ENERGY STAR Imaging Equipment
Version 2.0 Specification Revision
Discussion Document

March 2011

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2 SUMMARY

This document is a summary of the highest-priority issues for consideration in the upcoming revision of the ENERGY STAR product specification for Imaging Equipment. The list of issues has been assembled from a number of sources, including:

- Stakeholder comments on the Final Draft Version 1.1 specification,
- Section 7, “Future Specification Revisions”, of the Version 1.1 specification,
- Comments made by stakeholders during the product qualification process,
- Telephone consultation with representatives of EU government agencies, and
- Issues noted by EPA and its contractors during review of qualified product submissions.

This document addresses issues related to both program scope and product testing: which products should be covered in a revised imaging equipment specification and how energy consumption should be measured. Additional issues relating to the development of a revised specification, such as grouping products into categories, setting of specification levels, etc., will be addressed at a later time. A tentative schedule for future discussions appears in section 7.

3 RATIONALLE FOR A SPECIFICATION REVISION

3.1 Qualified Products

EPA monitors the extent to which certain factors apply to each product category and accordingly prioritize specifications for each product category for potential revision. The circumstances prompting a revision can be varied but significant increase in market penetration of ENERGY STAR qualified models is a key driver. High market shares indicate an opportunity to provide consumers additional energy savings.

Table 1 shows market penetration for each type of product covered by the Imaging specification, and the applicable test method: Typical Electricity Consumption (TEC) and Operational Mode (OM). Note that shipments increased from 2008 to 2009 for mailing machines, printers, and copiers. Although qualified shipments *decreased* for digital duplicators, scanners, and multi-function devices (MFDs), some of the decrease may be due to a decrease in total (qualified and non-qualified) shipments. For example, the market penetration for scanners actually increased as unit shipments decreased. The high number of qualified shipments and resultant high market penetration has motivated EPA to begin a revision of the imaging equipment specification.

Table 1: Unit Shipment Data and Market Penetration for 2008 and 2009

Equipment Type	2008 ENERGY STAR Qualified U.S. Shipments ('000s)	2008 ENERGY STAR Market Penetration	2009 ENERGY STAR Qualified U.S. Shipments ('000s)	2009 ENERGY STAR Market Penetration	Year-Over-Year Growth in ENERGY STAR Shipments
Imaging Equipment	**14,256**	**43%**	**14,279**	**-**	**0%**
Copiers - TEC	-	-	149	-	-
Copiers - OM	-	-	0	-	-
Copiers - Total	**140**	**91%**	**149**	**78%**	**6%**
Digital Duplicators - Total	**16**	**NA**	**9**	**NA**	**-41%**
Fax Machines - TEC	-	-	256	-	-
Fax Machines - OM	-	-	0	-	-
Fax Machines - Total	**144**	**4%**	**256**	**7%**	**78%**
Mailing Machines - Total	**20**	**NA**	**24**	**NA**	**22%**
MFDs - TEC	-	-	1,704	-	-
MFDs - OM	-	-	7,258	-	-
MFDs - Total	**9,656**	**49%**	**8,962**	**47%**	**-7%**
Printers - TEC	-	-	3,128	-	-
Printers - OM	-	-	1,336	-	-
Printers - Total	**3,779**	**43%**	**4,463**	**67%**	**18%**
Scanners - Total	**502**	**87%**	**416**	**97%**	**-17%**

Note: EPA did not calculate market penetration for all equipment types (NA) and did not track shipments by TEC or OM in 2008. Also, note that the current Tier 2 (Versions 1.1 and 1.2) of the specification came into effect mid-year, on July 1, 2009.

