Adobe Acrobat Sign

Carbon Footprint of e-signatures: Documentation of methods

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Disclaimer

About Anthesis

Anthesis is the sustainability activator. We seek to make a significant contribution to a world which is more resilient and productive. We do this by working with cities, companies, and other organisations to drive sustainable performance. We develop financially driven sustainability strategies, underpinned by technical expertise and delivered by innovative collaborative teams across the world.

The company combines the reach of big professional services groups with the deep expertise of boutiques. Anthesis has clients across industry sectors from corporate multinationals such as Reckitt Benckiser, Cisco, Tesco, The North Face and Target, and also supports early-stage companies through Anthesis Ventures.

The company brings together 500 experts operating in 40 countries around the world and has offices in Andorra, Brazil, Canada, China, Colombia, Finland, France, Germany, Ireland, Italy, the Middle East, the Philippines, Spain, Sweden, the UK, and the US.

Table of contents

Table of figures

List of tables

1 Background

Adobe is interested in understanding the environmental footprint of one of its leading solutions: Acrobat Sign. As part of this environmental program, they commissioned Anthesis LLC (Anthesis) to conduct a carbon footprint of product (CFP) of an e-signature. This analysis aims to complement the Resource Saver Calculator, developed by Adobe, that estimates the environmental savings of avoiding paper use.

The main purposes of this project are to:

- Understand the carbon footprint of the Adobe Acrobat Sign service;
- Communicate the carbon footprint to customers; and
- Develop a proof of concept for a more general framework that can be applied to other products.

The approach to calculate the carbon footprint is based on Life Cycle Assessment (LCA). LCA is a decision support tool that allows quantitative environmental profiles to be generated for different products systems. It follows a four-stage iterative process, defined in the ISO 14040 and ISO 14044 standards, and presented in Figure 1.

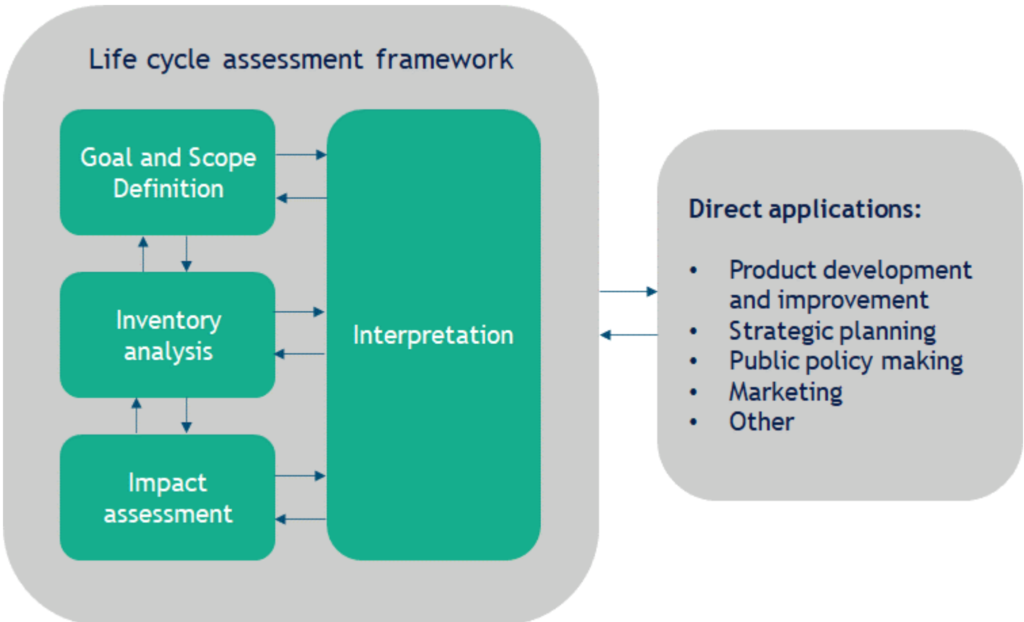

Figure 1 – The four stages of LCA as defined by ISO 14040

1. **Goal and scope definition:** The first stage of LCA is to define the goal and scope of study to understand the objectives and intended applications, the boundaries of what is being assessed and the performance requirement that the product fulfils.

