



Whitepaper:

# Digital print technology for a circular economy

*Digital print technology for a circular economy* is a white paper released by FUJIFILM Graphic Systems Europe, part of the Fujifilm Group. Fujifilm is committed to delivering technically advanced and sustainable printing solutions for the European graphics industry.

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Printed on the Jet Press 750S

## Executive summary

### Where does print fit in the circular economy?

From books, newspapers, magazines and brochures to folders, annual reports and packaging, print remains a vital and highly effective branding, marketing and communications tool. But in an age of heightened environmental concern and 'net zero' carbon reduction targets, how can print be used in the most efficient and responsible way? In this white paper, we take a look at how the latest digital printing technology is dramatically cutting waste and making recycling much easier.

### We must do more

As part of the "European Green Deal" project, there is an action plan for the EU to boost the efficient use of resources by moving to a clean, circular economy, restore biodiversity and cut pollution, and be climate neutral by 2050<sup>1</sup>. To achieve this goal, action must be taken at all levels. Switching to renewable energy will, on its own, reduce global greenhouse gas emissions by only 55%. The remaining 45% of emissions come from the way we make and use products, which means working smarter and wasting less.

### The way we print is changing

The graphics industry has many analogue techniques which, especially when used for bespoke or short run work, have an enormous impact on the environment.

Now, thanks to the latest developments in digital print technology, there are machines which can print while also:

- Massively reducing raw material use
- Using fewer and more sustainable consumables
- Needing far fewer parts replacing
- Producing less waste
- Consuming less water
- Producing 100% recyclable printed products

This technology is moving print from the linear to the circular economy in which everyone has a role to play in keeping our planet livable and our prosperity intact.

### Fujifilm: a leader in sustainable technology

Fujifilm Corporation, a global organisation spanning many industries, is continually striving across all parts of the business to develop more sustainable technologies. The Jet Press 750S is a perfect example of that commitment, producing high quality print that is fully recyclable with much lower levels of waste.

## Circular Economy

### What is a circular economy?

*“A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems”.*

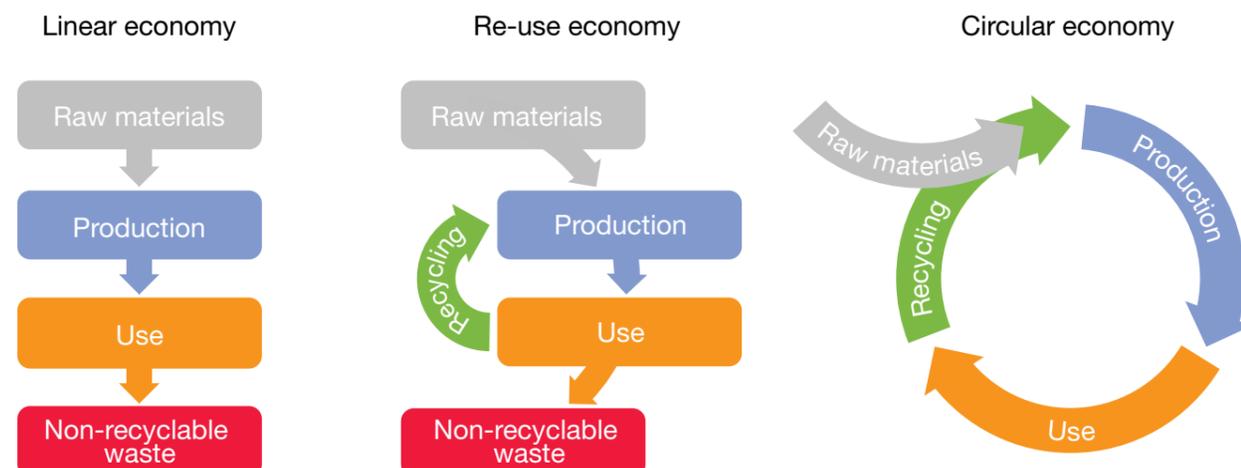
The Ellen MacArthur Foundation<sup>2</sup>

Current levels and methods of production and consumption are unsustainable. In 1684, Thomas Savery invented the steam engine and this invention set the Industrial Revolution in motion. Raw materials and energy were seemingly infinite and labour was readily available. Since then, technological progress has continued at a rapid pace. We continue to take resources from the ground to make products, and if we no longer want them, we throw them away. We call this a linear economy, take-make-waste. We need to transform all the elements of the take-make-waste system, only then can we create a thriving economy which benefits everyone.

