# Life Cycle Greenhouse Gas Assessment Summary Report

# Kodak Alaris models E1025/E1030, E1035/E1040, S2040, S2050, S2060w, S2070, S2080w Scanners ISO 14044 Protocol


Roy Wood
Roy Wood Independent Environmental Engineer
Created for Kodak Alaris
June 2019

Amended January 2023

# Summary

Kodak Alaris conducted an ISO 14044 Greenhouse Gas (GHG) Life Cycle assessment of seven Kodak Alaris desktop scanner models, E1025, E1035, S2040, S2050, S2060w, S2070, and S2080w. The models E1025 and E1035 were later upgraded to models E1030 and E1040 respectively. The upgrade increased scanning throughput while maintaining identical physical design. This assessment included the full life cycle - raw materials, manufacturing, packaging, distribution, use, and end of life. These GHG assessments were undertaken to meet several objectives:

1. Identify the key drivers of GHG emissions from these scanners to provide data to use to reduce the life cycle GHG emissions of future versions of these and other scanner models.
2. Provide average scanner GHG emissions data for use by Kodak Alaris customers.
3. Meet the optional IEEE 1680.2 Imaging equipment EPEAT greenhouse gas emissions requirement in 4.5.2.1.
4. Provide the life cycle inventory data to the US National Renewable Energy Laboratory Life Cycle Assessment Database.

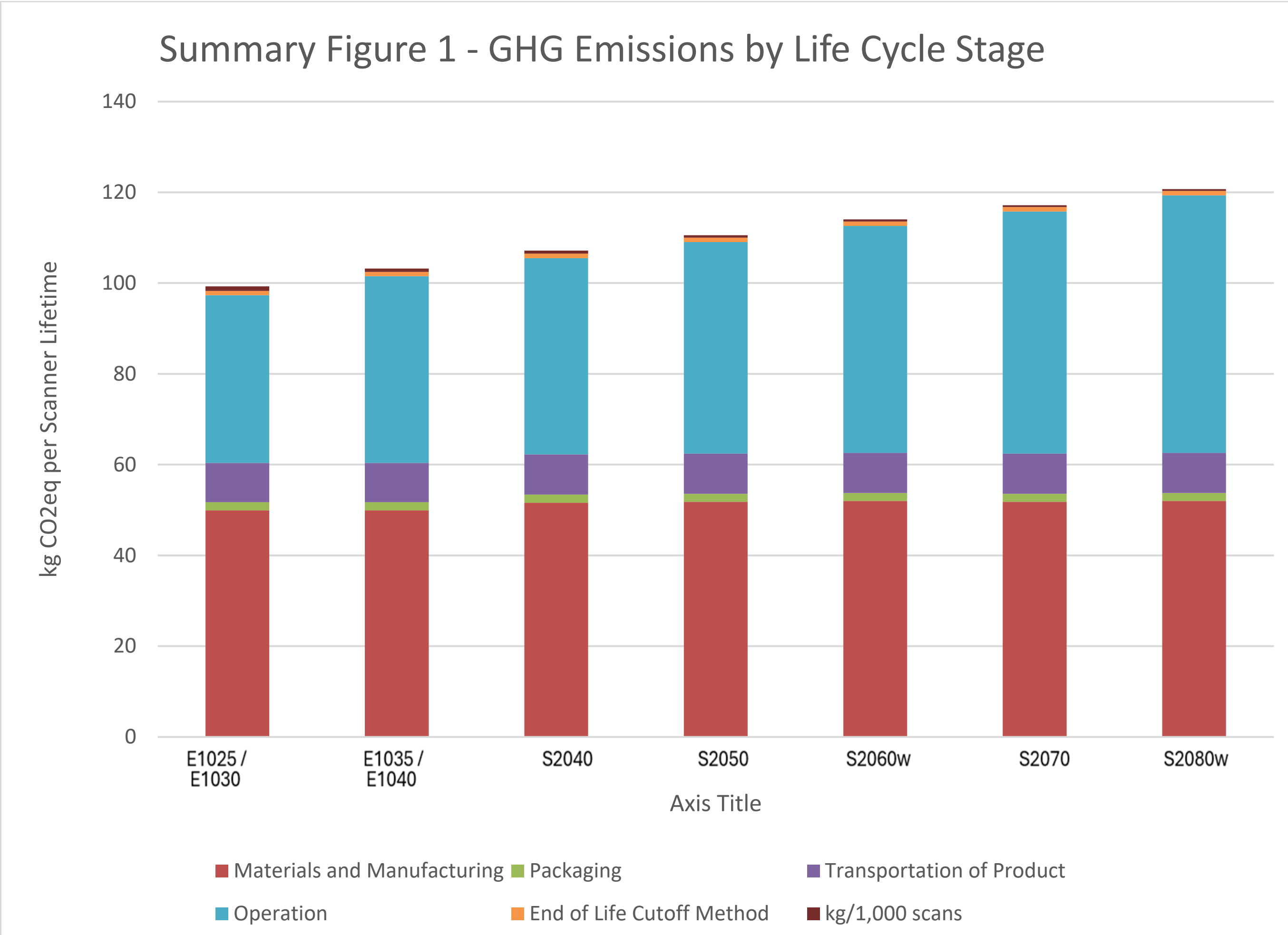
The GHG emissions calculations were based on IPCC 2013 GWP 100a Version 1.02 (100-year timeframe). The primary functional unit of this study was one scanner life, with a secondary functional unit of 1000 A4 scanned images. These two units are inter-convertible when combined with the user scenario as discussed in the Functional Units section.

