Imaging Equipment: Recommendations for policy design

August 26th 2008, Eric Bush and Anette Michel, Topten International Group TIG, Paris, www.topten.info

Summary: Recommendations in short

Topten supports the main findings of the EuP Preparatory Study 'Imaging Equipment' (Lot 4). A central conclusion of the study is being affirmed by Topten: there is a big range of imaging products performing much better than required by today's efficiency label Energy Star.

High standards
Set high standards guided by the best: the best models on the market should be taken as a reference, when setting new standards – such as those to be found on www.topten.info. Topten laser printers and multifunctional devices perform 25%-80% better than Energy Star-labelled devices. These innovations should be promoted by an efficiency label guided by the best.

Simple requirements
Energy Efficiency should be understandable, efficiency requirements traceable, in order to make the advantage of efficient products graspable: therefore, clear and simple efficiency requirements should be chosen.

Minimum Efficiency Requirements
Simultaneously to the promotion of efficiency innovations, the worst-performing models should be banned from the market by setting minimum efficiency requirements. Amending the commission regulation about Standby and Off mode losses, which will implement horizontal measures, vertical minimum efficiency requirements also including Sleep power input could be guided by the Energy Star label: Energy Star-products only should be allowed on the European market.

Declaration and Quality Control
The declaration procedure as well as the verification process should be clearly communicated in order to allow a credible quality control.

Political instruments and initiatives on energy efficiency of imaging equipment

Energy Star program

Since 2006 a second Energy Star Agreement coordinates the energy efficiency labelling programs for office equipment between the EU and the US. It is valid for another five years.

Regulation (EC) No 106/2008 of the European Parliament and of the Council of 15 January 2008 establishes the rules for the EU-Energy Star program and requires EU institutions and central Member State government authorities to use energy efficiency criteria no less demanding than those defined in the Energy Star programme when purchasing office equipment.

The Energy Star specifications for imaging equipment are being revisited at the moment, draft documents can be downloaded from Energy Star's Website. New criteria should be established by April 2009. These should ensure that 25% of the imaging products in each category receive the Energy Star label. At the moment, in the US close to 50% of all imaging products meet the Energy Star requirements.

Eco-design of Energy-Using products (EuP)

Requirements regarding the ecodesign of energy-using products, which in many cases determines most of a product's environmental impacts, will be set up. According to the directive 2005/32/EC, preparatory studies to propose implementing measures for imaging equipment and other product categories have been conducted. Imaging devices are concerned by the studies of LOT 4 (Imaging equipment) as well as by the horizontal study of LOT 6 (Standby and off mode losses). As for the horizontal standby and off mode measures, a regulation has already been proposed to the Commission of the EU: one year after the regulation has come into force, energy using products shall have a power consumption of no more than 1 Watt in 'Off mode', and no more of 1 or 2 Watts in Standby mode (Draft proposal for regulation). After four years, power consumption in off and standby mode shall be limited to 0.5 and 1 Watt, respectively.

Topten

Topten lists the most energy efficient products in Europe and on country-level. Topten imaging devices meet Energy Star and additional requirements: Topten laser printers and multifunctionals perform 25 to 80% better than Energy Star requires, and inkjet devices have a Sleep power consumption of no more than 3 Watt.

Blue Angel for office equipment with printing function:
Blue angel printers must also fulfil requirements regarding energy consumption, next to material input, recycling, declarations, paper, emissions and noise. Energy consumption requirements are less strict than for Topten products.

Nordic Swan Eco-labelling for copying machines, printers, fax machines and multifunctional devices. In the case of energy consumption, the Nordic Swan refers to the criteria of the Blue Angel or Energy Star, and Eco Mark, a Japanese environmental label.

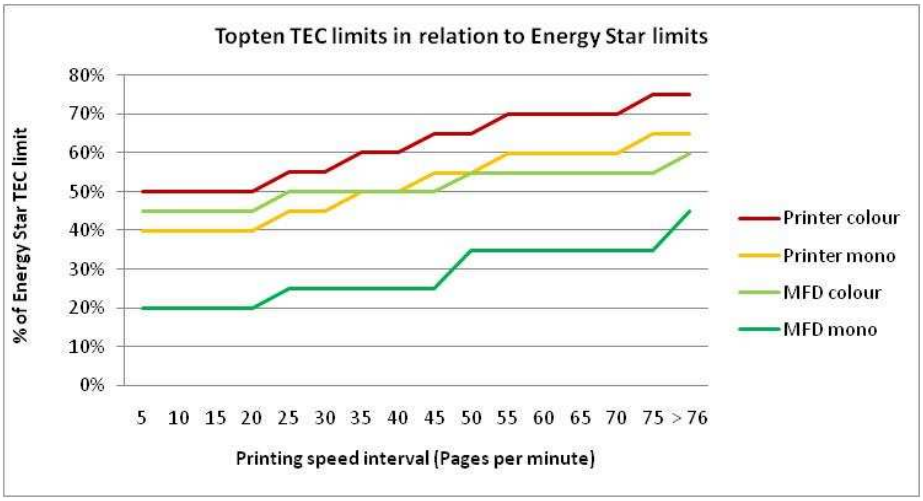
TCO (Swedish Confederation of Professional Employees)
TCO'99-labelled printers must meet high standards regarding ergonomics, emissions and ecology. Energy consumption is not a major focus of the label though, and the thresholds for energy consumption in the low power mode are not very stringent.

