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DEFOSSILIZATION + RECYLING + CARBON FOOTPRINT = MAIN INPUTS FOR SUSTAINABLE DIGITAL PRINTING

Dr. Lode Deprez - Xeikon

Agenda

- Importance of Recycling & Defossilization
- Analogue versus Digital – cost versus sustainability
- Sustainability goals of Flint Group and Xeikon
- Carbon footprint of (digital) printing
  - starting assumptions
  - What factors influence the CF and what values to we get ?
  - What can we learn from it ?
- Conclusions

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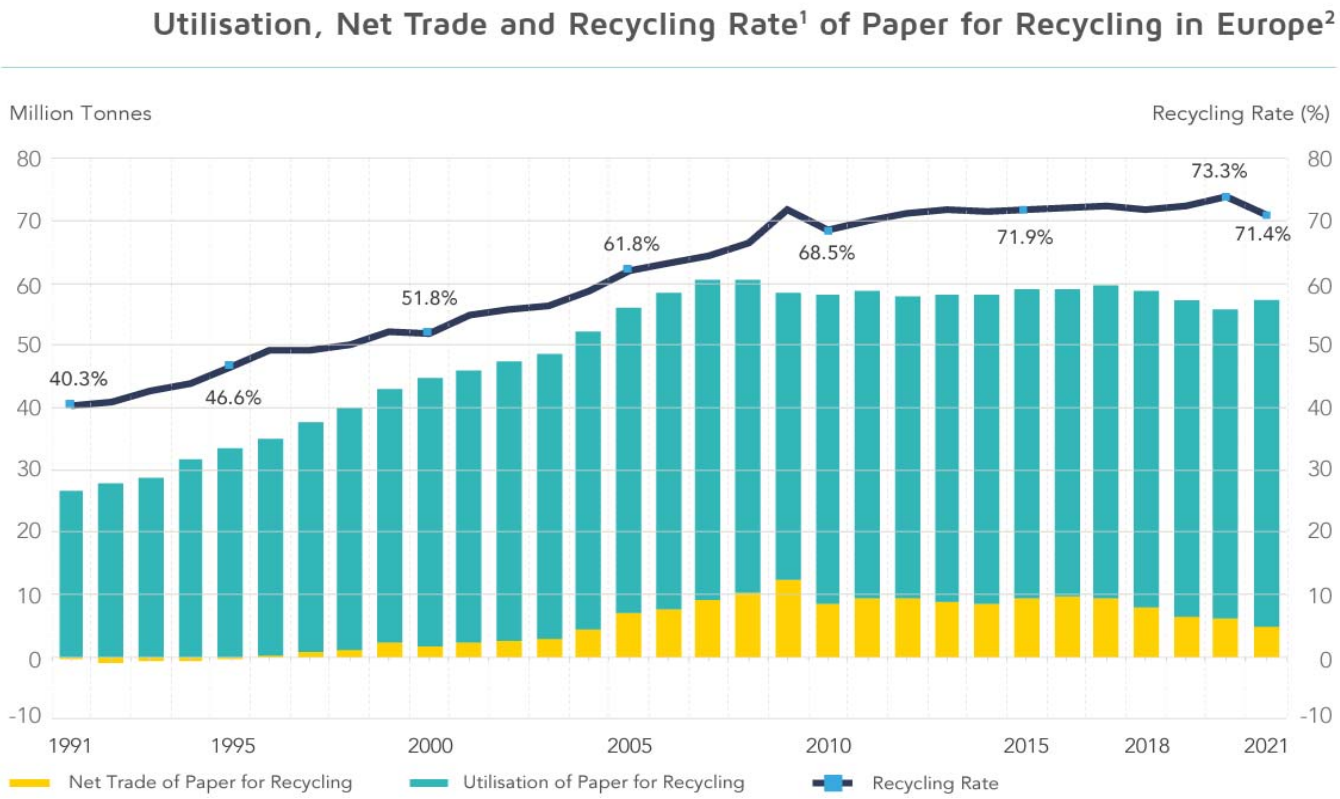
IMPORTANCE OF RECYCLING & DEFOSSILIZATION

Recycling of Materials

Paper

- Paper recycling rate in EU > 70 %
- Some paper material is not recyclable (tissues, toilet paper)
- Paper is biobased material