Source: Shipment data provided by ENERGY STAR partners. Market penetration data from ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2008 Summary and 2009 Summary

3.2 Analysis of Major TEC Products

As noted in Table 1, TEC printers and MFDs, typically used in office settings, represent a large portion of shipments. Market research indicates that the standard-format high-speed laser electrophotography (EP) products that constitute the majority of TEC models qualified will continue to dominate the market. Single-function monochrome laser printers are expected to remain popular due to their low cost, while increased competition is expected to lead to lower prices and thereby stimulate demand for color laser MFDs. Shipments of products employing high-performance ink jet (another TEC marking technology) are also expected to grow.[1]

EPA analyzed the energy savings opportunities from a more stringent ENERGY STAR specification for color and monochrome TEC printers and MFDs qualified since July 1, 2009 (the effective date of Version 1.1). This initial analysis included grouping qualified models into bins by product speed, simulating a revised ENERGY STAR level corresponding to the top 25% of shipments for that bin, and calculating the energy savings of models that meet the new, more stringent level (for an eventual market penetration of 40%).

The initial analysis revealed a potential per-unit savings of 51 kWh/year and cumulative savings of 380 GWh/year. This significant savings potential has prompted EPA to pursue a specification revision.

Issue 1: To improve its energy savings estimate and help set revised specification levels, EPA seeks to expand its data set to included current non-qualified models. EPA will consider complete data received by April 1, 2011, using the data form attached to this discussion document.

4 SCOPE OF REVISED IMAGING EQUIPMENT SPECIFICATION

4.1 Analysis of Current Scope

Aside from high-volume TEC printers and MFDs, numerous other products are included in the scope of the ENERGY STAR Imaging Equipment specification, including several types of printers and MFDs qualified under the OM method, as well as copiers and digital duplicators. Some of these products do not present as high a savings opportunity due to their low shipments or lack of product differentiation, and their continued inclusion in the scope of the specification is discussed in the sections below.

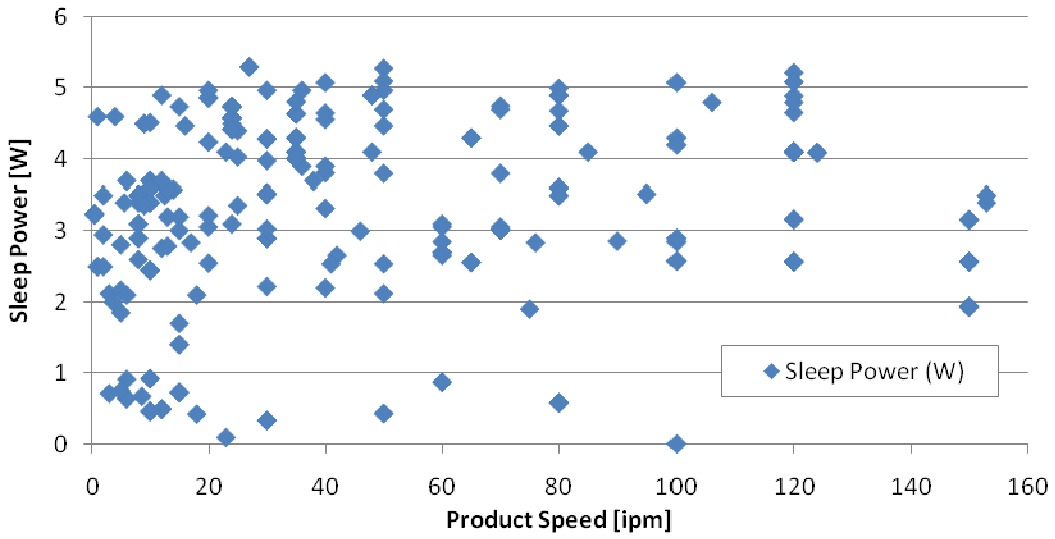
4.1.1 Scanners

The high market penetration for scanners (97% in 2009) indicates a specification level that is not sufficiently stringent and a resulting lack of differentiation between products. Scanners are currently qualified using the OM test method and must meet a standby power limit of 1 watt and sleep mode power limit of 4.3 watts (this applies to the main engine of the device, and does not include allowances for adders such as network interfaces, which may increase the total sleep mode power when tested).

