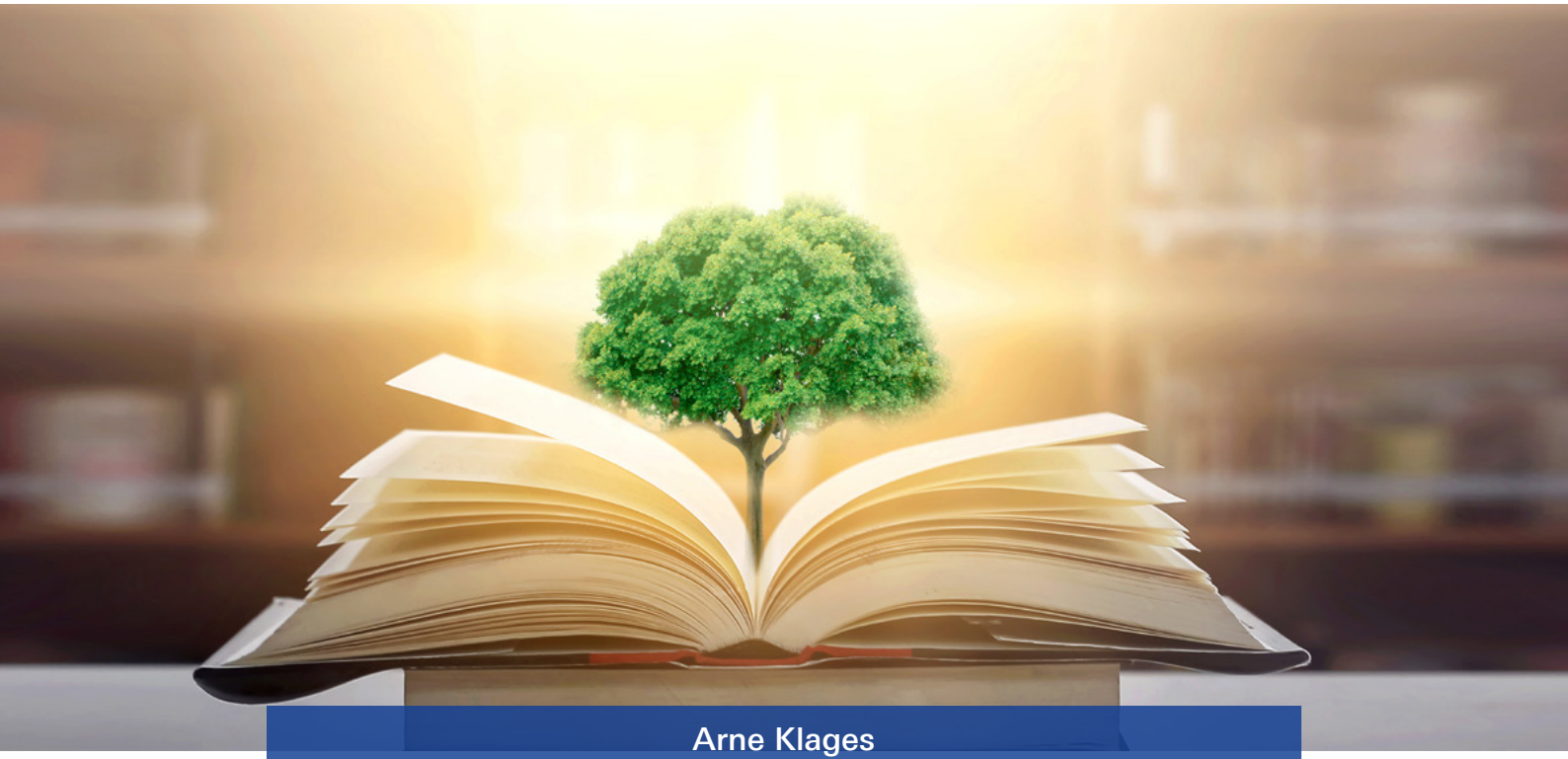


Arne Klages

A green future – with or without print?

In this blog, we're going to be discussing a topic that is becoming increasingly important – climate change and the associated sustainability in industry. In doing so, we will also be asking whether the printing industry can be part of a sustainable and globalized world. Or does the 500-year-old industry no longer have a place in our green future?

First, let us think a little outside the box. How far have we come in terms of climate protection? Has the problem been solved by itself due to corona? The second part will then focus on the printing industry and deal with the footprint that print media leave behind on our planet. A comparison will then wrap it up. What is more sustainable: print or its alternatives? Is the internet really as green as we generally think? What measures is the printing industry taking to protect our environment?

2020 was to become the year of a reversal in climate policies

For months now, almost everyone human being on our blue planet has been preoccupied with one matter: a global pandemic. Other subjects – such as environmental protection – have taken a backseat.