Market situation in Europe

4.5 million laser printers and 1.1 million laser copiers are estimated to be newly installed in European households and offices per year (EU-25, 2008). Even more popular are inkjet printers: 23 millions are estimated to be placed in 2008, with a fast growing percentage of multifunctional devices (more than two thirds in 2008) (EuP Preparatory Study Lot 4, Task 2).

A total of roughly 100 million inkjet printers are expected to be installed in the EU-25, and 23 million laser printers and copiers/multifunctionals. Of the laser devices, monochrome printers are the vast majority (60%) in stock, their most important speed class being 25-39 pages per minute. Still three quarters of the inkjet printers are of the single function type, but the partition of multifunctional inkjet devices is growing fast (EuP Preparatory Study Lot 4, Task 2).

30 - 50% of the imaging products reach Energy Star's efficiency standards in the US (DRAFT 2 Version 1.1 Energy Star Imaging Equipment Specification – Data Summary). In the EuP preparatory study for imaging efficiency has been noted that there are many laser printers and multifunctionals performing between 20 and 70% better than the Energy Star requirements (EuP Preparatory Study Lot 4, Task 6). These findings can be confirmed by the product lists on www.topten.info:
Topten laser printers perform at least 25 to 60% better than Energy Star requirements, Topten laser multifunctionals even 40 to 80%.



Graph 1

Despite the tough efficiency requirements by Topten, a wide variety of laser printers and multi-functional devices meets them, including devices for professional use: there are actually (June 2008) totally 37 laser printers of 16 different brands on the Topten lists, printing colour or black/white, between 8 and 105 pages a minute, and totally 40 laser multifunctionals of 14 brands, offering a range of 16 to 135 pages per minute, also printing colour or black/white. Among the 16 laser brands are well-known producers such as Brother, Canon, Dell, HP, Konica Minolta, Kyocera Mita, Ricoh, Samsung or Xerox.

In the case of inkjet devices, so far 28 models of only two brands (Canon, Epson) meet Topten's strict requirement of a Sleep power input of no more than 3 Watt, additional to Energy Star's Off mode power input and time delay requirements. Still, there is a considerable range of functions and printing speeds to be found: there are 14 inkjet printers, with a speed range between 9 and 31

images per minute (ipm), and 14 inkjet multifunctionals with a speed range between 18 and 40 ipm and three of them including a fax function listed on Topten.
The tables below provide an overview of the numbers of Topten imaging products.

Topten Laser Printers		
Speed (ppm)	colour	b/w
8-20	6	5
21-50	8	15
> 50		3
Total	14	23
Topten Laser Multifunctionals		
Speed (ppm)	colour	b/w
16-30	6	19
31-50	4	2
> 50	4	4
Total	14	25

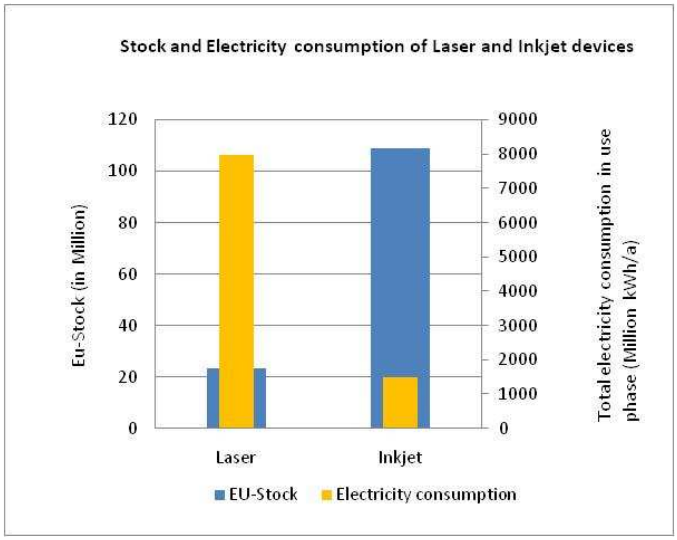
Topten Inkjet printers:	
Speed range (ipm)	9-31
Total models	14
Topten Inkjet multifunctionals:	
Speed range (ipm)	18-40
Inlcuding Fax Function	3
Total models	14

104 models of imaging equipment comply with Topten requirements, thereof 76 laser and 28 inkjet devices resp. 56 colour and 48 b/w devices.

Energy consumption and saving potentials

The total of roughly 125 million laser and inkjet copiers and printers installed in the EU-25 is estimated to consume between 10'000 million and 20'000 million kWh annually. The number of inkjet devices is about four times the one of laser printers and multifunctional devices. Mainly due to their short life cycle, inkjet printers consume most energy in the phase of production – other than laser printers, the production of which uses less energy due to their longer life cycle. Laser printers are designed for more intense usage and higher volume output than inkjet printers and use most energy during their use phase.
Despite the smaller number of laser devices, they are held responsible for more than 80% of the total electricity consumption during the use phase by all laser and inkjet imaging devices (EuP Preparatory Study Lot 4, Task 5).

30% (OM-approach) to 50% (TEC-approach) of the imaging devices meet today's efficiency requirements of Energy Star (EPA, 2008). A number of them however has an energy consumption far below energy star's limits.