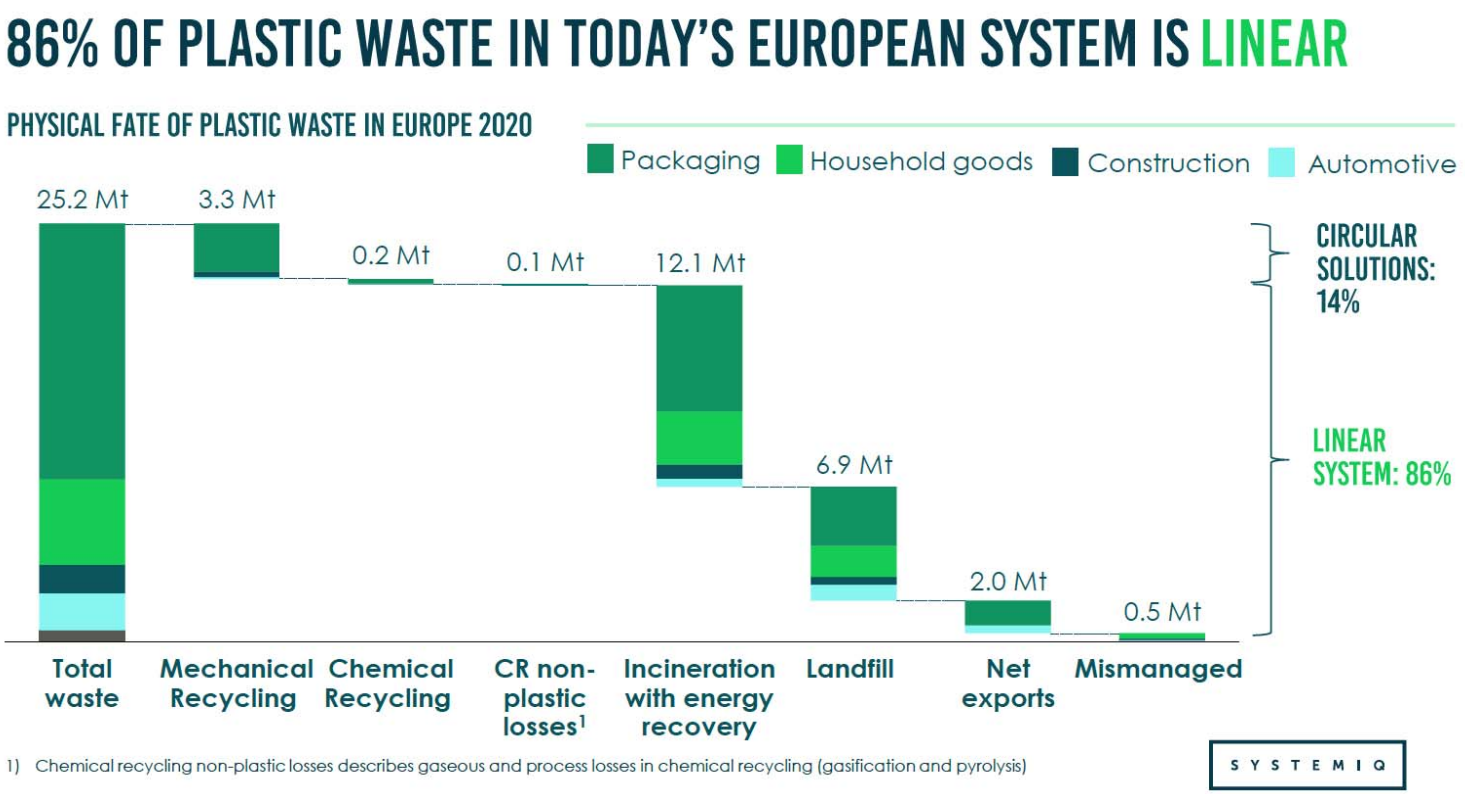


Source : Cepi 2021 report

Recycling of Materials

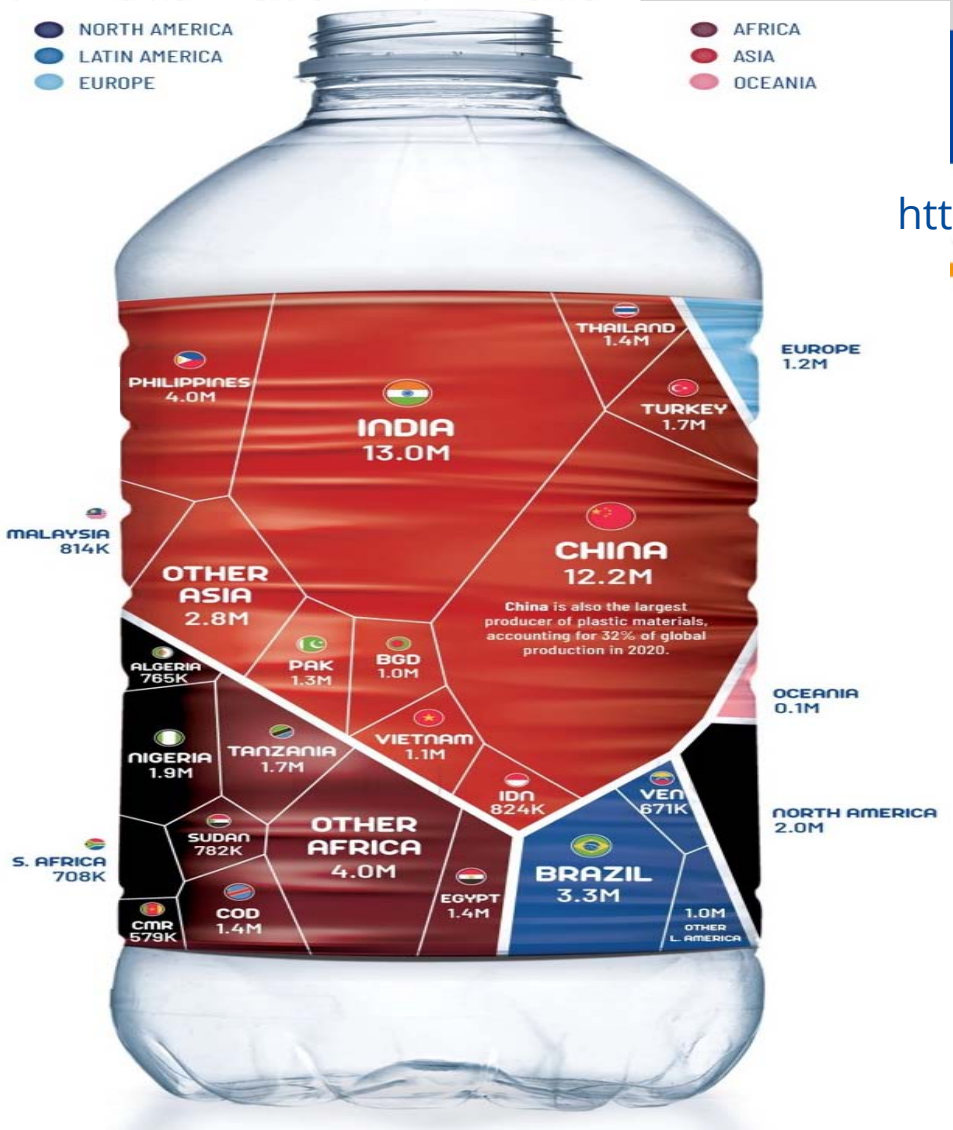
Plastic

- 60-65 Mton of plastic was put on the EU market in 2020
- 40 % collected (mainly packaging)
- 5-6 % recycled