A review of products qualified since July 1, 2009, indicates a wide distribution of sleep mode power for scanners with speeds below 160 IPM, as seen in Figure 1. EPA analysis indicates that revised specification levels such that only the top quartile of products could qualify would result in per-unit energy savings of 61%.

[1] Akia Ramsay. “IDC U.S. Peripherals 2010–2014 Forecast and Analysis.” No. 224070. August 2010.

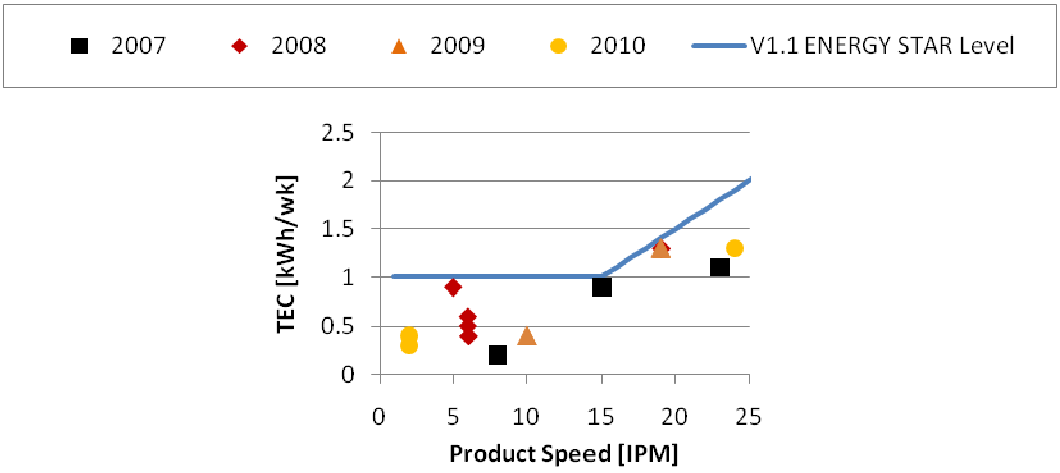
Figure 1: Sleep mode power with and without claimed functional adders for scanners qualified since July 1, 2009. (Excludes eight scanner models with speeds greater than 160 ipm.)



4.1.2 Fax Machines

Fax machines present the opposite issue as scanners: despite large numbers of U.S. shipments (3.7 million in 2009), ENERGY STAR market penetration is only 7%, with only 10 models qualified since the Version 1.1 specification came into effect in 2009 (and only one for use at 115 V in North America). The TEC of fax machines qualified at all voltages is shown in Figure 2. As can be seen in the Figure, several models at both the high and low ends of the TEC range can meet the specification with significant margins.

Figure 2: Energy consumption of non-ink jet fax machines qualified from 2007 to 2010 at 115 V and 230 V. (Note: no models qualified at 110 V.)



Issue 2: EPA seeks comment on the very high and very low market penetrations of scanners and fax machines, respectively, and on whether the ENERGY STAR label provides any differentiation in the market for these two equipment types. Please provide documentation on the state of the markets for faxes and scanners. (Note that scanners have not been included in the latest draft of the Industry Voluntary Agreement proposed for meeting the requirements of the Lot 4 Energy Using Products (EuP) Directive in the European Union.) EPA is interested in partner input on whether these products should continue to be of interest for ENERGY STAR labeling.

Issue 3: EPA also seeks comments on the characteristics of non-qualifying fax machine models and methods of promoting broader qualification.

Issue 4: EPA welcomes any further comment on the equipment types currently included in the scope of the imaging equipment specification, and whether any should be considered for removal due to low energy savings potential.