Summary Table 1 contains the average GHG emissions results for the full life cycle using the base case of 3 years of useful life. Key GHG emitting life cycle stages for all models were operating energy during the use phase and the combined raw materials and manufacturing phase. As expected, total emissions increased as the model output increased, largely due to higher user energy consumption. However when expressed as GHG emissions per 1000 scans, the higher output the scanner the fewer GHG emissions per scan, making the higher output models more efficient per scan.

**Summary Table 1 - Summary of Scanner GHG Emissions (kg CO2eq/scanner life) (IPCC 2013 GWP 100a V1.02)**

| Scanner Model | Scans/ Life | Materials and Mfg. | Packaging | Transportation of Product | Operation | End of Life Cutoff Method | Total | kg/ 1,000 scans |
|---|---|---|---|---|---|---|---|---|
| E1025/E1030 | 99,450 | 50 | 1.8 | 8.7 | 37 | 0.9 | 98 | 0.99 |
| E1035/E1040 | 139,230 | 50 | 1.8 | 8.7 | 41 | 0.9 | 102 | 0.74 |
| S2040 | 159,120 | 52 | 1.8 | 8.8 | 43 | 1.0 | 106 | 0.67 |
| S2050 | 198,900 | 52 | 1.8 | 8.8 | 47 | 1.0 | 110 | 0.55 |
| S2060w | 238,680 | 52 | 1.8 | 8.9 | 50 | 1.0 | 114 | 0.48 |
| S2070 | 278,460 | 52 | 1.8 | 8.8 | 53 | 1.0 | 117 | 0.42 |
| S2080w | 318,240 | 52 | 1.8 | 8.9 | 57 | 1.0 | 120 | 0.38 |

The total lifetime GHG emissions data from Table 1 is shown graphically and ordered by increasing scan rate in Summary Figure 1. Results are similar across all scanner models, except that use phase emissions increase as the scanner output increases.