### A circular economy in Europe by 2050

In a circular economy, all materials are re-used – nothing is thrown away or incinerated, just as has been the case in the natural world for billions of years. Cycles are closed, matter continually biodegrades and fuels the next phase of the cycle, and constant energy comes from the sun. There is much we can learn from that.

The EU's Circular Economy Action Plan<sup>3</sup> outlines a strategy to transform Europe's economy into a sustainably driven, fully circular economy by 2050. To achieve this goal, we must take action at all levels of society and set clear milestones. The first goal is ambitious but not unattainable: a 50% reduction in the consumption of primary raw materials (mineral, fossil and metals) by 2030.



These ambitious goals require not only technical innovations, but also societal and economic change. After all, circular solutions affect consumers, businesses and governments. When designing a product, for example, the period after its use must also be carefully considered. We all have a role to play in developing and supporting the types of initiatives that can get us to this goal.

## Printing techniques

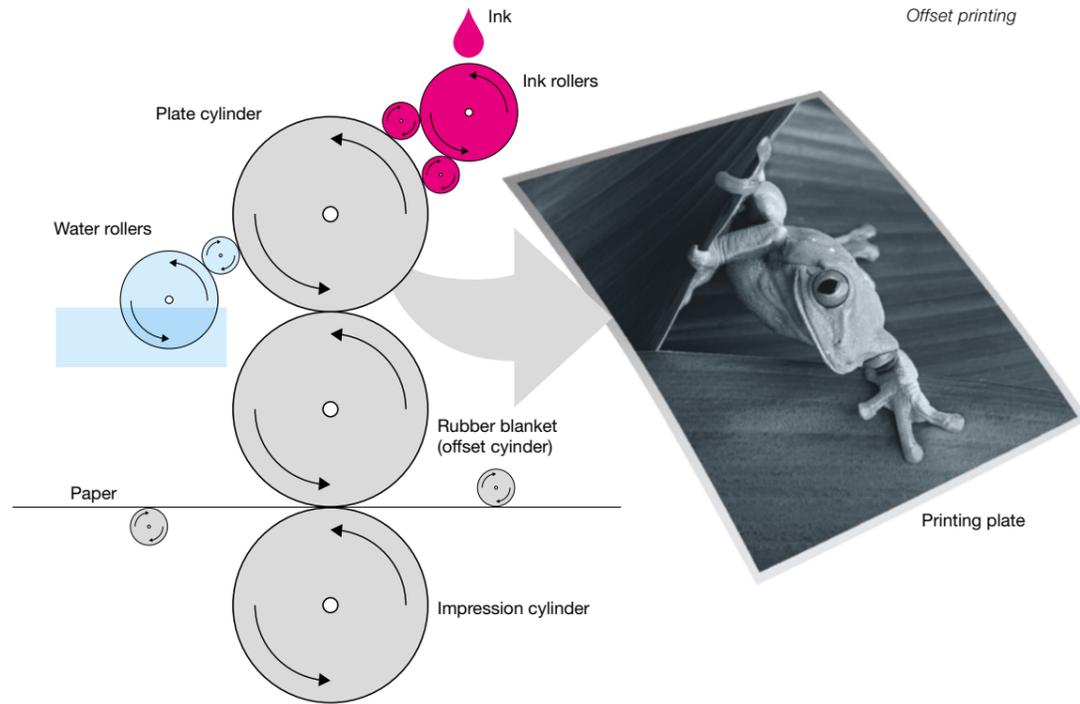
### What is printing?

The basic principle is familiar to all of us, but the technical detail is not really understood outside of industry professionals. In order to fully grasp how the latest technologies are making print more eco-friendly and more sustainable, it's important to understand a little bit about the most prominent modern printing techniques.