2. **Inventory analysis:** The second stage is inventory analysis, where an inventory of flows to and from nature is created, usually using a combination of primary and secondary data collected for each unit processes of the product system.

3. **Impact assessment:** The third stage is impact assessment, which is where inventory data are applied to characterization factors to generate the main results and determine the environmental impacts.

4. **Interpretation:** The final stage is interpretation, which is where conclusions are drawn, sensitivity and uncertainty analyses are performed, and recommendations made.

The main deliverables of the project are:

- An evidenced-based study to estimate the carbon footprint of e-signatures using Adobe Acrobat Sign;
- An interactive tool to estimate carbon footprint of e-signatures; and
- A proof of concept to analyse the carbon footprint of Adobe's services.

In this report, the method employed to develop the carbon footprint is documented. The intended audiences of this report are Adobe’s team and Adobe’s customers. It is important to note that the method and report have not been critically reviewed by independent reviewers and therefore are not ISO 14044-compliant.

2 Goal & Scope definition

This section describes the goal and scope element of the analysis.

One product system is considered in this analysis: Adobe Acrobat Sign. The function of the system is to sign documents from anywhere using either a computer, a tablet, or a smartphone. A functional unit is a reference unit used to quantify the performance of the system. All results are normalized to this unit. The functional unit of the system is:

“Sign one agreement between parties”

An agreement is completed when all parties attached to a document have signed it.

The system boundary of the carbon footprint is cradle-to-grave (Figure 2). It includes the extraction of raw materials and their processing, the manufacturing of the Information and Communication Technology (ICT) infrastructure (e.g., hardware and data centres of the cloud vendors) and of the signing devices (e.g., computer, tablet, or smartphone), the energy production associated with the use of the ICT infrastructure and of the signing devices, and the disposal of ICT infrastructure and of the signing devices.

The following stages are excluded from the analysis:

- Development of the electronic document before the agreement.

- Use of the electronic document after the agreement.

The temporal scope of the analysis is for the year 2022. The geographical scope of the analysis is for customers located in the United States (USA), Europe or Asia.

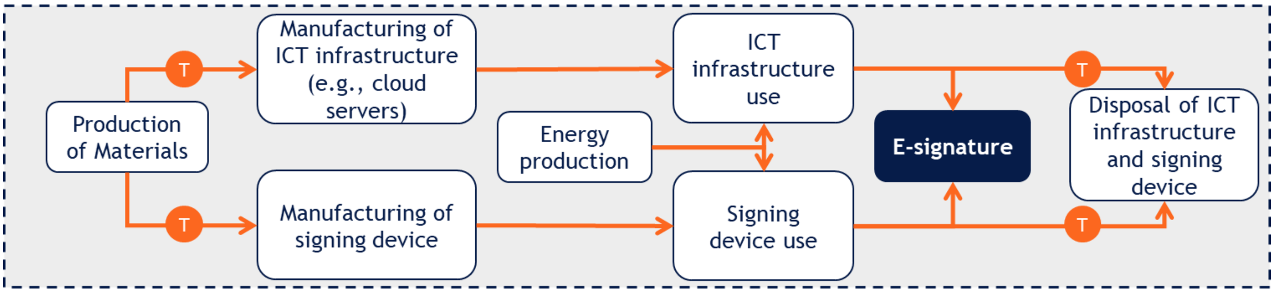

Figure 2 – System boundary of the Adobe Acrobat Sign product system

The carbon footprint uses the Global Warming Potential (GWP) factors developed by the Intergovernmental Panel on Climate Change (IPCC) and released in 2021 (IPCC, 2021).

