L/24h	113	1226.473	292.705	C
Free Standing	30L/24h	225	2452.946	187.235	A
High Throughput	50L/24h	375	4088.244	145.047	A

A++	A+	A	B	C	D	E	F	G
<100wh/L	<140wh/L	<190wh/L	<240wh/L	<310wh/L	<400wh/L	<500wh/L	<640wh/L	>640wh/L

Energy — Vending machine

Manufacturer SuperVend Inc. ◀A

Model XP77FB-2000

More efficient

A++ A+ A B C D E F G ◀A

Less efficient

Total energy consumption **187 wh/L**

Measured at **30 L/24h**

~ no. of cups in ml 225 cups of 133 ml

Energy consumption in Idle Mode: **3164 wh/24h**

C. ENAK Database for Fully Automatic Coffee Machines (Table-Top Non-Vending)

Brand	Model	Standby Power (Wh)	Energy Consumption for Preparing 60 Coffees (kWh)
Franke	A200	30	0.986
Franke	A600	73	0.757
Franke	FoamMaster FM840	92	0.825
HGZ	Rex Royal 530 RCST	100	0.730
Franke	A800	113	0.886
HGZ	Rex Royal S300 MCSTI	120	0.70
Thermoplan	Black & White 3 CTM2 Cool	120	1.330
EGRO	ONET TOPMXP 2P	129	0.892
Thermoplan	Black & White 3 CTM2 Cool + RF	150	1.370
Franke	Spectra HD CF	151	0.630
Franke	A1000	151	0.828
Schaerer	SCA P C/T/S-2M	159	0.966
Schaerer	SCA P / Best Foam	176	1.015
HGZ	Rex Royal S545 RCST	190	0.770

Table 12: ENAK Database for Fully Automatic Coffee Machines

D. Energy Consumption of Free-Standing Vending Machines

Brand	Model	Total Energy Consumption (Wh/l)	Standby Power (Wh)	Label (EVA EMP 3.1b)
Sielaff	HG SielCup	112	50	A+
Sielaff	HG CFT	120	68	A+
Sielaff	HG CVT	137	55	A+
Sielaff	HG CIS 500	151	99	A
Sielaff	HG CFS	151	99	A
Sielaff	HG SiGusto EC Espres.	174	79	A
Sielaff	HG CVS 500	179	90	A
Sanden Vendo	Espresso Double Boiler ED7	187	93	A
Coffeetek	Sigma	205	120	B
Coffeetek	Sigma Light	205	120	B
Coffeetek	Sigma Touch	205	120	B
Jaski	Crane MS Genesis	211	120	B
Coffeetek	Solo Encore	271	173	C

Table 13: Energy Consumption of Free-Standing Vending Machines

E. HKI Database for Table-Top Non-Vending Machines

The HKI Database (http://grosskuechen.cert.hki-online.de/de/geraete-nach-typ/liste?typ=Heissgetraenkebereiter) lists the DIN 18873-2 measurement figures of table-top coffee machines. The following table shows entries which have been consulted in June 2017. Machines with an output capacity higher than 80 cups of coffee are listed, variants and product series are not listed but according products are marked with asterisk (*). Based on the daily energy losses and the output, we calculated an efficiency criterion (energy losses Wh/L). Energy-efficient machine have less than 90 Wh/L of energy loss, the average for this list is at 125 Wh/L.

Brand	**Model** (* Further Variants/Series in Database Available)	**Energy Losses per Day (Wh)**	**Cups (125ml) of Coffee per Hour**	**Coffee Output in Litres per Hour**	**Efficiency (Energy Losses Wh/L)**
WMF	WMF1200S - Topping	410	93	11.63	35
Schaerer AG	Schaerer Coffee Prime ohne Dampf	420	93	11.63	36
WMF	presto! Topping	720	93	11.63	62
EGRO	Egro ZERO Pure Coffee	779	100	12.50	62
Melitta	Melitta cup II 1M *	890	109	13.63	65
WMF	WMF1800S - 3kW Topping	790	93	11.63	68
Schaerer AG	Schaerer Coffee Vito mit Pulvermilch	790	90	11.25	70
Schaerer AG	Schaerer Coffee Prime mit Frischmilch	770	85	10.63	72
WMF	WMF1200S - Frischmilch&Choc *	850	93	11.63	73
Franke	Flair	810	84	10.50	77
Schaerer AG	Schaerer Coffee Art 1 CT1 / 2KW	957	90	11.25	85
Schaerer AG	Schaerer Coffee Art CT1 Topping 2KW	962	90	11.25	86
Carimali	Armonia Easy *	1'310	120	15.00	87
Melitta	Melitta Cafina XT6-1G-0-0-0-0 *	1'300	113	14.13	92
Schaerer AG	Schaerer Coffee Art C T	1'156	99	12.38	93
Melitta	Melitta bar-cube II 1C-1G Barista *	1'370	113	14.13	97
EGRO	Egro ZERO Quick Milk	1'237	100	12.50	99
Franke	Pura Pronto	1'030	82	10.25	100
Melitta	Melitta bar-cube II 1W-2G *	1'440	113	14.13	102
Sielaff	HO Siamonie Touch	1'670	130	16.25	103
Melitta	Melitta bar-cube II 1W-1G-IS *	1'460	113	14.13	103
Sielaff	HO Piacere Touch	1'680	130	16.25	103