### Analogue systems

So let's take a look at three of the most common analogue printing methods. Each has its particular strengths and weaknesses, and particular applications for which it is best suited:

1. High pressure. Relief printing is the umbrella name for a number of printing techniques, such as a stamp, linocut, letterpress or flexo printing, and is the oldest printing technique. The most striking thing about this technique is that before printing, the ink is applied to the raised parts of the printing form. In order to multiply the image, lead type, rubber stamps, metal or plastic plates are used, which are pressed directly into the paper or cardboard with force. Packaging, decoration material and labels are examples of relief printing.
2. Flat pressure, (e.g. offset). Offset is a form of indirect printing. This technique is characterised by image conveyors consisting of a cylinder with an aluminium printing plate, and a cylinder with a rubber blanket. Unlike relief printing, with offset there are no raised parts of the plate or conveyor. Instead, the technique works on the principle that water (unprinted part) and grease (ink, printed part) repel each other. Examples of applications are books, magazines, brochures, advertising leaflets, stationery, business cards, etc. This is still the most common printing technique within the graphics industry.
3. Gravure printing, (e.g. etching and rotogravure). Gravure printing is a very old technique originating from the art of goldsmithing, and is characterised by the use of a printing form (copper cylinder) in which small sunken recesses hold the ink. Excess ink is scraped away with a squeegee and the paper only absorbs the ink from the cups. This technique is relatively expensive, but thanks to its high speeds, can be very suitable for printing large volumes – for example magazines or newspapers.



Offset printing

### Printing today

Most commercial printing is offset, and for long run jobs it remains the most appropriate technology given its very high speeds. But it is complex, and due to inevitable waste at the start of each new print job, and the lengthy time to set new jobs up, it is commercially and environmentally unsuited to short-run print jobs.

Since the end of the 1990s another technique has become popular: digital printing. Digital printing refers to a process in which a digital image is transferred to a printing press where the print job is printed within seconds, either using toner or ink. Because the image is transferred digitally, it is possible to print variable data, for example a unique name on each flyer or ticket (personalisation).

In addition, the first sheet from the machine can be colour correct and almost immediately dry so that it can be processed and delivered quickly. Printing-on-demand (POD) has also become possible thanks to digital printing. With POD, even if only one copy is printed, it is still cost-effective. It is a very sustainable method: You do not have to keep large quantities in stock, which makes a large warehouse superfluous and no more paper is used than is necessary – for example for books that will never be sold or flyers that will never be mailed. These are important advantages over conventional printing techniques.

### Digital printing

The most common digital printing technologies are toner and inkjet. Toner printing is a reproduction technique based on electrostatic “copying” and can be compared to the offset process, involving flat pressure onto the substrate to be printed. Inkjet printing, on the other hand, jets microscopic ink droplets using

a contactless method where the printheads do not touch the substrate. This is an important difference compared to toner and offset printing, which are both achieved by means of physical contact. Using a contactless printing method results in less wear and tear in the machine and fewer consumable parts that need replacing over its lifetime. Though the term ‘inkjet’ will make most think of an Epson or HP desktop printer – that is not what we are talking about here. The basic premise is the same, but modern inkjet presses for commercial print, packaging and sign & display applications are hugely intricate and highly productive machines in which thousands of printheads jet billions of ink droplets per second with pinpoint precision.

### Liquid toner printers

In this example of a popular liquid toner press, when you press start, a digital electrophotographic image is applied (1) to a drum holding an image processing plate (2). Electrically charged liquid toner is applied and remains on this drum in places where an image is required (3). The image is transferred (4) to a drum covered with a silicon blanket before a counter-pressure roller brings the substrate into contact with the blanket for final image transfer (5). This process is repeated for each colour.



