

Sustainability in Accounting

A comparison and analysis of the different forms of invoice processing

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Introduction

Digitalization is impacting many industries. Whether it's using self-checkouts in shops or filing tax returns online, technical advances are saving time and simplifying life. Invoicing has also changed significantly in recent years. Today, invoicing is increasingly done via e-mail or online banking with eBill, whereas invoices were generally delivered by mail with payment slips before. On behalf of SIX, carbon-connect AG has compared three invoicing methods in terms of their greenhouse gas emissions and analyzed the emissions levels of the individual processes.

The data used in this study on general invoicing volumes in Switzerland is based on the white paper "Future of Billing" from SIX, which was produced in collaboration with the Lucerne University of Applied Sciences and Arts.¹ Estimates were used for the time spent on the individual invoice processing steps.

The emissions factors from the widely used eco-database ecoinvent (version 3.8, method IPCC 2013, GWP 100a) were used as the basis for calculating the emissions resulting from the individual processes. To establish the greenhouse gas footprint for the different invoicing methods, all relevant processes were taken into account, including the tasks performed by the invoice issuer and invoice recipient for payments processing as well as the processing via the infrastructure of SIX. SIX collected and provided the data for the various invoicing methods.

However, the energy consumption of the servers on which the invoicing data is stored was not included. Furthermore, the study only looked at the impact of the dunning process in qualitative terms.

¹<https://six-group.com/future-billing> (2020).

Basics

The following section examines the individual components of invoice processing. The information is based on estimates and takes into account the relevant invoice processing steps.

Basics: paper invoices

Creating a paper invoice requires a number of processes, which are taken into consideration in this study. The invoice issuer creates, prints, and then sends the invoice to the invoice recipient by mail. Payment is made either using online banking or at a post office counter. In order to include the emissions – produced by the invoice issuers, SIX, and the invoice recipients – in the footprint, carbon-connect AG has calculated the power consumption resulting from the work related to each invoice.

carbon-connect AG has assumed the average Swiss consumer electricity mix for the individual processing steps on the computer. For payments made at a post office

counter, it was assumed that the invoice recipient needs to travel a distance of five kilometers. This corresponds to the average distance that the population of Switzerland needs to travel to reach a post office. This distance was determined using the total area of Switzerland and the number of post offices. carbon-connect AG referred to the study “Population’s Travel Behaviour, Results of the Mobility and Transport Microcensus 2015” by the Swiss Federal Statistical Office for the mode of travel. It was also assumed that the invoice recipient pays five invoices at the counter per the distance to the post office. A total of 136 million paper invoices were still paid at the post office counter in 2021.

Table 1: Paper invoice data collected for the emissions calculation

| Contributor | Parameter | Unit | Value |
|------------------------|--|------------------|-------|
| Invoice issuer | Time spent processing each invoice | minutes/invoice | 3 |
| SIX | Time spent processing each invoice | minutes/invoice | 3 |
| Printing | Percentage of recycled paper used | % | 30 |
| | Grammage of the main type of paper used | g/m ² | 80 |
| | Average number of sheets of paper used per invoice | x/invoice | 2 |
| Dispatch | Main dispatch method | Type | Mail |
| Invoice recipient (IR) | Time spent paying an invoice via online banking | minutes/invoice | 3 |
| | Percentage of IRs who pay via online banking | % | 82 |
| | Percentage of IRs who pay at the post office | % | 18 |
| | Time required for data storage | minutes/invoice | 2 |

Basics: e-mail invoices

Compared to paper invoices, invoicing via e-mail eliminates the need to print and send the invoice. The invoice issuer sends the invoice to the invoice recipient via e-mail, who can then pay it using online banking. The invoice recipient must register with the invoice issuer to facilitate e-mail invoicing. The registration process takes an average of one minute according to SIX. In principle, it is

possible for the invoice recipient to print out the invoice and pay it at the post office or bank counter. carbon-connect AG has made the same assumptions for payments made at a post office counter as for paper invoices. Invoice recipients may also still print out e-mail invoices for analog data storage, even if they are paid using online banking.

Table 2: E-mail invoice data collected for the emissions calculation

| Contributor | Parameter | Unit | Value |
|------------------------|---|-----------------|-------|
| Invoice issuer | Registration processing | minutes/invoice | 3 |
| | Time spent processing each invoice | minutes/invoice | 2 |
| SIX | Time spent processing each invoice | minutes/invoice | 3 |
| Invoice recipient (IR) | Time spent registering for an e-mail invoice | minutes/invoice | 1 |
| | Time spent paying an invoice via online banking | minutes/invoice | 3 |
| | Percentage of IRs who pay via online banking | % | 95 |
| | Percentage of IRs who pay at the post office | % | 5 |
| | Time required for data storage | minutes/invoice | 2 |
| | Percentage of IRs who print the invoices | % | 20 |

Basics: eBill

In contrast to paper and e-mail invoices, the invoice recipient does not receive a payment slip when using eBill. Optionally, information can be sent by e-mail when a new eBill invoice has arrived in online banking. The payment details of the invoice are already stored there and only require approval from the invoice recipient. The invoice

recipient can activate this invoicing method directly in their online banking with the respective financial institution. This eliminates the need to enter the payee details, for example. The payee can also store the data directly in their online banking.