Only six months ago, activists of Extinction Rebellion conjured up the mass extinction of animals, plants, habitats and even the extinction of humankind. They blocked roads and chained themselves to fences in order to force politicians to act. Hundreds of pupils also rose up

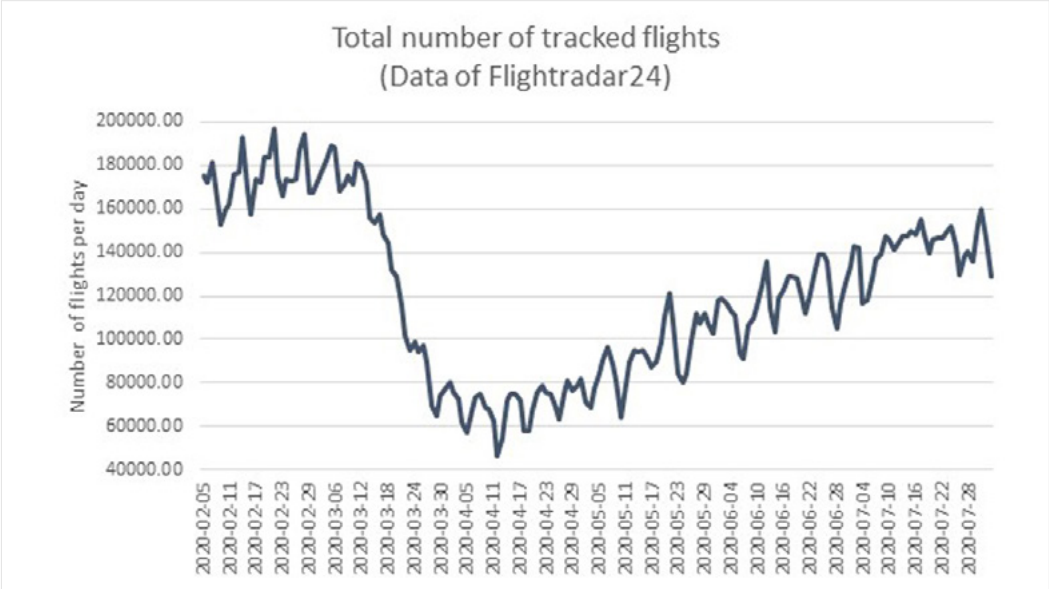
against their "evil boomer parents." They stopped going to school on Fridays and took to the streets to protest for their future. Because 2020 was to become the year of a reversal in climate policies...

...and then Covid-19 struck

But then the SARS-CoV-2 virus struck and the world held its breath. Quite literally. International air travel came to a halt, borders were closed, factories closed their gates, and people huddled under mountains of toilet paper and dry pasta in front of their TV sets. Absurd, right? In a few years, this situation will certainly cause some embarrassed laughter. Especially when the last pack of pasta has finally been eaten.

But is Covid-19 the "big break" that the climate needs from us humans?

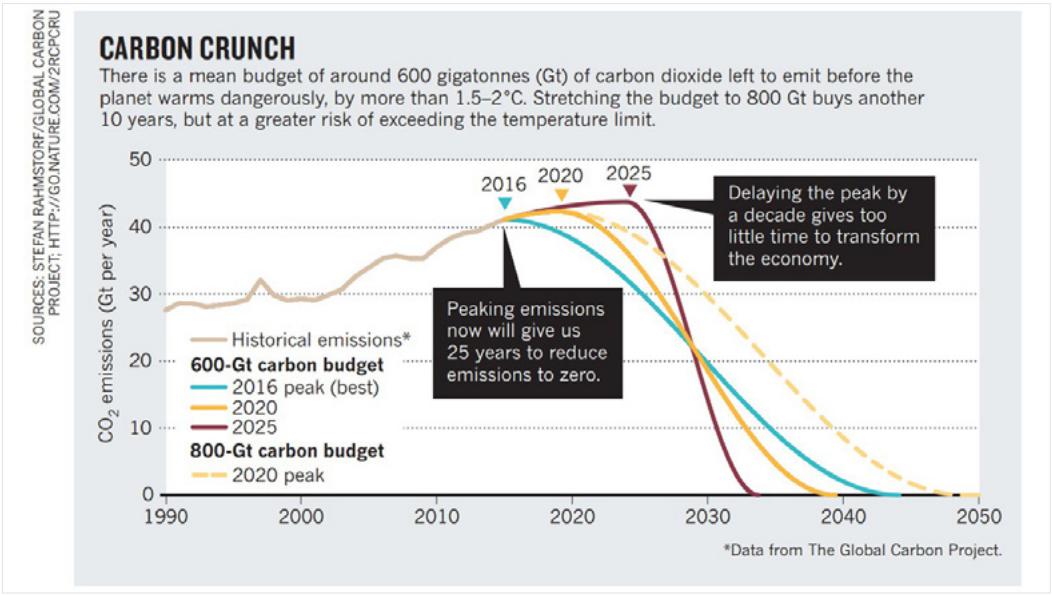
The answer is: unfortunately, no. The University of Sydney reported in a study that the corona crisis has resulted in global CO_2 emissions falling by about 2.5 gigatons per year (or 4.6 percent). By comparison, during the 2009 financial crisis, emissions dropped by 0.46 gigatons (source). That might sound initially promising, but is probably more the result of the above short-term measures. Global flight movements, for instance, have dropped by 70 percent since mid-March. This is shown by figures of flightradar24 (see chart).

