Going green through MPS

While remanufacturers and refillers are often very keen to promote their environmental benefits, and even with the most expensive aftermarket cartridges offering huge savings over OEM products, customers tend to be more attracted to the price.

Managed print services stands in much the same light, with the possibility for huge environmental benefits often overshadowed by the desire for savings. Creating a greener business is becoming increasingly popular, especially for governmental organizations.

With this in mind, OEMs tend to focus on publicity for their reduced energy and carbon usage, often comparing it to how many trees have been saved. Remanufacturers would do well to follow suit, especially as they already have a huge advantage in the green arena thanks to the benefits of using remanufactured and refilled cartridges.

Environmental benefits

Laura Heywood, CEO of UK remanufacturer Kleen Strike, commented: "There is an increasing awareness regarding climate change issues, and many local authorities are under increasing pressure to lower their carbon footprint, and one way is by low carbon choices.

"They are paying not only closer attention to their own carbon footprint but their suppliers' as well, usually sending out environmental questionnaires before inviting a company to tender, and this includes remanufacturers. A remanufacturer with good environmental credentials who has carried out their own carbon footprint would be able to more favourably compete in this respect."

Heywood, who is also secretary for the United Kingdom Cartridge Remanufacturers Association (UKCRA), continued: "The benefits of the more environmental, low energy and cost-effective printers using remanufactured toners are important. Any legacy printers should never completely be replaced by the large MFDs. They still have an important role in any working environment.

"There are studies and white papers out on the environmental advantages of printers using remanufactured cartridges over large format printers under a MPS contract using new cartridges."

A remanufacturer's MPS

She adds that the differences and positives of using remanufactured toners in an MPS programme are what remanufacturers need to hit home when attempting to work with a client.

"An OEM offering MPS will supply new toners and either request the local authority to recycle the used toners locally, or will offer a collection service where they are transported to a central location and recycled for material recovery. A remanufacturer will supply a remanufactured toner and offer their own local take-back service in order to reuse or remanufacture the toners.

"What are the advantages of remanufacturing? Energy and material savings, less pollution during production than a new cartridge, efficient use of energy, water and other natural resources, and carbon savings over a newly produced cartridge estimated to be between 25 to 60 percent. By reducing the volume of material in allowing for a longer productive life, it also reduces the amount of material entering the waste stream and landfill."

She concluded: "To put this in perspective, according to the World Health Organization - 'On a global scale, the estimated amount of energy saved during production processes through 'remanufacturing' is impressive, at 120 trillion BTUs (British Thermal Units) a year. This equals 16 million barrels of crude oil or 350 oil tankers, the lifetime fuel consumption of 75,000 car owners, or the electricity generated annually by eight average sized nuclear power plants.'"

Eager to find more empirical data to prove the environmental benefits of remanufacturing with MPS, Kleen Strike commissioned an in-depth study into the different levels of energy use and carbon reduction across OEM and aftermarket MPS programs.

Keep reading to find an extract detailing the environmental findings from the report.

Over the following few pages, you can find an extract from a new study commissioned by UK remanufacturer Kleen Strike. The study was undertaken by Xanfeon Energy & Environmental Services, and focuses on printing scenarios being implemented by schools.

The research compares three different MPS strategies, including the use of aftermarket cartridges, and compares and analyses the different levels of saving in cost and the environment. The following extract focuses on the environmental findings only.

Printing Scenarios in Schools & Colleges – Implications for whole-life costs and carbon

The three scenarios

The approach taken in this study was in two stages. The first stage involved carrying out reviews of printing infrastructure and activities across a range of schools and colleges to determine indicative metrics such as the numbers and characteristics of printers and copiers distributed across the school (or college), numbers of pages printed, amounts of paper consumed, toner cartridges used, indicative prices for printing and maintenance, and student numbers. The study focused only on laser toner printing and copying. From the various data gathered, a typical printing scenario was derived based on a model school with 500 students. Indicative results for schools of other sizes (i.e. larger numbers of students) can be obtained through scaling.

The second stage involved carrying out calculations for the model school for three different scenarios. In each scenario, the determining parameters for the model school were kept identical, except for those parameters which are changed because of the scenario itself.