Mismanaged (dumped/littered) Plastics 2019

https://www.visualcapitalist.com/visualizing-mismanaged-plastic-waste-by-country/



- 350 Mtons plastic waste globally
- **<u>20 % is mismanaged</u>**
- E.g. Phillipines alone take 37 % of all plastic that comes into the sea…
- A lot of export to developing countries (D, Japan, US)
- This behavior is feeding the plastic soup and global awareness

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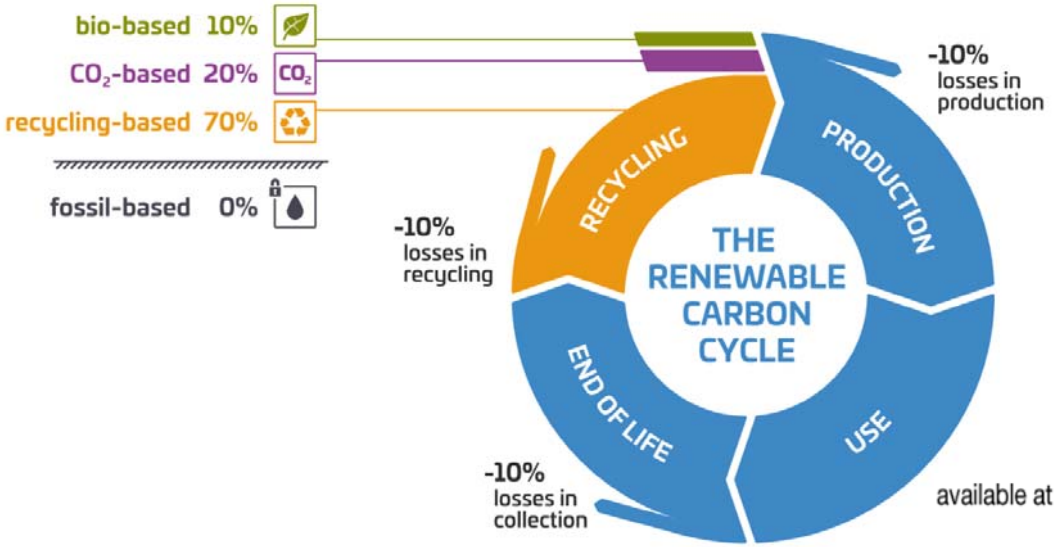
Recycling of Materials

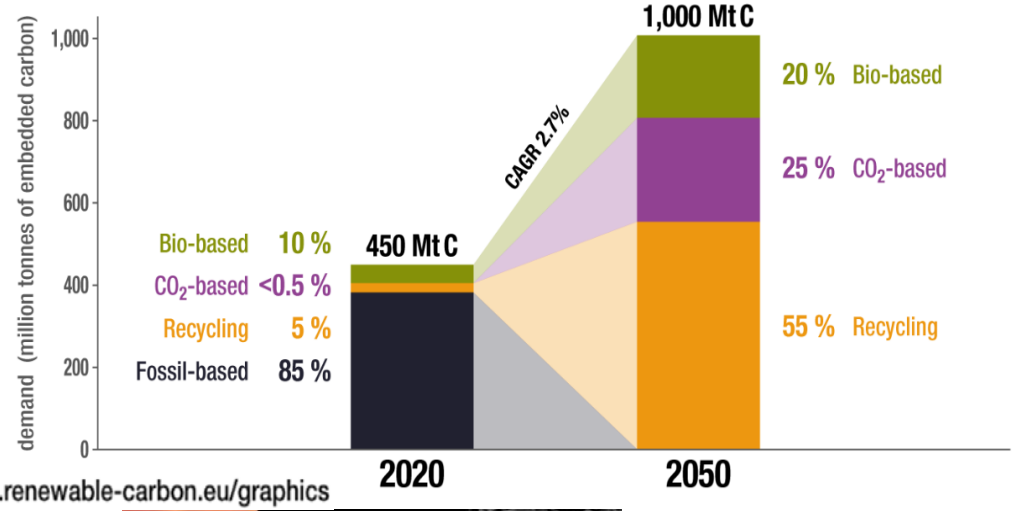
Feed the Carbon cycle – NO Decarbonizaton

SCENARIO FOR THE PLASTIC INDUSTRY 2050



Global Carbon Demand for Chemicals and Derived Materials

in 2020 and Scenario for 2050 (in million tonnes of embedded carbon)