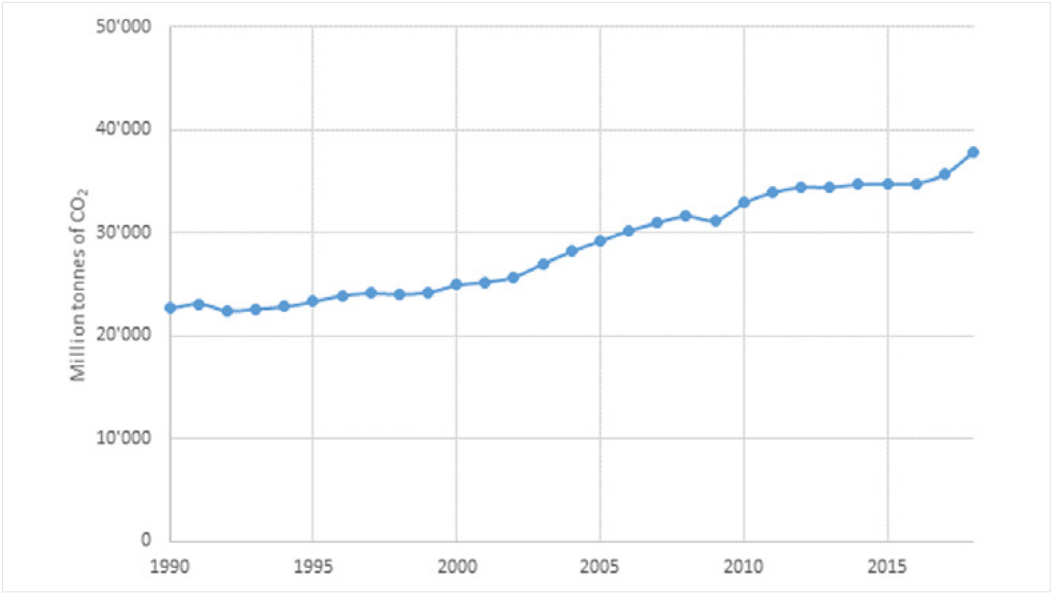


However, as soon as the restrictions are lifted, emissions will likely bounce back to the old level, and probably be even higher. After all, companies will be busy moving their figures back into the black. And people who have lost their jobs will be more worried about how to pay rent rather than the environment.

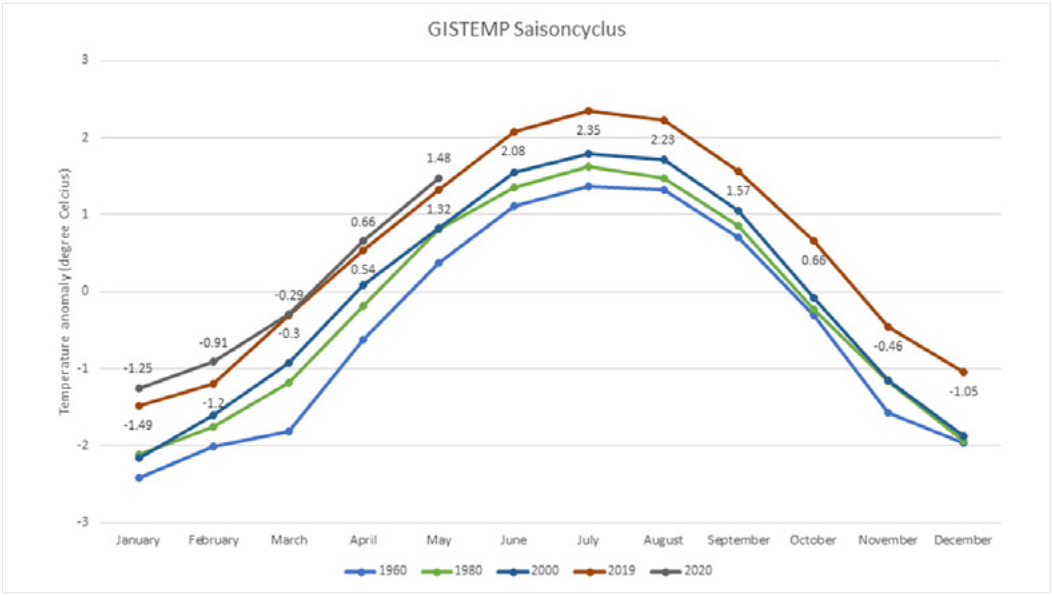
How much CO_2 is acceptable?