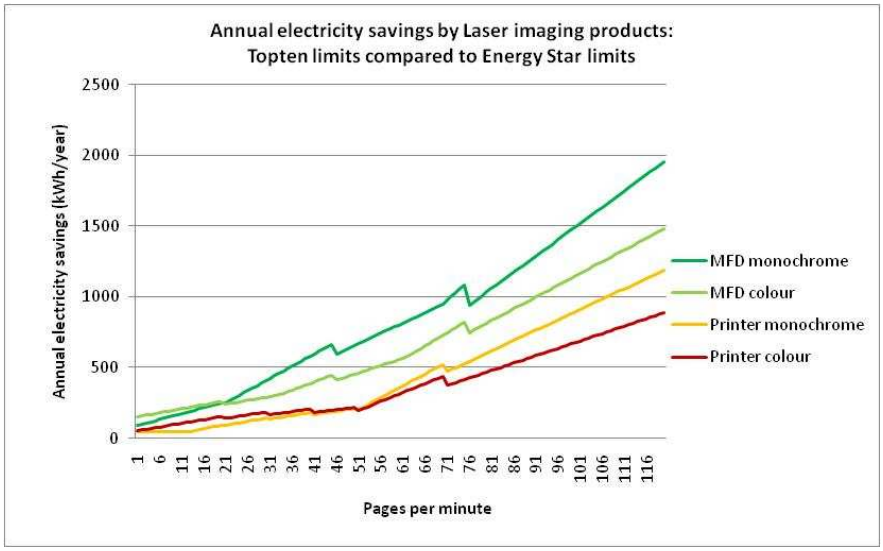


Graph 2

Inkjet
The roughly 100 million inkjet printers in the EU-25 are thought to consume at least 1'500 million kWh annually (EuP Preparatory Study Lot 4, Task 5).
Energy Star inkjet devices meet requirements regarding Off mode and Sleep mode power input and time dalay to Sleep. In the case of standard size inkjet printers and multifunctionals the basis for the Energy Star Sleep requirement is a power consumption of no more than 3 Watt. This value however refers to the marking engine of a product only, and up to around 7 Watt are allowed to be added for additional functions such as data- or network-interfaces, scanners, memory and power supply devices (Energy Star Program Requirements for Imaging Equipment). Since there is no clear Energy Star Sleep limit, but the thresholds have to be calculated for every product, it is not clear how much below the maximum Energy Star Sleep today's best products perform.
Additional to Energy Star requirements, the Topten maximum Sleep consumption for all inkjet printers and multifunctionals is strictly at 3 Watt, independent of the number of interfaces and the efficiency of the power supply (Topten Selection criteria).

Laser
The European stock of laser (or electrophotography – EP) imaging products consumes at least 8'000, probably rather around 15'000 million kWh each year (EuP Preparatory Study Lot4, Task 5, and own calculations). In the case of standard size laser devices, the power consumption is defined by the TEC (Typical Electricity Consumption, kWh/week), which is partly guided by the product speed.
Today, a Topten laser printer consumes between 47 (b/w, up to 12 pages per minute) and 1'186 kWh (b/w, 120 pages/minute) less each year than a comparable printer with Energy Star's limit values (assumption: use pattern according to TEC during one year). In the case of laser multifunctional devices, the differences in annual energy consumption are even higher: multifunctional devices with

Topten's energy consumption limit values consume between 92 (b/w, 1 page/minute) and 1950 kWh (b/w, 120 p./min) less each year than similar devices with Energy Star's maximum consumption. Similar electricity savings can be accounted for by colour laser printers and multifunctionals.