The workflow of an agreement is described in Figure 3. First, the electronic document is uploaded on Adobe Acrobat Sign with information regarding signing parties and locations of signatures. The electronic document is stored on the cloud. Adobe's cloud vendors, such as Microsoft Azure or Amazon Web Services, store the document on their data centres. Then, the different parties access the document, review it, and sign it. Finally, the document is processed with all signatures, finalized and the agreement is completed.

Figure 3 – Workflow of an agreement with Adobe Acrobat Sign

The following parameters and assumptions are taken to conduct the analysis:

- It takes 5 minutes of computer use to upload the electronic document on Adobe Acrobat Sign by one party.
- The electronic document is processed and stored by Adobe's cloud vendors.
- There is a total of 3 parties that need to sign the electronic document. It takes 15 minutes for one party to access the document, review it and sign it.
- It takes 5 minutes of computer use to download the final signed agreement.

3 Carbon Footprint Calculations

This section describes the primary and secondary data used to conduct the carbon footprint and the calculation step.

3.1 ICT infrastructure use

Adobe works with cloud vendors to process and store the electronic documents and run the Adobe Acrobat Sign service. Some of the cloud vendors can estimate the carbon footprint of Adobe's operations. In this analysis, data from Amazon Web Services (AWS) are used to conduct the carbon footprint of an agreement. It is important to note that the carbon footprint data provided by Amazon Web Services are associated with the accounts that run the Adobe Acrobat Sign's operations. However, each account runs multiple agreements and clients and the physical hardware associated with the accounts are in North America, in Europe, or in Asia. It is therefore not possible to extract computing data at an agreement level and to obtain exact physical locations of the data.

The carbon footprint of the ICT infrastructure use associated with a completed agreement's workflow is calculated using a top-down approach. Total number of completed agreements for all AWS' accounts are collected from Adobe as well as the carbon footprint of running these accounts from AWS.

3.2 ICT infrastructure production

The carbon footprint previously presented only consider scope 1& 2 emissions of the ICT infrastructure. It does not capture the production of the hardware required. It is important to note that a long list of equipment and hardware are required during a cloud computing operation: the network transmission line, the data center with its building and equipment, and the data server. In this study, the ICT infrastructure production is simplified and estimated through a data server. A study from Dell (2019) is used to estimate the carbon footprint of producing a data server. The parameters are presented in Table 1.

Table 1 – Parameters to calculate carbon footprint of data server production

Parameter	Value	Unit	Source
Carbon footprint of production of data server	4,283	kg CO_2 eq. / unit	Dell, 2019
Storage capacity of server	31,120	GB	Dell, 2019
Lifetime of server	4	years	Dell, 2019
Utilization rate	40%		NRDC, 2014

To allocate the carbon footprint of data server production to one agreement, the total storage capacity of the data server is multiplied by its lifetime and its utilization rate to obtain the total performance of the data server. Then, the storage capacity of one electronic document is multiplied by its storage duration to estimate the required performance of the functional unit. Finally, the allocation factor is the ratio between the required performance of the functional unit and the total performance of the data server. Equation 1 presents the method to estimate the carbon footprint of data server production allocated to one functional unit (i.e., one agreement). It is important to note that in the absence of computing data regarding the electronic document processing, only the storage is captured in this estimate.

Equation 1

$$CF_{prod,FU,CC} = \frac{S_{doc} * t_{storage}}{UR * S_{ds} * t_{ds}} * CF_{prod,ds}$$

With:

- $CF_{prod,FU,CC}$ the carbon footprint of data server production allocated to one functional unit;

- S_{doc} the size of the electronic document to be stored on the data server;
- $t_{storage}$ the storage duration of the electronic document on the data server;
- UR the average utilization rate of the data server;
- S_{ds} the storage capacity of the data server;
- t_{ds} the total lifetime of the data server; and
- $CF_{prod,ds}$ the carbon footprint of data server production.

3.3 Signing device production and disposal

Three signing devices are assumed in this analysis: a computer, a tablet and a smartphone. Table 2 presents the parameters and assumptions used to compute the carbon footprint associated with the signing devices.