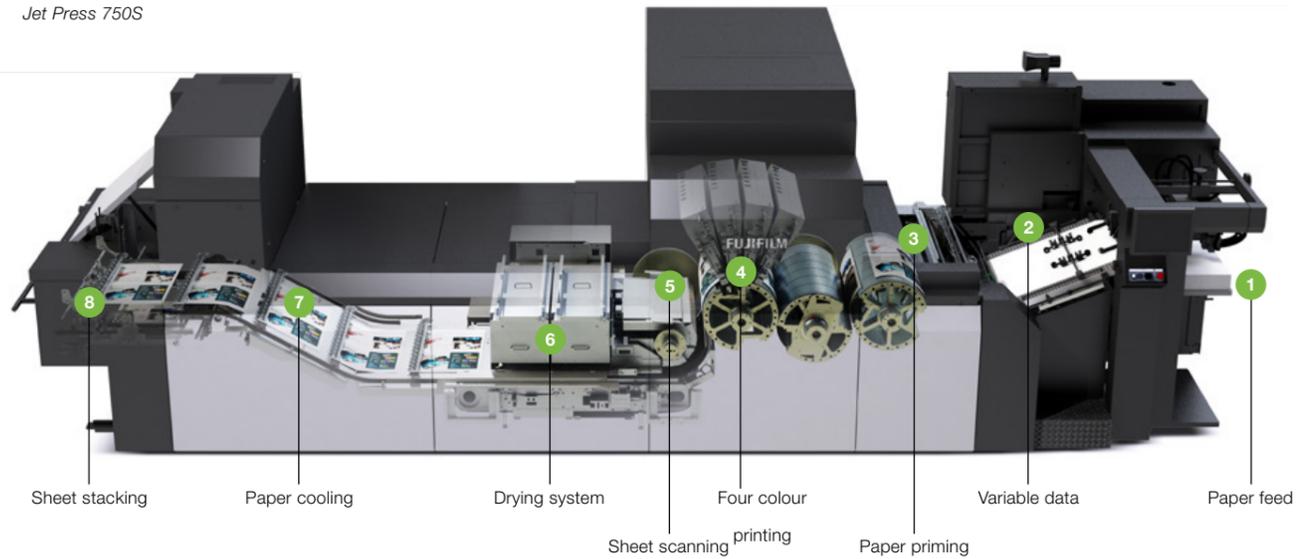
Samba printhead used in the Jet Press 750S. Invisible to the naked eye, 2048 nozzles are contained in the silver coloured silicon chip that measures just 44 mm wide by 18 mm deep.

### Inkjet printers

A digital image is also sent to the printer with inkjet printers. Here, however, the process is much simpler thanks to advanced printheads that accurately jet the ink directly onto the substrate. Multiple colours can be printed in a single motion and no drums or rollers are used to transfer an image to the substrate.

At the end of the 1990s, industrial printheads were developed that have a much longer life span than domestic units and are suitable for various types of ink. This triggered the rise of inkjet printing for print production on paper, cardboard and plastics. The development of silicon-based Microelectromechanical Systems (Si-MEMS) made it possible to produce piezo printheads that could fire very small droplets at high speed. Now inkjet printing can match or even surpass the quality of analogue printing technologies.

Jet Press 750S



After the printing process, the check (5) of the printed sheets follows. Here, the sheets are automatically scanned for quality, one by one, by sensors, so that errors are kept to a minimum. A drying system (6) with a drying unit from above and a heated belt along the bottom, dry the printed sheets evenly. Finally, the sheets are cooled (7) and stacked (8) for immediate processing. The registration accuracy from sheet-to-sheet also minimises the errors that occur in the finishing process, further reducing the waste produced.

## Environmental benefits of contactless printing

In addition to the fact that non-contact printers are less subject to wear and tear, they use far fewer consumables before, during and after the production process compared to a traditional offset sheetfed press or liquid toner machine, and there is virtually no waste. This results in a much smaller ecological footprint. As a result, non-contact printing provides an enormous gain for the environment.