4.2 Potential Additions to Program Scope

4.2.1 Small-Format High-Performance Ink jet

One product manufacturer requested that EPA consider high performance ink jet (IJ) printers with maximum width of 8 inches (small format) for eligibility. Currently, only standard-format high-performance IJ products are included. Small-format high-performance IJ products do not yet appear to be available on the market; however, they could be included within the scope of the revised specification, and held to the same OM requirements as other small-format printers. (Note: standard-format high-performance IJ printers are qualified using TEC.)

Issue 5: EPA seeks comment on the current and potential prevalence of small-format high-performance IJ printers and welcomes product performance test data.

4.2.2 Impact Marking for MFDs

It has also been requested that EPA consider MFDs with impact marking technology for eligibility. Currently, only impact printers are included in the scope (and qualified using the OM method), but manufacturers have been turning those products into impact MFDs by adding scanning capability. A similar approach could be taken with these products as with the small-format high performance IJ printers, above, namely grouping them with similar products under the OM test method.

Issue 6: EPA seeks comment on the current and potential prevalence of impact MFDs and welcomes product performance test data.

Issue 7: EPA also seeks comment on any other imaging equipment products with significant savings potential that should be added to the scope of the specification. (E.g., professional photo “minilabs”.)

5 TEST METHOD ISSUES

The following issues pertain to the ENERGY STAR test method, which includes the OM and TEC measurement procedures. These should be addressed first, as changes to the test method could require new testing before the specification can be revised.

5.1 Test Setup and Product Configuration

5.1.1 IEC Standard 62301

The International Electrotechnical Commission (IEC) has recently published Edition 2.0 of IEC standard 62301 “Household Electrical Appliances – Measurement of Standby Power.” Edition 1.0 of this standard influenced and is also directly referenced by the ENERGY STAR Imaging Equipment test method.

The revised standard includes several substantive amendments, such as improved testing requirements (additional emphasis on uncertainty and stability) and a list of voltages for test (already incorporated into the Version 1.2 test method).

Issue 8: EPA welcomes stakeholder comment on the impacts of incorporating IEC standard 62301 Ed. 2.0 into the ENERGY STAR Imaging Equipment test method.

5.1.2 Testing Color Devices Using Color Mode

The current ENERGY STAR test method requires color-capable imaging equipment to be tested with monochrome images; however, this may not be representative of typical use. Testing in both color and monochrome modes performed during the development of the first version of the TEC test method in April 2005[2] indicated that color printing consumes the same amount of energy as monochrome printing for parallel color printers. Serial color printers did exhibit higher energy consumption when printing in color mode; however, the *relative* energy consumption (i.e., the ordering of the units that ultimately determines ENERGY STAR qualification) was not significantly affected. Therefore, color testing was not included in the resulting test method.

The 2005 color printing evaluation used a modified test pattern from ISO/IEC standard 10561:1999, in which a monochrome text document was modified such that the (color) printer would have to use all four colors to produce the image.[3] Since the test image was still a text document, it remains unclear whether color printing of a full-page color image or photograph would consume additional energy. Furthermore, even if color printing is shown to consume more energy, there remains the question of whether color printing is used frequently enough to justify the additional burden of color testing.

Issue 9: EPA would appreciate data on the prevalence of color printing with current products, including color in text documents and full-page color images. EPA also seeks data on the impact of color printing of text and images on the absolute and relative energy consumption of imaging equipment.

Issue 10: EPA seeks data on the prevalence of color versus monochrome printing since the energy impact of color printing is a product of its frequency of use.