Allow me a short digression into the basics of climate mathematics. In 2015, the Paris Convention was signed. 197 parties to the agreement of the United Nations Framework Convention on Climate Change (what a name!) committed to limiting global warming to 1.5 degrees. This results in a so-called CO_2 budget. Think of it as a kind of "atmospheric landfill site." The "space" still available specifies the volume of emissions that may still be released to remain below the temperature increase target with a certain degree of certainty (66 percent). What this looks like is visualized as follows:





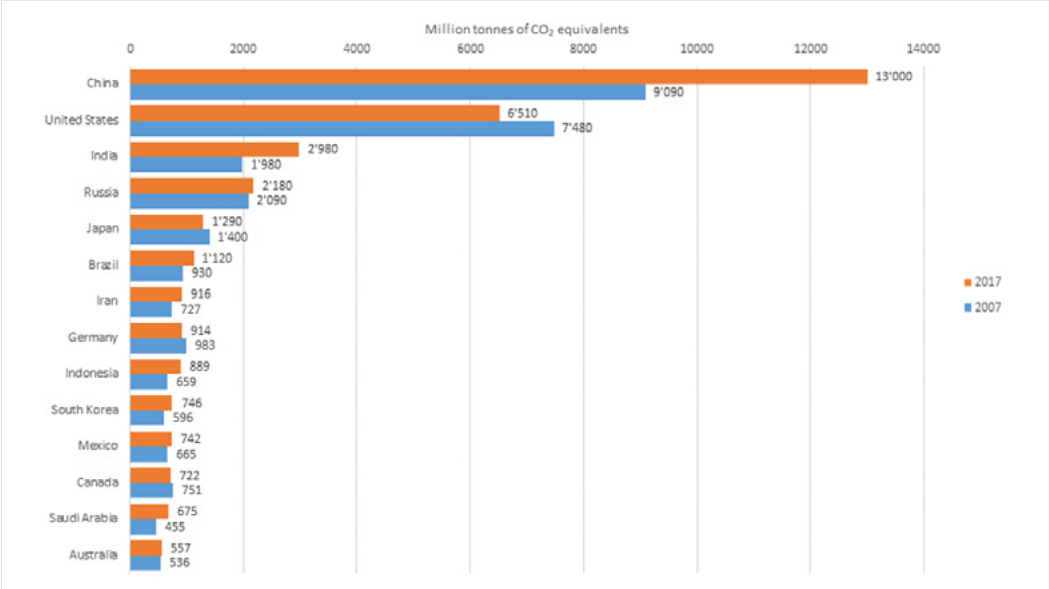
The second chart consists of the values published by the Climate Watch website. Comparing the two charts, it is striking that the sharp turnaround that was to be achieved in 2020 has yet to materialize. Corona will certainly make the statistics look more positive, but the trend is concerning. Initial effects on the change in temperature can already be seen today.



The above chart with data from the American space agency NASA shows relatively clearly that the global temperature has already risen in the summer months. May 2020, for instance, was 1.5 degrees Celsius hotter than the average month since 1880. The applied values are the deviations in each month compared to the global annual mean. Scientists from the National Oceanic and Atmospheric Administration are already now forecasting that 2020 will be the hottest year since records began.

The question of responsibility

As with every question in life, far more important is the question: Who is responsible?



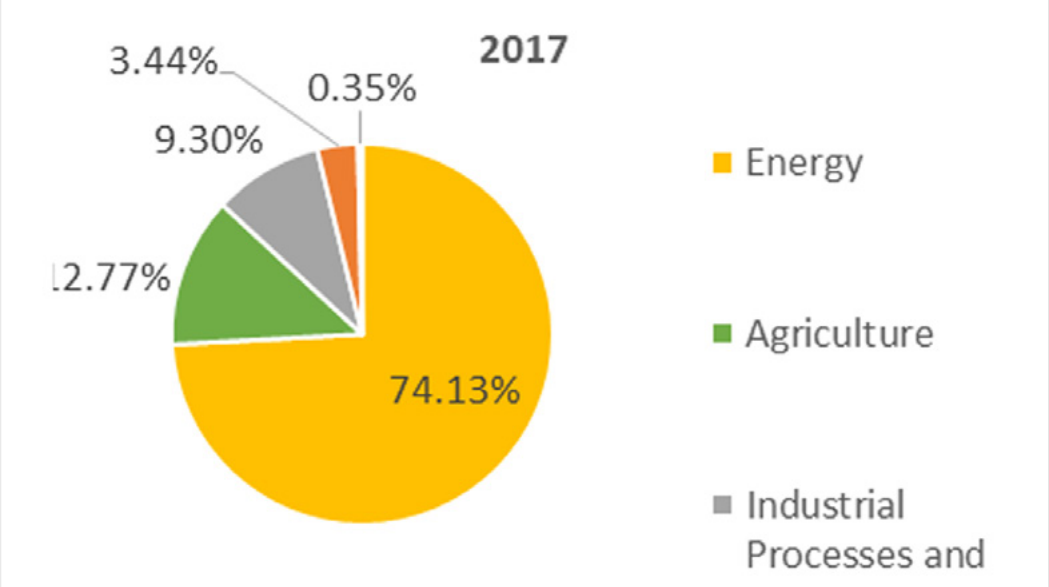
The chart above shows that CO_2 emissions have only minimally decreased in most traditional industrialized countries. By contrast, China's CO_2 emissions have increased by 43 percent and India's by 50 percent within ten years. By comparison, in 2017, Switzerland emitted 47 million tons of CO_2, which is about 0.1 percent of global emissions.

Does that then mean that the question of responsibility has finally been solved? Can we point the finger at China, the U.S. and India and blame them for everything?