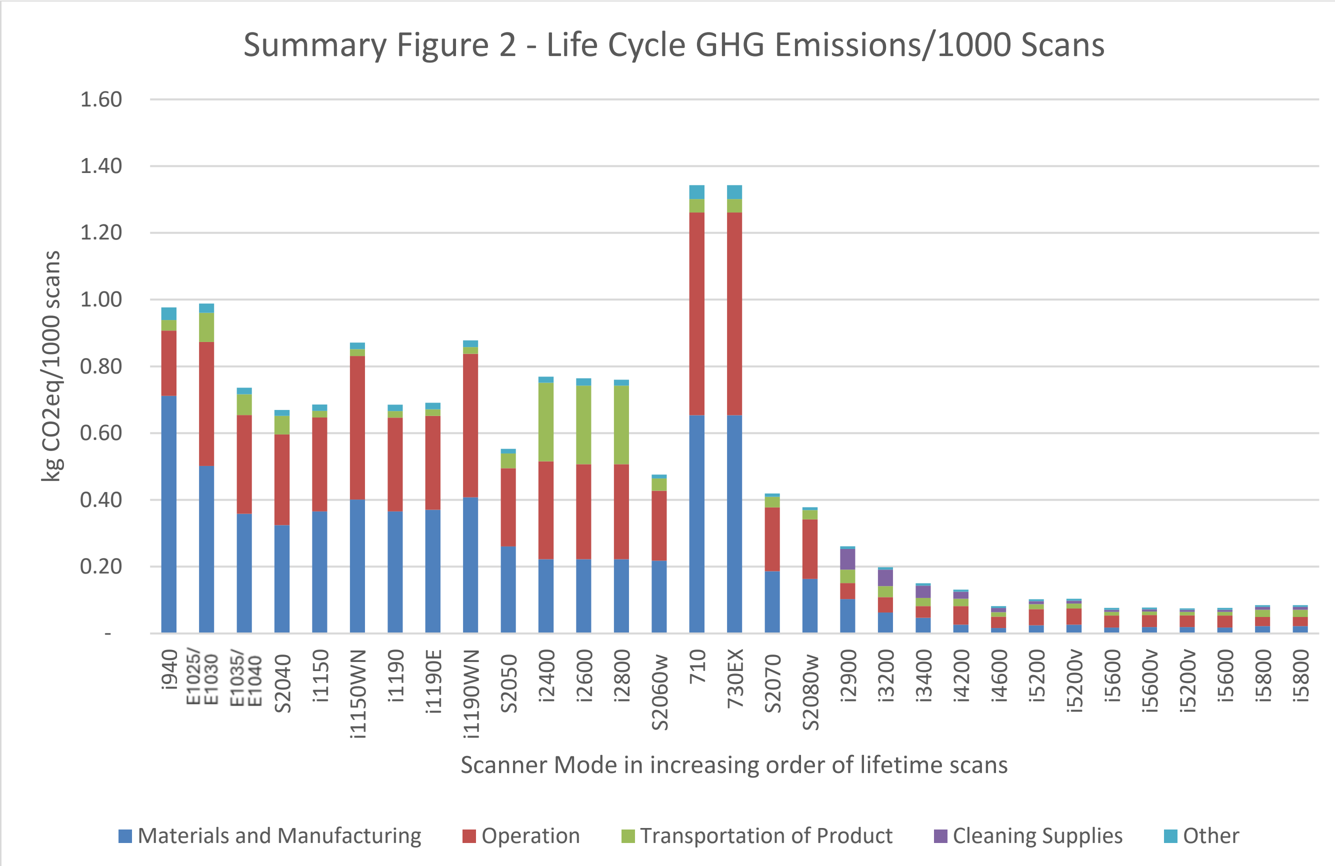



Summary Table 2 breaks down the GHG emissions further into the key sources of emissions. For the lowest output E1025/E1030 models, energy during sleep mode, energy during ready/idle mode, plastic components, and printed circuit boards all contribute between 15 and 21% of the total GHG emissions. Other significant contributors are manufacturing electricity, 9%, air transport, 7%, and metals, 4%, and 10% of the GHG emissions from other smaller sources. All other models have similar distributions except for the use phase. As model output increased the amount of GHG emissions from sleep phase dropped, while the quantity of GHG emissions from the ready idle mode increased. Ready/idle mode emissions increased as the model output increased, with the highest output model, S2080w, creating 2 ½ times the GHG emissions as the lowest output model, E1025/E1030. The sleep mode emissions dropped by about 80% from the E1025/E1030 to the S2080w model, since the S2080w only sleeps at the end of the workday before going into the off mode under the typical use scenario. Overall the higher output models had a higher use phase emissions (since ready/idle consumes 3 times as much power as sleep mode), slightly decreasing the percentage of total GHG emissions from other sources.

**Summary Table 2 – Key Contributors to Life Cycle GHG Emissions – Percentage of Total Life Cycle**

| Scanner Model | Ready/Idle Energy | Sleep Energy | Plastics | Circuit Boards & Electronics | Electricity at Mfg. Plant | Ferrous Metals | Air Transport | Misc. |
|---|---|---|---|---|---|---|---|---|
| E1025/E1030 | 17% | 16% | 21% | 15% | 9% | 4% | 7% | 10% |
| E1035/E1040 | 23% | 13% | 21% | 15% | 9% | 4% | 7% | 7% |
| S2040 | 26% | 11% | 20% | 14% | 8% | 4% | 7% | 9% |
| S2050 | 30% | 9% | 20% | 14% | 8% | 4% | 7% | 9% |
| S2060w | 34% | 7% | 19% | 14% | 8% | 4% | 6% | 9% |
| S2070 | 38% | 5% | 20% | 14% | 8% | 4% | 7% | 5% |
| S2080w | 41% | 3% | 19% | 14% | 8% | 4% | 6% | 5% |