Graph 3

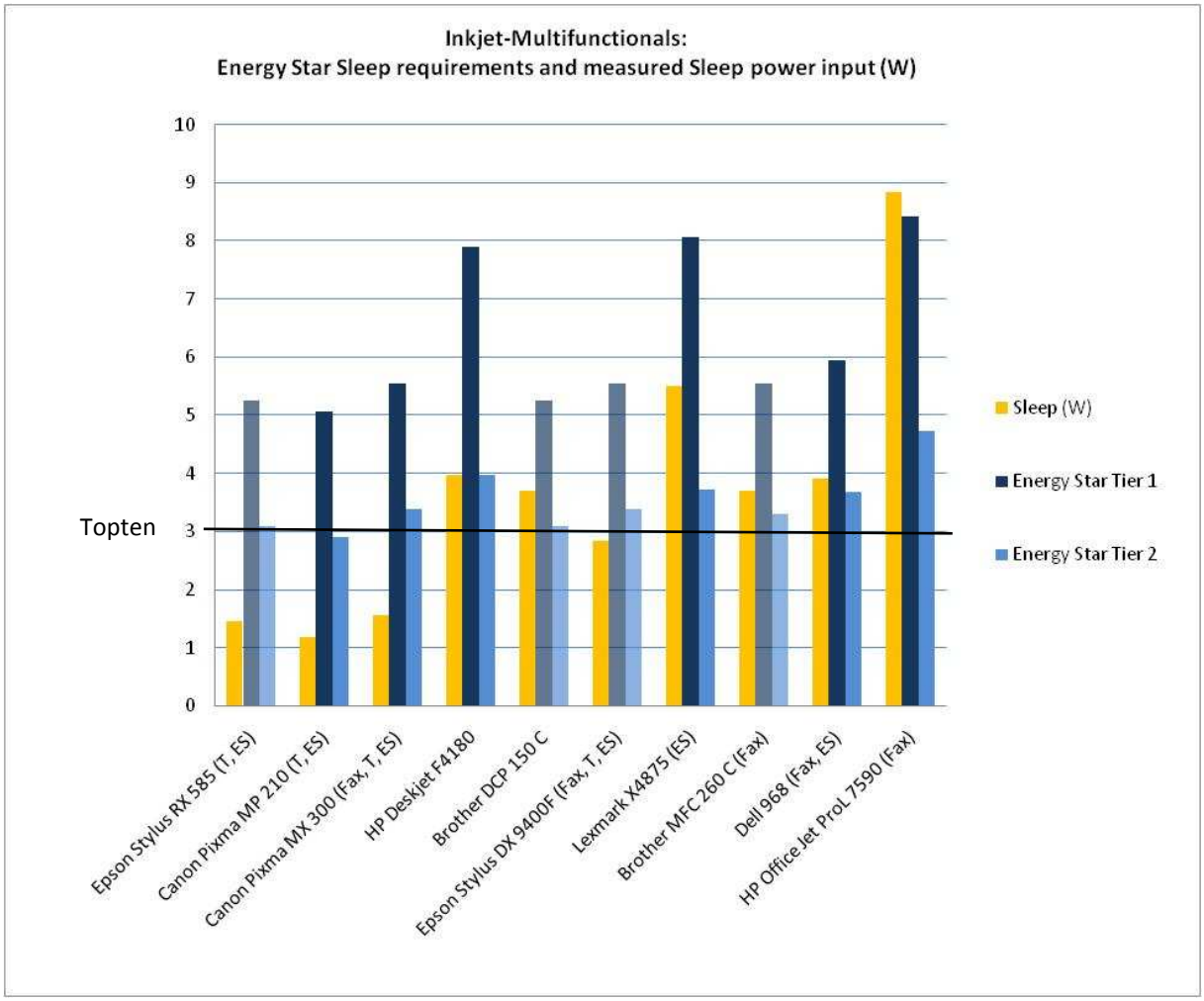
The typical laser imaging device is a monochrome printer of a speed of about 32 pages per minute (EuP Preparatory Study Lot 4, Task 2). This type of device consumes 50% less energy if it meets also Topten-requirements instead of only Energy Star's: 141 kWh/a instead of 282.

If the whole stock of laser imaging devices met Topten criteria, their energy consumption would drop by around 60%: more than 5'000 million kWh could be saved each year. This corresponds to about half of a nuclear power plant's production.

Energy Star

Inkjet
The maximum energy consumption of all inkjet devices is defined according to the Operational Mode (OM) approach (exception: in tier 2 the newly defined High Performance Inkjet devices will be considered under the TEC approach), as are most non-standard format devices based on other marking technologies. The basis for today's tier 1 OM requirements is a maximum Sleep power consumption of 3 Watt, to which up to at least 6 Watts can be added for a device's functions and interfaces. Other requirements concern Off mode power input (maximally 1W without fax, 2 Watts with fax) and time delay to Sleep mode (default: depends on printing speed, usually 60 minutes). Today's Energy Star OM requirements are met by 32% of the products on the US-market (Draft 2 Energy Star Imaging Equipment Specification – Data Summary), by July 2009 new tier 2 requirements shall qualify 20% for Energy Star. According to the Final Draft for the Version 1.1 Requirements (Data Summary and Requirements for Imaging Products), the general concept of the OM approach with 7 different maximum Sleep power limits, to which a number of allowances for a device's functions and interfaces can be added, will remain the same. These new Sleep power limits shall be strongly lowered in the case of large format non-inkjet printers (from 54 to 14W) and copiers and MFDs (from 58 to 30W), slightly lowered in the case of standard size inkjet MFDs, printers and scanners (OM 2: from 3 to 1.4W), standard size impact printers (OM 6: from 6 to 4.6W) and all other scanners (from 5 to 4.5 W). In the case of three OM groups, the Sleep power limit will even be higher than in tier 1

requirements: large format Inkjet printers and MFDs (from 13 to 15W), mailing machines (from 3 to 7W) and all small format printers (from 3 to 9W). The reason for the higher Sleep power limits is the adder allowance for the Power Supply Output Rating (PSOR) which will newly be allowed to be added in the case of the OM groups 2 and 6 only – two of the three groups for which the maximum Sleep limit will be lowered. Apart from these main changes, a few more changes are foreseen for the OM approach at tier 2: the maximum default delay time to Sleep for large format copiers shall be prolonged from 30 to 60 minutes, maximum off (Energy Star: 'standby') power input for small format and standard size products with fax function shall be lowered to 1W from 2W, the adder allowance for scanners with CCFL lamps shall newly be the same as for non-CCFL lamp scanners: 0.5 instead of 2W, the calculation for the adder allowance for the PSOR has changed a bit (resulting in a bit lower adders), fax modems are included in one of the interface functional adder categories, and the requirements for a Digital Front End (DFE) have changed (Energy Star Program Requirements for Imaging Equipment, Version 1.1 – Final Draft).