The following are examples of parameters which are kept fixed across the scenarios: the price of day time and night time electricity, the numbers of pages printed, the number of colour pages printed, the number of black and white (B&W) pages printed, the CO_2e emission factors for consumed electricity.

Fixed parameters as well scenario-dependent-parameters will be presented in tables through the report. All scenarios are evaluated over the same lifetime, which is five years. The lifetime of smaller printers is typically about six years though in practice this may be exceeded. In the case of large MFDs under a PMS contract, the device is usually maintained on-site for three to five years or more depending on the contractual agreement.

The three scenarios are:

Scenario REM

In this scenario the model school purchases a number of remarketed printers and uses remanufactured laser toner cartridges. There is a mix of B&W and colour printers and simple multi-function devices across the school, with the smaller to mid-size machines located in the classrooms and the larger machines in centralised (e.g. reprographics) facilities.

Scenario ITMS

In this scenario the model school is identical in every respect to that in the REM scenario except for the fact that the school purchases its printers and extended warranty from the ITMS contract provider and these are maintained under the IT managed services (ITMS) contract provider. The ITMS arrangement requires the school to purchase new genuine (OEM) cartridges.

Scenario PMS

In this scenario the model school is identical to that in the REM and ITMS scenarios in terms of its printing output (i.e. number of B&W and colour pages printed) but instead of a large number of smaller machines distributed throughout, the school has a small number of heavy-duty Multi-Functional Devices (MFDs) located in centralised or common facilities.

To allow for some localised printing by members of staff (e.g. for printing private letters and reports), the school has supplemented its PMS printing with a small number of auxiliary printers under an ITMS contract. The auxiliary printers are assumed to be a mix of B&W and colour printers in order to cater for a diversity of printing.

Parameters used in the scenario calculations

The following table (Table 1) lists various fixed and common parameters used to describe the model school scenario.

Parameter	Value
Number of students	500
Number of reams of paper consumed per year (500 sheets per ream)	1960 reams
Number of sheets of paper consumed per year	980,000 sheets
Number of B&W pages printed per year	1,220,000 pages
Number of colour pages printed per year	260,000 pages
Price of electricity at day-time tariff	£0.12 per kWh
Price of electricity at night-time tariff (0000 – 0600hrs)	£0.05 per kWh
Emissions factor for electricity [2]	0.54284 $kgCO_2e$ / kWh
Lifetime of the printing infrastructure (for this study)	5 years
Embodied CO_2e of paper (standard 80g/m2 printing paper) [3]	3.73 $kgCO_2e$ / kg

Table 1. Various fixed and common factors used to describe the model school and its printing activities.

Table 2 lists the power consumption and print speed of printers used in the scenarios. These ratings are representative of a large number of printers and copiers in the marketplace. The machines are characterised by the page yield of the toner cartridge. It is assumed that (i) the power ratings and print speeds are the same for B&W and colour printers, and (ii) the power ratings and print speeds are the same for a given remarketed and new printer characterised by a given cartridge page yield. All printers are assumed to have duplex capability.

In order to calculate the energy consumed by any given printer during each day, the number of pages that the printer prints and the print speed of the printer are used to derive the printing time (in hours h), which is the used to derive the energy consumed (in kWh) by the printer in print mode. Printing is assumed to take place only during the day time and so the day tariff for electricity is used. It is assumed that during the night (0000 – 0600 hrs) there is no printing and the printer is in sleep mode. During the remaining part of each 24 hours it is assumed that the printer is in a mix of standby and sleep modes. For printers characterised with cartridges of page yield of 4,500 pages, the percentage of that time in standby mode is assumed to be 20%. For the larger machines (page yield greater than 4,500 pages), the percentage of that time in standby mode is assumed to be 60%. Through this analysis it is then possible to determine energy consumed in each of the print, standby and sleep modes and from that to derive the costs of the electricity consumed, given the prevailing tariff (Table 1), and the associated CO_2e, using the conversion factor (Table 1) associated with the electricity consumption.

Table 3 lists the numbers of printers in each sub fleet (characterised by the page yield of the cartridges) used in the scenarios. The total number of machines in each of the printer fleets is 54 (REM scenario), 54 (ITMS scenario) and 14 (PMS scenario).