Summary Figure 2 displays the GHG emissions per 1000 scans for all the models in this study and all the models previously assessed during previous life cycle assessments. The models are arranged from the models with the fewest numbers of images scanned per lifetime to those with the most. The general trend was fewer emissions per scan as the number of scans increased. All the larger, high volume production scanners were much more efficient than the smaller volume scanners, largely due to fewer emissions per scan from materials and manufacturing and operating energy. The E-series models fell about where expected on the chart. The five S-series models had lower emissions than would have been predicted for the output of the model based on the other previous models, indicating significant improvements in overall life cycle emissions per scan. This reduction occurred because S-series GHG emissions from materials and manufacturing and, to a lesser extent, energy use were lower than predicted from the previous models. Air transport GHG emissions from all S-series and E-series models was much lower than for the older i2000 series.




**Key conclusions from this study are:**

1. The use phase and manufacturing and materials combined phase contributed the majority of GHG emissions.
2. The majority of use phase GHG emissions were from sleep and the ready/idle modes. These emissions can be reduced by reducing the power consumption from these modes and going from the ready/idle mode to sleep faster and going from sleep to off faster.
3. Printed circuit boards and Teflon were the two types of materials that contributed key quantities of GHG emissions per pound of material and were significant overall contributors to GHG emissions, so reduction of these materials would have significant impact on GHG emissions.
4. Overall material use was a large contributor to GHG emissions, so any reduction in weight will also reduce GHG emissions.
5. Air transport continues to be a smaller overall contributor, but is still significant. Further substitution of ocean transport for air transport would further diminish the transport GHG emissions.
6. Significant reductions in GHGs/scan would be achieved by increasing the lifetime of these scanners. The ability to upgrade the technical capabilities of the scanners to keep them from becoming technologically obsolete would reduce the GHG emissions per scan from materials, manufacturing, packaging, transport and EOL.
7. The GHG emissions per scan for the lower output E-series scanners were in the same range as previous models with similar outputs. However the higher output S-series models and the S2040 model had lower emissions due to lower use phase emissions, lower emissions from materials, and lower air transport emissions.

**Table of Contents**

## Tables



## Figures



## Attachments

1. Scanner Brochures
2. Scanner Data Request
3. Additional Detail on Data and Sources
    a. Scanner and Packaging Data Sources and Values
    b. Electricity Background Data
4. Calculation Spreadsheets
5. SimaPro Life Cycle Emissions Results – Flowchart Format
6. Roy Wood's Resume

# Introduction

This report covers the full life cycle greenhouse gas (GHG) emissions assessment of seven Kodak Alaris desktop scanner models, E1025, E1035, S2040, S2050, S2060w, S2070, and S2080w. The models E1025 and E1035 were later upgraded to models E1030 and E1040 respectively. The upgrade increased scanning throughput while maintaining identical physical design. This included the full life cycle - raw materials, manufacturing, packaging, distribution, use, and end of life (EOL). These GHG assessments were undertaken to meet several objectives:

1. Identify the key drivers of GHG emissions from these scanners to provide data that can be used to reduce the life cycle GHG emissions of future versions of these and other scanner models.
2. Provide average scanner GHG emissions data for use by Kodak Alaris customers.
3. Meet the optional IEEE 1680.2 Imaging equipment EPEAT greenhouse gas emissions requirement in 4.5.2.1.
4. Provide the life cycle inventory data to the US National Renewable Energy Laboratory Life Cycle Assessment Database.

This GHG Assessment covered the full life cycle of each of these scanners and was based on data from the bill of materials, the assembly facility, the distribution plan, typical users, and best knowledge of end of life scenarios. Customized data was used for each scanner model, although for some life cycle stages, the data was the same for multiple models. Where data from previous studies was useful, it was leveraged for this assessment. Because these scanners are used in variable office environments, there is a range of actual use scenarios and transportation modes and distances for each model, which impacts the scanner's GHG emissions. The base case calculations used weighted average transportation distances and modes and typical use scenarios. Emissions from high and low use scanner operating modes was also presented under alternative operating modes.