Graph 4: In the case of the transparent Energy Star columns the Sleep limit could not be calculated completely due to missing data. The actual limits are probably somewhat higher than assumed here. T: Topten, ES: Energy Star.

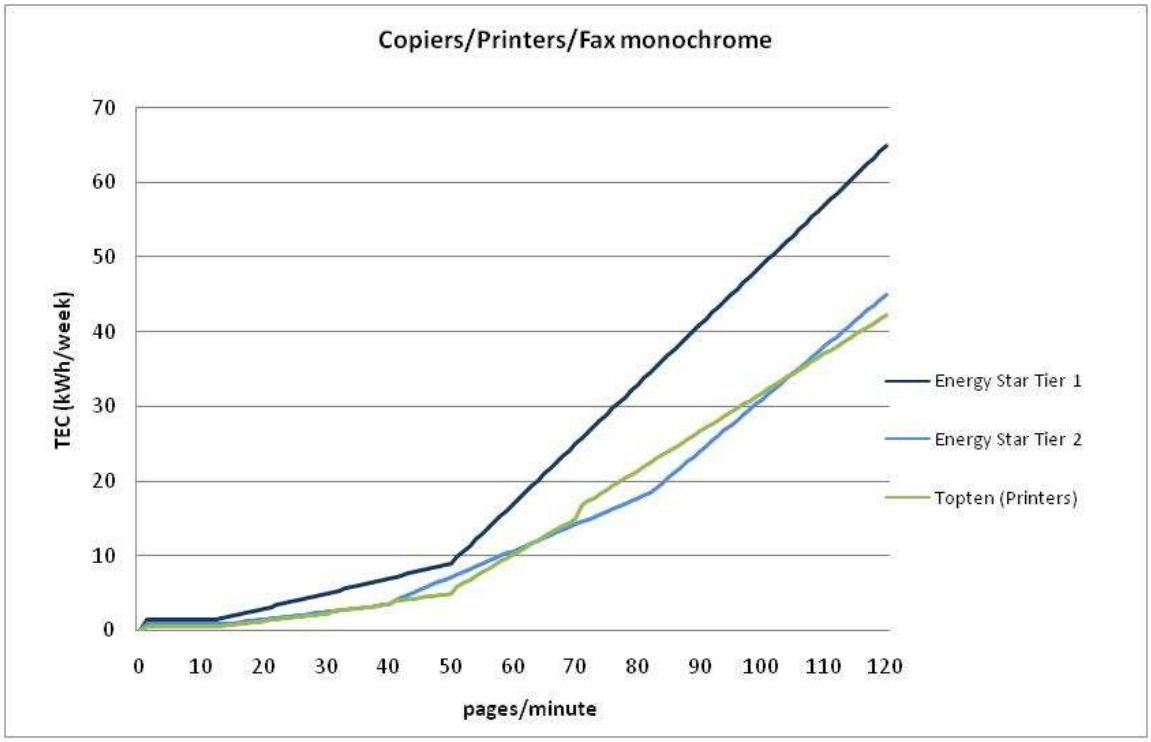
In a recent Swiss study the Sleep power consumption of ten current inkjet multifunctional devices was measured and compared to the current (tier 1) and future (tier 2) Energy Star requirements (Bush, Michel, 2008). Only the device with the highest power consumption did not meet the tier 1 Energy Star Sleep requirement, which was calculated by the authors. In the case of four devices (transparent columns) the 'Functional Adder' for the power supply output could not be defined due

to missing indications. In these cases the lowest adder calculated among the six other devices was added. The 'real' Sleep limit is probably higher than assumed here. Despite these uncertainties the graph displays clearly that the tier 1 Energy Star Sleep requirements are too low to achieve a distinction between efficient and inefficient devices: the Energy Star Sleep power limit of the models which were measured is up to four times higher than the effective Sleep power consumption (Graph 4). The Canon MP 210 for instance showed a Sleep power input of 1.2W, but even with 5W it would have met Energy Star's tier 1 requirements. Also the Epson RX 585 (measured: 1.4W, ES-limit: 5.2W) and Canon MX300 with fax (measured: 1.5, ES-limit: 5.5W) have a power input more than 3.5 times below the tier 1 requirements.
With the tier 2 Sleep requirements only four instead of nine out of the ten devices meet Energy Star Sleep requirements. In the case of five devices the Sleep power limit is around 3 Watt and thus comparable to Topten requirements. The highest tier 2 Sleep limit that was calculated for the ten devices was 4.7W (instead of 8.4W at tier 1) in the case of the HP Officejet Pro L 7590. On average the ten calculated tier 2 Sleep power limits are 43% lower than the tier 1 limits.
The study implies that the tier 2 Sleep limits are clearly stricter than the actual limits – at least in the case of the ten OM2-devices which were tested. No conclusion can be made about other OM categories though. The general concept of the complex Sleep power calculation for every single model remains the same. The concept of the maximum power input calculation leaves room for improvement: the complicated formula for the Sleep criteria and the mass of data required to calculate its value will also at tier 2 not always allow to definitely calculate the Sleep limit, even under time-consuming efforts.