Of course not. After all, most of the emissions caused by these countries have been merely exported by us. This problem is also known as "carbon leakage". If climate protection measures in one country are too stringent and production costs too high, companies simply relocate their production to other countries where the regulations are less stringent, making costs significantly lower. It goes without saying that this is not the only influencing factor here. The fact that other influences facilitate relocating our waste to other countries will, however, not be discussed here.

Hunger for energy

As the following chart shows, the hunger for energy is one of the biggest driving factors for the rise in emissions. Nearly three quarters of global greenhouse gas emissions are accounted for by energy generation. This subject was already set out in detail by Knud Wassermann in his blog "Digital is no more sustainable than print – on the contrary".



How high is the share of print here?

What does that have to do with the printing industry? Industrial production is responsible for as much as 9 percent of global CO_2 emissions - how high is print's share?

According to the World Resources Institute, the pulp, paper and print industry accounts for around 1 percent of global CO_2 emissions. By comparison, all digital technologies (networks, computers, tablets, cell phones) together cause about as many emissions as all of Germany. Some 4 percent of global emissions are made up by our digital infrastructure, with an increasing tendency. (Source)

The largest share of the CO_2 footprint of print products is attributable to substrate production. Depending on which substrate is used (and who you ask), the proportion of substrate is between 55% and 80%.
This is not a major surprise, as the paper industry is one of the most energy-intensive industries and is therefore in the same category as the glass and steel industry. It is obvious why this is the case. Production consumes lots of water, heat and mechanical energy. It certainly causes you to sweat. Anyone who has ever been in a paper mill will know what I mean.

How much CO_2 does 1 kg of paper cause?

Heidelberg states in its "Solutions for an environmentally friendly printing process" report that one kilogram of paper causes 1.28 kg of CO_2 in production (source). This data refers to the results of the ecoinvent database and applies to coated sheet-fed offset paper.

The Swiss association Ecopaper, which also bases its results on the ecoinvent database, states a value of 1.10 kg of CO_2 in its paper calculator for one kilogram of fresh fiber paper. For recycled paper, the value is 0.81 kg CO_2 (source).

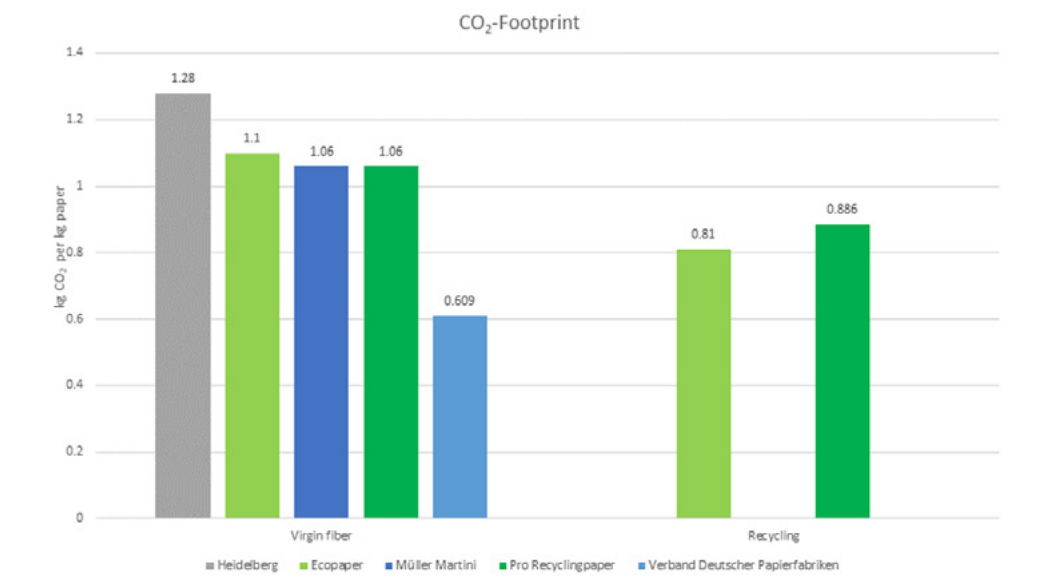
Muller Martini arrives at similar figures. The Swiss machine manufacturer states a value of 1.06 kg CO_2 for the production of one kilogram of fresh fiber paper. This value also matches the data of the Initiative Pro Recyclingpapier's [Pro Recycled Paper Initiative] sustainability calculator. For recycled paper, the Initiative states a value of 0.886 kg CO_2 (source).

Germany's federal government figures put average CO_2 emissions for one kilogram of paper at 0.609 kg of CO_2. It arrives at this figure on the basis of data from the Association of German Paper Mills and states that this matches the figures from emissions trading.