5.2 TEC Test Method

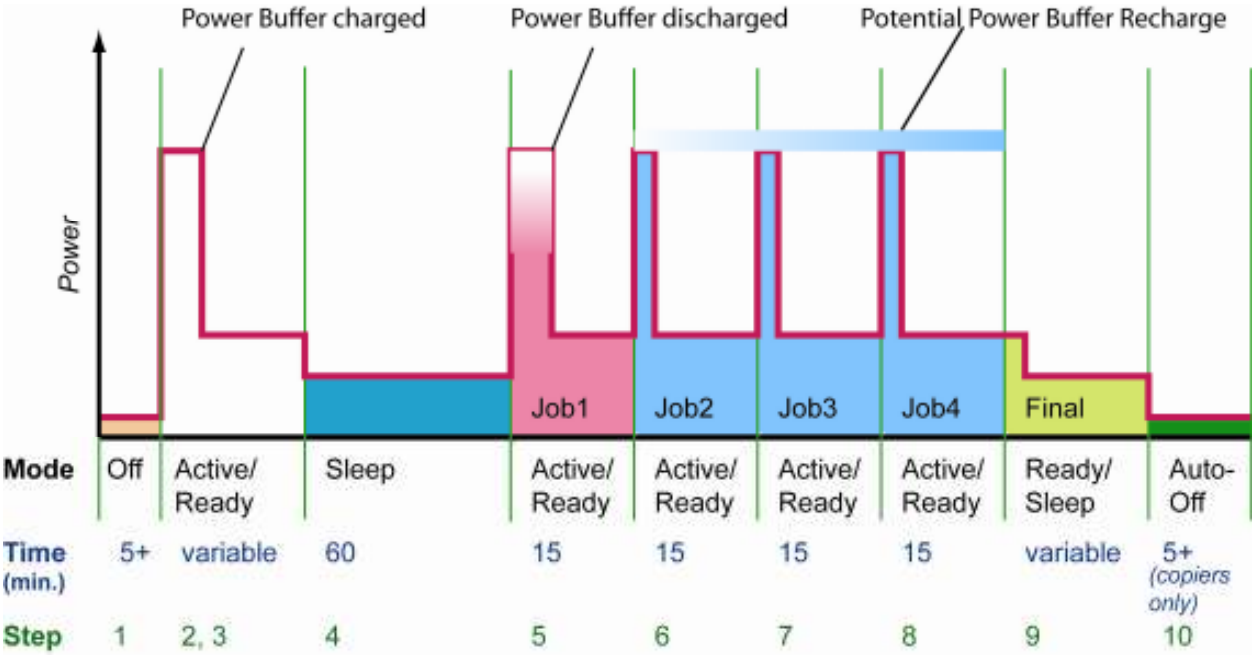
5.2.1 Drum Warm-up Using Stored Energy

EPA believes that the current TEC test method may not account for all the energy used to warm up the drum that fuses toner to paper in EP products if it is stored in a capacitor or battery (a “Power Buffer”) prior to the start of a print job and then discharged to speed up recovery from sleep. Although this function could improve the user experience, it may cause under-reporting of energy consumption. As shown in Figure 3, a printer may store energy in the Power Buffer during Step 2 of the TEC test method for use later in the test; the energy consumed during this step is not currently recorded. Also, it is unknown whether the Power Buffer would be recharged (and therefore measured) during a later portion of the test.

[2] “ENERGY STAR® Qualified Imaging Equipment Typical Electricity Consumption (TEC) Test Procedure Rationale.” July 11, 2005. p. 1. http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/TECTPRationale.pdf

[3] “ENERGY STAR® Qualified Imaging Equipment Final Draft Test Procedure Typical Electricity Consumption.” April 15, 2005. p. 6. http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/img_equip/April15_TEC_Test_Procedure.pdf

Figure 3: Illustration of TEC Test Method Steps and Potential for Under-reporting Energy Consumption when Using Stored Energy to Heat Drum



Methods of accounting for this energy include:

- Requiring printing for several cycles, such that any stored energy is depleted, and then using only the energy measured over the final cycle or an average cycle to evaluate performance.
- Measuring energy consumed over the entirety of a print cycle, rather than just the job and sleep energy.

Issue 11: EPA seeks comment on the prevalence of storing drum warm-up energy in a Power Buffer prior to the beginning of measurement and any effects on the energy consumption of the product.