Table 3: eBill data collected for the emissions calculation

| Verursacher | Parameter | Unit | Value |
|------------------------|---|-----------------|-------|
| Invoice issuer | Registration processing | minutes/invoice | 3 |
| | Time spent processing each invoice | minutes/invoice | 2 |
| SIX | Time spent processing each invoice | minutes/invoice | 3 |
| Invoice recipient (IR) | Time spent registering for an eBill invoice | minutes/invoice | 1 |
| | Time spent paying an eBill invoice | minutes/invoice | 1 |
| | Time required for data storage | minutes/invoice | 1 |

Emissions footprint

carbon-connect AG has calculated the greenhouse gas emissions per invoice created in 2021 for the entire invoicing process (invoicing, payment, and data storage) for all invoicing methods. The following section contains a detailed analysis of these emissions. To compare the three types of invoices with each other, average values are used that are additionally weighted with the probability of the various payment variants.

Emissions: paper invoices

Table 4 shows the emissions for the entire invoicing process of a paper invoice. A paper invoice causes average emissions of approximately 76 g CO₂-eq, with the main share of the emissions being attributable to payments made at a post office counter and the printing of the in

voice. For each paper invoice, a total of 54.4 g CO₂-eq is produced if the paper invoice is paid via online banking and 175.9 g CO₂-eq if it is paid at a post office counter. The emissions for the entire invoicing process are therefore highly dependent on how the invoice is paid.

Table 4: Greenhouse gas emissions in g CO₂-eq for the creation and payment of a paper invoice

| Category | Emissions (g CO ₂ -eq/invoice) | Percentage (%) |
|--|---|----------------|
| Production and printing of the invoice | 30.9 | 40.5 |
| Production and printing of the envelope | 2.3 | 3.0 |
| Disposal of the paper | 0.5 | 0.7 |
| Dispatch by mail | 8.0 | 10.4 |
| Tasks performed by the invoice issuer | 3.6 | 4.8 |
| Tasks performed by SIX | 3.6 | 4.8 |
| Tasks performed by the invoice recipient | 5.5 | 7.2 |
| Travel and tasks required for payment at a post office counter | 21.8 | 28.6 |
| Total emissions (g CO₂-eq/invoice) | 76.2 | 100 |

Emissions: e-mail invoices

Table 5 shows the emissions footprint for the entire invoicing process of an e-mail invoice. 23 g CO₂-eq is produced per invoice sent by e-mail. According to estimates, up to 5% of e-mail invoices are printed out and then paid at a post office counter. This process adds to the CO₂ footprint, and this method of settling an e-mail invoice is the most harmful to the environment. Since this kind of payment transaction rarely occurs, the travel factor was adjusted by a certain probability factor and is significantly lower than for paper invoices.

Compared to paper invoices, the greenhouse gas emissions of an e-mail invoice are reduced by almost 70% per invoice. This is because the rate of emissions for e-mail invoices is highly dependent on the payment method: If the invoice is processed digitally and paid using online banking, only 17.4 CO₂-eq is produced per invoice. Approximately 138.9 g CO₂-eq is produced for each payment at the post office counter.

Table 5: Greenhouse gas emissions in g CO₂-eq for the creation and payment of an e-mail invoice

| Category | Emissions (g CO ₂ -eq/invoice) | Percentage (%) |
|--|---|----------------|
| Registration of the invoice recipient | 0.1 | 0.4 |
| Printing of the invoice by the invoice recipient | 1.9 | 8.3 |
| Disposal of the paper | 0.1 | 0.4 |
| Tasks performed by the invoice issuer | 6.0 | 26.1 |
| Tasks performed by SIX | 3.6 | 15.7 |
| Tasks performed by the invoice recipient | 5.7 | 24.8 |
| Travel and tasks required for payment at a post office counter | 5.6 | 24.3 |
| Total emissions (g CO₂-eq/invoice) | 23.0 | 100 |

Emissions: eBill

Table 6 shows the greenhouse gas emissions for the entire invoicing process of an eBill invoice. Approximately 10 g CO₂-eq is produced per eBill invoice. The largest share of the total emissions is attributable to invoice creation. Digital processing, i.e., without emissions for printing and without the distance traveled to the post office, results in a reduction in greenhouse gas emissions of 87% (compared to paper invoices) and 57% (compared to

e-mail invoices). Another advantage of eBill is the greatly reduced dunning process, which was not included in this calculation. A reminder is triggered for approximately 10% of paper and e-mail invoices, while the share of reminders in the total eBill volume is under 1%. On average, a reminder has to be sent for every tenth paper and e-mail invoice, whereas with eBill, reminders only need to be sent for less than one in every thousand invoices.