available at www.renewable-carbon.eu/graphics

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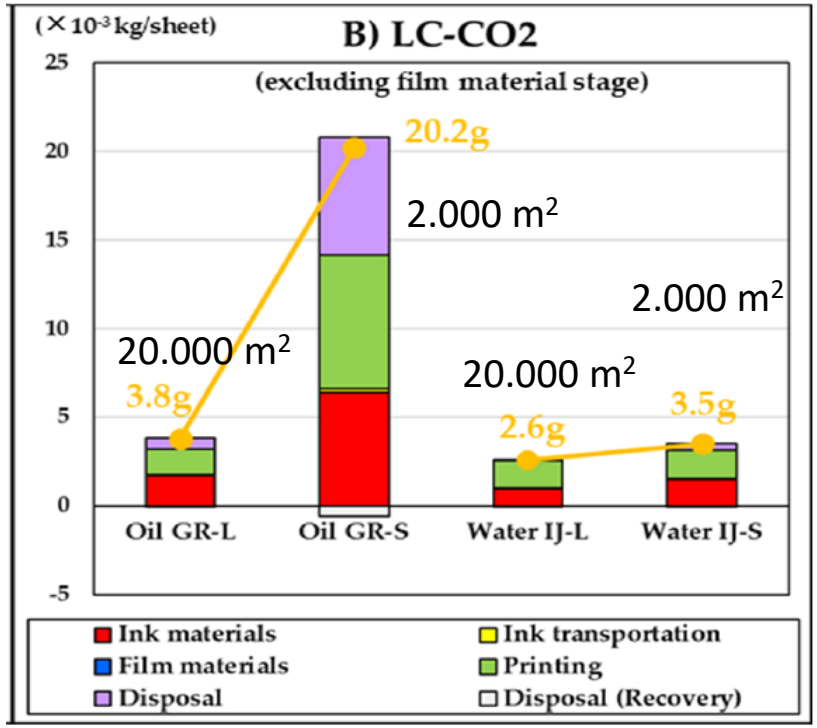
ANALOG VERSUS DIGITAL

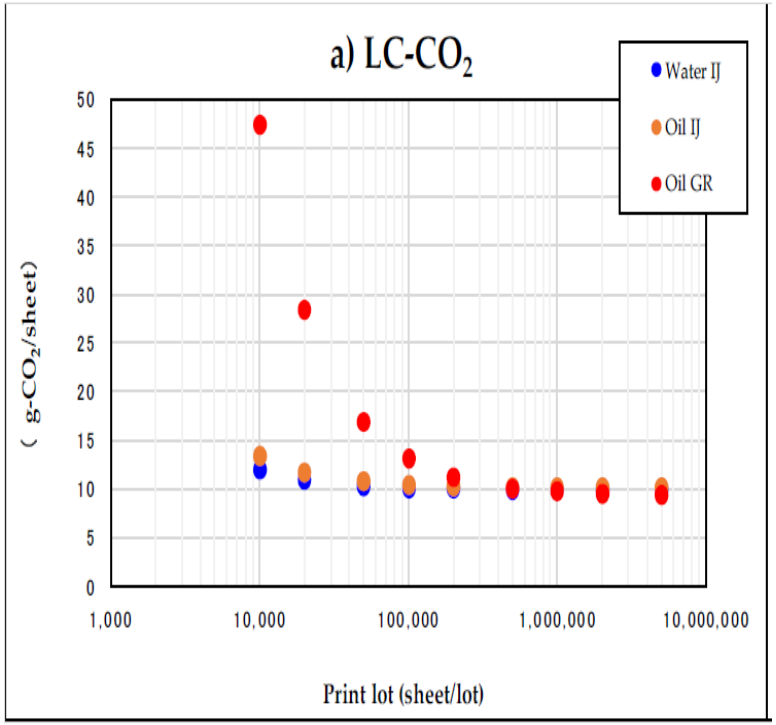
Analog versus Digital

Sustainable versus Economcal break even

- The economical crossing in joblength (equal cost) versus the sustainable crossing (equal carbon footprint) will not be the same volume
- Lower waste & stocks, faster delivery, variation will play role too



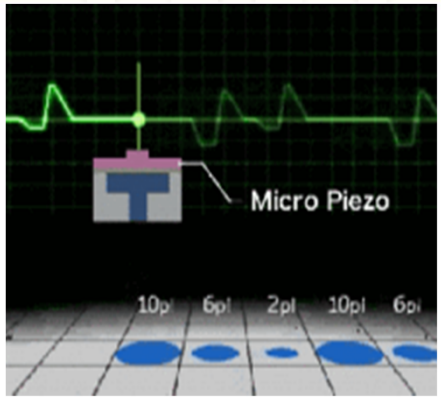
https://www.mdpi.com/2071-1050/13/17/9851



Digital Inks versus Analog Inks

Cost of Inks

Piezo head



(UV) ink type	Viscosity (mPas or cP)
Sheet-fed offset	10 000 – 80 000
Web offset	10 000 – 80 000
Screen printing	1 000 – 50 000
Flexographic printing	50 - 500
Inkjet	4 – 10 (sometimes up to 30)

Main differences with flexo and offset

- Layer thickness IJ is 3 times thicker because pigment concentration is 3 times lower (for viscosity reasons)
- Cost is 3 times higher to make (all particles have to be smaller than 300 nm) + more expensive ingredients
- Same reasoning valid for toner

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SUSTAINABLE GOALS FLINTGROUP & XEIKON

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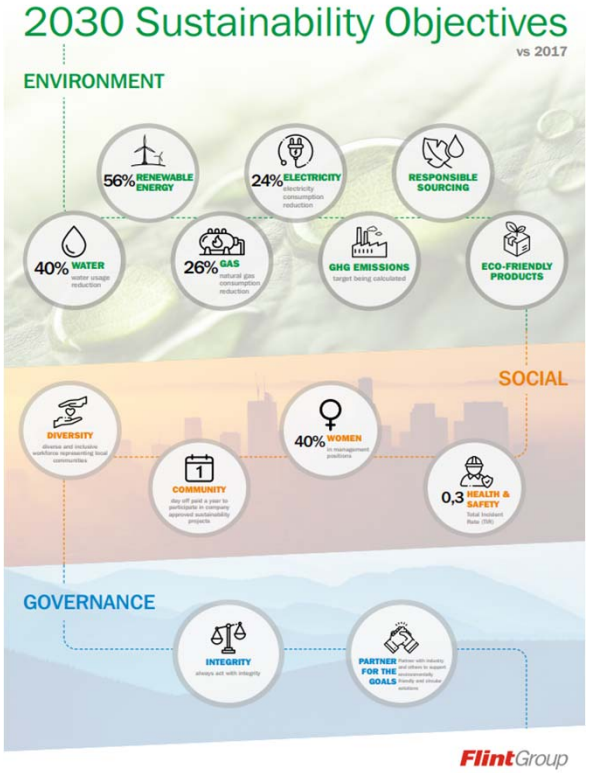
Sustainability Approach Xeikon/Flint Group