## The circular economy and printing

### How does a contactless inkjet printer work?

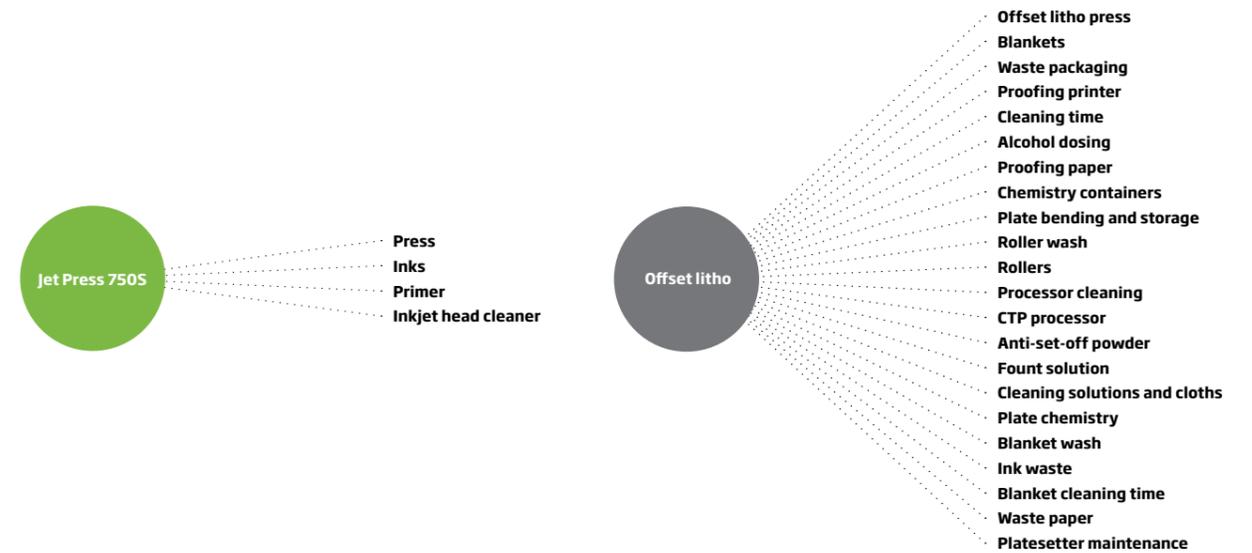
The benefits of inkjet digital printing bring print production much closer to what is required in a circular economy. But in order to understand why, it is worth looking in more detail at how one of these inkjet digital printing machines works. Here, we focus on the industry-leading Jet Press from Fujifilm. Here is how it works.

The paper feed (1) is controlled by a robust and traditional transport system which feeds the exact amount of paper required for printing, resulting in high productivity with minimal waste. Then (2) the sheets are scanned for accurate registration and variable data for possible double-sided printing, after which (3) the paper is coated with a primer. This is necessary so that the water-based ink can adhere to the paper without sinking into it, and means that normal offset paper can be used, rather than specially coated digital paper, which is better from both a commercial and environmental standpoint. The primer also optimises the print quality, and ensures that the ink can easily be removed from the paper during the recycling process.

Colour (4) printing with water-based inks is done by four print bars with Samba Si-MEMS printheads that simultaneously jet the four primary colours cyan, magenta, yellow and black (CMYK) directly onto the paper. The Jet Press also uses ink reduction techniques to minimise the amount of ink used. The water-based inks used by the Jet Press guarantee ultra-high print quality, thanks to tiny 2 picolitre (= 10<sup>-12</sup> liter) ink drops that can print up to 90% of all Pantone colours, and a food-safe ink is also available if required. The printed output is also very consistent, matching the ISO 12647-2 standard, an exceptionally high quality standard.



Application options with a Jet Press: Books, brochures, annual reports, photobooks, leaflets, stationery, direct mail, posters, calendars, packaging and much, much more.



### Fewer products so less waste

To better understand this argument, it is worth looking at some examples. The figures are based on the annual production of 4,000 jobs, with each job having an average of 666 sheets, making a total of 4 million finished sheets of paper in a B2 format of 500 x 700 mm.

In contrast to offset and toner printing, non-contact printers do not require the transfer of the image from one surface to another. In offset printing, there are many more products involved in the production process. On the press itself, as can be seen from the diagram above, many more chemical consumables are used, including alcohol-based founts, powders and washing solutions to not only operate the press, but maintain it in a condition where it can produce

high quality print. Offset printing also requires the imaging of aluminium printing plates, a process that Fujifilm has been steadily improving from a sustainability point of view for many years with the introduction of processless plates that don't require chemical processing<sup>10</sup>, but inevitably these products require manufacturing, with devices required to image them, and they also produce waste. It is clear, therefore, that offset printing is not suitable for this type of short-run work.