Under the ITMS scenario it is assumed that each printer is required to be covered by a warranty in order to be supported, which is £5 per month throughout the lifetime of the printer. Under the PMS contract there is a monthly maintenance charge which is assumed to be dependent on size and functionality of the printer. These monthly maintenance charges, usually paid quarterly, are assumed to be £110, £165 and £220 for each of the 20000, 30000 and 40000 page yield characterised printers. The maintenance charge is applied at the level of each printer. The pay-per-print charges for B&W and colour printing under the PMS scenario are £0.0045 and £0.045 per page respectively. It should be noted that these charges are indicative and have been assumed for the purposes of making comparative assessments between the scenarios. In practice the actual charges agreed between a school / college and the ITMS or PMS provider will reflect contractual agreements specific to the two parties. This study is not intended to suggest what any such agreements should be.

In the REM scenario, the warranty

Going green through MPS continued

charge is reflected by a fleet token charge. One token (costing about £42 and surrendered for each repair visit) covers the entire fleet of REM printers and can be used to cover repair for any of the printers in the fleet. The remarketed printers come with the first year warranty cover. In practice schools have found that very few tokens are required because the smaller machines in the REM scenario tend to have much fewer maintenance requirements compared with the larger and more sophisticated machines in the PMS scenario. Given this, a cost of £0.10 per printer per month for maintenance tokens through the lifetime of the REM fleet has been assumed.

Table 4 lists the costs of printers. The printers are characterised by the page yield of the cartridge. For example, the 4,500 page yield colour printer would hold four cartridges (one black, one magenta, one yellow, and one cyan) each with a yield of 4,500 pages. Tables 5 and 6 respectively list the costs of printers using black and colour cartridges (remanufactured and OEM).

PRINTER by cartridge page yield	B&W or Colour	Cost of Printer Remarketed	New
4,500	B&W	£125	£200
4,500	colour	£295	£440
10,000	B&W	£195	£370
10,000	colour	£474	£595
20,000	B&W	£335	£729

Table 4. Cost of printers.

Values for embodied CO_2e for remanufactured and OEM cartridges (as well as embodied CO_2e of printers and copiers) have been calculated using a methodology described in detail elsewhere [1] and been derived from studies on a wide range of printing systems [1, 4]. The methodology used to calculate the CO_2e values is based on the assessment of emissions of CO_2 and other greenhouse gases through the life cycle of a product (exclude the use phase). The Kyoto set of greenhouse gases is considered, and so the units of carbon footprint are given in terms of equivalent mass CO_2 or CO_2e. Other studies have also been published [for example, 5-7].

The CO_2e values used for the 4500, 10000, 20000 page yield remanufactured cartridges are 1.9, 2.1, and 3.2 kg CO_2e respectively. The corresponding values used for OEM cartridges are 7.3, 8.2, and 9.9 kgCO_2e. The corresponding values used for new printers (using the same value for a mono and colour printer) are 170, 270 and 450 kg CO_2e. The embodied CO_2e of a remarketed printer is estimated to be 15% of that of the corresponding new printer.

Printer by cartridge page yield	B&W or Colour	Cost of Printer Remanu-factured	New
4,500	B&W	£25.49	£78.00
4,500	Colour	£23.87	£70.31
10,000	B&W	£36.29	£101.00
10,000	Colour	£45.29	£107.00
20,000	B&W	£44.22	£176.68

Table 5. Cost of black cartridges.

Colour Cartridge by page yield	Cost per cartridge Remanufactured	OEM
4,500 page yield cartridge (magenta, yellow, or cyan)	£24.59	£81.60
10,000 page yield cartridge (magenta, yellow, or cyan)	£58.77	£196.00

Table 6. Cost of colour cartridges.

The calculations do not include the following aspects in any of the scenarios:

- costs associated with machine down-time (i.e. printer unavailability)
- costs associated with paper (these are common across the scenarios because the amount of paper used in each of the three scenarios is the same)
- CO_2e associated with repairs and maintenance processes
- CO_2e associated with remote access of printers by students (e.g. during the evening)
- CO_2e associated with in-school network management systems
- CO_2e associated with remote access and remote PMS applications

COSTS AND CARBON ANALYSIS

Lifetime costs

Table 7 below provides a list of the labels used to denote each of the sub fleets of printers in the three scenarios. These labels are used in the figures and tables that follow.