Table 6: Greenhouse gas emissions in g CO₂-eq for the creation and payment of an eBill invoice

| Category | Emissions (g CO ₂ -eq/invoice) | Percentage (%) |
|--|---|----------------|
| Registration of the invoice recipient | 0.1 | 1.0 |
| Tasks performed by the invoice issuer | 6.1 | 62.3 |
| Tasks performed by SIX | 1.2 | 12.2 |
| Tasks performed by the invoice recipient | 2.4 | 24.5 |
| Total emissions (g CO₂-eq/invoice) | 9.8 | 100 |

Overall assessment

Based on the emissions per invoice and the volume of invoices generated in 2021, it is possible to estimate the greenhouse gas emissions of invoicing traffic throughout Switzerland (excluding standing orders and payments between companies and banks). In the case of e-mail and paper invoices, there is a distinction between payments at a post office counter and via online banking. In line with this, invoicing traffic currently generates approximately 63,222 t CO₂-eq (61.7 g CO₂-eq/invoice) per year. This corresponds to the CO₂ footprint of over 4,215 Swiss citizens (15 t CO₂-eq per person per year, including consumption, travel, living, and eating).

According to the forecast of SIX, invoice issuers will send approximately 80% of all invoices in Switzerland using eBill by 2028. This would result in an emissions reduction of 66% to approximately 21,181 t CO₂-eq (20.7 g CO₂-eq/invoice) if invoice volumes remain the same. Assuming an annual sequestration of approximately 6 t CO₂-eq per hectare of forest, approximately 7,007 ha of forest could be conserved in 2028. This corresponds to approximately 0.5% of the total Swiss forest area or the annual CO₂ sequestration of 2.9 million trees.

Table 7: Estimation of emissions from all invoicing

| Invoicing | Emissions/invoice (g CO ₂ -eq) | Volumes in 2021 (million) | Emissions (t CO ₂ -eq) |
|--|---|---------------------------|-----------------------------------|
| Paper invoices (online banking) | 54.4 | 622 | 33,839 |
| Paper invoices (post office counter) | 175.9 | 136 | 23,917 |
| E-mail invoices (online banking) | 17.4 | 206 | 3,589 |
| E-mail invoices (post office counter) | 138.9 | 10 | 1,389 |
| eBill | 9.8 | 50 | 488 |
| Total emissions for invoicing in 2021 | | 1024 | 63,222 |

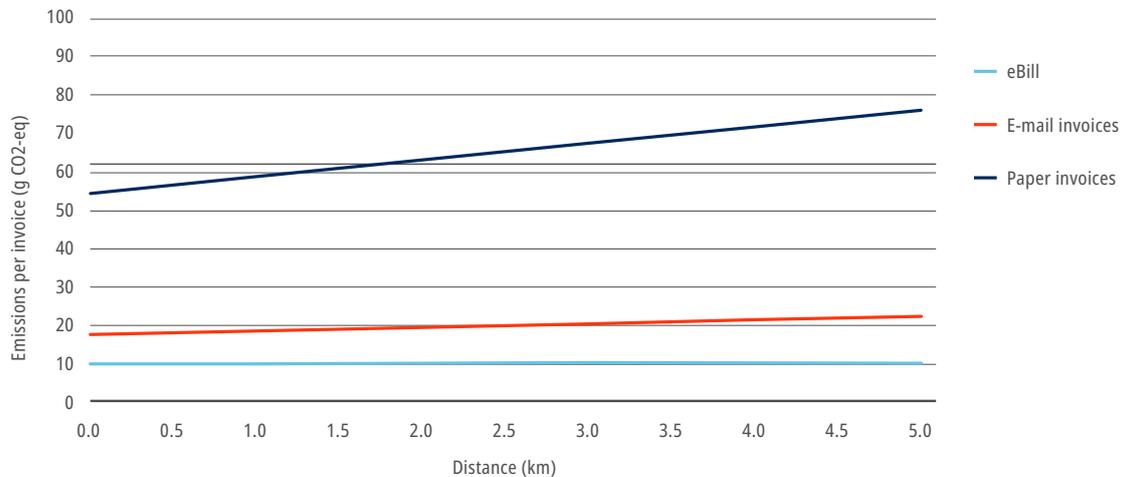
Uncertainty sensitivity analysis

The calculations made in this study are subject to uncertainty. In particular, carbon-connect AG had to make many assumptions to calculate the emissions for payments made at a post office counter. For this reason, a sensitivity analysis has been performed regarding the distance that must be traveled and the number of invoices paid per distance traveled to the post office. Figures 1a and 1b show the emissions per invoice in relation to the distance to the post office and the number of invoices paid. Based on the data used and the assumptions made, a clear statement can be made about both illustrations: eBill is the method of invoicing that produces the lowest greenhouse gas emissions per invoice.