XEIKON is fully aligned with FlintGroup 2030 strategy based upon the 17 points set forward by the United Nations

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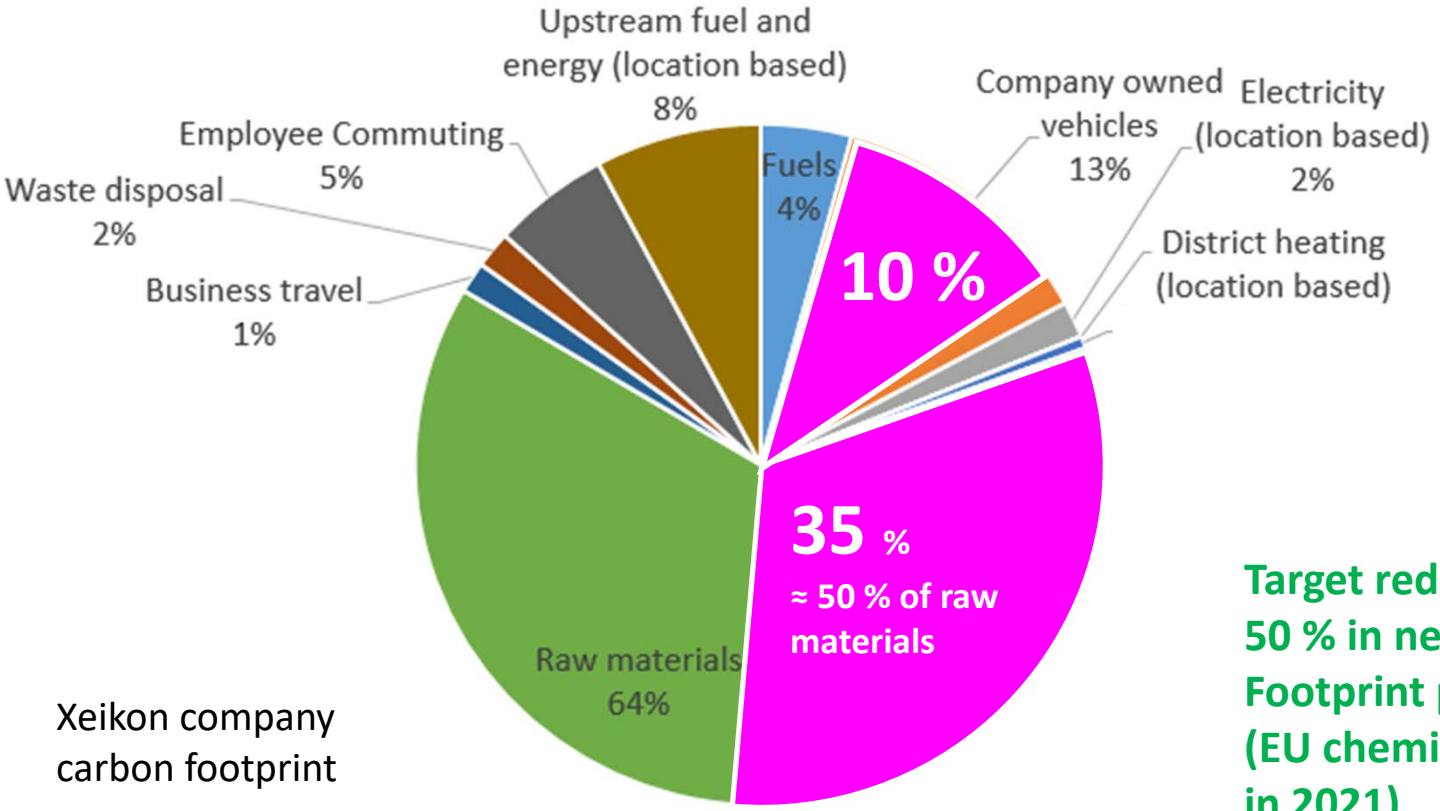
Carbon Footprint of Xeikon



Xeikon company carbon footprint

Target reduction of global Company CF by 50 % in next 2-4 years bringing the Footprint per employee below 10 t/year (EU chemical industry : 36 tons/person in 2021)

Xeikon CF reduction program on short term

Action Items

- Using recycled PET in toner resin (Recycle)
- Study the use of replacing residual monomers by renewable C-monomers (Recycle, Biobased)
- Evaluate the use of paper bottles (Recycle)
- Use as much recycled Aluminum as possible (Recycle)
- Continued Focus on deinking, both paper and foil (Recycle)
- Change the company car park to e-cars (Reduce)
- Educate the printers what factors in the printing processcontribute to the CF

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CARBON FOOTPRINT OF (DIGITAL) PRINTING

The complex issue of Carbon Footprint Calculation

Transport, substrates, life cycle of printed product, logistics of raw materials, engine production, .. are not considered

What can be controlled, what can be measured (per square meter substrate printed) ?