In Figure 1 the lifetime costs, i.e. costs over the five year period, of each of the

PRINTER (by cartridge page yield)	Power rating in print mode (W)	Power rating in print standby mode (W)	Power rating in sleep mode (W)	Print speed (pages per minute, ppm)
4,500 page yield	275	23	7	16
10,000 page yield	550	50	10	27
20,000 page yield	1050	100	14	42
30,000 page yield	1550	150	17	54
40,000 page yield	2050	200	19	65

Table 2. Power ratings and print speeds of the machines.

PRINTER SUBFLEET (by cartridge page yield)	NUMBER OF PRINTERS REM scenario	ITMS scenario	PMS scenario	PAGES / MACHINE / DAY REM scenario	ITMS scenario	PMS scenario
4,500 page yield (B&W)	25	25	2	12	12	12
4,500 page yield (colour)	25	25	2	4	4	4
10,000 page yield (B&W)	1	1		800	800	
10,000 page yield (colour)	2	2		600	600	
20,000 page yield (B&W)	1	1		5000	5000	
20,000 page yield (colour)			4			323
30,000 page yield (B&W)			5			200
30,000 page yield (colour)						
40,000 page yield (B&W)			1			5076
40,000 page yield (colour)						

Table 3. Printer sub fleets and pages printed per machine per day.

Going green through MPS continued

printer sub fleets in the REM scenario are shown. It can be seen from Figure 1 that the largest cost is associated with the REM10KC sub fleet, as this sub fleet performs the majority of colour printing (see table 3) and therefore carries a large cost burden in terms of replacement cartridge costs.

The upfront costs are the largest for the REM4KM and REM4KC sub fleets as each of these sub fleets has 25 printers, which are distributed across the establishment.

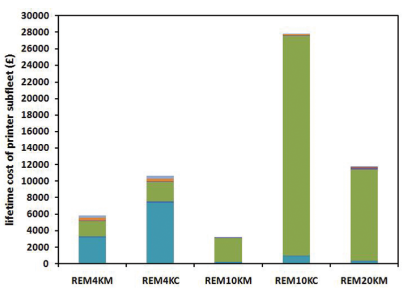

Figure 1. Lifetime cost of each printer sub fleet (see Table 7) in the REM scenario

Lifetime CO_2e

In Figure 5 the lifetime CO_2e for each of the sub fleets in the REM scenario are shown for the cases of paper included (Figure 5a) and paper excluded (Figure 5b). The CO_2e comprises two types of CO_2e: embodied CO_2e emissions and operational CO_2e emissions.

The embodied emissions are those associated with the printers, cartridges and paper. The operational emissions are those associated with the consumption of electricity and break down into the emissions associated with the printers in print, standby and sleep modes.

The main printing workload in the fleet is through the REM20KM sub fleet and Figure 5b shows this sub fleet has the largest embodied CO_2e for paper.

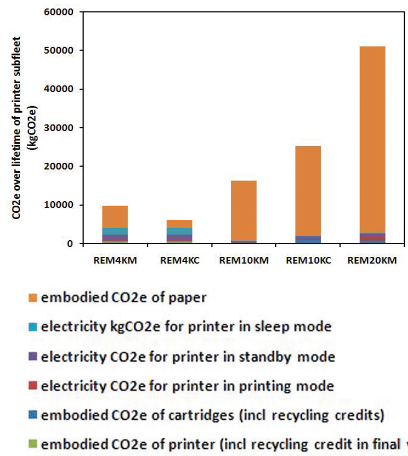

Figure 5a. CO_2e over the lifetime of each printer sub fleet in the REM scenario including paper.

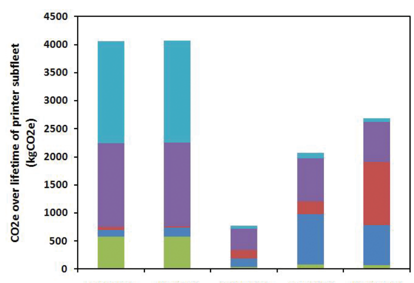

Figure 5b. CO_2e over the lifetime of each printer sub fleet in the REM scenario excluding paper. The key is the same as that shown in Figure 5a.