Major difference between types of paper

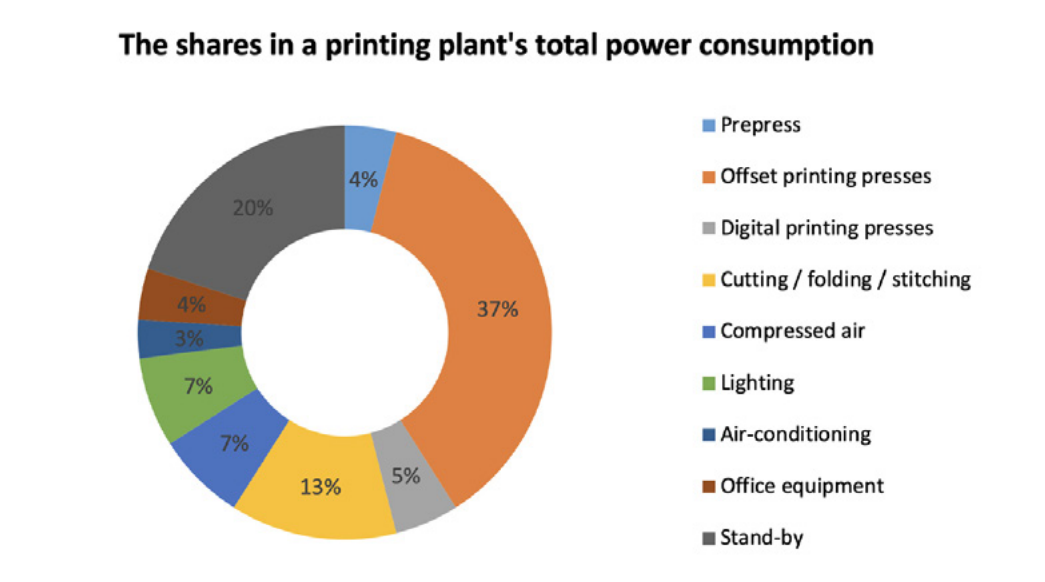
However, this figure seems somewhat unrealistic and will likely relate to the totality of all paper products, i.e. to cardboard packaging or sanitary papers. The truth is likely somewhere between these values. The footprint varies strongly between the types of paper and depends on the share of recycling fibers.

The origin of the raw materials also has a strong impact on the CO_2 footprint. After all, the transport route makes a crucial contribution to how many emissions are caused. Whether the raw material of wood or in many cases already fiber (or pulp) needs to be transported for thousands of kilometers, of course, changes the value by several orders of magnitude.



Processing accounts for about 13 percent

Printing and processing machines make only a small contribution to a product's CO_2 footprint. Print finishing, in particular, requires energy as the sole means for production. A printing plant's power consumption is therefore the second largest source of emissions. The second largest one here, however, is 10 to 20 percent of the emissions.



According to the Umweltdruckerei, of these 10 to 20 percent, 37 percent are made up by offset printing presses and 5 percent by digital printing presses. Print finishing of products contributes some 13 percent through cutting, folding and stitching. Another factor having an impact is the consumption of compressed air. Almost every machine in this area of production requires this costly energy to move pneumatically driven parts or separate signatures. The

Umweltdruckerei states that the proportion of compressed air is around 7 percent.

Muller Martini's position

Muller Martini conducted in-house investigations into energy consumption some time ago – and came up with several interesting findings. The electric energy consumption of a print finishing machine increases in a linear fashion with the speed of the machine. In addition, a machine consumes only about 10 percent more energy when operating compared to when it is idling. This means that as production speeds increase, the electric energy requirement (and thus CO_2 emissions) per copy decreases.

As a result, the typical electric energy requirement caused by print finishing of, for example, 1,000 products in saddle stitching is only about 1 kilowatt hour.

On the topic of compressed air consumption: it is highly dependent on the user settings for suction and blow air, which – if you think about it – also makes sense.
Saddle stitchers also create the greatest blow air consumption by separating and opening signatures.

When considering all this information together, Muller Martini states the energy requirement share of further processing at around 2 to 3 percent for a product, which roughly matches my findings.

Some calculation examples

I have now tried to create a rough CO_2 footprint for a print product with these figures. Let us take a softcover book in DIN A5 format.
It has a volume of 402 pages and the paper a grammage of 100 g/m^2, whereas the cover has a grammage of 200 g/m^2.

After some rule of three and conversion, our sample brochure comes in at about 630 g. Let us now assume that the paper for the book block corresponds to the normal paper mix with a recycled paper share and the cover is a nicely coated glossy paper made from fresh fiber. If we now use the above values of Initiative Ecopaper and Pro Recyclingpaper, we arrive at a value for the CO_2 emissions of the paper. As we have already established that paper manufacturing makes up about 80 percent of the emissions when making printed material, we can therefore estimate how much the rest will be. Ultimately, we arrive at a quite precise value of 1 kg of CO_2 for our sample book.

When searching for comparison values, a study of the Freiburg-based Öko-Institut keeps popping up. It has calculated that about 1.1 kilograms of CO□ are required for the production of a book with 200 DIN A5 sheets and 135 g/m^2, which consists solely of fresh fiber paper. If I adjust the values in my calculation accordingly, I arrive at the same result. However, I consider such a high grammage to be excessive for a normal book.