Liquid toner printers also work on the basis of an image transfer. In this case no aluminium plates, but plastic image processing plates and silicon rubber blankets. These plastic plates and rubber blankets have to be replaced, on average, every 25,000 sheets. That is about 200 plastic plates and 128 synthetic rubber blankets each year. These consumables, together with around 375 m<sup>2</sup> of cleaning wipes and 32 binary ink development units, consisting of plastic and metal, will enter the waste stream along with any chemical waste.

In contrast to offset and liquid toner printing, non-contact printers do not require image transfer from one surface to another.

### What is not necessary in a process does not have to be made

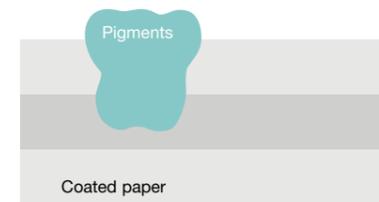
During the production process, based on the annual figures above, one offset press also consumes 25,000 litres of water: for plate making (750 litres); as rinse water (10,000 litres); top up water (10,000 litres); gum water (120 litres) and water on press (5,000 litres). For contactless printing such as inkjet, the equivalent figure is 0.

An offset press will also waste a number of sheets of paper in preparation for printing to achieve acceptable quality and colour for each print job. On an annual basis this can result in paper waste of 1,2000,000 B2 sheets or 67,392 kg. For comparison: 1000 kilos of paper equates to around 15 trees. A contactless printer generates around 16,800 waste sheets (943 kg) and liquid toner 24,000 sheets (1,348 kg). Paper can also be recycled, but this waste must also be transported, de-inked and processed. The de-inking of printed matter deserves a separate chapter as paper waste is seen as a new raw material and thus contributes to the circular economy.

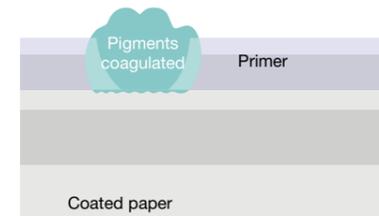
## Contributing to becoming circular

### Digital Watermark

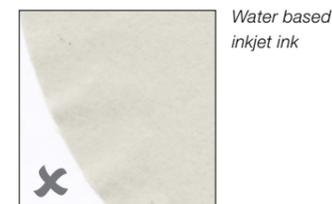
The AIM - European Brand Association<sup>5</sup> (AIM.be) has launched a project to get the "Digital Watermark" off the ground. The aim is to provide as many products as possible with a small code the size of a postage stamp, the so-called Digital Watermark. These codes can be read by a standard high resolution camera used in waste separation. The code contains all the information about the composition of the product. In this way, the quality of sorting can be greatly improved, and the circular economy can take further shape.



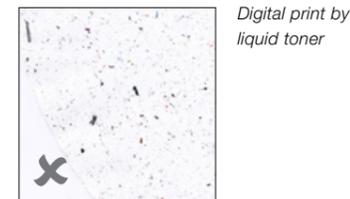
Normal water based inks



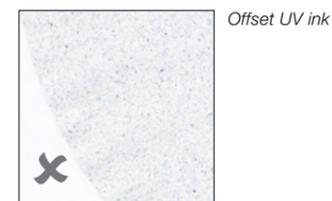
Fujifilm Jet Press technology



Water based inkjet ink



Digital print by liquid toner



Offset UV ink



Jet Press 750S

### De-inking of printed matter

Paper is durable. It comes from renewable sources and can be fully recycled into products of the same value. This only works when printing inks can be removed from the printed matter during the paper recycling process - the de-inking process. The de-inking process is the most important step in obtaining high quality, recycled graphic paper.

The environmental performance of the Jet Press 750S digital inkjet press is further improved by the fact that Jet Press printed material can be easily recycled. From the recovered paper fibres, excellent quality, strong white paper can be made. Waste becomes the new raw material. But how is this possible? The Jet Press uses a primer (Rapid Coagulation Primer). This prevents ink pigments from sinking into the structure of the paper, making them much easier to remove during the de-inking and recycling process. This contrasts with normal water-based inks without primer and also liquid toner.