5.2.2 Print Driver Settings

The TEC test method does not currently specify printer driver settings that must be used when sending jobs to a printer or other imaging equipment with print functionality. Testers could conceivably change the driver settings (e.g., by printing in draft mode or rasterizing the image on the computer), which could decrease the printing time, thereby decreasing the measured energy use.

Issue 12: EPA seeks comment on the impact of print driver settings on a TEC product's energy consumption as well as methods of eliminating this potential source of testing variation.

5.2.3 Revising the TEC Test Method Instructions

EPA has identified several areas where the TEC test method could be further amended to make it clearer and/or simpler:

- In the current test method, it could be unclear to a third-party tester when a device has reached its final sleep mode. Version 1.2 instructions specify that if unsure, the tester should wait 4 hours. As an alternative, the manufacturer could specify a power level below which the product could be considered to be in its final sleep mode. This proposed change would eliminate ambiguity about product power modes and streamline the testing process.

- The TEC test method requires measurements of both energy and time in sleep and auto-off modes. These values are used in the specification to calculate power consumption. It may be simpler to permit testers to measure the power consumption directly, if stable, using methods specified in IEC standard 62301.

Issue 13: EPA welcomes comment on the above two areas for clarification and/or simplification. Alternatively, EPA also welcomes suggestions for additional edits to the TEC and OM test methods.

5.2.4 TEC Test Method Usage Assumptions

During the development of the Version 1.1 specification, EU efficiency agencies commented that the TEC usage assumptions that go into calculating job size and the number of jobs per day are too intensive and may result in an artificially high estimate of paper use and energy consumption, as indicated by top-down market studies of annual paper use.[4] Similarly, a test method developed by Buyers Laboratory, Inc. (BLI) results in lower average energy consumption when compared to the ENERGY STAR TEC method across several units. However, the effect is not consistent: the percentage difference between the results of the ENERGY STAR TEC and BLI test methods ranges from -72% to 45% for the units tested.

EPA may consider changes to the TEC usage assumptions; however, any change would invalidate existing TEC test data so that the potential benefit of a more accurate TEC value would need to be balanced against the burden of retesting.

Issue 14: EPA welcomes comment and usage data that could be used to support more representative usage assumptions for the TEC test method. In particular, EPA would appreciate data from manufacturers engaged in managed print services, who track the number of sheets printed as well as time spent in various modes across an entire fleet of imaging products.

5.3 TEC and OM Test Methods

5.3.1 Recovery Times

Many manufacturers commented that a revised specification should take into account recovery time—the time required for an imaging product to leave a lower-power mode and begin a primary function (e.g., printing), while EU member states commented that recovery times should be investigated.

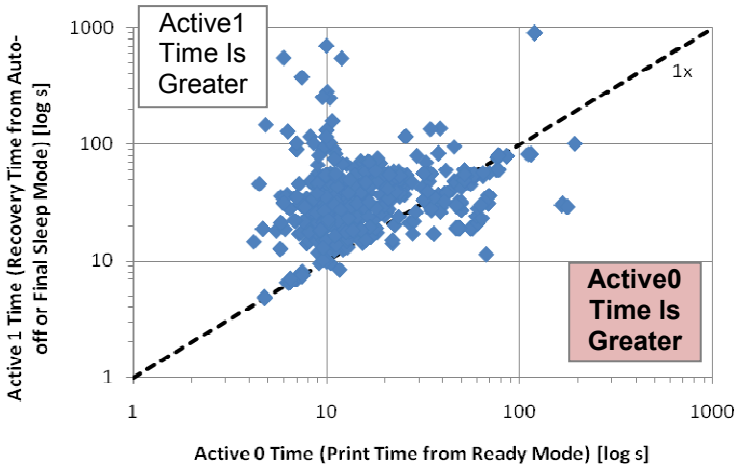
Recovery time is important, as it determines the impact of low-power modes on imaging equipment productivity. Products with long recovery times may frustrate users, leading to the disabling of energy-efficient features, thus compromising their energy-saving potential.