Fluctuations due to different volumes

A similar calculation can be found on the www.printintelligent.de website. It arrives at CO_2 emissions of 1.36 kg per book, but also assumes slightly different parameters. I also arrive at this result with the same configurations for the book (source)

This small example already shows the following: the CO_2 emissions fluctuate very strongly in line with the volume of the product because the majority is made up by the paper, as we already know. They also include the production-related emissions, of course. If a report from the Süddeutsche Zeitung is believed, shipping the parcel via DHL generates about 500 g of CO_2 (source)

The final result is therefore 1.5 kg of CO_2. This means that I am almost exactly in the average range of all values that I could find on this subject. The sole dissenter of this magnitude is the Babcock School of Business, which states some 10.2 kg of CO_2 emissions for a book. However, a weight of 2.18 kg was assumed in their calculations, which I consider to be a lot. The details for this calculation were unfortunately not available, which is why I cannot verify this calculation.

Printing bad – internet good?

Now you could continue that line of thought and say: If paper generates so much CO_2 and entire trees are consumed, why print at all? Why do we not use our tablets and smartphones to read and do away with all the nonsense about dead trees? But this line of thought neglects some facts about these alternatives.

Let us consider the life cycle of a book. The first steps of a book mostly start with someone giving old printed material such as magazines or books to the waste paper collection. The majority of all paper grades produced in Germany has a share of recycled paper. The recycling rate in the European Union is 72 percent (source).

Trees in the form of fresh fiber are therefore used as little as possible. Not because paper producers feel sorry for them, but because fresh fiber material is expensive and needs to be imported over long routes. And don't forget that paper or wood is a renewable material. If used responsibly, it can also be available to future generations.

Little recycling among the digital alternatives

Smartphones and tablets, by contrast, require rare earths (in particular for magnets in electronic components), which are barely recycled. What's more, they are mostly mined in China and Inner Mongolia in conditions that I would describe as uncomfortable from a European perspective.

The plastic parts are also very rarely recyclable. The quality of recycled plastics is often insufficient for glossy products.

Apple states that only 35 percent of the plastic components in an iPhone 11 are made from recycled materials (remember: paper has a recycling rate of 72 percent). Similar to books, the majority of the emissions is generated when producing the devices – according to a study conducted by the Öko-Instituts e.V., about 80 percent. With an e-reader (not a tablet), 8 to 10 kg of CO_2 equivalents are released on average, most of which are made up of sulfur hexafluoride (SF6), which has an extreme impact on the environment. It is considered to be the strongest known greenhouse gas (source).

Amazon states that it sets the CO_2 footprint of its devices very precisely and in detail and creates models on that basis to calculate the emissions. However, it does not publish the data – a pity...

Apple, by contrast, states a carbon footprint (i.e. over the entire economic life-time of the product) for its latest generation iPad Pro of 151 kg of CO_2. However, it must be remembered that an iPad has a far greater range of functions than the mere reading of books. The example shows, though, that purchasing an iPad to simply read books is certainly not a green alternative (source).

The book emits CO_2 only once – during production

However, there is one silver lining to the iPad: its packaging. It is 96 percent fiber, which comes entirely from woods with sustainable forestry. After all, 43 percent of the fiber content comes from recycled sources (source).

Another difference is quite obvious: the book emits CO_2 only once over its entire life cycle – during production.

Tablets and smartphones, however, require power to work. Added to this is the growing trend not to store books on the device, but in the cloud. Every time the book is opened, all data is freshly transferred, which increases indirect energy consumption by a value that is hard to estimate. Regardless of how energy efficient tablets, smartphones and data centers might become, the book will always come out on top.

65 million tons of electric waste annually

Of course, you also need light to read a book in the dark. But I assume that tablets are also not read in dark rooms. What's more, books are rarely thrown away. The average life cycle of a book is therefore about twelve years, in which time, the book is mostly read by several people. We all know the scenario where we are given grandma's box of books with more than 50 dime novels. After sorting through them, grandma's old books can at least still go to recycling.

The e-reader, however, has an average life expectancy of two years. Another thing we know all too well – especially after the warranty has expired (source). Recycling tablets, however, is not so simple. The majority of the electric waste is toxic waste and ends up in landfill sites in developing countries. And the burden of the waste is crushing; just remember Knud Wassermann's blog. Sixty-five million tons of electric waste are created globally every year, and only 16 percent is recycled.

Ever more electronic devices

Added to this is the vast volume of tablets, smartphones and other gadgets. According to Cisco, one of the world's largest telecom companies, every person in Western Europe will own 2.9 units of these devices by 2023 (source).

Here, the so-called rebound effect plays a major role. Because semi-conductor, screen and processor technology is becoming ever more energy-efficient, ever greater resolutions (we have now arrived at 16k) and screen sizes are being offered. The question now is whether this increase in performance will offset the reduced power consumption.

There are some indications of this. For instance, the figures of the French Shift Project show that the so-called Koomey's Law is increasingly cooling off, i.e. a plateau has been reached. It says that the energy efficiency of computer capacity has doubled every 1.6 years for 60 years. Since 2000, it has only doubled every 2.7 years. The Shift Project think tank indicates that the efficiency improvements are already no longer sufficient to compensate for the 9 percent annual increase in energy demand (source).

What can be done?

So what do we make of these figures? We can draw two conclusions from them. First, the main potential for cutting CO_2 emissions in the print industry is in saving paper. Heidelberg and Muller Martini, who both conducted such analyses already some time ago, also come to the same conclusion.