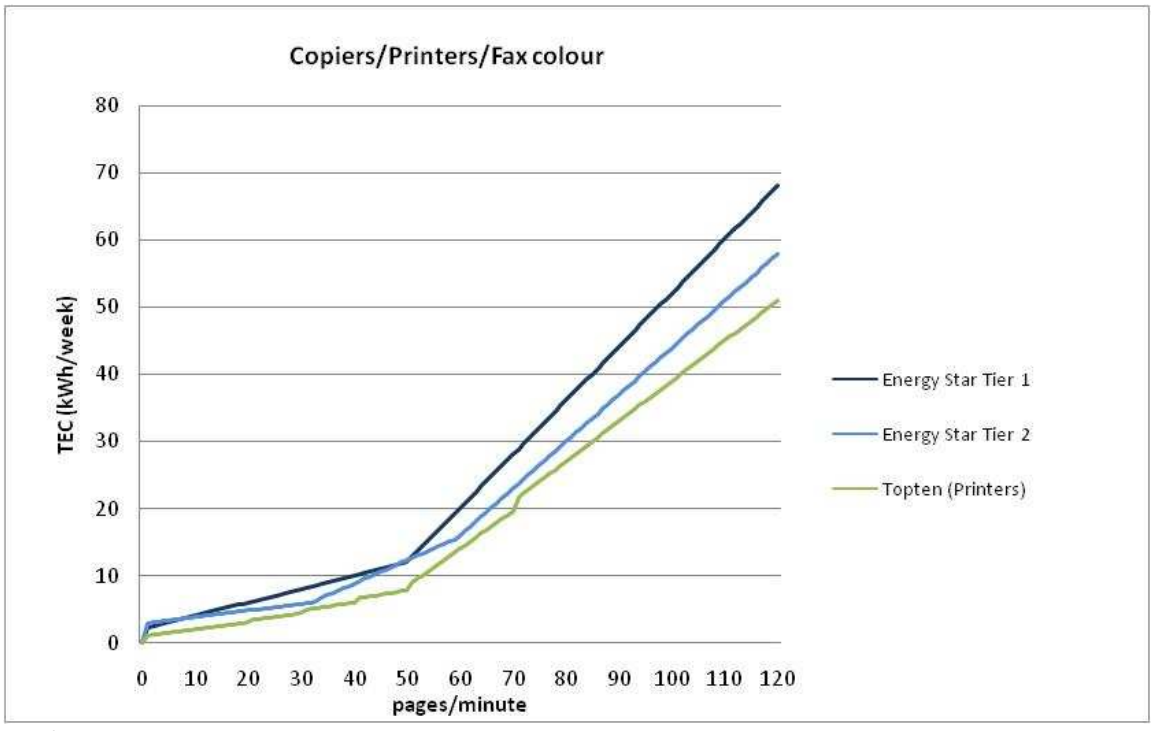
EP /Laser
EP/Laser imaging devices are considered according to their Typical Electricity Consumption (TEC, in kWh/week). 50% of the imaging models considered according to the TEC approach on the US market meet today's tier 1 Energy Star requirements. As from July 2009, tier 2 requirements shall qualify 25% of the TEC-products only for Energy Star. New TEC calculations depending on printing speed have been proposed for the four TEC categories. Proposed TEC 1-4 for tier 2 are all stricter than at tier 1, but at different levels among the different TEC groups and at different printing speeds (ES Program Requirements for Imaging Equipment Version 1.1, Final Draft).

Graphs 5 to 8 show Energy Star's tier 1, foreseen tier 2 and Topten's TEC requirements. Since there are few single function copiers, Topten at the moment only displays printers; fax devices are not considered according to the TEC approach.
On average across all printings speeds up to 120 Pages/minute and all four TEC categories, tier 2 TEC limits are 30% stricter than tier 1 TEC limits, and 40% higher and thus less strict than Topten TEC limits.
In the case of monochrome single function copiers, printers and faxes (TEC 1, Graph 5), the strongest accentuation of Energy Star's TEC limits is planned: tier 2 requirements are almost as strict as Topten requirements (10% higher on average), at high printing speeds of around 65 to 100 pages/minute they are even stricter than Topten limits. On average, tier2 TEC1 limits are 40% lower than tier 1 limits; the reduction at different printing speeds is between 50% (15-40 pages/minute) and 20%. The accentuation foreseen in single function colour devices (TEC 2, Graph 6) is the weakest of the four TEC categories: on average, tier 2 TEC 2 limits are only 14% stricter than at tier 1. The strongest reduction foreseen in TEC 2 is 30%, at some printing speeds tier 2 limits remain the same (around 50 pages/minute) or – at low printing speeds - are even higher than tier 1 limits. Compared to Topten, Energy Star's TEC 2 limits are on average one third higher.
The average reduction of the TEC 3 limits for monochrome multifunctionals of 38% is displayed in Graph 7. The strongest reduction of up to 60% is foreseen at rather low printing speeds up to around