1. Energy consumption during printing (mechanics, drying, curing, fusing, …)
2. How much is ink is used + basic ink composition (emmision coefficent of raw materials) – energy for ink making not included yet (Xeikon uses green electricity)
3. How much waste is generated (packaging, usage parts) and use the emission coefficients for these materials
4. Packaging of inks not involved in this approach for now

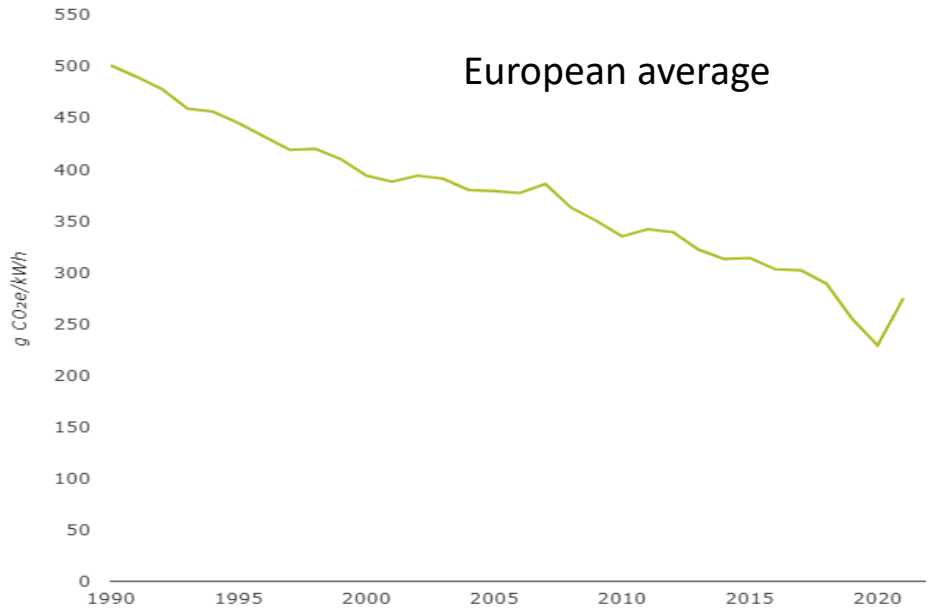
Carbon Footprint Calculator

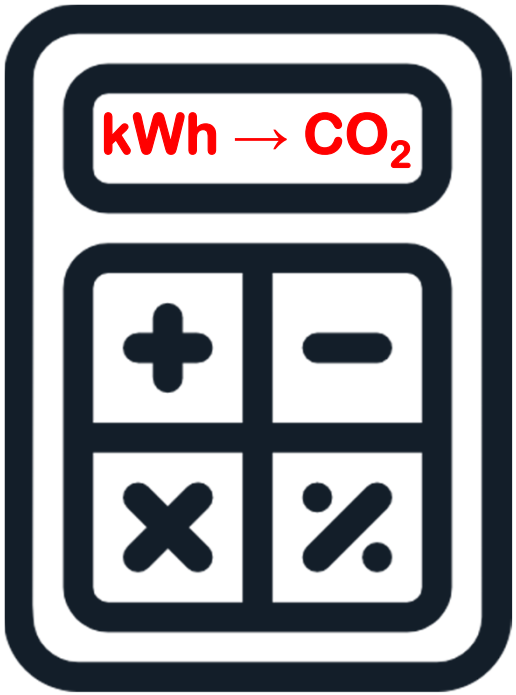
EU-Conversion of 1 kWh to 287 g CO2 (2021)

Member State	Greenhouse gas (GHG) emission intensity
Sweden	9
France	67
Luxembourg	68
Finland	77
Slovakia	113
Austria	114
Lithuania	120
Denmark	130
Croatia	138
Belgium	154
Latvia	155
Hungary	195
Portugal	220
Slovenia	222
Spain	232
Italy	247
Malta	318
Romania	323
Ireland	363
Germany	402
Netherlands	418
Czechia	442
Bulgaria	463
Greece	604
Cyprus	646
Poland	750
Estonia	946

https://www.eea.europa.eu/ims/greenhouse-gas-emission-intensity-of-1

Figure 1. Greenhouse gas emission intensity of electricity generation

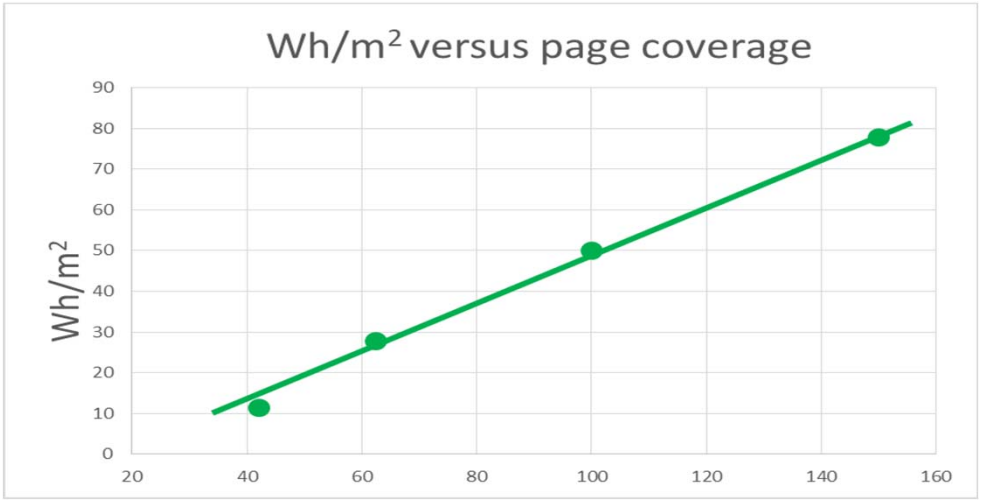




Carbon Footprint Calculator

Measured Energy of printing expressed in Wh/m²

- Printing energy for EP and UV is quite independent on substrate type and ink coverage – m²/minute is very important
- For waterbased inkjet this is not true – amount of ink/water) determines drying energy (paper based printing, no special primer needed)