The ENERGY STAR TEC test method currently addresses recovery time through the measurement of Active0 time (the time required to print a page from ready mode) and Active1 time (the time required to print a page from sleep mode). Analysis of these measurements reveals that Active1 time varies greatly among TEC products, from several seconds to hundreds of seconds, as shown in Figure 4. Surprisingly, for some products, Active0 time is greater than Active1 time, indicating that it takes longer to print from sleep than from ready mode—as much as 6 times longer in some cases.

As this seems improbable, EPA believes that the test method is not being implemented correctly, perhaps due to confusion regarding the definition and measurement of Active0 time and Active1 time.

[4] Öko-Institut and Fraunhofer IZM. "EuP Preparatory Studies 'Imaging Equipment' (Lot 4) Final Report on Task 3 'Consumer Behavior and Local Infrastructure' ". November 2007. p. 13. http://www.ecoimaging.org/doc/Lot4_T3_Final_Report_2007-11-12.pdf.

Figure 4: Recovery time versus print time from Ready Mode for TEC products with speeds 20–60 ipm (typical office equipment where recovery time would be the biggest concern) tested at 115 V.



Issue 15: EPA welcomes comment on the apparent discrepancy between Active1 time and Active0 time, as well as any test method clarifications that could eliminate this discrepancy.

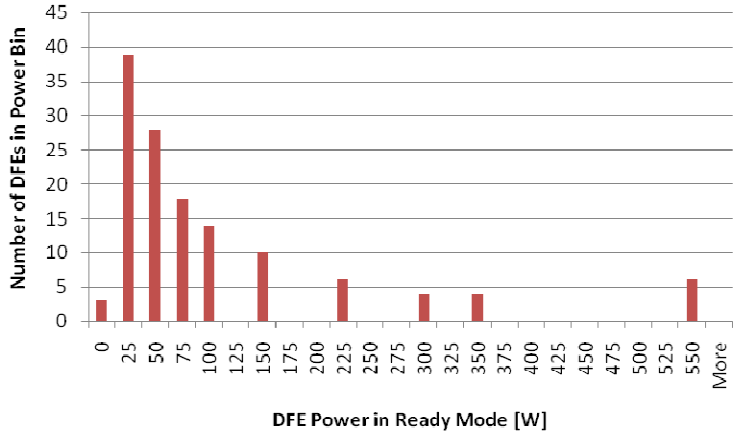
Issue 16: Further, EPA welcomes comment on including a similar measurement of Active1 time and Active0 time into the OM test method.

Issue 17: Finally, EPA has received comments on setting a specific maximum recovery time and a default recovery time. EPA would appreciate receiving supporting data from partners to justify the energy savings associated with specifying a recovery time requirement.

5.3.2 Treatment of DFEs

Digital Front End (DFE) power or energy consumption is currently excluded from the qualification process: it is either not measured or, if not possible, the DFE power is subtracted from that of the imaging product itself. As a result, there is no limit on the energy consumption of DFEs, and some DFEs consume upward of 100 W in ready mode, as shown in Figure 5.

Figure 5: Distribution of DFE power in Ready Mode for ENERGY STAR qualified products.



EPA is currently considering ways of reducing the energy consumption of DFEs, including:

- Promoting DFE qualification as a server or small-scale server, as defined in the ENERGY STAR Servers and Computers specifications, respectively;
- Treating DFEs as functional adders;
- Incenting or requiring a sleep mode for DFEs (with a power limit and maintenance of full network connectivity) when imaging equipment is in sleep mode; and
- Considering the DFE an integral component of the imaging equipment and recording the DFE power measured through the test method

Issue 18: EPA welcomes comment on the best method of addressing the energy consumption of DFEs.

5.3.3 Additional Test Method Issues

EPA seeks comment on the following issues pertaining to the TEC and OM test methods:

Issue 19: Specifying that only one network/data connection be used during testing.