In Figure 6 the lifetime CO_2e of the printer fleet in each of the three scenarios are compared for the cases of paper included (Figure 6a) and paper excluded (Figure 6b). The total embodied CO_2e of paper is the same in each of the three scenarios. Although there is some redistribution of emissions across the categories in the embodied and operational aspects, the overall CO_2e profiles are broadly similar. The overall CO_2e in the PMS scenario is dependent on the number of machines deployed.

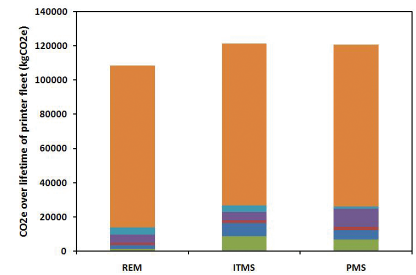

Figure 6a. CO_2e over the lifetime of the printer fleet in each of the scenarios including paper. The key is the same as that shown in Figure 5a.

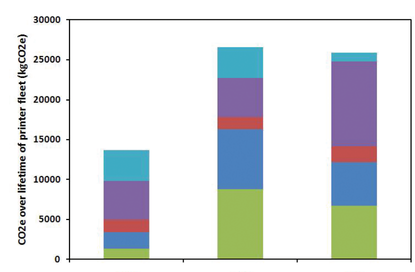

Figure 6b. CO_2e over the lifetime of the printer fleet in each of the scenarios excluding paper. The key is the same as that shown in Figure 5a.

In Figure 7 the operational CO_2e for each of the three scenarios are shown separately. It can be seen from Figure 7 that CO_2e from printers in the standby mode under the PMS scenario are much larger than those of the other two scenarios. The CO_2e emissions factor (see Table 1) is the same for each scenario, and Figure 7 therefore reflects the relative quantities of electricity consumed (in kWh and £). The electricity consumed in each of the REM and ITMS scenarios is identical and, given the lower TCO of the REM scenario compared with the ITMS scenario (£59,315 for the REM scenario, £188,406 for the ITMS scenario, and £181,810 for the PMS scenario), the proportion of the TCO that apportions to electricity is higher in the case of REM scenario (3.6%) compared with the ITMS scenario (1.1%). The larger machines in the PMS scenario have much higher standby ratings than any of those in the REM and ITMS scenarios. The electricity cost as a percentage of the whole life cost in the PMS scenario is 1.6%.

PRINTER SUBFLEET (by cartridge page yield)	Black & white (B&W) or colour	LABEL FOR PRINTER SUBFLEET REM scenario	ITMS scenario	PMS scenario
4,500 page yield	B&W	REM4KM	ITMS4KM	PMS4KM
4,500 page yield	colour	REM4KC	ITMS4KC	PMS4KC
10,000 page yield	B&W	REM10KM	ITMS10KM	
10,000 page yield	colour	REM10KC	ITMS10KC	
20,000 page yield	B&W	REM20KM	ITMS20KM	
20,000 page yield	colour			PMS20KC
30,000 page yield	B&W			PMS30KM
30,000 page yield	colour			
40,000 page yield	B&W			PMS40KM
40,000 page yield	colour			

Table 7. Labels used to denote the printer sub fleets.

Going green through MPS continued

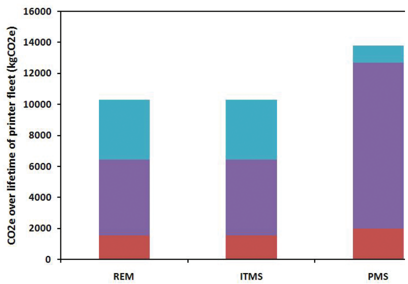

Figure 7. Operational CO_2e (electricity use) over the lifetime of the printer fleet in each of the scenarios. The key is the same as that shown in Figure 5a.