### Recycling of printed matter

INGEDE<sup>6</sup>, the International Association of the Deinking Industry was founded by leading European paper manufacturers, and has the aim to ensure that more used paper is recycled in the future, a critical component in print's move to contribute more towards the circular economy. It carried out tests on the de-inkability of printed output on coated paper from multiple printing machines. As a result, print produced by the Jet Press 750S scored 85 out of 100 points. This is equivalent to a "good" score and is comparable to offset inks.

Below is a quote from an INGEDE press release<sup>7</sup> on the subject of the de-inking and recyclability of printed output from liquid toner-based digital presses:

*"It has been known for more than ten years that printing with liquid toner causes massive problems in paper recycling, even in the smallest quantities. According to the EN 643 paper for recycling standard, Indigo print shop waste must not be disposed of with the graphic paper for recycling"*

### So what next?

Print is an ancient method of communication, but a modern one as well. In an age when screens dominate so much of our lives it provides welcome respite and is the perfect medium to cut through the noise. It communicates authority, seriousness and quality. It offers tangibility in a world so often lived in the virtual. But like anything we produce, we must source it carefully, and ensure it is produced as efficiently and sustainably as possible. We must also use it responsibly, and re-use or recycle it at the end of its life.

Fujifilm is fully committed to fully integrating print into the circular economy. Net zero doesn't have to mean online only – print will always have a vital role to play in marketing, entertainment and education, and we're committed to making sure it can always play that role efficiently, effectively and sustainably.

## Fujifilm environmental objectives

Fujifilm's company mission:

**“We will strive to resolve social issues through our business activities and contribute to the realization of a sustainable society”**

Fujifilm has recently adjusted its environmental targets for the fiscal year 2030<sup>8</sup>. The target to reduce carbon dioxide (CO<sub>2</sub>) emissions worldwide by the Fujifilm Group over the product lifecycle has been increased from 30% to 45% compared to the 2013 fiscal year level. This target has been certified as WB2°C (well below 2°C) by the international environmental initiative Science Based Targets, to scientifically meet the “2°C target” of the Paris Climate Conference. The target to contribute to the reduction of CO<sub>2</sub> emissions in society by providing low-emission products and services has been increased from 50 million tonnes to 90 million tonnes.

Under the Sustainable Value Plan 2030<sup>9</sup> (SVP2030), the Fujifilm Group will present further measures in its aim to make a greater contribution to a sustainable society.

In Europe, the production process at the Fujifilm production site in Tilburg, a producer of photographic paper, offset plates and membranes, has been running 100% on wind energy since 2016. The five wind turbines on the Tilburg site generate approximately 20% of the electricity. The rest of the green electricity for the site is produced via wind turbines in the Netherlands and Belgium.

In 2018, the Fujifilm Group introduced its “Green Value Products” Certification Program, which sets internal rules for the development of environmentally conscious products. This certification program is implemented in compliance with the requirements of the international standard “ISO14021 Self-declared Environmental Claims” and obtains the opinions of external experts in order to ensure the objectivity, reliability, and transparency of the program. When Fujifilm introduced the program, advice was obtained from Professor Norihiro Itsubo at the Tokyo City University.

The program specifies assessment criteria for each product group, in which the assessment weight varies according to the product's usage and characteristics as determined from a product lifecycle perspective. With these assessment criteria, the Design for Environment for each product is assessed during the product development process. Ninety two products were certified with the Gold rank, including the sheet-fed digital inkjet press Jet Press 750S with its significant energy saving performance.



FUJIFILM Group  
Green Value Products

### Sources

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11. Fujifilm Jet Press 750S:  
[www.fujifilmjetpress.com](http://www.fujifilmjetpress.com)

### For further information:

<b>Web</b>	<a href="http://www.fujifilm.eu/print">www.fujifilm.eu/print</a> <a href="http://www.fujifilmjetpress.com">www.fujifilmjetpress.com</a>
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