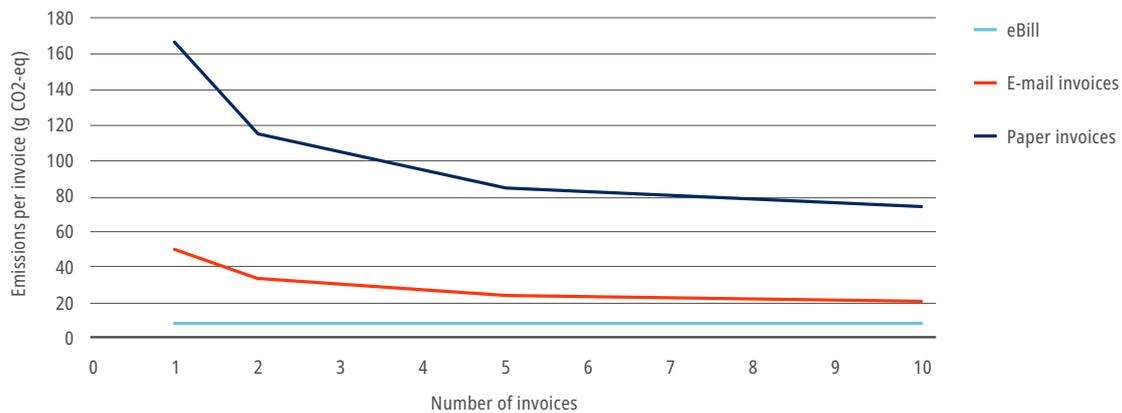
It is clear that the results for e-mail and paper invoicing vary greatly depending on the distance to the post office and the number of invoices paid. Based on the most favorable assumptions (more than ten invoices per distance traveled to the post office and a shorter distance), a paper invoice produces approximately 55 g CO₂-eq and an e-mail invoice produces approximately 18 g CO₂-eq. These assumptions show that there are a major uncertainties associated with the results for e-mail and paper invoices. However, the data provided clearly shows that eBill produces fewer greenhouse gas emissions than the other invoicing methods.

Figure 1: Uncertainties with regard to the emissions footprint for payments made at a post office counter category

(a) Uncertainty of distance



(b) Uncertainty of the number of invoices



Summary

Invoicing is an important element of Swiss payment transactions. Over one billion invoices are sent annually in Switzerland, and the majority of these are still sent by mail. Currently, invoice processing generates 63,222 t CO₂-eq (61.7 g CO₂/invoice). This corresponds to the CO₂ footprint of more than 4,215 Swiss citizens. eBill offers a purely digital solution and is, according to this analysis, also the most sustainable alternative compared to e-mail and paper invoices.

carbon-connect AG examined the three invoicing methods (eBill, e-mail, and paper invoices) to determine their carbon footprint. The calculations take into account the CO₂ emissions resulting from process handling, production, travel, and energy consumption. The production of a paper invoice in combination with the distance traveled to the post office counter has a particularly negative effect on the CO₂ footprint. Subtle variations are also apparent in process handling. Processing an e-mail invoice generates additional work that should not be underestimated. With a reminder rate of around 10%, e-mail and paper invoices create additional work that is not included in the emissions calculation.

eBill offers the greatest CO₂ savings potential. With emissions of 9.8 g CO₂-eq, eBill reduces CO₂ pollution by at least 44% (17.4 g CO₂-eq) compared to e-mail invoices and achieves a savings rate of around 82% (54.4 g CO₂-eq) compared to paper invoices, which are paid via online banking in the best-case scenario.

In 2028, it is expected that 80% of all invoices in Switzerland will be sent using eBill. If the invoice volume remains the same, this will result in an emissions reduction of 66%; this corresponds to a saving of 42,041 t CO₂-eq. Assuming an annual sequestration of approximately 6 t CO₂-eq per hectare of forest, approximately 7,007 ha of forest could be conserved in 2028. This corresponds to approximately 0.5% of the total Swiss forest area or the annual CO₂ sequestration of 2.9 million trees. The calculations made by carbon-connect AG show that sustainability is an important aspect in the digitalization of invoicing. In this regard, a switch to eBill is an investment in a sustainable future.