Cost and CO_2e per page

In Figures 8 and 9 the cost per page and CO_2e per page are shown for each of the sub fleets in each scenario. The page yields of the sub fleets are defined in Table 7. For example, in the REM scenario there are two points plotted (one for B&W and one for colour) corresponding to 4500 page yield, two points plotted corresponding to 10000 page yield, and one point plotted corresponding to the 20000 page yield. Where two points are plotted for a scenario at any given page yield, the cost per page for colour is higher than that for B&W because four cartridges (black, magenta, cyan and yellow) are being depleted to print the page. In the case of the PMS scenario, the points plotted for the PMS4KM and PMS4KC sub fleets are the same as those for the corresponding ITMS sub fleets, because the sub fleets are assumed both to be under an ITMS arrangement.

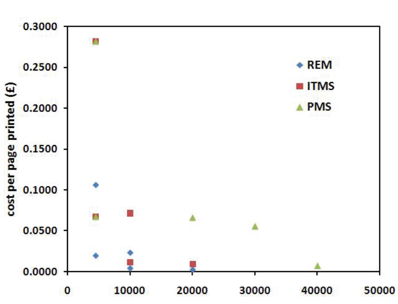

Figure 8. Cost per page printed in each sub fleet for each scenario. The page yields of the sub fleets are defined in Table 7.

Table 8 provides a summary of the whole life average cost per page and CO_2e per page for each of the three scenarios. The average cost-per-page (using the TCO framework) is £0.008 for the REM scenario, £0.025 for the ITMS scenario, and £0.025 for the PMS scenario. The average CO_2e per page is 1.9g CO_2e for the REM scenario, 3.6 g CO_2e for the ITMS scenario, and 3.5 g CO_2e or the PMS scenario.

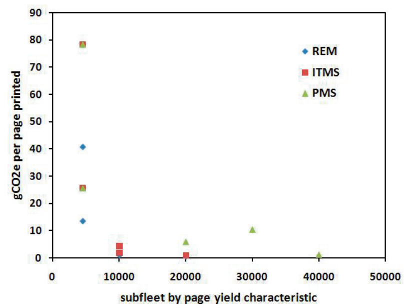

Figure 9. CO_2e per page printed in each sub fleet for each scenario (excluding paper).

The REM scenario has both the lowest cost and lowest CO_2e footprint. Compared with the REM scenario the cost per page in the ITMS and PMS scenarios is 3.1 times higher. The CO_2e per page (excluding paper) in both the ITMS and PMS scenarios is just under twice that of the CO_2e per page in the REM scenario.

In addition to cost and CO_2e considerations, a school may have other considerations which influence its choice of printing infrastructure and arrangements. For example,

- A school may prefer to have a printer in each classroom. This may help to minimise classroom delays and also helps to avoid the situation whereby an instructor leaves a classroom unattended in order to obtain a printout.
- The school may wish to minimise disruption to scheduled timetables caused by students and instructors queuing at a preferred centralised printing facility.
- The school may wish to have a resource of necessary localised printers. These would be used to print confidential information (e.g. student or personnel reports of a personal nature, printing of cheques, private letters to parents, etc.) rather than being printed in communal areas where there is the possibility of information being seen, forgotten or left in a printer due to sudden printer stoppage (e.g. paper jam, power failure, insufficient paper to complete a job, and unexpected breakdown where information is part printed and not accessible for retrieval).
- Localised printers can be focused for specific functions, such as printing of visitor badges in a reception area or for other minor easily accessible printouts.
- Localised printers can be used to access and print information easily in library or study areas where course work may be laid out for working on.

A school may wish to have a number of centralised printing devices under a PMS Service contract in order to use external resources for certain requirements, such as

- To have all maintenance, repairs and cartridges provided.
- To overcome insufficient storage facilities in the classrooms for a printer and stock of paper.
- To have the convenience of large format printing (e.g. A3+, banners) with finishing capabilities (e.g. booklet maker, hole puncher, sorter, stapler) in a specific functional area such as the reprographics department.
- To perform heavy-duty printing jobs requiring speed, multiple paper trays and a high volume of paper needed for a single task.

Each establishment is unique and a single solution, such as all remarketed printers or all PMS systems may not be optimal. In practice, a hybrid solution, such as a mix of REM and PMS systems, may be the best solution for a given school or college.

There may be a need to upgrade older models of MFDs on PMS contracts. There may be a need to upgrade to a more current and efficient remarketed printer that uses larger capacity toner cartridges for better value printing output. It is, however, recommended that a school/college should carry out TCO and TCCO assessments to determine its ideal configuration.

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