The primary functional unit for this study was one scanner life, with a secondary functional unit of 1000 A4 scanned images. These units are inter-convertible when combined with the user scenario data as discussed below in the section on Functional Units.

**<u>GHG Assessment Methods (5.2(e)(1), (5), (6), (7))</u>**

The GHG emissions calculations were based on IPCC 2013 GWP 100a Version 1.02 (100-year timeframe). This is the most recent version available of the IPCC 100 year timeframe in the Simapro software used to compute full life cycle GHG emissions. The 2016 scanner life cycle assessment used this version. Kodak Alaris had previously calculated life cycle greenhouse gas emissions in 2012 and 2013 for many scanners using the previous version of this methodology (IPCC 2007 GWP 100a Version 1.02). Changes between and 2007 and 2013 IPCC methodology have minimal impacts on the results, so the results from all four assessments are readily comparable. This GHG protocol is the most widely respected and used protocol for assessing GHG emissions.

As a comparison to the base case calculations, IPCC 2007 GWP 500a Version 1.02 (500-year timeframe) and IPCC 2007 GWP 20a Version 1.02 (20-year timeframe) were also used in some earlier assessments of other models to calculate the life cycle GHG emissions. Although there were small variations in GHG emissions consistent with expectations, the use of these alternative timeframes in the initial assessment did not change any conclusions or create any additional actionable results. Using these additional GHG timeframes were not expected to change any conclusions or create actionable results in the current study. Therefore, these alternative GHG timeframes were not used for the scanners in the current study.

Simapro version 8.5.2.0 life cycle assessment software with its available datasets was used to conduct these GHG assessments. Earlier versions, Simapro versions 8.2.0.0 and 7.3.3 software were used for previous studies. The changes between versions are not believed to significantly impact results.

Roy Wood of Roy Wood Independent Engineer (See resume in Attachment 4) conducted this and previous assessments (5.2(a)(1)). The other primary members of the team were Jay Mathewson, Kodak Alaris EHS Division, who has worked on life cycle assessments previously and William Kiley of Kodak Alaris Scanner Operations. They conducted an internal review of the report.

This GHG Assessment followed ISO 14044 methodology. The report is organized to be consistent with the reporting requirements of ISO 14044 and is largely organized in the same order as the ISO 14044 Section 5 reporting requirements. However the order of Section 5 is not strictly followed in situations where a different organization provides better clarity for the reader. Numbering for ISO 14044 reporting and requirements is included in parentheses throughout the report (i.e. (5.2(a)(3)) means section 5.2(a)(3) of ISO 14044).

**Goals for the Study**

As discussed in the introduction, the goals of the study were (5.2(b)(1)):

1. Identify the key drivers of GHG emissions from these scanners to provide data that can be used to reduce the life cycle GHG emissions of future versions of these and other scanner models.
2. Provide average scanner GHG emissions data for use by Kodak Alaris customers.
3. Meet the optional IEEE 1680.2 Imaging equipment EPEAT greenhouse gas emissions requirement in 4.5.2.1.
4. Provide the life cycle inventory data to the US National Renewable Energy Laboratory Life Cycle Assessment Database.

A previous life cycle assessment of the i2400, i2600, and i2800 scanners showed a strong correlation between GHG emissions and overall environmental impact. Although not perfectly representative of all environmental impacts, the LCA provided support that GHG emissions identify most key contributors to significant environmental impacts. Since GHG emissions appear correlated with other environmental impacts and the other primary drivers were meeting the EPEAT GHG requirements and providing GHG information to customers, it was decided that GHG emissions would be the only environmental impact evaluated. Given the drivers of the study, the additional cost of addressing a wider range of environmental impacts was not justified (5.2(e)(5)).

The key contributors to GHG emissions will be considered when modifying future designs of these and other scanner models (5.2(b)(2)) as was done with previous GHG assessments. The results from this assessment will also be used internally to help understand the GHG emissions impact of these scanners in relation to other Kodak Alaris scanners and in relation to other brands' scanners.

They may also be used to help calculate corporate Scope 3 GHG emissions and to understand the impact of scanners on Kodak Alaris' overall sustainability strategy. However, there is no intention to use this study for comparative marketing purposes (5.2(b)(4)). Kodak Alaris will make no claims that these scanners have lower or preferable GHG emissions or environmental impacts compared to another company's scanner(s) based on this GHG Assessment, because it was not the study's intention to do so and competitors' models were not included in this study 5.2(e)(8).