In particular, the saving of start-up waste and the avoidance of machine stops can help to make book production as climate friendly as possible. The maximum use of a format for collective forms can also reduce CO_2 emissions, of course. By comparison, in my sample calculation, for 5,000 books, about 166 kg of CO_2 are made up by production waste alone.

To make better use of the format, Muller Martini offers, for example, the option of replacing traditional barcodes with specific image elements using the Asir 3 barcode identification system. The additional white area, the "quiet zone" with the barcode printed on it, is not used at all.

Although print finishing is responsible for only a small share of CO_2 emissions in the print process, there are nevertheless efforts in this production area to reduce the footprint. In Muller Martini's latest machines, servo motors in the IE3 efficiency class are used. They use an energy feedback system for the dynamic movement of heavy parts, which return part of the energy used back to the grid.

Potential savings with perfect binders

Muller Martini has identified potential savings, in particular, with perfect binders. For instance, instead of the traditional application rollers, glue nozzles can be used. Only small amounts of glue need to be used for them and no longer entire pots pre-melted.

Producing books locally can reduce transport via truck, ship or even plane, thereby also protecting the environment. Muller Martini also offers corresponding solutions to this end with the combination of the Vareo perfect binder/InfiniTrim three-knife trimmer.

A workflow management system is also a vantage point for saving resources. Digital job sheets, with the JDF format, prevent errors that may have resulted in production waste, waste sheets or even faulty copies.

Such a system also makes a life cycle analysis for print products possible. If I know my energy consumption and the details on the resources used, a precise analysis of the life cycle of each print product becomes possible.

Conclusion

What are our findings from this whole subject? What have we learned from this three-part blog series?

1. First (and this is my most important concern): the global pandemic has not made climate change any less topical. Quite the opposite. We are running out of time. The figures are not looking good for mankind.

2. Yes, we can scapegoat other countries and say that they should finally do something about it. But we must be clear that our consumption behavior means that we are also responsible for these emissions. I am including myself here, because I, too, have a smartphone and it comes from China.

3. The majority of greenhouse gas emissions comes from our increasingly rising hunger for energy. Energy that is not only used by industrial production, but also by the increasing volume of flashing plastic waste that we use day to day in order to watch Netflix series or share images from our vacation in the Caribbean.

4. The pulp, paper and print industry accounts for around 1 percent of global CO_2 emissions. The majority is created by the pulp industry, which makes up about 80 to 90 percent. The remaining energy use generates some 10 to 20 percent of the emissions. Of them, in turn, about 10 to 15 percent are caused by print finishing. The total share of print finishing in the product is therefore about 2 percent.

5. Despite this being only a small share, there are innovative printing companies that are becoming active in the area of sustainability and creating ecological benefits with smart automation or by recovering energy. Digital transformation is making the analysis of product life cycles as easy as never before, considering that today's objective is to track every product.

6. Not all digital alternatives are as green as we always think. Digital infrastructure already emits 4 percent of global greenhouse gases. According to forecasts, the CO_2 emissions of the IT sector are set to double to 8 percent by 2025.

7. The resources of our blue planet are limited. If we want to continue to generate wealth, we will have to think about how we use resources that will also need to be available in the future. Given the right framework conditions, paper can be such a raw material.

8. Print products such as books emit only about one tenth of carbon dioxide compared to the digital alternative during production. Subsequently, they emit zero emissions as opposed to tablets and e-readers. And books have a superior economic life-time, are mostly lent on to other people, and can be nearly 100 percent recycled.

9. Book-of-one production can cause shorter transport routes and less excess copies, but slightly increases the CO_2 emissions per copy.

Sustainability means more than mere ecological aspects

During my research for this blog, I came across a statement that I deem highly relevant for the entire climate debate: "Don't think ecologically, but comprehensively."

This might sound provocative, and that is the intention. But there is also a lot of truth in this statement. After all, sustainability means more than mere ecological aspects. Economic and social aspects are equal to such objectives. They ensure that objectives remain viable and fair.

If you buy a tablet for environmental reasons so that no more trees are felled in the future, this initially makes sense from an ecological perspective. Obviously: fewer destroyed trees. But if you buy the latest iPad model every other year and additionally replace the battery every year, this approach no longer works.

Raise awareness and improve consumer behavior

The climate issue has been emotionally strongly charged by the media and campaigns such as Fridays for Future. I don't think this is the right approach. It is certainly important to highlight the problem and to raise awareness and improve consumer behavior. But it is also important not to resort to collective thinking patterns.

Plastic is bad, felling trees is bad, online is always greener are but a few of the industry-relevant prejudices.
If, for example, a plastic film around a cucumber ensures that it remains fresh for twice as long, it certainly makes sense, even if it does not seem ecological at first glance. However, it is also sustainable for other reasons.

Climate change is a problem and the problem is real.
Now this problem needs to be solved – and that is best achieved with logic and thinking. Going to school also helps by the way...

Arne Klages is a student at the Stuttgart Media University in Germany. He has been taking the relatively new Print Media Technologies course toward a Bachelor of Engineering degree since 2018. Before that he trained as a Print Media Technician, where he developed an interest in all things related to print.