Table 2 – Parameters to calculate carbon footprint associated with signing devices

Device	Parameter	Value	Unit	Assumptions and source
Computer	Lifetime	3 years or 8760 hours		Williams, 2005
	Power consumption	20	W	EcoCostSavings
	Production carbon footprint	170	kg CO_2 eq. / unit	ecoinvent
	Disposal carbon footprint	3.1	kg CO_2 eq. / unit	ecoinvent
Smartphone	Lifetime	3 years or 8760 hours		Own assumptions
	Power consumption	3.2	W	Modelled as iPhone 13 (Apple, 2021)
	Production carbon footprint	123	kg CO_2 eq. / unit	
	Disposal carbon footprint	0.6	kg CO_2 eq. / unit	ecoinvent
Tablet	Lifetime	3 years or 8760 hours		Own assumptions
	Power consumption	0.545	W	Modelled as iPad Pro (Apple, 2020)
	Production carbon footprint	52	kg CO_2 eq. / unit	
	Disposal carbon footprint	0.3	kg CO_2 eq. / unit	ecoinvent

In the analysis, the production and disposal carbon footprints of the signing devices are normalized to a functional unit (i.e., "sign one agreement between parties"). To do so, Equation 2 is applied:

Equation 2

$$CF_{prod,FU,d} = \frac{t_{FU,d}}{t_{lifetime,d}} * CF_{prod,lifetime,d}$$

$$CF_{disposal,FU,d} = \frac{t_{FU,d}}{t_{lifetime,d}} * CF_{disposal,lifetime,d}$$

With:

- $CF_{prod,FU,d}$ and $CF_{disposal,FU,d}$ the carbon footprints of production and disposal of the device *d* associated with the functional unit;
- $t_{FU,d}$ the time of use of the device *d* to fulfill one functional unit;
- $t_{lifetime,d}$ the lifetime of the device *d*; and
- $CF_{prod,lifetime,d}$ and $CF_{disposal,lifetime,d}$ the total carbon footprints of production and disposal of the device *d*.

It is important to note that the three devices are assumed to be used for one functional unit.

3.4 Electricity production

The carbon footprint associated with the electricity produced to run the signing devices are described in Table 3.

Table 3 – Emission factors of electricity production in the USA, Europe and Asia.

Location	Value	Unit	Source
USA	0.39	kg CO_2 eq. / kWh	IEA, 2021
Europe	0.24	kg CO_2 eq. / kWh	
Asia	0.65	kg CO_2 eq. / kWh	

The carbon footprint of using a signing device is described in Equation 3.

Equation 3

$$CF_{use,FU,d} = t_{FU,d} * P_d * EF_{elec,l}$$

With:

- $CF_{use,FU,d}$ the carbon footprint of using the device *d* for one functional unit;
- $t_{FU,d}$ the time of use of the device *d* to fulfill one functional unit;
- P_d the power consumption of the device *d*; and
- $EF_{elec,l}$ the emission factor of electricity production in location *l* (i.e., USA, Europe or Asia).

It is important to note that the three devices are assumed to be used for one functional unit according to the device mix described in section 2.

4 Limitations of the methods

The method to calculate Adobe Acrobat Sign service presented in this document relies on many assumptions and has the following limitations:

- Carbon footprints of device production (e.g., smartphone, computer, data center) are based on specific products and models and may not be representative of average device specifications.
- Carbon footprints of ICT infrastructure use rely on historical AWS data and may not be representative of future data. As cloud vendors pursue the use of renewable energy sources, their carbon footprint may decrease.
- Carbon footprint of ICT infrastructure production relies on the carbon footprint of data server production. Carbon footprints of manufacturing networks and other hardware in the data centres are not included, and they may be as significant (Malmodin, 2018).
- This study only focuses on carbon footprint and does not capture other environmental impacts such as water consumption, air pollution, plastic pollution, etc.

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