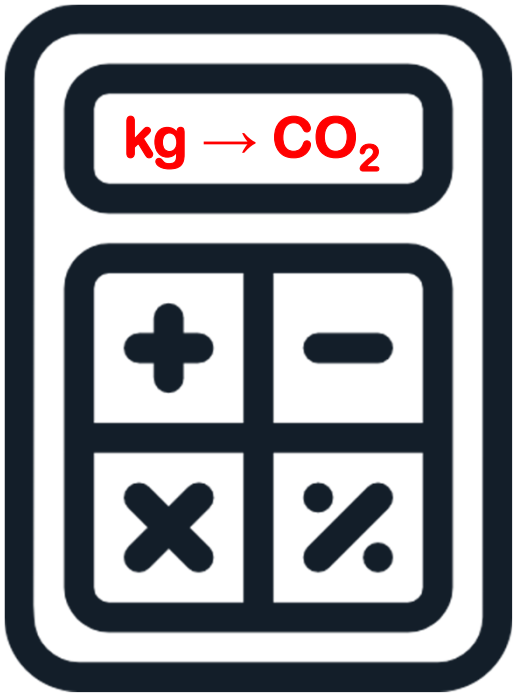


printer	speed (m/min)	width (mm)	energy Wh/m2	number of colors
Xeikon PX3300 LED	50	300	12	5
Xeikon PX3300 L&B	50	300	15	5
Mouvent UV	45	317	26	4
Xeikon CX500	30	500	27	5
Domino N610	35	345	27	2
Xeikon CX300	30	330	34	5
Xeikon CX50	20	330	36	5
Xeikon CX500 TITON	30	500	38	5
CX30	20	330	47	5
HP WS6800	15	200	86	6

Carbon Footprint Calculator

Conversion of kWh to ton CO2

Emission factor for each type of material based on GaBi Professional 2021, Ecoinvent 3.8 and CEPE tool



Material	Emission factor (ton CO_2/ ton product)
C-black	2.37
Pigments	6.87
Aluminum	8.78
Acrylic monomers	1.69
Polyester	2.91
Polyethylene	2.00
Aliphatic Solvents	2.47
Carrier EP	3.75

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Carbon Footprint Calculator

Amount of ink/chemistry on substrate

weight %	thickness dry/cured for 100 % coverage (micron)	g CO_2/m^2 for 100 % PC of dry layer
UV Inkjet	8.0	17.2
AQ Inkjet	1.3	2.8
Dry Toner	4.5	13.5
Liquid Toner	1.5	2.6

- Amount of pigment is quite independent of the technology = same pigmentation for all technologies (analog and digital)
- A General consumption 95 % CMYK (equal divided) and 5 % white
- Same amount of has been used for all technologies to obtain the 100 % page coverage (OD 1.4 & CMY, 1.8 K)

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Carbon Footprint Calculator

Printing related aspects – waste and consumables

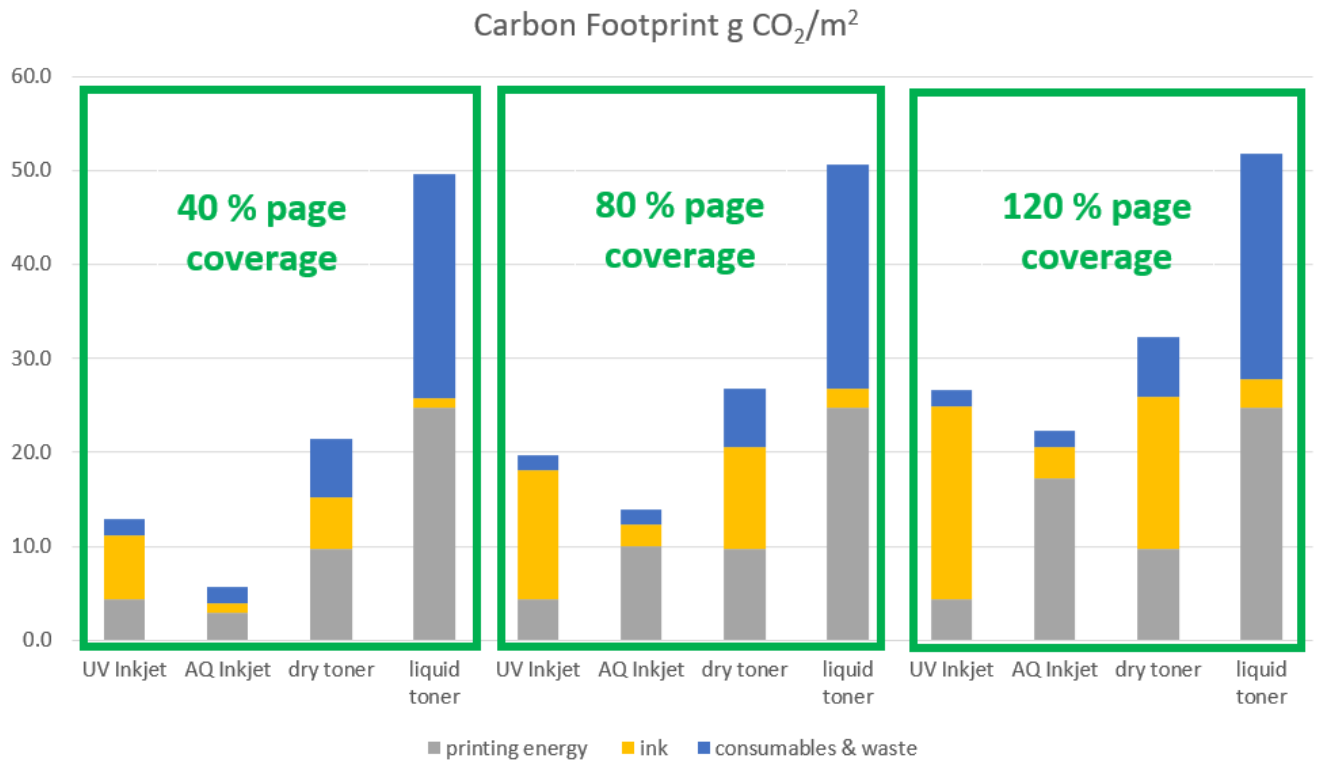
g CO_2/m^2	solvent	parts drums developer	heads	g CO_2 to be added for each m^2 produced
UV Inkjet			1.68	1.68
AQ Inkjet			1.68	1.68
dry toner		6.28		6.28
liquid toner	21.01	2.91		23.92