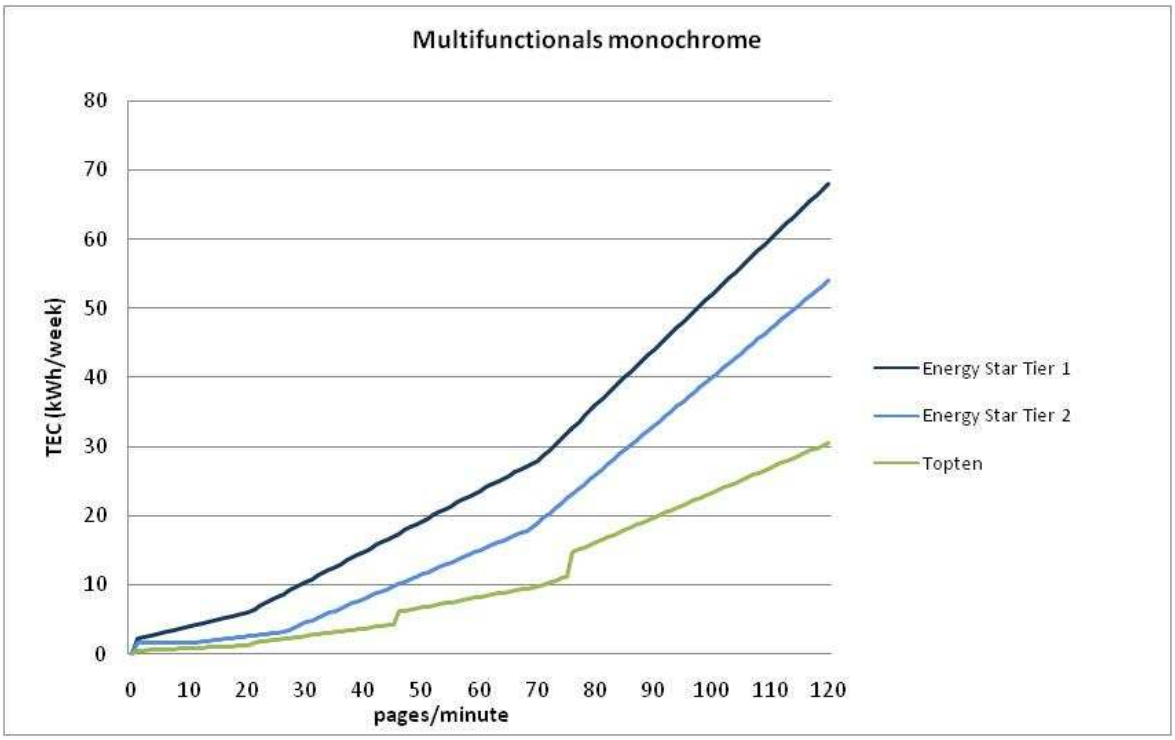
30 pages/minute, while the least strict reduction (20%) is planned at high printing speeds. Still, tier 2 TEC 3 limits on average are 70% higher than Topten limits, and are even the double at low printing speeds of up to 20 pages/minute as well as around 40 pages/minute. As for color multifunctionals, an accentuation of 25% on average of the TEC 4 limits is planned for tier 2, the strongest TEC reduction being 40%, the least 17% (Graph 8). On average tier 2 TEC 4 limits are 40% higher than Topten requirements.