The key audience for this assessment will be Kodak Alaris personnel, particularly Scanner business and engineering personnel who can impact future scanner designs and goals (5.2(b)(3)) and Environment, Health and Safety staff. Additionally, a summary of the study may be placed on the Kodak Alaris website for use by interested parties and the study or a summary may also be distributed in other forms. Summary data will also be provided to customers as requested and the information used to help customers assess and minimize their GHG emissions. Life Cycle data will be provided on the US National Renewable Energy Laboratory (NREL) Life Cycle Assessment Database for use by the wider audience of people interested in using life cycle inventory data.

## GHG Assessment Parameters

**Scope of the Study**

This study assessed the full life cycle GHG emissions (raw materials, manufacturing, distribution, use, and end of life) of seven Kodak Alaris desktop scanner models, E1025/E1030, E1035/E1040, S2040, S2050, S2060w, S2070, and S2080w. The primary function of each scanner is to capture images from a variety of hard-copy sources, and convert them to digital, searchable formats. The different scanner models are designed with specific customer workflows in mind and, therefore, vary with respect to rated speed, size, and features. A more detailed description of the scanner performance characteristics is contained in Attachment 1- Scanner Brochures (5.2(c)(1)(i)). A picture of the S2080w scanner is also on the cover of this report. There are no excluded capabilities in this GHG Assessment (5.2(c)(1)(ii)).

Most of the scanners are assembled in Shanghai or Guangzhou, China, primarily from subcomponents manufactured in China. Based on 2018 data, about 30% of the scanners are sold in North America, with more sales in the US than any other single country. About 30% of the scanners are sold in the Europe, Africa, Middle East, primarily in Europe. 20% are sold in the Greater Asia Pacific Region, primarily in China, and 20% are sold in the Latin America Region. 90% are shipped by ocean freight with trucking from the port, although 10% are shipped by air with trucking from the airport. The distances shipped are estimated averages for each region.

**Functional Unit**

The primary functional unit of this study is one scanner life, as described below, with a secondary functional unit of 1000 A4 scans (A4 images are 210 mm x 297 mm, which is 7.3 x 11.7 in). The secondary functional unit (1000 A4 scans) is the actual function of a scanner, but this was not chosen as the primary functional unit because users typically purchase a scanner to conveniently serve a particular person or location rather than to maximize scanner output. Kodak Alaris scanners typically continue to function properly at the end of their life, but are replaced due to technological improvements in the next generation of scanners. Therefore, for the majority of users, impact per scanner life is more meaningful and more readily understood. 1000 A4 scans is presented as a secondary functional unit because it represents actual output and is more appropriate when evaluating different scanner lifetimes or different lifetime scan volumes (5.2(c)(2)(i)). Impact per 1000 A4 scans is also a means of normalizing the comparison and efficiency of scanners with different scanning rates and volumes.

For the average case, the functional unit of one scanner life is based on the operating conditions shown in Table 1 – Scanner Overview Data. The average unit operates during the normal business day 10 hr/day, 5 day/week, 52 weeks/year. High, low, and typical scanning volumes were modeled. Each time the unit scans, it remains in idle mode for 15 minutes and then goes into sleep mode unless it scans again. Because the unit automatically turns off after sleeping for one hour, the scanner was modeled in off mode on weekends and outside the 10 hr workday, except for sleeping the first hour (5.2(c)(2)(ii)). The units have a typical life of 3 years, due to technological change, so that time frame was used as the base case for the life cycle assessment (5.2(c)(1)(iii)).

To model the operating conditions for the typical user, it was assumed that material was scanned in batches of 10 images, with batches spread evenly over the 10-hour day based on the average images scanned per day in Table 1. Notice that all 7 scanners have similar scanner and packaging weights and similar power requirements. The biggest differences are in scan rate (images per minute). The higher scan rate units are typically purchased by higher volume users, so they have higher lifetime images per scanner.

In addition to a typical scenario, a high use and a low use scenario were modeled. For the high use scenario, twice as many images were scanned per day as for the typical user. For the low use scenario, 20% of the typical images per day were scanned. For the average GHGs emitted, it was assumed that 80% of the users were typical, 10% were high use scanners, and 10% were low use scanners. The base case consisted of the weighted average of these three scenarios. These assumptions were based on knowledge of and feedback from the customer base.