WMF	WMF1500S - Basic Milk & Choc, Festwasser	1'290	96	12.00	108
WMF	WMF 5000S - Easy Milk & Choc	1'550	112	14.00	111
WMF	WMF1500S - Basic Milk & Choc, Tank	1'290	93	11.63	111
WMF	WMF8000S - 3,5kW Frischmilch & Choc *	1'830	130	16.25	113
WMF	WMF1500S - Easy Milk & Choc, Festwasser	1'370	96	12.00	114
WMF	WMF1800S - 3kW Frischmilch & Choc	1'360	93	11.63	117
WMF	WMF2000S - 3kW Frischmilch & Choc	1'420	96	12.00	118
EGRO	Egro ONE Pure Coffee	1'703	109	13.63	125
WMF	WMF2000S - 3kW Active Milk mit Choc	1'530	96	12.00	128
WMF	WMF8000S - 3,5kW Active Milk mit Choc *	2'080	130	16.25	128
Franke	FCS4043, A600 MS2 2G 2P H1	1'604	100	12.50	128
WMF	WMF1800S - 3kW Aktive Milk mit Choc	1'500	93	11.63	129
EGRO	Egro ONE Quick Milk	1'772	109	13.63	130
Franke	Pura Fresco	1'390	82	10.25	136
WMF	bistro! - 3,3kW Frischmilch & Choc *	2'020	119	14.88	136
EGRO	Egro ONE Top Milk XP	1'873	109	13.63	137
Franke	Foam Master FM 800 D-E50	1'980	115	14.38	138
Schaerer AG	Schaerer Coffee Vito mit Frischmilch	1'550	90	11.25	138
Franke	Spectra S Milchsystem CF2/D-E50 230 V	1'990	115	14.38	138
Franke	FCS4043 A600 MS2 2G 1P H1 S2	1'682	96	12.00	140
Franke	Spectra S Milchsystem CF2/D-E50	2'130	115	14.38	148
Schaerer AG	Schaerer Coffee Art C T S	1'871	99	12.38	151
Schaerer AG	Schaerer Coffee Art C T S CHOCO	1'886	99	12.38	152
WMF	bistro! - 3,3kW Active Milk mit Choc *	2'280	119	14.88	153
Franke	Evolution Top D-E43	1'990	103	12.88	155

WMF	WMF 5000S - Dynamic Milk & Choc	2'230	112	14.00	159
Franke	Spectra S Milchsystem CF/D-E50	2'290	115	14.38	159
Carimali	Armonia LM / Classic *	2'390	120	15.00	159
WMF	WMF 9000S+ 3,6 kW Dynamic Milk & Choc *	2'590	130	16.25	159
Melitta	Melitta Cafina XT6 *	2'287	114	14.25	160
Franke	FCS4050 A800 MS 2G 2P H1 S2	2'272	109	13.63	167
Franke	FCS4043, A600 FM1 1G 1P H1, FCS4048, SU05 FM1 1C 1M	2'546	100	12.50	204
Franke	FCS4043: A600 FM1 2G 1P H1, FCS4048: SU05 FM1 1C 1M	2'595	100	12.50	208
Schaerer AG	Schaerer Coffee Art TouchIT Best Foam	2'734	99	12.38	221
Melitta	Melitta c35-12M-1G *	3'110	108	13.50	230
Schaerer AG	Schaerer Coffee Art Plus CS	2'900	99	12.38	234
Franke	FCS4050, A1000 2G 1P H1 S2	3'203	109	13.63	235
Franke	FCS4026, FM850 T 2M 1P H FM KE300, KE300 FM 1C1M	3'080	92	11.50	268

Table 14: HKI Database for Table-Top Machines