Issue 20: Specifying the type of network connection active during testing, in order of preference (e.g., USB, Ethernet, WiFi, other wired, other wireless, etc.). These are currently unspecified (except for an instruction that the device be connected to the network if an interface is available);

Issue 21: Specifying the state of the network connection during testing (could impact the energy consumption of the product under test);

Issue 22: Specifying that any fax function, if available, be enabled and connected to the phone line during testing to better represent the typical usage scenario.

Issue 23: Measuring and/or specifying the default delay time to sleep for TEC products;

Issue 24: For imaging equipment that supports Energy Efficient Ethernet, requiring that the network device connected to the imaging equipment during the test also support Energy Efficient Ethernet; and

Issue 25: Applying the TEC test method or on-mode measurement to some OM products that spend significant time in active mode (e.g., receipt printers, ink jet printers for business, etc.).

6 LIFE-CYCLE IMPACTS

The goal of the ENERGY STAR program is to reduce greenhouse gas (GHG) emissions via energy efficient technologies and best practices. In an effort to secure greater GHG reductions, EPA is considering how to respond to consumer interest in environmental benefits beyond just the use phase. This is, in part, an effort to guard against unintended consequences where non-use phase GHG impacts are similar to or exceed those during the use phase. EPA is interested in input regarding opportunities to provide incentives to manufacturers that engage in GHG reporting and reduction activities.

During the last specification revision, EPA noted that it would be interested in further input on quantifying the greenhouse gas impacts of imaging equipment products outside of use phase. Recently EPA conducted a high level screening of ENERGY STAR product categories to identify opportunities or risks represented by non-use phase GHG emissions. EPA worked with Dr. Sangwon Suh, of the Bren School of Environmental Science and Management at UC Santa Barbara, to run an economic input output life cycle assessment (LCA) and identify product categories that present opportunities for further reducing GHG emissions. The analysis showed that short-lived products, such as some of the imaging equipment products, presented a potential vulnerability for the program as well as an opportunity for EPA to offer consumers a higher level of environmental benefit.

EPA will seek to reduce the GHG emissions associated with these ENERGY STAR products during the Version 2.0 specification process. Further, as the ENERGY STAR program and the marketplace mature,

EPA is considering how it can respond to consumer interest in other environmental benefits such as lower toxicity in their ENERGY STAR products.

Issue 26: EPA seeks clarification on sources of high GHG emissions in the imaging equipment life cycle and supporting data. EPA would welcome input from stakeholders on any work they may have conducted on life cycle impacts of imaging equipment, including the results of any life-cycle analyses (LCAs).

7 NEXT STEPS AND SCHEDULE

EPA welcomes written comment from stakeholders on the issues presented above through **Friday, April 1, 2011**. Please send all comments and supporting information to imagingequipment@energystar.gov. EPA will also host a webinar to further discuss the issues, propose approaches to resolving them, and receive additional input on **Wednesday, April 13, 2011**. Please RSVP to imagingequipment@energystar.gov by Monday, April 12, to receive call-in information.

The above dates as well as further process steps are outlined in Table 2, below. Please note that the final schedule depends on the extent of changes to the test method: significant changes would require new testing and a dataset assembly period during the second or third quarter (Q2–Q3) of 2011.

Table 2: Specification Development Schedule (Note that Specification Development Will Be Accelerated if There Are No Significant Changes to the Test Method)

Deadline for Written Comments on Scope and Test Method Issues	April 1, 2011
Imaging Equipment Webinar	April 13, 2011
Revision of Test Method (If Necessary)	Q2 2011
Dataset Assembly In Accordance with New Test Method (If Necessary)	Q2–Q3 2011
Draft 1 Version 2.0 Specification and Stakeholder In-Person Meeting	Q3 2011
Additional Draft Version 2.0 Specifications and Stakeholder Webinars	Q4 2011
Final Version 2.0 Specification	Q4 2011
Version 2.0 Specification Effective	Q3 2012