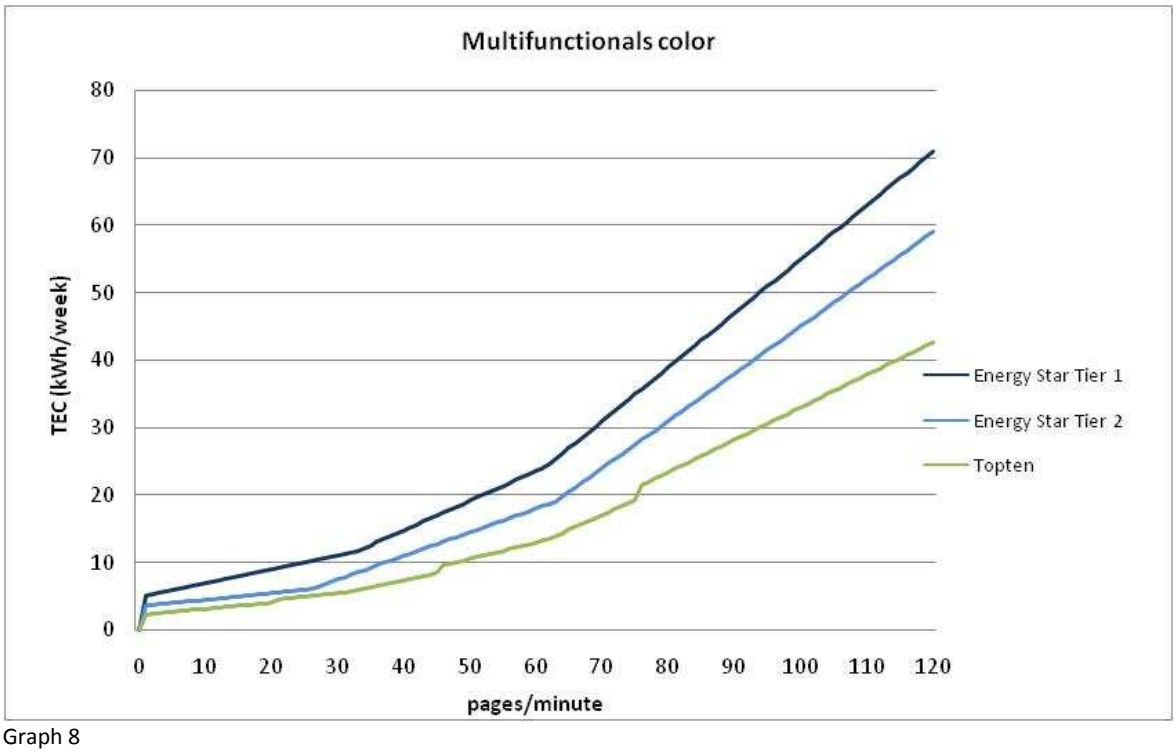
Graph 5



Graph 6



Graph 7



Graph 8

Recommendations regarding policy design

High standards
High standards guided by the best: When setting new standards, the best models on the market should be taken as a reference – such as those to be found on www.topten.info. Topten laser printers and multifunctionals perform 25%-80% better than Energy Star-labelled devices. They are not niche products, but many well-known brands are among the Topten imaging products, showing a wide variety of functions and printing speeds. New Energy Star specifications as well as a possible new European efficiency label thus should take these as a guideline. High standards only can promote the very best models and at the same time ensure ongoing innovations of even better devices.

Simple requirements
Energy efficiency should be understandable and traceable, and the advantages of efficient products should be graspable for buyers. Therefore, energy efficiency should be promoted by simple and clear requirements, allowing little or no exemptions. Today's Energy Star OM approach for inkjet devices, where 13 different 'functional adders' can be added to a device's maximum Sleep consumption, some of which have to be calculated in a complicated manner, should be taken as an example to be avoided. Instead, it should be easily checkable if a model meets certain requirements or not. Topten recommends to renounce on functional adders, but to set power consumption thresholds as clear-cut as possible – in the new Energy Star specifications and in possible future European efficiency instruments.

Minimum Efficiency Requirements
Energy efficiency standards keep improving thanks to technical innovations by manufacturers. Today there are numerous imaging devices performing up to 80% better than the Energy Star requirements. Simultaneously to the promotion of these innovations, the worst-performing models should be banned from the market by setting minimum efficiency requirements.
The horizontal 'Commission Regulation with regard to eco design requirements for standby and off mode electric power consumption of household and office equipment' will set certain standards for standby and off mode power consumption also for imaging devices.
These can be amended by additional requirements also concerning Sleep power input, which could be guided by the Energy Star label: only Energy Star-products should be allowed on the European market. Minimum efficiency requirements protect buyers from energy dissipating products and enhance the importance of energy efficiency when new products are developed.

Declaration and Quality Control
Energy consumption values of imaging equipment should be declared. Measurement procedure should be clearly defined in a sensible way in order to allow a quality control. According to Energy Star the declaration only refers to so-called marking models, requirements are also necessary for "real" models including optional functions and integrated in network (not stand alone). Additionally, the procedure of quality control and verification should be communicated clearly (verification of declared values, not only whether compliant with Energy Star!). A credible system of declaration and quality control enhances consumer reliance.

Links and References

Links

Energy Star program: www.eu-energystar.org

Eco-design of Energy-Using products (EuP):
http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm

Preparatory study on imaging equipment:
http://www.ecoimaging.org/

Best-performing products of Europe:
www.topten.info

Blue Angel:
www.blauer-engel.de/en/index.php

Nordic Swan:
www.svanen.nu

TCO:
http://www.tcodevelopment.com/

Regulations of the EU

Agreement between the Government of the United States of America and the European Community on the coordination of energy-efficiency labelling programs for office equipment, 2006:
http://ec.europa.eu/energy/demand/legislation/energy_star_programme_en.htm

Regulation (EC) No 106/2008 of the European Parliament and of the Council of 15 January 2008:
http://ec.europa.eu/energy/demand/legislation/energy_star_programme_en.htm

Draft documents of the revised Energy Star Specifications on Imaging Equipment:
http://www.eu-energystar.org/en/253.shtml#20080410

Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32005L0032:EN:NOT

Draft Proposal for a Commission Regulation implementing Directive 2005/32/EC with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment. 7. July 2008.
http://ec.europa.eu/energy/demand/legislation/doc/regulatory_committee/2008_06_03_standby_post_vote_en.pdf

References

EuP Preparatory Study 'Imaging Equipment' (Lot 4), Final Report on Task 2 'Economic and Market Analysis'. Stobbe, Nov 2007.

EuP Preparatory Study 'Imaging Equipment' (Lot 4), Final Report on Task 5 'Base case Analysis'. Stobbe, Nov 2007.

EuP Preparatory Study 'Imaging Equipment' (Lot 4), Final Report on Task 6 'Technical Analysis BAT', Stobbe, November 2007.

Cover Memo Draft, C. Kent, Environmental Protection Agency of the U.S. (EPA), April 2008.

Energy Star Program Requirements for Imaging Equipment, Version 1.0.

DRAFT 2 Version 1.1 Energy Star Imaging Equipment Specification – Data Summary

Energy Star Program Requirements for Imaging Equipment Version 1.1 – DRAFT Final

Eric Bush, Anette Michel, Thomas Bruggmann: Energieeffizienz von Tintenstrahl-Multifunktionsgeräten. S.A.L.T., August 2008.

Topten Selection criteria Inkjet printers and multifunctionals
www.topten.info > Office Equipment > Inkjet printers/multifunctionals > Selection criteria
Topten Selection criteria laser printers or multifunctionals:
www.topten.info > Office Equipment > Laser printers / Laser multifunctionals> Selection criteria

Topten product lists:
www.topten.info – office equipment – Laser printers/Laser multifunctionals/ Inkjet printers / Inkjet multifunctionals