- Major consumables that are replaced frequently (fuser drums, photoconducter elements, developer or waste which is generated during the printing and has to be removed)
- Data for printing head is difficult to obtain, here we chose the carbon emission value of producing one smartphone (50 kg CO_2 per piece)

Carbon Footprint Calculator

Carbon Footprint per technology as a function of page coverage

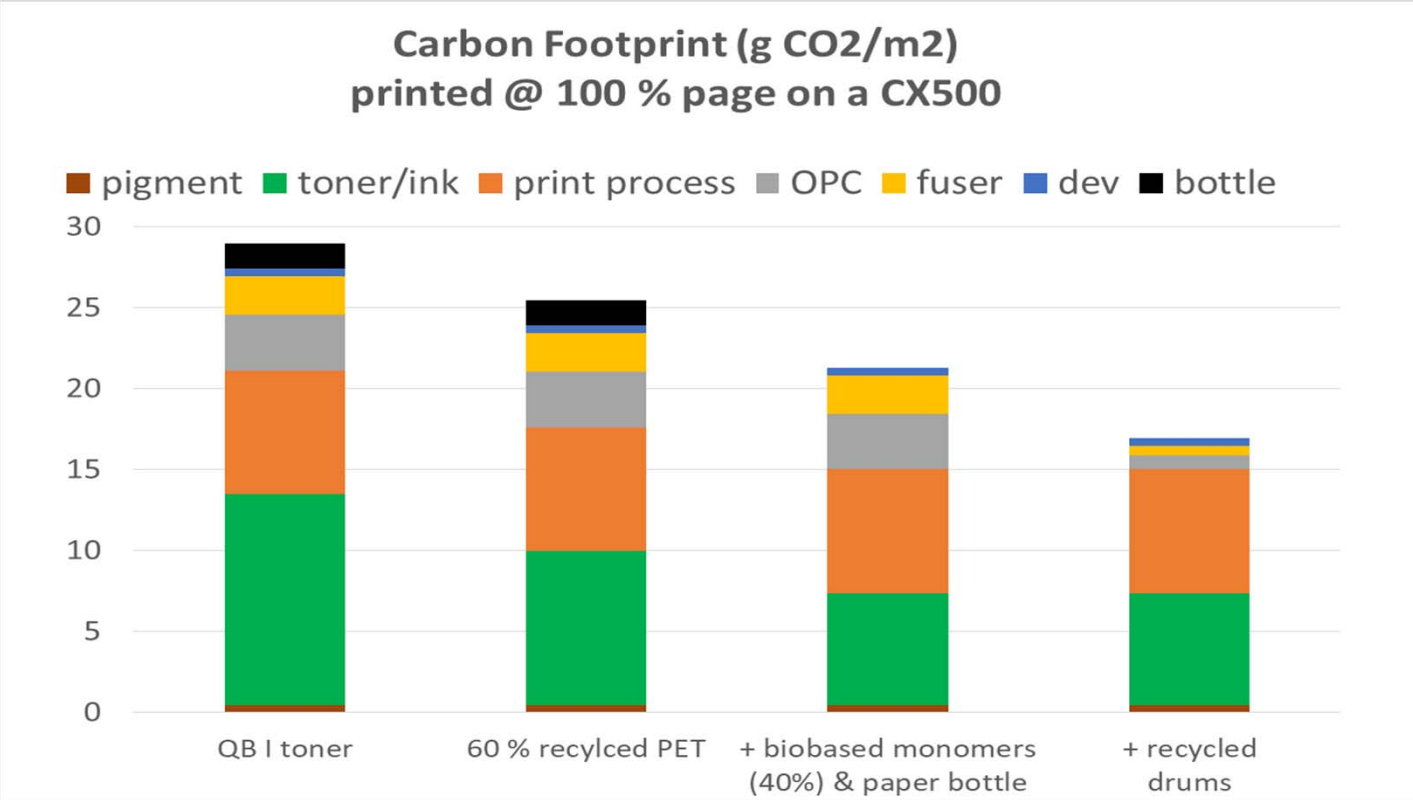
- Bringing all data together….
- Dependent on the technology the focus for reduction of the CF is different
- Xeikon choose to work in first phase on ink and consumables



Carbon Footprint Calculator

Future Xeikon Dry toner system

- Work towards :
  - Recycled resin
  - Sustainable monomers
  - Recycled materials in drums
  - Convert packaging from fossil based to paper based



Carbon Footprint Calculator

Short term Outlook

- When Digital printing is available, Xeikon also want to make the comparison with main analogue printing processes(mainly UV and waterbased Flexo)
- But analogue printing is more complex to handle
  - Preprint preparation (reuse plates)
  - Waste generated while adjusting printing quality and color
  - Waste generated with inks
  - Printing higher quantities to avoid short reruns…

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CONCLUSIONS

Conclusion

- Key points to take away
  - Key aspects are : Defossilization, Recycling/Reuse
  - Use the carbon we have now, do not add anything new from below the earth crust, do not convert towards CO_2 anymore
  - Identify the company CF calculation to identify where to focus and define realistic plans
  - Use/exploit the sustainable aspects of digital printing
  - Be aware of the sustainable differences between technologies
  - Educate the customers

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THANK YOU

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