**Table 1 – Scanner Overview Data**

| Scanner | Scanner Weight with Power Adapter | Packaging Weight | Average Speed | Average Use | Energy in Off Mode | Energy in Sleep Mode | Energy in Idle Mode | Energy when scanning | Total Images scanned per scanner life |
|---|---|---|---|---|---|---|---|---|---|
| | kg | kg | ipm | ipd | watts | watts | watts | watts | images |
| E1025/E1030 | 3.59 | 2.16 | 50 | 125 | 0.18 | 2.76 | 7.16 | 22.7 | 99,450 |
| E1035/E1040 | 3.59 | 2.16 | 70 | 175 | 0.18 | 2.76 | 7.16 | 22.7 | 139,230 |
| S2040 | 3.71 | 2.16 | 80 | 200 | 0.18 | 2.76 | 7.2 | 22.7 | 159,120 |
| S2050 | 3.72 | 2.15 | 100 | 250 | 0.18 | 2.76 | 7.16 | 22.7 | 198,900 |
| S2060w | 3.73 | 2.15 | 120 | 300 | 0.18 | 2.76 | 7.16 | 22.7 | 238,680 |
| S2070 | 3.72 | 2.15 | 140 | 350 | 0.18 | 2.76 | 7.16 | 22.7 | 278,460 |
| s2080w | 3.73 | 2.15 | 160 | 400 | 0.18 | 2.76 | 7.16 | 22.7 | 318,240 |

During the consumer's typical 3 years of operation, some units require replacement parts. On average 3% of the scanner parts are replaced in 5% of the scanners each year. Typically, no consumables or cleaning supplies are purchased for these scanners. Because maintenance was only about 0.1% of the GHG emissions, and for ease of calculation, the replacement parts were included in the total materials and manufacturing and their packaging, shipping, use, and EOL were included in those life cycle stages, respectively.

There were no life cycle stages or functions excluded. The full life cycle impact of electricity was included using the information from the country of origin (China) for manufacturing. For users, an estimated average impact was calculated using the US average electricity for customers in the Americas, German average electricity for customers in EMEA (Europe, Middle East, Africa), and China average electricity for customers in the Asian Pacific Regions (5.2(c)(3)).

It should be noted that either functional unit is only meaningful when tied to the scanner use scenarios in Table 1, since the impact per scanner and the impact per 1000 scans will vary if the use scenario changes. Furthermore, it should be noted that the scanner scenario description in Table 1 allows the reader to calculate the GHG emissions per scanner lifetime from the GHG emissions/1000 scans and also calculate the GHG emissions/1000 scans from the GHG emissions per scanner lifetime. Therefore, these two functional units are simply alternative ways of expressing the same results depending on what is more useful for a particular situation or audience.

**System Boundary**

The GHG Assessment is designed to cover the full life cycle of the scanners – raw materials, components, assembly, packaging, distribution of both the components and the raw materials, scanner use and maintenance, and the end of life (5.2(c)(3)(i)). The complete components list for each scanner, including packaging, was used to develop the raw materials and component manufacturing data in combination with SimaPro library data. The assembly plant and Kodak Alaris support services energy consumption rates were included as part of the manufacturing. Transportation full life cycle impacts were also included. The appropriate country average full life cycle electricity impacts were used (5.2(c)(3)(iii)).

End of Life (EOL) impacts were included for the scanner and included as described later in this report (5.2(c)(3)(ii)). The cutoff EOL approach, providing no credits for the reuse of materials which are recycled was used. Although providing credits is more accurate, good data on recycling and reuse was not available, so the more conservative approach of providing no reuse credits was used. An alternative scenario providing credits was modeled and presented as an alternative scenario.

**Cut-off Criteria (5.2(c)(4))**

An attempt to include all inputs and emissions was made. There were no excluded elements or data.

**Description of Unit Processes (5.2(d)(2))**

Raw materials are extracted, transported, transformed into component materials, and transported to the manufacturing plant for assembly, with energy being consumed in all these steps. During assembly, electricity is consumed, waste is produced (about 0.5% of total materials used) and energy is also consumed for various sales, administrative, and research functions which are required to produce the scanners. All these steps were included in the manufacturing and materials life cycle stage, except that the disposition of all waste (<.01% of total CO2eq emissions)